

# Indian Academy of Forensic Medicine (IAFM)

(Registration No.349, 12th May, 1972, Panji, Goa)



## Governing Council 2013-2016

### President

Dr. S.D. Nanandkar

### General Secretary

Dr.C.B.Jani

### Treasurer

Dr.S.K.Daddu

### Vice Presidents

**North Zone:** Dr. A.S. Thind

**South Zone:** Dr. N. Srinivasa Ragavan

**East Zone:** Dr. Tulsi Mahto

**West Zone:** Dr. M.I. Sheikh

**Central Zone:** Dr. A.K.Srivastava

### Joint Secretaries

**North Zone:** Dr. Pankaj Gupta

**South Zone:** Dr. Prateek Rastogi

**East Zone:** Dr. P.P.Mukhopadhyay

**West Zone:** Dr. Sudhir Ninave

**Central Zone:** Dr. Mukesh K.Goyal

### Editor

Dr. Mukesh Yadav

### Joint Editor

Dr. Akash Deep Aggarwal

### Executive Members

Dr. D.S.Badkur (Ex. President, IAFM)

Dr. Anil Mittal

Dr. Yogender Malik

Dr.Cyriac Job

Dr. Anand

Dr.S.C. Mahapatra

Dr. Adarsh Kumar (Ex. Secretary, IAFM)

Dr. T.K. Bose

Dr. Ravi Rautji

Dr. Lavlesh Kumar

Dr. R.K. Singh

Dr.P.K.Tiwari

# Journal of Indian Academy of Forensic Medicine (JIAFM)

*The Official Publication of Indian Academy of Forensic Medicine*

**Editor,**

**Dr. Mukesh Yadav**

Professor & Head

Rama Medical College and Hospital,  
Hapur, UP

**Residence:**

G-216, Parsvanath Edens,  
Alfa-II, Greater Noida, G.B. Nagar, U.P.INDIA  
Ph. No. 0120-2326060, Cell: 08527063514  
Email: drmukesh65@yahoo.co.in

**Joint Editor**

**Dr. Akash Deep Aggarwal**

Associate Professor,  
Department of Forensic Medicine,  
Govt. Medical College, Patiala  
Punjab, INDIA

**Residence:**

H.No. 14, Desi Mehmandari,  
Patiala-147001, Punjab, INDIA  
Cell: 9815652621  
Email: toakashdeep@yahoo.co

## International Advisory Board

**Prof. Derrick J Pounder**, Dundee, UK

**Prof. D N Vieira**, Coimbra Portugal

**Prof. Dan Dermengiu**, Romania

**Prof. Peter Vanezis**, London, UK

**Prof. Roger Byard**, Australia

**Dr. Michael S. Pollanen**, Canada

**Prof. Leandro Duarte De Carvalho**, Brazil

**Dr. Shubhakar K.P.** UK

**Dr. BL Meel**, South Africa

**Dr. John Clark**, Glasgow, UK

**Dr. George Paul**, Singapore

**Dr. Serap Annette AKGUR**, Turkey

**Dr. Clifford Perera**, Sri Lanka

**Dr. B.N. Yadav**, Nepal

**Dr. K. P. Saha**, Bangladesh

**Dr. Imran Sabri Al-Ahasa**, KSA

## National Advisory Board

Srivastava A.K. (U.P.)

Pillay V.V. (Kerala)

Gorea R.K. (U.P.)

Jani C.B. (Gujarat)

Bose T.K (West Bengal)

Pradeep Kumar G. (Karnatka)

Verma S.K. (New Delhi)

Kumar Shantha B. (Tamil Nadu)

Gupta B.D. (Gujrat)

S.C. Mahapatra (Odisha)

Manju Nath K.H. (Karnatka)

Das Sanjoy, (Uttarakhand)

Mahtoo Tulsi, (Jharkhand)

Ravindran K. (Puducherry)

Rastogi Prateek (Karnatka)

Potwary AJ (Assam)

Singh R.K. (Chhatisgarh)

Dongre A.P. (Maharastra)

Sharma Aditya (H.P.)

Gupta Pankaj (Punjab)

Harish D. (Chandigarh)

Khanagwal V. (Haryana)

Rastogi Pooja (U.P.)

Khaja Shaikh (A.P.)

P.P. Mukhopadhyay (W.B.)

Naik R.S. (Maharastra)

Godhikirakar Madhu (Goa)

Job Cyriac (Kerala)

Vinita K. (U.P.)

Mohite Shailesh (Mumbai)

Yadav Jayanti (M.P.)

Kochar S.R. (Rajasthan)

L. Fimate (Manipur)

Printed and published by Dr. Mukesh Yadav, Editor, JIAFM and Dr. A. D. Aggarwal, Joint Editor, JIAFM on behalf of Indian Academy of Forensic Medicine at name of the press [SHIVANI PRINTERS, NOIDA, [U.P.]

# Journal of Indian Academy of Forensic Medicine

Volume: 37 • Number: 4 • October-December 2015

## Contents

Sr.		Page
I.	<b>From the Editor's Desk</b>	333-333
II.	<b>Editorial: Is There Need for Danger to Health (Physical/Mental) / Life Ground of MTP beyond Permissible Limit in Exceptional Cases?</b>	334-337

## Original Research Paper

1.	<b>Pattern of Medico-legal Cases in the Casualty Department of A Teaching Hospital, Bareilly, Uttar-Pradesh</b> Atul Saxena, Vinod Kumar, S. R. Chaudhary, Jasvinder Singh, Sadhana Awasthi	338-340
2.	<b>Written Informed Consent: Is It Practiced What Is Being Preached?</b> Ashish Jain, Rajeev Kumar Banzal, Rajneesh Pandey, Jayanthi Yadav	341-345
3.	<b>Observations on Symmetry and Sexual Dimorphism from Morphometrics of Foramen Magnum and Orbits In Adult Bengali Population</b> Saswata Biswas, Soumeek Chowdhuri, Aniruddha Das, Partha Pratim Mukhopadhyay	346-351
4.	<b>Easy Confirmation of Drowning By Detection of Diatoms in Trachea</b> Neelam Shrivastava, D.K. Satpati, Alok Kumar	352-354
5.	<b>Stampede in Gandhi Maidan Patna: A Medico-legal Analysis</b> Anil Shandil, Mukesh Prasad, Shiv Ranjan Kumar	355-357
6.	<b>Burn Deaths: A Study on Female Victims in Manipur</b> Th. Meera, Pabitrimala Nandeibam, Daunipaia Slong, H. Nabachandra	358-360
7.	<b>Cephalometry Compliments Dactylography</b> B. Ajay Reginald, P. Pankaj Mallik, Veera Nagi Reddy	361-364
8.	<b>Estimation of Adult Human Stature from Measurements of Inter-Acromial Length in Gujarati Population of India</b> Sweta H Patel, Binaya Kumar Bastia, Lavlesh Kumar, Senthil Kumaran M	365-368
9.	<b>Study of Fingerprint Patterns in South Indian Population</b> Nithin Mathew Sam, Rema P., Venugopalan Nair B	369-373
11.	<b>Determination of Sex from Index and Ring Finger Ratio in Neonates</b> Manohar Shelake, Nitin Ninal, Rajesh Bardale, Vaibhav Sonar	378-380
12.	<b>Pattern of Mechanical Injuries of Fatal Interpersonal Violence Cases in a Tertiary Care Centre</b> Niraj Kumar, Arun Kumar Singh, R. K. P. Singh	381-384
13.	<b>Trauma to Spleen: A Marker to Assess the Prognosis In Blunt Trauma to Abdomen Cases</b> Mohd. Asrarul Haque, Munawwar Husain, S. Hasan Harris, Jawed A. Usmani	385-387
14.	<b>Estimation of Stature from Radiological Measurement of Sternal Length with Corroboration in Living Individuals: A Study in Contemporary Bengali Adults</b> Soumeek Chowdhuri, Parthapratim Mukhopadhyay	388-391

15. **Profile of Disease Related Deaths in Custodial Cases An Autopsy Based Experience** 392-395  
*Satinder Pal Singh, Dalbir Singh, Akashdeep Aggarwal, Surinder Singh Oberoi, Krishan Kumar Aggarwal*
16. **Trends of Poisoning in a Tertiary Care Centre of North West Uttar Pradesh** 396-399  
*Jaswinder Singh, Jaspreet Kaur, Vinod Kumar, K.A. Shah, R.N. Tandon, V.R. Patil*
17. **Profile of Acute Poisoning Cases at Pravara Rural Hospital, Loni** 400-404  
*Sandesh Datir, Madusudan Petkar, Jamebaseer Farooqui, Chandeesingh Makhani, Sayyed N. Hussaini, Kalidas Chavan, Rajendra Bangal*
18. **Study of Unnatural Deaths in Married Females Within Seven Years of Marriage in Allahabad** 405-409  
*Rajesh Kumar Verma, P.C. Srivastava, U.S. Sinha, Archana Kaul*

## **Review Research Paper**

19. **Patient Autonomy and Informed Consent: The Core of Modern Day Ethical Medical** 410-414  
*Dasari Harish, Ajay Kumar, Amandeep Singh*
20. **Medico-legal Aspect of Pregnancy and Delivery: A Critical Case Review** 415-421  
*Mukesh Yadav, Pooja Rastogi*
21. **Criminal Amendment Act 2013 and Issue of Age** 422-423  
*P S Thakur, Jayanti Yadav, Arneet Arora*
22. **Acute Neurogenic Pulmonary Edema: The Unaddressed Mechanism of Death** 424-426  
*Raghvendra Singh Shekhawat, Puneet Setia*

## **Case Reports**

23. **Refrigerator Blast: A Rare Explosion Fatality** 427-429  
*R. Sudha, Sudheer B. Balla, J. Ammani, Suresh Kumar Karthikeyan, V. Jayasurya Prasad Babu*
24. **Suicidal Shotgun Wound on Chest: An Uncommon Site with an Unusual Track** 430-432  
*Abhishek Yadav, Rajanikanta Swain, Mantaran Singh Bakshi, Sudhir Gupta*
25. **Autopsy in an Embalmed Corpse: A Case Report** 433-434  
*Biplab Shee, Saurabh Chattopadhyay, Shouvanik Adhya*
26. **Paediatric Poisoning Panic and Forensic Toxicologist** 435-437  
*MZ Saiyed, S Prajapati, CB Jani, BS Prajapati*
27. **Sudden Cardiac Death in Young Adults** 438-440  
*Soumya Ranjan Nayak, Braja Kishore Dash, Subhasis Mishra, Tushar Bhutada, Manoj Kumar Jena*

**Copy Right © All rights reserved:** No part of this publication may be reprinted or publish without the prior permission of the Editor, JIAFM. Submission of all manuscripts to the journal is understood to imply that it is not being considered for publication elsewhere. Submission of multi authored papers implies that the consent of each author has been obtained. In this journal, every effort has been made NOT to publish inaccurate or misleading information. However, the Editor, Joint Editor, Peer Review Group and Advisory Board accept NO liability in consequences of such statements. The Journal of Indian Academy of Forensic Medicine is indexed in **Index Copernicus** [Poland] and **IndMED** [India]

Address request for reprint or further information relating to any article may please be made with author and in case of multi authored article, please communicate to Corresponding Author or the

## From Editor's Desk

# JIAFM

A Quarterly Publication

Volume 37, Number 4, October-December, 2015

I feel immense pleasure to present before you the fourth issue of 2015. I would like to inform all of you that our esteemed Journal of Indian Academy of Forensic Medicine which is published quarterly since 1991 has been started gaining wide recognition not only in India but globally among the scientific community. I am trying to maintain your faith and trust in me to bring this journal to highest level of its achievements.

I have received many requests from other countries about inclusion of many papers in their indexing data base, including USA Government agencies. JIAFM is indexed not only in **IndMed** and **MedInd Indian indexing** agencies but also in the **SCOPUS**, **IMSEAR** informed by the **Information Management and Dissemination (IMD)**, **World Health Organization, Regional Office for South-East Asia, Indraprastha Estate, New Delhi, India**. It is hoped that once this journal indexed in IMSEAR it would be automatically indexed in the **Global Index Medicus managed by WHO Headquarters in Geneva as informed**.

The title mentioned above has been evaluated for inclusion in **SCOPUS by the Content Selection & Advisory Board (CSAB)**. The review of this title is now complete and the CSAB has advised that the title will be **accepted** for inclusion in Scopus. For your information, the reviewer comments are copied below:

**This is a well produced journal in an important subject field with interesting content, which deserves a wide readership. The editors are to be commended on their efforts.**

I assure you about the quality of research papers and quality of printing in future issues. Your valuable suggestions are always encouraging me and I heartily welcome for future suggestions.

**Professor [Dr.] Mukesh Yadav**  
**Editor, JIAFM**

### Subscription Information

- Members of IAFM will receive the free of cost.
- Non Members and Institutions (Annual Subscription rates)
- Personal: In India, **Rs. 1000/ (Rest of the world: US\$ 200/ or equivalent)**
- Institutions: In India, **Rs. 4000/ (Rest of the world: US\$ 400/ or equivalent)**
- We Accept: Bank Cheque / Demand Drafts (Add Rs. 50/- for outstation Cheques)
- The Scope of the Journal covers all aspects of Forensic Medicine and allied fields, research and applied.

Subscription orders and payments should be made in favour of  
**"Editor, JIAFM, payable at Greater Noida"**

### Claims for missing issue:

A copy will be sent free to the member / subscriber provided the claim is made within 2 months of publication of the issue & self addressed envelop of the size 9" x 12" is sent to the Editor. (Those who want the journals to be dispatched by Registered Post must affix Rs. 50/- worth postage stamps).

The journal is indexed with IndMed and made available online by following website:

[www.jiafm.com](http://www.jiafm.com)

[www.medind.nic.in](http://www.medind.nic.in)

[www.indianjournals.com](http://www.indianjournals.com)

<http://indmed.nic.in>

[www.iafmonline.in](http://www.iafmonline.in)

## Editorial

### Is There Need for Danger to Health (Physical/Mental)/Life Ground of MTP beyond Permissible Limit in Exceptional Cases?

The most commonly quoted **definition of health** is that formalized by the World Health Organization (WHO) over half a century ago; "a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity." This found application for the first time in a case of MTP beyond 20 weeks from Gujarat on the directions of the Hon'ble Supreme Court of India. In this case mental health has been given due importance in taking decision about MTP involving a clinical psychologist as part of team of doctors examining alleged minor victim of rape.

Abortion is an issue overshadowed and shrugged with glaring questions of morality, infanticide, suicide, ethics, religious beliefs and women's rights. To what amplitude, abortion should be permitted, encouraged, restricted or repressed is a social issue that has effectively divided theologians, philosophers, legislators and general mass. The laws governing this delicate sphere of the woman's autonomy reflects immensely on the plight of woman in the society and encompasses emotive and poignant sets of views making it a mammoth task for the legislators to ensure that the constitutional mandate of equality and liberty are adhered to and the constitutional spirit is kept alive. (Women's Right to Abort (2011) 10 SCC J-23)

Many cases come before courts in India on the issue of MTP. One such case came before the Division Bench of Madras High Court for directions. Some of the relevant extracts are as follows:

#### **Medical Opinion on Teenage Pregnancies and Abortion:**

According to learned counsel for the petitioner, Medical Experts are advising against teenage pregnancies in view of the complications which may be caused thereby. He places reliance on the following passages found in "**Current Reviews in Obstetrics & Gynaecology -- J.K. Russell -- Early Teenage Pregnancy -- Churchill Livingstone:**

"In western advanced societies few mothers now die in childbirth and because of the sparsity of deaths it is difficult to assess the specific risk for selected groups of mothers. In England and Wales since 1952 confidential enquiries have been made on all maternal deaths and the results have been published at 3-early intervals in a series of report (Report on Confidential Enquiries) into Maternal Deaths in England and Wales, 1952-1975). In these reports there is some acknowledgment of the risk to the lives of very young mothers though the number of maternal deaths in the youngest age group is understandably small. But it is accepted by the Regional Assessors for Maternal Deaths in England and Wales that the available evidence points to a higher than average risk of mortality in mothers aged 15 and younger." (Page 24)... ..

"Indeed the optimal age for reproduction would certainly include girls aged 17-19 and the risk of morbidity or mortality in this group is very slight indeed." (Page 25) ... ..

"In summary the evidence points to an increased risk of mortality especially among less educated, poorly motivated youngsters and those aged 16 and under." (Page 26)... ..

"Again people tend to associate teenage pregnancy with poor standards of childbearing high infant death rates and subsequent uncontrolled high fertility. In summary most advanced societies regard teenage pregnancy as being socially as well as medically unacceptable." However, in the Introduction at page 4, the author says:

"Finally I have come to learn over the years that it is not possible to talk or write of teenage pregnancy in terms of that are applicable throughout the world. The social, educational, medical and nutritional consequences of early teenage pregnancy vary considerably and depend upon the community in which the girl lives."

At page 19 it is said:

"In summary, I have found that operations of pregnancy termination in girls aged 13 to 16 years compared with those in the age group 17 to 19 carry greater risks of immediate medical complications attributable to the immature state of the cervix in the younger group."

Teenage pregnancies are generally discouraged in view of the fact that in many a girl the cervix could not have grown fully and properly and deliveries may have to be caused by caesarean operations.

But, even to-day, normal deliveries are recorded in the case of several teenage girls. As per the Medical History, the youngest mother in the world delivered a child in Lema, Peru, in May 1939 and her

age at that time was 5 years 8 months. But, once a pregnancy has come into existence, the question is **whether the same should be terminated because the pregnant girl is in her teens.** N. Jeffcoate in "Principles of Gynaecology", 5th Edition, says that "Termination of pregnancy, therapeutic or legal, is always potentially dangerous". (Page 630)

The learned author has listed out the dangers and complications which follow the termination of pregnancies on women who are generally fit physically, such as mortality and morbidity. At page 623 in the same book it is said:

"The World Medical Association laid down some principles in the Declaration of Geneva and stated that abortion should only be performed as a therapeutic measure and that doctors should be advised always to act on the principle "I will maintain the utmost respect for human life from the time of conception."

15. In a Book entitled "Abortion --Questions & Answers" by Dr & Mrs. J.C. Willke, 1985 Edition, the questions and answers are as follows: (vide pages 108 to 111):

**What about Teenage Abortions? Are They Different?** After years of legalized abortion experience, a pro-abortion professor of OB/GYN at the University of Newcastle-on-Tyne reported on his follow-up, ranging from two to twelve years, of 50 teenage mothers who had been aborted by him. He noted that "the cervix of the young teenager, pregnant for the first time, is invariably small and tightly closed and especially liable to damage on dilatation". He reported on the "rather dismal" results of their 53 subsequent pregnancies:

Six had another induced abortion. Nineteen had spontaneous miscarriages. One delivered a stillborn baby at 6 months. Six babies died between birth and 2 years. Twenty-one babies survived.

J. Russel, "Sexual Activity and Its consequences in the Teenager," Clinics in OB, GYN, Vol.1, No.3, Dec. 1974, pp.683-698.

"Physical and emotional damage from abortion is greater in a young girl. Adolescent abortion candidates differ from their sexually mature counterparts, and these differences contribute to high morbidity." They have immature cervixes and "run the risk of a difficult, potentially traumatic dilatation." The use of laminaria in no way mitigates our present concern over the problems of abortion."

C. Cowell, Problems of Adolescent Abortion, Oriho Panel 14, Toronto General Hospital.

"The younger the patient, the greater the gestation (age of the unborn), the higher the complication rate....Some of the most catastrophic complication occur in teenagers."

"Eighty-seven per cent (87%) of 436 obstetrician and gynecologists has to hospitalize at least one patient this year due to complications of legal abortions."

B. Sutton-Smith, Jour. of Youth and Adolescence, as reported in the New York Times, April 24, 1979.

Pregnancy in a very young teenager (12 to 16 years) does not appear to be inherently high risk.

J. Dwyer, Roosevelt Hospital, New York Family Practice News, May 1, 1978.

Dr. Jerome Johnson of John Hopkins University, and Dr. Felix Heald, Professor of Pediatrics, University of Maryland, agree that the fact that teenage mothers often have low birth weight babies is not due to a pregnant teen-ager's biologic destiny." They pointed to the fact that the cause for this almost invariably is due to the lack of adequate parental care. With optimal care, the outcome of an adolescent pregnancy can be as successful as the outcome of a non-adolescent pregnancy."

Family Practice News, Dec. 15, 1975.

"The overall incidence of pregnancy complications among adolescents 16 years and younger is similar to that period for older women." E. Hopkins, "Pregnancy Complications Not Higher in Teens, OB GYN News, Vol.15, No. 10, May 1980.

"Obstetric and neonatal risks for teenagers over 15 are no greater than for women in their twenties provided they receive adequate care."

There is evidence that in 15 to 17 years old women, pregnancy may even be healthier than in older ages.

E. McAnarney, Pregnancy May be Safer." OB-GYN News, Jan. 1978. Pediatrics, Vol.6 No. 2, Feb. 1978, pp. 199-205.

The question relating to abortion to save mother's life and the answer to the same are as follows:

"What about Abortion to Save the Mother's Life? These are almost nonexistent in today's sophisticated medical climate. Such an abortion would be a true "therapeutic" abortion.

If the mother's actual life were threatened, a conscientious doctor would try to save both. In the rare, rare case where such a decision is really needed, the problem would be that of balancing one human life against another (note that all other reasons given for abortion are reasons less than human life itself).

In such a case, it would be proper to give to the local family and local medical and ethical authorities the right to make whatever decision they believed right. An ethical physician would certainly try to save both, but might have to make a choice. The proposed Human Life Amendments allow this exception."

In a tragic incidence the girl from District Sabarkantha, Gujarat was allegedly raped by a doctor she had visited for treatment. The minor became pregnant after being allegedly raped by her doctor Jatin Bhai K. Mehta when she had visited him after suffering from typhoid in February, 2015.

The girl's father had first moved the Sessions Court seeking termination of pregnancy, saying she was in no position to take care of the child, but court turned down her plea to terminate the pregnancy as she was past the 20th week. Later on Gujarat High Court's Justice Abhilasha Kumari had refused permission for abortion on 16<sup>th</sup> April 2015 on the ground that the law does not allow it after 20 weeks of pregnancy.

The Supreme Court, which empathized with her plight saying "for no fault of her, she is suffering", also ordered a DNA test of the foetus be carried out to help in the trial of the doctor. The Supreme Court came to the rescue of a minor rape victim, by ordering that the requisite surgery may be done if the gynaecologists and clinical psychologists permit it.

Initially, the bench of Justices A.R. Dave and Kurian Joseph said it would not like to do something which is contrary to law. The bench, after hearing Kamini Jaiswal, appearing for the victim, said it would direct the authorities at the Civil Hospital at Ahmedabad to get the girl examined by two senior-most gynaecologists.

A medical team at Ahmedabad Civil Hospital on 30<sup>th</sup> July 2015 gave permission for termination of a 14-year-old rape survivor's 25-week-old pregnancy saying it wouldn't affect her health. The law allows abortion till the 20th week. The nod follows the Supreme Court's order on 28<sup>th</sup> July 2015 that she could undergo abortion if the medical experts allowed it.

According to Dr.M. M. Prabhakar Superintendent of the Civil Hospital, Ahmadabad, Gujarat: "A panel of five doctors: four from civil hospital and a private practitioner has given the nod for abortion."

### **Opinion of Board of Doctors**

It is needed to keep provision of constitution of medical board comprising psychologist and psychiatrist in addition to senior gynecologist in pregnancy especially involving alleged rape in advanced stage. As per the provisions of the MTP Act opinion of one doctor has been needed up to 12 weeks, of two doctors between 12-20 weeks before actual performance of MTP.

### **Who should be the Members of Board?**

Pregnancy beyond 20 weeks where there is no danger to her physical health due to continuance of pregnancy but with suicidal tendency should be examined by a team of doctors comprising at least on clinical psychologist / psychiatrist as the case may be. Decision of majority members of five member team will prevail as per the SC order dated 29<sup>th</sup> Aug 2015.

- Clinical Psychologist
- Senior Gynecologist (Three)
- One doctor who has previously endorsed opinion

### **Gujarat High Court Observations:**

Having heard the learned counsel for the parties and having gone through the materials on record, High Court find unable to grant the relief as prayed for mainly for **two reasons**.

**First**, considering the background facts and pendency of investigation I am not in a position to directly come to the conclusion that it had been a matter of rape.

**Secondly**, for the time being, I leave this aspect of rape aside.

Assuming that the pregnancy for whatever reason had been against the wish and desire of the applicant, the intriguing aspect in the present case is that by the time the applicant chose to file this writ petition i.e. on 31.3.2015, the pregnancy had been of about 27 weeks as is borne out from the medical reports. Although it is the case of the applicant that since she was in unlawful confinement of the accused persons she had no opportunity to get the pregnancy terminated within the statutory time period as provided in the Act, yet I am unable to accept such submission as the law does not permit the termination of pregnancy beyond 20 weeks except in cases where the life of the mother is in danger.

The learned counsel for the applicant strenuously contended that when read in the context of the Explanation-1 to Section-3, where pregnancy caused by rape is said to be of grave injury to the mental health of a pregnant woman, the same aspect must *ipso facto* ought to have been made applicable to the provisions of Sec.5 of the Act of 1971 too whereby the pregnancy could be terminated if required



immediately in order to save the life of the pregnant woman. Mr. Barot wants this Court to read something on the statute which the legislature has not thought fit to provide. [Para 11.2]

A result flowing from a statutory provision is never an evil. A court has no power to ignore that provision to relieve what it considers a distress resulting from its operating. A statute must of course be given effect to whether a court likes the result or not.

### **Impact of Not Allowing MTP:**

I am conscious of the fact that to carry a child in her womb by a woman as a result of conception through an act of rape is not only extremely traumatic for her but humiliating, frightening and psychologically devastating and as a human being, more particularly in the Indian society she becomes an object of scorn and ostracisation. This is very unfortunate. However, at the same time, assuming for the moment that termination at this stage is permissible, there would be likelihood of danger to the life of the applicant in case of carrying-out termination of pregnancy. If labour is induced for carrying-out termination of pregnancy, in every possibility the same would result in a live birth of a new born as the maturity of foetus is 28 weeks.

High Court Judge observed that I may only say having regard to the peculiar facts and circumstances of the case that the applicant will have to bravely go ahead with the pregnancy and when time comes, she should deliver the child. I am conscious of the fact that it is easy for a judge to say so in his judgment because it is ultimately the applicant who will have to face the hard days ahead, but as observed above, howsoever harsh one may find the law, yet it remains the law and one has to respect it. She must understand that termination at this stage will put her own life in peril.

Gujarat High Court observed that I can only remind her of what **Helene Evans**, a victim of rape, had to say in these types of situations. I quote "After the abortion, I wanted to die. How could I live when I had just ended the life of my child? The negative feelings resulting from the rape were not eliminated by the abortion. Nothing was solved; instead, the grief was now doubled."

Gujarat High Court further observed that I may also quote a short extract from an article "rape, incest and abortion; searching beyond the myths by David C. Reardon Ph.D. "Finally we must recognize that children conceived through sexual assault also deserve to have their voices heard. Rebecca Wasser-Kiessling, who was conceived in a rape, is rightfully proud of her mother's courage and generosity and wisely reminds us of a fundamental truth that transcends biological paternity. "I believe that God rewarded my birth mother for the suffering she endured, and that I am a gift to her. The serial rapist is not my creator, God is." Similarly, Julie Makimaa, who works diligently against the perception that abortion is acceptable or even necessary in cases of sexual assault, proclaims. "it doesn't matter how I began. What matters is who I will become."

### **Summary and Conclusions:**

It is right time to expedite the proposed amendments in the MTP Act, 1971, keeping in mind the plight of the rape survivor as a result of unwanted pregnancy and resulting harm to mental health which ultimately leading to danger to physical health and loss of life under suicidal impulse. There is need for creating awareness among teenagers to diagnose the problem of pregnancy as a result of forceful or sexual intercourse which is not consensual. Protection of overall health as per the definition of the WHO way back should be taken into consideration before taking decision to terminate pregnancy in such cases.

Mandatory provision of the medical board including psychologist and psychiatrist in addition to gynecologist in such cases should be constituted to rule out the possibility to the danger to the mental health ultimately danger to life.

It is not that legislature intent was not to provide provisions for such situations as MTP Act's **Explanation 1 reads:** *Where any pregnancy is alleged by the pregnant woman to have been caused by rape, the anguish caused by such pregnancy shall be presumed to constitute a grave injury to the mental health of the pregnant woman. There is need to extend it to some more weeks (24 to 28 weeks) as a special case under strict regulations to avoid misuse in future.*

It is a welcome decision of medical board which followed the Supreme Court's order dated 28<sup>th</sup> July 2015, a medical team on 30<sup>th</sup> July 2015 gave permission for termination of a minor rape victim's 25-week-old pregnancy though the law allows abortion only until the 20th week.

**Dr. Mukesh Yadav**  
**Editor, J Indian Academy of Forensic Medicine**  
**DOI: 10.5958/0974-0848.2015.00087.1**

## Original Research Paper

# Pattern of Medico-legal Cases in the Casualty Department of A Teaching Hospital, Bareilly, Uttar-Pradesh

<sup>1</sup>Atul Saxena, <sup>2</sup>Vinod Kumar, <sup>3</sup>S. R. Chaudhary, <sup>4</sup>Jasvinder Singh, <sup>5</sup>Sadhana Awasthi

### Abstract

Casualty department is the Heart of any hospital and is an important key area because most of medical and surgical emergencies and almost all medico-legal cases first reported here. It is the duty of first attending doctor to prepare report of all the medico-legal case with all required guidelines. Considering the importance of this work this retrospective study was conducted to analyze the pattern and magnitude of all the medico-legal cases registered in the casualty department of SRMS IMS Medical College Bareilly between January-December 2014. This study revealed that RTA constituted majority (64.39%) of medico-legal cases followed by poisoning (17.80%) and fall from height (3.79%). Majority of cases were male (81.44%). The most of the cases were in the age group 21-30 years (30.68%). The most of cases were reported in casualty between 12 p.m. to 6 p.m. (35.61%) followed by 6 p.m. to 12 a.m. (35.23%). The maximum case were reported in November (17.05%) followed by July (12.5%). The most of cases reported in Rainy season (July-October) (38.64%) followed by winter (34.85%).

**Key Words:** Medico-legal cases, Pattern, Road Traffic Accident, Season, Casualty department

### Introduction:

The casualty department is the very important area of any hospital. Almost all Medical and Surgical emergencies reported first to Casualty Department of Medical College and apart from these emergencies all medico-legal cases are registered in casualty and all medico-legal formalities are required to be fulfilled here.

Casualty Medical Officer (CMO) is the first contact doctor. First and prime duty of CMO is to give First Aid and save the life of patient and another duty of CMO is to do all medico-legal formalities concerned to patients.

A medico-legal case is a case of injury or illness where attending doctor after eliciting, listing and examining patient; is of opinion that some investigation by law enforcement agencies is essential to establish and fix responsibility for the case in accordance with the law of the land. [2]

Profiling of Medico-legal cases is an integral aspect for the prevention of preventable casualties in future and to study the crime rate in area. [3] In present study an attempt is made to know the pattern and magnitude of medico-legal cases in aspect of types of cases, age and sex of cases, time of arrival in casualty department, months and seasons of arrival of cases in casualty and analyze the data and find out suggestion for improvement of medico-legal work in casualty.

### Material and Methods:

This is a record based retrospective study of medico-legal cases registered in medico-legal register in casualty of SRMS IMS Medical College Bareilly from January to December 2014. Related general data like type of medico-legal cases reported in casualty during this period, age and sex of cases, time of arrival, months and season concern in arrival of medico-legal cases in casualty were collected from medico-legal register. During this study period the total 264 medico-legal cases were registered in casualty of SRMS IMS Medical College Bareilly.

The collected data was analyzed and presented in tables, graphs and pie charts by using various parameters and compared with other studies. Summer season means cases reported in months of March, April, May and June, Rainy season means July, August, September and October and Winter season

### Corresponding Author:

<sup>1</sup>Junior Resident II<sup>nd</sup> year  
Department of Forensic Medicine and Toxicology  
SRMS IMS, Medical College, Bareilly  
E-mail: dratulsaxena786@gmail.com

<sup>2</sup>Prof & HOD,

<sup>3</sup>Assoc. Prof,

<sup>4</sup>Assist. Prof,

<sup>5</sup>Assoc. Prof, Dept. of Community Medicine,  
Government Medical College, Haldwani  
DOR: 06.05.2015 DOA: 22.05.2015  
DOI: 10.5958/0974-0848.2015.00088.3

means November, December, January and February.

### **Observations and Results:**

In this one year retrospective study from 1 January 2014 to 31 December 2014, a total number of 264 medico-legal cases were reported and studied. Out of all cases, maximum number of cases were RTA (64.39%) followed by poisoning (17.80%) and fall from height (3.79%). Minimum number of cases reported was sexual offences (Rape) (0.38%). (Table 1)

In our study maximum cases were between 21-30 years of age (30.68%) followed by between 11-20 years (21.59%), 31-40 years (21.59%). Number of medico-legal cases reported between age, 11-20 year and 31-40 year were same (21.59%). Minimum cases (3.41%) reported were between age 60 to above years. (Table 2)

Present study showed that out of total cases reported in casualty male cases (81.44%) predominant over female cases (18.56%). (Table 3) Maximum number of cases were reported between 12 p.m. to 6 p.m. (35.61%) followed by 6 p.m. to 12 p.m. (35.23%), 6 a.m. to 12 p.m. (17.80%). Time of arrival of cases was the time mentioned in medico-legal register.

It was observed that minimum cases were reported at night time i.e. 12 a.m. to 6 am (11.36%). It was also observed that maximum numbers of cases were reported between 12 p.m. to 12 a.m. (70.84%) in comparison to 12 am to 12 p.m. (29.16%). (Table 4)

In our study maximum number of cases registered in casualty were in November (17.05%) followed by July (12.50%). Minimum number of cases was reported in January (3.41%). (Table 5) This study also showed that maximum cases reported in Rainy season (38.64%) followed by winter (34.85%) as compared to summer (26.52%). (Table 6)

### **Discussion:**

Present study showed that maximum cases reported to casualty were RTA. This finding was consistent with other studies. [1, 2, 6-8, 10, 11] Malik Y [3] and Yadav A [4] studies observed that maximum cases reported to casualty were of poisoning which differ to our study. It may be because both medical institutes are situated in rural area with most of the people involved in agriculture related activities with more accessibility to pesticides in their studies.

Hussain SN [5] study also showed maximum number of case reported to casualty were of burn which was differ to our study because at Akola Govt. Medical College all medico-legal cases reported to casualty and

also due to fact that there are very few private burn unit in Akola and surrounding district so that all such cases report to casualty of Akola Govt. Medical College.

In our study maximum numbers of cases reported to casualty were from age group 21-30 years (30.68%) followed by 31-40 years (21.59%) and 11-20 years (21.59%), similar to other authors studies. [2-5, 9-11] This may be due to fact that individual of these age group lead more active life, involved more in outdoor, sports and recreation activities and take risk for work, which leads to more injuries and accidents among these group.

In our study male (81.44%) outnumbered female (18.56%) as seen in others. [2-5, 9-11] This is because males are more involved in outdoor activities so they are more vulnerable to accident or injuries.

Present study showed that maximum number of medico-legal cases reported to casualty between 12 p.m. to 6 p.m. (35.61%) because in this time of day most of people are maximally involved into their activities.

This is similar with the study of Garg V [2], Gupta B [7] and Mahesh & Rahul. [10] As the day progress frustration of person was increased and the temperature and humidity level of environment was also high during this time period of day. [10] This study also showed that minimum number of medico-legal cases reported to casualty between 12 am. to 6 am.(11.36%). [10]

Our study showed that maximum number of medico-legal cases reported to casualty were in month of November (17.05%) followed by July (12.5%). This is differ with the study of Mahesh & Rahul [10], Garg V [2] and Hussian S.N [5], their studies reported maximum number of cases were noted in to the month of October and September. Discrepancies may be due to fact that later studies were conducted in rural setup where people are more involved in agricultural activities.

In this study maximum number of medico-legal cases were reported during Rainy season (38.64%), followed by winter (34.85%) and summer season (26.52%).

Garg V [2] and Hussian SN [5] studies showed similar result in respect of Rainy season but differ in winter and summer season. Reason of difference is that our Medical College is situated near Bareilly-Nainital Highway and in winter season there is dense fog which was responsible for RTA cases. That was the mean reason in our study number of cases in winter was grater then summer.

## Conclusions & Recommendations:

The casualty department of any hospital is not only deal medical and surgical emergencies but also carry out legal responsibilities to examine documentation and certify medico-legal cases, this puts a lot of burden on casualty department and on first contact doctor, most of time they are MBBS only. The doctor those are involved in handling medico legal cases need to be more trained.

Casualties of Medical Colleges have lot of exposure of medico legal cases, so hospital has the need for round the clock availability of Forensic experts. Most of the time first contact doctor in casualty is MBBS only.

They are not expert in handling medico-legal cases so we focus to thing to demand increases in time in practical training of students during MBBS in the curriculum. The 15 days posting under Forensic Medical Department during internship should be mandatory for better exposure to medico legal cases.

## References:

1. Agarwal SS, Kumar L, Chavali K. Legal medicine manual. New Delhi: Jaypee Brothers medical publishers (P) Ltd.; 2008:12-3.
2. Garg V, Verma SK. Profile of Medico-legal Cases at Adesh Institute of Medical Sciences and Research, Bhatinda, Punjab. J Indian Acad. Forensic Med. 2010; 32 (2):150-2.
3. Malik Y, Chawla R, Sharma G, Malik P, Singh R, Tripathi A. Profile of Medico-legal Cases in Casualty of a Rural Medical College of Haryana. J Indian Acad. Forensic Med. 2013; 35(4):367-8.
4. Yadav A, Singh NK. Pattern of Medico-legal Cases in rural Area of Faridabad, Haryana. J Indian Acad. Forensic Med. 2013; 35(1):60-2.
5. Hussaini SN, Kulkarni CS, Batra AK. Profile of Medico-Legal Cases Coming to Casualty of Government Medical College, Akola. Journal of Forensic Medicine, science and Law. 2013; 22(2):
6. Benomran FA. The medico-legal science in Dubai: 2002-2007. J of Forensic and Legal Medicine. 2009; 16:332-7.
7. Gupta B, Singh S, Singh H, Sharma RK. A one Year Profile of Medico-legal Cases at Tertiary Care Hospital in Western Uttar Pradesh. Medico-Legal Update. 2012; 12(2):30-5.
8. Bhullar DS, Aggarwal KK. Medico Legal Diagnosis & Pattern of Injuries with Sharp Weapons. JIAFM 2007; 29(4):112-4.
9. Marri Murad Zaffar, Baloch Umar. Frequency and pattern of medico legal cases reported at Sandeman Civil Hospital Quetta Baluchistan- 1year study.
10. Mahes M. Trangadia, Rahul A. Mehta, Nita H. Rada, B. D. Gupta. Profile of Medico-Legal Cases in Tertiary Care Hospital in Jamnagar, Gujarat: Retrospective Study of One Year. Journal of Research in Medical and Dental Science. 2014; 4(2):57-62.
11. Haridas SV, Pawale DA. A Retrospective Study of Pattern of Clinical Medico-Legal Cases Registered at Tertiary Health Care Centre in Kolhapur District. J of Forensic Medicine, Science and law. 2014;23(2)

**Table 1: Profile of Medico-Legal Cases**

Types of medico-legal cases	cases (N)	Percentage (%)
Injury by self	01	0.38
Firearm	02	0.76
RTA	170	64.39
Thermal	04	1.52
Violent Asphyxia	03	1.14
Sexual offences	01	0.38
Assault	05	1.89
Fall from Height	10	3.79
Trauma by Animal	01	0.38
Poisoning	47	17.80
Accidental	08	3.03
Trauma by train	06	2.27
Brought Dead	06	2.27
Total	264	100

**Table 2: Age Wise Distribution**

Age (years)	Cases (N)	Percentage (%)
0-10	18	6.82
11-20	57	21.59
21-30	81	30.68
31-40	57	21.59
41-50	28	10.61
51-60	14	5.30
61 to above	09	3.41
Total	264	100

**Table 3: Sex Wise Distribution**

Sex	Medico legal cases	Percentage (%)
Male	215	81.44
Female	49	18.56

**Table 4: Time of Arrival at Casualty**

Time	Cases	Percentage (%)
6 am -12 pm.	47	17.80
12pm -6 pm.	94	35.61
6pm. -12 am.	93	35.23
12am. -6 am.	30	11.36
Total	264	100

**Table 5: Month wise Distribution**

Months	Medico legal cases	Percentage (%)
January	9	3.41
February	19	7.20
March	17	6.44
April	18	6.82
May	16	6.06
June	19	7.20
July	33	12.5
August	17	6.44
September.	21	7.95
October	31	11.74
November	45	17.05
December	19	7.20
Total	264	100

**Table 6: Seasonal Distribution**

Seasons	cases	Percentage (%)
Summer(March- June)	70	26.52
Rainy(July-October)	102	38.64
Winter (November-February)	92	34.82
Total	264	100

## Original Research Paper

# Written Informed Consent: Is It Practiced What Is Being Preached?

<sup>1</sup>Ashish Jain, <sup>2</sup>Rajeev Kumar Banzal, <sup>3</sup>Rajneesh Pandey, <sup>4</sup>Jayanthi Yadav

### Abstract

The principles of informed consent are often neglected during clinical practice in developing countries. We tried to assess the level of knowledge of doctors with regards to informed consent and whether they adhere to the principles of informed consent in actual practice. Questionnaire based cross-sectional survey was conducted among 150 randomly selected clinical practitioners of various specialty and super-specialty working at Bhopal City of India. The questionnaire comprised of 30 items of fixed-response type (yes/no/can't say) testing mainly three attributes – knowledge, attitude and practice. Out of 150 clinical practitioners selected to participate in the survey, 115 completed the survey (Response rate=76.66%). Majority of respondents answered correctly when asked about the fundamental principles of obtaining a valid consent (correct response rate varying from 97.4% to 83.4%). However there was marked disparity between level of knowledge and actual practice with regards to informed consent. Study provides valuable insight into how doctors approach informed consent during their practice. It seems that doctors meet many, but not all, of the legal requirements for informed consent. We recommend regular workshops for doctors, on this important issue.

**Key Words:** Written Informed Consent, Medical Ethics, Consumer Protection Act

### Introduction:

In India, last two and half decades have witnessed a drastic rise in the sphere of patients' autonomy. In the past, doctors' attitude towards patients was predominated by the paternalism- "The doctor knows best, what is good for his patient".

However with enactment of legislations such as consumer protection act and after the inclusion of medical services under this act, this era of paternalism in clinical practice is long gone. [1] It is now widely accepted that clinicians should negotiate rather than dictate what is in the best interest of the patients. The idea of "Doctor knows best" has given way to "Partnership in care". [2]

### Corresponding Author:

<sup>1</sup>Assistant Professor,  
Department of Forensic Medicine,  
Gandhi Medical College, Bhopal, M.P.-462001  
E-mail: ashish8158@gmail.com

<sup>2</sup>Assist. Prof, Dept. of Forensic Medicine,  
Bundelkhand (Govt.) Medical College, Sagar, M.P.

<sup>3</sup>Junior Resident, Dept. of Forensic Medicine,  
Gandhi Medical College, Bhopal, M.P.

<sup>4</sup>Assoc. Prof & HOD, Dept. of Forensic Medicine,  
Gandhi Medical College, Bhopal, M.P.

DOR: 05.05.2015 DOA: 02.06.2015

DOI: 10.5958/0974-0848.2015.00089.5

Consent in the context of a doctor-patient relationship, means the grant of permission by the patient for an act to be carried out by the doctor such as a diagnostic, surgical or therapeutic procedure. In UK, the elements of consent are defined with reference to the patient and a consent is considered to be valid and 'real' when

1. The patient gives it voluntarily without any coercion;
2. The patient has the capacity and competence to give consent; and
3. The patient has the minimum of adequate level of information about the nature of the procedure to which he is consenting to. [3]

In a landmark judgment in case of *Samira Kohli v/s Prabha Manchanda*, the Supreme Court of India reiterated the importance of informed consent in patient care. In above case, Supreme Court did a comprehensive analysis of concept of informed consent in clinical practice and its applicability in a developing country like India. [3]

In spite of strict legislations and examples set by the orders of apex court, it is commonly observed that the principle of informed consent during patient care is often neglected in our country.

Various factors may be responsible for this situation like lack of knowledge among clinicians, or it is difficult for them to change their

attitude and practice according to demands of the time. The present research tries to find out knowledge of the clinicians regarding informed consent, and how they apply it during their practice and; also to find out the ways by which we can improve the procedure of obtaining consent from patients in compliance with various rules and acts of this country.

### Material and Methods:

The present study is a Questionnaire based cross-sectional survey similar to Knowledge, attitude, practice (KAP) survey.

Study population comprised of clinical practitioners of various medical specialty and super-specialty, working in Government and Private hospitals in the Bhopal city of India.

A total 150 respondents were randomly selected to participate in the study. The study team designed a questionnaire after taking into the account of, the observations made by Honorable Supreme Court in *Samira Kohli v/s Prabha Manchanda* case and, also the guidelines prescribed by WHO and ICMR for obtaining written informed consent from patients participating in clinical research.

The questionnaire comprised of 30 items of fixed-response type (yes/no/can't say) testing mainly three attributes knowledge, attitude and practice. Complete information about the study was provided to the participants in the form of printed information sheets, highlighting objectives, methodology and policy regarding the confidentiality of data.

After obtaining written informed consent from the respondents, questionnaire was administered, both in printed form and web form using Google docs as online tool. Online tool was selected to enhance the response rate.

### Observations and Results:

Out of 150 clinical practitioners selected to participate in the survey, 115 completed the survey by answering all 30 questions provided to them in questionnaire. Response rate was 76.66%. Regarding knowledge of respondents about the written informed consent, majority of private clinical practitioners (76 out of 86, 88.4%) were aware that medical services are covered under the ambit of Consumer Protection Act.

But only few (12.2%) had any knowledge about the landmark judgment of honorable Supreme Court in case of *Samira Kohli Vs Dr. Prabha Manchanda*.

All the respondents knew that written informed consent of the patient is compulsory before any diagnostic and therapeutic procedure, which extends beyond the routine

clinical check-up where only, implied consent suffice.

Most respondents answered correctly when asked about the fundamental principles of obtaining a valid consent, such as consent must be obtained voluntarily from patient without any force or fear (97.4%), after providing complete information about the planned procedure explaining all the benefits and risks (correct response=97.4%), must be obtained from the patient himself (correct response=96.5%), in his own language or in a language that he understands (correct response=97.4%) and he must be given sufficient time to make his decision (correct response=88.6%) unless it is an emergency.

Most of the respondents also knew that patients have right to second opinion and informed refusal (correct response=83.4%). (Table 1)

But do the clinicians actually practice what they know? Second part of the questionnaire was focused on this aspect, and various questions along with responses pertaining to this aspect are summarized in Tabular form. (Table 2)

Although most respondents know that consent is a voluntary agreement between patient and themselves, almost half of them (49.6%) leave the responsibility of obtaining consent to their subordinate staff such as nursing staff, resident doctors or even clerical staff. Majority of respondents (67.8%) prefer hand written format over printed proforma for obtaining consent. A sizeable chunk of respondents (26.9%) use English language for taking written consent.

Most of them admit that they provide complete information about the planned procedure to the patients including risks and side effects and alternative procedures if available. But about half of them (44.4%) do not provide separate information sheet to the patient. 68.7% respondents also provide cost estimate of planned procedure.

About half of doctors (53.9%) do not mention their name in the consent sheet and overwhelming majority of doctors (78.3%) do not put their signature on the consent form, so consent form looks more like a surrender letter by patient. In about 39.1% cases patient's attendants sign the consent form on patient's behalf. 86.1% doctors do not provide a copy of consent sheet to patient.

As far as time of obtaining consent is concerned, about 90% respondents take consent at the time of admission or a night before the planned procedure. If there is any

deviation from the planned procedure, when the operation is underway and patient is anesthetized, 66.1% doctors take consent midway from the patient's attendant and only 12.2% wait for the patient to come out of anesthesia. We also tried to identify reasons behind the ineffective implementation of informed consent in clinical practice.

About 50% respondents believe that they cannot provide complete information to patients due to lack of time and excessive workload. Even more respondents feel that revealing too much information about the risks may scare the patient and he may become averse to undergo surgery.

Majority of respondents fear Indian legal system because of its slow and costly nature. They do not want to get involved in any litigation due to lack of valid consent. Therefore almost all of them agree that there is need for regular workshop on this issue. (Table 3)

### Discussion:

Informed consent can be sought and obtained in two different senses, each with different implications." The first is the legal sense in which authorization for the professional to act implies that the patient has a reasonable understanding of the procedure and its consequences. The second and more important moral sense of informed consent is based on a true commitment to patient autonomy and the need for shared decision-making. [4]

To make an informed consent really valid, it needs to fulfill both the above stated objectives. In this context it is pertinent to cite the case of *Samira Kohli v/s Prabha Manchanda*, in which doctor obtained the consent for "laparoscopy and laparotomy if needed" but after finding extensive endometriosis during laparoscopy, doctor just informed the mother of the patient about her condition, and proceeded with hysterectomy, without waiting for the patient to come out of anesthesia. Supreme Court of India held consent to be both legally and morally invalid as it was not truly informed. [3]

This case exemplifies the paternalistic attitude of doctors to make decisions on patient's behalf. Most doctors in developing country like India still view informed consent to be just a legal formality and not an ethical issue, related to patient's autonomy.

Based on above pretext, present study attempts to find out factors affecting the informed consent. Our study shows clear-cut discordance between the knowledge of doctors and their actual practice with regards to informed

consent. Results clearly showed that doctors, who participated in the survey, have adequate knowledge about the fundamental principles of written informed consent. So it is not the medical education system of the country that is at fault.

This is contrary to the study done in Pakistan by Humayun A et al, who suggested incorporating formal training of Bio-Ethics in the undergraduate and postgraduate medical curriculum. [5] In present study, about half the doctors, despite knowing very well that it is their legal responsibility to obtain the consent from patient, leave this important task to be performed by their subordinate staff, such as resident doctors and nursing staff. Such consent may not be truly informed and legally valid.

This observation highlights the fact that, for most doctors informed consent is not a moral obligation towards the patient but a legal ritual that has to be complied with.

About 39.1% doctors, who were surveyed, do not take consent directly from the patient but from their relatives and family members. This may be a "cultural artefact", because in India, individuals prefer to make important decisions after consulting with the family members. And during sickness, it is the views of family members that take precedence over individual decision.

Moreover during sickness, patient may not want to listen about the risks and cost of the procedure. Thereby doctors prefer to disclose information to attendants and seek consent from them although it may have serious legal repercussions. Study done in various Asian countries like, Pakistan, Japan, Hong Kong also point out this cultural artefact. [5-7]

Most doctors take consent in hand-written format, which may be written in haste and handwriting may not be legible. Also it is difficult to provide complete information to the patient in such format. A sizeable chunk of respondents (26.9%) still use English language for taking consent, which is neither first nor even second language for most of their patients.

Linguistic barrier has been identified as a major obstacle in obtaining a proper informed consent by several authors. [8, 9]

Results show majority of doctors disclose complete information about planned procedure to their patients, which is in contrast to studies conducted in Pakistan and Japan, where doctors still follow paternalistic model of healthcare decision making Doctor knows best what is good for their patients. [5, 6]

Application of Consumer protection Act in healthcare field necessitates the revealing of the cost to the patients, otherwise it may be

regarded as deficiency in service. In our study 68.7% doctors said, they provide cost estimate of planned procedure to their patients. In contrast a study conducted at South Africa by Henley L et al shows, 75% doctors do not reveal the cost of the procedure to the patient. [10]

Shortage of time and excessive workload is often cited as a major obstacle in obtaining proper informed consent. This fact is reiterated once more in our study. Many doctors believe that full disclosure about the risks associated with procedure may unnecessary scare the patient and he may be devoid of potentially lifesaving measure. This view is also echoed by Yousaf RM et al. [11]

### Limitations of the Study:

The study findings must be viewed in the light of the following limitations. A questionnaire based survey cannot expose the process of consent taking in real world situation.

Study would have been more meaningful, if it had been supplemented with the auditing of the consent form. This study reflects doctor's perspective only. Patient, who represents the other side of the coin in the whole process of informed consent, has not been taken into account. We recommend a patient centric survey on the same topic to have a holistic view.

### Conclusion:

To the best of our knowledge, this is first attempt to identify the gap between the knowledge and practice among clinical practitioners with regards to written informed consent. Despite its limitations, the study provides valuable insight into how doctors approach informed consent during their practice. It seems that doctors meet many, but not all, of

the legal requirements for informed consent. We recommend regular workshops for doctors, on this important issue and also on various other aspects of medical ethics, not only to refresh the knowledge but also bring about change in attitude according to the demands of time.

### References:

1. The Consumer Protection Act 1986. Available at: <http://chdconsumercourt.gov.in/consumerProtectionAct1986.pdf>. Accessed on 15.01.2014.
2. Doyal L. Good clinical practice and informed consent are inseparable. *Heart*. 2002; 87: 103-106.
3. Available at: <http://judis.nic.in/supremecourt/imgs1.aspx?filename=30116>. Accessed on 15.01.2014.
4. Faden RR, Beauchamp TL. A History and Theory of Informed Consent. New York: Oxford University Press; 1986.
5. Humayun A, Fatima N, Naqqash S, Hussain S, Rasheed A, Imtiaz H, Imam SZ. Patients' perception and actual practice of informed consent, privacy and confidentiality in general medical outpatient departments of two tertiary care hospitals of Lahore. *BMC Medical Ethics*. 2008; 9:14.
6. Miyashita M, Hashimoto S, Kawa M, Shima Y, Kawagoe H, Hase T, Shinjo Y, Suemasu K. Attitudes toward disease and prognosis disclosure and decision making for terminally ill patients in Japan, based on a nationwide random sampling survey of the general population and medical practitioners. *Palliat Support Care*. 2006; 4: 389-98.
7. Chan HM. Informed consent Hong Kong style: an instance of moderate familism. *J Med Philos*. 2004; 29: 195-206.
8. Kaufert JM, Q'Neil JD. Biomedical rituals and informed consent: Native Canadians and the negotiation of clinical trust. *Social Science Perspectives on Medical Ethics*. Netherlands: Kluwer Academic Publishers; 1990: 41-63.
9. A practical guide to informed consent. Available at: <http://www.templehealth.org/ICTOOLKIT/html/ictoolkitpage23.html>. Accessed on 15.01.2014.
10. Henley L, Benatar SR, Robertson BA, Ensink K. Informed consent – a survey of doctors' practices in South Africa. *S Afr Med J*. 1995; 85: 1273-1278.
11. Yousaf RM, Fauzi ARM, How SH, Rasool AG, Rohana K. Awareness, knowledge and attitude towards informed consent among doctors in two different cultures in Asia: a cross sectional comparative study in Malaysia and Kashmir, India. *Singapore Med J*. 2007; 48: 559-65.

Table 1: Questionnaire Part-1

Question	Response	N (%)
Do you know your services are covered under Consumer Protection Act?	Yes	76 (66.1%)
	No	10 (8.1%)
	N.A.	29 (25.2%)
Have you heard about Honorable Supreme Court's decision on Samira Kohli Vs. Dr. Prabha Manchanda case?	Yes	14 (12.2%)
	No	101 (87.8%)
Do you know Written Informed Consent is necessary before any therapeutic or diagnostic procedure which is beyond the ordinary clinical check-up	Yes	100 (100%)
	No	0 (0%)
Do you know consent without adequate information is no consent at all	Yes	112 (97.4%)
	No	3 (2.6%)
Do you know a written informed consent is a voluntary agreement between you and your patient	Yes	112 (97.4%)
	No	3 (2.6%)
Do you know written informed consent should be taken from the patient himself / herself, unless he / she is incapable of doing so due to any reason (such as minors, unconsciousness, emergency etc.)	Yes	111 (96.5%)
	No	4 (3.5%)
Do you know the consent should be taken in patients' own language or in the language the patient understands	Yes	112 (97.4%)
	No	3 (2.6%)
Do you know it is necessary to give sufficient time to patient to make the decision about the proposed procedure	Yes	102 (88.6%)
	No	13 (11.4%)
Do you know the patient has right to second opinion before consenting to any procedure	Yes	96 (83.4%)
	No	19 (16.6%)
Do you know that patient has right to informed refusal	Yes	96 (83.4%)
	No	19 (16.6%)



**Table 2: Questionnaire Part-2**

Question	Response	N (%)
Who takes the consent in your setup	Yourself	58 (50.4%)
	Subordinate	57 (49.6%)
Which type of consent proforma do you use for written informed consent	Handwritten	78 (67.8%)
	Printed	37 (32.2%)
In which language do you prefer to take consent	English	31 (26.9%)
	Hindi	84 (73.1%)
Do you use separate information sheet and consent sheet	Yes	64 (55.6%)
	No	51 (44.4%)
Do you provide complete information about the planned procedure	Yes	100 (86.9%)
	No	15 (13.1%)
Do you provide complete information about alternatives	Yes	88 (76.5%)
	No	27 (23.5%)
Do you provide complete information about risks and side-effects	Yes	105 (91.3%)
	No	10 (8.7%)
Do you provide rough estimate of cost involved in the procedure and cost escalation, if any complication arises	Yes, written	12 (10.4%)
		67 (58.3%)
	No	36 (31.3%)
Who signs the consent on patient's behalf, in majority of elective procedures in your setup	Attendant	45 (39.1%)
	Patient	70 (59.9%)
Does the name of Primary physician (treating doctor) features in the written informed consent sheet	Yes	62 (53.9%)
	No	53 (46.1%)
Do you also sign the consent yourself	Yes	25 (21.7%)
	No	90 (78.3%)
When do you take the consent in elective procedures	On admission	43(37.4%)
	Night before procedure	61(53%)
	Just before procedure	11(9.6%)
Do you take consent midway if there is any deviation in the planned procedure (when the operation is underway and patient is anaesthetized)	Yes	82 (71.3%)
	No	8 (7%)
	N. A.	25 (21.7%)
If the answer of the above question is Yes, then time of taking such consent	During the procedure from attendant	76 (66.1%)
	Wait for patient to recover from anesthesia	14 (12.2%)
	N. A.	25 (21.7%)
Do you provide a copy of informed consent sheet to the patient	Yes	16 (13.9%)
	No	99 (86.1%)

N.A.=Not Applicable

**Table 3: Questionnaire Part -3**

Question	Response	N (%)
Do you feel you cannot provide complete information to the patient due to shortage of time	Yes	58 (50.4%)
	No	57 (49.6%)
Do you feel it will be more time consuming and costlier if you happen to run into a court case due to lack of a valid consent, considering the Indian legal system	Yes	99 (86.1%)
	No	16 (13.9%)
Do you feel revealing too much information about risks and complications may scare the patient and he may be devoid of any life-saving procedure	Yes	74 (64.3%)
	No	41 (35.7%)
Do you feel revealing the cost may cause you to lose your patient to some other doctor	Yes	31(27%)
	No	84 (73%)
Do you feel a need of a workshop or conference on this topic that is "Informed Consent in Clinical Practice" to improve the quality of your services	Yes	108 (93.9%)
	No	7 (6.1%)

## Original Research Paper

# Observations on Symmetry and Sexual Dimorphism from Morphometrics of Foramen Magnum and Orbits In Adult Bengali Population

<sup>1</sup>Saswata Biswas, <sup>2</sup>Soumeek Chowdhuri, <sup>3</sup>Aniruddha Das, <sup>4</sup>Partha Pratim Mukhopadhyay

### Abstract

Human body exhibits bilateral symmetry along the sagittal plane. Symmetry in nature is approximate. Human bones show sexual dimorphism. Determination of sex is necessary from skeletal remains for establishment of an identity. In this study conducted on 53 skulls, the measurements of foramen magnum and orbits were taken by digital slide calipers. The mean length, breadth and areas calculated from Radinsky and Texeria formulae for male skulls were 3.4 cm, 2.8 cm, 7.52 cm<sup>2</sup> and 7.6 cm<sup>2</sup> and those for female skulls were 3.3 cm, 2.74 cm, 7.15 cm<sup>2</sup> and 7.22 cm<sup>2</sup> respectively. The orbital indices for the male skulls fall in the Mesoseme category (86.89) while that for the female skulls fall in the Megaseme category (90.31). Asymmetry exists between right and left orbits of each individual. The interorbital distance between male and female skulls were significantly different and may be used as an indicator for sex determination from skulls.

This study conducted first time on Bengali population aims for formation of a craniometric database; provide clues on facial asymmetry for facial reconstructions and superimposition and newer methods for determination of sex from dry adult cranial bones.

**Key Words:** Symmetry, Craniometrics, Foramen Magnum, Orbits, Identification, Bengali

### Introduction:

Symmetry can be defined as the quality of being made up of exactly similar parts facing each other or around an axis. [1] On simpler terms it can also be said as similarity or exact correspondence between different things. Symmetry essentially reflects order. Scientists have recognized that symmetry has relation with aesthetic appeals and human beings are attracted to it. Symmetry is abundant in nature from plant leaves and sea anemones to higher vertebrates including human body.

Human body exhibit bilateral or mirror symmetry and is symmetrical along the sagittal plane which divides it into two equal halves with identical limbs and identical facial halves with eyes and ears. However symmetry in nature is very approximate and humans tend to over generalize it.

No two things in nature are exactly symmetrical including the anatomy of the human body. Essentially male and female are different in nature and abundant dimorphism exists in human body. Human bones are also different in males and females. In Forensic Medicine determination of sex is very necessary particularly from skeletal remains. Identification is an utmost necessity for Forensic experts from skeletal remains and sex determination stands as the first pillar for establishment of an identity.

The determination of sex is based mainly upon the appearances of the pelvis, skull, sternum and the long bones.

According to Krogman the degree of accuracy in sexing adult skeletal remains is: Entire skeleton-100%, Pelvis alone-95%, Skull alone-90%, Pelvis and Skull-98% and Long bones alone-80%. [2] Skull is extensively used for sex determination in day to day autopsy practice and various traits are looked after.

The most commonly looked after traits are: general appearance, architecture, glabella, frontonasal junction, **orbits**, supraorbital ridge, zygomatic arch, nasal aperture, external auditory meatus, occipital area, mastoid process, digastric groove, palate, **foramen magnum**, teeth etc. [3]

### Corresponding Author:

<sup>1</sup>Post Graduate Trainee II<sup>nd</sup> Year  
Department of Forensic and State Medicine,  
Burdwan Medical College, Burdwan; West Bengal  
E-mail: bony.biswas.mmc@gmail.com

<sup>2</sup>Post Graduate Trainee II<sup>nd</sup> Year

<sup>3</sup>Post Graduate Trainee Final Year

<sup>4</sup>Prof & Head

DOR: 06.02.2015 DOA: 12.08.2015

DOI: 10.5958/0974-0848.2015.00090.1

The male orbits are square, relatively smaller with rounded margins while in female it is rounded relatively larger with sharp margins.

The foramen magnum is relatively large and longer in males and small and rounded in females. [4] Measurements of different cranial features or craniometrics are very important for Forensic experts. Craniometric database formation for different population is not only of anthropometric importance but also for Forensic interest. Craniometric measurements such as inter and bi-orbital diameter from skull helps in superimposition and also facial reconstruction.

It is beyond any doubt that superimposition and facial reconstruction are very important for establishment of identity in this modern era of Forensics.

The foramen magnum is a wide communication between posterior cranial fossa and the vertebral canal. The foramen magnum is surrounded by different parts of the occipital bone, squamous part lies behind and above, basilar part in front and a condylar part on either side. On each side its antero-lateral margin is encroached by occipital condyles, hence the foramen magnum is narrow anteriorly.

The anterior edge of the foramen magnum is slightly thickened and lies between the anterior ends of the condyles. The posterior half of the foramen magnum is thin and semicircular. Upper ends of anterior and posterior atlanto-occipital membranes are attached to the anterior and posterior margins of the foramen magnum respectively, and their lower ends are attached to the superior surface of anterior and posterior arches of the atlas respectively.

Foramen magnum is about 3 cm wide by 3.5 cm antero-posteriorly and is located midway between and on a level with mastoid processes. [5] The orbits are bilateral structures in the upper half of the face below the anterior cranial fossa and anterior to the middle cranial fossa that contain the eyeball, the optic nerve, the extra-ocular muscles etc. Seven bones contribute to the framework of each orbit.

They are the maxilla, zygomatic, frontal, ethmoid, lacrimal, sphenoid, and palatine bones. Together they give the bony orbit the shape of a pyramid, with its wide base opening anteriorly onto the face, and its apex extending in a posteromedial direction.

Completing the pyramid configuration are medial, lateral, superior, and inferior walls. The average dimensions of the orbit are as follows: Height of orbital margin - 40 mm, Width of orbital margin - 35 mm, Depth of orbit - 40-50

mm, Interorbital distance - 25 mm, Volume of orbit - 30 cm<sup>3</sup>. [6]

The present study was conducted to find out the baseline measurements of foramen magnum and both orbits in Indian Bengali subjects. The morphometric differences between two sexes were observed and orbital symmetry for each individual was assessed.

### Materials and Methods:

In the present study dried specimens of human skull which were at the Museum of The Department of Forensic Medicine, Burdwan Medical College, Burdwan were used. The sex of the specimen skulls were already known and retrieved from the catalogue.

Then the measurements were taken using a digital Vernier calipers [AEROSPACE Digital Caliper] to the nearest of 0.01mm. All the measurements were taken by a single individual on two different occasions and the average of the two readings were taken.

### Measurements of the Foramen Magnum: [7]

- a. **Longitudinal diameter (LD)** of the foramen magnum: It is distance between basion and opisthion.
- b. **Transverse diameter (TD)** of the foramen magnum: It is maximum distance between two lateral margins.

Area of the foramen magnum was calculated by using two different formulae: [8, 9]

- **Texeria Formula:**  $\text{Area} = \pi \{ (LD+TD)/4 \}^2$
- **Radinsky Formula:**  $\text{Area} = 0.25 \pi LD \cdot TD$

### Measurements of the Orbit: [10]

The ectochion, the intersection of the most anterior surface of the lateral border of the orbit and a line bisecting the orbit along its long axis, was used as a landmark for the most lateral point of the orbit.

**Orbital Breadth:** The sloping distance between the dacryon, (the point on the medial border of the orbit at which the frontal, lacrimal, and maxilla bones intersect), and the ectochion was taken to be the orbital breadth.

**Orbital Height:** The direct distance between the superior and inferior orbital margins perpendicular to the orbital breadth.

**Orbital Index:** This was calculated by dividing the orbital height with the orbital breadth and multiplying the result by 100.

**Interorbital distance:** The direct distance between the most medial points of the right and left orbit was taken as the interorbital distance.

The data was analyzed statistically using SPSS version 19.0 computer software (SPSS, Inc., Chicago, IL, USA) for descriptive and inferential statistics.

## Result Analysis:

### 1. For Foramen Magnum:

The mean length of foramen magnum in male skulls (n=31) was 34.02 mm (Table 1) and the mean length of foramen magnum in female skulls (n=22) was 33.03 mm. (Table 2)

The mean breadth of foramen magnum in male skulls was 28.1 mm (Table 1) and that of female skulls was 27.46 mm. (Table 2) The area of foramen magnum as calculated by **Radinsky Formula** was  $752.26 \text{ mm}^2$  (Table 1) for male skulls and  $715.31 \text{ mm}^2$  (Table 2) for female skulls. Similarly the area calculated from **Texeria Formula** was  $760.25 \text{ mm}^2$  (Table 1) for male and  $722.11 \text{ mm}^2$  (Table 2) for female.

The comparison of foramen magnum length, breadth and areas between male and female skulls were depicted in graph. (Graph 1)

### 2. For Orbits:

The distribution of orbital length, breadth, index and inter-orbital distances in male and female skulls are discussed. (Table 4, 5)

The comparison of these parameters between male and female skulls is shown graphically too. (Graph 2) The comparison between Right Orbital Indices, Left Orbital Indices and Inter orbital distances were done. (Table 6, 7 and 8) This comparison is also shown graphically. (Graph 3)

## Discussion:

There has been no previous documented evaluation of foramen magnum dimensions and orbital measurements in Bengali population. In this study the baseline measurements of foramen magnum and orbits were taken and were compared with previous studies done in India and abroad.

Sex determination from human cranium is usually done on difference in sizes and robustness. However these differences depend on various other factors like genetic, environmental and socio-economic factors. Again these differences also vary according to the place. So there is widespread necessity for these types of studies and formation of a worldwide craniometric database.

The foramen magnum reaches its adult size rather early in childhood and is therefore unlikely to respond to significant secondary sexual changes. [11] There is no significant muscular attachment around the foramen magnum area and its prime function is the passage of medulla oblongata.

The nervous system attains maturity in the childhood and so there is very little effect of its growth in the foramen magnum. A large foramen magnum usually results from chronic

increased intracranial pressure or from direct effects of an expanding process within foramen magnum like syringomyelia, Arnold Chiari malformations. Asymmetry of foramen magnum occurs with cranio-vertebral anomalies or premature synostoses of one or more of occipital synchondroses. [12] Key-hole shaped foramen magnum has been described in hydrolithalus syndrome. [13]

The measurements obtained in this study was compared with previous other studies (Table A) in a tabular form. [14] The results of the present study was similar to that of Sayee done in Karnataka where length and breadth of foramen magnum for male skulls were 33.4 mm and 28.5 mm respectively and that for female were 33.5 mm and 28.0 mm respectively. [15]

The results of these studies were consistent with other studies to find out that dimensions of foramen magnum are larger in male skulls than female.

Again the differences were not significant enough to discriminate between the male and female skulls, which are consistent with the previous studies. However this study is dissimilar with that of Tanuj Kanchan et al who found out statistically significant sex differences in the area of foramen magnum as derived by formula given by Texeira and Radinsky. [16]

The orbital index for the male skulls in this study was 86.89 while that of female skulls was 90.31. The interorbital distance for male and female skulls was 1.85 mm and 1.97 mm respectively. The mean orbital index for right side (86.59) was lower than that of left side (90.05) which was not consistent with previous studies. [17] Statistically significant differences were observed between male and female skulls in their interorbital distances. Again the orbital index of the left side had significant difference between male and female skulls.

Taking the orbital index as the standard, three classes of orbit have been classically described:

- Megaseme (Large):** The orbital index is 89 or over. This type is seen in Orientals except Eskimos. [18]
- Mesoseme (Intermediate):** The orbital index range between 89 and 83. This type is seen in the Caucasians. [19]
- Microseme (Small):** Orbital index 83 or less. This type is characteristics of the Africans. [20]

This places the male skulls (86.59) of this modern Bengali population into the MESOSEME group and the female skulls (90.05) into the Megaseme group. This result is quite contrary to previous study conducted on

north Indian population, [17] which placed the skulls in **Microseme** group.

The results of this study were quite similar to those conducted on male Nigerian skulls which also placed the skulls in Megaseme group quite contrary to previous results. [21]

The results of this study is also similar to study conducted by Igbigbi and Ebite on the Malawian population. [22]

The significant differences of inter orbital distances between male and female skulls can be a new dimension of sexual dimorphism of human crania. This can also provide important guidelines for facial reconstruction and superimposition techniques. No previous studies could be found on inter orbital distances to corroborate with the present study.

Many factors have been implicated in the transformation of the facial skeleton into the adult form. Although the basic structure is determined in accordance with genetically regulated blueprint while in utero, that is modified pre- and postnatal through functional matrices responding to environmental and epigenetic influence such as climate, activity patterns and masticatory functions. [23]

This study can create an adjustment which will help in correction of orbital fractures, orbito-ethmoid disjunctions and bony pathologies of the face. This can also help in a near perfect design of cranio-facial prosthesis.

The slight difference observed between the right and left side, though not significant, could be attributed to the differential growth of the two sides of the brain.

This difference should be kept in considerations while surgical correction of the bony orbits. However further investigations are necessary using a larger sample.

In the present study it was observed the left orbital index differed between two sexes. This difference was significant. Regarding the right side there was no significant differences between the two sexes.

This interesting observation should be kept in mind while conducting future studies. Asymmetry exists in each individual cranium. In an individual two orbits are of different dimensions. This shows we tend to over generalize symmetry in the facial region. These aspects should be explored further in future studies with large sample using different craniometric variables.

### Conclusion:

1. Foramen Magnum dimensions including its area are larger in male skulls compared to the female skulls.

2. Foramen Magnum dimensions are not reliable indicators for determination of sex in adult Bengali population.
3. Orbital indices of the skulls of the Bengali population fall in the Mesoseme-Megaseme category.
4. Orbital indices of the female skulls are greater than that of the male skulls.
5. Orbital indices of the left side were greater than of the right side for both the male and female skulls.
6. The left orbital index was significantly different for both male and female skulls.
7. The inter-orbital distance was significantly different in male and female skulls.

### References:

1. [https://www.google.co.in/?gfe\\_rd=cr&ei=t5SuVlrsNqjM8gfrqIGADg&gws\\_rd=ssl#q=symmetry+definition](https://www.google.co.in/?gfe_rd=cr&ei=t5SuVlrsNqjM8gfrqIGADg&gws_rd=ssl#q=symmetry+definition). Accessed on 16.11.2014
2. **Iscan MY, Steyn M.** The Human Skeleton in Forensic Medicine. Springfield, Illinois. Charles C Thomas • Publisher, Ltd; 2013. Chapter 4, Sex; p.143.
3. **Reddy K S N.** The Essentials of Forensic Medicine and Toxicology. 32<sup>nd</sup> ed. Hyderabad: K Suguna Devi; 2013. Chapter 4, Identification; p.60
4. **Mukherjee J B.** Forensic Medicine and Toxicology. In: Karmakar R N, editor. Personal Identification. 4<sup>th</sup> ed. Kolkata. Academic Publishers; 2011. p.86-175.
5. **Standarding S. Gray's anatomy.** The anatomical basis of clinical practice. 39<sup>th</sup> ed. London: Elsevier Churchill Livingstone; 2005 .p.460.
6. <http://emedicine.medscape.com/article/835021-overview>. accessed on 16.11.2014
7. **Routal RR, Pal GP, Bhagwat SS, Tamankar BP.** Material studies with sexual dimorphism in foramen magnum of human crania. J. Anat Soc. India. 1984; 33(2):85-89.
8. **Radinsky L.** Relative brain size e a new measure. Science 1967; 155:836-8
9. **Teixeria WR.** Sex identification utilizing the size of Foramen Magnum. Am J Forensic Med pathol 1983; 3:203-206.
10. **Jeremiah M, Pamela M, Fawzia B.** Sex differences in the cranial and orbital indices for a black Kenyan population. Int. J. Med. Med. Sci. 2013; 5(2):81-84.
11. **Scheuer L, Black S.** The Juvenile Skeleton. London.Elsevier Academic Press; 2004. Chapter 4, The Head and Neck; p.76.
12. **Shapur PM, Magi M, Nanjundappa B, Havaladar PP, Gogi P, Saheb SH.** Morphometric Analysis of Foramen Magnum. Int. J. Anat. Res. 2014; 2(1):249-55.
13. **Stevenson RE, Hall JG.** Human malformations and related anomalies. 2<sup>nd</sup> ed. Cleveland; 2006.p.260-61
14. **Ukoha U, Egwu OA, Okafor IJ, Anyabolu AE, Ndukwe GU, Okpala I.** Sexual Dimorphism in the Foramen Magnum of Nigerian Adult. Int. J Biol. Med Res. 2011; 2(4):878-81.
15. **Sayee R, Jankiram S, Thomas IM.** Foramen magnum measurements of crania from Karnataka. J. Anat Soc. India. 1987; 36(2):87-89.
16. **Kanchan T, Gupta A, Krishan K.** Craniometric Analysis of Foramen Magnum for Estimation of Sex. International Journal of Medical, Health, Pharmaceutical and Biomedical Engineering. 2013; 7(7):166-68.
17. **Kaur J, Yadav S, Singh Z.** Orbital dimensions- A direct measurement study using dry skulls. J. Acad. Indus. Res.2012; 1(6):293-95.
18. **Cassidy PJ.** "Megaseme" webster dictionary. answers.com (homepage on the internet) 1913a; available from <http://www.answers.com/topic/megaseme>. accessed on 20.11.2014
19. McGraw hill dictionary of scientific and technical terms "mesoconch" McGraw hill company inc, answers .com(homepage on the internet)

- 2003; available from <http://www.answers.com/topic/mesoconch>. accessed on 20.11.2014
20. Cassidy PJ. "microseme" webster dictionary. answers.com (homepage on the internet) 1913b; available <http://www.answers.com/topic/microseme>. accessed on 20.11.2014
21. Ukoha U, Egwu OA, Okafor IJ, Ogugua PC, Onwudinjio O, Udemezue OO. Orbital dimensions of adult male Nigerians: a direct measurement study using dry skulls. Int. J. Biol. Med. Res. 2011; 2(3): 688-90.
22. Igbigbi PS, Ebite LE. Orbital Index of Adult Malawians. Anil Aggarwal's Internet Journal of Forensic Medicine and Toxicology. 2010; 11(1).
23. Vidarsdotir US, O'Higgins P, Stinger C. A geometric morphometric study of regional differences in the ontogeny of the modern human facial skeleton. Journal of Anatomy. 2002; 201(3):211.

**Table 1: Foramen Magnum Length, Breadth & Area in Male Skulls (N=31)**

Parameters	Max	Min.	Mean	SD	Range
FML	38.40	31.50	34.02	1.79	37.60-30.44
FMB	31.00	23.70	28.10	2.16	32.42-23.78
FMA-R	927.14	600.29	752.26	86.81	925.88-578.64
FMA-T	937.91	616.00	760.25	85.45	931.15-589.35

**Table 3: Comparison of Means of Foramen Magnum Dimensions in Male and Female Skulls**

Parameters	Sex	N	Mean	SD	T-value	p-value
FML	M	31	34.02	1.79	1.71	0.09
	F	22	33.03	2.42		
FMB	M	31	28.10	2.16	0.99	0.32
	F	22	27.46	2.51		
FMA-R	M	31	752.26	86.81	1.38	0.17
	F	22	715.31	106.46		
FMA-T	M	31	760.25	85.45	1.45	0.15
	F	22	722.11	105.13		

[FML=foramen magnum length, FMB=foramen magnum breadth, FMA-R=foramen magnum area calculated from RADINSKY formula, FMA-T= foramen magnum area calculated from TEXERIA formula]

**Table 4: Orbital Length, Breadth, Index & Inter-Orbital Distance in Male Skulls (N=31)**

Parameters	Max	Min	Mean	SD	Range
ROL	3.76	2.79	3.18	0.26	3.7-2.66
LOL	3.7	2.92	3.25	0.24	3.73-2.77
ROB	4.05	3.21	3.73	0.27	4.27-3.19
LOB	4.22	3.2	3.7	0.30	4.3-3.1
ROI	97.89	74.07	85.54	7.27	100.08-71
LOI	95.20	72.03	88.25	6.22	100.69-75.81
IOD	2.32	1.52	1.83	0.21	2.25-1.41

[ROL-Right side orbital length, ROB- Right side orbital breadth, LOL- Left side orbital length, LOB- Left side orbital breadth, ROI- ORBITAL INDEX of right side, LOI-ORBITAL INDEX of left side, IOD-Inter-orbital distance]

**Table 6: Comparison of Right Orbital Index, Left Orbital Index & Inter-Orbital Distance in Male and Female Skulls**

Parameters	Sex	N	Mean	SD	P-Value
ROI	Male	31	85.54	7.27	0.22
	Female	22	88.05	7.37	
LOI	Male	31	88.25	6.23	0.01
	Female	22	92.57	5.91	
IOD	Male	31	1.85	0.23	0.02
	Female	22	1.97	0.24	

**Table 5: Orbital Length, Breadth, Index & Inter-Orbital Distance in Female Skulls (N=22)**

Parameters	Max	Min	Mean	SD	Range
ROL	3.51	2.77	3.21	0.23	3.67-2.75
LOL	3.85	2.78	3.34	0.32	3.98-2.7
ROB	4.17	3.09	3.66	0.33	4.32-3.0
LOB	4.13	3.15	3.61	0.34	4.29-2.93
ROI	99.71	78.87	88.05	7.37	102.97-73.31
LOI	98.74	79.74	92.57	5.92	104.41-80.73
IOD	2.35	1.68	1.97	0.23	2.43-1.51

[ROL-Right side orbital length, ROB- Right side orbital breadth, LOL- Left side orbital length, LOB- Left side orbital breadth, ROI- ORBITAL INDEX of right side, LOI-ORBITAL INDEX of left side, IOD-Inter-orbital distance]

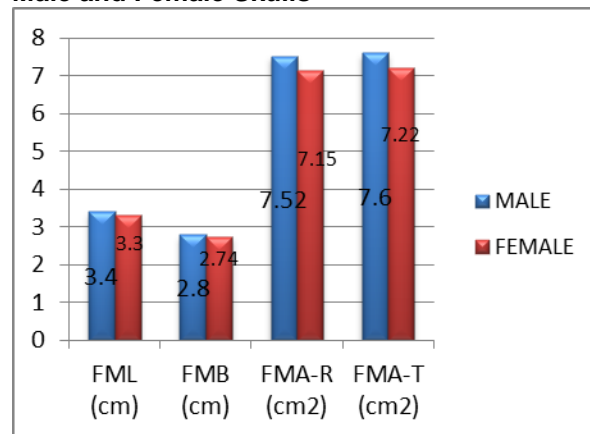
**Table 7: Comparison of Orbital Indices of Right & Left Sides (For Male and Female)**

Orbital Index	N	Mean	SD	P-Value
Right Side	53	86.59	7.26	0.08
Left Side	53	90.05	6.35	

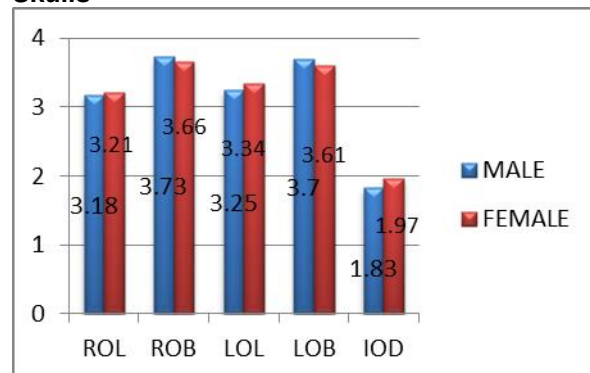
**Table 8: Comparison of Orbital Indices of Male and Female Skulls (Considering Right & Left Side Together)**

Orbital Index	N	Mean	SD	P-Value
Male	31	86.89	6.75	0.07
Female	22	90.31	6.64	

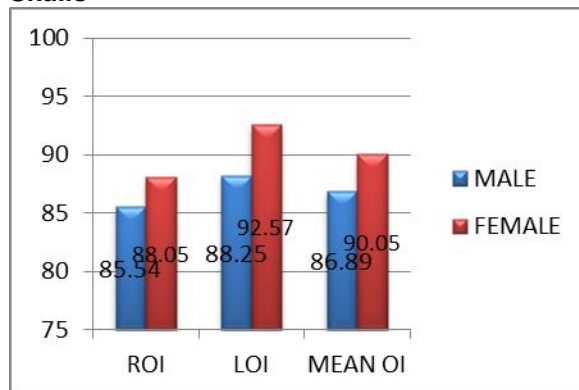
**Graph 1: Comparison of Means of Foramen Magnum Length, Breadth & Area between Male and Female Skulls**



**Graph 2: Comparison of Means of ROL, ROB, LOL, LOB & IOD between Male and Female Skulls**



**Graph 3: Comparison of Means of ROI, LOI and Mean OI between Male and Female Skulls**



**Table 2**  
**Foramen Magnum Length, Breadth & Area in Female Skulls (N=22)**

Parameters	Maximum	Minimum	Mean	SD	Range
FML	37.00	29.70	33.03	2.42	37.87-28.19
FMB	31.40	22.50	27.46	2.51	32.48-22.44
FMA-R	889.43	594.00	715.31	106.46	928.23-502.39
FMA-T	892.33	605.05	722.11	105.13	932.37-511.85

**Table A**  
**Comparison of Various Studies**

STUDY	FML(M) [Mean±SD]	FML(F) [Mean±SD]	FMB(M) [Mean±SD]	FMB(F) [Mean±SD]	FMA(M) [Mean]	FMA(F) [Mean]
Present 2014	34.02±1.79	33.03±2.42	28.1±2.16	27.46±2.51	760.25	722.11
Routel et al 1984	35.5±2.8	32.0±2.8	29.6±1.9	27.1±1.6	819.0	771.0
Murshed et al 2003	37.2±3.2	34.6±3.16	31.6±2.99	29.3±2.99	931.7	795
Catalina 1987	36.2±2.6	34.3±2.04	31.1±2.6	29.6±1.53	888.4	801.0
Gapert et al 2008	35.91±2.41	34.71±1.91	30.51±2.6	29.6±1.53	783.82	730.28
Suazo et al 2009	36.5±2.6	35.6±2.5	30.6±2.5	29.5±1.9		
Ukoha U et al 2011	36.26±2.3	34.39±3.88	30.09±2.5	28.16±1.9	857.30	760.94

## Original Research Paper

# Easy Confirmation of Drowning By Detection of Diatoms in Trachea

<sup>1</sup>Neelam Shrivastava, <sup>2</sup>D.K. Satpati, <sup>3</sup>Alok Kumar

### Abstract

One of the ways adopted by a person for suicide is drowning. Criminals also hide their crime by throwing person in water after murder. To identify ante mortem drowning or post-mortem drowning, many postmortem findings are considered e.g. hairs and clothing found wet; washer woman's appearance in palm and sole; copious leathery froth from mouth and nostrils, etc. But these are not confirmatory and also not present in every case. As, froth also present in poisoning cases and hair and cloth may not be wet if body remains outside water after taking out from alleged place of drowning, therefore to overcome all these fallacies in ante-mortem drowning; presence of diatom in trachea can be considered as a confirmatory test. The conventional Diatom test from bone marrow also has many fallacies and false result. To overcome all these difficulties, the new method is proposed which is easy, less cumbersome, economical and confirmatory test of drowning.

**Key Words:** Drowning, Tracheal fluid, Diatom, Poisoning

### Introduction:

Since long time, it is in practice that confirmation of drowning is done by diatom test from bone marrow of long bone. Tibia or femur, which used to taken out at the time of postmortem and handed over to police constable who brought them for examination after a long time or sometimes didn't turn up.

Bone marrow is taken out by the unskilled person where due to chances of contamination, false positive results will be more and if bone marrow is taken from such body, where the place of drowning is having less diatom or marrow is taken from place where diatom is not present, then false negative result will obtain. During post-mortem, bone is taken out resulting in disfigurement of body which hurt relatives. [1] To overcome all these difficulties, it has forced us to think that why we cannot take fluid from primary site i.e. trachea which causes asphyxia death in drowning for diatom test.

### Corresponding Author:

<sup>3</sup>Prof & HOD

Dept. of Forensic Medicine & Toxicology  
UP Rural Institute of Medical Sciences and Research,  
Saifai, Etawah-206130 (U.P.), India  
E-mail: drsalok@rediffmail.com

<sup>1</sup>Senior Medical Officer, Medico Legal Institute,  
Gandhi Medical College, Bhopal, India

<sup>2</sup>Prof & HOD, Dept. of FMT

Laxminayaran Medical College, Bhopal, India  
DOR: 25.10.2014 DOA: 11.08.2015  
DOI: 10.5958/0974-0848.2015.00091.3

### Diatom:

Most natural water contain diatom, a class of microscopic unicellular algae suspended in water. They have silicon cell wall which resist acid digestion and putrefaction most species occupy a size range 10  $\mu$  to 80  $\mu$ .

They live free or unite to form colonies drifting, either on the plankton or attached to mud, sand or any other solid substance.

Only the live body with a circulation can transport diatom from the lung to brain or bone marrow from where they may be detected microscopically after suitable treatment. Their presence in other viscera such as liver, etc. does not have much significance. [2, 3]

### Material and Methods:

Material used: Sterile syringes, Test tubes, Centrifuge machine, Concentrated HNO<sub>3</sub> and HCl, Microscope, Pipette, Glycerin, Distilled Water, Lamp, Slides, Cover slip

Tracheal fluid from trachea has been taken in a sterile syringe at the time of postmortem and this fluid was mixed with equal amount of concentrated HNO<sub>3</sub> and HCl and kept for 4 to 6 hours and heated till clear fluid is obtained. After that, this fluid is centrifuged for 2 minutes at 3000 revolutions/minute.

The sediment material washed with distilled water and washed sediment was used for preparation of diatom in clean slides and visualized under microscope. [3]

**Precautions:** Slides, cover slip and syringes should be clean properly with distilled water.



In all study cases (Table 1), bone was preserved but unfortunately, only one bone was brought to the department for examination where Diatom test was found positive.

### Result:

In present study, 17 cases were examined in the Medico-legal Institute, Bhopal during July 2012 to March 2014. All cases were positive except one case of a new born baby who was underweight (1.3 kg).

Hospitalized case might be thrown after death in water. Even in the decomposed bodies the results were 100% accurate. Water will not enter in trachea in decomposed body even after rigor mortis passed away as shown in photographs of autopsy case in which duration of death is 1-2 weeks since postmortem examination. (Fig. 5)

### Other Signs of Drowning:

Clothing and hairs are generally found wet and washer women appearance exists on palm and sole. In drowning cases, white, copious, leathery and tenacious froth exist at nostril mouth and trachea which increases on compression of chest and squeezing of lungs.

Lungs are voluminous and cover the chest wall and impression of ribs are found. On dissection of lung, white froth with blood oozes out with crackling sound.

### Discussion:

As trachea is devoid of anything except mucus therefore, even a single diatom algae mud particle is positive sign of drowning because it reflects that some outside fluid or material containing diatom has entered the trachea. It is important to note that in some cases the number of diatom is very less or where fluid does not get the opportunity to enter in trachea like laryngospasm, fear etc. in such situations tracheal fluid may not demonstrate diatom.

In asphyxia death case, death occurs in very little time and it is not known how much time diatom will take to reach up to long bone because circulation of blood stops immediately after death. Results are also doubtful as location of bone marrow taken, for test may not contain diatom in conventional method.

As we know Diatoms have a strong silicon wall and stick to Trachea. It doesn't come out with froth which oozes after sometime because it is always white in color in spite of dirty or clear water which is free of dirt that means diatom remains in trachea and sucked in syringe by creating negative pressure.

Stomach water can't be taken for Diatom as it gives false positive result if person

had drunk water just before murder and thrown in alleged place of water from where body recovered.

### Conclusion:

The results are more accurate, chances of artifact are almost nil by this easy going method in comparison to conventional method. The method proposed as above will give a scientific conclusive and quick result by which we can extract a scientific conclusive opinion immediately. Deceased relatives will not be hurt and will not object due to any disfigurement of dead body.

For confirmation of drowning, above method should be adopted as the demerits of conventional method could be overcome by this proposed method.

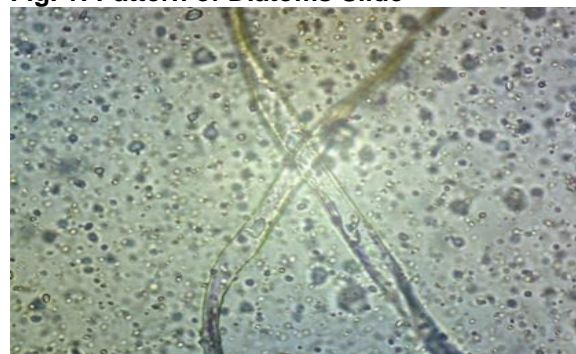
### References:

1. Bortolotti F, Tagliaro F, Manetto G. Objective diagnosis of drowning by the "diatom test" A critical review; Forensic Sci. Rev;16:135-148; 2004. Internet site- [http://www.forensicsciencereview.com/Abstract/16-8A%20\(Bortolotti\).pdf](http://www.forensicsciencereview.com/Abstract/16-8A%20(Bortolotti).pdf)
2. Parikh's C.K. Textbook of Medical Jurisprudence and Toxicology Medical publication, 6 owner's court, Kolaba, Bombay textbook of Medical Jurisprudence P. 215
3. Apurba Nandi. Principles of Forensic Medicine; New Central Book Agency, Calcutta, India;P.332,

**Table 1: Observation Table**

S. N.	Age (Yrs)	Duration of Death (Hrs, day & week)	Diatom In Tracheal Fluid
1	16	24 Hours	Positive
2	16	24	Positive
3	18	61	Positive
4	35	36	Positive
5	30	24	Positive
6	15	24	Positive
7	11	24	Positive
8	12	24	Positive
9	12	36	Positive
10	18	24	Positive
11	20	36	Positive
12	2 Days	24	Negative
13	13	24	Positive
14	25	3-5 Days	Positive
15	3 Months	24	Positive
16	Full Term	24	Positive
17	22	1-2 Weeks	Positive

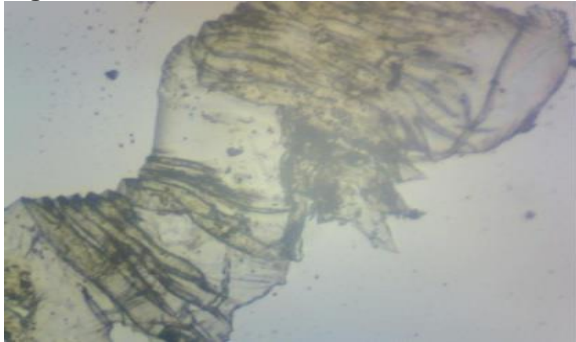
**Fig. 1: Pattern of Diatoms Slide**



**Fig. 2: Pattern of Diatoms Slide**



**Fig. 3: Pattern of Diatoms Slide**



**Fig. 4: Pattern of Diatoms Slide**



**Fig. 5: water will not enter in trachea even after rigor mortis Passed off (Decomposition Changes 2 Weeks after Death)**



**5a: water will not enter in trachea even after rigor mortis Passed off (Decomposition Changes 2 Weeks after Death)**



## Original Research Paper

# Stampede in Gandhi Maidan Patna: A Medico-legal Analysis

<sup>1</sup>Anil Shandil, <sup>2</sup>Mukesh Prasad, <sup>3</sup>Shiv Ranjan Kumar

### Abstract

A stampede is a disastrous event in which a crowd of people collectively begins running with no clear direction causing large number of casualties. This usually occurs during religious pilgrimages, professional sporting or in times of panic, as in fire or explosion when large number of people try to get away from a close space like theatre, fair etc. On 3<sup>rd</sup> October 2014, during Dussahera celebration at Gandhi Maidan Patna, when people were returning back after watching the "Ravan Vadh" on the rumor of fall of live electric wire in the ground, crowd started running to get away and some of them were fallen and crushed by the unruly mob leading to heavy casualty.

In this accident 33 deaths occur and most of them (81.82%) were females and of younger age group. Multiple blunt force injuries especially on chest and abdomen were seen in most of the cases. Cause of death was Traumatic Asphyxia (54.55%) and Shock and hemorrhage (39.39%) in most of the cases. The cases of head injury were few, seen in only in 6.06% cases.

**Key Words:** Stampede, Crowd-crush, Traumatic asphyxia, Rupture of liver, Fracture of ribs

### Introduction:

Stampede, in lay man's term is called as "crowd crush" in which crowd of people collectively begins running with no clear direction or purpose causing large number of casualties.

Such types of casualties occur throughout the world. This year, in the celebration of New Year at Shanghai (China), thousands of people gathered and 36 people killed and 47 injured in stampede. [1]

In 1913, in Italy 73 people died when they are trying to escape from a crowded Christmas party due to false fire alarm. In India it is more often seen during religious pilgrimages. [2] On 3<sup>rd</sup> February, 1954 during Kumbha Mela at Allahabad more than 800 people died and over 100 injured in a stampede when people were going to take bath in river Ganga.

Other few notable stampedes are at Sabarimala temple on 14<sup>th</sup> January 1999, Naina Devi temple on 3<sup>rd</sup> August 2008, Chamunda Devi temple in Jodhpur on 30<sup>th</sup> September 2008 and Ratangarh Mata Temple in Datia Madhya Pradesh on 13<sup>th</sup> October 2013. [3]

### Corresponding Author:

<sup>1</sup>Assistant Professor  
Dept. of Forensic Medicine and Toxicology  
Patna Medical College and Hospital Patna  
E-mail: dranilshandil@gmail.com

<sup>2</sup>Junior Resident III<sup>rd</sup> Year

<sup>3</sup>Tutor

DOR: 29.01.2015 DOA: 01.08.2015

DOI: 10.5958/0974-0848.2015.00092.5

Stampede at Gandhi Maidan Patna on 3<sup>rd</sup> October 2014 during Dussahera festival was due to a rumor of fall of live electric wire and uncontrolled mob started running to go out from the ground causing heavy casualty including death of 33 person.

The dead bodies were brought to the mortuary of PMCH Patna where identified by their relatives and friends. Post-mortem examination was conducted and all the important data regarding cause of death were compiled and presented in this paper.

### Material and Method:

This retrospective study was conducted on all 33 dead bodies died in the stampede and received in the Department of Forensic Medicine and Toxicology PMCH, Patna for autopsy. The cases died due to unnatural deaths other than the stampede were not included in this study.

The demographic profile of the victims was noted from the police papers and interrogation with the accompanying persons. Injuries and causes of death were noted at the time of post mortem examination of dead bodies.

All the information of every case was recorded carefully, analyzed and presented in tables, bar and pie diagrams in result.

### Observations and Results

Total death in Gandhi Maidan stampede was 33, of which majority of the victims (81.82%) were female. Most of the victims are young adult, maximum 24.24% in 21-30 years of age group followed by 21.21% in 1-10 years and 18.18% in 40-50 years of age group. (Fig. 1)

In this study males were only 18.18%, mostly boys below 14 years (12.12%) or elderly (06.06%) above 50 years. (Table 1)

In the post-mortem examination of victims of stampede cyanosis was seen in 48.48% cases, congestion of face & chest in 45.45%, sub-conjunctival hemorrhage in 36.36%, bleeding from mouth and nostrils in 63.64% and expulsion of fecal matter was seen in 30.30% cases but bleeding from ear not seen in any of the case. (Table 2)

Most of the injuries on stampede victims were in the form of contusions and abrasions and these were present all over the body mostly on chest and abdomen. The Injuries present on chest and abdomen alone or with surrounding areas in 48.48% cases, all over the body in 30.30% and only on face and chest in 15.15% cases. (Table 3)

Injuries only on upper and lower parts of body causing death in stampede were not commonly seen. Injuries only on head & face and on limbs causing death each were seen only in one case. Internally, fracture of ribs was the commonest found in 57.57% cases in which sternum was also fractured in 18.18% cases.

Amongst other thoracic injuries contusions/lacerations of lungs were found in 54.54% cases but rupture of heart was seen only in 03.03% cases. (Table 4) In other injuries, intra-cranial hemorrhages and fracture of skull bones were seen in 06.06%, contusion/rupture of liver in 18.18%, rupture of spleen in 09.09 %, rupture of intestine in 12.12%, fracture of pelvis in 09.09% and fracture of limb bones in 06.06% cases.

Congestion of trachea and lungs were seen in 66.67% and congestion of liver and brain in 48.48% cases. In our study most common cause of death in stampede was traumatic Asphyxia in 54.54% cases. (Table 5)

### **Discussion:**

A stampede is an act of mass impulse among crowd of people or among herd animal in which crowd or herd collectively begins running with no clear direction or purpose. Human stampede most often occur during religious pilgrimages, political gathering, professional sporting and music events, as these event tend to involve a large number of people. [4, 5]

These occur in time of panic as a result of rumor, fire, explosion etc. As people tries to get away and the crowd is so big that, those in the back continues pushing forward not knowing that those in front are being crushed.

The vulnerability of religious gathering is also increased due to venue inadequacy, remote

or hazard prone setting, poor facilities or lack of basic infrastructure and medical care center. It is concluded that a simple accident or an intentional act or even a rumor can trigger a crowd disturbance. The risk factors identified from study of past incidents have led to the development of basic framework allied on four interlinked compartment for interagency co-operation and multidisciplinary contemplation ranging from hazard identification to the execution of mitigating measures for stampede control. It is believed that stampede or crowd disaster can be prevented by simple crowd management strategies such as organization and traffic control such as barriers.

One major problem is lack of feedback from people being crushed to the crowd pressing behind. Feedback can instead be provided by police, organizer and observer, who survey the crowd and use loudspeaker to communicate and direct the crowd.

At individual Level one is advised to move sideways between swells. A law is required that all public entertainment venue equipped with doors open outward.

Our study revealed that death from stampede was primarily from traumatic asphyxia followed by shock and hemorrhages and head injury in comparison to previous studies from 1883 Victoria Hall disaster, 1913 Italian hall disaster and 1989 Hills Borough disaster and 2014 Shanghai stampede where death occurs primarily from compressive asphyxia too.

### **Conclusion:**

Stampede is usually predisposes by some sudden mis-happening or its rumor. Lack of proper crowd management in religious gatherings, social events, fair etc. is the main reason behind stampede.

The important features of this stampede at Gandhi Maidan Patna are:

1. Most of the victims of stampede were female and boys below 14 years of age.
2. Cyanosis, congestion of face and chest and bleeding from mouth and nostrils were seen in majority of the cases.
3. Injuries in form of contusion and abrasion were seen all over the body especially on the chest and abdomen.
4. Traumatic asphyxia and Shock & hemorrhage were the two important causes of death in stampede.
5. Fracture of ribs and contusion/laceration of lungs were seen in cases of death due to Traumatic asphyxia and rupture of liver, spleen and intestine in Shock & hemorrhage.

Large number of casualties occurs in stampede every year throughout the world. It can be minimized by effective disaster management program at high risk areas.

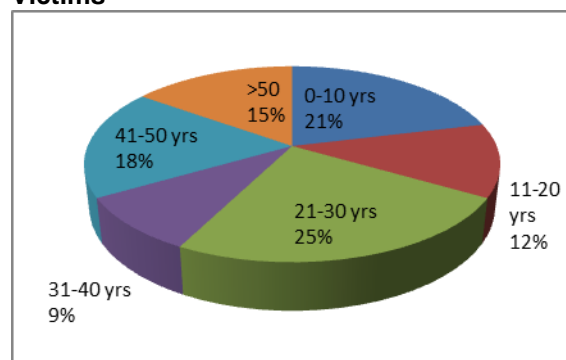
Visualization and control of over-crowded areas through CCTV cameras and mobilization of mob in less pressure zone, emergency medical facility near the disaster site are few measures which can be implemented.

District authorities must be made responsible for such happenings.

### References:

1. New Year's Eve stampede in Shanghai kills dozens. Sydney Morning Herald. 1<sup>st</sup> January 2015.
2. Illiyas FT, Mani SK, Pradeep Kumar AP, Mohan K. Human stampedes during religious festivals: A comparative review of mass gathering emergencies in India. International Journal of Disaster Risk Reduction, Available online 15 September 2013, ISSN 2212-4209, <http://www.sciencedirect.com/science/article>
3. Death toll in MP stampede reaches 115; Congress wants CM to quit. Times of India. 14<sup>th</sup> October 2013.
4. Nandi A. Principles of Forensic Medicine. New central book agency (P) Ltd Kolkata, 2<sup>nd</sup> edition 2000; 340.
5. Dikshit PC. Textbook of Forensic Medicine and Toxicology. PEEPEE New Delhi, 1<sup>st</sup> edition 2007; 216.

**Fig. 1: Age wise Distribution of Stampede Victims**



**Table 1: Age and Gender wise distribution of the Victims of Stampede**

Age (yrs)	Male (%)	Female (%)	Total (%)
0- 10	2(6.06)	5(15.15)	7(21.21)
11 -20	2(6.06)	2(6.06)	4(12.12)
21 -30	0	8(24.24)	8(24.24)
31 -40	0	3(9.09)	3(9.09)
41-50	0	6(18.18)	6(18.18)
>50	2(6.06)	3(9.09)	5(15.15)
<b>Total</b>	<b>6(18.18)</b>	<b>27(81.82)</b>	<b>33(100)</b>

**Table 2: External Pathological Features in Stampede's victims**

External features	Cases	%
Cyanosis	16	48.48
Congestion of face & chest	15	45.45
Sub-conjunctival hemorrhage	12	36.36
Bleeding from mouth	03	09.09
Bleeding from nostrils	02	06.06
Bleeding from mouth & nostrils	16	48.48
Bleeding from ear	-	-
Bleeding from ear, nose and mouth	-	-
Expulsion of fecal matter	10	30.30

**Table 3: Major Body Areas Involved in Stampede's victims**

Body parts involved	Cases	%
Head	-	-
Head & face	01	03.03
Face and chest	05	15.15
Face, chest & abdomen	03	09.09
Chest & abdomen	05	15.15
Chest, abdomen & limbs	08	24.24
Limbs	01	03.03
All over the body	10	30.30

**Table 4: Internal Injuries/Pathological Features in Stampede' Victims**

Internal injuries	Cases	%
ICH with fracture of skull bones	02	06.06
Fracture Ribs	13	39.39
Fracture Ribs and sternum	06	18.18
Contusion/laceration of lungs	18	54.54
Rupture of heart	01	03.03
Contusion/ rupture of liver	06	18.18
Rupture spleen	03	09.09
Rupture of intestine	04	12.12
Congestion of trachea and lungs	22	66.67
Congestion of liver and brain	16	48.48
Fracture of pelvis	03	09.09
Fracture of limb bones	02	06.06

**Table 5: Causes of Death in Stampede**

Cause of death	Number	%
Traumatic Asphyxia	18	54.54
Shock & hemorrhage	13	39.39
Head injury	02	06.06



## Original Research Paper

### Burn Deaths: A Study on Female Victims in Manipur

<sup>1</sup>Th. Meera, <sup>2</sup>Pabitrimala Nandeibam, <sup>3</sup>Daunipaia Slong, <sup>4</sup>H. Nabachandra

#### Abstract

This retrospective study was carried out in a tertiary care hospital during 2004 to 2013 to assess the pattern of burn deaths amongst females in the State of Manipur. Out of the total 38 burn cases brought for autopsy, 26 were female burn cases. The highest number of victims was in the age group of 21 to 30 years (53.85%). Majority of the cases were non-Manipuris (57.69%) and 84.62% of the victims were married. The body surface area involvement of >80% was observed in 61.54%, and 57.69% of the cases died within 24 hours. The cause of death was due to burn shock in 65.38%, and the nature of death was accidental in 50% of the cases. History of domestic violence was present in 40% of the suicidal deaths and in all the three cases of homicidal deaths. High mortality in young married women from burns is attributed to dowry in rural India. Dowry system is almost non-existent in the State of Manipur, and it is reflected in the present study where majority of the female victims of burns were non-Manipuris residing in this State.

**Key Words:** Female, Burn, Nature of Death, Dowry, Non-Manipuri

#### Introduction:

Burns are injuries produced by application of dry heat and these injuries are one of the most destructive injuries. Burns constitute a major role in mortality and morbidity in the entire world and these are the fourth most common type of trauma worldwide, following traffic accidents, falls and interpersonal violence. [1] According to WHO (2000) report, 2, 38,000 individuals died of fire related deaths and 95% of these deaths occurred in low and middle income countries. [2] A significant number of deaths in India occur due to burns every year and over 10,00,000 people are moderately or severely burnt every year in this country. [3]

About 60,000 people suffer from burn, more than 50,000 treated in hospitals and about 10,000 succumb to the thermal injuries in India. [4] Interestingly, in India, burn injury is one of the important causes of deaths, specifically in females.

The reasons for this endemic are manifold like dowry, marital infidelity, sexual jealousy, and oedipal dominance of mother-in-law over the grooms, etc. [5] The present study has been taken up to assess the pattern of female deaths in this part of the country and factors associated with such female deaths.

#### Materials and Methods:

This retrospective study was carried out in a tertiary care teaching institute in Manipur during the period of 10 years from 2004 to 2013 to assess the pattern of burn deaths amongst females. A thorough analysis of the history and post-mortem findings was carried out.

The age, caste and marital status of the victims, the place and time of occurrence, involvement of body surface area in burns, survival period, cause and nature of deaths, etc. were studied, and these findings were statistically analysed.

#### Observations and Results:

Out of the total 38 burn cases brought for autopsy during the period of 10 years from 2004 to 2013, 26 were female burn cases. (Fig. 1) In this study the highest number of victims was observed in the age group of 21 to 30 years (53.85%) followed by 15 to 20 years (23.08%). (Fig. 2) Interestingly, majority of the cases were non-Manipuris (57.69%) in our study. (Fig. 3) This study showed that 84.62% of the victims were married. (Fig. 4)

In present study we observed that 76.92% of the cases died at the hospital and 23.08% died at the site of the incident. (Fig. 5)

#### Corresponding Author:

<sup>1</sup>Associate Professor  
Dept. of Forensic Medicine,  
Regional Institute of Medical Sciences,  
Imphal – 795004, Manipur  
E-mail: meera\_th@yahoo.com

<sup>2</sup>Post Graduate Trainee, Dept. of Forensic Medicine

<sup>3</sup>Assist. Prof, Dept. of Forensic Medicine,  
North Eastern IGRIHMS, Shillong

<sup>4</sup>Prof & HOD, Dept. of Forensic Medicine,  
Regional Institute of Medical Sciences, Imphal  
DOR: 09.02.2015 DOA: 10.08.2015  
DOI: 10.5958/0974-0848.2015.00093.7

Most of the cases occurred during night time (57.69%). (Fig. 6) The body surface area involvement of >80% was observed in 61.54% cases (Table 1), and 57.69% of the cases died within 24 hours and 30.77% survived more than one week. (Fig. 7)

The cause of death was due to burn shock in 65.38% (Fig. 8), and the nature of death was accidental in 50% of the cases; suicidal in 38.46% and homicidal in 11.54% cases. (Fig. 9) History of domestic violence was present in 40% of the suicidal deaths and in all the three cases of homicidal deaths. (Table 2)

### Discussion:

High mortality in young married women from burns is common in rural India and in the present study, the highest number of victims was observed in the age group of 21 to 30 years (53.85%). Similar findings were observed by Vaghela et al and Subrahmanyam. [1, 6]

Mori et al [7] observed that 62.74% of the female victims were married in their study, while 74.79% of the victims were married in another study by Vaghela et al. [1] These may be favourably compared with the findings of our study where majority of the victims were married (84.62%) and all these cases died at their marital homes. Interestingly, majority of the cases were non-Manipuris (57.69%) and the rest were constituted by Manipuri victims belonging to different ethnic groups.

Shinde and Keoliya [8] observed that out of the 94 female burn victims, 44 sustained burns in the night during 22:01 to 06:00 hours. Similarly, in the present study, most of the cases occurred during night time (57.69%).

In a study by Zanzad and Godbole [9], 12.2% of the female victims died within 24 hours, while 23.5% survived 1-2 weeks. However, in our study, 57.69% of the cases died within 24 hours and of these, 23.08% died at the site of the incident; only 30.77% survived more than one week. This could be due to the fact that 61.54% had >80% body surface area involvement and the cause of death was burn shock in 65.38% cases.

The nature of death was accidental in 50% of the cases; suicidal in 38.46% and homicidal in 11.54%. Zanzad & Godbole [9] observed that in 65.8% of the married female burn victims, the nature of death was accidental while 18.3% were suicidal and 15.8% were homicidal. In our study, history of domestic violence was present in 40% of the suicidal deaths and in all the three cases of homicidal deaths, and this was observed only amongst the Non-Manipuri victims.

### Conclusion:

Most of the deaths amongst young married women from burns in rural India are attributed to dowry. Dowry system is almost non-existent in the State of Manipur, and it is reflected in the present study where majority of the female victims of burns were non-Manipuris residing in this State.

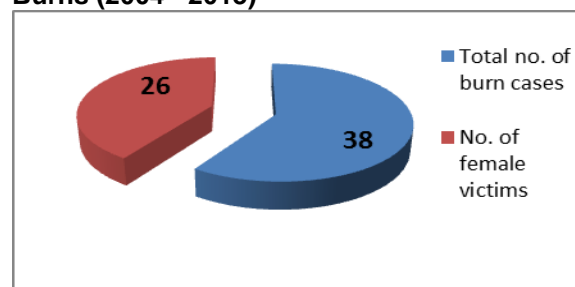
### References:

1. Vaghela PC, Ahir GN, Patel MH. Epidemiology of fatal burn cases in GK General Hospital, Bhuj. National Journal of Community Medicine. 2012; 3(2):326-29.
2. WHO Report 2000. Available from: <http://www.who.int/whr/2000/en/>. Last accessed Nov 10 2014.
3. Burns. World health Organization. Available from: <http://www.who.int/mediacentre/factsheets/fs365/en/>. Last accessed Nov 11 2014.
4. Gupta R, Kumar V, Tripathi SK. Profile of the Fatal Burn Deaths from the Varanasi Region, India. 2012; 6(4):608-11.
5. Kumar V. Bride burning – a social evil. J For Med Toxicology 1999; 9(9):28-9.
6. Subrahmanyam M. Epidemiology of burns in a district hospital in western India. Burns. 1996; 22:439-42.
7. Mori RK, Patel V, Shah K, Momin S, Patel D. Study of pattern of suicidal deaths in females of Ahmedabad region, Gujarat. Int. J Res Med 2014; 3(2):135-38.
8. Shinde AB, Keoliya AN. Socio-demographic characteristics of burn deaths in rural India. Int. Journal of Health Care Biomed Research. 2013; 1(3):227-33.
9. Zanzad NP, Godbole HV. Study of fatal burn cases in medico-legal autopsies. J Ind. Acad. For Med. 2007; 29(3):42-49.

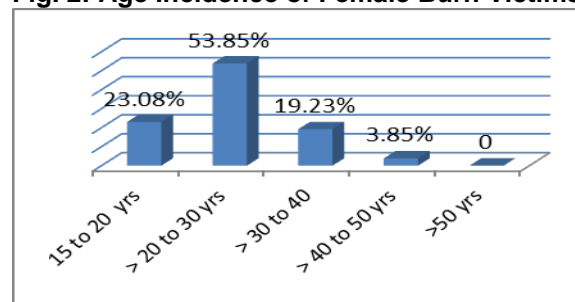
**Table 1: The Body Surface Area Involved**

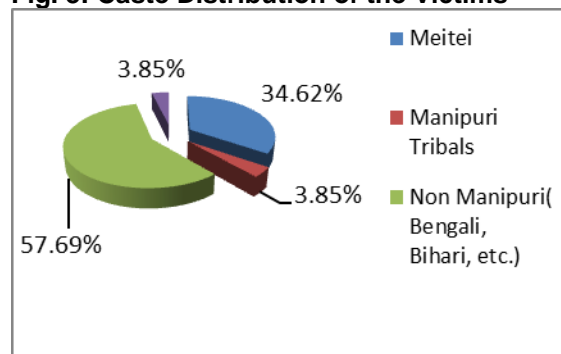
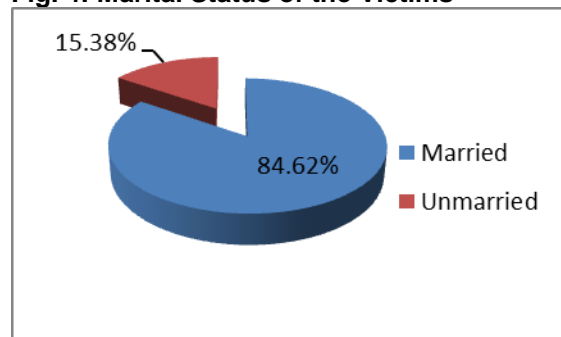
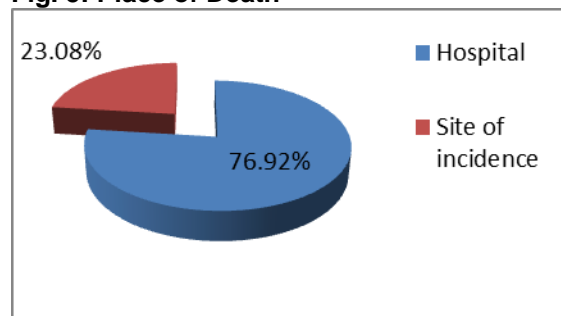
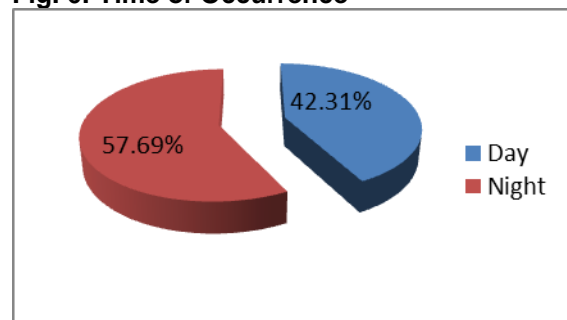
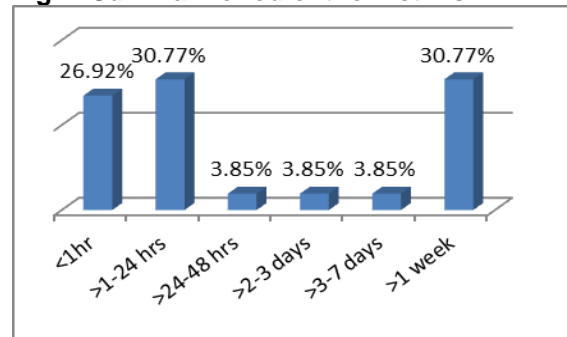
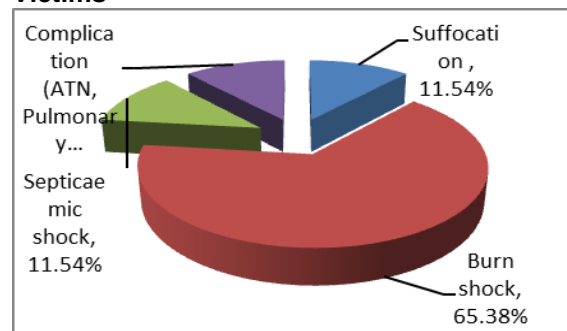
Body Surface area involved	Cases	Percentage (%)
<10% (only smoke & suffocation)	3	11.54
<40%	0	0
41-50%	0	0
51-60%	0	0
61-70%	0	0
71-80%	7	26.92
>80%	16	61.54

**Fig. 1: Incidence of Female Deaths due to Burns (2004 - 2013)**



**Fig. 2: Age Incidence of Female Burn Victims**



**Fig. 3: Caste Distribution of the Victims****Fig. 4: Marital Status of the Victims****Fig. 5: Place of Death****Fig. 6: Time of Occurrence****Fig. 7: Survival Period of the Victims****Fig. 8: Causes of Deaths in Female Burn Victims**



## Original Research Paper

# Cephalometry Compliments Dactylography

<sup>1</sup>B. Ajay Reginald, <sup>2</sup>P.Pankaj Mallik, <sup>3</sup>Veera Nagi Reddy

### Abstract

Forensic identification either strives to achieve or claim's to achieve conclusions of 'individualization'. Acceptable methods include Anthropometry, Dactylography, DNA analysis, Forensic Odontology. Among which Fingerprints is a well-known field used widely for personal identification and preferred in data bases and Cephalic index in distinguishing Sex, ethnicity, geographical identification, and Forensic reconstructions. As both Finger prints and Head shapes develop genetically, as unique characteristics of individuals, we intended to study the relation between these two methods of individualization. Finger prints and cephalic index of 100 volunteering students, in the age group of 19-23 yrs were recorded and categorized. The data was subjected to statistical analysis and it was found that, the mean cephalic index among all participants was mesocephalic predominant while the females were predominantly Brachiocephalic. The finger print pattern revealed a predominance of Loop (72%), followed by whorl and arch as a whole, where the Loop pattern predominated in the Mesocephalics, and the whorl in Brachiocephalics. Of interest was the presence of the Arch pattern, seen only in brachiocephalic female. The findings of our study does point to a correlation between Finger print patterns and Cephalic indices of the individuals.

**Key Words:** Forensic identification, Anthropometry, Cephalometry, Dactylography

### Introduction:

In this new millennium, society is faced with fresh challenges in every conceivable area. Despite advancements in modern technology, medical breakthroughs and the geographical changes, that the past have brought, crime still persists in all areas of our livelihood. The apprehension and subsequent prosecution of the perpetrator(s) is essential to maintain law and order. Experts use forensic science to help the Court of Law to punish the culprit.

Forensic identification either strives to achieve or claim's to achieve conclusions of 'individualization' e.g., personal identification, or narrow the pool to specific population e.g., race, region and sex. To obtain individualization many methods are followed in Forensic Medicine.

Most accepted and applicable branches are Anthropometry, Dactylography, DNA analysis; Forensic Odontology. Living beings are highly organized that have evolved according to their needs. Human body no less is of a higher order with a near perfect form and function.

Any disruption in this form of human body could lead to pathologies. Every unit of human body is unique to it-self and is synchronous with the other parts, to function normally resulting in a distinctive pattern of that individual. Being so unique, we are able to identify one-self using various parameters for various reasons.

Dactylographic/Fingerprints are widely used for individualization, and Cephalometrics a branch of Anthropology can determine the Race/ region/ sex of the individuals [1, 2] narrowing down the probability. Dermatoglyphics is a well-known field used widely for personal identification and preferred in data bases the world over. The term Dermatoglyphics is derived from the Greek words "derma" meaning skin and "glyphic" meaning carvings. [3]

These are very unique from individual to individual which are widely used for Individualization and also have a value in diagnosing genetic disorders during embryogenesis. Many studies clearly stated the genetic basis for epidermal ridge patterns.

### Corresponding Author:

<sup>1</sup>Professor,  
Department of Oral and Maxillofacial Pathology,  
Narayana Dental College and Hospital,  
Chinthareddypalem, Nellore,  
Andhra Pradesh, India Pin- 524 003  
E-mail: jayberna@gmail.com

<sup>2</sup>Post Graduate Student,  
Dept. of Oral and Maxillofacial Pathology,

<sup>3</sup>Prof & Principal, Dept. of Forensic Medicine  
Narayana Medical College, Nellore  
DOR: 18.03.2015 DOA: 13.08.2015  
DOI: 10.5958/0974-0848.2015.00094.9

The dermal ridges develop on Volar pads which are formed in 6<sup>th</sup> week of intrauterine life, the patterns of these dermal ridges are formed according to the size and shape of these Volar pads. [4] Various studies have shown that the measurement of the cephalic index which measures dimensions of head in cadaveric, living or radiologic specimen, is helpful in distinguishing Sex, ethnicity, geographical identification, forensic reconstructions, surgical corrections etc. [5]

Each method having its own pros and cons we propose to use a combination of different parameters that would make identification even more fool proof.

Thus, a thought was conceived to study the relationship between Dactylography and Cephalometrics, if at all one existed. What were the chances of a certain facial form having a particular fingerprint pattern?

This pilot study was undertaken to record fingerprints and cephalic index of individuals and to correlate both the parameters.

### Materials and Methods:

For this study 100 volunteering students (50 male & 50 female) in the age group of 19-23 yrs, who were apparently healthy without any congenital abnormalities or trauma/previous surgeries related to arms and craniofacial regions were selected. Subjects with obstructive hair styles were avoided, and all the participants were native to Andhra Pradesh state, India.

Cephalic measurements and Finger print pattern were recorded individually.

### Cephalic Index Measurements:

The measurements were recorded with the subjects sitting on chair with head in anatomical position and nearest to 1 mm.

To obtain cephalic index three anatomical landmarks were considered, the Glabella, Inion, and Euryon.

The head length was measured using a spreading calliper from Glabella to Inion, and head breadth was measured as the maximum transverse diameter between the two euryons using spreading calliper.

Cephalic index (C.I.) was calculated based on the formula given by Soames: [6]

$$\text{C.I.} = \text{Head width} / \text{Head length} \times 100$$

Head shape of the subjects was determined according to the score of Cephalic Index obtained as:

- Dolicocephalic C.I. > 70 but < 74.9
- Mesocephalic C.I. > 75 but < 79.9
- Brachiocephalic C.I. > 80 but < 84.9
- Hyperbrachiocephalic C.I. > 85 but < 89.9

### Fingerprint Pattern Analysis:

Ink prints of fingers were obtained according to method of Cummins. This was done first by cleaning the hands to avoid dirt from hands. The rolled fingerprints were obtained by placing the digits on an inked plate and then rolling them on to a white sheet (record sheet) which had specific spaces allotted for the respective fingers and hands. These were later screened with the aid of magnifying hand lens to reveal the patterns. [7]

Fingerprint patterns were classified under three main types' i.e. Arches/curve, Loops, and Whorls. This classification was based on the number of triradii (Lines meet) present, Arches have no triradii, Loops have one and Whorls have two. [8, 9]

The pattern that is predominant among ten fingers was considered as the type of fingerprint pattern for that individual.

Data obtained was subjected to statistical analysis, using IBM SPSS V.20.0 software and obtained cross-tabulations, Chi-Square test, Spearman correlation, and Pearson's relation.

### Observations and Results:

The mean cephalic index among all participants was 79.89, being mesocephalic predominant. Male participants showed a similar mean of 78.45, mesocephalic followed by Brachio, Dolico, and Hyperbrachiocephalic's while in females a mean of 81.32 was recorded, being predominantly Brachiocephalic followed by Meso and Hyperbrachiocephalic with no Dolicocephalics (Table 1)

The finger print pattern revealed a predominance of Loop (72%), followed by whorl and arch pattern, with no significant difference of distribution among the genders. (Table 2) An interesting finding was of an arch/curve pattern noted only in Brachiocephalic Females.

Correlating the finger print pattern and the cephalic index, the Loop pattern predominated among the mesocephalic individuals, while the whorl pattern predominates the Brachiocephalic's. (Table 3)

### Discussion:

Human identification is a decisive event in Forensic medicine, for which various branches of medicine work with different methods to achieve individualization of the person.

Among which some are used for identification of age, gender, ethnicity and region while some are useful in identification of the person accordingly to the need of circumstances. Some forums insist for an

adjunctive parameter to a principle method of individualization to enhance the authenticity.

Taking this cue our study utilizes, Dermatoglyphics and Cephalic index which are two established parameters helpful in personal identification of an individual.

The present study showed a mean cephalic index of 79.89 in the complete sample, which was similar to a study by Bhargava & Kher, on Berelas of Central India [10] and Gujarat region population [11]. While many other studies done on different populations were not in agreement with our results which can be credited to the complex interactions between genetics and environmental factors. [12]

In the present study the mean cephalic index type for Males was predominantly Mesocephalic (C.I=78.45), in Females it was Brachiocephalic (C.I=81.32) showing a statistical significant difference among both genders (Table 4, 5) which was an important inference from the previous studies, suggesting that cephalometric analysis will determine the gender and communal differences. [12, 13, 14]

The rare types of head shapes observed in this study were Dolicocephalic present only in males and Hyperbrachiocephalic present in both the genders. Dolicocephalic was the common and predominant type in males in most of other Indian studies as against our mesocephalic, while Hyperbrachiocephalic was a rare type [12], a common observation with our study.

In our study, the Loop patterns predominated in 65% of the individuals followed by the whorl pattern in 25%, Arch/ Curve pattern in 7% and composite in 2-3% individuals. This was in accordance to the normal range of distribution found among world population. [15]

Literature stated that the formation of different types of finger print patterns might not be directly determined by genes, but is the indirect consequence of the size and shape of the finger pads of hand at the time of dermal ridge development. [4]

As the finger pads develop and regress in size, a series of dermal ridges are formed at dermal and epidermal junction by twelfth and thirteenth week where the surface remains smooth. These become reflected by identical configurations on the skin surface as epidermal ridges with a definite pattern by nineteenth week of intrauterine life. [4]

The final pattern type may be interpreted as the result of height and contour of finger pad, where a low pad with little disruption of parallel lines results in an Arch, a high pad giving a Whorl, and an intermediate height pad marks a loop. The Shape and Size of the individual with

basis of genetics in the gestation time will influence the finger print pattern, which even dictates the future head shape and size.[4] Many studies have previously correlated between Finger print patterns and blood groups, adult hypertension, gender determination, cleft lip/palate, PMD's, Caries, periodontitis, malocclusions [12, 16, 17] and many other parameters where they have shown the common genetic basis for their results, where dermatoglyphics has played a diagnostic role in a number of diseases having a hereditary basis.

Our study showed the Loop pattern to predominate in Mesocephalic's, where the loop is said to be a result of an intermediate height pad, similar to the mesocephalic's which are intermediate, while the Whorl pattern predominated in Brachiocephalic and Arch pattern was restricted only to Brachiocephalic female individuals. This can be explained as the whorl pattern develops from a high bulbous finger pad and likewise the Arch pattern with a Flat pad which is seen more in Brachiocephalics where head is also flat and broad.

### Conclusion:

This study suggests a correlation between Finger print patterns and Cephalic indices of the individuals, so also is the Arch/Curve pattern found only in Brachiocephalic and Female individuals. Though a pattern of relationship has evolved, further repeated studies on a larger population are necessary, to establish that the findings of this study were not merely a coincidence but do have a scientific basis. If this correlation exists it would act as an adjunctive parameter for identification of individuals.

### References:

1. Francis Galton, F.R.S. FINGER PRINTS: London, Macmillan and Co. 1892: 146-54.
2. Kasai K, Richards LC, Brown T. A Comparative Study of Craniofacial Morphology in Japanese and Australian Aboriginal Populations. Hum Bio. 1993;68:821-34
3. Cummins, Midlo. The Topographic History Of The Volar Pads (Walking Pads) In The Human Embryo". Embryol. Carnig. Int. Wash, 1929; 20:103-109.
4. John J., Mulvihill, David W. Smith. The Genesis of Dermatoglyphics. J Pediatrics. 1969;75(4):579-89
5. U.G. Esomonu, M.I. Badamasi. Cephalic Anthropometry of Ndi Igbo of Abia State of Nigeria, Asian Journal of Scientific Research. 2012;5(3):178-84
6. Soames, R.W. Skeletal System. In: Grays Anatomy, Williams, P.L., L.H. Bannister, M. M. Berry, P. Collins, M. Dyson, J.E. Dussek and M.W.J. Fergusson (Eds.). 1995; 38th Ed., Churchill Livingstone, New York, P: 425-736.
7. Yogesh N. Umraniya Y, Hetal H Modi, Himanshu K Prajapati. Sexual Dimorphism in Dermatoglyphic Pattern Study. International Journal Of Medical And Public Health Science Research (IJMPHSR), 2013;1(2): 1-6
8. Lin Hong, Anil Jain. Classification Of Fingerprint Images, Department of Computer Science, Michigan State University, East Lansing, Mi 48824.

9. **NamdeoPrabhu, Rakhilssrani, SaurabhMathur, Gaurav Mishra, ShrutiSinha.** Dermatoglyphics in Health and Diseases. J Res Adv. Dent 2014; 3:2:20-26.
10. **Bhargava I, Kher GA.** A comparative anthropometric study of Bhils and Berelas of Central India. J Anat Soc India, 10: 26-33(1961)
11. **Sapna Shah, S.P. Rathod, S.V. Patel, T. C. Singh, S. M. Patel, ParthPandya.** The Study of Cephalic index in living subjects in Gujarat region. NJIRM 2012; 3(4): 54-56.
12. **Mahesh Kumar, Patnaik V.V. Gopichand.** The Study of Cephalic Index in Haryanvi Population, Int. J. Pure App. Biosci.2013;1(3):1-6
13. **IlaJitheshGujaria, Vishal Manoharrao Salve.** Comparison of Cephalic Index of Three States Of India, Int. J Pharm Bio Sci. 2012;3(4): 1022-31
14. **VaishaliKiranYagain, Shakunthala R. Pai, Sneha G. Kalthur, Chethan P, I Hemalatha.** Study of Cephalic Index in Indian Students. Int. J. Morphol. 2012; 30(1):125-29.
15. **Rajesh Bardale.** Principles of Forensic Medicine and Toxicology. P74-75, First Edition 2011, Jaypee publications.
16. **Dhall U, RatheeSK, Sharma BD.** Utility of Fingerprints in Myocardial Infarction Patients. J Anat. Soc. India. 2000; 49(2): 153-54.
17. **Lakshmi V.** Dermatoglyphics and Orthodontics- A Review, Annals and Essences of Dentistry. 2013;5(4):30-33

**Table 4: Chi-Square test (P<0.05)**

	Value	Df	p-value
Pearson Chi Square	12.153 <sup>a</sup>	3	.007 Significant
Likelihood Ratio	15.293	2	.002
Linear by Linear association	8.718	1	.003

**Table 1: Gender Based Cross Tabulation of the Cephalic Index**

			Dolicocephalics	Mesocephalic	Brachiocephalic	Hyperbrachio	Total
Gender	Males	Count	8	24	15	3	50
		% Within Sex	16.0%	48.0%	30.0%	6.0%	100 %
		%Within Index Type	100.0%	55.8%	35.7%	42.9%	50%
		% of Total	8%	24.8%	15%	3%	50%
	Females	Count	0	19	27	4	50
		% Within Sex	0.0%	38.0%	54.0%	8%	100%
		%Within Index Type	0.0%	44.2%	64.3%	57.1%	50%
		% of Total	0.0%	19%	27%	4%	50%
Total	Total	Count	8	43	42	7	100
		% Within Sex	8%	43%	42%	7%	100%
		%Within Index Type	100%	100%	100%	100%	100%
		% Of Total	8%	43%	42%	7%	100%

**Table 2: Gender Wise Finger Print Predominance**

			Finger print Types			Total
			Loop	Whorl	Curve	
Gender	Males	Count (%)	35(35)	15(15)	0(0)	50(50)
	Females	Count (%)	37(37)	11(11)	2(2)	50(50)
Total		Count (%)	72(72)	26(26)	2(2)	100 (100)
		% of Total	72%	26%	2%	100%

**Table 3: Correlation of Finger Prints with Cepahlic Indices**

Cephalic Index Type			Finger Print Predominant Type			Total
			Loop	Whorl	Arch / Curve	
Dolicocephalic	Gender	Males	6	2	0	8
	Total		6	2	0	8
Mesocephalic	Gender	Males	17	7	0	24
		Females	16	3	0	19
	Total		33	10	0	43
Brachiocephalics	Gender	Males	9	6	0	15
		Females	19	6	2	27
	Total		28	12	2	42
Hyperbrachio	Gender	Males	3	0	0	3
		Females	2	2	0	4
	Total		5	2	0	7
Total	Gender	Males	35	15	0	50
		Females	37	11	2	50
	Total		72	26	2	100

## Original Research Paper

# Estimation of Adult Human Stature from Measurements of Inter-Acromial Length in Gujarati Population of India

<sup>1</sup>Sweta H Patel, <sup>2</sup>Binaya Kumar Bastia, <sup>3</sup>Lavlesh Kumar, <sup>4</sup>Senthil Kumaran M

### Abstract

Stature is one of the biological characteristics often used in Forensic Anthropology, both to help build profiles for unidentified individuals and to support putative identifications. Frequently fragmentary remnants are brought to a Forensic expert for investigation purpose. It is, therefore, necessary to have different formulae for the determination of stature using measurement of different body parts. The aim of this study was to estimate the stature from anthropometric measurement of inter-acromial length and derive a linear regression equation. A total of 300 subjects (150 males and 150 females) of SBKS Medical Institute & Research Center, Sumandeep Vidyapeeth, Vadodara, Gujarat belonging to the age group 22 – 44 years were selected for the study. The stature and inter-acromial length of each subject were measured with the help of a stadiometer, spreading caliper and self-retracting tape measure. There exists a positive correlation between the stature and the inter-acromial length in both males and females combined ( $p < 0.001$ ), which was highly significant. Our study also showed low degree of positive correlation in case of males & females measured separately. P- Value is highly significant ( $p < 0.001$ ) in all the cases.

**Key Words:** Stature estimation; Inter-acromial length; Forensic anthropology; Regression equation

### Introduction:

Establishment of individuality of an individual carries an immense importance in medico legal investigation in living as well as in dead. Identification is determination of the individuality of a person based on physical properties. [1] When the whole set of skeleton is available, the task is easy; but it becomes challenging when incomplete set of skeleton or only part of the body is available.

Such incomplete bodies are encountered in homicides [to conceal evidence], in railway accidents, plane crashes, bomb explosions, various mass disasters, etc. The estimation of sex, age and stature from the available material helps in identifying an individual. [2]

The points usually noted for the purpose of identification are race, sex, age, complexion and features, hair, anthropometry, dactylography, foot prints, deformities, scars, tattoo marks, occupation marks, handwriting, clothes and personal articles, speech, voice, gait, ticks, manner, habit, mental power, memory, education, DNA profile and miscellaneous methods of identification. [3]

The branch of Forensic science that uses the data obtained from body parts and skeletons from the living or dead people for Forensic purposes are called "Forensic Anthropology". [4] Height of a person increases progressively and becomes maximum at the age between 21-25 years. Later, for every 25 years, it is shortened by 2.5 cm due to thinning of intervertebral discs and some stooping posture as a result of decreased tone of muscles. [5]

Human stature has always been a symbol of an authority, physical prowess and dominance over other living beings. Stature or body height is an important factor in establishing the identity of a person especially in the skeletonized remains. The calculation of stature is based on the relative proportions of different body parts, both in relation to each other and in relation to the overall height of the individual.

In ancient times, physicians & surgeons like Charak & Sushruta were well acquainted with the relation of different parts of body with

### Corresponding Author:

<sup>1</sup>Senior Resident

Dept. of Forensic Medicine

All India Institute of Medical Sciences Bhopal

E-mail: sweta.srfmt14@aiimsbhopal.edu.in

<sup>2</sup>Addl. Prof, Dept. of Forensic Medicine

All India Institute of Medical Sciences Rishikesh

<sup>3</sup>Prof & HOD, Dept. of Forensic Medicine

SBKS Medical Institute and Research Centre, Vadodara

<sup>4</sup>Senior Resident, Dept. of FMT

JIPMER, Pudducherry

DOR: 09.03.2015 DOA: 13.08.2015

DOI: 10.5958/0974-0848.2015.00095.0

height. According to Charak, the height of an average man should be 84 - *anguls*, thigh - 21 *anguls*, forearm - 15 *anguls* & arm -16 *anguls*. [6] "*Angul*" is a Sanskrit terminology for width of a finger except thumb, which was an easy and common way to get approximate measurement of lengths of various objects.

Although many formulae for stature estimation from long bones have been proposed, there is concern regarding the accuracy of the use of population specific formulae to people of different geographical regions. It is obvious that there are no universally applicable formulae for stature estimation from the length of long bones as the relationship between them is influenced by the race, sex and age of an individual. Thus, the need for race, age and sex specific stature estimation formulae is proved beyond doubt. [7]

There are two ways by which we can determine the height of an individual i.e. from cadaveric bones and in living subjects. The cadaveric estimation of height shows marked difference in findings when compared to the studies estimating heights in living subjects.

However, the studies estimating heights in cadavers do not represent a population. Also, cadavers are likely to have been lying in abnormal postures for long durations and it may not be possible to straighten the body to get accurate stature measurement. According to Mildred Trotter & Goldine C. Glesser there is an increase in height of 2.5 cm after death when measurement is taken in recumbent position. [8]

The height of an individual has changed from earlier times to the present. Pliny believed that mortals grow smaller and smaller, generation by generation. [9] This belief which derived apparently from old heroic mythology persisted tenaciously.

However, the contrary is the view of Krogman; who explicitly expressed in the introductory paragraph to 'Calculation of Stature' that "We are taller today than ever before". [10]

It is also necessary to have different formulae for the determination of stature from the measurement of different body parts, like cases in which only the fragmentary remnants are available (without even a single long bone) for identification.

Literature search revealed that only few studies have been published to find out formulae for estimation of stature without long bones. [11]

With this background a need was felt to conduct a study which can enlighten if there exists any correlation between stature and IAL and if so then any sexual variation in correlation of stature and IAL. This study also aim to derive

linear regression formulae from correlation of stature and IAL and then to compare the correlation between stature and IAL with previous studies.

### Material and Methods:

An observational study was conducted from Mar 2012-Feb 2013 in the Department of Forensic Medicine, Sumandeep Vidyapeeth, Vadodara, Gujarat, among the students and staff members after obtaining approval from institutional ethical committee.

A total of 300 subjects (150 males and 150 females) belonging to the age group 22 - 44 years were selected for the study.

The rationale behind selecting this age limit is that, by 22 years, all the epiphysis of shoulder joint including clavicles are fused; and normally no further growth is expected.

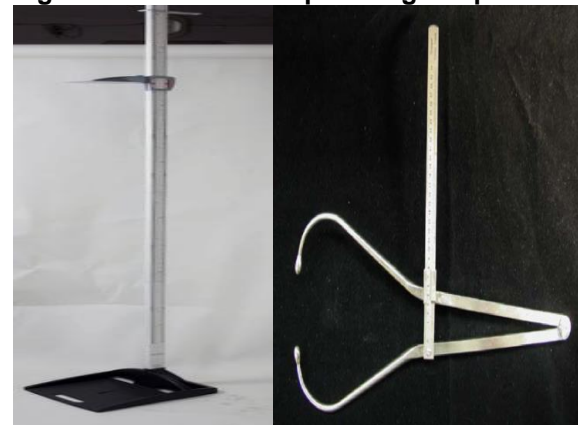
Furthermore, by 44 years the decrease in growth due to degenerative changes is not significant enough to affect the regression equation. [5] Apparently healthy Gujarati individuals in the age range of 22 - 44 years (Verified by School Leaving Certificate / Birth Certificate) and are willing to participate by giving valid consent were included in the study.

Those whose ethnicity is other than Gujarati and also those having grossly visible or previous history of injury leading to skeletal abnormality of spine long bones and upper trunk were excluded from the study.

### Methodology:

Volunteers were explained the need and purpose of the study and were shared the relevant details of this research prior to participation. The stature and inter-acromial length of each subject were measured in centimeter with the help of a stadiometer (Fig.1), spreading caliper (Fig. 2) and self-retracting measuring tape.

**Fig. 1: Stadiometer & Spreading Caliper**



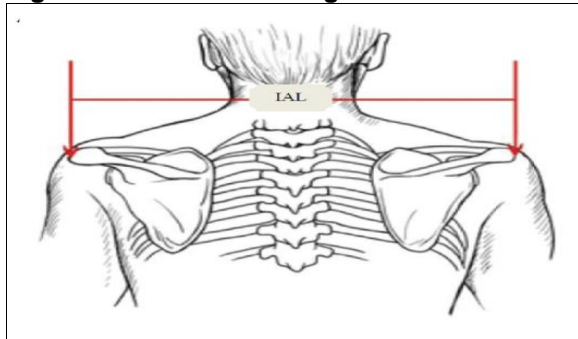
After taking consent and recording general particulars, the stature was measured



by making the subject stand straight on a horizontal resting plane bare footed with the head in the Frankfort plane, buttocks and heels pressed against the upright position of the instrument and the palms of the hands turned inwards and the fingers pointing downwards. Then the movable piece of the anthropometer was brought in contact with the vertex in the mid sagittal plane.

Similarly, inter-acromial length was measured with the person sitting in the erect position. Inter-acromial length is the distance between two bony landmarks, i.e. acromial process of scapula on each side. (Fig. 3)

**Fig. 3: Inter-acromial Length**



The participant was asked to sit erect with the arms hanging freely at the sides. The posture of the participant was checked from behind making sure that the shoulders are neither too far back nor forward, and that there is a noticeable curvature in the lower back.

Then the participant was requested to hold the breath for few seconds so that the lateral border of acromial process can be located by following the scapula out to the arm until it makes a sharp turn and marked on each shoulder. A blunt ended spreading caliper (pelvimeter) was gently placed between the thumb and forefinger, which allowed palpating the bony ridges with other fingers.

The arms of the spreading caliper were then placed directly on the skin next to the lateral border of each acromial process and pressure was applied to compress the soft tissue over the acromial processes without hurting the participant. The measurement was taken twice i.e., once with a spreading caliper and once with a self-retracting measuring tape.

Both the measurements were taken at a fixed time between 14:00 - 16:30 hours to eliminate discrepancies due to diurnal variation.

The linear regression equation formulae were evolved using statistical methods for the relationship between statures and inter-acromial lengths. The results were analyzed using statistical package SPSS version 20.0.

## Results:

The maximum, minimum and average statures of different sexes along with their maximum, minimum and average inter-acromial lengths were calculated and tabulated. The linear regression formulae, standard errors and coefficient of co-relations of the above data were computed using statistical methods by presuming X as an independent variable and Y as dependent variable. "p" value is the probability role at 0.05 level of significance. For the purpose of the present study, a 'p' < 0.05 is considered significant; and 'p' > 0.05 is considered not-significant.

### Regression equation:

$$\Sigma y = Na + b \Sigma x$$

$$\Sigma xy = a \Sigma x + b \Sigma x^2$$

Where  $\Sigma$  = Sum value,

y = Value of stature

N = Number of cases studied

x = Value of inter-acromial length

a = Unit greater than x value by y value

b = Regression coefficient

The maximum inter-acromial length in case if males and females combined was 48.9 cm; minimum was 30.0 cm, with a mean of 39.1 cm. (Table 1)

From the above equations, linear regression formulae, standard errors and coefficient of correlations were developed to fulfill the aims and objectives of the study. After statistical analysis of the results, three linear regression equation formulae were obtained. (Table 2)

## Discussion:

Male and female skeletons require different formulae, due to the difference in bodily proportions between the two sexes. For this reason, if an individual skeleton cannot be sexed, it is difficult to allocate an estimated height. A lot of researches had been done on stature estimation from long bones of extremities, but a little is known about stature from other body measurements.

Obviously, a little work has been reported from India on the use of statistical methods to calculate the stature from the inter-acromial length. The present study showed high degree of positive correlation in case of males and females combined (unknown sex) while it shows low degree of positive correlation in case of males & females separately. P- value is highly significant (i.e. p < 0.001).

The males had longer inter-acromial lengths. Males tend to develop broader shoulder from puberty compared to the females, and this may be a reason for the higher inter-acromial

length. In this study, the standard errors came out to be  $\pm 6$  cm in males and  $\pm 5$  cm in females.

Therefore, there is no difference in the standard errors in case of males but there is difference of +1 cm in case of females as compared to the study conducted by Koulapur VV et al. [11] However, for females the standard error can be comparable to studies by Momonchand A et al, [12] but in case of males, the difference in standard errors is 2 cm.

In a study conducted by Koulapur VV et al the standard errors came out to be  $\pm 6$  cm (males) and  $\pm 4$  cm (females). [11] While in a study done by Momonchand A and Meera Devi T to determine the stature from inter-acromial length, the standard errors were  $\pm 8$  cm (males) and  $\pm 5$  cm (females). [12] There was a standard error of 6-8 cm for males and 4-5 cm for females between different regression equation formulae.

Ozaslan A. et al, conducted a study to estimate stature from bi-acromial and bi-iliocristal measurements on Turkish Population and concluded that the best correlation was observed in males for Bi-Acromial Breadth ( $r=0.42$ ) and for females ( $r=0.26$ ), but for Bi-Ilio-Cristal Breadth there was a very weak correlation in both males ( $r=0.21$ ) and females ( $r=0.19$ ).

When both variables were used together, it was detected that a small increase observed in stature of males ( $r=0.43$ ). Standard error in males for Bi-Acromial Breadth (BAB) was  $\pm 6.2$  cm while for Bi-IlioCristal Breadth (BICB) it was  $\pm 6.6$  cm. In case of females standard errors came out to be  $\pm 6.3$  cm and  $\pm 6.4$  cm for BAB and BICB respectively. [13]

In present study, co-efficient of correlation  $r=0.59$  in cases of males and females combined, in case of males  $r=0.31$  and in females  $r=0.23$ . Therefore, a similar coefficient of correlation has been found in case of females and standard errors in case of males of Indian Population and Turkish Population.

Stature varies at different times of the day by 1.5- 2 cm. It is less in the afternoon and evening due to reduced elasticity of the intervertebral discs and the longitudinal vertebral muscles. On an average the body lengthens after death by about 2 cm, due to complete loss of muscle tone, relaxation of large joints and loss of tensioning effect of para-spinal muscles on intervertebral discs. [5]

Therefore; in this study all the measurements were taken at a fixed time to avoid diurnal variations.

### Conclusion:

This study will provide baseline information for stature estimation from inter-acromial length in Gujarati population of India. It could lead to the development of a standard data on various groups of population. In context of anthropology, comparison made with other population could contribute to understanding of the relative ethnic composition of our population. From a forensic point of view, the approximate height of an individual can be estimated if upper portion of the trunk is available without the long bones.

### References:

1. Reddy K.S.N. The Essentials of Forensic Medicine and Toxicology. 30th ed. Hyderabad: Devi KS; 2000. p.51.
2. Tyagi A.K., Kohli A., Varma S.K., Aggarawal B.B.L. Correlation between stature and finger length. International Journal of Medical Toxicology and Legal Medicine. 1999; 1(2):20-22.
3. Modi J.P. Modi's Medical Jurisprudence and Toxicology. 23rd ed. New Delhi: Lexis Nexis Butterworths publications; 2006. p.3.
4. Forensic Science. [cited 2013 July 15]. Available from: <http://jimfisher.edinboro.edu/forensics/general.html>
5. Vij K. Textbook of Forensic Medicine and Toxicology, Principles and Practice. 5th ed. New Delhi: Elsevier; 2011.p.51.
6. Shastri H. Charak Samhita.1940; Chapter 7:410-414.
7. Ilayperuma I., Nanayakkara G., Palahepitiya N. A model for the estimation of personal stature from the length of forearm. Int. J. Morphology. 2010; 28(4):1081-1086.
8. Trotter M., and Gleser G.C. Estimation of stature from long bones of American Whites and Negroes. Am J. Phy. Anthro. 1952; 10(4):463-514.
9. Telkka A. On the prediction of human stature from the long bones. Acta Anat 1950; N9:103-111.
10. Krogman W.M., Iscan M.Y. The Human Skeleton in Forensic Medicine. 2nd ed. Illinois: Charles Thomas, 1986.p.302.
11. Koulapur V.V., Agarwal S.S., Mestri S.C. Estimation of Stature by Anthropometric Measurements of Inter-Acromial Length. JIAFM. 2010; 32(2):101-103.
12. Momonchand A., Devi T.M. Determination of Stature from the inter-acromial length. J of Forensic Med and Toxicology 1999; 16(1):72-73.
13. Ozaslan A., Karadayi B., Kolusayin M.O., Kaya A. Stature estimation from bi-acromial and bi-iliocristal measurements. Rom J Leg Med. 2011; 19(3):171-176.

**Table 1: Sex-wise and combined Distribution of statures and inter-acromial Lengths (cm)**

Characters	Males	Females	Combined (M+F)
Maximum Stature	186.0	171.2	186.3
Minimum Stature	141.0	139.5	139.5
Average Stature	169.3	155.9	162.6
Max. inter-acromial length	48.9	46.0	48.9
Mini. inter-acromial length	35.0	30.0	30.0
Avg. inter-acromial length	41.2	37.0	39.1

**Table 2: Correlation between Stature (y) and Inter-acromial length (x)**

Characters	Linear Regression Formulae	Standard Error	Coefficient of Correlation R / r	p-value
Males and Females combined	$y=102.27+1.54x$	$\pm 7$ cm	0.59	0.000
Males only	$y=140.01+0.71x$	$\pm 6$ cm	0.31	0.000
Females only	$y=137.31+0.50x$	$\pm 5$ cm	0.23	0.000



## Original Research Paper

## Study of Fingerprint Patterns in South Indian Population

<sup>1</sup>Nithin Mathew Sam, <sup>2</sup>Rema P., <sup>3</sup>Venugopalan Nair B**Abstract**

Study of finger prints as a method of identification is known as Dactylography or Dactyloscopy. Dactylography is a progressing science and new methods for the recording, lifting and developing of prints under different field conditions, including those from the decomposed body, are being introduced regularly. Identification using finger prints is absolute and infallible. Since the turn of the century, finger prints have been used as a very effective means of establishing identity of the individual. Study of finger prints as a method of identification is known as Dactylography. The present study was conducted on 100 males and 100 females of South Indian Population aged between 18 and 81 years. Rolled fingerprints were obtained using pre-inked strips, and their patterns were identified. Each type of fingerprint pattern and their subtypes were identified and analysed for gender differences.

**Key Words:** Dactylography, Fingerprint Pattern, Gender Difference, Identification

**Introduction:**

Study of finger prints as a method of identification is known as *Dactylography* or *Dactyloscopy* or *Dermatoglyphics* and at present, also as Henry-Galton system of Identification. [2] The word Dactylography is taken from two Greek words, *daktylos* meaning 'finger' and *graphein* meaning 'to write'. [3]

It is the study of the impressions of patterns formed by the papillary ridges on the bulbs of fingers and thumbs, when taken upon unglazed paper with the help of printer's ink. [1, 4, 5] Dactylography is a progressing science and new methods for the recording, lifting and developing of prints under different field conditions, including those from the decomposed body, are being introduced regularly. [5] As far back as seventeenth century AD, the finger print impressions in ink were used in Assyria and Far East as an evidence of good faith in the sealing of bonds or the issue of documents. [1]

Dr. Henry Faulds came to Darjeeling, Bengal in 1872 as a medical missionary and observed the use of Tip Sahi in lieu of signature and other official purposes. [1, 7]

He recognized the importance of finger prints, and published an article in *Nature* in 1880, [7, 8] but the first mentionable study on finger print was done by Sir Francis Galton, an English anthropologist in 1892.

Sir Edward Richard Henry, Inspector General of Police, Lower Bengal could develop and improve the applied aspect of Galton's observation, further by classifying the prints for practical application in the field of identification in the 1890's. [1, 7]

That system of finger print study is still in effect in most of the countries of the world, which is popularly known as *Henry-Galton system* or simply, Galton's system of identification. [2]

**Characteristics of Fingerprints:**

- They are present at birth, both on epidermis and dermis. [9] Finger prints appear for the first time from the 12<sup>th</sup> to 16<sup>th</sup> week of intrauterine life and their formation gets completed by 24<sup>th</sup> week of intrauterine life. [6, 10] The ridges appear on the fingers first, then on the palm or sole. [1]
- **Permanency or Persistency:** They remain constant for the whole life of the individual. [9] Herschel first demonstrated this, and his own impressions taken when aged 28 and again at 82 were unchanged except for the addition of coarse lines due to old age. [11]
- **Individuality or Variety:** They form patterns that are absolutely individualistic. No two hands are entirely alike, not even in identical twins. [1, 2, 4, 9, 13, 14]
- **Immutability:** Simple injuries, old age, diseases etc. will not change the formation

**Corresponding Author:**

<sup>1</sup>Junior Consultant, Department of Forensic Medicine, General Hospital, Thrissur, Kerala, India – 680001  
E-mail: drnithinmathewsam@yahoo.co.in

<sup>2</sup>Prof, Dept. of Forensic Medicine, Medical College, Thiruvananthapuram, Kerala

<sup>3</sup>Former Deputy Director, State Fingerprint Bureau, Kerala Police  
DOR: 18.03.2015 DOA: 11.08.2015  
DOI: 10.5958/0974-0848.2015.00096.2

of patterns and ridge characteristics, unless dermis is affected.

Finger prints are classified into four types:-

- 1) **Loop**
- 2) **Whorl**
- 3) **Arch**
- 4) **Composite**

#### **Core or Inner terminus:**

Core means the central part of the pattern, otherwise called the inner terminus. The type of core varies according to the pattern.

**Fixing the Inner terminus:** Inner terminus is a fixed point on the core. In the case of staple (innermost ridge in loop pattern which goes up and turns back in the same way) being the core, the point on its shoulder farthest from the delta, is the 'inner terminus'. When the core consists of uneven number of ridges, the top of the central one is the 'inner terminus'.

When the core consists of even number of ridges, the two central ridges are considered as joined at their summit by an imaginary neck, and the point farther from the delta on the shoulder is the 'inner terminus'. [16]

#### **Delta or Outer terminus:**

It may be formed either (1) by the bifurcation of a single ridge, or (2) by abrupt divergence of two ridges that hitherto had run side by side.

**Fixing the delta:** When the delta is formed by the bifurcation of a single ridge, the point of bifurcation is the 'outer terminus'. When there are several such bifurcations, the one nearest to the core is taken as the 'outer terminus'. When the delta is formed by the divergence of two ridges which run side by side, the first in front of the place where divergence begins, even it be a mere point, whether it is independent of, or sprung from the divergence ridges or not, is the 'outer terminus'. [16]

1. **Loop:** In loops, some of the ridges make backward turn, but without twist. There is one delta. There must be at least one ridge count between the inner and outer terminus. Loops can be :
  - **Ulnar loop:** the ridges about the core terminate in the direction of the ulna bone of the forearm. In other words, the ridges about the core slant towards the right in the case of right hand fingers, and towards left in the left hand fingers. (Fig. 1)
  - **Radial loop:** the ridges about the core terminate in the direction of radius bone of forearm. i.e., the ridges slant towards left in case of right hand fingers, and towards right in the left hand fingers. [10,16] (Fig. 2)

2. **Whorl:** In whorls, some of the ridges make a turn through at least one complete circuit. There are two deltas, one on the left and the other on the right. Whorls can be:

- **Concentric / Circular** (Fig. 3)
- **Spiral** (Fig. 6)
- **Double core** (Fig. 4)
- **Elliptical / almond shaped** (Fig. 5)

3. **Arch:** This pattern can be of two types:

- **Plain Arch:** In this pattern, the ridges run from one side to the other making no backward turn. There is usually no delta. But when delta appears, no ridge must intervene between the inner terminus and outer terminus. (Fig. 7)
- **Tented Arch:** In this pattern, the ridges near the middle may have an upward thrust, arranging themselves as it were on both sides of an axis towards which adjoining ridges converge. The ridges thus converging give to the pattern the appearance of a tent in outline, hence the name 'tented arch'. (Fig. 7)

4. **Composite or Compound:** A composite pattern means combination of two or more patterns, either of the same or different type, in one print. Types of composite pattern are:

- **Central Pocket Loop:** this pattern can be described as an *incipient whorl*, because a few ridges about the core possess features of whorl type, and remaining ridges conform the loop type surrounding them as a pocket.

There must not be more than four recurving ridges intervening between the core and the innermost delta. There must be two deltas. If an imaginary line is drawn between two delta points, it would not cut or touch a recurving ridge within the inner pattern area. (Fig. 8)

- **Lateral Pocket Loop:** when the ridges constituting a loop bend sharply downwards on one side before recurving thereby forming an interspace or pocket on that side, ordinarily filled by the ridges of another loop. In lateral pocket loop, the ridges containing the point of core have their exit on the same side of delta. (Fig. 8)
- **Twinned Loop:** It consists of two well defined loops one superincumbent on or surrounding the other. In this pattern, the ridges containing the point of core have their exit on different sides of the delta. (Fig. 9)
- **Accidental:** It is comparatively uncommon type of pattern, being one of the more complicated combination of the same or

different patterns i.e. loop by loop, whorl resting on loop, loop resting on whorl, whorl resting on whorl, arch with pocket etc. It has two or more deltas. [16] (Fig. 9)

### Materials and Methods:

Two hundred subjects (100 males and 100 females) brought for medico-legal autopsy at the Department of Forensic Medicine, State Medico-legal Institute, Medical College, Thiruvananthapuram, Kerala from May 2011 to April 2012 were selected for the study.

In this study we included fresh, identified dead bodies brought for autopsy of the persons above 18 years of age. We excluded the Subjects with any evidence of injury, scars or any alterations of fingertips and other than those from South India.

**Materials Used:** (1) Pre-inked strips, (2) Cadaver spoon, (3) Foldable magnifying lens, (4) Transparent film strip, (5) Pointer

**Method:** Hands were washed and dried to remove sweat, dirt and grease. The rolled impressions of each finger were obtained using pre-inked strip and cadaver spoon. Thus rolled finger prints were obtained. Similarly, prints of entire ten fingertips were prepared for each and every subject.

### Results:

Rolled fingerprints of ten fingers of all the 200 subjects were collected. Hence a total of 2000 fingerprints were obtained, which were analysed and their patterns and subtypes were determined. Among the 2000 fingerprints obtained, 1142 were loops, 607 were whorls, 127 were composites and 124 were arches. (Table 1)

The distribution of different patterns of fingerprints was analysed separately for both males and females. (Table 2) Out of the 1142 loop patterns obtained in this study, 1089 were ulnar loops (95.36%) and 53 were radial loops (4.64%). Similar distribution was observed in both males and females. (Table 3)

Out of the 607 whorl patterns obtained in this study, 374 were spiral whorl (61.6%), 154 were circular whorl (25.4%), 48 were double core whorl (7.9%) and 31 were elliptical whorls (5.11%). In both males and females, same distribution pattern was observed. (Table 4)

In present study we observed that out of the 127 composite patterns, 64 were twinned loops (50.39%), 43 were lateral pocket loop (33.86%), 16 were accidental type (12.6%) and 4 were central pocket loop (3.15%).

Our study showed that in males, the most common type of composite pattern was twinned loop (63%), followed by lateral pocket

loop (27.4%) and accidental pattern (9.6%). Central pocket loop pattern was not observed in males. In females, the most common type was lateral pocket loop (42.6%), followed by twinned loop (33.3%), accidental pattern (16.7%) and central pocket loop (7.4%). (Table 5)

Of the 124 arch patterns obtained in the study, 118 were plain arch (95.16%) and 6 was tented arch (4.84 %). In both males and females, **plain arch** was the predominant type of arch pattern. (Table 6)

Overall frequency distribution of all subtypes of fingerprint patterns in either sex, was tabulated. (Table 7)

### Discussion:

Aim of this study was to study various patterns of fingerprints and their distribution in the South Indian population. Most common pattern was **loop** and the least common was **arch** Prevalence of fingerprint patterns as given by other authors and that obtained in the present study were compared. (Table 8) When we compare the previous data with the present study, it is found that

- 1) Prevalence of loop pattern is between 60 and 70% according to other authors, whereas it is lesser in this study (57.1%).
- 2) Prevalence of whorls and arches corresponds to that quoted by other authors (6.2%).
- 3) Prevalence of composite pattern is quoted to be between 1 and 4% by other authors, but it is found to be higher in this study (6.4%).

On analyzing the distribution of fingerprint patterns in either sex, Loops were the predominant pattern in both genders, followed by whorls. In males, the third most common pattern was composite, followed by arch. While in females, it was arch followed by composite.

Hence we find that the distribution of fingerprint patterns in male subjects is similar to that observed in the general sample population, whereas the distribution in female subjects is similar to the general distribution pattern quoted by the previous authors. (Table 8)

Subtypes of each of the four fingerprint pattern were identified and their distribution is given below:

**Loops:** In both males and females, **Ulnar loop** is the commonest type and **Radial loop** is the least common.

**Whorls:** In both males and females, **Spiral whorl** is the predominant type and **Elliptical whorl** is the least common one.

**Arches:** In both males and females, **Plain arch** is the most common, **Tented arch** the least.

**Composites:** The most common type of composite pattern was **twinned loop** and the least common was **central pocket loop**. In males, **Twinned loop** is the commonest type; **Accidental pattern** is the least common type. In females, **Lateral pocket loop** the commonest, and **Central pocket loop** the least common.

On gender-wise analysis of all types of fingerprints together, In males, **Ulnar loop** is the commonest, whereas **composite loop** (subtype of composite) is the least common type.

In females, **Ulnar loop** is the commonest, whereas **tented arch** is the least common type of fingerprint pattern.

### Conclusions:

In this study, distribution of types of fingerprints as well as their subtypes was made out. Loop pattern is the predominant type, and composites are the least common type.

Little data is available in the literature, regarding frequency distribution of subtypes of various fingerprint patterns. Ulnar loop is the commonest fingerprint pattern, in both males and females. Central pocket loop (subtype of composite) is the least common type in male, tented arch is the least common type in females.

No statistically significant gender-based differences could be established in the distribution of fingerprint patterns. This emphasizes the importance of fingerprints as an absolute and infallible tool for establishing identity.

### References:

1. **Karmakar RN.** J B Mukherjee's Forensic Medicine and Toxicology. 3<sup>rd</sup> Ed; 2007: 166-173.
2. **Nandy A.** Principles of Forensic Medicine. 3<sup>rd</sup> Ed. New Central Book Agency (P) Ltd; 2010: 158-163.
3. **Kumar A.** Textbook of Forensic Medicine, Medical Jurisprudence and Toxicology). 1<sup>st</sup> ed. Avichal Publishing Company; 2011: 4-5.
4. **Mathiwaran K, Patnaik AK.** Modi's Medical Jurisprudence and Toxicology. 23<sup>rd</sup> ed. Lexis Nexus Butterworth; 2005: 314-320.
5. **Vij K.** Textbook of Forensic Medicine and Toxicology- Principles and Practice. 5<sup>th</sup> ed. Reed Elsevier India (P) Ltd; 2011: 62-64.
6. **Dikshit PC.** Textbook of Forensic Medicine and Toxicology. 1<sup>st</sup> ed. Peepee Publishers and Distributors (P) Ltd; 2007: 80-85.
7. **Basu R.** Fundamentals of Forensic Medicine and Toxicology. 1<sup>st</sup> ed. Books and Allied (P) Ltd; 2003:40-44.
8. **Mant AK.** Taylor's Principles and Practice of Medical Jurisprudence. 13<sup>th</sup> ed. B I Churchill Livingstone; 1994: 176-177.
9. **Parikh CK.** Parikh's Textbook of Medical Jurisprudence and Toxicology. 5<sup>th</sup> Ed; 1986: 53-57.
10. **Reddy KSN.** The Essentials of Forensic Medicine and Toxicology. 31<sup>st</sup> Ed; 2012: 76-79.
11. **Polson CJ.** The Essentials of Forensic Medicine, 2<sup>nd</sup> ed. Pergamon Press Ltd; 1965: 75-78.
12. **Bardale R.** Principles of Forensic Medicine and Toxicology. 1<sup>st</sup> ed. Jaypee Brothers Medical Publishers; 2011: 72-76.
13. **Chandrachud YV, Manohar V R, Singh A.** Ratanlal and Dhirajlali's – The Code of Criminal Procedure Code. 18<sup>th</sup> ed. Wadhwa and Company; 2006
14. **Saukko P, Knight B.** Knight's Forensic Pathology, 3<sup>rd</sup> ed. Hodder Arnold; 2004: 101-102.

15. **Krishnan M KR.** Handbook of Forensic Medicine. 3<sup>rd</sup> Ed; 1971: 47-51.
16. **Padmanabhan AM.** Role of Fingerprint Science in Police and Judiciary. 1<sup>st</sup> Ed; 2008.

**Table 1: Distribution of Different Patterns of Finger Prints**

Pattern	Cases	%
Loop	1142	57.1
Whorl	607	30.35
Composite	127	6.35
Arch	124	6.2
Total	2000	100

**Table 2: Fingerprint Patterns and Gender Distribution**

Pattern	Males		Females	
	No.	%	No.	%
Loop	557	55.7	585	58.5
Whorl	318	31.8	289	28.9
Composite	73	7.3	54	5.4
Arch	52	5.2	72	7.2
Total	1000	100	1000	100

**Table 3: Types of Loop Pattern**

Type of loop	Males (%)	Females (%)	Total
Ulnar	532(95.5)	557(95.2)	1089
Radial	25(4.5)	28(4.8)	53
Total	557(100)	585(100)	1142

**Table 4: Types of Whorl Pattern**

Type of whorl	Males (%)	Females (%)	Total
Spiral	184(57.9)	190(65.7)	374
Circular	83(26.1)	71(24.6)	154
Double core	33(10.3)	15(5.2)	48
Elliptical	18(5.7)	13(4.5)	31
Total	318(100)	289(100)	607

**Table 5: Types of Composite Pattern**

Type of composite	Males (%)	Females (%)	Total
Twinned loop	46 (63)	18(33.3)	64
Lateral pocket loop	20(27.4)	23(42.6)	43
Accidental	7(9.6)	9(16.7)	16
Central pocket loop	0(0)	4(7.4)	4
Total	73(100)	54(100)	127

**Table 6: Types of Arch Pattern**

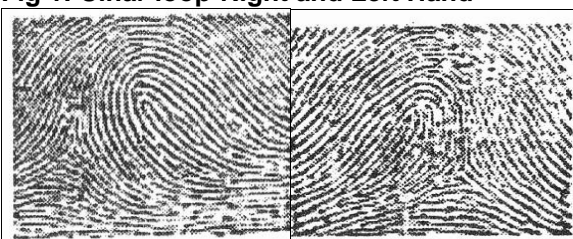
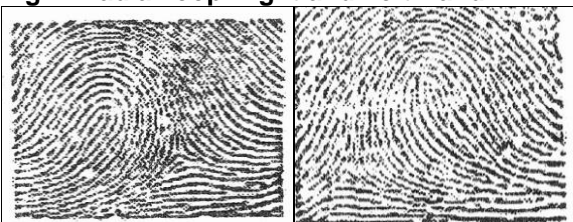
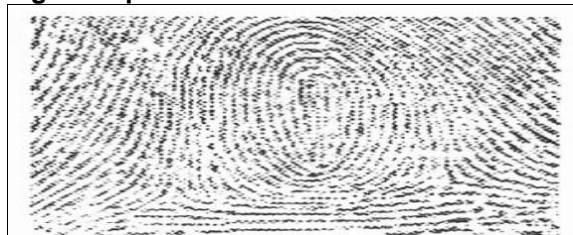
Type of Arch	Males (%)	Females (%)	Total
Plain	47(90.4)	71(98.6)	118
Tented	5(9.6)	1(1.4)	6
Total	52(100)	72(100)	124

**Table 7: Frequency Distribution of Fingerprint Patterns**

Subtype (Pattern)	Males	Females	Total
Ulnar (loop)	532	557	1089
Spiral (whorl)	184	190	374
Circular (whorl)	83	71	154
Plain (arch)	47	71	118
Twinned loop (composite)	46	18	64
Radial (loop)	25	28	53
Double core (whorl)	33	15	48
Lateral pocket loop (composite)	20	23	43
Elliptical (whorl)	18	13	31
Accidental (composite)	7	9	16
Tented (arch)	5	1	6
Central pocket loop (composite)	0	4	4
Total	1000	1000	2000

**Table 8: Comparison of Prevalence of Fingerprint Patterns**

Fingerprint Pattern	Prevalence given by previous authors (%)	Prevalence in the present study (%)
Loops	60 [4] 65 [2,5,12] 65 to 67 [7] 60 to 70 [6,10]	57.1
Whorls	25 [2,5,7,12] 25 to 35 [10] 30 to 35 [6]	30.4
Arches	5 [4] 6 to 7 [7,10] 7 [2,5,12] 5 to 10 [6]	6.2
Composites	1 to 2 [6,10] 2 to 3 [2,5,12] 3 to 4 [7]	6.4

**Fig 1: Ulnar loop-Right and Left Hand****Fig 2: Radial loop-Right and Left Hand****Fig 3: Single Cored Whorl****Fig 4: Double Cored Whorl****Fig 5: Elliptical Whorl****Fig 6: Spiral Whorl****Fig. 7: Plain and Tented Arch****Fig. 8: Central and Lateral Pocket Loop****Fig. 9: Twinned and Accidental Loop**

## Original Research Paper

# A Study on Trends and Pattern of Head Injuries, Due to Road Traffic Accidents Involving Two Wheelers

Vijay Mathur

### Abstract

The incidence of head injuries is growing with greater mechanization in industry an increase in high velocity mode of transport. The present study is conducted on 187 cases of fatal road traffic accidents of all age groups. All the cases of head and neighboring injuries admitted in respective health centers from January, 2013 to January, 2014, for treatment are included in the study. The pattern and distribution of head injuries due to Road Traffic Accidents (RTA) with/without helmet and other associated life saving measures are analyzed. Most of the cases of head injury belong to younger age group (21-40) years comprising of (70%) with male and (30%) with female of the cases related to road traffic accidents. Scalp injury in 100 cases whereas 60 cases are of the skull fracture and extradural haemorrhage 15% is most common intracranial injury followed by subdural haemorrhage (5%).

**Key Words:** Head injury, Road traffic accidents, Head injuries, Two-wheelers

### Introduction:

Head injury is one of the major public health problems which occurred most of the times due to certain types of accidents and has attained epidemic proportion in India.

The incidence of head injuries is growing with greater mechanization in industry an increase in high velocity mode of transport. According to 2012 report of National Crime Record Bureau of India 120,502 persons were killed in fatal RTAs and out of those about 66276 (55%) were killed while riding on two wheeler. [1]

The mortality rate is steadily rising. In many countries around the world, injuries mainly head injuries are the major cause of death. Approximately 18% of all unintentional deaths worldwide occur in children below the age of 18 years. Road accidents account for 17% of all deaths in this age group.

In India accidental death of children accounts about 19% of total such death. It is outside conflict zones, the dangerous place on earth, and a strip of law less asphalt where an angry army of humans and a bewildering variety of vehicular traffic battle for space and the right of way.

### Corresponding Author:

Assistant Professor,  
Dept. of Forensic Medicine and Toxicology,  
R. K. D. F. Medical College Hospital and Research  
Centre, Bhopal- (M.P.); India  
E-mail: dr.vijaymathur@yahoo.in  
DOR: 18.03.2015 DOA: 13.08.2015  
DOI: 10.5958/0974-0848.2015.00097.4

It is quite literally, death trap. India's road accident deaths are more than only other single cause. Every hour, 13 people die due to road accidents, the highest in the world.

Every 10<sup>th</sup> person, who dies in road accidents, is an Indian. Scarier is the fact that road fatalities in India have been rising at the rate of 10% a year and paradoxically have only increased even as massive amounts of money have been pumped into improving roads and adding new highways, flyovers and express ways. Study showed that a 10% increase in speed leads to a 35% increase in road accident fatalities.

Here is another shocking statistics a leading cause of road deaths is drunk riders (or drivers), others factors that lead to the high incidence of road accidents, poor traffic management, bad roads, total lack of observance of traffic rules, no legal deterrents, jaywalking pedestrians and deadly mix of slow and fast moving traffic, including the fact that a sizable number of fatalities due to road accidents is avoidable for want of better road safety management and availability of prompt medical help.

In fact, drunken driving accounts for about 36% of deaths involving motorized two wheelers. Similarly, wearing a helmet can reduce the risk of death by 40%. It is also observed that about 20% accidents are occurring to those both male and female, who are using mobile phone while driving motorized two-wheeler. The tragedy is that these basic

road safety measures are either not followed or blatantly violated in India.

The Global States Reports on Road Safety (GSRRS) report said that, "In India roads are planned and built to allow motor vehicles to travel faster while insufficient thought is given to the needs of pedestrians and cyclists. Most people use their motorized two-wheeler as a murder weapon as they drive with intense rage.

Speed thrills also calm them down". In India poor public transport is a major cause of accidents. In reality, driving licenses are like a license to kill. In many cities there is no need even to go to the licensing authority to get a license made, thanks to touts!

Two-wheelers contribute about 65% of total vehicles plying or running on the roads of Bhopal city and nearby places. Few reliable and realistic epidemiological data are available for the study of RTA involving motorized two wheelers with and without using helmet.

The main aim and objective of the present study is to find out the trend and pattern of head injuries and other body part injuries due to RTA with/without helmet and other relating risk factors and to provide a suggestive measure in order to control and reduce such injuries.

Head injury as defined by National Advisory Neurological diseases and stroke council, is a morbid state resulting from gross or subtle structural changes in the scalp, skull and/or contents of skull, produced by mechanical forces.

Injury to brain without fracture of skull is not uncommon; though fracture of skull is usually accompanied by some degree of injury to the brain. [2] The study of pattern of skull fractures is important for head being the most exposed and prominent part of body.

### **Material and Method:**

In the present study 187 cases of various types of injuries pertaining to head injury occurred due to accidents mainly by motorized two wheelers or those cases hit by other light and heavy vehicles to riders and pillioners of two wheelers. Most of the cases are selected from the present study are those victims who were admitted or brought for the medical help in tertiary care hospital, Bhopal (M.P.) and some cases are admitted in other medical Centres of Bhopal city after fatal road traffic accidents.

The analysis of 187 cases of head injury due to RTA for a period of about 13 months from January, 2013 to January, 2014 has been performed. After victim is brought and admitted to the hospital, a brief history pertaining to injury is recorded from relatives and eye witnesses

regarding cause of manner of injury, time and place of injury, whether homicidal or accidental period of survival after following head injury and approximate age and sex of the person (victim).

Sometime when a motorcyclist or two wheeler riders are hit by a heavy four wheeler (such as truck, bus, multiaxial vehicle) the driver of two wheeler fall down, consequently his/her is crushed by wheel of the heavy vehicle leads to burst fracture tearing multiple laceration of brain matter, leading to instantaneous death of motor cyclist on the spot.

Head injuries are examined critically and methodically, with available facilities in the hospitals. The inner aspect of the scalp was also examined for want of our study. Fractures of the skull are examined in detail as to the type, extension and location of injury.

Fracture of skull tested by CT scan and MRI. We have examined the cases thoroughly and hence found some depressed fracture, cervical fracture, crushed fracture etc.

### **Observations and Results:**

In all 187 cases are studied during one year period. Male comprised 83% and female 17% makes male: female ratio about 5:1. The age in year is grouped taking interval of 10 years starting from 0-80 years. The youngest victim is 9 years old boy and the oldest is 74 year male. Highest victim of RTA found in the age group 21-40 years (55%) and minimum in both extreme group 0-10 and 70-80. (Table 1)

As per the information gathered from our study, the largest number of fatal road traffic accidents occurred during 8.00 A.M.-12.00 Noon and 20.00 -24.00 and lowest number of cases reported to occur during the period 00.01-4.00. But the fatal cases of RTA are occurred in between 11.30 P.M. to 3.30 A.M. because this period is considered as most dangerous period for driving any kind of vehicle. (Table 2)

In our study it is found that pedestrians 31.1% and vehicular occupants 68.9% involved in accidents. (Table 3)

In our study majority of victims did not use helmets (74%) and only (26%) using helmets (male and female both included). (Table 4) Majority of the victims met with head injury studied are riders (75%) followed by (15%) head injury of pillion riders and remaining have minor injuries in the other part of the body.

Regarding kind of injury, contusion of the scalp is most common. The laceration of the scalp is observed and noted in (20.5%) cases. Also similar findings are obtained for contusion (88.2%) and laceration (31.6%) to the membrane. As far as injury to the brain is

concerned, contusion is seen in (92.5%) case and laceration is only (30.5%) cases. (Table 5)

It is found that the variety of intracranial haemorrhage is subdural haemorrhage 95% followed by subarachnoid haemorrhage 90%, intra-cerebral and extradural haemorrhages are present in 15% and 8% of cases respectively, whereas intra-ventricular haemorrhage is found in 6% cases. It is found that 5% cases are of crushed fracture found in stem of brain, 4% are of depressed fracture and 2% cases are of cervical fracture. Interestingly, 5% cases of isolated intracranial haemorrhage are observed.

### **Discussion:**

There is a rapid rise in the number of the vehicular accidents in the present era in both rural and urban areas. Tremendous growth in the road transport sector as well as population explosion acts as catalyzing factors responsible for increasing number of accidents.

Since accidents are multi factorial in causation, so the inter-sectoral approach to both prevention of accidents and taking care of the injured persons are essential.

In our study it is found that pedestrians 31.1% and vehicular occupants 68.9% involved in accidents similar to other studies. [3-5, 10, 12] This reflects the ignorance of traffic rules and traffic signal, talking over the mobile phone, using ear phone and poor lighting of streets.

India has 2.2 % of vehicles in the world, but it accounts about 7% of the total cases of unintentional injuries. In the present study, males accounts 82.5% and females accounts 17.5% among all the total victims. [6]

Males being the breadwinner in majority of family are exposed more frequently to outside the home work rather than females.

This is only reason that there are maximum numbers of male victims who are either injured or dead rather than females. In our case the male to female ratio is 4.7:1.

Singh et al [10] showed that male to female ratio is 9: 1; Choudhary et al [11] showed that male to female ratio is 4.9:1. Arvind K. et al [12] reported that male to female ratio is 7.49:1.

A total of 187 cases of fatal road traffic accident belonging to all age groups and both sexes are under study. The victims of RTA are more between the age group of 21-40 years.

Least fatalities are observed in age group of 50-70 years and above it are about 2%, the main cause of this reduced number is due to more experience, more traffic sense, less tendency to take undue risks and some other non-desirable reasons. Our findings are in

general consistent almost with the number of fatalities reported by research workers. [7-9]

India is a developing country where poverty, illiteracy, unemployment, compel to more towards the urban area in search of employment, better medical facilities etc. In our study, we found that there is a significant relationship between place of accident and residence of the victims. It is observed that incidents are occurring more in the urban area rather than rural areas. Rash driving is also one of the reasons occurring more fatal road traffic accidents among youths.

Poor enforcement of traffic safety regulations, inadequacy of health facilities, alcohol intake, not wearing helmet, using mobile phone and ear phone etc. have contributed significantly to the rise in number of cases of traffic accident head injuries. It is noted that amongst the kinds of offending vehicles involved in RTA, Four wheeler (LMV's, HMV's) is observed to be the culprit. An increase in the number of heavy motor vehicles (government city buses and others) and congested narrow roads contribute to the rise in RTA.

Our study showed that Injury to two or more than two body regions such as head, legs, chest and spinal cords were found in majority of cases similar to other author's studies. [11]

### **Conclusion and Recommendations:**

With exploding population rise in number of registration of vehicles every month, rampant encroachment of roads, unusual tendency of violating rules and chaotic traffic system have greatly contributed much fastly in head injury due to RTA.

Fatal road accidents are the major cause of some serious injuries in some parts of body below the age of 40 years. Children below 16 years of age are involved in accidents injuries. In order to prevent such unusual happening majority of people should be educated about traffic rules.

The pedestrian and cyclists should be given proper an effective training and should also be encouraged to obey traffic rules.

From the present study it is found that males in the age group (21-40) years are suffering more from road accidents.

It is amounting more in accidents by two-wheeler occupants than any other vehicles. It is essential to do much more studies on RTA and strict implementation of the already existing traffic rules.

### **References:**

1. The Government of India, Ministry of Home Affairs, National Crime Record Bureau, Accidental deaths and suicides in India. 1999.



2. **Mukherjee J. B.** Forensic Medicine and Toxicology, p-390, Academic Publishers, Kolkata.
3. **Goyal Mukesh K, Kochar Shiv, Goel MR.** The correlation of Ct Scan (Head) vis a vis operative as well as Postmortem findings in cases of Head Trauma ( A prospective study). JIAFM, 2003; 25 (4), pp. 125-132.
4. **Pathak et al.** Profile of Road Traffic Accidents and Head Injury in Jaipur, JIAFM, 2007; 30 (1), pp. 6-9.
5. **Patel N. S.** Traffic fatalities in Lusaka, Zambia. Med. Sci. Law, 1979; 19 (3), pp. 186-193.
6. **Menon A. et al.** Pattern of Fatal Head Injuries due to vehicular accidents in Manipal. JIAFM, 2005; 27 (1), pp. 19-22.
7. **Bahera C., Rautji R., Lalwani S. and Dogra, T. D.** A comprehensive study of motorcycle fatalities in South Delhi. JIAFM 2009, 31 (1), pp. 6-10.
8. **Dandona R., Kumar G. A., Raj T.S., Dandona L.** Patterns of road traffic injuries in a vulnerable population in Hyderabad, India, Inj. Prev. 2006; 12 (3), pp. 183-188.
9. **Khajuria B., Sharma R. and Verma A.** A Profile of the autopsies of road traffic accident victim in Jammu. J clinc. Diag. Res. 2008; 86 (2) pp. 97-102.
10. **Singh H., Dhattarwal S. K.** Pattern and Distribution of injuries in fatal road accidents in Rohtak. JIAFM, 2004 26 (1), pp. 20-23.
11. **Choudhary B. L., Singh Deepak, Tirpudi B. H., Sharma R. K., Meel Veena.** Profile of Road Traffic Accidents cases in Kasturba Hospital of MGIMS, Sevagram, Wardha, Maharashtra, India, Medico Legal update, 2005, 5 (4). pp. 1-12.
12. **Arvind K., Sanjeev L., Deepak A., Rautji R., Dogra T.D.** Fatal road traffic accidents and their relationship with head injuries: An epidemiological survey of five years. Indian, J. Neurotrauma, 2008, 5 (2), pp. 63-67.

**Table 2: Time Slots of Accidents**

Time-Interval (Hrs.)	Victims	Percentage
00:01-4:00	10	5.3
4:01-8:00	15	8.0
8:01-12:00	74	39.6
12:01-16:00	20	10.7
16:01-20:00	25	13.3
20:01-24:00	43	23.0
Total	187	100.0

**Table 1: Age and Sex wise Distribution of RTA Victims**

Age-Group (Yrs)	Sex Distribution		
	Male	Female	Total
0-10	01	00	01
11-20	25	02	27
21-30	45	12	57
31-40	45	11	56
41-50	24	03	27
51-60	15	02	17
61-70	01	00	01
71-80	01	00	01
Total	157	30	187

**Table 3: Distribution of Type of Victim**

Type of Victim	Victim	Percentage
Pedestrians	58	31.1
Vehicular Occupants	129	68.9
Total	187	100.0

**Table 4: Use of Helmet and Persons Died**

Use of Helmet	RTA Victim (%)	Type of Person	Dead RTA Victim (%)
Yes	49(26)	Rider	06(3.2)
No	138(74)	Pillion	02(1.07)
Total	187(100)	Total	08(4.27)

**Table 5: Head Injury-Contusion and Laceration in Scalp, Brain and Membrane**

Type of Injuries	Scalp		Brain		Membrane	
	Present	Absent	Present	Absent	Present	Absent
Contusion	161 (86.1%)	26 (13.9)	173 (92.5%)	14 (7.5%)	165 (88.2%)	22 (11.8%)
Laceration	38 (20.5%)	149 (79.5%)	57 (30.5%)	130 (69.5%)	59 (31.6%)	128 (68.4%)

## Original Research Paper

# Determination of Sex from Index and Ring Finger Ratio in Neonates

<sup>1</sup>Manohar Shelake, <sup>2</sup>Nitin Ninal, <sup>3</sup>Rajesh Bardale, <sup>4</sup>Vaibhav Sonar

### Abstract

Determination of identity is one of the important concerns in forensic medicine, especially in neonatal age group. The purpose of present study is to evaluate sexual dimorphism of index and ring finger in neonates. The study was carried out on a cross sectional sample of 60 neonates out of which 30 were males and the remaining 30 were females. Data on age, sex and weight were collected. Statistically data was expressed as mean  $\pm$  Standard deviation ( $\pm$  SD). Descriptive statistics and Students'-test were used to analyze and determine the parameters studied in both male and female neonates. 2D:4D ratio was calculated on both hands of each individual. The relationship between the parameters studied was established using Pearson correlation to establish the strength of the relationship between the lengths of second and fourth digits (2D&4D), and the digit ratios. Statistical significance was accepted at P value less than 0.05 ( $P < 0.05$ ). The 2D:4D ratios were found higher in female neonates than male neonates and appear sexually dimorphic. The present study suggests that 2D:4D ratio of less than 0.93 suggests male neonate while a ratio of 0.93 or more suggests female neonate.

**Key Words:** Forensic, Identification, Neonate, Digit, Sex

### Introduction:

Determination of identity is one of the important concerns in Forensic Medicine, especially in neonatal age group. It assumes greater importance if the child is abandoned one or decomposed or mutilated one. Earlier studies have shown that index and ring finger ratio of hand exhibit sexual dimorphism. [1-8]

However, most of these studies were conducted in adult population or in adolescents or in children. [1-10] Very few studies were conducted in neonatal age group. [11-13] The purpose of present study is to evaluate sexual dimorphism of index and ring finger in neonates.

### Material and Methods:

The present prospective study consists of neonates in PNC ward of Government Medical College and Hospital, Miraj, District Sangli, Maharashtra. Only healthy full term neonates with normal delivery were selected.

The study was carried out on a cross sectional sample of 60 neonates out of which 30 were males and the remaining 30 were females. Data on age, sex and weight were collected.

The length of the second digits (2D) and fourth digits (4D) of the left and right hand of each subject were measured with the aid of rigid transparent plastic ruler with centimeter and millimeter markings.

The measurement was taken from the tip of the digit to the ventral proximal crease, where there was a band of crease at the base of the digit, the most proximal crease was used.

To spread out fingers for ease of measurement dorsum of hand was gently tapped. All aseptic precautions were taken before, during and after taking measurements while handling the babies. All measurements were made in centimeters to the nearest millimeter with digits fully extended. Consent of mother was taken and they were informed that the survey was completely voluntary.

Statistically data was expressed as mean  $\pm$  Standard deviation ( $\pm$  SD). Descriptive statistics and Students'-test were used to analyze and determine the parameters studied in both male and female neonates. 2D:4D ratio was calculated on both hands of each individual.

The relationship between the parameters studied was established using Pearson correlation to establish the strength of the relationship between the lengths of second

### Corresponding Author:

<sup>1</sup>Assistant Professor  
Dept. of Forensic Medicine  
Government Medical College and Hospital,  
Miraj – 416 410 Dist. Sangli (Maharashtra)  
E-mail: dr.manohar\_shelake@yahoo.co.in

<sup>2</sup>Assist. Prof

<sup>3&4</sup>Assoc. Prof

DOR: 10.04.2015 DOA: 15.08.2015

DOI: 10.5958/0974-0848.2015.00098.6

and fourth digits (2D&4D), and the digit ratios. Statistical significance was accepted at P value less than 0.05 ( $P < 0.05$ ). The sectioning point was calculated for sex differentiation from the index and ring finger ratios as – mean male ratio + mean female ratio  $\div$  2.

### Observations and Results:

The result of present study shows that the mean age of male neonate is 2.8 days while the mean age of female neonate population is 5 days. The mean weight of male neonates is 2.91 Kg while mean weight in female neonates is 2.83 Kg. It is observed that the index and ring finger shows significant difference between the lengths in both sexes ( $P < 0.05$ ).

The mean lengths of index and ring finger in male are 2.61 cm and 2.80 cm respectively in right hand and 2.60 cm and 2.80 cm in left hand respectively.

The mean lengths of index and ring finger in female are 2.61cm and 2.75 cm respectively in right hand and 2.62 cm and 2.78 cm in left hand respectively. (Table 1) In the present study no significant difference exists between the lengths of index and ring finger in right and left hand in both sexes. (Table 2)

In male, the mean difference between index and ring finger in right hand is  $0.19 \pm 0.11$  cm and in left hand it is  $0.19 \pm 0.09$  cm. In female, the mean difference between index and ring finger in right hand is  $0.16 \pm 0.10$  cm and in left hand it is  $0.16 \pm 0.11$  cm. (Table 3)

Statistically significant difference ( $p < 0.05$ ) between 2D:4D ratios in male and female are observed. (Table 4) In male, the mean 2D:4D ratio in right and left hand is 0.932 and 0.932 respectively while in female the mean 2D:4D ratio in right and left hand is 0.950 and 0.944 respectively. (Fig 1 and 2)

A sectioning point was calculated for the index and ring finger ratios (2D:4D) to differentiate between male and female neonates and the value is 0.93. A ratio of 0.93 or more is suggestive of female neonate while ratio less than 0.93 suggest male neonate. With this sectioning point we could predict 63.33% male neonate from right hand and 70% from left hand.

Similarly with a value of 0.93 or more we could predict 76.66% female neonates from right hand and 73.33% from left hand.

### Discussion:

Many times bodies are mutilated so badly that only pieces of body parts are recovered. Establishment of identity in such cases is big challenge. Nowadays various statistically approved methods and anthropological principles are implemented in

establishing the identity and for solving the medico-legal issues. Sophisticated techniques like DNA profiling are not always available at periphery or rural setup. Also their practical usefulness and implementation is largely uncertain in many cases for example in decomposed bodies or contaminated samples.

So, the methods which can be easily implemented without much technical difficulties would better serve the purpose. The present study was conducted with an aim to determine sexual dimorphism in neonates.

Manning et al had noted that females had longer second digits than fourth digits while males have longer fourth digits than second digits. [2] This difference was accounted for higher digit ratios in females than in males.

This sexual dimorphism in 2D: 4D ratio is apparent by 2 years of age and appears to be established early in life, by the 14th week of gestation. [11, 12, 14] The differences may be linked to the prenatal production of testosterone and oestradiol and in the case of testosterone, to interactions with the homeobox genes *Hoxa* and *Hoxd*, which control differentiation of the urogenital system and development of the digits. [4] Galis et al had noted a slight but significant sexual dimorphism in deceased human fetuses in the age group of 14 to 42 weeks.

On an average a ratio of 0.924 in females and 0.916 for males were noted. [11] Ventura et al studied the digit ratio in 106 newborns and noted that males had lower mean 2D:4D ratios than females but this dimorphism was significant only for the left hand. [13]

The findings of the present study are in agreement with these studies. We had noted slight but significant sexual dimorphism in male and female neonates. In male neonates, the mean 2D:4D ratio in right and left hand is 0.932 and 0.932 respectively while in female neonate the mean 2D:4D ratio in right and left hand is 0.950 and 0.944 respectively.

The data of present study confirms sexual dimorphism at birth and confirms the findings of previous studies. [11, 13] However, considering the studies conducted in adults, the ratio for sexual dimorphism is less and this was also noted in previous studies conducted by Galis et al and Ventura et al. [11,13] The probable reason could be that, in addition to prenatal exposure, postnatal androgen exposure would be influential for the accentuation of dimorphism and subsequent stabilization of 2D:4D ratio.

In a longitudinal study of Jamaican children conducted by Trivers et al it was noted that a slight but significant increase in the 2D:4D ratios for boys and girls from 7-13 to 11-17 years

of age four years later, with a high correlation between the measurements on the same individuals suggesting that 2D:4D ratios slowly increases in a stable manner during childhood. [15] Previous studies conducted on children, adolescents and adults also exhibit the increasing difference of ratio as per advancing age. [7-10, 13, 15]

### Conclusion:

In conclusion, it was observed that lengths of second and fourth digits in female neonates were approximately same or was like that of male neonates. The 2D:4D ratios were found higher in female neonates than male neonates and appear sexually dimorphic.

The present study suggests that 2D:4D ratio of less than 0.93 suggests male neonate while a ratio of 0.93 or more suggests female neonate. The findings of present study can be utilized to establish sex especially in circumstances where body is mutilated or only remains are brought for medical examination.

### References:

1. Ibegbu AO, Danjuma ZC, Hamman WO, Umana UE, Ikembe DT, Musa SA. Anthropometric study of the index (2<sup>nd</sup>) and ring (4<sup>th</sup>) digits in Ebira ethnic group of Nigeria. Asian J Med Sci 2012; 4:79-84.
2. Manning JT, Barley L, Walton J. The 2nd:4th digit ratio, sexual dimorphism, population differences and reproductive success: Evidence for sexually antagonistic genes? Evol Hum Behav 2000; 21: 163-83.
3. McFadden D, Loehlin JC, Breedlove SM, Lippa RA, Manning JT, Rahman Q. A reanalysis of five studies on sexual orientation and the relative length of the 2nd and 4th fingers (the 2D:4Dratio). Arch Sex Behav 2005; 34:341-56.
4. Gillam L, McDonald R, Ebling FJP, Mayhew TM. Human 2D (index) and 4D (ring) finger lengths and ratios: cross-sectional data on linear growth patterns, sexual dimorphism and lateral asymmetry from 4 to 60 years of age. J Anat. 2008;213:325-35
5. Manning JT, Stewart A, Bundred PE, Trivers RL. Sex and ethnic differences in 2nd to 4th digit ratio of children. Early Hum Dev. 2004; 80:161-168.
6. Churchill ATG, Manning JT, Peters M. The effect of the sex, ethnicity and sexual orientation on self-measured digit ratio (2D:4D). Arch Sex Behav 2007; 36: 251-60.
7. Kanchan T, Kumar GP, Menezes RG. Index and ring finger ratio – a new sex determinant in south Indian population. Forensic Sci. Int. 2008;181:53e1-e4
8. Dahodwala TM, Bardale RV, Sonar VD. Determination of Sex from Index and Ring Finger Ratio. Indian J Forensic Med Pathol 2013; 6:47-51.
9. Kanchan T, Kumar GP. Index and ring finger ratio – a morphologic sex determinant in South Indian children. Forensic Sci. Med Pathol 2010;6:255-60
10. Kanchan T, Kumar GP, Menezes RG, Rastogi P, Rao PP, Menon A et al. Sexual dimorphism of the index to ring finger ratio in South Indian adolescents. J Forensic Leg Med 2010;17:243-6
11. Galis F, Broek TCMA, Van Dongen S, Wijnaendts LCD. Sexual Dimorphism in the prenatal digit ratio (2D:4D). Arch Sex Behav. 2010; 39:57-62
12. Malas MA, Dogan S, Evcil EH, Desdicoglu K. Fetal development of the hand, digits and digits ratio (2D:4D). Early Hum Dev. 2006; 82, 469-75.
13. Ventura T. Gomes MC, Pita A, Neto MT, Taylor A. Digit ratio (2D:4D) in newborns: influences of prenatal testosterone and maternal environment. Early Hum Dev. 2013; 89:107-12.
14. Manning JT, Scutt D, Wilson J, Lewis-Jones DI. The ratio of 2nd to 4th digit length: A predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. Hum Reprod 1998; 13: 3000-04.
15. Trivers R, Manning J, Jacobson A. A longitudinal study of digit ratio (2D:4D) and other finger ratios in Jamaican children. Hormones and behavior 2006; 49:150-6.

**Table 3: Difference between Male and Female Index and Ring Fingers (cm)**

Parameters	Male	Female
	Mean $\pm$ SD	Mean $\pm$ SD
R2D – R4D	0.19 $\pm$ 0.11	0.16 $\pm$ 0.10
L2D – L4D	0.19 $\pm$ 0.09	0.16 $\pm$ 0.11

**Table 1: Descriptive Statistics of Male and Female Index and Ring Finger Measurements (cm)**

Sex	Parameters	Min	Max	Mean	SEM	SD	Significance
Male (n = 30)	R2D	2.2	2.9	2.61	0.0354	0.194	P < 0.05
	R4D	2.4	3.2	2.80	0.0368	0.202	
	L2D	2.2	2.9	2.60	0.0328	0.180	P < 0.05
	L4D	2.4	3.1	2.80	0.0380	0.208	
Female (n = 30)	R2D	2.3	2.9	2.61	0.0278	0.153	P < 0.05
	R4D	2.4	3	2.75	0.0290	0.159	
	L2D	2.4	2.9	2.62	0.0238	0.130	P < 0.05

**Table 2: Measurements of Index and Ring Fingers in Male and Female Neonates (cm)**

Measures	Right Index Finger		Right Ring Finger		Left Index Finger		Left Ring Finger	
	Male	Female	Male	Female	Male	Female	Male	Female
Minimum	2.20	2.3	2.4	2.4	2.2	2.4	2.4	2.4
Maximum	2.9	2.9	3.2	3	2.9	3.1	2.9	2.9
Mean	2.61	2.61	2.80	2.75	2.60	2.80	2.78	2.78
SD	0.19	0.15	0.20	0.16	0.18	0.20	0.13	0.13

**Table 4: Ratios of Index and Ring Fingers in Male and Female Neonates**

Sex	Parameters	Min	Max	Mean	Median	SD	CV**	CD**	Correlation
Male (n =30)	D2:D4 ratio right	0.857	1	0.932	0.927	0.038	4.1%	0.031	0.843
	D2:D4 ratio left	0.871	1	0.932	0.930	0.030	3.2%	0.023	0.901
Female (n=30)	D2:D4 ratio right	0.889	1.080	0.950	0.931	0.046	4.9%	0.037	0.680
	D2:D4 ratio left	0.893	1.038	0.944	0.930	0.041	4.4%	0.035	0.607

\* CV- Coefficient of Variation \*\*CD- Coefficient of Dispersion

## Original Research Paper

# Pattern of Mechanical Injuries of Fatal Interpersonal Violence Cases in a Tertiary Care Centre

<sup>1</sup>Niraj Kumar, <sup>2</sup>Arun Kumar Singh, <sup>3</sup>R. K. P. Singh

### Abstract

For every person who dies as a result of violence, many more are injured and suffer from a range of physical, sexual, reproductive and mental health problems. Violence places a massive burden on national economies, costing countries billions of money expenditure each year in health care, law enforcement and lost productivity. In India the share of violent crimes in total crimes was 10.9% during 2009-2010, 11.0% in 2011, 11.5% in 2012 and 11.3 % (total 3, 00, 357) in 2013 respectively. The present prospective study on Interpersonal Violence cases was conducted in the Department of Forensic Medicine and Toxicology, Patna Medical College and Hospital Patna from September, 2008-2010 on 80 cases. The primary aim of present study is to find out Pattern of fatalities after death in the region due to violence affecting human body. Our study showed that maximum number of injury was seen on upper limb 86.25%, but maximum number of death was due to injury to head and neck 75%. Abrasion 92.5% was the most common type of external injury followed by contusion 56.25%, skull fractures 51.25% and firearm injuries 8.75%.

**Key Words:** Violent crimes, Homicide, Injury Pattern, Head Injury

### Introduction:

WHO defines violence as follows: "The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, mal-development, or deprivation". [1]

More than 1.3 million people worldwide die each year as a result of violence in all its forms i.e. self-directed, IPV (Interpersonal) and collective, accounting for 2.5% of global mortality. For people aged 15–44 years, violence is the fourth leading cause of death worldwide. [11,12] IPV disproportionately affects Low and Middle Income Countries (LMICs). The WHO report on violence and health estimates that more than 90% of all violence-related deaths occur in LMICs.

The estimated rate of violent death in LMICs was 32.1 per 100,000 people in year 2000, compared with 14.4 per 100,000 in high-income countries. [9] Violence directly affects health care expenditures worldwide.

Indirectly, violence has a negative effect on national and local economies-stunting economic development, increasing economic inequality, eroding human and social capital, and increasing law enforcement expenditures. [14]

Studies show a strong, inverse relationship between homicide rates and both economic development and economic equality.

Poorer countries, especially those with large gaps between the rich and the poor, tend to have higher rates of homicide than wealthier countries. [5] The South-East Asia and Western Pacific Regions account for the highest number of injury deaths worldwide.

As per the NCRB report of 2013, the share of violent crimes affecting human body shows a rising trend from year 2009 to 2013. All India 'incidence' of violent crimes affecting human body increased from 107580 to 145542 while 'rate' increased from 9.2 to 11.9. [2]

According to report, among all IPC Crimes, crime rate for violent crimes in Bihar in year 2013 was 30 against national average of 24.4 and in state wise violent crime rank; Bihar attained 11<sup>th</sup> rank whilst highest violent crime rate was reported in Delhi. [2]

### Corresponding Author:

<sup>1</sup>Assistant Professor,  
Department of Forensic Medicine,  
VCSGMS & RI Srinagar,  
Pauri Garhwal, Uttarakhand, 246174  
E-mail: K\_niraj77@yahoo.co.in

<sup>2</sup>Prof, Dept. of FMT

Patna Medical College and Hospital, Patna

<sup>3</sup>Prof &HOD, Dept. of FMT

Patna Medical College and Hospital, Patna

DOR: 13.04.2015 DOA: 17.08.2015

DOI: 10.5958/0974-0848.2015.00099.8

Overall IPC crime rate in Patna in year 2013 was 702.8 while Bihar average was 166.3. In Patna alone total 317 murder cases reported out of total 3403 cases from Bihar in year 2014. [3] If we are to envision a less violent world, we must first understand how violent the world is.

In 1996, the World Health assembly declared violence a leading global public health problem. [1]

### **Material and Method:**

The present prospective study was conducted in the Department of Forensic Medicine Patna Medical College and Hospital, Patna during the period from September 2008 to September 2010, a period of two years.

All the cases brought to the Department for medico-legal autopsy with alleged history of IPV and also the cases which later registered as IPV cases were studied and cases subjected for autopsy with alleged history of IPV but which were later registered as non-homicidal based on the autopsy findings, circumstantial evidence and investigation by the police were excluded.

Ethical clearance was obtained. Detailed information regarding the circumstances of crime was sought from the police, victim's relatives and friends, visits to the scene of occurrence or deduced by the photographs of the scene of occurrence. Post-mortem examination of the case was carried out as per the standards.

Descriptive statistics for qualitative type of data was summarized using frequency and percentage along with 95% confidence interval.

### **Results:**

Total 5121 Post-mortems was done during the study period, out of which total number of injury cases was 721(14.07% of total autopsy) and IPV cases amounts 92 (1.79%).

A total of 80 IPV cases were selected for study excluding cases with incomplete data.

It was observed that maximum number of injury were seen on upper limb 77.5% (n=62), but maximum number of death were due to injury to head and neck 75%. Most of the external injuries over head were contusion, lacerated wounds by hard and blunt force followed by chop and incised wounds by sharp cutting weapons.

Lower limb, Thorax and Abdominal region accounted for rest of the most injuries. (Graph 1) In the present study abrasion 92.5% (74) was the most common type of external injury. Contusion, laceration, fracture/dislocation and skull fracture, each type of injury was found in almost half of the total case. In almost all cases with fracture skull 58.75%, intracranial injuries were main cause of death. (Table 1)

Maximum contusions were present on limbs followed by head-neck, thorax, and abdomen. Maximum lacerations were present on head-neck followed by limbs and equally on thorax and abdomen.

Maximum abrasions were present on limbs followed by head- neck, thorax and abdomen. In our study out of all Intracranial injury (58) cases most common pattern of intracranial hemorrhage was combination of Subdural and Subarachnoid hemorrhages 33.75%. It was followed by combination of Subdural, Extradural and Subarachnoid hemorrhages 17.5%.

In most cases of head injuries all three structures were involved i.e. scalp, skull and brain. Fracture skull was present in 58.75% (47) cases, while brain injuries were found in 30% (24) cases. (Table 2)

Among 47 cases of skull fracture most common fracture seen was linear 51.06% followed by 36.17% cases of comminuted fracture. But no cranial fracture was found in 36.17% cases of intracranial injuries. Firearm fractures 14.89% cases included fracture in cranium due to entry and exit wounds. (Table 3)

In the present study, it was observed that defense wounds were present in 43.75% victims while it was absent in the majority of 56.25% cases. (Graph 2)

This study showed that maximum cases had internal injury in head neck followed by thorax, abdomen and limb. Two cases had no any internal injury.

### **Discussion:**

In this study there was considerable overlap of different type of injuries in different areas of body, hence we have calculated percentage for each injury type from total number of cases. In our study slightly more number of injuries were seen on upper limb 77.5% (n=62) than injury to head and neck 75% (60), but maximum number of death were due to injury to head and neck. This was in accordance with study conducted by Carmo et al who observed that upper limbs were most frequent injury location. [6]

In a large study Waldis et al found that with the mean age of 30 years, craniofacial injury (72%) was the most common type of injury followed by Injuries to extremities. [14] In a study of the burden of intentional injuries in Mwanza City by Phillippo and Japhet the head/neck and upper limbs were the most common body regions affected in 49.2% and 43.3% respectively. [13]

According to Adelson [4] dominance of head injuries is because the head is the target of choice in the great majority of assaults involving blunt trauma. When the victim is pushed or knocked to the ground, he often strikes his head and the brain and its coverings are vulnerable degrees of blunt trauma that would rarely be lethal if applied to other areas.

The injuries in multiple region of body suggest the degree of anger, aggressive and intention of the assailant to kill their victim. Abrasion being the most common, combination of each type of injuries Contusion, laceration, fracture/dislocation and skull fracture was found in almost half of the total cases.

Carmo noted similar finding of abrasion being most common injury. [6] Burnett in his article on Domestic Violence Clinical Presentation, mention that blunt force trauma to the skin includes the most common injury, contusion, as well as abrasions and lacerations, and Pattern injuries suggest violence by different weapons. [10]

It was observed in our study that the chances of fatality following head injury are greater when multiple cranial bones are involved. Overall in 58.75% cases cranial fracture was detected. This also pointed toward intention that most common area of target was the head.

Study of cranial and intracranial injuries showed that most common pattern was combination of Subdural and Subarachnoid hemorrhages followed by combination of Subdural, Extradural and Subarachnoid hemorrhages. In most of the intracranial injuries all three head structures, i.e. scalp, skull and intracranial structure were involved.

A similar trend has also been observed by various studies. [7, 8] This indicates that the use of strength by the assailants was maximum during the material moment to make sureness of the death of the victims.

Most common skull fracture seen was linear 41.38% followed by 29.31% cases of comminuted fracture among intracranial injuries. But no cranial fracture was found in 29.31% cases. Also, bleeding from ear, Nose and mouth was present in 11%, of cases.

Characteristic injuries bilateral injuries, especially to the extremities, back & eyes, injuries at multiple sites Fingernail scratches, cigarette burns, rope burns Abrasions, minor lacerations, welts, Black eye with or without sub-conjunctival hemorrhage suggests a vigorous struggle between victim and assailant.

Very little information about the extent and nature of injuries in homicides is available from any national crime data set. It is known to researchers that how statistics and data from thousands of homicide cases each year is useful in assisting law enforcement, criminal justice system and public policy making.

Much more research is needed for understanding of how these lethal criminal incidents occur and to enhance the likelihood of apprehending the perpetrators of crimes.

### Conclusion:

Violence and crime is an integral part of the society from the primitive era. In the context of evolving the societal response to the violence and crime in society, formulating data driven policy making and evolving effective intervention strategies and for undertaking actionable and policy-oriented research by the people related with criminal and justice system, administrators and academia, a vast amount of data on various aspects of crime is required.

Patna, from where most of the cases examined for the present study, leads the other cities in violence and crime data in State of Bihar but unfortunately there is very little information and research done about nature and extent of injuries in Interpersonal violence cases.

According to present study our findings are in agreement with records available from different sources for crime in this area.

The strategies to control homicide rates should focus on the individuals and their living context or the social circumstances in which it occur. Development, employment generation, awareness campaign against alcohol and substance abuse, political stability in State, political solution to insurgent problem and improve in law and order situation may reduce Interpersonal Violence related Deaths significantly.

Imparting high moral values especially in young male population and discouraging violence culture in every forum will go long way in controlling crime in the society.

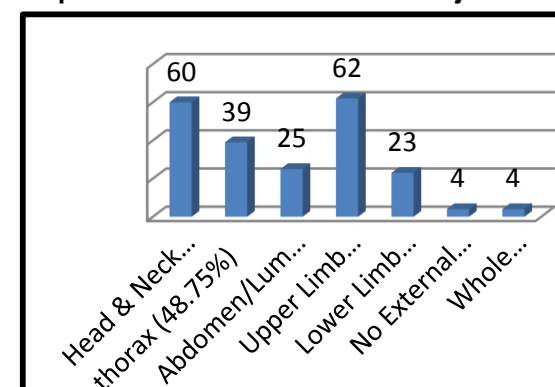
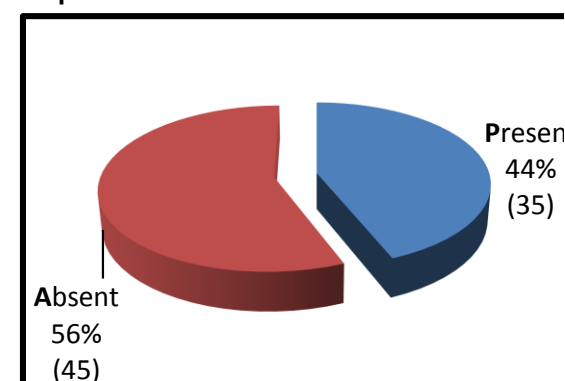
### References:

1. World Health Assembly Resolution WHA49.25 Prevention of violence: a public health priority. World Health Organization, Forty-Ninth World Health Assembly, 1996 Geneva.
2. Crime in India 2013 Compendium. Crime data, National Crime Records Bureau, Ministry of Home Affairs, Government of India, New Delhi.
3. Crime statistics. (2015). Retrieved from Bihar Police: <http://biharpolice.bih.nic.in/>
4. L. Adelson. Homicide by blunt violence. In, The pathology of homicide, 1<sup>st</sup> ed. Springfield: Charles C Thomas.
5. Butchart A., Engstrom K. Sex and Age Specific Effects of Economic Development and Inequality on Homicide Rates in 0 to 24 Year Olds: A Cross-Sectional Analysis. 2002 Pubmed, Bulletin of the World Health Organization 80; P. 797-805.

6. Carmo R., Grams A., Magalhaes T. Men as victims of intimate partner violence. 2011 Journal of Forensic and Legal Medicine, 18; P.355-9.
7. Chattopadhyay S., Tripathi C. B. Skull fracture and haemorrhage Pattern among fatal and nonfatal head injury assault victims a critical analysis. 2010. Journal of Injury and Violence Research, 2(2).
8. Dixit P. C., Dogra T. D., Chandra, J. Comprehensive study of Homicides in South Delhi 1969-1979. 1986 Med. Science and Law, 26(3), P. 230-234.
9. Etienne G. K., Linda L. D. Violence: A Global Public Health Problem. In G. K. Etienne, L. D. Linda, A. M. James, B. Z. Anthony, & L. Rafael (Eds.), World Report on Violence and Health 2002 (p. 1-21). Geneva: World Health Organization.
10. Lynn B. B., Jonathan A. Retrieved April Friday, 10, 2015, from Medscape: <http://emedicine.medscape.com/article/805546-clinical#a0217>
11. WHO Global status report on violence prevention 2014. Retrieved April 10, 2014, from World Health Organization: <http://www.who.int/topics/violence/en/>
12. WHO Global status report on violence prevention 2014. Prevention and control, Geneva.
13. Phillip L. C., Japhet, M. G. The burden of intentional injuries in Mwanza City, north-western Tanzania: 2012 Tanzania Journal of Health Research, 14(3).
14. Waters H., Hyder A., Rajkotia Y., Basu, S., Butchart A. The Economic Dimensions of Interpersonal Violence. 2004 World Health Organization, Injuries and Violence Prevention, Geneva.
15. Wladis A., Bostrom L., Nilson B. (1999). Unarmed violence-related injuries requiring hospitalization in Sweden from 1987 to 1994. 1999 J Trauma, 47; P. 733-7.

**Table 1: Type of External Injuries**

External Injury type	Cases	Out of total IPV cases (%)
Abrasion	74	92.5
Contusion	45	56.25
Laceration	33	41.35
Fracture/ dislocation	34	42.5
Fracture skull	47	58.75
Sharp cut & stab	12	15%
Fire arm injuries	7	8.75%

**Graph 1: Distribution of External Injuries****Graph 2: Defence Wound****Table 2: Type of Intracranial Injuries**

Type of Intracranial Injuries	Cases	Out of total IPV cases (%)	Out of total Intracranial Injuries cases (%)
EDH	2	2.50	3.45
SDH	4	5	6.90
SAH	5	6.25	8.62
EDH + SAH	4	5	6.90
SDH + SAH	27	33.75	46.55
EDH + SDH + SAH	14	17.50	24.14
Brain injuries	24	30	41.38
Fracture skull	47	58.75	81.03
Total Intracranial injuries cases	58	72.5	100

**Table 3: Type of Skull Fracture**

Type of Skull Fracture	Cases	Out of total Intracranial Injuries cases (N=58) (%)	Out of Total Skull Fracture cases (N=47) (%)
Linear Fracture	24	41.38	51.06
Basilar Fracture	4	6.90	8.51
Comminuted Fracture	17	29.31	36.17
Depressed Fracture	4	6.90	8.51
Firearm Fracture	7	12.07	14.89
Crush Fracture	0	0	0
No Fracture	17	29.31	36.17
Total skull Fracture	47	81.03	100



## Original Research Paper

# Trauma to Spleen: A Marker to Assess the Prognosis In Blunt Trauma to Abdomen Cases

<sup>1</sup>Mohd. Asrarul Haque, <sup>2</sup>Munawwar Husain, <sup>3</sup>S. Hasan Harris, <sup>4</sup>Jawed A. Usmani

### Abstract

It has been reported that the emergency section of Jawaharlal Nehru Medical College Hospital, Aligarh is predominantly occupied by trauma cases (85-90%) out of 100 attending per day. 40-50 patients come as a result of assault and Road Traffic Accident (RTA). This study is primarily based on Blunt Trauma to Abdomen and seeking answers to morbidity and mortality arising out of intra-abdominal splenic injury. Amazingly, before the start of the project, the authors unfailingly assumed that splenic injury carries higher risk of mortality irrespective of grading of injury to the organs.

Our study have demonstrated that out of our series of victims (n=250), 97 cases sustained splenic injury of various grading, and a single mortality was reported. Splenic injury was also involved along with injuries of other organs in the following decreasing sequence. However to make the study more precise the authors have focused research on splenic trauma scale to mortality and morbidity.

**Key Words:** Splenic injury, Blunt trauma abdomen (BTA), Assault, RTA

### Introduction:

The emergency Department of J. N. Medical College, AMU, Aligarh, India, is an extremely vibrant section since it receive about 100 – 150 patients per day and cater to the population of about 6 lakhs.

Out of these 100 cases, 10-15 are from the medicine and allied specialties and 85-90% patients per day occupy the notoriety of surgical/orthopedic involvement. Ironically out of these number 40-50 patients comes as a result of assault and road traffic accidents.

Our aim and objective to pursue this study was derived from the fact that in Blunt Trauma Abdomen (BTA), involvement of spleen was maximum ultimately leading to quick death or near quick death. [1]

The finding of our study extending a period of three years has revealed remarkable findings. Diagnostic techniques like USG, CT and MRI contributed vastly to this study.

A case has been reported in which sub capsular haemorrhage of spleen took place from a fall of 3-4 feet [2] which is indicative of vulnerability of spleen from a minor blunt trauma.

### Materials and Methods:

The study spanned a period of 3 years i.e. Jan 2011 to Dec 2013. All those patients who sustained blunt injury abdomen due to a variety of causes and reporting at the emergency section of J. N. Medical College, Aligarh, formed subjects for study taking due consideration in terms of consent and voluntariness. A total of 250 patients formed the study material, out of which 97 has sustained splenic injury alone. Rest 153 suffered injuries to other organs too.

Since our study focused exclusively on splenic injury, therefore 97 cases were segregated from 250 and detailed analysis was conducted on these cases only. No exclusion was done on the basis of relative age, sex, occupation, sports etc.

The trauma score follows the splenic injury scale (1994 revision). (Table A)

### Result and Discussion:

It is evident from our study that out of total 97 cases the maximum number of cases of splenic injury fall in 11-20 years (29.9%); 21-30 years (23.7 %); and 31-40 years (16.5%), age groups respectively. (Table 1)

The 11-20 years period is considered as adolescent and early adulthood; hence it carries

### Corresponding Author:

<sup>1</sup>Junior Resident III

Dept. of Forensic Medicine

J N Medical College

Aligarh Muslim University, Aligarh 202 002

E-mail: asrar428@gmail.com

<sup>2</sup>Prof, Dept. of Forensic Medicine

<sup>3</sup>Assoc. Prof, Dept. of Surgery

<sup>4</sup>Prof & Chairman, Dept. of Forensic Medicine

DOR: 24.02.2015 DOA: 10.08.2015

DOI: 10.5958/0974-0848.2015.00100.1

the risk of injuries attributable to fast pace of life and less toleration. [4]

**Table A: Spleen Injury Scale (1994 Revision)**

Grade*	Injury type	Description of injury	ICD-9	AIS-90
I	Hematoma	Sub-capsular, <10% surface area	865.01	2
	Laceration	Capsular tear, <1cm	865.02	2
		parenchymal depth	865.12	2
II	Hematoma	Sub-capsular, 10%-50% surface area	865.01	
		Intraparenchymal, <5 cm in diameter	865.11	
				2
	Laceration	Capsular tear, 1-3cm parenchymal depth that does not involve a trabecular vessel	865.02	
			865.12	
				3
III	Hematoma	Sub-capsular, >50% surface area or expanding; ruptured		
		Sub-capsular or parenchymal hematoma; intraparenchymal hematoma $\geq$ 5 cm or expanding		
	Laceration	>3 cm parenchymal depth or involving trabecular vessels	865.03	3
IV			865.13	
	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)		4
V	Laceration	Completely shattered spleen	865.04	5
	Vascular	Hilar vascular injury with devascularizes spleen	865.14	5

\*Advance one grade for multiple injuries up to grade III. \*\*AIS= Abbreviated Injury Scale Moore et al<sup>3</sup>.

Present study showed that the primary mode of injury was RTA (52.57%), males involved in 44 and females in 7 cases. Fall from height constituted 29.9% of cases, (males 20 and females 9). Assault cases constituted 15.46%. In female category assault always took place by males. No case was detected of female assaulting female in our series of study.

The last to occupy this space was fall of heavy object on to the victim (2.1%), in males' 2 and no case in female. (Table 2)

Thus it was evident that RTA is the most common mode of splenic injury. Our findings are in consistent with other studies. [5, 6]

Regarding the vehicle, largest number of cases of RTA was caused by motorcycle (45.1%) followed by light motors (23.5%), other (21.6%), heavy motors (7.8%), unknown (1.9%) in this study. (Table 3)

The maximum cases of injured victims belongs to the motor cyclists (52.9%) followed by light motor vehicle occupants (21.6%), pedestrians (19.6%) and heavy motor occupants (5.9%) respectively. (Table 4) These findings were similar to other author's studies. [7, 8]

In this study the objects of offense used to cause splenic injury were stick or any other blunt object in maximum cases (73.33%) of assaults followed by direct kick to abdomen in 26.67% cases. (Table 5) Fata P el I study also showed similar results. [9]

In this study it was noted that 48(49.5%) cases had grade-II (Fig. 1), followed by 25(25.8%) with grade-I, 18(18.5%) with grade-III, zero grade IV and 6 (6.2%) grade V splenic injuries. (Table 6) (Fig. 2, 3) It was observed that total number of cases in grade II and grade III was significantly higher.

Male and female ratio in each grade: Grade I males 21 females 4; grade II males 34 females 14; grade III males 13 female 5; grade V males 4 females 2.

In present study Average duration of stay in the hospital of grade I, grade II and grade III victims (91 cases) of splenic injury was 8.9 days. Average length of stay in the hospital of grade V splenic injury victims was 19.2 days.

Out of six cases of grade V splenic injury only single mortality was seen. [11-17]

### Conclusion and Summary:

Based on this study, authors conclude that proper evolution and management can prove vital for successful outcome of the patients with blunt splenic injury.

Blunt trauma to abdomen involving spleen was most common in males, predominantly occurred in second decade of life. Main mode of injury was RTA followed by fall from height and physical assault. Grade II splenic injury was most common and mortality was reduced to one.

### References:

1. Pachter HL, Guth AA, Hofstetter SR, Spencer FC. Changing patterns in the management of splenic trauma. *Ann Surg*. 1998; 227: 708-719.
2. Haque MA, Husain M, Usmani JA. Injury to spleen after fall from height in an unusual posture. *JIAFM*; 2014, 36 (2): 213-14. ISSN 0971-0973
3. Moore EE, Cogbill TH, Malangoni M, Jurkovich GJ, Champion HR. Scaling system for organ specific injuries. Trauma score, The American Association for the Surgery of Trauma. Accessed on 13rd Feb. 2015 at <http://www.aast.org/library/traumatools/injuryscoringscales.aspx#>
4. Saurabh G, Kumar S, Gupta A, Mishra B, Sagar S, Singhal M, Khan RN, Misra MC. Splenic trauma - our experience at a level I Trauma Center. *Turkish Journal of Trauma & Emergency Surgery*. 2011; 17 (3):238-242.
5. Yao T, Rong J, Liang M, Sun J, Xuan F, Zhao L, Wang X, Li F, Wang G, Han Y. Emergency treatment of splenic injury in a novel

mobile minimally invasive interventional shelter following disaster: a feasibility study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*. 2014; 22: 44. Available at <http://www.sjtem.com/content/22/1/44>

6. Peitzman AB, Heil B, Rivera L, et al. Blunt splenic injury in adults: multi-institutional Study of the Eastern Association for the Surgery of Trauma. *J Trauma*. 2000; 49: 187-189.
7. Gaunt WT, McCarthy MC, Lambert CS, et al. Traditional criteria for observation of splenic trauma should be challenged. *Am. Surg.* 1999; 65: 689-691.
8. Willmann JK, Roos JE, Platz A, et al. Multi-detector CT: detection of active hemorrhage in patients with blunt abdominal trauma. *AJR Am J Roentgenol*. 2002; 179: 437-444.
9. Fata P, Robinson L, Fakhry SM. A survey of EAST member practices in blunt splenic injury: a description of current trends and opportunities for improvement. *J Trauma*. 2005; 59: 836-841.
10. Shapiro MJ, Krausz C, Durham RM, et al. Overuse of splenic scoring and computed tomographic scans. *J Trauma*. 1999; 47: 651-658.
11. Velmahos GC, Zacharias N, Emhoff TA, et al. Management of the most severely injured spleen. *Arch Surg*. 2010; 145: 456-460.
12. Rajani RR, Claridge JA, Yowler CJ, et al. Improved outcome of adult splenic injury: a cohort analysis. *Surgery*. 2006; 140: 626-632.
13. Izu BS, Ryan M, Markert RJ, et al. Impact of splenic injury guidelines on hospital stay and charges in patients with isolated splenic injury. *Surgery*. 2009; 146: 787-791.
14. Savage SA, Zarzaur BL, Magnotti LJ, et al. The evolution of blunt splenic injury: resolution and progression. *J Trauma*. 2008; 64: 1085-1092.
15. Forsythe RM, Harbrecht BG, Peitzman AB. Blunt splenic trauma. *Scand. J Surg*. 2006; 95:146-51.
16. Mirvis SE, Whitley NO, Gens DR. Blunt splenic trauma in adults: CT-based classification and correlation with prognosis and treatment. *Radiology*. 1989; 171:33-9.
17. Iribhogbe P. Is Splenic Preservation after Blunt Splenic Injury Possible in Africa? [Last cited on 2011 Jan 11]. Available from: [http://www.ptolemy.ca/members/archives/2005/Splenic\\_Preservation\\_Africa\\_Sept\\_2005.pdf](http://www.ptolemy.ca/members/archives/2005/Splenic_Preservation_Africa_Sept_2005.pdf)

**Table 1: Age & Sex wise Distribution**

Age Grps (Yrs)	Total Cases (n=97)	Male	Female
0-10	14 (14.4%)	10	4
11-20	29 (29.9%)	24	5
21-30	23 (23.7%)	19	4
31-40	16 (16.5%)	11	5
41-50	10 (10.3%)	6	4
51-60	3 (3.1%)	1	2
61-70	2 (2.1%)	1	1

**Table 2: Mode of Injuries**

Mode of injury	Cases (n=97)	Male	Female
RTA	51 (52.58%)	44	7
FFH	29 (29.9%)	20	9
Assault	15 (15.46%)	6	9
Fall of heavy object	2 (2.1%)	2	0

**Table 3: Types of Offending Vehicle causing RTA**

Offending vehicle	Cases (n=51)
Heavy motors	4 (7.8%)
Light motors	12 (23.5%)
Motorcycle	23 (45.1%)
Other	11 (21.6%)
Unknown	1 (1.9%)

**Table 4: Types of Victim**

Types of Victim	Cases (n=51)
Pedestrians	10 (19.6%)
Motorcyclist	27 (52.9%)
Light motor vehicle occupant	11 (21.6%)
Heavy motor vehicle occupant	03 (5.9%)

**Table 5: Mode of Assault**

Mode of assault	Cases (n=15)
Assault with stick/ lathis/ other blunt object	11 (73.33%)
Direct blow/ kick to abdomen	4 (26.67%)

**Table 6: Grading of Splenic Injury**

Grade of splenic injury	Cases (n=97)
Grade I	25 (25.8%)
Grade II	48 (49.5%)
Grade III	18 (18.5%)
Grade IV	0 (0%)
Grade V	6 (6.2%)

**Fig. 1: Scanned Diagram of Splenic Injury Grade II on CT scan**



**Fig. 2: Splenic Injury Grade V (Picture Taken Post Splenectomy)**



**Fig. 3: Scanned Diagram of Splenic Injury Grade V on CT scan**



## Original Research Paper

# Estimation of Stature from Radiological Measurement of Sternal Length with Corroboration in Living Individuals A Study in Contemporary Bengali Adults

<sup>1</sup>Soumeek Chowdhuri, <sup>2</sup>Parthapratim Mukhopadhyay

### Abstract

The role of Forensic anthropology to derive alternative and newer modes of identification is increasing every day. The simple and inexpensive means of measurement of radiological length of sternum from digital radiographs and its use to estimate stature in a contemporary Indian (Bengali) population is the aim of this study. By generation of linear regression equations for male and female from this data we propose to estimate the stature and compare the same from the stature available from measurement of the individuals. Thus we shall be able to predict the accuracy with which such projection from radiological assessment is applicable. In this study the standard error of estimate for the male model is 2.943 and correlation coefficient is 0.636. The r square for the model is 0.4. In this study the standard error of estimate for the female model is 2.230 and correlation coefficient is 0.843. R square = 0.7.

The present investigation shows that estimation of stature by this method has its shortcomings in terms of accuracy and therefore be used only as an alternative for practical Forensic purpose.

**Key Words:** Forensic anthropology, Stature estimation, Sternal length, linear regression

### Introduction:

Physical anthropologists and Forensic pathologists have always given great importance to the methods of stature estimation from long bones. Often in Forensic investigations it is seen that mutilated bodies, few bones or fragments of bones are presented to the investigator.

Earlier works done by Trotter and Glesser [1] have been monumental. This has given rise to newer research on the topic. Several such investigations have been documented.[2-8]The human sternum have been the subject of extensive research on morphometry and their application on stature[9,10], age[11-13] and sex. [14-18]

Several population specific studies have been reported showing consistent results. [19, 20]Population specific studies done on estimation of stature from fragment of tibia [21] and bicondylar width [22] and maximum length of femur in Bengali population help us to form a preliminary idea on the applicability of regression equation from long bones in regional population.

Recent works have been done on development of regression formula for estimation of stature from sternum by J.Singh et al on North-western Indians [11] and by Menezes et al on south Indian females. [10]

Those researchers have suggested population specific regression equations to estimate stature in Indians. Studies on specific populations done by radiological measurement of sternal length with correlation in cadaver length in Spaniards [14] have reported standard error of estimate of 6.2 and 5.56 in male and female subjects respectively.

This present study was designed to develop a population specific regression formula (Regression equation) to correlate the stature of an individual with length of sternum measured by digital radiography.

After searching available literature to the best of our ability, this preliminary study is perhaps the first work done on correlation of stature in living individuals to the radiologically measured sternal length.

We propose to see whether in absence of the entire skeleton this process can help to solve medico-legal problems giving due consideration to regional factors.

### Aims and Objectives:

1. To derive a mathematical model to preliminarily test whether radiological length of sternum measured from chest radiograph

### Corresponding Author:

<sup>1</sup>PG student 2<sup>nd</sup> year

Department of Forensic State Medicine,  
BMC Burdwan, West Bengal

E-mail: smk.kgp@gmail.com

<sup>2</sup>Prof & Head, Dept. of FSM

DOR: 24.02.2015 DOA: 13.08.2015

DOI: 10.5958/0974-0848.2015.00101.3

can be correlated to stature measured in living individuals.

2. To observe as to whether a relatively inexpensive and easily available technique as digital radiography is useful for this purpose.
3. To test its reliability as a test for estimation of stature in a regional population
4. To test the population specificity of the model.

### Material and Methods:

A population consisting of students and residents who are registered with the B.C.Roy technology central government hospital was selected for this study as it has a heterogeneous mixture of people of Bengali origin along with people from all ethnicities because of students and teachers from all parts of India associated with the institute. The study design is cross sectional.

Random samples were selected from patients/healthy volunteers who agreed to participate in the study when explained the risk/benefit factors of the study. The radiographs for the study were conducted at the hospital from June to December 2014 for a study period of approximately 6 months. The results and statistical analysis was done at Department of Forensic medicine BMC, Burdwan.

Consent was taken from the patients or their relatives for the use of their data for research purposes. The data used in this study was obtained from patients/volunteers who underwent lateral radiograph examination in the radiology department of the hospital. The data consists of 102 individuals from 16 years age to 89 years. Of the population were 59 males and 43 females. Living height was taken by measurement in stadiometer.

X-rays were done in care stream direct view vita CR. Sternal dimensions were recorded from digital images using measurement tools included within the image analysis software program associated with the care stream CR 4.51 digital system radiographic system. The exposure given was 65 Kva 0.4 s and 24-30 mA.

The distances between chest plate and tube are 90 cm. The digital images were obtained and then studied altering the contrast and using filter to enhance the visualization of the sternum as whole. The sternal length was measured in two parts by the software provided tools. The magnification error (20% zoom) due to digital radiography was calculated and the length was accordingly calculated reducing the 20% as final sternal length used for the study.

A test for repeatability of the measurements was first performed before the data was subjected to statistical analysis by recording the lengths a second time at an interval of 3 weeks. Mean intra-observer error was 1.3% for both dimensions. Length of sternum was measured in two parts:

1. The distance from suprasternal notch (A) to manubrio-sternal junction (B) = (M) and
2. The distance from manubrio-sternal junction (B) to xiphoid (C) = (B) and Then added to get the total sternal length (M+B).

**Fig. 1: Measurement of Length of Sternum**



### Observations and Results:

In this study Out of total 102 cases of Bengali origin 59 were males and 43 were females. These were used to get the regression model. We included 10 cases of Bengali origin and 10 cases of other ethnic origin in the study to test the applicability of the obtained model in a geographically different ethnic population.

The data being normally distributed was tested by Shapiro-wilk test and P-P plot. The p value was significant (0.121 for males and .000 for females). Then the data was subjected to statistical analysis using SPSS 20.0 version. The analysis was done by bivariate linear regression.

Independent variable was length of sternum. Dependent variable is stature of the individual. Being linear this follows the equation  $y = c + mx$ . The stature was calculated in males as  $137.58 + 1.15 \times \text{sternal length}$ . The standard error of estimate is 2.94.

The stature was calculated in females as  $120.47 + 1.81 \times \text{sternal length}$ . The standard error of estimate is 2.23. Thus from this study it can be derived that a large percentage of cases the stature can be calculated within 95% confidence intervals of the predicted value.

In this study the standard error of estimate for the male model is 2.943 and correlation coefficient is 0.636. The r square for the model is 0.4. In this study the standard error of estimate for the female model is 2.230 and correlation coefficient is 0.843. R square = 0.7.

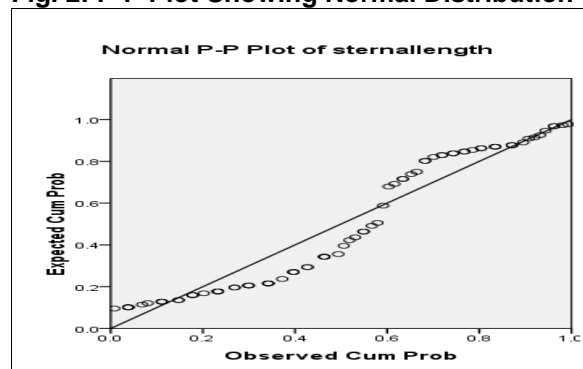
The stature was calculated in males as stature (cm) =  $137.58 + 1.15 \times \text{sternal length}$ .

The stature was calculated in females as stature (cm) =  $120.47 + 1.81 \times \text{sternal length}$ .

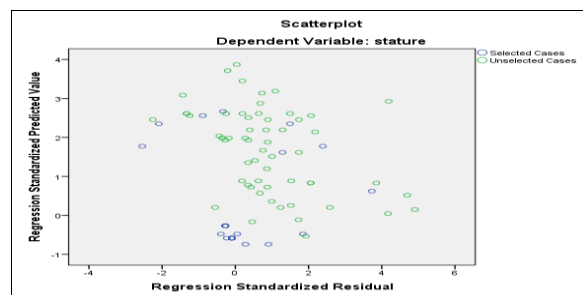
**Table 1: The coefficients of regression**

	Males	Females
R	0.636	0.843
R Square	0.405	0.711
Std. error of estimate	2.943	2.230

**Fig. 2: P-P Plot Showing Normal Distribution**



**Fig. 3: Scatter Plot showing normal distribution of predicted values**



## Discussion:

Earlier studies [10,11,012,13]done on North Western Indian population, south Indians and Portuguese have helped to develop population specific regression formula for estimation of stature of an individual from various parameters of sternum. The results obtained in the present study show that It was possible to predict with greater accuracy (70%) stature from sternal length in females (value of R is 0.84 and R square 0.7) of cases in contemporary Bengali adult population.

This prediction was however less accurate in males (value of R is 0.636 & R square 0.4) of cases in contemporary Bengali adult population. The standard error of estimate is 2.94 for males and 2.23 for females thus it cannot distinguish persons of nearly similar stature. Rather it can be used to give preliminary discerning information regarding the stature. This is consistent with results from studies on Spanish population. [14]

The correlation coefficient and standard error of the estimate values obtained in the current study are generally comparable to those observed in previous investigations [8-14] that assessed the efficacy of sternal measurements for stature estimation in other population groups.

Marinho and colleagues [12] reported a correlation coefficient of 0.329 and a standard error of 6.59 cm for the length, including the xiphoid process, of fresh sterna in a male sample from Portugal. Similarly, Singh et al, in their study of a Northwest Indian population sample, obtained correlation coefficient values of 0.316 for males and 0.328 for females for regression models based on sternal length taken from dry bone specimens.

The corresponding standard errors of the estimate for these regression models were 6.83 and 6.65 cm for males and females, respectively. Menezes et al obtained higher correlation coefficients and lower standard errors of the estimate for regression models derived from the combined length of the manubrium and meso-sternum recorded from dry bone specimens in a South Indian sample. [9]

For the male sample, the correlation coefficient was 0.638 and the standard error was 5.64 cm, whereas for the female sample, these two values were 0.639 and 4.11 cm, respectively.

Our present method is relatively simple and inexpensive technique for estimation of stature when data from long bones are not available. Thus it can be concluded that sternal measurements obtained from digital radiographs used for estimation of stature cannot be taken as a highly reliable method.

One limitation of the present investigation was that the sample was small. This can be mitigated by a larger study to examine the applicability of the results for use in Forensic practice.

This model when applied to different regional population shows a much lower predictive value. This regional variation agrees with previous studies. [9-14]

Separate models must be developed for different populations for accurate prediction of stature from sternal measurements.

Further research will add to the corpus of ever-growing knowledge in physical anthropology and Forensic Medicine.

## References:

1. Trotter M and Glesser G.C. Estimation of stature from long bones of American whites and Negroes. Am J Phys. Anthropol. 1952; 10: 463-514.

2. **Dayal M R , Steyn M, Kuykendall K L.** Stature estimation from bones of South African whites South African Journal of Science 2008;104(2): 124-28.
3. **Pelin I C, Duyar I.** Estimating stature from tibia length: a comparison of methods. J Forensic Science. July 2003; 48(4): 21-26.
4. **Chibba K and Bidmos M.A.** Estimation of stature and maximum long bone length of the tibia from fragments of the tibia in South Africans of European descent. Forensic Science International. 2007; 169(2): 145-51.
5. **Bidmos A Mubarak.** Stature Reconstruction Using Fragmentary Femora in South Africans of European Descent. Journal of forensic Sciences 2008; 53, (5,): 1044-1048. 6.
6. **Duyarizet and Pelin C.** Body height estimation based on tibia length in different stature groups. Am J Phys. Anthropol 2003; 122(1): 23-27.
7. **Steele D G, McKern T W.** A method for assessment of maximum long bone length and living stature from fragmentary long bones. Am J Phys. Anthropology. 2005; 31(2): 215-227.
8. **Scheuer L.** Application of osteology to forensic medicine. Clin Anat. 2002; 15(4):297-312.
9. **Menezes RG, Kanchan T, Kumar GP, Rao PPJ, Lobo SW, Uysal S, Krishan K, Kalthur SG, Nagesh KR, Shettigar S.** Stature estimation from the length of the sternum in South Indian males: a preliminary study. J Forensic Leg Med 2009; 16:441-443
10. **Menezes RG, Nagesh KR, Monteiro FNP, Kumar GP, Kanchan T, Uysal S, Rao PPJ, Rastogi P, Lobo SW, Kalthur SG.** Estimation of stature from the length of the sternum in South Indian females. J Forensic Leg Med 2011; 18:242-245
11. **Singh J, Pathak RK, Chavali KH.** Skeletal height estimation from regression analysis of sternal lengths in a Northwest Indian population of Chandigarh region: a postmortem study. Forensic Sci. Int. 2011; 206:211.e1-221.e8
12. **Marinho L, Almeida D, Santos A, Cardoso HFV.** Is the length of the sternum reliable for estimating adult stature? A pilot study using fresh sterna and a test of two methods using dry sterna. J Forensic Sci. Int. 2012; 220:292.e1-292.e4
13. **Chandrakanth HV, Kanchan T, Krishan K, Arun M, Kumar GNP.** Estimation of age from human sternum: an autopsy study on a sample from South India. Int. J Legal Med 20112; 126:863-868
14. **Macaluso PJ JrLucena J.** Stature estimation from radiographic sterna length in contemporary Spanish population. Int J Legal Med; 2014; 128:845-51.
15. **Atal DK, Murari A, Rani Y, Naik SK.** Gender differentiation from sternum: a postmortem metric study. Int. J Med Toxicol. Legal Med; 2008; 11:53-58
16. **Hunnargi SA, Menezes RG, Kanchan T, LoboSW, Binu VS, Uysal S et al.** Sexual dimorphism of the human sternum in a Maharashtrian population of India: a morphometric analysis. Leg Med 2008; 10:6-10
17. **Mukhopadhyay PP.** (2010) Determination of sex from adult sternum by discriminant function analysis on autopsy sample of Indian Bengali population: a new approach. JIAFM 2010; 34:321-324
18. **Bongiovanni R, Spradley MK.** Estimating sex of the human skeleton based on metrics of the sternum. Forensic Sci. Int.2012; 219:290.e1-290.e7
19. **Singh J, Pathak RK, Singh D.** Morphometric sex determination from various sternal widths of Northwest Indian sternums collected from autopsy cadavers: a comparison of sexing methods. Egypt J Forensic Sci. 2012; doi:10.1016/j.ejfs.2011.12.002
20. **Mysorekar NL, Verma P.K. Mandedkar A.N, Sarmat T.C.S.R.** Estimation of stature from parts of bones lower end of femur and upper end of radius. Med. Science. Law, 1980, 20(4): 283-286.
21. **Dan U, Mukhopadhyay P P, Ghosh T K, Biswas S.** Estimation of stature from fragment of long bone (tibia) in Indian Bengali population J. Anat Soc. India 2009; 58(2): 169-172.
22. **Mukhopadhyay P P, Ghosh T K, Dan U, Biswas S.** Correlation between Maximum Femoral Length and Epicondylar Breadth and Its Application in Stature Estimation: A Population Specific Study in Indian Bengali Males JIAFM 2010; 32(3): 204-07.



## Original Research Paper

# Profile of Disease Related Deaths in Custodial Cases An Autopsy Based Experience

<sup>1</sup>Satinder Pal Singh, <sup>2</sup>Dalbir Singh, <sup>3</sup>Akashdeep Aggarwal, <sup>4</sup>Surinder Singh Oberoi,  
<sup>5</sup>Krishan Kumar Aggarwal

### Abstract

The death of a person in custody always raises suspicion of torture at the hands of authorities culminating in death. In view of above, the present study was conducted to bring to light the pattern of deaths among the prison population of northwest India and suggest suitable preventive measures. This study extended over a period of four years (January 2010 to December 2013) and analysed 60 such cases. Male predominance was observed. The maximum number of fatalities (26.6%) occurred in 21-30 years age group. Most (80%) of the prisoners belonged to rural areas. Contrary to the common perception, natural causes (80%) were responsible for death in the majority of cases, with lung pathologies (29.2%) as the major killer. The study concluded that provision of timely and adequate health care to prison inmates is likely to bring down the morbidity & mortality. It is likely to bring down the morbidity and mortality among prison inmates and also save the authorities from the unnecessary mental agony and harassment of getting accused of the death of the person.

**Key Words:** Prison, Custody, Death, Autopsy, Human rights

### Introduction:

Death in custody is a serious issue as it raises the question mark on the fundamental rights of a citizen. These incidences not only cast a shadow over the image of police, but also raise eyebrows concerning the health related facilities available to prisoners.

As per the directions of the National Human Rights Commission (NHRC) of India, all such deaths must be investigated by a magistrate, the entire process of autopsy should be videographed followed by submission of the report within 24 hours of autopsy. [1]

Death is an inevitable event of life, it cannot always be presumed to be consequent to foul play.

The data shows majority cases of morbidity and mortality among the prisoners to be the result of natural causes. [2, 3] In view of above the present study was conducted to bring to light the pattern of deaths among the prison population from this region of northwest India.

### Material and Method:

The present retrospective study was conducted in Government Medical College, Patiala which is a leading tertiary care institute of northwest India that caters to the health needs of the local population. During the study period from January 2010 to December 2013, a total of 60 prisoners were admitted in this hospital for various conditions and died.

These prisoners belonged to the local jail and represent the local prisoner population only. Their dead bodies were subjected to medico-legal autopsy as required by Indian laws.

The data were collected from the post-mortem records, medical records, police inquest reports and toxicological records of prisoners. The data thus collected was subsequently analysed and compared with other national and international studies.

### Observations and Results:

During our study period from January 2010 to December 2013, a total of 2510 medico-legal autopsies were conducted out of which 60 (2.3%) deaths involved prison inmates. Though male predominance was observed (96.6%), it

### Corresponding Author:

<sup>1</sup>Senior Resident,  
Department of Forensic Medicine,  
PGIMER, Chandigarh, India, Pin code 160012  
E-mail: spsingh9988@yahoo.co.in

<sup>2</sup>Profe & HOD, Dept. of Forensic Medicine,  
PGIMER, Chandigarh, India, Pin code 160012

<sup>3</sup>Assoc. Prof, Dept. of Forensic Medicine,  
Govt. Medical College, Patiala,  
Punjab, India, Pin Code 147001

<sup>4</sup>Addl. Prof, Dept. of Forensic Medicine,  
GMC, Patiala, Punjab, India

<sup>5</sup>Prof, Department of Forensic Medicine,  
GMC, Patiala, Punjab, India  
DOR: 20.05.2015 DOA: 17.07.2015  
DOI: 10.5958/0974-0848.2015.00102.5



was not found to be statistically significant ( $p$  value 0.666 and chi square 6.724).

The proportion of deaths was highest in 21-30 years (31.6%) followed by 31-40 years (23.3%) and 41-50 years (15%) age groups.

The minimum number of deaths was observed in 51-60, 61-70 and >70 year age groups (10% in each group). (Fig.1) In 11-20 years age group, three prisoners were detected and all were above the age of 18 years, which is the legal age of adulthood in India. Statistical significance was observed for age with maximum number of deaths in the younger age groups ( $p$  value = 0.012, chi square = 14.60).

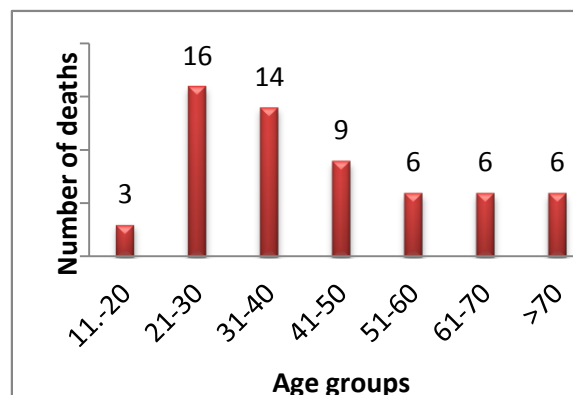
Rural preponderance was observed (80%) and was found to be statistically significant ( $p$  value = 0.024, chi square = 18.55).

The month of January (16.7%) recorded the highest number of cases followed by October (13.3%) while the minimum number of cases was observed in the months of May and June (1.7% each). No significant statistical relation to the season was observed ( $p$  value 0.405, chi square = 28.118).

**Table 1: Distribution of Natural/Unnatural Deaths among Prisoners**

Natural Causes of Death	Cause of death	Percentage
	Lung pathology	29.2
	Heart pathology	16.7
	Neuro pathology	10.4
	GIT pathology	4.1
	More than organ system involved	25
	Cancer	4.1
	Renal pathology	10.4
	Total	100
Unnatural Causes of Death	Poisoning	66.7
	Hanging	25
	Burns	8.3
	Total	100

**Fig. 1: Age wise Distribution of Cases**



Death from natural causes was observed in a majority of cases (80%). Among the natural causes, lung related pathology was the main killer (29.2%) and 86% of lung pathology related deaths were attributed to

tuberculosis ( $n=12$ ) followed by pneumonitis due to other pulmonary pathologies.

Among the unnatural causes of death, the top position was occupied by poisoning that affected around two thirds of the prisoners.

Out of a total of 8 poisoning deaths, 50% were due to Aluminium phosphide (ALP) followed by Organophosphorus (OPC) and Chloro compounds (CC) (25% each). One case of homicidal thermal burns was also reported. (Table1)

### Discussion:

The present study revealed that the custodial deaths constitute 2.39% share of total unnatural deaths reported at this hospital. The observation that males were predominantly affected is also consistent with the findings of other studies done in India [2, 3] and other developed countries like USA, [4] Australia, [5-7] Canada [8] and UK. [9-11]

The greater involvement of males may be explained by the fact they are more commonly involved in criminal activities and likely to be present in larger numbers in jails and consequently die in greater numbers.

The age range varied from 21 years to 80 years and the mean age was found to be 43.9 years. It was discovered that the most frequently affected age group has been 21-30 years, followed by 31-40 years. Comparable findings were observed in India [3] Canada [8] and UK [12] with a mean age of 46.4 years, 40.9 years and 38.4 years respectively.

However, contrasting findings were observed in another study conducted in the UK [10] where 65-74 years age group was found to be most frequently affected. More deaths in the younger group can be possibly be explained by the fact that people in the age group are most energetic and prone to greater stresses of life and constitute the largest number of prisoners in India and consequently show maximum deaths as was reported by the National Crime Records Bureau of India in 2012.

The present study found that rural population (i.e., area of usual residence of the prisoner before the arrest) was more commonly affected. However, the rural population may be overrepresented as a vast majority of India's population still resides in rural areas (about 68.8% in 2011 as per census data).

The current study found that natural causes were responsible for death in 80% of the cases which is in accordance with other national [2] and international studies, viz. USA [4,13,14] UK [9,10] and Australia. [15]

Among natural causes, lung pathologies were the leading causes of death. Concordant findings were also reported from India [3] and UK [9] showing lung pathology followed by cardiovascular pathology as the leading causes of death. Some studies conducted overseas, viz. UK [10, 12] on the other hand, observed cardiovascular diseases as the leading cause of death. Tuberculosis is prevalent in 40% of the total Indian population and is still an important cause of preventable deaths.

The observation that tuberculosis was the main offender in deaths related to lung diseases indicates that this treatable medical condition is getting ignored in prisoners.

According to National Crime Records Bureau, the jails in Punjab had inmate strength of 27449 in 2013 against the capacity of sanctioned capacity of 18629 indicating 144% occupancy. The resultant overcrowding might be a contributory factor for dissemination of tuberculosis from one person to another and consequent development of the disease.

Contrary to our finding that poisoning was the leading cause of death, the industrialized world, i.e., Australia [5, 16, 17] and UK [9] presented a different picture with hanging as the leading cause of death followed by multiple traumas. A Canadian study [8] reported violent causes as the most frequent cause of death in men led by suicide by strangulation (31.8%) poisoning (16.9%) and homicide (5.6%).

The access of prisoners to poisons like ALP, OPC and CC indicates lapses in jail security. Easy availability of ligature material poses a difficult problem for the jail staff as even a shirt can be used for the purpose and hence a close vigil of prisoners is essential at all the times. (Table 2)

### Conclusion:

Death from natural diseases that can be properly treated with adequate and timely medical facilities is a serious lapse that should be addressed at the earliest.

On the other hand, deaths from poisoning and hanging throw light on the loose security of our jails leading to access of prisoners to poisonous substances and ligature materials that can be used to commit suicide.

The authors are of the view that respective governments should improve the infrastructure of the jails through requisite financial support and tighten vigilance to decrease fatalities in prisoners.

The problems of long delays in the judicial system and mistreatment at the hands of jail authorities should be addressed. Proper

arrangement should be made to ample living space to each prisoner.

A more humane approach to their genuine needs of prisoners is likely to bring relief to the families of the prisoners and relieve the jail staff of unwanted stress of being responsible for the deaths of prisoners.

### Limitations:

The study might not represent a true picture of prison fatalities in this region of India as it included only the cases that presented at a particular health institute.

### References:

1. Dogra TD, Bhardwaj DN, Sharma GAS, Lalwani S. Postmortem examination in cases of custodial death in India. *J Indian Med Assoc* 2008; 106(2):51-3.
2. Bansal YS, Murali G, Singh D. Custodial Deaths- An overview of the prevailing healthcare scenario. *J Indian Acad Forensic Med* 2010; 32(4):315-7.
3. Sonar V. A retrospective study of prison deaths in western Maharashtra (2001-2008). *Medico-Legal update* 2010; 10(2):112-3.
4. Kim S et al. Deaths in the Cook County Jail: 10 year report, 1995-2004. *J Urban Health* 2007; 84(1):70-84.
5. Kariminia A. et al. Factors associated with mortality in a cohort of Australian prisoners. *Eur. J Epidemiol.* 2007; 22(7):417-28.
6. Collins L, Mouzos J. Deaths in custody: A gender-specific analysis. Trends and issues in crime and criminal justice, Australian Institute of Criminology. 2002 Sept [cited 2013 June 2]; 238:1-6. Available from: <http://www.aic.gov.au>.
7. Petschel K, Gall JA. A profile of deaths in custody in Victoria, 1991-96. *J Clin. Forensic Med* 2000; 7(2):82-7.
8. Wobeser WL, Datema J, Bechard B, Ford P. Causes of death among people in custody in Ontario, 1990-1999. *CMAJ* 2002; 167(10):1109-13.
9. Statistical Analysis of all recorded deaths of individuals detained in state custody between 1 January 2000 and 31 December 2010. Independent Advisory Panel on Deaths in Custody. 2011 Oct [cited 2013 Aug 29]; 1-17. Available from <http://iapdeathsincustody.independent.gov.uk/wp-content/uploads/2011/10/IAP-Statistical-Analysis-of-All-Recorded-Deaths-in-State-Custody-Between-2000-and-2010.pdf>.
10. Learning from PPO investigations: Natural cause deaths in prison custody 2007-2010. Prisons and Probation Ombudsman, Ashley House, London 2012. [cited 2013 Aug 21]; 1-18. Available from [http://www.ppo.gov.uk/docs/learning\\_from\\_ppo\\_investigations\\_natural\\_cause\\_deaths\\_in\\_prison\\_custody.pdf](http://www.ppo.gov.uk/docs/learning_from_ppo_investigations_natural_cause_deaths_in_prison_custody.pdf).
11. Farrell M, Marsden J. Acute risk of drug-related death among newly released prisoners in England and Wales. *Addiction* 2008; 103(2):251-5.
12. Fazel S, Benning R. Natural deaths in male prisoners: A 20-year mortality study. *Eur. J Public Health* 2006; 16(4):441-4.
13. Springborn RR. Death in custody, California. Criminal Justice statistics center. Outlook. 2005 May [cited 2013 Aug 30]. Available at <http://oag.ca.gov/sites/all/files/pdfs/cjsc/publications/misc/DINCOutlook.pdf>.
14. Salive ME, Smith GS, Brewer TF. Death in prison: Changing mortality patterns among male prisoners in Maryland, 1979-87. *Am J Public Health* 1990; 80(12):1479-80.
15. Annual report 2005-06. Queensland, Australia. Department of corrective services. [cited 2013 Aug 21]; 1-120. Available from [http://www.correctiveservices.qld.gov.au/Publications/Corporate\\_Publications/Annual\\_Reports/annual05-06/images/Annual%20Report%2005-06.pdf](http://www.correctiveservices.qld.gov.au/Publications/Corporate_Publications/Annual_Reports/annual05-06/images/Annual%20Report%2005-06.pdf).
16. McDonald D, Thomson NJ. Australian deaths in custody, 1980-1989. *Med J Aust.* 1993; 159(9):581-5.
17. Beacroft L. Trends and Issues 20 Years of Monitoring Deaths in Custody in Australia. Australian institute of Criminology [cited 2013

Aug 21];1-23. Available from  
http://www.courts.qld.gov.au/\_data/assets/pdf\_file/0005/163769/os  
c-asia-pacific-conference-04-beacroft-l.pdf.

18. **Blaauw E, Kerkhof AD, Vermunt R.** Suicides and other deaths in police custody. *Suicide Life Threat Behaviour* 1997; 27(2):153-63.

19. **Okoye M, Kimmerle EH, Reinhard K.** An analysis and report of custodial deaths in Nebraska, USA. *J Clin. Forensic Med* 1999; 6(2):77-84.

20. **Bhana BD.** Custody-related deaths in Durban, South Africa 1998-2000. *Am J Forensic Med Pathol* 2003; 24:202-7.

**Table 2: Comparison with Various National and International Studies**

S. N	Study	Study Year	Sex	Most frequently affected age group	Incidence	Type of death (most common)
1	USA, Maryland <sup>14</sup>	1990	Males	-	-	Natural, 68.62%
2	Netherlands, Amsterdam <sup>18</sup>	1997	-	-	-	Unnatural (Suicide, 33.8% Intoxications 32.2%)
3	USA, Nebraska <sup>19</sup>	1999	Males 94%	41-50 yrs, 29.4%	-	Unnatural, 52.9% (Suicide, 33.3%) Natural, 45.1%
4	Australia, Victoria <sup>7</sup>	2000	Males 93.7%	Mean age 34.6 yrs, >50% deaths- less than 33 yrs old	2.09 deaths/1000 prisoners	Unnatural, 81.25% (Accidental, 32.2% Suicides, 30.2%)
5	Canada, Ontario <sup>8</sup>	2002	Males 97.2%	Mean age (males) 40.9 yrs	420.1/100000 (for federal institutions)	Unnatural, 59% Natural, 41%
6	South Africa <sup>20</sup>	2003	21-30 yrs, 48.7%	Males, 100%	-	Unnatural
7	India, New Delhi <sup>1</sup>	2008	Males 100%	21-30 yrs, 53.8%	-	Unnatural, 76.9%
8	India, Chandigarh <sup>2</sup>	2010	Males 95%	46-55 yrs, 21.1%	-	Natural, 89% Unnatural, 11%
9	UK <sup>9</sup>	2011	Males 72%	21-50 yrs	-	Natural, 66%
10	Present study (India, Patiala)	2014	Male 96.6%	21-30 yrs, 26.6%	2.3% of total autopsies	Natural, 81.6% Unnatural, 18.3%

## Original Research Paper

# Trends of Poisoning in a Tertiary Care Centre of North West Uttar Pradesh

<sup>1</sup>Jaswinder Singh, <sup>2</sup>Jaspreet Kaur, <sup>3</sup>Vinod Kumar, <sup>4</sup>K.A. Shah, <sup>5</sup>R.N. Tandon, <sup>6</sup>V.R. Patil

### Abstract

Poisoning cases account for a considerable proportion of all the cases reported to both government and private sector casualty departments and causes considerable morbidity and mortality due to low cost and easy availability of poisons. The present study evaluates the pattern of poisoning at a tertiary care hospital in Bareilly city of North West U.P. A retrospective and prospective analysis of all poisoning cases reported to the emergency department of SRMS-IMS from Jan 2010 to Dec 2012 was done to study the pattern of poisoning. Data were collected and analyzed. A total of 178 patients (male: 100, female: 78) were included in the study. The male female ratio was 1.28:1. The types of poisons were insecticides like Organophosphorus compound, halogenated insecticides, rodenticides, petroleum products, corrosive substance, snake bite, Dhatura etc. Most of the victims (75.28%) were Hindu. Most common age group reported was between 21-30 years. Most of the cases were from summer months, which happen to be the harvesting and selling season for farmers. Fatal outcome was observed in 16.29% cases. Recent trends in our study showed that cases of unknown poisoning are on rise possibly due to industrial chemicals.

**Key Words:** Poisoning trends, Organophosphorus, Insecticides, Casualty, Mortality

### Introduction:

History of poisoning dates back to before 4500 BC. Through this long journey art and science of poisoning have undergone tremendous changes. In Indian context history shows that poisons were not only known but were also used to destroy enemies and get rid of prisoners. Indian surgeon Sushruta is said to have defined the various stages of slow poisoning and the treatment of slow poisoning. He also mentions antidotes and the use of traditional substances to counter the effects of poisoning. [1]

Poisoned weapons were used in ancient India [2] and war tactics in ancient India have references to poison. A verse in Sanskrit reads "*Jalam visravayet sarmavamavisravayam ca dusayet*," which translates to "Waters of wells were to be mixed with poison and thus polluted." [2] Chanakya (350–283 BC) was adviser of first Maurya Emperor Chandragupta (c. 340–293 BC). He suggested employing means such as seduction, secret use of weapons, and poison for political gain. [3]

He also urged detailed precautions against assassination—tasters for food and elaborate ways to detect poison. [4]

At Present over 11 million chemical substances are known and some 60,000 to 70,000 are in regular use. Between 200 and 1000 chemicals are produced in excess of one ton annually. Currently new chemicals are entering the market at the rate of about 600 each month (or over 7000 per year). [5]

Before human started making new chemical substances, they were exposed to poisonous plants, venomous animals, and chemicals of natural origin. With the onset of mining and smelting of minerals, workers were exposed to fumes and dusts.

Poisoning occurred in early civilizations through the use of lead and mercury. However, the rapid industrialization of the last century, the increasing numbers and volume of chemicals

### Corresponding Author:

<sup>1</sup>Assistant Professor  
Department of Forensic Medicine,  
Shri Ram Murti Smarak Institute of Medical Sciences,  
Bareilly-243202, U.P. India  
E-mail: drjasvinder.singh@ymail.com

<sup>2</sup>Research Associate, Dept. of Biochemistry  
SRMS, Bareilly-243202, U.P. India

<sup>3</sup>Prof. & HOD, Dept. of Forensic Medicine  
SRMS, Bareilly-243202, U.P. India

<sup>4</sup>Prof, Dept. of Forensic Medicine,  
B. J. Medical College, Ahmedabad-380016, Gujarat

<sup>5</sup>Prof. & Head, Dept. of Forensic Medicine,  
B. J. Medical College, Ahmedabad-380016, Gujarat

<sup>6</sup>Prof, Dept. of Forensic Medicine,  
GMC, Vadodara-390001, Gujarat, India  
DOR: 18.05.2015 DOA: 09.07.2015  
DOI: 10.5958/0974-0848.2015.00103.7

produced in this century, and the growing global market in chemicals of the recent decades has accelerated dramatically the range of chemicals and types of exposure experienced by individuals and populations.

Worldwide, an estimated three million cases of pesticide poisoning occur every year, resulting in an excess of 250000 deaths. Of these 90% of fatal poisoning occur in developing countries particularly amongst agricultural workers. [6]

Intentional and unintentional pesticide poisoning has been acknowledged as a serious problem in many agricultural communities of low- and middle-income countries, including China, India, Sri Lanka, and Vietnam.

An estimated total of 877000 people committed suicide worldwide in 2002 and around 28% of these cases *i.e.* 246000 are from south East Asia region (SEAR). [7] Globally around one third of all suicide cases are due to intentional pesticide ingestion. Use of pesticide ingestion for self-poisoning occurs mostly in rural areas of middle and low income countries.

Deaths from pesticide ingestion are major contributor to premature mortality and global burden of suicide. In developed countries medicines are most common source of self-poisoning with fatality rate of <1% but in developing countries pesticides are major source with at least ten times higher fatality.

In attempted suicide, which is considerably more frequent than completed suicide, pesticide poisoning results in temporary or permanent disability. Pattern of poisoning in a particular region depend on factors like availability, socioeconomic status, religious and cultural influences and availability of drugs.

The commonest cause of poisoning in India is pesticides due to easy availability, agriculture based economy and poverty. In developing countries like India occupational poisoning is common due to illiteracy, unsafe practices like storing the pesticide at home and handling them without safety gear. [8]

WHO and other humanitarian organizations are coercing the authorities of different countries to ban the highly toxic pesticides and also imposing restrictions to their access. Controlling access to pesticides is not only critical in reducing self-directed violence, it is key to preventing unintentional poisoning and terrorism. International conventions attempt to manage hazardous substances; however, many highly toxic pesticides are still widely used.

Studies indicate that bans must be accompanied by evaluations of agricultural

needs and replacement with low-risk alternatives for pest control. [6]

A lot of studies have been done on same subject of poisoning under different names in different regions of our country but due to lack of a central agency there is no consolidated database. Globally, there is a scarcity of information on the magnitude of both intentional and unintentional poisoning, as well as on the relative importance of different pesticides.

The detailed and accurate community-based data on the pesticides responsible for fatal self-harm are not available, from most of rural Asia. [9] Present study is a small effort to provide some information from this part of North West Uttar Pradesh.

### Materials and Methods:

The present study was conducted in Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, a tertiary care super specialty teaching hospital from 1<sup>st</sup> Jan 2010 to 31<sup>st</sup> December 2012. During this period a total of 178 cases of poisoning were reported to casualty department. This study was a retrospective and prospective study.

Cases from 1<sup>st</sup> Jan 2010 to 30 Sept 2011 were studied retrospectively from case files of record room and prospectively from 1<sup>st</sup> Oct 2011 to 31<sup>st</sup> December 2012. In prospective study relevant data was collected from relatives accompanying the patient, casualty medical officer, treating doctor and from case file.

Data related to name, age sex, religion, marital status, economic status, type of poison ingested, mode of ingestion, was collected in standardized proforma specially designed for the purpose and analyzed.

### Observations and Results:

During our study period one hundred and seventy eight cases were admitted to the Hospital with diagnosis of acute poisoning. Males were more prone to poisoning (56.2%) as compared to females (43.8%). (Table 1)

The incidence of poisoning according to age and sex (Table 2) revealed that there was an increasing trend of poisoning with increase in age up to 30 years and then declined with a peak incidence in the age group 21–30 years which represented 85 (47.8%) cases in this study. In present study incidence of poisoning was more in Hindu people (75.3%) followed by Muslims (19.7%) and 5.1% cases comprised of others which included Sikhs and Christians. (Fig. 1) Among the 178 cases admitted to the hospital with diagnosis of acute poisoning 105 (59%) cases were married. (Fig. 2))

Out of married cases 65 were male and 40 were female. Out of total 73 (41%) unmarried cases, 35 were male and 38 were female.

In our study maximum incidences of poisoning were recorded in summer season. (Table 3) The poisons used were organophosphate and other insecticides (Organochlorine) (41%), Celphos(23%) and liquids like kerosene in 2.81%. (Table 4)

Organophosphorus poisons are the most commonly abused poison followed by Aluminium phosphide. (Table 4) In this study out of total 178 cases of acute poisoning cases 29 admitted (16.29%) cases died during the treatment and 149 (83.71%) cases survived the acute poisoning. (Fig. 3)

### Discussion:

Poisoning cases, pesticide poisoning in particular, impose a huge burden on the economy in developing countries. Non-fatal cases of self-poisoning with insecticide also place burden on already stretched health care resources of low and medium income countries like India because many cases require ventilation for several days and transport to specialist hospitals because they cannot be managed in small rural hospitals.

In 1995–96, 41% of intensive care beds in a Sri Lankan hospital were occupied by people poisoned by organophosphates. The overall estimated cost of treating self-poisoning cases in Sri Lanka in 2004 was about \$1 million.

According to a study from India it is found that around 27% of pesticide poisoning cases require ventilation for varying periods. [10]

Most of the times pesticide and celphos poisoning is due to impulsive act of self-harm.

At any rate, it is known that the pesticides that cause most deaths in rural Asia, and in the world, are WHO Class I and II Organophosphorus pesticides causing an estimated 200,000 deaths. [11-13]

The present study shows that most of the cases belong to the age between 21 to 30 years which constitute 47.8% followed by age group 31 to 40 years which constitute 18% of the total cases. This observation is consistent with the other studies. [14-20]

In this study it has been observed that there is decreasing trend of poisoning cases after the peak of 21-30 years and it is least in extremes of life. Further it has been observed in the present study that most of the cases are due to organophosphate and other insecticide poisoning. This is in accordance with the other authors studies. [11-14, 16-19]

The present study showed that around 75% victims were Hindus. This data is consistent with other observations. [14, 15, 18] Out of total 178 cases studied 100(56.2%) were male and 78(43.8%) were female which is consistent with other studies. [14-16, 18-20]

It is worth noting that most of the cases occurred in summer months from our study. This finding is similar to other studies. [16, 19] In the present study 105 (58%) cases were found to be married and around 73 (42%) were unmarried this is consistent with other studies. [14, 15, 18, 19] As far as data on mortality is concerned not many studies have taken this aspect into consideration plus many are autopsy based studies. In our study mortality of 29 cases (16.29%) differs with other studies with varying mortality percentage. [14, 16, 17]

### Conclusion:

Many studies have been conducted on fatal/nonfatal poisoning, deliberate self-poisoning and accidental poisoning.

Most of the studies stress on the fact that most of cases of poisoning are self-harm types *i.e.* suicidal in nature. Though this fact has not been accounted for in this paper but this is a constant fact in all studies.

Authentic data on poisoning not only from India but from entire SEAR (South East Asia Region) is lacking and WHO states that many cases go unnoticed and mortality may actually be higher.

Pesticides again are clear culprit in most of cases. So to cut short it may be stated that self-harm pesticide poisoning is most common type of poisoning which is more common in Hindu and most of the cases are from age group 21-30 years.

### References:

1. Wujastyk D. et al. The Roots of Ayurveda: Selections from Sanskrit Medical Writings. ISBN 0-14-044824-1. p. 144
2. Chatterjee Hiralal. International Law and Inter-state Relations in Ancient India (1958). K. L. Mukhopadhyay. p. 104
3. Chamola SD. Kautilya Arthashastra and the Science of Management: Relevance for the Contemporary Society ISBN 81-7871-126-5. p. 40
4. Boesche, Roger. Moderate Machiavelli. Contrasting the Prince with the Arthashastra of Kautilya". Critical Horizons (Brill Academic Publishers). DOI: 10.1163/156851602760586671. ISSN 1440-9917. 2002;3 (2): 253
5. WHO Collaborating Centre for an international Clearing House for major chemical incident. ISBN 1-902724-10-0. 1999
6. WHO Library Cataloguing-in-Publication Data: Guns, knives, and pesticides: reducing access to lethal means. ISBN 978 92 4 159773 9. 2009
7. WHO Library Cataloguing-in-Publication Data: Safer access to pesticides: community interventions. ISBN 92 4 159489 6. 2006
8. Reddy KSN. The essentials of Forensic Medicine and Toxicology. 33<sup>rd</sup> Ed; 2014, p.500
9. Clinical Management of Acute Pesticide Intoxication: Prevention of Suicidal Behaviours. ISBN 978 92 4 159745 6, WHO 2008 P 9
10. Rao CHS, Venkateswarlu V, Surender T, Eddleston M and Buckley NA. Pesticide Poisoning in South India – Opportunities for

- Prevention and Improved Medical Management. Trop Med Int. Health. 2005; 10(6): 581-588.
11. **Buckley NA, Karalliedde L, Dawson A, Senanayake N and Eddleston M.** Where is the evidence for the management of pesticide poisoning - is clinical toxicology fiddling while the developing world burns? Journal of Toxicology Clinical Toxicology. 2004; 42: 113-116.
  12. **Eddleston M.** Patterns and problems of deliberate self-poisoning in the developing world. Quarterly Journal of Medicine. 2000; 93: 715-731.
  13. **Gunnell D, Eddleston M, Phillips MR, Konradsen F.** The global distribution of fatal pesticide self-poisoning: systematic review. BMC PublicHealth. 2007b; 7: 357.
  14. **Kiran N, Shobha Rani RH, JaiPrakash V, Vanaja K.** Pattern of poisoning reported at south Indian tertiary care hospital. Indian Journal of Forensic Medicine and Toxicology. 2008; 2 (2): 7-12.
  15. **Patil A, Peddawad R, Verma VSR, Gandhi H.** Profile of Acute Poisoning Cases Treated in a Tertiary Care Hospital: a Study in Navi Mumbai. Asia Pacific Journal of Medical Toxicology. 2014; 3: 1.
  16. **Jesslin J, Adepu R, and Churi S.** Assessment of Prevalence and Mortality Incidences Due to Poisoning in a South Indian Tertiary Care Teaching Hospital. Indian J Pharm Sci. 2010; 72(5): 587-91.
  17. **Memon A, Shaikh JM, Kazi SAF, Kazi A.** Changing Trends in Deliberate Self Poisoning at Hyderabad. J LUMHS. 2012; 11: 3.
  18. **Gupta BD, Vaghela PC.** Profile of Fatal Poisoning in and around Jamnagar. JIAFM. 2005; 27 (3): ISSN 0971 -0973
  19. **Dash SK, Raju AS, Mohanty MK, Patnaik KK.** Socio-demographic Profile of Poisoning. JIAFM. 2005; 27 (3). ISSN 0971 -0973
  20. **Srivastava A, Peshin SS, Kaleekal T, Gupta SK.** An epidemiological study of poisoning cases reported to the National Poisons Information Centre, All India Institute of Medical Sciences, New Delhi. Hum Exp. Toxicol. 2005; 24(6): 279-85.

**Table1: Gender Distribution**

Gender	Cases	%age
Male	100	56.18
Female	78	43.82
<b>Total</b>	<b>178</b>	<b>100</b>

**Table 2: Age and sex wise Distribution of Poisoning Cases**

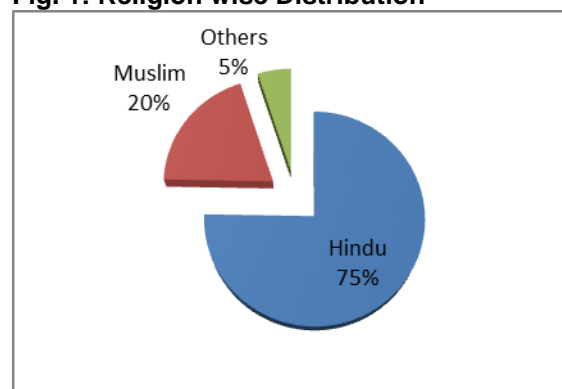
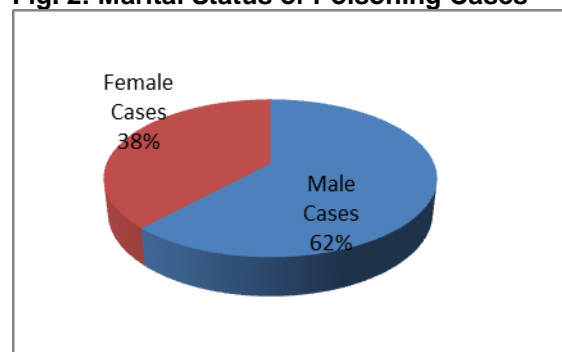
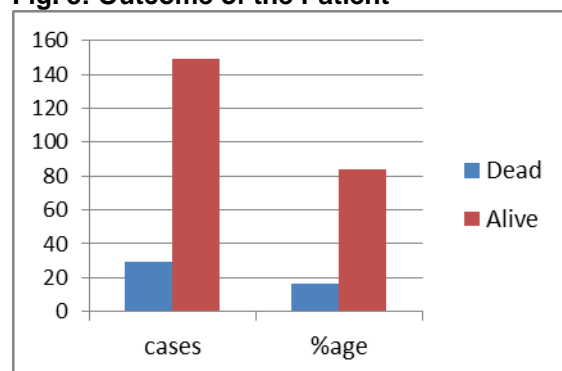
Age Grp (Yrs)	Cases	Male	Female	Total (%)
0-10	10	5	5	5.62
11-20	20	10	10	11.24
21-30	85	47	38	47.75
31-40	32	17	15	17.98
41-50	19	12	7	10.67
51-60	5	3	2	2.81
61-70	5	4	1	2.81
71-80	2	2	0	1.12
<b>Total</b>	<b>178</b>	<b>100</b>	<b>78</b>	<b>100</b>

**Table 3: Month & Year Wise Distribution of Cases**

Months	Year-2010	Year-2011	Year-2012
January	0	5	6
February	6	3	6
March	2	5	3
April	3	6	9
May	6	10	10
June	6	7	6
July	2	4	8
August	5	3	8
September	1	3	6
October	2	3	5
November	5	9	3
December	3	1	8

**Table 4: Types of Poison**

Poison	Cases	%age
Organophosphorus	44	24.72
Celphos	41	23.03
Unknown	34	19.10
other insecticides	29	16.3
Snake bite	8	04.49
Corrosives	7	03.93
Alcohol	5	02.81
Kerosene	5	02.81
Dhatura	5	02.81
<b>Total</b>	<b>178</b>	<b>100</b>

**Fig. 1: Religion wise Distribution****Fig. 2: Marital Status of Poisoning Cases****Fig. 3: Outcome of the Patient**

## Original Research Paper

### Profile of Acute Poisoning Cases at Pravara Rural Hospital, Loni

<sup>1</sup>Sandesh Datir, <sup>2</sup>Madusudan Petkar, <sup>3</sup>Jamebaseer Farooqui, <sup>4</sup>Chandeepsingh Makhani, <sup>5</sup>Sayed N. Hussaini, <sup>6</sup>Kalidas Chavan, <sup>7</sup>Rajendra Bangal

#### Abstract

This hospital based prospective cross sectional study was carried out over a period of two years duration from 01/09/2008 to 31/08/2010 in the Rural Medical College and Pravara Rural Hospital, of Pravara Institute of Medical Sciences, Loni, Taluka Rahata, Ahmednagar (M.S) India to know the socio-demographic profile and pattern of acute poisoning in the rural region. All admitted and brought dead cases of acute poisoning, cases of known and unknown bites and stings from all age were included in the study. Total 557 cases of acute poisoning were recorded out of which 62 (11.13%) cases were fatal. Most of the poisoning cases were male 325 (58.35%), belonged to literate group 173 (31.06%) and the lower middle socioeconomic class (class III) 290 (52.7%). Farm owners, clerical, shop owners group was most commonly 143 (25.68%) affected and most common route of poisoning was oral ingestion (64.81%). In maximum 247 (44.34%) cases category of poison was agrochemicals and maximum number of cases were of Organophosphorus insecticides (19.03%). Highest numbers of cases (50.81%) were suicidal. The present study helps to interpret the pattern of poisoning in the rural area.

**Key Words:** Acute poisoning, Snake bite & sting, Organophosphorus insecticides

#### Introduction:

At present due to vast developments in the field of chemistry and medical science, a significant number of new compounds have appeared as new poisonous substances. [1]

According to World Health Organization (WHO) reports, about 3 million people around the world consume poison every year, out of them 2, 20,000 deaths occur annually. About 99% of these deaths occur in the developing countries. About 50,000 deaths occur in India due to poisoning every year. [2]

#### Corresponding Author:

<sup>1</sup>Assistant Professor  
Department of Forensic Medicine & Toxicology,  
Dr. D.Y. Patil Medical College,  
Hospital and Research Center, Pune, Maharashtra  
E-mail: sandeshdatir@gmail.co

<sup>2</sup>Assist. Prof,

<sup>3</sup>Assoc. Prof, Dept. of FMT,  
Rural Medical College, Loni, Maharashtra

<sup>4</sup>Reader & Instructor, Dept. of FMT, AFMC, Pune

<sup>5</sup>Assoc. Prof, GMC, Rajnandgaon, Chhattisgarh

<sup>6</sup>Controller of Examinations, MUHS, Nashik, MHA

<sup>7</sup>Prof & HOD,

Smt. Kashibai Navale Medical College & General  
Hospital, Pune, Maharashtra

DOR: 23.04.2015 DOA: 19.08.2015

DOI: 10.5958/0974-0848.2015.00104.9

With green revolution and industrialization, use of insecticides, pesticides, Organophosphorus compounds become a boon to agriculturists and horticulturists to protect crops and stored grains from pests and rodents.

Though these substances have been in the market only for a few decades in our country, they have created many serious problems, because most suicides in the recent years have been traced to their oral intake. [3, 4]

In India, due to the relative ease with which poisons are available, naturally or in the market, cases of human poisoning are commoner than the West. In cities, cases of poisoning by acids, cyanides and various alkaloids are of occasional occurrence.

Accidental poisonings are more uncommon here than in developed countries, though instances of accidental poisoning of agricultural and industrial workers are reported.

Thus all forms of poisoning namely homicidal, suicidal and accidental are reported from all parts of the country. [1]

From ancient times, human and animals have been victims of snake bites and it has become a rural and occupational hazards worldwide. Frequently reported mortality of snake bite in India alone is over 15,000 per annum [5] and 40,000 to 60,000 per annum worldwide (2.35%). [6]



The recognition of poisoning during life is a matter of first importance. The availability of various poisons, socio-economic status of the population, religious and cultural influences, the prescribing pattern of drug, the etiology and demographic characteristics of acute poisoning are likely to be the key determinants for the development of preventive measures, early diagnosis and treatment of poisoning cases, hence it is of critical importance that these factors be firmly established. [7]

In India, due to variations in geographical conditions and differences in religious and cultural practices, the incidence and pattern of poisoning vary from place to place, hence it is desirable to perform regional studies periodically to recognize the extent and evolution of the problem.

### **Aims and Objectives:**

The present study is undertaken to know the socio-demographic profile and pattern of acute poisoning which is necessary not only for the purpose of early diagnosis and treatment of poisoning but also for its preventions.

### **Material and Methods:**

This hospital based prospective cross sectional study was carried out over a period of two years duration from 01/09/2008 to 31/08/2010 in the Rural Medical College and Pravara Rural Hospital, of Pravara Institute of Medical Sciences, Loni, which is a tertiary care teaching hospital chiefly catering to the demands of rural area of Ahmednagar & adjacent districts of Maharashtra.

It was also approved by Institutional Ethics and Research committee.

All admitted and brought dead cases of acute poisoning, cases of known and unknown bites and stings from all age were included in the study. All cases of chronic poisoning, poisoning cases admitted and referred to other hospitals, absconded cases, brought dead cases without history of acute poisoning, cases admitted without history of poisoning, bites and stings were excluded from the study.

Comprehensive proforma for the study was designed which contains demographic aspect and pattern of poisoning cases. Relevant data of the individual poisoning cases was collected from medico-legal cases register of casualty, case papers from concerned department, inquest, post-mortem reports, chemical analysis report after taking informed consent from patient or relatives.

Data was statistically analyzed using statistical software SPSS Statistic 17 and Microsoft Office Excel 2003.

### **Observations and Results:**

During the period of 24 months from September 2008 to August 2010 total 557 cases of acute poisoning were reported out of which majority of cases 495 (88.87%) were recovered and discharged, 15 (2.7%) cases were brought dead and 47 (8.43%) cases died during treatment. Total mortality due to poisoning was found to be in 62 (11.13%) cases.

This study revealed that out of 557 cases, 325(58.35%) were males while 232 (41.65%) were females. Males outnumbered females with male: female ratio of 1.40:1.

In the present study maximum number of cases were observed in age group of 21–30 years 195 (35.01%) followed by 0–10 years 101 (18.14%), 11–20 years 100 (17.95%) and least number of cases were found in the age group of 71–80 years and 61–70 years with 7 (01.26%) and 11 (01.97%) cases respectively. (Table 1) Out of total 557 cases, maximum cases (31.06%) were those having completed their educational qualification up to higher secondary school certificate, intermediate, ITI.

The second largest group 135 (24.24%) consisted of those who had completed education till secondary school certificate level. Only 19 (03.41%) cases were illiterate.

No poisoning case was found having educational status as professional degree, honors degree and postgraduate degree. Educational status was not applicable in 82 (14.72%) cases as those were children below five years of age. (Table 2)

In our study maximum cases of acute poisoning were found in farm owners, clerical, shop owners 143 (25.68 %) followed by students and housewives each with 118 (21.18%) cases and unemployed 50 cases (08.98%). No case was found in professional group. (Table 3)

Socio-economic status was determined according to All India Consumer Price Index 2008 and Modified Prasad Classification. [8] Present study showed that the maximum cases were from lower middle socio-economic class III (52.07%) followed by upper lower class (29.62%) while only 04 cases (00.72%) were from upper class. (Table 4)

Oral route of poisoning was observed in maximum cases 361 (64.81%) followed by bite & sting in 191 (34.29%) cases. Inhalational route was observed in 3 (00.54%) cases and dermal route in only 2 (00.36%) cases.

In this study maximum 247 (44.34%) cases were due to agrochemicals, followed by animal bites and stings 191 (34.29%), household poisons 28 (05.03%) and

pharmaceutical drugs (2.51%). Industrial chemicals were found in (00.36%) cases, miscellaneous 6 (1.08%) cases and plant poisons in 10 (1.8%) cases. In (07.54%) cases the poison was unknown and in (3.05%) cases the results of analysis was pending. (Table 5)

**Table 1: Age and sex Wise Distribution of Acute Poisoning Cases**

Age Grps (Yrs)	Male (%)	Female (%)	Total (%)
0-10	63(11.32)	38(6.82)	101(18.14)
11-20	55(9.87)	45(8.08)	100(17.95)
21-30	107(19.21)	88(15.8)	195(35.01)
31-40	48(8.61)	32(5.75)	80(14.36)
41-50	29(5.21)	13(2.33)	42(7.54)
51-60	14(2.51)	07(1.26)	21(3.77)
61-70	02(0.36)	09(1.61)	11(1.97)
71-80	07(1.26)	00(0.0)	07(1.26)
<b>Total</b>	<b>325(58.35)</b>	<b>232(41.65)</b>	<b>557(100)</b>

**Table 2: According to Educational Status**

Educational status	Cases (%)
Professional degree, honors degree, postgraduate degree	00 (0.0)
Graduation	44(7.9)
Higher secondary school certificate (HSC), Intermediate, ITI (Industrial training institute)	173(31.06)
Secondary school certificate (SSC)	135(24.24)
Middle school certificate (7 <sup>th</sup> Class)	61(10.95)
Primary school (Literate)	43(7.72)
Illiterate	19(3.41)
Not applicable to children below 5 years of age	82(14.72)
<b>Total</b>	<b>557(100)</b>

**Table 3: Occupation wise Distribution**

Occupation	Cases (%)
Professional	00(0.0)
Farm owners, clerical, shop owners	143(25.68)
Skilled workers	01(0.18)
Semiskilled workers	20(3.59)
Unskilled workers	25(4.49)
Unemployed	50(8.98)
Student	118(21.18)
Housewife	118(21.18)
Not applicable to children below 5 years of age	82(14.72)
<b>Total</b>	<b>557(100)</b>

**Table 4: According to Socio-Economic Status**

Socio-economic status	Cases	%
Upper (Class-I)	04	00.72
Upper middle (Class II)	62	11.13
Lower middle (Class III)	290	52.07
Upper Lower (Class IV)	165	29.62
Lower (Class V)	36	06.46
<b>Total</b>	<b>557</b>	<b>100</b>

**Table 5: According to Category of Poisons**

Category of Poisons	Cases	%
Agrochemicals	247	44.34
Industrial chemicals	02	00.36
Household poisons	28	05.03
Pharmaceutical drugs	14	02.51
Animal bites and stings	191	34.29
Plant poisons	10	01.80
Miscellaneous	06	01.08
Unknown	42	07.54
Pending	17	03.05
<b>Total</b>	<b>557</b>	<b>100</b>

**Table 6: According to Manner of Poisoning**

Manner	Total (%)
Suicide	283 (50.81)
Homicide	00 (00.00)
Accidental	269 (48.29)
Undetermined	05 (00.89)
<b>Total</b>	<b>557 (100)</b>

The maximum number of cases was of Organophosphorus insecticides (19.03%) which were followed by Formamidine group of pesticide amitraz (14.54%). Most common snake bites cases were of Vasculotoxic snake bite 48 (8.61%). Kerosene was detected in (4.31%) cases, Organochloro insecticides in (4.13%) cases, pyrethroid insecticides in (3.95%) cases, scorpion bite (sting) in (3.41%) cases and Organophosphorus & pyrethroid mixed insecticide in (2.15%) cases.

In 42 (7.54%) cases the type of poison could not be known and in another 37 (6.64%) cases were attributed to unknown bites.

Our study revealed that highest number of cases were suicidal (50.81%) followed by accidental (48.29%) and in only 05 (00.89%) cases the manner of death was undetermined. No case was found to be homicidal. (Table 6)

The categorization of the cases according to the manner of poisoning was done based on the information available from history given by patient, relatives, the treatment records, the documents received from police at the time of autopsy and the autopsy findings. In case of conflicts in the history, manner was categorized as undetermined.

During the study no attempt was made to consider the police investigations, court proceedings and orders in each individual case in order to categorize them according to the manner of poisoning.

## Discussion:

During the study period, total 557 cases of acute poisoning were recorded. Mortality found in the present study was 11.13% which was less than mortality reported by Sinha US et al study (33.69%). This may be due to fact that this Pravara Rural Hospital, Loni is a tertiary care teaching hospital and hence easy and faster approach to this hospital and early treatment may have reduced mortality.

Our study revealed that male outnumbered females Findings of the present study are consistent with other author's study. [1-3, 9, 11] This may be because males are more exposed to stress and strains of day to day life as they have to run the family and bear many pressures i.e. economic problems, difficult life conditions and various psychological stresses.

Males are also exposed to occupational hazards and they have easy accessibility to the agrochemicals and they often need to handle it in agricultural work. But our findings are in contrast to finding of Kristinsson J et al [7] and Alagozlo H et al [12] who reported that females outnumbered males. This may be due to fact that females prefer toxic ingestion for inflicting self-harm relative to males and this finding might reflect a tendency by females to use deliberate ingestion as a help seeking behavior in stressful situations. [13]

In this study maximum numbers of cases were observed in age group 21–30 years (35.01%) similar to other observations. [2, 9, 10] This may be due to social or familial problems as this age group is suffering from all types of stress and strain i.e. domestic, economic, unemployment, educational, dowry, marital conflicts, failure in love etc.

In our study maximum number of cases (31.06%) were having their educational qualification as higher secondary school certificate, intermediate, ITI in the present study. This finding of present study was consistent with study done by SK Dhattarwal [13] This may be due to fact that such incomplete educational status does not warrant sufficient economical outcome and satisfaction.

Similarly they may have false confidence about right or wrong things. In such situations, family conflicts and any other stressful situation may be a cause for impulse for suicide in these victims as they are immature to control anger and to bear stress.

In the present study only 19 (03.41%) cases were illiterate which was in contrast to findings of the study done by Dhattarwal SK [13] and Chaudhary BL et al [2]. It may be due to more knowledge of the poisons as compared to illiterate persons. Though Loni is a village in a rural area, it is an educational hub with more than 15 colleges and thousands of students and hence the surrounding rural population is literate. Hence in the present study the victims of poisoning were found to be literate.

In this study the numbers of poisoning cases were higher in farm owners, clerical, shop owners group and it was consistent with Bhatukule PR study. [11] This can be explained by the fact that major population of India mainly depends upon agricultural activities which in turn is affected by seasonal variation. So sometimes the farmers are able to grow their crops and sometimes they fail due to seasonal variations and irregularity of monsoon season.

This lead to less income compared to the hard work done, financial crisis, frustrations,

tensions etc. and in such situations, easy availability of agricultural chemical poisons due to their occupation makes them more vulnerable to consume poison. Students are exposed to educational stress, expectations from parents and in such situation, fear of examination or failure may provoke them to consume poison.

Similarly housewives also are one of the commonest victims of poisoning. As housewives are economically not independent and dowry demands are common in rural area. There is higher incidence of violence against women. So social and economic instability may leads to poisoning in housewives. As the professional group is socioeconomically sound, poisoning cases are not reported in this group.

The present study showed that maximum cases (52.07%) were from lower middle socio-economic class III which was consistent with others. [10, 13] The middle and lower socioeconomic group are more vulnerable for poisoning which may be due to the fact that they are under continuous financial and other stress during life.

In this study oral route (64.81%) was the commonest route of exposure to poison. Chavan KD et al [9] and Zariwala RC [4] also observed commonest route of exposure to poison as oral route in 89.13% and 90.3% cases respectively.

Reason for these differences in the percentage of oral route may be due to fact that these studies had excluded bites & sting i.e. snake bites, unknown bites and scorpion stings.

Bite & sting is one of the common routes of poisoning in this area as this rural area acts as a habitat for snakes. It signifies the need of more emphasis in treatment of poisoning by oral route as compared to others.

In spite of extensive search we could not compare distribution of poisoning cases according to category of poisons. Findings of the present study were similar to the Wananukul W et al study [14] in Thailand which showed that maximum cases were due to pesticides (41.5%).

But it was in contrast with the same study as regards the findings of animal bite and stings which were relatively less (2.7%) as compared to present study (34.29%).

This may be due to fact that present study was done in rural area of India where main occupation is farming and agriculture and most of the agricultural work is done manually leading to more exposure to animal bite and stings as compared to more use of machineries in agricultural works in western countries. Food poisoning and recreational and abused agents like alcohol and food poisoning were observed in

0.5% and 0.1% cases respectively which is comparable with the present study.

While use of household poisons (19.5%) and pharmaceutical products (18.7%) was more in Thailand as compared to our study which may be due to fact that this study was undertaken in a rural area so lack of awareness and knowledge about pharmaceutical drugs and household poisons might have played a role for less cases.

But our study was in contrast with Alagozlo H et al study [12] in Turkey which reported that maximum number of cases of poisoning were due to pharmaceutical drugs (54.8%) followed by plant poisons (10.9%).

This may be explained on the basis that the present study is carried out in rural region of India where agriculture sector is the commonest occupation and differences in agricultural practices allows a large number of population (farmers) an easy access to agrochemicals like pesticides in India while only few people in Western countries use agrochemicals like pesticides. As rural agricultural area acts as a habitat for animals like snakes, scorpion and other insects, more number of cases due to animal bites and stings were seen in this study.

In our study out of 557 cases maximum cases were of Organophosphorus insecticides consistent with other studies. [9-11, 15]

These compounds are easily available, commonly used in day-to-day life, economic, ideal for suicide and quick in action.

Sinha US et al [3] in Allahabad, UP observed maximum cases with Aluminium phosphide as Aluminium phosphide is widely used as grain preservative and fumigant in the North India. In contrast to present study Zariwala RC [4] in Ahmedabad, Gujarat observed maximum cases with acid-corrosives. This may be because of that study was carried out in metros where there are various industries.

Snake bites cases were of vasculotoxic snake bite (8.61%); neurotoxic (5.75%) and non-poisonous snake bite (9.87%). The present study was carried out in rural region of India and rural agricultural area acts as a habitat for animals like snakes. Findings of our study regarding the manner of death were consistent with findings of the other studies. [3, 9, 11]

However these authors have found a very high percentage of suicidal poisoning cases in their studies i.e. 89.13%, 92.8% and 87.02% respectively than in present study (50.81%).

This may be due to the fact that present study includes cases of snake bites, scorpion bites (stings) and unknown bites which were excluded by these authors. As these cases were

accidental in nature, this has resulted in lowering the percentage of suicidal poisoning in the present study. Due to the very same reason the percentage of accidental poisoning in the present study was much higher than that reported by above mentioned authors.

Though manner of poisoning decided on the basis of history given by patient, relatives and investigating agencies and inquest, final decision by judiciary is not taken in to account. This is a limitation of this study.

### Conclusion:

The present study helps to interpret the trends of poisoning in this greenbelt. It is imperative to identify these changing trends in poisoning, as it will immensely help the health policy makers to equip health care institutions accordingly for better management; thereby reducing the mortality.

### References:

1. Dogra TD, Rudra A. editors. Lyon's Medical Jurisprudence & Toxicology. 11<sup>th</sup> edition; Delhi (India): Delhi Law House; 2007. P. 1065-1079.
2. Chaudhary BL, Singh D, Tirpude BH. Trends of poisoning in the Kasturba hospital, MGIMS, Sevagram. Int. J Med Toxicol. Legal Med 2005 Jan-Jun; 7(2):13-17.
3. Sinha US, Kapoor AK, Agnihotri AK, Srivastava PC. A profile of poisoning cases admitted in SRN Hospital, Allahabad with special reference to Aluminium Phosphide poisoning. JFMT 1999 Jan-Jun; 16(1):40-43.
4. Zariwala RC, Merchant SP, Mehta T, Bhise R. Trends of poisoning in Ahmedabad. JIAFM 2009 Apr-Jun; 31(2):125-132.
5. Reid HA. Snake bites in tropics. Br Med J 1968; 3: 359-362.
6. Marquardt H. 'Toxicology'. London: Academic Press; 1999: p.968-971.
7. Kristinsson J, Palsson R, Gudjonsdottir GA, Blondal M, Gudmundsson S, Snook CP. Acute poisonings in Iceland: A prospective nationwide study. Clin. Toxicol. 2008; 46:126-132.
8. Suryakantha AH. Community Medicine with Recent Advances. 1<sup>st</sup> ed. New Delhi, Jitendar P Vij, Jaypee Brothers Medical Publishers (P) Ltd; 2009. P.659-660.
9. Chavan KD, Kachare RV, Goli SK. A retrospective study of acute poisoning in adult- In rural region of Beed district of Maharashtra. JMLAM 2002 Dec; 14(1-2):7-9.
10. Dash SK, Raju AS, Mohanty MK, Patnaik KK, Mohanty S. Socio-demographic profile of poisoning cases. JIAFM, 2005; 27(3):133-138.
11. Bhatkule PR. Poisoning cases in Yavatmal Medical College, July 2004-June 05. In Suicide of farmers in Maharashtra: Background Paper Submitted to the Government of Maharashtra by Indira Gandhi Institute of Development and Research (IGIDR), Mumbai 2005 July [cited 2010 25 Nov 25];p.125-130. Available from: URL:[http://www.igidr.ac.in/suicide/BackgroundPapers\\_SFM\\_IGIDR\\_26Jan06.pdf](http://www.igidr.ac.in/suicide/BackgroundPapers_SFM_IGIDR_26Jan06.pdf)
12. Alagozlo H, Sezar H, Candan F, Tabak E, Eladi N. A survey of patients with acute poisoning in the Sivas region, Turkey, between 1994 and 1998. Turk J Med Sci. 2002; 32:39-42.
13. Dhatterwal SK, Singh H. Profile of deaths due to poisoning in Rohtak, Haryana. JFMT 2001 Jul-Dec; 18(2):28,29.
14. Wananukul W, Sriapha C, Tongpoo A, Sadabthamarak U, Wongvisawakorn S, Kaojarern S. Human poisoning in Thailand: The Ramathibodi Poison Center's experience (2001-2004). Clin. Toxicol. 2007; 45: 582-588.
15. Taruni NG, Bijoy TH, Momonchand A. A profile of poisoning cases admitted in RIMS hospital, Imphal. JFMT 2001 Jan -Jun; 18(1):31-33.

## Original Research Paper

# Study of Unnatural Deaths in Married Females Within Seven Years of Marriage in Allahabad

<sup>1</sup>Rajesh Kumar Verma, <sup>2</sup>P.C. Srivastava, <sup>3</sup>U.S. Sinha, <sup>4</sup>Archana Kaul

### Abstract

Throughout most of India's history, women have been targeted as unimportant, burdensome, and disposable. This tragedy begins shortly after conception and continues until their death. A prospective cross-sectional study was carried out comprising 221 medico-legal cases of unnatural death of females within seven years of their marriage brought to the mortuary at S.R.N. Hospital, Allahabad, Uttar Pradesh for autopsy during one year study period. Amongst 864 female victims, 467 females were married and 221 females died within seven years of their marriage. Maximum number of death (56.56%) occurred between 18-25 years of age and that too within first 3 years of marriage (57.47%). Accidental burn was most common cause of death and most common manner of death was suicide (47.98%) followed by accident (42.07%) and homicide (9.95%). Quarrel with husband/ in-laws and dowry demand by husband or his family members were two important reasons behind suicidal as well as homicidal deaths. 15.84% cases were labelled as Alleged Dowry Deaths. Comprehensive study was done revealing the need of various socio-cultural and legal measures to be taken to handle the grave results of this study.

**Key Words:** Within seven years of marriage, Burn, Dowry death, Socio-cultural and legal measures

### Introduction:

Manu, the great law-giver, said "*Yatra Naryastu Puiyante, Ramante Tatra Devata*" meaning the Gods reside in places where women are worshipped. The worth of a civilization can be judged by the place given to women in the society. One of several factors that justify the greatness of India's ancient culture is the honorable place granted to women.

During the Vedic period, women had equal rights and status with men. Widows were permitted to re-marry; they enjoyed equality in the learning of Vedas and in the performance of religious rituals, as Vedic religion required the performance of rituals jointly by husband and wife. In the post-Vedic period between 1000 B.C. and 200 A.D., the status of women suffered a set-back when their role got restricted to the four walls of their home.

The status of women in India has been subject to many great changes over the past few millennia. From equal status with men in ancient times through the low points of the medieval period to the promotion of equal rights by many reformers, the history of women in India has been eventful. However, women in India continue to face discrimination and other social challenges and are often victims of abuse and violent crimes. Indians' attitudes towards women have always been under scrutiny and crimes against women have galvanised India at many moments of time. Women always have been at receiving end of male dominated society.

Types and trends of crime however, kept changing with change in mind-set and techniques. Death is called unnatural if it results directly from an injury or poison or indirectly an injury which may precipitate pre-existing natural disease in an individual. In other words, death is unnatural when caused prematurely against the order of nature by injury, poison or other means of violence. This could be homicidal, suicidal, accidental or of unexplained origin.

In our Indian set-up, the enormous numbers of deaths in females occur in unnatural conditions and among young married women, "Bride burning" commonly known as dowry deaths assumes much importance. In the present Indian scenario, dowry death is a buzz word because the incidents are increasing leaps

---

### Corresponding Author:

<sup>1</sup>Assistant Professor,  
Department of Forensic Medicine & Toxicology  
Rohilkhand Medical College and Hospital, Bareilly  
E-mail: drkverma2910@gmail.com

<sup>2</sup>Prof, Dept. of FMT  
Rohilkhand Medical College and Hospital, Bareilly

<sup>3</sup>Professor, Dept. of FMT  
M. L. N. Medical College, Allahabad, UP

<sup>4</sup>Assist. Professor, Dept. of FMT  
M. L. N. Medical College, Allahabad, UP  
DOR: 24.07.2014 DOA: 10.08.2015  
DOI: 10.5958/0974-0848.2015.00105.0

and bounds and the number of dowry deaths has reached an alarming proportion.

Dowry deaths or suicide by young married women consequent to their cruelty or harassment by the husband or in-laws constitutes a slur on Indian society.

### **Material and Methods:**

This study was a prospective cross-sectional descriptive study comprising the profile of all medico-legal cases (n=221) of unnatural deaths of married females within seven years of their marriage who were brought to the mortuary at the S.R.N. Hospital/ M.L.N. Medical College, Allahabad, Uttar Pradesh for medico-legal autopsy during the study period of one year extending from 11<sup>th</sup> April, 2012 to 10<sup>th</sup> April, 2013. Permission from Institutional Ethical Committee was taken for the same.

The unidentified bodies and bodies in advanced state of decomposition, and the cases where death was opined to be due to a natural cause after the autopsy were excluded from the sample of study.

A standard proforma was used to collect information regarding age, socio-economic background, education, occupation, marital status, residential status and manner of death after detailed enquiry with investigating officers, relatives and friends and hospital records of the deceased. Standard autopsy protocol was followed and relevant samples/ viscera subjected to chemical analysis and histopathology to arrive at a conclusion.

Number of dowry deaths comprised those alleged cases in which F.I.R. was lodged under Sec. 304-B I.P.C. before autopsy as well as any natural cause of death was excluded in those alleged cases after autopsy.

### **Observations and Results:**

During the study period of one year extending from 11<sup>th</sup> April, 2012 to 10<sup>th</sup> April, 2013, a total of 2857 autopsies were done at mortuary, S.R.N. Hospital, Allahabad with 1993 (69.76%) male victims and 864 (30.24%) female victims, which gave a male-to-female ratio of 2.3:1. Amongst 864 female victims, 467 females were married and 221 females died within seven years of their marriage. So the percentage of death of females within seven years of marriage out of total female mortality was found to be 25.58% and that out of total unnatural deaths during study period was 7.74%.

In the present study, maximum number of deaths (56.56%) occurred between 18-25 years of age and least (5.43%) in the age-group 31-35 years. (Table 1) In our study maximum number of death occurred within first 3 years of

marriage 127 (57.47%) cases, among these, 41 (18.55%) in first years, 52 (23.53%) cases in 1-2 years and 34 (15.38%) in 2-3 years, and only 14 (6.34%) cases in 6 to 7 years of marriage. (Table 2)

Majority of the victims were Hindu (79.64%) and used to live in the rural areas (66.52%). During this study period, no unnatural death was reported from the Sikh community while only one Christian female died within seven years of her marriage and she belonged to urban area of Allahabad. (Table 3 & 4)

In our study maximum numbers of cases were either illiterate (35.75%) or just educated up to primary standard (25.79%). Only two victims (0.90%) were graduate and belonged to Hindu community from urban area whereas one (0.45%) was post-graduate and belonged to Christian community from urban area. (Table 5)

Present study showed that most of the cases were seen from lower socio-economic strata (37.10%) and lower middle socio-economic strata (35.29%) whereas only two cases (0.90%) were seen from upper socio-economic strata. (Table 6)

Almost all the marriages were arranged and 184 cases (83.26%) belonged to joint type of family. (Table 7) The distribution of cases according to cause of death in this study showed that burns was the leading cause of death (39.82%) cases followed by death due to road traffic and railway track injuries (19%) cases.

Hanging was found as a cause of death in 18.56% cases, strangulation/ throttling 4.07% cases, drowning 2.26% cases, stampede only 1.81% cases, electrocution 1.36% cases and one case each died due to gun-shot injury and anaesthesia-cum-operative procedure related cause for which the case was registered under sec. 304-A I.P.C. In 12.22% cases, the cause of death was concluded as a result of poisoning on the basis of history, police-inquest papers, hospital records (if available), remaining part/ source of poison and suggestive autopsy findings. However, viscera were preserved and sent to FSL for toxicological analysis to confirm the suspicion of poisoning.

As per the history, circumstantial evidences and post-mortem findings, it was noticed that in most of the victims the manner of death was suicide (47.98%) followed by accident (42.07%) and homicide (9.95%). (Table 8)

In suicidal cases, hanging was the commonest (18.56%) cause of death, followed by burning (13.12%) and poisoning (11.32%). Quarrel with husband/ in-laws (49.06%) and excessive dowry demand by husband or his family members (32.07%) were two important

reasons behind suicidal deaths. In homicidal cases also, burning was the commonest (5.43 %) cause of death, followed by strangulation/ throttling (3.62 %) and failure to fulfil dowry demands (31.82%) & quarrel with husband/ in-laws (27.28%) were main reasons behind murders. Majority of accidental deaths were due to burning (21.27%) followed by deaths due to road traffic and railway track injuries. (Table 9)

Out of 221 cases of unnatural death of married females within seven years of marriage, a total of 35 cases (15.84%) were labelled as Alleged Dowry Deaths in which F.I.R. was lodged under sec. 304-B I.P.C. before autopsy as well as any natural cause of death was excluded after autopsy. Burning constituted the maximum number of dowry deaths 15 (42.86%), followed by poisoning 11 (31.43%) cases, hanging 4 (11.43%) cases, throttling 4 (11.43%) cases and injuries by assault 1 (2.85%) case.

In this study 68.57% cases were suicidal and again the burning was most common (31.43%) cause of these alleged dowry deaths followed by poisoning (25.71%) and hanging (11.43%). Remaining 31.43% cases were homicidal in nature, and burning and throttling each method had the equal share (11.43%) with regards to the cause of death followed by the poisoning (5.71%). (Table 10)

### **Discussion:**

The high incidence of unnatural death in young Hindu females belonging to rural areas, within 3 yrs of their marriage was most probably due to unending demands of dowry (cash/ kinds) by their husbands and/or in-laws, for which they sometimes kill or torture the bride in such a way that she commits suicide, which is consistent with other authors findings [1-9].

The other reason was of higher incidence of accidental deaths of females in this age was due to kitchen accidents as well as involvement and exposure of young married females to the outdoor world.

The higher incidence of unnatural death in illiterate and low-standard educated population was due to the more number of the cases belonging to rural areas [7,8] and lower as well as lower middle socio-economic strata. [3, 4] However, study of Srivastava & Arora [1] showed that incidence of death in married females was higher in lower middle socio-economic and middle socio-economic strata and this dissimilarity with our findings could be due to more urban population in their study.

With respect to duration of married life, our findings were similar with others. [1, 3] Religion wise distribution of cases showed the

results similar to those of others [9,10]. However, the findings were in slight variance with the work of Kulshrestha et al [2] who observed in their study that 88% affected females belonged to Hindu followed by 10.25% Muslims and 1.7% Sikhs.

Sinha et al [4] found 94.9% Hindus, 4.22% Muslims, 0.53% Sikhs and 0.35% Christians in their study. Very low population and higher and professional qualification and cultural differences may be responsible for no case having been reported from Sikh religion.

The incidences of cause of death in female showed that in maximum cases, the victims had died due to burns, followed by injuries sustained. Burns as a major cause of death in females was also concluded by other authors in their study [2-6] but this was in variance with the study of Lalwani [11] observed that vehicular accidents (32.6%) followed by hanging (17.3%), poisoning (12.6%) and burns (n = 123; 10.2%) as the common modes of unnatural deaths in females. In another study, poisoning was most common cause of death followed by thermal injuries. The difference in the observation and result with other studies could be due to deficient availability of poisons and the fact that in our study, more victims belonged to rural areas and constitute major chunk to lower sections of the society. Amongst the cases of deaths due to burn, accident was the most common manner of death and homicide was the least common manner of death.

In the present study, the higher incidence of accidental deaths due to burn in young, newly married females from lower socio-economic class, helps to emphasize the fact that the burn fatalities in India go beyond the meaning implied in the term 'accident' to be aptly termed as a 'Social Calamity'. These deaths in general and homicidal and suicidal burn deaths in particular have genuinely been termed as 'Bride Burning' or 'Dowry Deaths'. The high incidence of burn deaths, especially among the young females is often attributed to cooking on open unguarded flames. Loose, voluminous, highly inflammable, synthetic garments / saris of the victims are alleged to catch fire suddenly while cooking.

Kerosene oil, match sticks, and other cooking material, being easily available in houses, is usually preferred by Indian women to commit suicide, and as for killing, it helps to hide not only the torture and other means of violence but also helps to tamper with or even destroy the circumstantial evidences. Moreover, the most common manner of burns was accidental

followed by the suicidal and homicidal types as per the reports, but these data may not be factual due to under reporting.

In India, many deaths are not registered as suicide due to fear of social and legal consequences associated with the same (IPC 306 and 309). Same was the opinion and findings of Batra [12], Ambade & Godbole [13], Singh et al [14] and Singh et al [15].

Hanging was concluded as a cause of death in 18.56% victims, almost similar to Srivastava et al [1] (29.37% cases) and Kulshrestha et al [2] (11.96%), while Sinha et al [4] noticed hanging as a cause of death in 4.22% cases and Sharma et al [3] in 3.81% cases.

Drowning was found as a cause of death in 2.26% cases, which was in variance with that noticed by Sharma et al [3] in 1.0% cases and Srivastava & Arora [1] in 0.7% cases and this variation can be attributed to the fact that Allahabad is situated at and near the banks of rivers the Ganges and the Yamuna, and also the occurrence of mega event Mahakumbh during the study period, making people more prone for accidental and suicidal drowning.

Our study included 1.81% cases due to stampede that broke out at railway station, Allahabad on 10 Feb., 2013 during the grand organisation of Mahakumbh.

Due to the huge number of attendees stampedes are relatively common during Kumbh Mela festivals. The 1954 KumbhMela stampede was the deadliest since India's independence, with an estimated 1,000 deaths.

The 2003 KumbhMela stampede killed 39 people in the city of Nashik, and seven were killed during the 2010 KumbhMela in Haridwar [16]. Quarrel with husband/ in-laws and dowry demand by husband or his family members were two important reasons behind suicidal as well as homicidal deaths and this finding was consistent with other authors too. [2]

Prajapati et al [17] and Kailash et al [18] observed that dowry demand, ill treatment by in-laws, rash and negligent behaviour of husbands and infidelity were the most common reasons for unhappy married lives in all such cases.

The findings of present study were similar to the findings of many other authors [7, 8, 19, 20] as far as age, community, habitat and manner of alleged dowry death was concern. India's National Crime Records Bureau reported that 8,233 Indian women were killed in 2012 in dowry-related violence, or nearly one per hour. [21, 22] The incidence of dowry deaths grew by nearly 3% over the previous five years, and torture at the hands of a husband or family increased by 5.4%, with 99,135 cases reported

by survivors in 2011.

The scope of the problems is likely to be wider than the statistics suggests, as many women and their parents are reluctant to seek prosecution for fear of scandal that would destroy their other daughters' chances of getting married, analysts say. Sociologists and women's rights advocates attribute the disturbingly persistent trends to rising consumerism in India, where once-scarce and unaffordable goods like appliances and motor vehicles are now available but still beyond the reach of many families.

### Conclusions:

In spite of stringent laws and their amendments, awareness programs and specialized cells, incidence of unnatural female deaths is continuously increasing. The prevailing system of dowry, which is mainly responsible for all such deaths, is a product of emerging capitalist ethos the offshoot of an unequal society, a result of rampant consumerism, aided and abetted by the black market economy.

Its increasing incidence is symbolic of continuing erosion and devaluation of women's status in independent India. Now the time has come to pay sincere attention and take important stringent and strict social and legal measures by the government and law enforcing agencies so that we can save our sisters' and our daughter's lives from devil of Dowry !

### References:

1. **Srivastava AK & Arora P.** Suspicious deaths in newly married females - a medico legal analysis. JIAFM. 2007; 29(4): 63-67.
2. **Kulshrestha P, Sharma RK and Dogra TD.** The study of sociological and epidemiological variables of unnatural deaths among young women in South Delhi within seven years of marriage. JPAFMT. 2002; 2: 7-17.
3. **Sharma BR, Singh VP, Sharma R and Sumedha.** Unnatural deaths in northern India - A profile. JIAFM. 2004; 26(4): 140-46.
4. **Sinha US, Kapoor AK and Pandey SK.** Medico legal aspects of dowry death cases in Allahabad range (UP). Int J of Med Toxicol & Legal Med. 2002; 5(1): 35-40.
5. **Sharma BR, Harish D, Sharma A, Sharma and Singh H.** Accidental burns in Indian kitchen; Are they really accidents? JIAFM. 2006; 28(1): 14-17.
6. **Ghaffar UB, Husain M and Rizvi SJ.** Thermal burn: An epidemiological prospective study. JIAFM. 2008; 30(1): 10-14.
7. **Kumar V, Tripathi CB, Kanth S.** Burn Wives - A Sociologic Study. International Journal of Medical Toxicology & Legal Medicine. 1999; 2(1): 18.
8. **Saha KK, Mohanty S.** Alleged Dowry Death: A study of homicidal burns. Med. Sci. Law. 2006; 46 (2):105.
9. **Agnihotri A.** The Epidemiological Study of Dowry Death Cases with Special references to burn cases in Allahabad zone. Anil Aggarwal's Internet Journal of F.M & T. 2001; 2 (1).
10. **Satpathy DK.** Burning Brides - A medicolegal study. Med Law. 14: 547-52.
11. **Lalwani S.** Profile of unnatural deaths of females at AIIMS - A retrospective review. FORENSICON 2001, 49.
12. **Batra AK.** Burn mortality: recent trends and sociocultural determinants in rural India, Burns; May 2003; 29(3): 270-5.
13. **Ambade VN, Godbole HV.** Study of burn deaths in Nagpur, Central India. Burns. Nov 2006; 32(7): 902-8.



14. Singh D, Jash P, Tyagi S. Recent trends in burn mortality in northwest India and its preventive aspects. JIAFM. 1998; 19(4): 79-88.
15. Singh D, Singh A, Sharma AK, Sodhi L. Burn mortality in Chandigarh zone: 25 years autopsy experience from a tertiary care hospital of India. Burns. Mar 1998; 24(2): 150-56.
16. "Why We Shouldn't Be Surprised by the KumbhMela Stampede". *Wall Street Journal*. 2013-02-11. Retrieved 2013-02-12.
17. Prajapati P, Prajapati S, Pandey A, Joshi V, and Prajapati N. Pattern Of Suicidal Deaths in Females of South Gujarat Region. NJMR. Jan – March 2012; 2(1): 31-34.
18. Kailash UZ, Mugadlimath A, Gadge SJ, Kalokhe VS, Bhusale RG. Study of some socio-etiological aspects of unnatural female deaths at Government Medical College, Aurangabad. JIAFM. 2009; 31(3): 210-17
19. Sharma BR, Harish D, Singh VP, Bengar S. Septicemia as a cause of death in burns: an autopsy study. 2007; PMID:16797127 [PubMed - indexed for MEDLINE]
20. Agnihotri AK, Sinha US, Kapoor AK, Srivastava PC. The epidemiological study of dowry deaths with special reference to burn cases in Allahabad range (UP). International Journal of Medical Toxicology and legal Medicine. 1998; 1(1): 65-71.
21. Crime against Women (Chapter-5) in Crime in India 2012. National Crime Records Bureau, Ministry of Home Affairs. p. 81-84. Available from: <http://ncrb.nic.in/CD-CII2012/cii-2012/Chapter%205.pdf> accessed on 22/06/2015.
22. Dowry deaths: One woman dies every hour. The Times of India. Sept. 1, 2013. Available from: <http://timesofindia.indiatimes.com/india/Dowry-deaths-One-woman-dies-every-hour/articleshow/22201659.cms> accessed on 22/06/2015.

**Table 1: Age wise Distribution of the Victims**

Age-group (yrs)	Cases	Percentage (%)
18-25	125	56.56
26-30	84	38.01
31-35	12	5.43
Total	221	100

**Table 2: Duration since Marriage of Victims**

Duration of marriage (Yrs)	Cases	Percentage (%)
<1	41	18.55
1-2	52	23.53
2-3	34	15.38
3-4	23	10.41
4-5	26	11.76
5-6	31	14.03
6-7	14	6.34
Total	221	100

**Table 3: Religion of Victims**

Religion	Cases	Percentage (%)
Hindu	176	79.64
Muslim	44	19.91
Christian	01	0.45
Sikh	00	00
Total	221	100

**Table 4: Residential Status of Victims**

Residential status	Cases	Percentage (%)
Rural	147	66.52
Urban	74	33.48
Total	221	100

**Table 5: Educational Status of Victims**

Educational status	Cases	Percentage (%)
Illiterate	79	35.75
Primary	57	25.79
Jr. High School	36	16.29
High School	29	13.13
Intermediate	17	7.69
Graduate	02	0.90
Post-graduate	01	0.45
Total	221	100

**Table 6: Socio-economic Status of Victims**

Socioeconomic status	Cases	Percentage (%)
Lower (Class V)	82	37.10
Lower middle (class IV)	78	35.29
Middle (class III)	41	18.56
Upper middle (class II)	18	8.15
Upper (class I)	02	0.9
Total	221	100

**Table 7: Type of family of victims**

Type of family	Cases	Percentage (%)
Joint	184	83.26
Nuclear	37	16.74
Total	221	100

**Table 9: Reasons behind Suicidal and Homicidal Deaths**

Reason	Manner of Death	
	Suicide (%)	Homicide (%)
Quarrel with spouse/ in-laws	52(49.06)	06(27.28)
Dowry demands	34(32.07)	07(31.82)
Infertility in females	01(.95)	02(9.09)
Extra-marital affairs	00(00)	01(4.54)
Chronic illness	07(6.60)	00(00)
Property disputes	00(00)	01(4.54)
Not known	12(11.32)	05(22.73)
Total	106(100)	22(100)

**Table 10: Cause and Manner of Death in Cases of Alleged Dowry Deaths**

Cause of Death	Manner of Death		
	Suicide (%)	Homicide (%)	Total (%)
Burning	11(31.43)	04	15
Poisoning	09(25.71)	02(5.71)	11(31.43)
Hanging	04(11.43)	00(00)	04(11.43)
Strangulation	00(00)	04(11.43)	04(11.43)
Assault	00(00)	01(2.86)	01(2.85)
Total	24(68.57)	11(31.43)	35(100)

**Table 8  
Cause and Manner of Death of Victims**

Cause of Death	Manner of Death			
	Suicide	Accident	Homicide	Total
Burning	29(13.12)	47(21.27)	12(5.43)	88(39.82)
Road traffic and railway injuries	08(3.62)	34(15.38)	00(00)	42(19.0)
Hanging	41(18.56)	00(00)	00(00)	41(18.56)
Strangulation	00(00)	01(.45)	08(3.62)	09(4.07)
Drowning	03(1.36)	02(.90)	00(00)	05(2.26)
Stampede	00(00)	04(1.81)	00(00)	04(1.81)
Poisoning	25(11.32)	02(.90)	00(00)	27(12.22)
Others	00(00)	03(1.36)	02(.90)	05(2.26)
Total	106(47.98)	93(42.07)	22(9.95)	221(100)

## Review Research Paper

# Patient Autonomy and Informed Consent: The Core of Modern Day Ethical Medical

<sup>1</sup>Dasari Harish, <sup>2</sup>Ajay Kumar, <sup>3</sup>Amandeep Singh

### Abstract

The UN Charter of Human Rights says: "All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood." In the words of Judge Cardozo, "Every human being of adult years and sound mind has a right to determine what shall be done with his own body; a surgeon who performs an operation without his patient's consent commits an assault, for which he is liable". This in complete contradiction to the Hippocratic Oath, which is the Oath taken by most medical graduates in the world.

The most important principle for modern medical ethics is respect for patient autonomy, informed consent and patient confidentiality. The goal of informed consent is to respect patient autonomy and enable him to make decisions regarding his medical care, of his free will, without coercion, after understanding fully what he is consenting for. The Principle of Autonomy, its implications on informed consent and patient care situations will be dealt with in this paper.

**Key Words:** Principle of Autonomy, Informed Consent, Ethical Medical Practice, Patient Autonomy,

### Introduction:

The Original Hippocratic Oath states: "I swear by Apollo and Aesculepius that I will follow that system of regimen which according to **my** judgment **I** consider best for the benefit of **my** patients.... **Conceal** most things from the patient.....give necessary orders with cheerfulness and serenity....**revealing nothing** of the patient's future or present condition". [1]

We have come a long way from that Paternalistic approach to the present, as exemplified by the words of Judge Cardozo in *Schloendorff vs. Society of New York Hospital* (1914, US)[2] and the United Nations Universal Charter of Human Rights adopted by the General Assembly in 1948. [3]

The foundation of modern day bioethics stands on four principles enunciated by Beauchamp and Childress [4]: Autonomy, Beneficence, Non-maleficence and Justice. They have withstood challenge for nearly three decades and still form the basis for most decision making in both clinical practice and biomedical research.

They have withstood challenge for nearly three decades and still form the basis for most decision making in both clinical practice and biomedical research. Collectively, these four have been termed as 'principilism'. [5]

**Autonomy** requires the ability to decide for the self, free from control of the others, and with sufficient level of understanding so as to arrive at a meaningful choice. [6] A person should have the capacity to decide upon a course of action, and to put that plan into action.

**Beneficence** implies that we "do good" for the others and contribute towards their well being. In order to give the "optimum" good to the patient, the doctor should be able to understand "how much" good would give the best result to the patient; that is; he should weigh the benefits with the risks involved and then act accordingly.

However, Beneficence is hindered by Autonomy. It is not ethical to "do good" for the patient without obtaining an informed consent from him. Determining what is "good" to oneself is that person's personal decision and that may differ from what the doctor/ relatives etc, think would be best for the patient.

**Non-maleficence:** "Primum non nocere" – 'first does no harm', is another guiding principle of bioethics. It may also be taken to represent the risk side of risk-benefit analysis of any regimen. Whatever the doctor does for the patient should be done in 'Good Faith' and for his good health only.

---

### Corresponding Author:

<sup>1</sup>Prof & Head

Dept. Forensic Medicine & Toxicology,  
Govt. Medical College & Hospital, Chandigarh  
E-mail: dasariharish@gmail.com

<sup>2,3</sup>Assoc. Prof, Dept. of FMT

DOR: 20.04.2015 DOA: 13.08.2015

DOI: 10.5958/0974-0848.2015.00106.2

[S. 52 IPC] [[7] states: Nothing is said to be done or believed in good faith if it is not done or believed with due care and attention. **Justice** addresses the question of

- a. Distribution of scarce health care resources.
- b. Respect for people's rights and
- c. Respect for morally acceptable laws.

It is also one of the toughest Principles of Bioethics as it raises one serious question – Is there a universal right to health care?

If there is not, how to provide care for those who cannot afford it? If there is, to what level in such case to be offered and who will fund it? How will fairness be ensured? [5]

### **The Principle of Autonomy:**

The Greek definition of Autonomy implies “Self-rule & Self-determination”, which comes from the term “autos nomos”.

It implies that the doctor is obligated not only to respect the free choice of his patient, but more importantly, to facilitate in every reasonably possible way the making of such a free choice by the patient. Autonomy is the capacity for self-determination.

To respect a person's autonomy is to acknowledge his right to make choices and take action based on his own values and belief system. The principle of respect for autonomy implies that one should be free from coercion in deciding to act, and that others are obligated to protect confidentiality, respect privacy, and tell the truth. Respect for patient autonomy involves not only ethical obligations to respect patient choices, but also obligation to promote both patient autonomy and autonomous choice.

In the practice of health care, a person's autonomy is exercised through the process of obtaining informed consent. Patients who do not comply with the instructions given by the doctor or who refuse investigations/ blood transfusions, etc. pose a great challenge for their doctors.

The main reason is that non-compliance generally leads to undesirable/ bad medical outcomes; whereas patient's good health is the main goal of the physician. Hence, these doctors tend to develop a “paternalistic” attitude towards their patients and try to influence/ manipulate/ or outright coerce the patients into following the treatment regimen to the hilt.

Many doctors/ health care workers tend to override the patient's autonomous decision in the mistaken belief that their primary duty is the good, healthy outcome for their patient. This is an instance of ‘**Medical Paternalism**’, which, according to Zenbaty: [8] “Paternalism is the interference with a patient's autonomy justified by reasons referring exclusively to welfare;

good, happiness, needs, interests, or values of the person being constrained.”

Even with such justifications, paternalism presents number of moral problems and has been held to be an unethical practice. It negates patient autonomy completely and is considered an unethical practice. Such doctors do not respect their patients as autonomous individuals and perceive informed consent as a mere legal formality designed to protect them from malpractice litigations.

Failure to obtain informed consent of the patient is an infringement on the autonomy of the patient, regardless of the fact whether a potential for harm exists and is a failure on part of the doctor to respect a patient as an equal individual. Even when only one type of medical treatment available to the patient, he still has two choices: Accept/ Refuse the said treatment.

Thus, the principle of beneficence appears to contradict the principle of patient autonomy. But, both these principles, when brought to play in such a way as to complement each other, form the basis for another very important concept of Bioethics Informed Consent. The doctor explains to the patient in a simple, clear, non technical language the ailment/ disease condition he is suffering from, the proposed treatment which the doctor thinks is the best for the patient, the proposed cons (including risks, etc), alternatives, prognosis with the proposed plan and without it.

The patient, after understanding the whole proposed treatment regime and after satisfying himself completely, makes a decision- accepting or refusing the same. The doctor has to abide by this decision.

Informed consent is not just a legal duty to warn the patient about potential risks and obtain this signature on the dotted line. It is not just a formality for ensuring that the “conditions of understanding between the doctors and his patient are placed in writing”. [9]

It is a process that underlies the doctor - patient relationship an ongoing “dialogue” between the patient and his doctor and not merely a dateable event that occurs when ever a decision must be made because of the potential harmful consequences. [10]

It brings about a different equation to the doctor-patient relationship: one based on mutual trust and respect. It becomes an ongoing dialogue where in the risks and benefits of all treatment alternatives are explained and explored so as to customize (tailor) the same for the patient, keeping in view his personal values, interests and goals.

The principle of autonomy also places important responsibilities on the patient. The most important of these is the fact that the patient accepts responsibility for his own decisions. Once, it is clear that there was no deception /manipulation /undue influence/ coercion and that there was no negligence on part of the doctor, once an autonomous decision is made by the patient, the responsibility for all the consequences of that decision lies with him only. This responsibility does not shift even if the decision so taken was "medically in correct."

The second responsibility of the patient is to "contribute freely and truthfully to the going medical dialogue" for obtaining his informed consent. [11]

One important duty of an individual is to respect other individuals as beings with dignity. This implies that a person should respect another person's decisions and not override those decisions.

It means that no person should use another as merely a means to achieve some result, even if that result benefits the other person. By doing so, the patient is not perceived as an individual with dignity. Hence, the principal foundation of informed consent is the principle of autonomy; the primary goal is the protection and enhancement of autonomy.

In *Harnish vs. Children's Hospital Medical Center* [12], the court ruled: "A physician owes to his patient the duty to disclose in a reasonable manner all significant medical information that he possess or should reasonably possess that is material to an intelligent decision by the patient whether or not to undergo that procedure". It is important for the physician to understand that for proper decision making, 'not all medical facts are material ones and not all material facts are medical ones'.

Let's take an example: Ankita and Harleen are 39 years old and both are diagnosed as case of breast cancer (2 cm lump). They were told by their doctors that they have two choices, each with almost similar cure rates: Lumpectomy with adjunctive chemotherapy or mastectomy with chemotherapy. Ankita decides to undergo lumpectomy as she is more interested in having minimal recovery time and a minimal surgical scar, confident in the belief that there would be almost no recurrence.

Harleen is also worried about the surgical scar and recovery time but she is afraid of recurrence as her mother died of breast cancer after protracted treatment and suffering.

She hence, goes for bilateral mastectomy to ease her fears of recurrence.

Even though the facts are the same for both the ladies, their decisions are different, based on non-medical issues: minimal recovery period and surgical scar for Ankita and the past experience of her mother's prolonged fight with breast cancer for Harleen.

### Components of Patient Autonomy:

Patient autonomy includes **confidentiality** and their **right to privacy** regarding their body, health information and their decisions. When they choose to surrender some of their privacy, they expect that what they say or what is done to them is kept confidential.

This expectation dates way back to the Hippocratic Oath [3], when physicians were cautioned not to disclose what was said to them in confidence by their patients – "And whatever I shall see or hear in the course of my profession, as well as outside my profession in any interaction with men, if it be what shall not be published abroad, I will never divulge, holding such things to be holy secrets..."

The Oath by Charaka, [13] which predates the Hippocratic Oath says, "..... The peculiar customs of the household of the patient shall not be made public..."

What about patient confidentiality in today's world of electronic record maintenance, billing, etc and the Right to Information Act? [14] Electronic data can be retrieved/ and is being retrieved by unauthorized personnel and hackers for reasons best known to them. The RTI Act has made it possible for 3<sup>rd</sup> party persons to have access to one's medical record on one ground or the other.

The wards, OPDs, semi private/ private rooms and corridors of the hospitals are usually full of relatives/ friends of the patients, other patients, their relatives and friends, etc making it almost impossible to maintain strict confidentiality while dealing with a patient.

The case file needs to be sent to different investigative departments. Paramedical staff, OT attendants, pharmacy, laboratories, etc all have to be given information regarding the case to enable them to do their part in the whole treatment regimen. Number of hospitals post OT lists on the notice board near their OT, detailing the patient's particulars, ailment and surgery to be performed for the convenience of the staff and the relatives. But what if someone with an ulterior motive got hold of a copy of that OT list or for that matter someone, whom the patient did not want to know, reads the list and gets to know of the patient's condition? All these compromise the patient confidentiality and require special care to be taken by the treating doctor in a bid to

protect it. Otherwise, patients, in the fear of their secrets becoming public would not approach the doctor with their ailments and problems, resulting in more harm than good and completely negating both the principles of autonomy and beneficence.

**Truth telling (Veracity)** is another vital ingredient of Autonomy. A patient expects that his doctor give him truthfully, without mincing words, a clear picture of his condition.

The fiduciary genre of the doctor-patient relationship demands that the physician owe the highest degree of fidelity, honesty and lack of self-interest to his patient. However, absolute truth may not be digestible to the patient and may actually be harmful to him.

That is when; the doctor can invoke the **Doctrine of Therapeutic Privilege** and refrain from telling the whole truth to the patient. [If the doctor is of the opinion that disclosure of the complete information can seriously harm the patient's life, he has the privilege to withhold such information, but he has to take any of the close relatives of the patient in to confidence and share this information with them; otherwise he cannot claim this privilege.]

Many doctors choose to give information in pieces over a period of time so as not to overwhelm the patient. This is ethically acceptable and justified because no one ultimately knows how well the patient would respond to treatment.

**Fidelity or 'promise-keeping'** is also important ingredient of Autonomy. For any relationship to sustain, the partners must keep their promises. Same is the case in a doctor-patient relationship. The doctor, by getting the license to practice puts forth the promise to treat the patients with dignity and fairness and provide due care in "good faith". The society expects this from him. The doctor, on his part, expects the patient to promise to tell the truth and diligently follow his instructions.

### **Informed consent:**

Informed consent, in the medical field, is the procedure whereby a patient consents to or refuses (**informed refusal**) a medical intervention based on the information provided by a health care worker regarding the nature and potential consequences of the proposed treatment regimen. The goal of the informed consent is to respect patient autonomy and enable him to make important decisions regarding his medical care. The principle of autonomy emphasizes that a competent adult always has the right to decide what ought or ought not to be done to them.

There are essentially two types of consent:

1. The **'clinician-centered'** one which, according to the doctor, involves divulging the minimum required to be told to the patient to protect the doctor from a charge of assault on the patient.
2. The **'patient – centered'** one in which the doctor gives all information required by the patient to make an informed choice. This is the "Informed Consent" and is always patient-specific.

The patient should be able to understand:

1. Nature of the procedure – what is to be done and how is it to be done
2. Risks involved – the most likely risks; if a patient asks about a risk not told to him, he should be explained about it.
3. Consequences – likely outcomes of the procedure and alternatives
4. Alternatives – what would be the possible outcome if the patient chooses not to have the procedure performed/ have an alternative procedure.

Full disclosure includes:

- The condition/ disorder/disease that the patient is suffering from
- Necessity for further testing
- Natural course of condition and possible complications
- Consequences of non-treatment
- Treatment options available
- Potential risks and benefits of treatment options
- Duration and approximate cost of treatment
- Expected outcome
- Follow—up required

The patient should be given opportunity to ask questions and clarify all doubts. There must not be any kind of coercion, misconception or misrepresentation of facts and the consent must be "full, free and voluntary". The patient should also have the freedom to revoke the consent, if he feels like it, at any later stage.

The elements of informed consent include: disclosure of information, competence, understanding, voluntariness and decision-making. A doctor provides information to a competent patient, who after understanding the information, makes a valid decision.

Consent is based on the Latin maxim "volenti non fit injuria" – he who consents cannot complain. It may be defined as "A free and voluntary agreement, compliance or permission given for a specified act or purpose."

As per S. 90 IPC [7] Consent is not valid if given:

- a) By a person under fear/ injury or
- b) By a person under misconception of facts and the person obtaining knows or has a reason to believe this or
- c) By an intoxicated person or
- d) By a person of unsound mind or
- e) By a person of less than 12 years

As per S.13 of the Indian Contract Act [15]: two or more persons are said to be in consent if they agree upon the same thing in the same sense. S. 14 [15] says: consent is "free and voluntary" when it is NOT obtained by

- a) coercion/ force, b) fraud, c) under influence, d) intoxication, e) misrepresentation, f) from mistaken subjects, and g) mentally unsound persons.

Informed Consent has become extremely important in the present day settings.

As the doctor-patient relationship is primarily contractual by nature, it requires agreement between the parties as to the proposed medical intervention. Hence, patient's consent is fundamental to lawful medical interventions. This includes the physician's ability to properly explain to the patient regarding his condition and answer all possible queries of the patient; combined with the patient's understanding of the same and ability to form a valid decision (consent/refusal) based on the facts put forward to him.

In a number of cases, improper/partial or faulty explanation by doctor results in distrust by patient and his relatives, culminating in allegations of substandard medical care; even though there is no fault in the doctor's medical judgment or treatment skill.

In various kinds of medical and surgical procedures, the likelihood of an accident or misfortune leading to death can't be ruled out.

A patient willingly takes such a risk. This is part of the doctor-patient relationship and the mutual trust between them. This forms the basis for informed consent/ informed refusal.

Finally, a physician who undertakes to treat a patient should keep in mind that his patient has three fundamental rights with regard to his condition:

- 1. Right to expect a reasonable degree of skill and care from his doctor
- 2. Right to complete confidentiality, i.e., Professional Secrecy
- 3. Right to be informed what is wrong with him and what is to be done about it, i.e., Full Disclosure

### Conclusion:

Autonomy as a principle of ethics assumes a certain level of respect for persons

and their ability to take actions. It includes issues of informed consent, confidentiality of information, truth telling and promise keeping.

The principles of Privacy and Confidentiality are intimately related to Autonomy as disclosure and dissemination of a person's intimate information and thoughts destroys this important Ethical and Moral Principle. The patient, in fear of the dissemination of his intimate secrets, would never confide in the doctor and this will lead to a number of problems in future both to the doctor and to the patient.

The consent given by the patient should be voluntarily, free, fair, uninhibited, clear, direct and personal; without any fear, force, fraud, misrepresentation of facts, threat of physical injury or death, etc. The information given by the physician to the patient must include the disease condition, nature and consequences of the treatment procedure/ examination, alternatives, prognosis, etc. The disclosure so made should be complete, honest and truthful and should be made prior to implementation of the procedure.

### References:

1. Available at: [digitalcommons.law.yale.edu/cgi/view\\_content](http://digitalcommons.law.yale.edu/cgi/view_content). Informed Consent – Must It Remain a Fairy Tale? Accessed 10<sup>th</sup> November 2013.
2. Universal Declaration of Human Rights. Available at: <http://watchlist.org/wordpress/wp-content/uploads/Universal-declaration-of-human-rights.pdf>. Accessed on 10<sup>th</sup> November 2013
3. 1914, 211 N.Y.R. 125, quoted by Rudra A, Dogra TD. Eds. Lyon's Medical Jurisprudence and Toxicology. 11<sup>th</sup> Ed. Delhi Law House. pp 182.
4. **Beauchamp TL, Childress JF.** Principles of biomedical ethics. 5<sup>th</sup> Ed, New York, NY: Oxford Press; 2001.
5. **Lawrence DJ.** The four principles of biomedical ethics: a foundation for current bioethical debate. J. Chirpr Humanit 2007; 14: 34-40.
6. **Feinberg J.** Harm to self. In: The moral limits of criminal law. New York, NY: Oxford Univ. Press; 1986.
7. The Indian Penal Code, 1860. Act 45 of 1860. Available at: <http://police.mizoram.gov.in/uploads/files/indian-penal-code-1860.pdf>. Accessed on 15<sup>th</sup> November 2013.
8. **Zenbaty J.S.** A limited defense of paternalism in medicine .In: MappesTA, Zenbaty JS (eds.: Biomedical ethics. New York, NY, Mc Grow-Hill Inc, 1981:57.
9. **Purtilo RB.** Applying the principles of informed consent to patient care: legal and ethical considerations for physical therapy. Phys. Ther. 1984; 64: 934-37.
10. **Coy JA.** Autonomy-based informed consent: ethical implications for patient noncompliance. Phys. Ther 1989; 69 (10):826-33.
11. **Newton L.** A framework for responsible medicine. J Med Philos.1979; 4(1):57-69. As quoted by Coy JA at 10, above.
12. Janine Harnish vs. Children's Hospital Medical Center & others. 387 Mass 152,429 N.E. 240. 1982. Available at: <http://masscases.com/cases/sjc/387/387mass152.html>. Accessed 15<sup>th</sup> November 2013.
13. Oath of Initiation (Charaka Samhita). [First Century AD?] Available at:<http://www.bioethics.org.au/Resources/Codes%20and%20Oaths/Oath%20of%20Initiation,%20Caraka%20Samhita.pdf>. Accessed on 15<sup>th</sup> November 2013.
14. The Right to Information Act, 2005. (Act 22 of 2005). Available at: <http://rti.gov.in/rti-act.pdf>. Accessed on 15<sup>th</sup> November 2013.
15. The Indian Contract Act, 1872. Act 9 of 1872. Available at: [http://vakilno1.com/bareacts/indiancontract\\_act.pdf](http://vakilno1.com/bareacts/indiancontract_act.pdf). Accessed 20<sup>th</sup> November 2013.

## Review Research Paper

# Medico-legal Aspect of Pregnancy and Delivery: A Critical Case Review

<sup>1</sup>Mukesh Yadav, <sup>2</sup>Pooja Rastogi

### Abstract

For all parents and grandparents, birth is a joy, a wonder and a renewal of hope. But, one of the most devastating, life-changing events for parents is finding out their child suffered cerebral palsy. NCDRC while awarding compensation observed that human life is most precious; it is extremely difficult to decide the **quantum of compensation in the medical negligence cases**. NCDRC pointed out the difficulty in calculation of compensation and further observed that the multiplier method which typically used in motor accident cases not often conclusive for **'just and adequate compensation'**. Hon'ble Supreme Court has held that there is no restriction that courts can award compensation only up to what is demanded by the complainant. NCDRC cautioned that the corporate hospitals and Specialists, as might be expected, must perform at a higher level than other hospitals/ general practitioners.

This paper deals with critical analysis of NCDRC Judgment dated 24<sup>th</sup> April 2015 to understand the reasons for medical negligence, factors and methods for calculation of compensation in medical negligence cases and accordingly recommend for prevention of such cases in future.

**Key Words:** Antenatal Care, LSCS, Cerebral Palsy, Compensation, Deficiency in Service, Complications, Damage

### Introduction:

This is perhaps 3<sup>rd</sup> case [1] of medical negligence in India in which more than one crore compensation has been awarded. First case of medical negligence was in 1990, twenty-year old Prasant S. Dhananka, a student of engineering, was operated upon at the Nizam Institute of Medical Sciences, Hyderabad. Due to medical negligence of the hospital, he was completely paralysed. Compensation was claimed, and the matter finally reached the Supreme Court.

The court did not apply the multiplier method and awarded a compensation of Rs. 1 crore plus interest. [2] Second case was of Dr. Kunal Saha [3] in which Rs. 6.8 Crore along with interest at the rate of 6%, highest compensation is awarded for medical negligence in India till date. NCDRC in its judgment dated 24<sup>th</sup> April 2015 [1] observed that the corporate hospitals and Specialists, as might be expected, must perform at a higher level than other hospitals/ general practitioners.

### Corresponding Author:

<sup>1</sup>Professor & Head,  
Dept. of Forensic Medicine & Toxicology  
Rama Medical College, Hapur, U.P.  
Email: drmukesh65@yahoo.co.in

<sup>2</sup>Prof & Head, SMSR, Sharda University  
Greater Noida, U.P.

DOR: 25.05.2015; DOA: 10.08.2015

DOI: 10.5958/0974-0848.2015.00107.4

They, after all, represent themselves as possessing highest standard facilities, care superior skill and additional training. The hospital charges and the doctor's fees normally reflect this. No doubt that the compensation in medical negligence cases has to be just and adequate, that the medical professionals need to be accountable to a certain degree. [1]

### Joy of Birth of a Child: Patient Perspective

*"The most important and emotional event in the life of a couple is the birth of a child and it's always a joyous occasion in the family when a newborn arrives. Most parents have a nagging fear that the nine months of pregnancy is comparable to walking through a minefield. Things can go wrong at any time. They only breathe a sigh of relief when they've counted all ten toes and fingers of their newborn. It's no wonder they feel that way because it can be the most devastating thing if your baby is born with a birth defect". -Dr. S. M. Kantikar, Member, NCDRC, Judgment dated 24<sup>th</sup> April 2015*

### Grief to Parents after Death of Child:

For all parents and grandparents, birth is a joy, a wonder and a renewal of hope. But, one of the most devastating, life-changing events for parents is finding out their child suffered cerebral palsy. Parents often go through stages of grief similar to those they would have if they had lost the child. Caring for a child with a Cerebral Palsy

can negatively impact the physical and mental health of parents and caregivers.

Many parents experience significant depression, fear and anxiety, which may have a devastating effect on the whole family.

These feelings are often suppressed due to embarrassment, shame or guilt. Many families suffer a financial burden when they have a child who has a birth defect due to a variety of factors. In some cases, the financial burden on families gets so great that families must change residences and adjust their standard of living, which can cause stress for all involved.

If the child needs regular physical, occupational, or speech therapy, this can create debilitating financial strain which can stigmatize the child who has a birth defect.

Many parents live with a sense of isolation, particularly if the birth defect of their child is rare and there is little support. This can cause significant anxiety in social settings and distressed parents further isolate themselves. [1]

### **Facts of the Case:**

The complainant patient, (Dr. Indu Sharma, B.A.M.S.), during her first pregnancy, was under observation and follow-up of Dr. Sohni Verma, at Indraprastha Apollo Hospital, New Delhi. Previously, she took treatment from Dr. Sohni Verma, for infertility, thereafter, spontaneously; she conceived, after 4½ years.

On 10.6.1999, after midnight, due to rupture of membranes, she got admitted in Apollo hospital for her delivery. No senior doctor was available at that time, the resident doctor examined her. In the morning, Dr. Sohni Verma examined her and advised her medicines, started IV fluid with 1 ampule of Syntocinon for speeding up the process of delivery.

But, the patient noticed that the dose was maximum, and the Cardiographic Tracings (CTG) machine showed that the heart rate of the child began to sink (80/min.), during the midnight of 11/12-6-1999. It was alleged that none attended the patient, immediately.

Thereafter, the patient was shifted to operation theatre at 2.00 a.m. for emergency caesarean (LSCS), and at 3.36 a.m. a female baby was delivered by LSCS, weighing 3.7 kg.

The baby did not cry immediately after birth and it took almost five minutes. The baby was kept on ventilator in NICU. The OP assured that all the reports were normal. The condition of baby deteriorated further, till 29.6.1999. The baby was unable to suck milk. Meanwhile, the patient was discharged on 16.6.1999, while the baby was discharged from Apollo Hospital, on 30.6.1999. [1]

### **Complications or Damage occurred due to Birth Asphyxia:**

After 2½ months of birth, the baby suffered, loose motions and strong clonic seizures and was admitted to Holy Family Hospital. After doing EEG and C.T. Scan, it was revealed that the baby was severely affected by the atrophy of brain, which may lead to severely mental retardation.

The complainant observed that, at age of 1 year 8 months, the milestones were delayed, and the episodes of seizures persisted. Baby was unable to hold her neck and unable to suck milk. Therefore, the complainant had to appoint a special nurse for her care.

### **Expert Opinion:**

The child was treated at AIIMS, from 21.09.1999 to 03.12.2002, where, the Paediatric Neurologist, Dr. Veena Kalra, opined that, a full term baby having such problems were because of the negligence during the delivery.

The child was further investigated by CT scan and x-ray, but the Hospital declared reports as normal. In this regard, the complainant sought opinion of doctors in USA and from her brother, who is a paediatric surgeon, in USA.

The opinion was that severe atrophy of baby's brain cortex due to birth asphyxia and the child might remain severely mentally retarded for as long as she lives.

The Disability Board of AIIMS, New Delhi certified the baby as '95% disability'. Baby survived for 12 years with disabilities and with mental retardation. Unfortunately, baby Nistha died on 15.1.2012. [1]

### **Allegations of Medical Negligence:**

Allegations are mainly related to protocol failure, manipulation in medical record and not supplying the medical record to patient which is an unethical practice and amount to professional misconduct.

It was further alleged that false assurance about the condition of the baby and prognosis, and not able to attend baby immediately. Specific allegations are as follows:

- The complainant alleged that doctor failed to perform LSCS within 12 to 18 hours after rupture of membrane. It was abnormally delayed for about 27 hours. [1]
- The doctor advised excessive dose of Syntocinon, which caused foetal distress and cerebral anoxia- palsy. [1]
- None attended the patient, immediately. Therefore, it was alleged that, baby suffered birth asphyxia and seizures. [1]
- The hospital assured that all the reports were normal.



- The doctors/hospital made number of corrections/interpolations on the case sheets. The neo-natal record was also tampered. The hospital purposely concealed Cardiotocograms (CTG) tracings, which was the vital document in this case.
- The doctor failed to take proper care during delivery, which resulted in birth of an asphyxiated baby.
- The hospital did not issue entire medical record, CTG graphs etc. [Para 1]

### **Compensation Claimed:**

The complainant filed this complaint of medical negligence and has prayed total compensation of Rs. 2.5 crores plus Rs.5 lacs for the mental agony and Rs.25000/- as costs of litigation. The complainant paid approximately 2.5 lakhs towards hospitalisation. [1]

### **Compensation Awarded and Factors considered:**

Considering the peculiarity of this case [1], NCDRC partly allowed this Complaint and pass the following order:

- The opposite parties were held responsible for medical negligence in this case, NCDRC, therefore fixed total compensation of Rs. One Crore; out of which, Indraprastha Apollo Hospital, will pay Rs.80 lacs and, Dr. (Mrs.) Sohini Verma will pay Rs.20 lacs to the patient/complaint within 90 days from the date of receipt of this order.
- The insurance company shall indemnify the respective OPs, as per law.
- Further, NCDRC imposed Rs.10 lacs as punitive cost which Apollo Hospital shall deposit in the Consumer Legal Aid Account, NCDRC within 90 days from the date of receipt of this order.
- If the order is not compiled within 90 days, the OPs are liable to pay interest @ 9% per annum, till its realization.

### **What went wrong: Legal Perspective?**

The patient had pregnancy after 4½ years of infertility, thus it was a precious pregnancy. She was under regular observation during ANC period. Thus, the OP-3 should have taken prudent approach to deliver baby with utmost care and caution. After spontaneous rupture of membranes and administration of Syntocinon she should not have waited for more than 8 hours to take decision of C-section.

The Nurses chart speaks volumes of negligent act of OP-3. The nursing notes clearly establish hypertonic contractions foetal distress; which OP-3 failed to take proper decision for emergency C-section. It was act of omission, thus negligence.

After going through several OBG and Paediatric text books, we are of considered view that, it was the case of excessive use of Syntocinon and delay in decision to perform C-section, which caused birth asphyxia to baby.

In addition there is unflappable evidence that, the medical record of baby and mother are tampered in several places, noted interpolation, pinholes, overwriting the doses of Syntocinon.

Therefore, the doctor and it's nursing staff failed in a duty of care to accord the obstetric and paediatric care with the reasonable skill and diligence prevailing in the medical profession in order to the safe delivery of the baby. [1] NCDRC concluded that thus, in this instant case, the patient with precious pregnancy was unnecessarily suffered during prolonged labour; there was administration of excessive Syntocinon which caused birth asphyxia to the baby Nishtha, who further suffered Cerebral Palsy and 95% disability. She survived in such pathetic condition for 12 years.

Keeping in the view that during this period certainly her parents were whole time engaged in care of Nishtha, incurred heavy expenditure for care, medical assistance, regular medication and physiotherapy etc. from several hospitals in Delhi. Also, the parents sustained distress and suffered mental agony, further embroilment in the society for 12 years.

They sustained a loss of their baby forever. In case of precious full term pregnancy, no prudent Obstetrician/ Gynecologist will wait for more than 24 hours after rupture of membranes and allow induction by Oxytocin stimulation.

Thus, the complainant had established a prima facie case of negligence against the OPs. The complainant's evidence stood uncontroverted, and that there was no cogent evidence adduced by the OP. [1]

### **Case Law on Duties of Doctors:**

In two decisions rendered by Hon'ble Supreme Court [4, 5], it was laid down that when a Doctor is consulted by a patient, the Doctor owes to his patient certain duties which are (a) a duty of care in deciding whether to undertake the case; (b) a duty of care in deciding what treatment to give; and (c) a duty of care in the administration of that treatment.

A breach of any of the above duties may amounts for negligence and the patient may on that basis recover damages from his Doctor. [1]

### **Duty of Obstetricians and Nurses /Team Members:**

Obstetricians and nurses must carefully monitor a baby during labour and delivery in order to make sure that the baby is getting

enough oxygen and is not in foetal distress. The primary way to detect whether a baby is in distress is through **electronic foetal monitoring (EFM)**, which records both the mother's contractions and the baby's heart beat in response to contractions.

Despite its standard use in hospitals today, sometimes doctors and nurses still fail to monitor their patients or improperly interpret monitor **CTG tracings**. This can lead to debilitating birth injuries for the baby.

When the CTG tracings show that the baby's heart rate pattern is non-reassuring, it means she is in distress and is being deprived of oxygen and must be delivered very soon.

Often, a C-section delivery is the safest and fastest way to do this. Delaying the delivery of such a baby can cause permanent brain damage due to a prolonged lack of oxygen rich blood in the baby's brain. Indeed, it is important for obstetrician and the medical team to pay close attention to the foetal heart tracings.

Medical personnel should be **skilled enough in heart tracing interpretation** that they notice even subtle changes in the tracings. Not only is it crucial for the medical team to recognize non-reassuring heart tracings, but the staff must be prepared to act on these findings. It is the responsibility of the medical team to pay very close attention to the heart tracings. [1]

### **Standard Protocol for Delivery:**

As per **standard of practice**, after rupture of membrane (PROM or spontaneous) the obstetrician shall wait for maximum up to 12 hours; and then supposed to proceed for C-section or alternatives. In this case, **what was the need for OP-3 to conduct emergency LSCS at 2 a.m. if CTG was normal?**

The OP-3 visited the patient every 2-3 hours, thus, the foetal heart rate taken to waver at night which was unnoticed by the OP or by its staff. There is no cogent evidence that the nursing staff or labour room staff managed the FHR properly. Unfortunately the CTG tracings were not available to prove the reality. [1]

### **Issue of Informed Consent /Informed Refusal Consent and Medical Records:**

The statement of OP that, the patient was informed about emergency LSCS which was rejected by the patient or by her husband, but, there is no evidence as such, the OP failed to take written consent or signature of the complainant or her husband about refusal of C-section. The progress sheet clearly showed some insertion made by OP/staff to show that

patient was informed. Thus, the entry was also tampered one.

### **When to Declare Non-Progress of Labour? And to decide about LSCS?**

NCDRC members concluded that we can clearly infer in this case that, after rupture of membranes, within 12 to 18 hours OP should have declared the non-progress of labour.

It is also obvious that if oxytocin did not cause effective dilation of the cervix even after 18-20 hours of rupture of membranes, the decision of LSCS should have been taken much earlier. Thus, the delay and heavy doses of Syntocinon resulted into foetal distress and brain damage of new born in this case. [1]

### **Delayed Decision for Emergency C-Section:**

A delayed decision of emergency C-section delivery was finally ordered by OP-3. Foetal scalp pH should be checked if augmented labour is prolonged and higher dosages are given. However, the same was not done by the OP-3; it was the act of omission.

The baby was born with very low Apgar scores, wasn't breathing. Resuscitation manoeuvres were initiated right after birth, by mask ventilation and further intubation.

The umbilical cord showed blood pH 7.12; indicate baby had acidosis during delivery i.e. she was deprived of oxygen for a significant period of time. She began having seizures, which is also an indication that she experienced an oxygen depriving insult.

In fact, **hypoxic ischemic encephalopathy (HIE)** is the most common cause of seizures in the newborn period. HIE is caused by oxygen deprivation/ asphyxia. The **CT scan/ head imaging** of the baby showed oedema which is also sign of asphyxia. [1]

In the instant case, the cervical dilation never took place more than 2 cm, thus it was unfavourable cervix; and not a Cervical Dystocia as declared by OP-3 after 27 hrs. It was not an absolute indication for emergency LSCS as stated by OP-3, but certainly there would have been foetal distress noticed on CTG which OP-3 decided for emergency c-section. In our view, the OP-3 should have done LSCS after 8 hrs of Oxytocin infusion when there was no response/ no cervical effacement of cervix. [1]

As per the Complainant, she never received the CTG graphs from the OP but, the OP stated that all CTG graphs were handed over to the Complainant at the time of discharge, which was kept in separate brown folder.

The CTG tracings are vital evidence in the case of HIE which caused damage to Baby

Nistha at the time of her birth. OPs should have kept standby records of CTG tracings. [1]

NCDRC also rejected the contention of OP that, the patient was reluctant to undergo c-section, but preferred to wait for vaginal delivery. In this context, it was the bounden duty of the doctor to decide, the correct line of treatment; doctor wouldn't just blindly obey the wishes of the patient., which itself it would be unethical as discussed by the Hon'ble Supreme Court in the case of Malay Kumar Ganguly vs. Dr. Sukumar Mukherjee & Ors. 2009. [6]

### **Inappropriate Action with Suspicious or Pathological CTG:**

Once a diagnosis of suspicious or pathological FHR trace is made action must be taken depending on the severity of CTG abnormality. Thus may mean continued observation, change in maternal position, administration of tocolytic, hydration, omission of oxytocin infusion in cases with suspicious traces and in addition fetal blood sampling/immediate operative delivery in cases with pathological traces. Accurate documentation of the time of observation and any other actions taken is very important from a medico-legal view point.

In the presence of an abruption, cord prolapse or scar rupture intervention should be taken immediately as they warrant immediate delivery (within 15-30 min).

In these situations a CTG may suddenly present with acute bradycardia. In cases of bradycardia <80bpm, the pH can decline by 0.01 every min and with prolonged decelerations that have transient recovery to the baseline rate the pH can decline by 0.01 every 2-3 min. Fetal scalp blood sampling (FBS) is an inappropriate action in such situations and is likely to compromise the baby.

Special arrangements should be in place in each unit to deliver these cases as category 1 caesarean section.

### **Storage of CTG:**

NCDRC observed that CTGs should be stored for at least 25 years and the hospital should make adequate provision for safe storage and easy retrieval.

### **Need for Teamwork and Role of Communication:**

Effective intra-partum FHR monitoring requires good teamwork. All members of the maternity team (doctors, midwives, nurses) should be aware of how FHR traces are interpreted, which FHR patterns are associated with actual or impending fetal acidemia and within what time frame the senior team member should be notified of abnormal FHR pattern.

We have gone through the medical text, medical literature and **WHO manuals**. In the instant case, it was due to a **breakdown in communication amongst the team of doctor and nursing staff during delivery of patient**.

The resident and nurses failed to appreciate the signs of distress on the foetal heart monitor, and they failed to inform the attending OP-3 of the non-reassuring heart tracings. The Nurses chart clearly revealed that there were hypertonic contractions and the Syntocinon was decreased to 80ml/hr, again at 10.30am it was increased to Synto 100/hr, pt was getting moderate contraction and at 1130 am FHS decreased below 120/min. Also, at 5 PM FHR dipped below 100/min.

Those findings were brought to notice of OP-3, but the OP-3 failed to take decision for emergency C-section. Thus at that time, the uterus was in a hypertonic state, or a state of almost constant contraction.

Contraction causes the vessels in the placenta to be compressed, which means they cannot easily refill with fresh, oxygen-rich blood to be transported to the baby through the umbilical cord. This can lead to be severely deprivation of oxygen to the baby and can result in permanent brain damage, as was the case with baby Nistha.

Therefore, it was against the standard of care for a hospital to quickly deliver a baby by emergency C-section when necessary. [1]

### **Standard of care allow obstetricians**

two options to ensure that the continuation of labour is safe for the baby. One option is to perform a test to make sure that the baby is not acidotic. (If a baby is acidotic, it means that the baby is being deprived of oxygen.)

If that test is not performed, the Oxytocin must be stopped. However, if stopping the Oxytocin did not improve the heart tracing, the standard of care required C-section delivery.

Even if the foetal acidosis test is not familiar to some obstetricians, all obstetricians are familiar with the necessity of calling a stat C-section when a foetal heart tracing does not improve despite resuscitative measures.

A good trial on fetal resuscitation would require randomization based on fetal distress diagnosed using the "gold standard" of fetal scalp blood pH < 7.2, testing the methods used for resuscitation, and accounting for the variables. [1]

In the instant case, there was the long labour process brought about by poor and negligent medical management caused the birth of asphyxiated child with cerebral palsy and seizures/ fits. As per medical literature, we

confirm that the long hours in labour caused pressure on the umbilical cord and placenta; that the oxygen supply to the foetus and very importantly to the brain was reduced and or off completely, and this caused hypoxia.

In addition the liquor was completely drained out due to prolonged period, which in turn exerted direct compression of placenta, because of pressure from contacting uterine wall. This was happened because the labour process was poorly handled. A lot of time was wasted and critical warning signs were missed by OP-3.

The cause of the baby's traumatic birth resulting in her being a cerebral-spastic quadriplegic was attributable to the fact that during the long labour process from the rupture of the membranes to the time she was delivered after 27 hours. There were stages when his brain had insufficient amounts of oxygenated blood, and as a consequence, hypoxia and perinatal asphyxia occurred. The birth record voluminously speaks about the asphyxia. [1]

#### **Substandard Care during Labour:**

NCDRC are of considered view that, in this case due to substandard care to the patient during labour resulted poor outcome despite using modern technology of cardiography (CTG). Inability to interpret the CTG trace, not taking into consideration the clinical situation suggesting foetal distress and delay in taking appropriate action due to poor communication and team work were the reasons for the poor outcome. [1]

#### **Issue of Unethical Practices and Medical Record:**

The OPs were indulged in the unethical medical practices and professional misconduct like tampering of medical records to the maximum extent. They had not issued entire medical record to the patient and made false submission before NCDRC on 27.10.2007, that "whatever record of treatment was available with hospital has already been filed and hospital is not having other records", but produced original records of child at belated stage of proceedings in this case i.e. on 20.11.2014.

The conduct of OP was to mislead the commission on the pretext of one and other.

It is not acceptable to us, that OP issued CTG to the patient, but it was the duty of hospital to preserve CTG tracings. Thus OP did not follow the standard of medical practice, not maintained medical records. Therefore, NCDRC further imposed punitive cost of Rs.10 lacs on the OP-1. [1]

#### **Discussion and Reasons:**

A person may lie, but the documents will speak the truth. NCDRC perused the original medical records of patient maintained by the Hospital. [1]

#### **Clinical Findings in Patient (Mother) after hospitalization:**

It is most relevant to mention about the sequence of events after admission to OP-1 as stated in **medical record**:

At the time of admission uterus was 36 weeks' in size. There was Cephalic presentation, 2/5 fixed, FHR 144/minute and the PV findings are leaking ++. Cervix was long, with uneffacement, OS was closed and the head was at Station 2. The OP advised for "start 5 units Syntocinon, 40 ml/minute, and (10 drops per minute) ↑ every 30 minutes by 10 drops till desired contractions, 3/10 minutes".

#### **Continuous CTG Monitoring:**

The note at 08:10 a.m. at 11.06.1999 revealed cervix was uneffaced totally, OS was 1 cm. CTG-FH 130 per minute and there was "Poor beat to beat variability otherwise regular"

#### **The OP continued the same treatment**

- At 11.50 a.m. the cervix gel (prostaglandin) was instilled in posterior fornix and injection Pethedin was advised stat, but not available hence, not given, but injection Drotin was given.
- At 03.00 p.m. there were mild contractions and Syntocinon ↑ to 100 ml per minute, at 05.50 p.m. Syntocinon ↑ to 150 ml per minute and at that time CTG showed beat up to 100 beats per minute and the same was informed to OP-3.
- At 06.00 p.m. the OP-3 mentioned that FHS satisfactory and the OS was 1.25 cm, syntocinon 10 units induction continued @ 200 ml/min.
- At 09.00 p.m.: cervical OS admits one finger, cervix was 60-70% effaced; findings explained to the patient and her husband, they wish to continue labour requesting USG to confirm presentation (Pt. obese)-Agreed.
- The USG was conducted and the findings were informed to the patient and her husband and they wish to continue labour. At 00.00 hours on 12.06.1999, the notes are that "explained poor prognosis LSCS advised, but the patient and her husband refused and wished to wait for 2 more hours as FH satisfactory agreed to wait for only 2 more hours.
- Thereafter, at 02.00 a.m. the OP examined the patient and there were same findings

and the Syntocinon was stopped and performed the LSCS.

- The clinical note at 02.40 hrs: "Patient feeling unhappy and very bitter about being taken for LSCS. Says, "Brought to OT against her wishes", although consent signed! Explained the reasons for C-Section again. Foetal Heart heard-Regular-120/ml."

On careful perusal of **clinical notes** revealed that; at the first instance, OP-3 examined the patient at 7.00 am; the CTG findings taken at 08.00 a.m. clearly establish that there was poor beat to beat variability.

The subsequent findings and nursing notes on 11.6.1999 at 9.00 am, Hypertonic contractions were noticed, thereafter at, 11.30 am revealed the FHS decreased <120, informed Dr. Geeta, again at 5 pm, FHR was dipped below 100/min. Thus, the danger signals were noted thrice, and brought to the notice of OP-3, but, OP-3 did not take any prompt action or decision for emergency C-Section.

Also, it was quite obvious that, due to continuous leaking of liquor, the uterine contractions went on unnoticed. Under these circumstances, in addition to Syntocinon, administration of Cervigel caused further stimulation to the uterus.

Therefore, OP-3 should have taken the decision for urgent C- Section at least at 5pm. It was the duty of Obstetrician to counsel the patient properly about the progression of labour for every 2 hours. NCDRC do not find any such counseling was done by OP-3 or by her staff.

The OP-3 was aware that it was a precious pregnancy. Thus, NCDRC was surprised that why the OP-3 delayed the decision to perform C-section. It is apparent from the medical record that there was poor Bishop's score. [1-Cervical Favorability]

### Neonatal Record:

Baby delivered at 3.07 on 12.6.1999, did not cry at birth even after stimulation. Bag mask ventilation was done for 1 min; at 4 am- tonic convulsions- bag mask ventilation. [1]

### Suspected? Metabolic Acidosis:

**Arterial Blood Gas (ABG)=** at 3.30 am pH 7.12, PCO<sub>2</sub>-50, PaO<sub>2</sub>-38, HCO<sub>3</sub>-16, BE-12 On the basis of medical text books and literature, NCDRC are of considered view, that all these findings are of **asphyxia that baby suffered during birth process.** [1]

### Summary and Conclusions:

NCDRC observed that thus, accordingly, the complaint deserves for just and proper compensation. The higher the level of hospital had specialised facilities and specialist doctors

available and also the cost of treatment will be higher, thus the level of expectation of the patient certainly will be high. NCDRC further added that most of the hospitals either government or private sector who treat a large number of patients and must be held accountable in cases of negligence.

It is very disappointing that, the sky-rocketing costs in health care spurred public and private reform.

There is need to debate on the issue of reasons for high cost of healthcare in India. Is there any relation with high cost of medical education in private medical colleges, excessive commercialization of healthcare, less spending by government in healthcare, etc?

There is need for awareness among medical fraternity about the changing perception of public and judicial bodies in this respect.

Following of Medical ethics and Etiquettes in letter and spirit will go a long way in improving the situation as most of the high compensation cases of medical negligence in India are filed by doctors or their relatives.

There is a strong need for developing protocol, creation of awareness about these protocols, regular CMEs, and strengthening of regulatory mechanism on healthcare providers. State Medical Councils /Medical Council of India should play their much awaited role of regulating medical profession. Professional organization and IMA should come forward to intervene in timely manner to fill the gap in such scenario.

### References:

1. J.M. Malik, J., Presiding Member, NCDRC, Mr. Dr. S.M. Kantikar, Member, NCDRC. Dr. (Mrs.) Indu Sharma vs. Indraprastha Apollo Hospital and Ors. O.P./104/2002, Date of Judgment: 24.04.2015. [Online] [2015 April 27]. Available from: [URL:http://cms.nic.in/ncdrcusersWeb/GetJudgement.do?method=GetJudgement&caseid=0%2F0%2FOP%2F104%2F2002&dtofhearing=2015-04-22](http://cms.nic.in/ncdrcusersWeb/GetJudgement.do?method=GetJudgement&caseid=0%2F0%2FOP%2F104%2F2002&dtofhearing=2015-04-22)
2. B.N. Agrawal, J., Harjit Singh Bedi, J., G.S. Singhvi, J. Nizam's Institute of Medical Sciences vs. Prasanth S. Dhananka & Ors., Civil Appeal No.4119 of 1999, with With C.A. No. 3126 of 2000, Date of Judgment: 14.05.2009; [2009 (7) SCALE 407]. Available from: [URL:http://judis.nic.in/supremecourt/imgs1.aspx?filename=34648](http://judis.nic.in/supremecourt/imgs1.aspx?filename=34648)
3. V. Gopala Gowda, J., Chandramauli Kr. Prasad, J. Dr. Balram Prasad vs. Dr. Kunal Saha & Ors., Civil Appeal No.2867 of 2012, with Civil Appeal No.692 of 2012, Advanced Medicare & Research Institute Ltd. vs. Dr. Kunal Saha & Ors., with Civil Appeal No.2866 of 2012 Dr. Kunal Saha & Ors. vs. Dr. Sukumar Mukherjee & Ors., with Civil Appeal No.731 of 2012, Dr. Baidyanath Halder vs. Dr. Kunal Saha & Ors., and with Civil Appeal No.858 of 2012, Dr. Sukumar Mukherjee & Ors. vs. Dr. Kunal Saha & Ors., Date of Judgment: 24<sup>th</sup> Oct 2013; (2014) 1 SCC 384. [Online] [2015 May 12]. Available from: [URL:http://judis.nic.in/supremecourt/imgs1.aspx?filename=40897](http://judis.nic.in/supremecourt/imgs1.aspx?filename=40897)
4. Dr. Laxman Balakrishna Joshi vs. Dr. Trimbak Babu Godbole & Anr. AIR 1969 SC 128
5. A.S. Mittal vs. State of U.P. AIR 1989 SC 1570.
6. Malay Kumar Ganguly vs. Dr. Sukumar Mukherjee & Ors. [(2009) 9 SCC 221]

## Review Research Paper

# Criminal Amendment Act 2013 and Issue of Age

<sup>1</sup>P S Thakur, <sup>2</sup>Jayanti Yadav, <sup>3</sup>Arneet Arora

### Abstract

The Criminal Amendment Act 2013 has redefined crime and has labeled some activities criminal. This seems appropriate with changing sensitivity of people to issues like privacy, exploitation and helplessness. There is a definite aggression towards preventing crime against women, which is evident in the Act. One aspect although which seems unjustified and out of modern context is enhancing the age for consent of sexual intercourse by women. With more freedom and opportunities for self-exploration available to adolescents and greater acceptance of western culture, there seems to be greater acceptability for physically intimate associations amongst the two genders. Consensual sexual intercourse is getting commoner, even in the absence of a formal relationship.

In this context, increasing the age of consent for sexual intercourse by women puts any sexual relationship before the age of 18 years of the female in category of a crime and the male as accused for the crime. It seems to be unfair and holds a disproportionate gender bias. The relevance of age of maturity, its origin, acceptance in the present scenario and its consequences discussed in this paper.

**Key Words:** Crime against women, Consent, Age, sexual intercourse, Gender

### Introduction:

The **2012 Delhi gang rape** case involved a rape and fatal assault that occurred on 16 December 2012 in Munirka, a neighbourhood in South Delhi, when a 23-year-old female physiotherapy intern was beaten and gang raped in a private bus in which she was travelling with a male friend. [1]

There were six others in the bus, including the driver, all of whom raped the woman and beat her friend. The woman died from her injuries thirteen days later while undergoing emergency treatment in Singapore. [2, 3] The incident generated widespread national and international coverage and was widely condemned, both in India and abroad.

Subsequently, public protests against the state and central governments for failing to provide adequate security for women took place in New Delhi, where thousands of protesters clashed with security forces. Similar protests took place in major cities throughout the country.

### Corresponding Author:

<sup>1</sup>Associate Professor  
Department of Forensic Medicine  
M G M Medical College Indore, M.P.  
E-mail: drpramendra@gmail.com

<sup>2</sup>Assoc. Prof, Dept. of Forensic Medicine  
Gandhi Medical College Bhopal, M.P.

<sup>3</sup>Professor, Dept. of Forensic Medicine  
AIIMS Bhopal, M.P.

DOR: 05.05.2015 DOA: 12.06.2015

DOI: 10.5958/0974-0848.2015.00108.6

As a result of the protests, in December 2012, a judicial committee was set up to study and take public suggestions for the best ways to amend laws to provide quicker investigation and prosecution of sex offenders.

After considering 80,000 suggestions, the committee submitted a report which indicated that failures on the part of the government and police were the root cause behind crimes against women.

The central government has amended section 375 & section 376 of IPC. The amendments in all these sections are important & need to be discussed but we want to focus on one very important issue regarding amendment in age of woman in section 375 of IPC for giving consent for sexual intercourse.

The section 375 of IPC stating that "A man is said to commit Rape if he has done any of the act mentioned in clause (a), (b), (c) or (d) of section 375 of IPC with or without her consent, when she is under eighteen years of age". [4]

Here as per this section 'consent' means an unequivocal voluntary agreement when the woman by words, gestures or any form of verbal or non-verbal communication, communicates willingness to participate in the specific sexual act. [4]

### Discussion:

Now question arise that has central government taken correct step by raising age for

consensual sexual intercourse from 16 years to 18 years in section 375 of IPC?

Now we are living in 21<sup>st</sup> century and there is a remarkable change in the attitude of the society. 21<sup>st</sup> century is century of internet, mobile & television, now younger generation is exposed to various kind of knowledge exposure to which was prohibited by the society up to a certain age so is it a right step by government to increase the age from 16 years to 18 years for consensual sexual relation?

If we compare the laws of various countries regarding age for informed consent for sexual act by woman Age of consent laws vary widely from jurisdiction to jurisdiction, though most jurisdictions set the age of consent in the range 14 to 18.

### Global Scenario:

In Europe, countries that have the age of consent set at 16 include **Cyprus, Finland, Georgia, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, and Switzerland**. For **Austria, Germany, Portugal and Italy** it is 14, and in **France, the Czech Republic, Denmark, and Greece** it is 15. **Spain** did have one of the lowest ages of consent on the continent at just 13, but recently agreed to raise this to 16.

Throughout the rest of the world, there are big variations. In **Bahrain**, it is set at 21 for women who want to marry without their father's consent, while in nearby **Saudi Arabia**, all sex outside of marriage is illegal but there are no laws limiting the age at which you can get married. In **China**, the age of consent is 14, in **Iraq** it is 18, while in **Japan** it is five years lower at 13.

The countries likes of **Brazil, Peru, Paraguay, Ecuador and Colombia** all have it set at 14 and in some countries - such as **Chile** the minimum age of consent is 14, but there are legal restrictions on sexual activities up to the age of 18, and homosexual sex is illegal before that age.

**Australia's** age of consent varies between 16 and 17 depending on which territory you are in, and the same goes for **America** where it ranges from 16 to 18 between different states. In **Angola**, the age of consent is just 12. [5]

Each US state has its own age of consent. State laws set the age of consent at 16, 17 or 18. The most common age is 16.

6.

Age of consent laws are designed to protect children and young people from sexual exploitation and abuse. Such laws effectively determine that children and young people below the age of consent do not have the emotional maturity to consent to sexual activities.

A big question is regarding consensual sexual intercourse if both the parties are under the age of consent as described in section 375 of IPC. Basically all these laws are made to stop sexual exploitation of children & teen age from adults. As teen age becoming more & more aware of all these aspects of life & government has raised the age from 16 years to 18 years it may increase complexities in the society like increase in numbers of criminal abortion to hide these relations.

After amendment in Section 375 of IPC, There is already increasing trend of complaints by parents/guardians in police stations of various states in cases of consensual sexual intercourse between boys and girls when age of girl is less than 18 years and this trend are going to increase day by day.

As happened in case of misuse section 498-A of IPC & its consequences, now government is re-thinking about section 498-A of Indian Penal Code & trying to modify it. Same will happen in case of Section 375 IPC and Government will be bound to make amendment in this section in future.

### Suggestions:

As society becoming more liberal, government should think about to modify law particularly when there is a consensual sexual act between two under age persons.

### References:

1. "IAP condole death of Delhi gang-rape victim". New Delhi: Zee News. Press Trust of India. 29 December 2012. Archived from the original on 30 December 2012. Retrieved 30 December 2012.
2. Mandhana, Nikarika; Trivedi, Anjani (18 December 2012). "Indians Outraged by Account of Gang Rape on a Bus". The New York Times. Archived from the original on 30 December 2012. Retrieved 30 December 2012.
3. "Delhi gangrape: Chronology of events". The Hindu (New Delhi). 31 August 2013. Retrieved 2 September 2013.
4. Guidelines & Protocols for Medico-legal care for survivors/victims of sexual violence by Ministry of Health & Family Welfare Government of India
5. What is the age of consent around the world? From Angola at 12 to Bahrain at 21 www.mirror.co.uk › News › UK News › Sex education

## Review Research Paper

# Acute Neurogenic Pulmonary Edema: The Unaddressed Mechanism of Death

<sup>1</sup>Raghvendra Singh Shekhawat, <sup>2</sup>Puneet Setia

### Abstract

Impaired pulmonary function is a frequent but poorly understood complication of acute head injury. A potential early contributor to the pulmonary dysfunction seen in Head injury patients is neurogenic pulmonary edema (NPE). Neurogenic Pulmonary Edema is pulmonary edema that is associated with neurological diseases in patients in whom no other cardiac or pulmonary cause for the edema is apparent. It is associated with several acute neurological catastrophes; including spontaneous intracranial haemorrhage in general and Sub-arachnoid haemorrhage secondary to aneurysmal rupture in particular, sudden unexpected death in epilepsy, and traumatic brain injuries of various types. Often, very less described in the literature, this can be an immediate cause of death in patients with head injuries. Its pathophysiology is multifactorial but largely unknown. It's not only for the clinician to be aware of this clinical entity but it's also important for the Forensic Medicine expert to know about the pathophysiology, clinical presentation and autopsy findings of NPE. This paper aims to review the current concepts on pathophysiologic mechanisms involved in the development of NPE and discuss the facts which are relevant for a Forensic expert.

**Key Words:** Neurogenic pulmonary edema, Head injury, Haemorrhage, Sudden death

### Introduction:

Neurogenic pulmonary edema is related to conditions associated with severe brain injury, such as head trauma [1, 2], subarachnoid haemorrhage, intraparenchymal haemorrhage [3], cerebellar haemorrhage [4], status epilepticus [5] and acute hydrocephalus. [6] Additionally, there are single case reports of electroconvulsive therapy [7, 8], hanging [9] and primary spinal cord haemorrhage. [10]

Meningeal haemorrhage is the most common cause of neurogenic pulmonary edema. Although NPE was identified over 100 years ago, it is still underappreciated in the clinical arena. The unawareness of this clinical condition for the person conducting the autopsy can often lead to misinterpretation of the autopsy findings.

### Background:

NPE found its mention in the medical literature more than a century.

### Corresponding Author:

<sup>2</sup>Assistant Professor, Dept. of Forensic Medicine  
All India Institute of Medical Sciences, Jodhpur  
Basni, Phase- II, Jodhpur- 342009  
Email id: setiap@aaimsjodhpur.edu.in

<sup>1</sup>Senior Resident

DOR: 19.05.2015 DOA: 25.08.2015

DOI: 10.5958/0974-0848.2015.00109.8

It was in 1903 that Harvey Williams Cushing first described the connection between CNS injury and hemodynamic dysfunction. [11]

Later, in 1908 findings of pulmonary edema were reported by W. T. Shanahan in 11 cases of epileptic seizure. With the progress of science the clinicians gained more interest in pulmonary complications secondary to head injuries. In 1969, Capt. Simmons reported findings of alveolar edema and haemorrhage in the lungs of 17 soldiers dying after isolated bullet head wounds in the Vietnam War. [12]

### Epidemiology:

Most of the information about NPE has originated from individual case reports and therefore it is very difficult to give an idea about the overall incidence of NPE in cases of Head Injury. From the epidemiological literature available it can be said that overall 7% of the patients with NPE die. [13, 14]

In patients with SAH, reports of NPE incidence range from 2% to 42.9%. [14, 16] It is further reported that patients with SAH who develop NPE have higher mortality rates. [14]

This can be speculated that reason for less number of epidemiological studies is probably the poor condition of the patient secondary to Head Injury and hence more attention of the clinician on the urgent treatment when pulmonary edema develops.



Further, unawareness of the entity by the Forensic Expert is expected to lead to low documentation.

### **Pathophysiology:**

The pathophysiology linking the neurologic, cardiac, and pulmonary conditions in NPE has been subject to debate and controversy since the recognition of NPE as a clinical entity. NPE has been often described as an unusual complication of sudden increase in Intracranial Pressure (ICP). [17]

It is believed that this abrupt increase in ICP gives rise to an intense activation of sympathetic nervous system and release of catecholamines. How this autonomic nervous system activation affects the pulmonary capillary permeability remains dubious and enigmatic.

To explain this, many theories like neuro-cardiac theory and neuro-hemodynamic theories have been described till date, but the 'blast theory' remains central to discussion. This theory proposes a mechanism both for hydrostatic pressure and vascular leak.

It says that following the release of catecholamine there is a sudden increase in systemic and pulmonary pressures and there is a 'net' shift of blood volume from the systemic circulation to the pulmonary one.

This pressure difference further causes barotrauma to the endothelium which is responsible for the transudative vascular leaks and protein rich edema. [18]

### **Clinical Presentation:**

NPE characteristically presents within minutes to hours of a severe central nervous system insult such as subarachnoid haemorrhage or traumatic brain injury.

However, more rapid onset (immediate) and delayed onset (hours to days) have been described. [2-4] Resolution usually occurs within several days. [5]

Dyspnoea is the most common symptom, although mild haemoptysis is present in many patients. The physical examination generally reveals tachypnoea, tachycardia, and basilar rales. Chest radiographs typically show a normal size heart with bilateral alveolar opacities, although unilateral opacities have also been described. [6-8]

Hemodynamic measurements are usually normal by the time NPE is diagnosed, including the blood pressure, cardiac output, and pulmonary capillary wedge pressure.

There is a broad range of severities of NPE and mild cases may never be detected. While NPE can be fulminant and contribute to death, mortality is more commonly due to the

neurologic insult that precipitated the onset of NPE.

### **Post-mortem Findings:**

The autopsy findings of NPE are often non-specific and are not described much in the available literature. It becomes indispensable to take a review of the clinical notes of the deceased before coming to a diagnosis of NPE.

The diagnosis of 'pure' NPE is a diagnosis of exclusion and, by traditional definition, requires documentation of non-cardiogenic pulmonary edema in the setting of neurological injury.

It should be kept in mind that large volume fluid resuscitation is often employed for patients of head injury and this may obviously lead to pulmonary overload. [18] It is also important to differentiate the findings of aspiration pneumonia from that of NPE.

Aspiration pneumonia is a very common instance in patients of head injury. NPE is characterised by presence of frothy, often blood tinged sputum and a more central distribution of the alveolar disease. On a contrary in case of aspiration pneumonia there is often a history of vomiting, witnessed aspiration.

In such cases gastric contents can be found in the oropharynx and the distribution of alveolar disease is more in the dependent parts of the lungs. These findings should be correlated with the pre-mortem x-rays of the patients.

A study conducted on 18 comatose patients with severe acute intracranial injuries resulting from trauma or spontaneous subarachnoid haemorrhage determined the pulmonary findings by using thermal green dye technique to objectively determine extravascular lung water. Extravascular lung water was determined post mortem in five patients using the gravimetric method of Pearce.

The results suggest that pulmonary edema is a distinct clinical event occurring frequently after acute intracranial injury. [19]

One single case study describes hypoxic brain damage, cerebral edema and pyknosis of nerve cells in the medulla oblongata, along with the presence of pulmonary edema as diagnostic finding of NPE. [13]

### **Conclusion:**

NPE is a distinct clinical entity which is seen in cases of head injury. Its occurrence is grossly understated due to the severe nature of the concomitant disease with which it is associated. It is recommended that in every case of head injury, both the clinician and the Forensic Medicine expert should be vigilant in diagnosing NPE so that it can be both diagnosed

and treated properly and also that its presence in cause of death can be more appropriately noted and documented.

## References:

1. Rogers FB, Shackford SR, Trevisani GT, Davis JW, Mackersie RC, Hoyt DB. Neurogenic pulmonary edema in fatal and nonfatal head injuries. *The J of trauma*. 1995;39(5):860-6; discussion 6-8.
2. Bratton SL, Davis RL. Acute lung injury in isolated traumatic brain injury. *Neurosurgery*. 1997;40(4):707-12.
3. Muroi C, Keller M, Pangalu A, Fortunati M, Yonekawa Y, Keller E. Neurogenic pulmonary edema in patients with subarachnoid hemorrhage. *J of neurosurgical anesthesiology*. 2008;20(3):188-92.
4. Young Y-R, Lee C-C, Sheu B-F, Chang S-S. Neurogenic cardiopulmonary complications associated with spontaneous cerebellar hemorrhage. *Neurocritical care*. 2007;7(3):238-40.
5. Wąsowska-Królikowska K, Krogulska A, Modzelewska-Holýńska M. Neurogenic pulmonary oedema in a 13-year-old boy in the course of symptomatic epilepsy—case report. *Med Sci Monit*. 2000;6(5):1003-7.
6. Aslam AF, Aslam AK, Vasavada BC, Khan IA. Cardiac effects of acute myelitis. *International journal of cardiology*. 2006;111(1):166-8.
7. Tsutsumi N, Tohdoh Y, Kawana S, Kozuka Y, Namiki A. A case of pulmonary edema after electroconvulsive therapy under propofol anesthesia. *Masui The Japanese journal of anesthesiology*. 2001;50(5):525-7.
8. Nelson AM, McMorro ME. Neurogenic Pulmonary Edema: A common complication of central nervous system injury. *AJN The American Journal of Nursing*. 2002;102:44-8.
9. Watanabe M, Higashimoto I, Niina K, Kawabata M, Osame M. An autopsy case of neurogenic pulmonary edema due to suicide by hanging. *Nihon Kokyuki Gakkai zasshi= the journal of the Japanese Respiratory Society*. 2000;38(10):797-800.
10. Inobe J-i, Mori T, Ueyama H, Kumamoto T, Tsuda T. Neurogenic pulmonary edema induced by primary medullary hemorrhage: a case report. *Journal of the neurological sciences*. 2000;172(1):73-6.
11. Cushing H. I. On the Avoidance of Shock in Major Amputations by Cocainization of Large Nerve-Trunks Preliminary to their Division. With Observations on Blood-Pressure Changes in Surgical Cases. *Annals of Surgery*. 1902;36(3):321-45.
12. Simmons RL, Heisterkamp CA, Collins JA, Genslar S, Martin AM. Respiratory insufficiency in combat casualties. 3. Arterial hypoxemia after wounding. *Annals of Surgery*. 1969;170(1):45-52.
13. Antoniuk SA, Oliva LV, Bruck I, Malucelli M, Yabumoto S, Castellano JL. Sudden unexpected, unexplained death in epilepsy autopsied patients. *Arquivos de neuro-psiquiatria*. 2001;59(1):40-5.
14. Fontes RB, Aguiar PH, Zanetti MV, Andrade F, Mandel M, Teixeira MJ. Acute neurogenic pulmonary edema: case reports and literature review. *Journal of neurosurgical anesthesiology*. 2003;15(2):144-50.
15. Friedman JA, Pichelmann MA, Piepgras DG, McIver JI, Toussaint LG, 3rd, McClelland RL, et al. Pulmonary complications of aneurysmal subarachnoid hemorrhage. *Neurosurgery*. 2003;52(5):1025-31; discussion 31-2.
16. Solenski NJ, Haley EC, Jr., Kassell NF, Kongable G, Germanson T, Truskowski L, et al. Medical complications of aneurysmal subarachnoid hemorrhage: a report of the multicenter, cooperative aneurysm study. Participants of the Multicenter Cooperative Aneurysm Study. *Critical care medicine*. 1995;23(6):1007-17.
17. Kosnik EJ, Paul SE, Rossel CW, Sayers MP. Central neurogenic pulmonary edema: with a review of its pathogenesis and treatment. *Child's brain*. 1977;3(1):37-47.
18. Lee K, Rincon F. Pulmonary complications in patients with severe brain injury. *Critical care research and practice*. 2012;2012:207247.
19. Mackersie RC, Christensen JM, Pitts LH, Lewis FR. Pulmonary extravascular fluid accumulation following intracranial injury. *The Journal of trauma*. 1983;23(11):968-75.

## Case Report

### Refrigerator Blast: A Rare Explosion Fatality

<sup>1</sup>R. Sudha, <sup>2</sup>Sudheer B. Balla, <sup>3</sup>J. Ammani, <sup>4</sup>Suresh Kumar Karthikeyan, <sup>5</sup>V. Jayasurya Prasad Babu

#### Abstract

Death from the blast of refrigerators is a rare entity and the cause of such explosions was contaminated gas in the cooling units. Methyl chloride or chloromethane also called as R-40 is a hazardous chemical compound that is extremely flammable, which was widely used refrigerant but its usage has been discontinued because of its toxicity and flammability. This paper reports a rare incident of blowing up of the fridge while filling nitrogen gas in compressor; at a refrigerator-cum-air conditioner repair center. Two youngsters who were filling the nitrogen gas were killed on the spot following explosion. Investigation confirmed that the cause of the explosion was the contaminated gas in the cooling units, which is very unusual and it was identified as R-40. The impact of the blast was so severe that the fridge dismembered into smithereens, ceiling fan and window panes were shattered to pieces.

**Key Words:** Refrigerator, Explosion, Methyl Chloride /Chloromethane, Contamination of Gas

#### Introduction:

Explosions or blasts results in some pattern of injuries or sometimes it might result in death. Death or survival rate sometimes depends on the site of the explosion.

Explosion in confined places such as buildings, mines are usually associated with greater morbidity and mortality. [1] The severity of these injuries also depend victim's vicinity to the source of the explosion. Among the variety of explosions, refrigerator blasts are considered to be the rarest. Few cases have been reported in lay press in recent past years in India.

On early morning a blast inside an apartment in residential area of New Delhi, left four members of a family seriously injured.

Sources said the compressor of the 6-7 year refrigerator [with recently replaced compressor] exploded and was so intense that portions of the doors and windows were blown away under its impact.

#### Corresponding Author:

<sup>1</sup>Associate Professor

Dept. of Forensic Medicine

Osmania Medical College, Hyderabad

E-mail: dr.rambarapu.sudha@gmail.com

<sup>2</sup>Assist Prof, Dept. of Forensic Odontology

Panineeya Institute of Dental Sciences & Research Centre

Hyderabad

<sup>3</sup>Assist. Prof, Dept. of Forensic Medicine

Osmania Medical College, Hyderabad

<sup>4&5</sup>Post Graduate Trainee, Dept. of Forensic Medicine

DOR: 08.04.2015 DOA: 11.08.2015

DOI: 10.5958/0974-0848.2015.00110.4

Akhilesh Arora, who teaches refrigeration at Delhi Technological University, said, "If the safety valve, which is used for high-pressure cut out, malfunctions and cuts off the electric supply it may cause an accident.

Another common reason of the blast could be the fact that these days compressors in refrigerators use hydro fluorocarbon (HFC) or hydrocarbon instead of chlorofluorocarbon (CFC). HFC is more flammable and in case of leakage the compressor can catch fire and explode. [2] He added the temperature of the winding of thermostat used in the compressor could rise due to fault in electric supply resulting in fire and blast. Arora said that routine maintenance by authorized mechanics could prevent such accidents. [2]

The refrigerators mainly follow the law of thermodynamics. Firstly the refrigerator requires a gas that cools on expansion and secondly, when two things of different temperatures comes in near or contact each other, the hotter surface becomes cooler and vice versa. [3]

Many of the old refrigerators around 1950's used refrigerants called Chlorofluorocarbons (CFC's) which was called as Freon. The liquid form of CFC is pushed by the pump through coils in the freezer area where it turns into a vapor. Then it soaks up some of the heat in the freezer compartment because of which the coil gets colder and the freezer begins to get colder.

But these CFC's are no longer used in the refrigerators as they were not environmental friendly and were harmful to the atmosphere upon release. [3, 4] Modern refrigerators are not using CFC's and these are replaced by another

type of gas called HFC-134a, also called as tetrafluoroethane. It is the widely adaptive alternative refrigerant for refrigeration and air conditioning equipment. [3, 4]

### **Case History:**

On 7<sup>th</sup> August 2013, two youngsters working in a refrigerator cum air conditioning work shop located in the area limits of Asifnagar police station, Hyderabad. They were filling the gas (nitrogen) in the pipe of the fridge which was under repair. An explosion occurred at 4:45pm.

Both the youngsters sustained blast injuries and succumbed to severe disruptive injury on the spot. (Fig.1) The impact of the blast was so severe that the fridge dismembered into smithereens, ceiling fan and window panes were shattered into pieces.

They ran out till the gate and collapsed. One of the vehicles parked outside the workshop was knocked down due to explosion and was layered with bluish color material [melted flex banner]. (Fig. 2)

Surprisingly the compressor tank was found intact amongst the debris of blast. (Fig. 3)

### **Autopsy Findings:**

At autopsy following injuries were observed:

#### **Victim-1:**

Blast injury at centre and left side neck extending into upper part of the chest cavity with massive disruption of muscles, nerves, vessels and fracture of C6 and C7 cervical bone.

Multiple fragmentations of left forearm fracture of tibia, fibular bone with torned muscles, tissues and vessels.

#### **Victim-2:**

Abdomen blasted with expelling out its contents with puncturing of intestines with multiple liver lacerations and multiple perforations. Blast injury extending from midline of chest to the right nipple with underlying tissue contused, fracture of 6<sup>th</sup> rib right in the mid clavicle line.

The samples collected from the scene of blast; analyzed at FSL by the flame Halide lamp test [A blue flame indicates the presence of normal gas while the green flame indicates the presence of chlorine] demonstrated the presence of chlorinated compounds. Traces of alumina ( $Al_2O_3$ ) were also found at the site.

A case of rash and negligent act resulting in death [U/S 304 A of IPC] was registered against the owner of that work shop.

### **Discussion:**

Meticulous articulation of observations at autopsy and scene of blast was attempted to scientifically deduce the mechanism of explosion

in the present case. Causes and mechanism of explosion reported so far were also taken onto account.

### **Causes of Explosion:**

The refrigerator explosions take place even after it was proved that R134a is an alternative to CFC's, safest and environmental friendly. It is now widely known that the contamination of the refrigeration systems is because of the addition of counterfeit refrigerant which uses a mix of chemicals including R40. [5]

R40 is a hazardous chemical compound that is extremely flammable. It was widely used in refrigerators in the past which stopped now.

According to Neutronics Inc.'s R40 alert [6]; R40 reacts with aluminum and creates trimethyl aluminum which will ignite spontaneously in air. The boiling point of R40 is similar to that of R134a; hence it is difficult to detect R40 when they were mixed into the refrigeration systems.

### **Explosion Mechanism:**

Usually the registration units contain polyester oil and the refrigerant HFC-134a, which cease the exploding capability of the refrigerator. But use of hazardous chemical compounds such as R40 along with R134a makes the refrigerator more vulnerable to explosion. R40 works as a refrigerant and at times it reacts with the Aluminium in the compressor probably forming

Trimethyl Aluminium is a liquid at room temperature. [7] According to Wiley's Guide to Chemical Incompatibilities [8] the extreme reactive quality of liquid trimethyl Aluminium will make it react violently with hydroxides; carbon dioxide, carbon tetrachloride, halon, halogens, oxides of nitrogen and many other substances.

Excessive moisture in refrigeration systems may also cause corrosion. The combination of moisture with hydrofluorocarbon (HFC) refrigerant containing chlorine creates much more serious corrosion, as the chlorine hydrolyses with the water to form hydrochloric acid (HCL) which is aggressive. The acid forming process in turn is aggravated by heat. [9, 10] It is obvious; in the present case; that the gas cylinder used [Fig. 3] for filling up the compressor was contaminated with Methyl chloride and was responsible of chemical reaction with coils / tubes of compressor accessories leading to explosion.

The recovered material from the explosion site also showed the presence of chlorinated compounds and traces of alumina ( $Al_2O_3$ ). So far as prevention of such explosion

matters; we suggest following safety precautions:

1. Refrigerant gas supplied to the service depots need to be from a certified source with a certificate of veracity of the contents;
2. The withdrawn units should be checked for contamination;
3. Once a contaminated unit has been identified a procedure for making them safe needs to be identified. There is no method till now for the removal of trimethyl Aluminium and yet to be identified;
4. Existing refrigerant stock needs to be checked for contamination;
5. A refrigeration certification scheme needs to be put in place for future purchases;
6. A method to check the withdrawn reefer units for contamination;
7. A safe method for compressor removal of contaminated units to be identified;
8. No repairs are attempted, parts cannot be removed;
9. They may not be plugged in until completion of the thorough technical investigation;
10. They should be stored in an isolated place;
11. It is also very to prevent unauthorized personnel in tampering with the containers.

### Conclusion:

Advancements in various gazettes are a need of hour for better quality of life. Use and maintenance of ones with compressed gases needs a special attention for all concerned to avoid/ minimize the risks coupled there in. A multidisciplinary approach in such unfortunate events does contribute to the exhaustive lists of do's and don'ts.

### References:

1. <http://www.cdc.gov/masstrauma/preparedness/primer.pdf>
2. **Blast in Refrigerator injures four of family.** The Times of India. New Delhi Edition. 14<sup>th</sup> March 2010.
3. [http://www.energyquest.ca.gov/how\\_it\\_works/refrigerator.html](http://www.energyquest.ca.gov/how_it_works/refrigerator.html)
4. <https://scitech.web.cern.ch/scitech/TopTech/03/Refrigerator/refrigerator2.shtml>
5. Safety notice to all-star cool service providers: MAERSK Container Industry: [www.Mcicontainers.com](http://www.Mcicontainers.com)
6. <http://www.refrigerantid.com/R40.html>
7. Revised Information regarding counterfeit refrigerant, Cambridge Refrigeration Technology: [www.crtech.co.uk](http://www.crtech.co.uk)
8. Richard P. Pohanish, Stanley A. Greene. Wiley's Guide to Chemical Incompatibilities- 3<sup>rd</sup> Edition
9. Refrigerant quality and its impact on refrigeration machinery [http://www.wilhelmsen.com/services/maritime/companies/buss/BUS\\_S\\_Pressroom/Documents/Refrigerant%20quality.pdf](http://www.wilhelmsen.com/services/maritime/companies/buss/BUS_S_Pressroom/Documents/Refrigerant%20quality.pdf)
10. **Mark Bennett.** Contamination of Refrigerated Container Systems. UNEP - Joint Meeting of the Regional Ozone Network For South

Asia, Southeast Asia and the Pacific Paro, Bhutan, May 2012  
[http://www.unep.org/ozonaction/Portals/105/documents/webinar/2012/MarkBennett\\_16COAcontaminatedrefrigerants.pdf](http://www.unep.org/ozonaction/Portals/105/documents/webinar/2012/MarkBennett_16COAcontaminatedrefrigerants.pdf)

**Fig. 1: Dead Bodied of Victim at Scene of Blast**



**Fig. 2: Knocked Down Motor Bile Layer with Bluish Material (Melted flex banner)**



**Fig. 3: Investigating Officer Inspecting Debris (Left Hand) and Intact Gas Cylinder (right hand)**



## Case Report

# Suicidal Shotgun Wound on Chest: An Uncommon Site with an Unusual Track

<sup>1</sup>Abhishek Yadav, <sup>2</sup>Rajanikanta Swain, <sup>3</sup>Mantaran Singh Bakshi, <sup>4</sup>Sudhir Gupta

### Abstract

The wounds in the suicidal cases due to firearms are generally in head region. When such a wound is found at other site an eyebrow of suspicion is raised. We report a case in which the deceased had a gunshot wound over his chest. The weapon used was a long double barrel shotgun. The track of the wound raised the suspicion towards sustaining of the gunshot injury in a homicidal manner by the use of that specific weapon. However when the circumstances in which the body was found were examined together with the account of the witnesses and police investigation report, it was noted that the theory of police regarding the suicidal manner was a certain possibility. By this case we want to reiterate a well-known fact that the Forensic Pathologists should not rush to opine about the manner of the case. Instead they should interpret their findings in light of the detailed history, circumstantial evidence, witnesses etc. This case is also being reported because of the unusual manner of sustaining a gunshot wound at a less commonly involved site and from a weapon unlikely to be used for suicide.

**Key Words:** Suicide, Shotgun, Firearm, Head Region, Weapon

### Introduction:

Misuse of firearms is an ever growing menace in the society. They can be used either for homicide or suicide with accidental cases not far behind. Shooting by a firearm is the most common method of suicides in males in United States. [1] In India the suicides by firearm are not very common (0.4%), with Hanging being the most common. [2]

This may be attributed to less availability due to stricter laws regarding firearm possession. In suicidal cases, Hand guns are used more frequently as compared to rifles or shotgun and the site of the wound is usually in head region both in the handguns and long weapons. [3] The type of weapon and unusual position of the wound may sometimes leads to doubt in the mind of investigators.

We present a case of a middle aged male who committed suicide with a shotgun with entry wound at a less common site and an unusual track.

### Corresponding Author:

<sup>1</sup>Assistant Professor  
Department of Forensic Medicine and Toxicology,  
AIIMS, New Delhi-110029  
E-Mail: drayad\_in@yahoo.com

<sup>2</sup>Senior Resident

<sup>3</sup>Junior resident

<sup>4</sup>Prof & HOD

DOR: 18.05.2015 DOA: 1.09.2015

DOI: 10.5958/0974-0848.2015.00111.6

This case is being reported because the post-mortem examination initially raised the doubt of homicide in the mind of autopsy surgeons. Then the findings were assessed with the circumstantial evidence, witnesses, type of weapon used and the manner was concluded as suicidal.

### Case History:

The deceased was a middle aged male found dead in his office. There were no eyewitnesses and nobody heard a gunshot. He was brought for post-mortem examination.

### Autopsy Findings:

The deceased was wearing a blood soaked t-shirt with a hole of diameter 2.5 cm over the left chest region with fibres turned inwards, a blood soaked vest with a hole of diameter 2.5 cm present in the upper part just below the neck border with fibres turned inwards. Both the holes were in correspondence with each other and underlying gunshot wound. Other clothes were also blood stained.

The deceased was thin built and moderately nourished, and 177 cm in height.

The rigor mortis was well developed in all the four limbs and post-mortem lividity was seen over the back and dependant areas except pressure areas.

### External Injuries:

A lacerated gunshot entry wound (Fig. 1) of size 2 x 1.5 cm was present over left side of chest. The wound was situated 137 cm from

left heel, 6 cm from the midline to the right and 17 cm below the left shoulder. The wound was associated with an eccentric reddish blue contused abrasion collar of size 2 x 2 cm over the medial aspect of the entry wound. The wound was surrounded by a rim of reddish blue contused abrasion of size 0.1 cm suggestive of muzzle imprint.

#### Internal Examination:

The track of the wound was directed downward, backward and laterally, shattering the fourth left rib underlying the entry wound. (Fig. 2) The wound was further extending in the chest cavity passing through left lung involving anterior aspect of lower lobe with about 1500 ml clotted and fluid blood in the pleural cavity.

The seventh, eighth and ninth ribs were fractured in the posterior axillary line on the left side of the chest associated with underlying haematoma. Multiple metallic pellets are present diffusely throughout the track of the wound in the back of the lower chest.

A red coloured plastic wad (Fig. 3) of length 2.5 cm and diameter 1.5 cm along with multiple metallic pellets are present in the subcutaneous tissue at the level of ninth ribs in the left posterior axillary line creating a bluish contusion of size 10 x 6 cm. (Fig. 4)

The contusion is situated 132 cm above the left heel, 15 cm from midline and 28 cm below the left shoulder.

The visceral organs were pale. The cause of death was ascertained as **Haemorrhagic shock due to gunshot wound to the left lung**. The injury was opined as ante-mortem in nature and sufficient to cause death in ordinary course of nature

#### Discussion:

We will first have a look at the characteristics of the shotgun wounds of the trunk. The shotgun contact wounds to the chest are different from the entry wounds over head. They do not produce as destruction as they produce in head. The contact wounds will be of circular in shape and having the diameter equal to the bore of the weapon. No soot will be surrounding the entrance site, but edges of wounds are blackened by gases.

There will not be any splitting of skin as the gases disperse in the surrounding soft tissues and visceral cavities. These gases will cause the abrupt flaring of the chest or abdominal cavity leading to muzzle imprint of weapon. [4] The entry wound present in our case typically shows all the features. (Fig. 1)

The exit wounds are uncommon in trunk as less energy is possessed by each pellet

because of the small size and also due to low muzzle velocity of the weapon. Commonly a bruise is present along the attempted exit wounds [5], as seen in the present case. (Fig. 4)

The track of the wound was going downwards, backwards and laterally. This considered with the length of the double barrel shotgun weapon as described by the investigation officer (length of the barrel was about 2<sup>1/2</sup> feet and of the butt was about 1<sup>1/2</sup> feet) (Fig. 5) raised the doubt about the suicidal theory of the police.

The possibility of the deceased being killed by somebody else while pointing the gun downwards on the chest of the deceased also came into the thought.

Crime scene photographs revealed the deceased lying in a prone position over a shotgun. (Fig. 6) An executive chair with wheels was present towards his legs and his head was towards a nearby wall. No office staff and family member revealed any kind of suspicion towards foul play or motive suggesting assault.

The investigating officer reported that the deceased used to run his office from a rental accommodation. In the evening when he didn't returned to his house, his son called on the landlord to check for him. The landlord found the door to be locked from inside. He then called the police who broke open the door. No suspicion was found regarding the movements of family members and office staff.

Di Maio [3] explained the trajectory of the bullet or pellets in self-inflicting wounds to the chest and abdomen from rifles and shotguns. The individual doing suicide braces the butt of the gun against the ground and lean over the weapon. They hold the muzzle end against chest or abdomen with the left hand and try to reach the trigger with the right hand.

In this process they rotate their body counter-clockwise. So due to above phenomenon the bullet follow a right to left part.

As the victim is hunched over the gun, the trajectory of the bullet is downwards and not upwards. The final trajectory will be downwards, and right to left in a right handed person, which is consistent with the track of the wound in our case. So keeping in totality of the circumstances and witnesses we were of the opinion that the theory of the police is possible and can be accepted. The police later recovered a suicide note also which confirmed our diagnosis.

Druid [6] reported that 97% cases of suicidal had single wound. The most common direction of wounds on left chest was backwards, downwards and to the left.



Strajina et al [7] studied series of cases involving suicidal single gunshot injury to the chest. The left side of chest was found to be most commonly involved area. The most common wound track was backwards, downwards and from right to left.

Demirci [8] in an eight year study reported 40.4% of the shotgun death cases being suicidal. The most preferred site was head (59.7%) and chest region was involved in only 12.3% of the cases.

The shooting distance was contact/near contact in 55 cases (96.5%). The findings in our case are consistent with the above studies.

### Conclusion:

During the autopsy if any such findings are noted by the Forensic Pathologist, he should not rush to opine about the manner of the case. Instead, he should interpret his findings in light of the detailed history, circumstantial evidence, witnesses etc. Any wrong opinion specifically mentioning the manner as homicidal may put the pressure on police who can apprehend an innocent person on the basis of minor suspicion leading to his harassment.

### References:

1. United States. National Vital Statistics Report (NVSR). Deaths: Final Data for 2012. [Internet]. [Cited 2014 Dec 26]. Available From: [http://www.cdc.gov/nchs/data/nvsr/nvsr63/nvsr63\\_09.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr63/nvsr63_09.pdf)
2. India. National Crime Records Bureau (NCRB). Ministry of Home Affairs. Accidental Deaths and suicide in India 2013. [Internet]. [Cited 2015 Apr 24]. Available From: <http://ncrb.gov.in/ads2013/ads2013.htm>
3. Di Maio VJM. Gunshot wounds-Practical aspects of firearms, ballistics and forensic Techniques, 2<sup>nd</sup> ed. London: CRC Press; 1999. Chapter-14. Suicide by firearms: p355-363.
4. Di Maio VJM. Gunshot wounds-Practical aspects of firearms, ballistics and forensic Techniques, 2<sup>nd</sup> ed. London: CRC Press; 1999. Chapter-8. Wounds from shotgun: p234- 236.
5. Knight B, Saukko P. Knight's Forensic Pathology, 3<sup>rd</sup> ed. London: Arnold; 2004. Chapter-8. Gunshot and Explosion deaths: p255.
6. Druid H. Site of entrance wound and direction of bullet path in firearm fatalities as indicators of homicide versus suicide. Forensic Sci Int. 1999; 88:147-162.
7. Strajina V, Zivkovic V, Nikolic C. Forensic Issues in Suicidal Single Gunshot Injuries to the Chest- An Autopsy Study. Am J For Med Pathol. 2012; 33(4): 373-376.
8. Demirci S, Dogan KH, Deniz I, Erkol Z. Evaluation of Shotgun Suicides in Konya, Turkey Between 2000 and 2007. Am J For Med Pathol. 2014; 35(1): 45-49.

**Fig. 1: Entry Wound over Chest**



**Fig. 2: Injuries to Rib Cage below Entry Wound**



**Fig. 3: Red Plastic Wad at the end of Track**



**Fig. 4: Bluish Contusion over Back**



**Fig. 5: Shotgun Used for Suicide**



**Fig. 6: Position of Body at the Crime scene**





## Case Report

### Autopsy in an Embalmed Corpse: A Case Report

<sup>1</sup>Biplab Shee, <sup>2</sup>Saurabh Chattopadhyay, <sup>3</sup>Shouvanik Adhya

#### Abstract

Medico-legal autopsy in an embalmed body is an extremely infrequent incidence. One such case has been conducted at Kolkata Police Morgue. The dead body was donated at department of Anatomy for academic dissection purpose by medical students, as desired by the deceased before death. The body was embalmed for preservation. But sixteen days after death, a complaint has been lodged by one of the legal heir having a suspicion of foul play. Hence the autopsy was performed on the order of the honorable court to ascertain actual cause and manner of death. There was a history of head injury due to fall from bed. On admission, surgical intervention was done at a nursing home but no police case was filed at that time. During autopsy all the injuries were evidently identified. The merits and demerits of autopsy on such embalmed body have been discussed in the case report. Embalming artefacts should be dealt with extreme caution before giving opinion.

**Key Words:** Embalmed corpse, Medico-legal autopsy, Head Injury

#### Introduction:

Embalming is the process of preservation of cadaver to prevent decomposition using antiseptics and preservatives. The ancient Egyptian technique of preservation involved evacuation of the intestinal contents and internal organs followed by use of some chemical agents.

The exact process followed by the Egyptians is not yet clearly known. [1] By this method there is coagulation of proteins, fixation of tissues and organs are hardened. Because of chemical stiffness due to embalming, normal rigor mortis does not develop.

Hanzlick has pointed out some predictable embalming artifacts. [2] According to Rivers, such procedure may simulate injuries and diseases, alter surgical wounds, eradicate trace evidences and alter postmortem changes. [3] In the present case embalming fluid was introduced via the femoral artery and the body was kept dipped into a formalin solution chamber for 16 days.

#### Corresponding Author:

<sup>3</sup>Associate Professor,  
Dept. Forensic Medicine & Toxicology,  
College of Medicine & JNM Hospital,  
WBUHS, Kalyani, West Bengal  
E-mail:shouvanikadhya@gmail.com

<sup>1</sup>Assoc. Prof, Dept. of FMT,  
NRS Medical College, Kolkata, West Bengal

<sup>2</sup>Assoc. Prof, Dept. of FMT,  
Murshidabad Medical College, West Bengal  
DOR: 11.05.2015 DOA: 29.08.2015  
DOI: 10.5958/0974-0848.2015.00112.8

Post embalming medico legal autopsy after a period of more than two weeks is an uncommon occurrence and has rarely been reported in literature.

#### Case History:

A dead body of a male aged 70 years was donated at Department of Anatomy, Medical College, Kolkata, India. The body was embalmed as a routine procedure before use for academic dissection by the students. Sixteen days after death, one of the relatives of the deceased complained to the police demanding post mortem examination as he was not satisfied regarding the cause of death as certified by the doctor – “**Cardio respiratory arrest in a case of intra cranial haemorrhage**”.

There was history of fall from bed followed by unconsciousness before admission at a nursing home. Neurosurgical intervention was done but the person expired. No police case was registered in the nursing home. On the orders of the honorable court police seized the body from the Department of Anatomy and sent it for medico-legal autopsy.

#### Autopsy Findings:

On examination a lacerated wound measuring 3cm X 1.5 cm X bone depth was noted on the left side of forehead 3 cm above the eye brow. It was stitched and the age matched with the date of fall.

One surgically made incised wound was found over left temporal-parietal area of scalp measuring 12 cm in length. (Fig. 1) A loose bone segment measuring 8cm X 3.5cm was found underneath. (Fig. 2) The duramater was stitched

and blood clot weighing 150 grams was found in the subdural space. (Fig. 3) Subarachnoid haemorrhage was also noted. (Fig. 4) No other ante-mortem injury could be detected.

### Discussion:

Any case of death following trauma is treated as unnatural death. In all such cases medico legal autopsy is compulsory in our country. In the present case as no police intimation was given by the nursing home authority, doubts were raised.

Death certificate was issued apprehending the possibility that the body would not be accepted for donation, as desired by the deceased prior to death, if it was considered as unnatural death.

On other hand objections were raised regarding insurance claims as autopsy was not conducted in a case of death following trauma. This ultimately led to the delayed claim for medico-legal autopsy after 16 days by one of the relatives. In the present case embalming had both advantages as well as disadvantages during autopsy. As the body was hardened usual meticulous dissection was hindered.

Preservation of viscera was of little value as toxicological examination by usual methods cannot be performed in formalin fixed organs. [4] However Alunni-Perret [5] and coworkers have detected heroin from bile and liver in embalmed bodies.

Steinhauer [6] has devised a useful test for detection of ketosis in such cadaver.

Detection of carbon monoxide from blood clot in cardiac chambers [7] and alcohol from vitreous of preserved bodies [8, 9] have also been reported. On the other hand as the body was well preserved the injuries could be examined in detail.

Artifacts due to decomposition did not alter the appearance, shape or size of the injuries and the intracranial hemorrhage was also very evident. This would not have been possible had the body been cremated by burning as per Hindu custom. In exhumed bodies decomposition limits the findings in autopsy.

Opeskin [10] reports of a case of unusual injury and highlighted the difficulties that may be encountered in interpretation of injuries. Possibilities of imaging studies by X ray and CT scan in embalmed bodies have also been reported in literature. [11]

Moritz has correctly stated "The mistake of a body to be embalmed before autopsy may be as disastrous as the performance of an incomplete autopsy". [12] Thus care must be taken in all cases of unnatural deaths to avoid

embalming prior to autopsy; else miscarriage of justice may result.

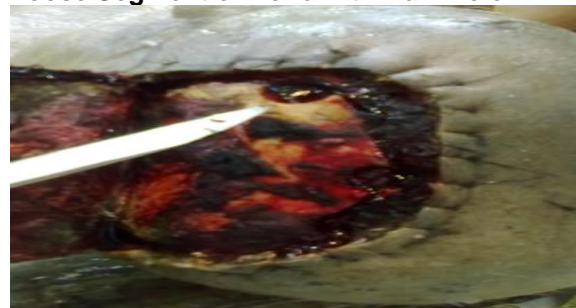
### References:

1. Robert G Mayer. Embalming. History, Theory & Practice. 3<sup>rd</sup> Ed. New York: McGraw-Hill; 2000.
2. Hanzlick R. Embalming, body preparation, burial and disinterment. An overview for Forensic pathologists. Am. J Forensic Med Pathol. 1994; 15(2): 122-131.
3. Rivers RL. Embalming Artifacts. J For. Sci. 1978; 23(3): 531-535.
4. Simpson K. Modern Trends in Forensic Medicine. London: Butterworth & Company; 1953.
5. Alunni-Perret V, Kintz P, Ludes B, Ohayon P, Quatrehomme G. Determination of heroin after embalment. Forensic Sci. Int. 2003; 134(1): 36-39.
6. Steinhauer JR, Volk A, Hardy R, Konrad R, Daly T, Robinson CA. Detection of ketosis in vitreous at autopsy after embalming. J Forensic Sci. 2002; 47(1): 221-223.
7. Iffland R, Madea B, Balling P. Diagnosis of carbon monoxide poisoning following embalming and exhumation. Arch Kriminol. 1988; 182(3-4): 100-106.
8. Scott WU, Root I, Sanborn B. The use of vitreous humor for determination of Ethyl Alcohol in Previously Embalmed Bodies. J Forensic Sci. 1974; 19(4): 913-916.
9. Coe JJ. Comparative Postmortem Chemistries of Vitreous Humor before and after Embalming. J Forensic Sci. 1976; 21(3): 583-586.
10. Opeskin K. An unusual injury. Med Sci. Law. 1992; 32(1): 58-60.
11. Ciranni R, Caramella D, Nenci R, Fornaciari G. The embalming, the scientific method and the paleopathology: the case of Gaetano Arrighi (1836). Med Secoli. 2005; 17(1): 251-262.
12. Moritz AR. Classical Mistakes in Forensic Pathology. American Journal of Clinical Pathology. 1956; 26(12): 1383-1397.

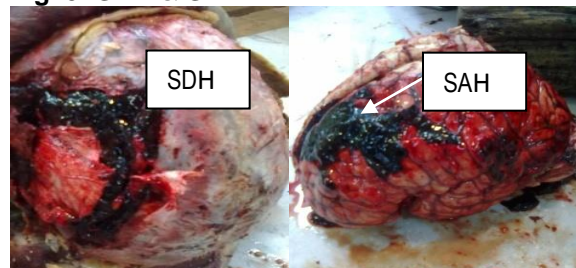
**Fig. 1: Stitched up Scalp**



**Fig. 2: Reflected Portion of Scalp Showing Loose Segment of Bone with Burr Hole**



**Fig. 3: SDH & SAH**



## Case Report

### Paediatric Poisoning Panic and Forensic Toxicologist

<sup>1</sup>MZ Saiyed, <sup>2</sup>S Prajapati, <sup>3</sup>CB Jani, <sup>4</sup>BS Prajapati

#### Abstract

Poisoning forms a reasonable chunk of morbidity and mortality amongst cases referred to the hospitals in India. Such cases comprise almost all age groups in both genders, but it is always panicking when it is a paediatric patient suffering from any manner of poisoning; most commonly accidental. It is obvious that poisoning cases need more attention so as to check mortality. Poisoning in children by biological plants is not uncommon as children are attracted towards the plants and their colourful fruits while playing. These cases may produce severe symptoms and may prove fatal. We are presenting a case report of a 2½ year old female child who consumed seeds of some plant while playing and suffered with severe vomiting within short duration of its consumption. It created great panic amongst the relatives of the patient as well as treating personnel as identity of the culprit seeds was not established; coupled with the fact that malnourished child was diagnosed to also suffer from some hematological disorder. Present case is a good example of multidisciplinary approach of a poisoning condition of clinical nature and hence discussed in detail.

**Key Words:** Clinical toxicology, Forensic Toxicologist, Paediatric poisoning, Panic

#### Introduction:

As per National Crime Record Bureau report [1] percentage share of deaths due to poisoning during the years 2012 and 2013 was 7.8% (rate 2.5) and 7.3% (rate 2.4) respectively.

Gunheti & Singh [2] observed 17.33% mortality in poisoning cases at Khammam region of Andhra Pradesh. Acute poisoning form a reasonable chunk among emergency cases brought to any hospital. Such cases comprise of almost all age groups of both genders.

Yadav & Singh [3] in their study in rural area of Haryana observed that "poisoning was the predominant cause (36.90%) out of all medico-legal cases". Distribution of paediatric age group in various studies on poisoning was 1.99% in Khammam region [2], 2% in Uttarakhand [4] and 2.1% in Jamnagar region [5], almost of same range. However, it was reported to be little higher in southwest Punjab region being 6.3% [6] and western Uttar Pradesh as 7.93%. [7]

Thus it is obvious that clinical cases of poisoning need more attention with reference to timely diagnosis and treatment so as to check mortality. Paediatric age group is not an exception to it. As poisoning cases of pediatric age group are more accidental as compared to elders; in addition to chemical substance; some biological plants are also responsible for poisoning. Timsinha et al [8] observed 11.81% cases of poisoning in his study at western region of Nepal during the years 2013 and 2014.

They also observed that in 30.75% of all medico-legal cases; opinion of surgery, Orthopedics and Medicine was sought. Surprisingly in two cases only Forensic Medicine department involvement was sought. Present case is a good example of multidisciplinary approach of a poisoning condition of clinical nature and hence discussed in detail.

#### Case History:

On 12/12/2013 at 6:30 pm, a 2½ year old female patient was brought by parents to GCS Medical College Hospital for treatment of vomiting following accidental ingestion of some seeds around 4:00 pm on same day.

The chief complaint was vomiting, 7-8 times in span of last two and half hours. General examination demonstrated normal vitals but right eye ptosis and squint. Systemic examination was not significant and there were no signs of dehydration. Parents shared history of accidental ingestion of some seeds [fumbling about the name or type and number of seeds -

#### Corresponding Author:

<sup>1</sup>Assistant Professor,  
Dept. of Forensic Medicine & Toxicology  
GCS Medical College, Hospital & Research Centre,  
E-mail: dr\_ziya\_saiyed@yahoo.com

<sup>2</sup>Junior Resident, Dept. of Paediatrics

<sup>3</sup>Prof & HOD, Dept. of FMT

<sup>4</sup>Prof & HOD, Dept of Paediatrics

DOR: 03.06.2015 DOA: 04.09.2015

DOI: 10.5958/0974-0848.2015.00113.X

cotton seeds, Dhatura seeds etc. as they didn't witness!] Looking to the clinical presentation; I/V fluids, Inj. Rantac and Syrup Domstal were administered to control vomiting.

However, attending pediatricians were not able to retrieve the information from parents about nature of seeds consumed and were anxious about further line of management.

In addition, patient was diagnosed to suffer from Protein Energy Malnutrition (PEM grade-III) on Anthropometric evaluation.

Hematological investigations indicated picture of thalasemic nature. This added to anxiety of paediatricians about further course and management. Under the circumstances; as an institutional protocol in medico-legal/potential medico-legal case, Department of Forensic Medicine & Toxicology was consulted.

We shared certain plant images available in books of Forensic medicine & Toxicology to parents and tried to narrow down the search on the type of plant.

They were yet not clear but said that there is a plant 5-6 meter height near their abode having fruits resembling lemon.

They were asked to bring a "sample" of the fruit they referred and worried parents brought the fruit within 15 minutes. The fruit was lemon yellow in colour, ovoid in shape and about 5-6 cm in diameter. The branch had two other fruits in dried condition, open exposing three lobes/compartments with one seed in each.

The seed was oval in shape, brownish in colour with creamish-white upper end. (Fig. 1)

On transverse section of the fruit three lobes/compartments with one seed in each was visible better. The cut section of seed showed creamish white pulp of seed with brownish coloured seed wall. (Fig. 2)

Attending paediatricians were called shown image of *Jatropha* plant, fruit, seed and cut section of seeds as documented in Textbook of Forensic Medicine and Toxicology [9], (Fig. 3).

It was very much convincing to them that they are dealing with no other seeds but *jatropha*. It was also made clear that the active principle curcin is a plant irritant which can produce signs and symptoms as burning sensation in the throat, vomiting, diarrhea, pain in abdomen etc. They watched for all the signs and symptoms but only vomiting was common and other reported signs and symptoms didn't develop in the case.

Attending paediatricians were updated that it is not life threatening in present case and the same line of treatment will check the recovery. Mathihran & Patnaik [10] mentioned

that on microscopy seeds show prismatic cells, polygonal in shape with slit like lumen and cell wall having fine transverse striae. To confirm the description, we submitted the seeds for microscopic examination so as to reconfirm the diagnosis. (Fig. 4 and Fig. 5)

However, keeping in mind pre-existing PEM grade III, hematological investigations were also advised for management of PEM-III and to rule out any other pre-existing disorder or hematological effect of poisoning. **Hb** – 11.2 gm/dl, **RBC count:** 5.16 million/cmm, **RBC indices:** PCV: 34.2 % MCV: 66.3 fl, MCH: 21.7 pg, MCHC: 32.7 g/dl, RDW: 19.8 %, TLC: 18700 /cmm. **Differential leucocyte count:** Neutrophils: 66%, Lymphocytes: 22%, Eosinophils: 8%, Monocytes: 4%, Basophils: 0%, Platelet count: 452000 / cmm, PDW: 10.6 fL, MPV: 9.1 fL.

**Peripheral smear:** Microcytic (+1), Hypochromic (+1) Anisopoikilocytosis (+1), WBC series showing Neutrophilic Leucocytosis with mild eosinophilia. Polymorphs show toxic granulation & cytoplasmic vacuoles. Platelets were adequate. With same line of treatment patient started recovering and was discharged on 14-12-2013 after two days of hospitalization. At discharge; parents were advised for Hb electrophoresis to rule out Thalessemia Minor (Indices suggestive).

### Discussion:

In present case, Department of Pediatrics sought opinion from Department of Forensic Medicine with reference to diagnosis and treatment subsequently in a clinical case of poisoning by unknown seeds.

A scientific approach for diagnosis was adopted in absence of exhaustive analytical facilities at the center; which proved beneficial not only to patient and relatives but also to attending clinicians. Diagnosis and management of poisoning conditions form part and parcel of curriculum in the disciplines of Forensic Medicine and General Medicine for undergraduate students. [11]

In this case; morphological comparison of seeds in question by gross and microscopic examination was sufficient to conclude it as *Jatropha* seeds. Signs, symptoms and treatment of poisoning by *Jatropha* seeds documented in biomedical literature were also of immense help.

Publication by Singh et al [12] on "*Jatropha* Poisoning in Children" was also discussed in detail. The sigh of relief for patient's relatives and clinicians at the end of entire exercise; that they are dealing with a "non-fatal poisoning case to be managed on symptomatic



and supportive line" was of immense help for discharge of patient with minimal duration of hospitalization.

In absence of exhaustive analytical facility for biological poisons at the center a multidisciplinary approach played a crucial role.

Microscopic appearance of the *Jatropha* seeds is documented in some literature but without any image in support of description.

Processing of seeds for histological examination in stained preparation can take 18-24 hours and hence can be explored in such situations. The striking feature of present case is image of microscopic appearance of the seeds, which is not available in biomedical literature available to us.

### Conclusion:

It is suggested that for clinical cases of medico-legal nature, where diagnosis and management of a condition is obscure; a multidisciplinary approach can be crucial and helpful. Neither clinicians nor Forensic Medicine expert shall hesitate for such approach; especially when Forensic Medicine nomenclature as per MCI is "Forensic Medicine Including Toxicology" and at many private Medical Colleges Forensic Medicine experts are not burdened with medico-legal post-mortem work and hardly have any additional assignments than teaching.

Secondly, in absence of a great analytical set up; optional but scientific approach can yield better results and hence for involving ourselves in such multidisciplinary work shall not have excuse of inadequate infrastructure and facilities. Available resources shall be explored to its best before requesting for modern gadgets having regard to cost effective capital expenses.

Once we prove ourselves, authority managing such institutions will be scientifically convinced for expansion of facilities.

### References:

1. Accidental Deaths and Suicides in India: National Crime Records Bureau, New Delhi; 47<sup>th</sup> Ed: 2014.
2. Gunheti B K and Singh U P. The pattern of poisoning in Khammam. JIAFM 2011; 33(4):296-300.
3. Yadav A and Singh NK. Pattern of Medico-legal cases in rural area of Faridabad, Haryana. JIAFM 2013; 35(1):60-62.
4. Saxena V and Das S. Retrospective analysis of pattern of poisoning in Uttarakhand. JIAFM 2014; 36(3):230-233.
5. Gupta BD and Vaghela PC. Profile of fatal poisoning in and around Jamnagar. JIAFM 2005; 27(3):145-148.
6. Garg V and Verma S K. Trends of poisoning in rural area of south-west Punjab. JIAFM 2010; 32(3):189-193.
7. Patel N S et al. Trends of Poisoning in western Uttar Pradesh: A clinico-pathological study. JIAFM 2014; 36(2):142-145.
8. Timsinha S et al. Profile of pattern of medico-legal cases in casualty of a teaching hospital of western region of Nepal. JIAFM 2015;37(1):46-49.
9. Pillay VV. Text Book of Forensic Medicine & Toxicology. 15<sup>th</sup> ed. New Delhi: Paras Publishers; 2010.pp 499
10. Mathiwaran K, Patnail AK, editors. Modi's Medical Jurisprudence and Toxicology. 23<sup>rd</sup> ed. Gurgaon: Lexis Nexis; 2010. p 252.
11. Graduate Medical Education, 1997. Medical Council of India, New Delhi.
12. Singh R K et al. *Jatropha* Poisoning in Children. Med Journal Armed Forces India 2010; 66(1):80-81.

**Fig. 1: Fruit Resembling "Lemon" and Adjoining Dried Fruit Showed Three Lobes having Oval Shaped Brownish Seeds**



**Fig. 2: Transverse Cut Section of Fruit- Three Compartments, One Seed in Each**

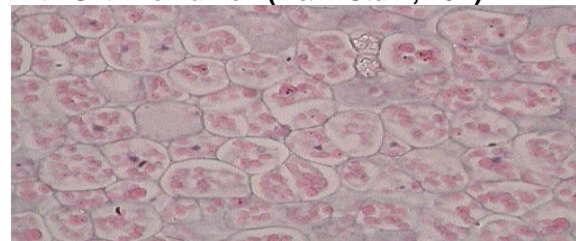


**Fig. 3: *Jatropha* Fruit and Seeds in Textbook of Forensic Medicine and Toxicology**

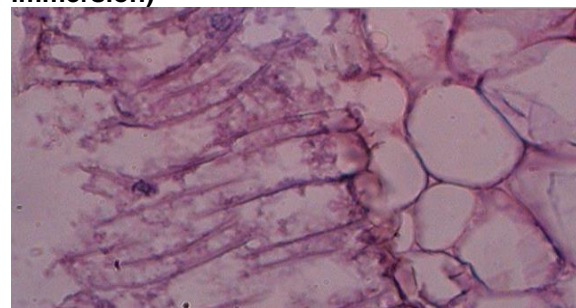


**Fig. 30.18 *Jatropha* fruit and seeds**

**Fig. 4: T S of Seed Shows Polygonal Cells with Slit like Lumen (H& E Stain, 40X)**



**Fig. 5: L S of Seed Shows Polygonal Cells with Slit like Lumen (H& E stain, 100X, Oil immersion)**



## Case Report

### Sudden Cardiac Death in Young Adults

<sup>1</sup>Soumya Ranjan Nayak, <sup>2</sup>Braja Kishore Dash, <sup>3</sup>Subhasis Mishra, <sup>4</sup>Tushar Bhutada, <sup>5</sup>Manoj Kumar Jena

#### Abstract

Sudden cardiac death is defined as death from unexpected circulatory arrest resulting from cardiac arrhythmia which occurs within one hour of the onset of symptoms. Hypertrophic cardiomyopathy (HCM) is the leading cause of sudden cardiac death in young athletes in the United States and the most common genetic cardiovascular disorder. HCM is characterized by a heavy muscular hyper contracting heart and is a diastolic disorder of heart with asymmetric hypertrophy of ventricular septum. HCM is mostly asymptomatic until sudden cardiac death occurs. Sudden death due to cardiac failure is the most common cause of death and particularly likely in young males with familial HCM or with a family history of sudden death. Major risk factors for sudden death in individuals with Hypertrophic cardiomyopathy include prior history of cardiac arrest, ventricular fibrillation, spontaneous sustained ventricular tachycardia, family history of premature sudden death, unexplained syncope, left ventricular thickness more than or equal to 30mm, abnormal exercise blood pressure and non-sustained ventricular tachycardia. We are hereby reporting few rare cases of sudden cardiac deaths, the bodies of which were brought to the mortuary of S.C.B Medical College, Cuttack for autopsy.

**Key Words:** Hypertrophy, Cardiomyopathy, Sudden Death, Young Male

#### Introduction:

Many a times Forensic experts encounter cases of deaths which are sudden, unexpected, clinically unexplained and suspicious in which there is usually no unnatural element. According to WHO, sudden death is defined as those deaths which occur within 24 hours from the onset of symptoms. [1]

Diseases of cardiovascular system account for about 45-50% of all sudden deaths. [2] Hypertrophic Cardiomyopathy (HCM) is one of the most common causes of sudden and unexplained death in young athletes. [3]

Hypertrophic cardiomyopathy is defined by the presence of unexplained myocardial hypertrophy typically involving the interventricular septum more than the posterior or free wall of the left ventricle. [4] The classic pattern of HCM is disproportionate thickening of the ventricular septum as compared with the free wall of the left ventricle for which it is also known as asymmetric septal hypertrophy. [3]

#### Corresponding Author:

<sup>1</sup>Associate Professor, Dept. of FMT  
V.S.S Medical College, Burla, Odisha  
E-mail: soumyarnayak@yahoo.com

<sup>2</sup>Assoc. Prof, Dept. of FMT,  
S.C.B Medical College, Cuttack,

<sup>3</sup>Assist. Prof, Dept. of Pathology, S.C.B.M.C., Cuttack,

<sup>4</sup>Post Graduate Student, Dept. of FMT,

<sup>5</sup>Prof & HOD, Dept. of FMT, S.C.B.M.C., Cuttack

DOR: 08.06.2015 DOA: 25.08.2015

DOI: 10.5958/0974-0848.2015.00114.1

Marked hypertrophy can involve the entire septum but it is usually most prominent in the sub-aortic region. [3]

In this disorder the ventricular cavity is compressed in to a banana like configuration as elicited on cross section. [3] Variable amount of scarring may be seen in the septum suggesting previous ischaemic episodes. [5] The exact cause of HCM is not yet known. [6]

However, in approximately half of cases the disease is familial and the pattern of transmission is autosomal dominant. [3] Rest of the cases is sporadic in nature. [3] About 60% of the HCM is caused by mutation of beta-myosin heavy chain, cardiac myosin binding protein C, cardiac troponin-T and I. [7] Majority of the patients with HCM have at least one other affected first degree relative. [6]

Most of the patients of hypertrophic cardiomyopathy have few or no symptoms but in hospital based populations dyspnea, chest pain, unexplained syncope, palpitation and fatigue are commonly seen. [7] The most important complication of HCM is sudden death. [7]

Sudden death most commonly occurs during mild exertion or sedentary activities. [4]

#### Case One:

A 22 year young man while climbing the stairs of his office suddenly fell down on the platform, sustained few non-fatal injuries on different body parts and became unconscious. He was then immediately shifted to hospital where the doctor declared him brought dead.

The dead body was sent to the central morgue of S.C.B Medical College, Cuttack for post-mortem examination with an allegation of death due to accidental fall in the company premises. During autopsy, surgical bandage was found on the head. Nail beds were bluish in color and rigor mortis present all over the body.

There were presence of several fresh abrasions of small size on face, left ear and dorsum of left elbow with presence of two small superficial lacerations on right side eyebrow and left ear. On Internal examination, scalp was found contused (2cmx2 cm) on right side frontal area. Skull, duramater and brain were found intact without any injury.

Heart was enlarged, weighing about 400gms with gross hypertrophy of left ventricular wall and inter ventricular septum. There was severe narrowing of left ventricular lumen.

Multiple small fibrotic patches were found in the interventricular septum. Stomach was found to contain semi digested food without emitting any characteristic smell. All other internal organs were found intact.

#### **Case Two:**

A 37 year old post-graduate student of Orthopedics suddenly became unconscious in the hospital and died immediately. During autopsy, face was congested, nail beds were bluish in color and there was no external or internal injury present on the body.

Hearts was enlarged in size, weighing about 450gms with thickening of left ventricular wall and inter ventricular septum and there was narrowing of left ventricular cavity. Other internal organs were found intact.

#### **Case Three:**

A young 27 years man suddenly became unconscious during a police training camp. He was then immediately shifted to hospital where he was declared brought dead.

During autopsy, few superficial abrasions were found on the body. Hearts was found enlarged in size, weighing about 380s gm with thickening of left ventricular free wall and inter ventricular septum with narrowing of left ventricular cavity. Stomach was found to contain water and other internal organs were intact.

#### **Case Four:**

A man of 32 years without any prior history of heart disease felt sudden chest pain in one morning and fell down and became unconscious. Immediately he was shifted to nearest hospital where he was declared brought dead by the doctor. During autopsy, no injury either external or internal detected on the body.

Heart was found enlarged in size, weighing about 420gms with gross asymmetrical hypertrophy of left ventricular wall and interventricular septum and narrowing of left ventricular lumen. Multiple small fibrotic patches were found in the left ventricular wall and inter ventricular septum. Stomach was empty. All other internal organs were found intact.

#### **Case Five:**

A 38 year old man felt sudden chest pain in the morning and then immediately shifted to S.C.B Medical College, Cuttack for treatment where he was received dead by the casualty medical officer. During post-mortem examination, face was found congested without presence of any injury on the body.

Heart was enlarged weighing about 400gms with asymmetric hypertrophy of left ventricular wall and inter ventricular septum with presence of small fibrotic patches throughout them. Internal structures of neck were found intact and stomach was empty. Other internal organs were intact and congested.

In all these cases heart was sent for histopathology and subsequently histopathology report showed presence of extensive myocyte hypertrophy, myofibre disarray and extensive interstitial fibrosis suggesting hypertrophic cardiomyopathy of heart. [Fig. 1 & 2] After going through all the post-mortem reports, autopsy conducting doctors opined cardiac arrest resulting from hypertrophic cardiomyopathy as the cause of death in these cases.

#### **Discussion:**

Hypertrophic cardiomyopathy was established as a diagnostic entity in 1950. [7] Males are more commonly affected than females. [4] It is the most common inherited cardio vascular disorder affecting up to 1 in 500 of the general population. [7]

The pathologic hallmark of this disease is myocardial hypertrophy, myocyte disarray (usually in association with myocardial fibrosis) and small vessel disease. [7] The most important microscopic feature of HCM is myocyte disarray which consists of:

- (1) Loss of normal parallel arrangement of the myocytes
- (2) Abnormal intercellular connections
- (3) Variation in the diameter and length of individual myocyte. [7]

In HCM myofibre disarray affects about 5 to 40% of the total myocardium. [7] Many patients have abnormal small intramural arteries with apparent narrowing of their lumen. [7] This leads to obvious mismatch between myocardial

mass and coronary artery blood flow resulting in myocardial fibrosis and scarring. [7]

The clinical presentation of the disease are heterogeneous ranging from asymptomatic gene carriers who have very minor electrocardiographic and echocardiographic abnormalities to patients who have severe hypertrophy, diastolic dysfunction, arrhythmias and disabling symptoms. [7]

Arrhythmias are commonly seen in HCM. Paroxysmal episodes of atrial fibrillation occur in approximately 20-25% of patients. Ventricular arrhythmia is found to be the major cause of sudden death in HCM. [7]

Sudden death occurs throughout life with a peak in adolescence and young adult hood and may be the initial disease presentation occurring without warning sign and symptoms. [4] The presence of multiple risk factors in a patient subsequently increases the risk of sudden death. [4]

The incidence of sudden cardiac death has declined from 4% per annum to 1% nowadays as a result of evolving diagnostic criteria, family screening and modern treatment procedures. [4] The mortality for premature death from HCM is approximately 2-3% per annum and the great majority of such deaths are sudden and unexpected. [8]

ECG, echocardiography and magnetic resonance imaging are investigation of choice in hypertrophic cardiomyopathy. [7] However, echocardiography is the mainstay investigation for the diagnosis of HCM. [7] Patients suffering from this disease are benefited by symptomatic treatment, beta blockers, septal alcohol ablation and surgery. [4]

Patients affected with Hypertrophic cardiomyopathy with multiple risk factors for sudden death should be considered for Implantable cardioverter-defibrillator therapy. [4]

### Conclusion:

Hypertrophic cardiomyopathy is a relatively common cardiac disorder in which sudden unexpected death is the most unwelcome component, occurring throughout life, often in asymptomatic patients.

Hence, priority should be given to identify HCM patients who are at high risk and appropriate measures should be taken to prevent sudden death. Awareness should be created among young people regarding the course and outcome of this condition.

Patients complaining of unexplained episodes of syncope, collapse and chest pain require appropriate clinical, electrocardiographic and echocardiographic assessment. The family

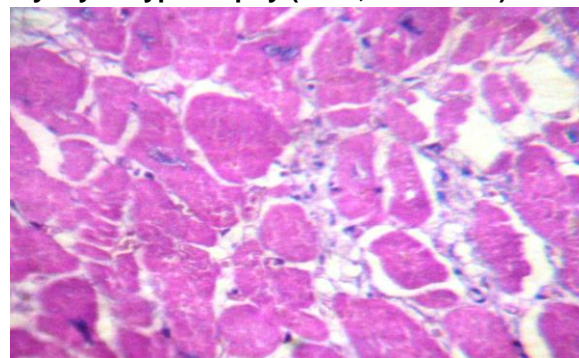
members of patients dying suddenly of HCM should undergo a noninvasive risk stratification assessment, including clinical history, echocardiography, maximal exercise tolerance testing and genetic screening to further prevent its hazardous outcome.

Steps should be initiated at the National level to decrease the mortality rate in our country. Forensic experts should keep in mind the condition of HCM while dealing with cases of sudden death in young people.

### References:

1. **Saukko P., Knight B.** Forensic Pathology, 3<sup>rd</sup> ed., Hodder Arnold, Part of Hachette Liver, UK, chapter no.25, The Pathology of Sudden Death, p-492-526.
2. **Mukherjee J.B.** Forensic Medicine & Toxicology, 4<sup>th</sup> ed., Kolkata: Academic Publishers; 2011, chapter-6, Death and its Medico-legal Aspects; p-225-234.
3. **Kumar V., Abbas A.K, Fausto N., Aster J.C.** Robbins & Cotran Pathologic Basis of Diseases, 8<sup>th</sup> ed., Philadelphia, Elsevier, 2010, chapter-12, The Heart, p-529-587.
4. **Topol E.J.** Text Book of Cardiovascular Medicine, 3<sup>rd</sup> ed., Lippincott Williams & Wilkins; 2007, chapter -29, Hypertrophic Cardiomyopathy, p-482-501
5. **Ivan D., Linder J.** Anderson's Pathology; 10<sup>th</sup> ed., Westline Industrial Drive, St. Louis, Missouri 63146, Elsevier, 2009, chapter-45, Heart Disease in the Adult, p-1256-1338.
6. **Sheikh I.** A Case of Hypertrophic Cardiomyopathy, Journal of Indian Academy of Forensic Medicine, 2004; 26(4), 157-159.
7. **Crawford MH., Dimarco J.P, Paulus W.J.** Cardiology, 3<sup>rd</sup> ed., Philadelphia, Elsevier Ltd., 2010, chapter-79, Hypertrophic Cardiomyopathy; p-1087-1101.
8. **Gourdie A.L., Robertson C.E, Busuttilla.** Sudden death in young people due to hypertrophic cardiomyopathy, Archives of Emergency Medicine; 1989 Sept. 6(3): 220-224.

**Fig. 1: Myocardium Showing Extensive Myocyte Hypertrophy (400x, H&E stain)**



**Fig. 2: of Myocardium Showing Interstitial Fibrosis (400x, H&E stain)**

