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



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Journal of Indian Academy of Forensic Medicine (JIAFM)

The Official Publication of Indian Academy of Forensic Medicine

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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: 36 • Number: 4 • October-December 2014

Contents

Sr.		Page
I.	From the Editor's Desk	335-335
II.	Editorial: Role of Expert Opinion in Medical Negligence cases	336-339

Original Research Paper

1.	Age Estimation from Sternum for Age Group 25 Years Onwards	Mukul Chopra, 340-342
	<i>Harpreet Singh, Kanika Kohli, O.P. Aggarwal</i>	
2.	Analysis of Asphyxial Deaths Due To Hanging	P. B. Waghmare, B. G. Chikhalkar, 343-345
	<i>S. D. Nanandkar</i>	
3.	Analyzing Pattern of Head Injuries Sustained By Patients Due to fall from Height: A Prospective Study	346-348
	<i>Manoj Kumar, Munawwar Husain</i>	
4.	Age Estimation by Clinico-Radiological Examination of Third Molar Teeth: A Study from Delhi	349-354
	<i>Anju Rani, S.K.Khanna, A.K.Mittal, Harpreet Grewal, C Behera</i>	
5.	A Medico-legal Study of Unnatural Deaths In Newly Married Females	355-358
	<i>Jaswinder Singh, Jaspreet Kaur, R.N. Tandon, K.A. Shah, V.R. Patil, Vinod Kumar</i>	
6.	A Study on Age at Menarche with its Relation To Pregnancy Induced Hypertension	359-362
	<i>Arista Lahiri, Soumyajyoti Bandyopadhyay, Shouvanik Adhya, Somanjana Ghosh, Sumita Ray, Swaraj Halder</i>	
7.	An Epidemiological Retrospective Study of Autopsied Dry Thermal Burn	363-366
	<i>Surendra Kumar Pandey, Awdhesh Kumar, Mayank Gupta</i>	
8.	Sex Determination from Anthropological Measurements of Thyroid Cartilage in the Population of Punjab	367-370
	<i>Sunil Subramanyam, Murali G, SP Mandal, YS Bansal, Dalbir Singh</i>	
9.	Perceptions of Relatives' towards Medico-Legal Investigation and Forensic Autopsy: A Survey from Rural Haryana	371-373
	<i>Shelesh Goel, Pankaj Chikkara, Virender K Chhoker, Abhishek Singh, Anu Bhardwaj, Rajesh DR, Nand Kishore Singh</i>	
10.	Estimation of Postmortem Interval by Measuring Potassium Level in Vitreous Humour	374-378
	<i>Bhavesh Bohra, Ramakant Verma, Indu Bala Mathur, Yogesh Sharma, Vijay Pal Khangwal, Manoj Joshi</i>	
11.	Use of RTI Act, 2005 in relation to Medical Ethics	379-380
	<i>Vaibhav Jain, Richa Garg, Mukesh Yadav</i>	
12.	Sex Determination Using Fingerprint Ridge Density In South Indian Population	381-386
	<i>Nithin Mathew Sam, Rema P, Venugopalan Nair B</i>	
13.	Medico-legal Aspects of Firearm Injury Cases in Agra Region	387-390
	<i>Sangeeta Kumari, Ajay Singh Rajput, Ajay Agarwal, Ayesha Arif, RK Chaturvedi</i>	
14.	Diagnostic Efficacy of Cardiac Isoenzyme CK-MB in Pericardial Fluid for	391-395

Post-mortem Diagnosis of Myocardial Infarction Pankaj Suresh Ghormade,

Narendra Baluram Kumar, Chaitanya Vidyadhar Tingne, Ajay Narmadaprasad Keoliya

15. **Study of Ossification Centres Fusion of Elbow Joint in 15 to 17 Years** 396-398
Garhwali Females of Dehradun Region Satya Prakash Dixit, R.K. Bansal

Review Research Paper

16. **Crimes against Women in Matrilineal Meghalaya: A Forensic Medical** 399-403
Perspective Amarantha Donna Ropmay
17. **Ethical and Legal Issues of Presumed Consent** M. S. Vinay Kumar, 404-406
Sameer Valsangkar
18. **Mitochondrial DNA: A Reliable Tool in Forensic Odontology** 407-410
Sreeshylla Huchanahalli Sheshanna, Usha Hegde, Meenakshi Srinivasaiyer, Balaraj BM
19. **Role of Informed Consent in India: Past, Present and Future Trends** 411-420
Mukesh Yadav, Pramendra Singh Thakur, Pooja Rastogi
20. **Sexual Harassment at Workplace in India: Medico-Legal Aspects** 421-424
M. Pallavi Jane Pereira, Edmundo J. Rodrigues

Case Reports

21. **Utility of X-Rays in Scar Examination: A Case Report** Sushim Waghmare, 425-427
Rajesh Bardale, Vaibhav Sonar
22. **Body beside Turtled Auto: Accident or Homicide** G.S.R.K.G. Ranga Rao, 428-431
Surendar Jakkam, G.K.V. Prasad
23. **Alprazolam Poisoning** Ankita Kakkar, Sushil Kumar 432-433
24. **Suicidal Death Due To Stabbing: A Case of Rare Occurrence** 434-436
Kh. Pradipkumar Singh, Supriya Keisham, Kamei Rishilu, Th. Meera Devi
25. **A Case of Suicide or Accidental Death Due To Self Stabbing** 437-438
Ravi Rautji, Avishek Kumar
26. **An Autopsy Twist: Natural Hidden Beneath Unnatural** Deepa Durga Roy, 439-441
Manish Nigam, Amit Verma

Book Review

27. **Recent Advances in Forensic Medicine & Toxicology** Gautam Biswas 442-442

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Print ISSN: 0971-0973. Electronic ISSN: 0974-0848. IndMED www.medind.nic.in/jal/jalm.shtml

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From Editor's Desk

JIAFM

A Quarterly Publication

Volume 36, Number 4, October- December, 2014

I feel immense pleasure to present before you the Fourth issue of 2014. 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

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Editorial

Role of Expert Opinion in Medical Negligence cases

Role of Expert Opinion in the form of Second Opinion sought by the treating doctor or patient himself and Opinion by a Medical Board on the direction of the Consumer Court or in cases of death due to alleged medical negligence before registration of the FIR by the Police is of paramount importance in terms of outcome of the case.

General Public Perception and Expert Medical Opinion:

Common man believes that doctor always favours their colleague while giving Expert Medical Opinion in medical negligence cases. It is very difficult to get even second opinion against doctors from any doctor especially of that specialty which is a matter of dispute.

Duty of Doctors for Exposure of Unethical Act:

MCI Regulations, 2002 reads:

Para 1.6, Highest Quality Assurance in patient care: Every physician should aid in safeguarding the profession against admission to it of those who are deficient in moral character or education.

Physician shall not employ in connection with his professional practice any attendant who is neither registered nor enlisted under the Medical Acts in force and shall not permit such persons to attend, treat or perform operations upon patients wherever professional discretion or skill is required.

Para 1.7 Exposure of Unethical Conduct: A Physician should expose, without fear or favour, incompetent or corrupt, dishonest or unethical conduct on the part of members of the profession.

Supreme Court Directions:

Hon'ble Apex Court of India has directed the Government of India and/State Governments to frame Statutory Rules or executive instructions incorporating certain guidelines in consultation with Medical Council of India for prosecution of Medical Professionals under Criminal Law for Medical negligence.

Hon'ble Apex Court has also proposed certain guidelines to Government regarding the prosecution of doctors for offence of which criminal rashness or criminal negligence is an essential ingredient. These guidelines are as follows:

1. A private complaint may not be entertained unless the complainant has produced prima facie evidence before the Court in the form of credible opinion given by another competent doctor to support the charge of rashness or negligence on the part of treating doctor.
2. The investigating officer should, before proceeding against the doctor accused of rash or negligent act of omission obtain an independent and competent medical opinion preferably from a doctor in government service qualified in that branch of medical practice who can normally be expected to give an impartial and unbiased opinion applying Bolam's test to the facts collected in the investigation.
3. A doctor allegedly accused of rash or negligence, may not be arrested in routine manner (simply because a charge has been leveled against him), unless his arrest is necessary for furthering the investigation or for collecting evidence or unless the investigating officer feels satisfied that the doctor proceeded against would not make himself available to face the prosecution unless arrested; the arrest may be withheld.

MCI Guidelines on Expert Medical Opinion:

In view of the above guidelines proposed by the Hon'ble Supreme Court of India, The following statutory rules/or executive instructions for prosecution of Medical Professionals under Criminal Law for Medical Negligence are being proposed:

- (i) As per "**Professional Conduct, Etiquette and Ethics Regulations, 2002** adopted by Medical Council of India, every physician shall maintain the medical records pertaining to his indoor patients for a period of 3 years from the date of completion of treatment.
- (ii) Any request made for the medical records either by the patients/authorized attendant or legal authorities involved, the same may be duly acknowledged and documents shall be issued within the period of 1 (one) week.
- (iii) In cases where the fellow treating doctor is accused of rash and negligent act. A Doctor qualified and well experienced in that branch of medical practice shall not hesitate in expressing independent, impartial and unbiased opinion against or in favour of a fellow treating doctor.

It shall be mandatory to patient/his relative that before lodging a complaint against treating doctor/hospital regarding rashness or negligence, he must obtain a credible opinion from a competent doctor qualified in that branch of medical practice on the facts mentioned in the documents supplied by the concerned doctor/hospital.

- a. No complaint shall be entertained by the police or investigating agency unless the allegation is specified and supported by a credible opinion of competent doctor qualified in that branch of medical practice.
- b. After receiving a complaint supported with a credible opinion of a competent doctors along with supporting treatment and investigation papers against the treating doctor/hospital, police or investigating agency before registering the Crime u/s 304A IPC or under any other relevant section of law should seek an independent, impartial and unbiased opinion from a Committee or Body constituted by Government of India or State Government comprising of uneven number of members and such committee must include an eminent senior faculty member of that branch of medical practice.
- c. The committee formed shall examine the complaint, opinion of the doctor in support of complaint submitted by the complainant in the light of documents related to investigation, diagnosis and treatment considering the qualification of doctor and the circumstances of case including time and place and shall give clear opinion about whether or not the treating doctor/s has/have been rash and negligent in their duty in treating the patient. This shall be communicated to police/investigating agency in minimum possible/reasonable duration.
- d. The Committee if think so, shall also visit the place/hospital where patient was treated and examine the facilities available for such treatment/operation given to the patient or not and the treating doctor is duly qualified, registered with competent body/organization and whether the place is recognized or not for such treatment. The police/investigating agency after receiving the opinion of Government doctor/Committee shall register a case only when, in the opinion of Committee the treating doctor/s has/have been found rash and negligent in act of commission or omission.
- e. If the doctor accuse is not found guilty by the Committee then no case should be registered and in such case the patient/relative may lodge a complaint in the appropriate court if they feel so and court should take appropriate action in the light of opinion given by the Govt. doctor/Committee constituted for this purpose.

Appointment and Duties of Doctor/s or Committee Constituted for the Purpose of Giving Opinion for Prosecution of Medical Professionals under Criminal Law for Medical Negligence:

Duties of Treating Doctor Against the Allegation of Rashness and Negligence act:

- (i) The treating doctor shall maintain a proper chronological record of treatment given investigation advised and carried out.
- (ii) The doctor shall supply the certified copies of all such documents which are related to treatment investigations or any other specific procedure whenever requested by patient or his relatives without delay.
- (iii) The treating doctor accused must produce all such original documents related to treatment, investigation or any other specific procedure undertaken by him whenever, required by the Committee constituted for the purpose of given opinion on a complaint against him for criminal prosecution.
- (iv) The treating doctor accuse must be given an opportunity and to be heard by the Committee before giving any opinion in favour or contrary to the allegation.

Formation and duties of the Committee shall be as follows:

- (i) Government shall have the power to constitute a Committee to give opinion on complaint for criminal prosecution of a doctor for rash and negligent act.
- (ii) There shall be a Committee in Divisional level preferably at a place where Govt. Medical Colleges are located and specialities in various disciplines of medical practice are available.
- (iii) The Committee should comprise of panel of doctors of various specialities of medical field on the list from whom the required members of selected field may be called depending upon the case entertained.
- (iv) The Committee shall be comprised of minimum three and maximum seven members from:
 - (a) One eminent senior member from that speciality/branch of medical field to which the complaint is specifically related and he shall be the Chairman of the Committee (selected from the panel).

- (b) One member from Government Health & Medical Education Services not below the rank of Joint Director/Dean/Professor.
- (c) One member belonging to legal department preferably a Judge not below the rank of Sessions Judge.
- (d) One member from speciality of Forensic Medicine especially when the rash and negligent act had resulted into death and autopsy was performed on the body of deceased.
- (e) Co-opted members may be appointed by the Chairman of the Committee if he thinks that the opinion of such a member is necessary in that particular case for giving opinion.
- (i) The Committee shall meet at least once or more time in a month or within a specified period which shall in no case be more than 30 days.
- (ii) The Chairman shall inform the other members of the Committee at least three days before the date of meeting or giving reasonable time to the members to ensure their attendance by a letter specifying the place and time of the meeting.
- (iii) The Committee shall consider and dispose off the case within 30 days after receiving the complaint against the doctor.
- (iv) The Committee shall have power for not to consider any complaint after 30 days of receipt of complaint to investigating agency or 90 days after the incidence. The investigating agency should forward all the relevant documents and the evidences collected to the Committee within 30 days of receipt of the complaint.
- (v) The Committee shall have power to call the treating doctor along with all original records related to treatment, investigation or any other specific procedure for inspection for personal hearing.
- (vi) The Committee shall have power to inspect the place, facilities available, conditions of equipments and assess the working conditions and shall give the opinion about the suitability of place for any specific treatment.
- (vii) The Committee shall have power to examine the authenticity of qualification, recognition and registration as per rules by MCI or any other such regulatory body and also in reference to any special law or act enacted by the Government of India or any other similar law.
- (viii) The Committee shall have power to assess the reasonable competency of doctor to practice that speciality of Medicine/Surgery, which has been used in treating the complainant.
- (ix) After consideration of the facts mentioned in the complaint, hospital records including investigation and treatment and after hearing the treating doctor, shall give a clear opinion whether the doctor has been rash and negligent or not which resulted in harm/damage or death alongwith detail report about the facts on which such opinion is based.

The Duties of Police in Cases of Criminal Prosecution of Doctors for Rash and Negligent act:

- (i) No Police station or investigating agency shall register an offence under 304A IPC for criminal negligence on the part of doctor unless the complainant clearly mentions the specific allegation of rashness and negligent act directly and attributively resulting in death of the patient and unless an opinion from the committee is obtained.
- (ii) After receiving any complaint regarding rashness and negligent act of doctor the investigating officer or In-charge of Police Station should forward such complaint along with all the papers related to treatment and investigation etc. to the committee constituted by the Government of India/State Government's for giving opinion in such cases.
- (iii) The police or investigating officer shall not arrest a person unless some prima facie evidence about the rash and negligent act of doctor is expressed by the Committee in opinion.
- (iv) The arrest shall also not be made if the doctor against whom the allegation is made gives reasonable assurance, by virtue of securities/bond to cooperate in the investigation and assure his availability whenever required by the investigating authorities.

The Police shall have power to seize all original documents relating to the treatment and investigation of the case if the concerned doctor fails to provide the documents to the Committee." [Page No. 284-287, Report 2007]

Are Doctors Favouring Colleague in Giving Expert Opinion in Medical Negligence Cases? View of Consumer Court:

In a case before Delhi District Consumer Court (DDCDRC) following adverse observations are worth mentioning that "we discard the experts report dated 28.11.11 given by the doctors of Safdarjung Hospital on the ground that the said report is against the record inasmuch as per the said record the patient did not report to Doctor from 20.06.05 to 15.07.05 (25 days) when cancer is a progressive

disease. Record Ex-DW/1 does not narrate any such story. As per the said record the patient had visited the E.N.T. OPD of OP 3 on 20.06.05 and the Junior Doctor after discussing the case with OP 2 “advised” to give date for surgery and come for review on 15.07.05 at 2 PM in Oncology Clinic. Therefore, as per the said record filed by OP 1 to 4 the patient himself was advised to come for review on 15.07.05

DDCDRC further add that we fail to understand as to why the Medical Experts Committee constituted under the chairmanship of Dr. J.S. Bhatia and consisting of Dr. Amar Bhatnagar, Dr.A.K. Rai, Dr. R. Chakra Borty and Dr. S.P. Katariya preferred to give the report against the facts existed on the record.

The second medical opinion has been obtained on the request of OP 7 to 8. In the facts and circumstances of the case we are inclined to take a view that the medical expert committee constituted under the Chairmanship of Dr. J.S. Bhatia, Safdarjung Hospital, Delhi, preferred to give a false report in order to give benefit to their brother-colleagues.

It is understandable that logically the opinion of medical experts cannot be ignored by the courts in medical negligence cases. However, many a times the courts tend to ignore them on 2 main grounds:

- 1) These are biased opinions from colleagues
- 2) The facts & circumstances are so clear that medical opinion is not required. Sometimes, medical boards present a medical opinion which is vague and ambiguous. Then it doesn't help any party. Sometimes the complainant also submits some literature which tends to dilute the impact of the medical opinions submitted by the doctor. So, there are so many factors playing a part and each case has to be defended on its merits.
- 3) It is important to note that
- 4) In consumer court cases where judges and members are not from medical background and matter in dispute is complex one, which only a medical expert can explain or understand
- 5) How can a Judge give verdict without deciding about negligence?
- 6) This he can do only with expert opinion

Thus the expert opinions by senior doctors are in favour of the accused doctor become of paramount importance. I have been defending doctors in Mumbai for many years and can tell you that no judge can disregard the expert opinion.

Disadvantages of Expert Opinion:

- It cause enmity among medical fraternity
- It causes delay in disposal of medical negligence cases
- Due to biased medical opinion and adverse comments by the courts causes distrust among public
- Patient died due to delay in treatment as no timely medical opinion was available due to various reasons

It is important to create awareness about these guidelines among medical fraternity as well as general public so that lost trust can be restored and larger public interest of quality of health care can be provided to masses. There is need to prepare a panel of doctors who are expert in particular specialty and who can provide Expert Medical Opinion as the occasion arise either on the request of patient or their legal representative or on the direction of the appropriate judicial / quasi judicial forum like consumer court.

Dr.Mukesh Yadav
Editor, JIAFM

Original Research Paper

Age Estimation from Sternum for Age Group 25 Years Onwards

¹Mukul Chopra, ²Harpreet Singh, ³Kanika Kohli, ⁴O.P. Aggarwal

Abstract

Age is one of the important parameters for the Identification of an individual whether the individual is alive, dead or human remains. A criminal will tell his age wrong to the investigating agencies to get less punishment from the court. Various government agencies are giving benefits like employment, pension and medical reimbursement according to age of a person. The age plays a vital role in sports competition. A person who's age more than 60 years is a senior citizen. The railways authority gives concession of 40% to male senior citizens and 50% to female senior citizens. The benefits are also on the income tax. Age is also important in onset of various diseases. The sternum can be visualized by radiography for age estimation. The earliest age of fusion of the Xiphisternum with the body of the sternum was 26 years in the males and 26 years in the females also. The earliest age of fusion of the manubrium with the body of the sternum was 29 years in males and 35 years in the females

Key Words: Age, Identification, Xiphisternum, Manubrium, Sternum

Introduction:

In our country at the age of 35 years, an Indian citizen can become president, vice president and governor of any state. There is a proposal to increase the retirement age of officials of Government, statutory bodies, autonomous bodies from 60 to 70 years. Medical council of India has increased the retirement age of medical teachers from 65 to 70 years.

A person who's age more than 60 years is a senior citizen. The railways authority gives concession of 40% to male senior citizens and 50% to female senior citizens. The benefits are also on the income tax. Income tax department has made changes in tax slabs 2013-2014 for Senior citizens (Aged 60 years but less than 80 years).

In commerce, some businesses offer customers of a certain age a "senior discount". The age at which these discounts are available vary between 55, 60 or 65, and other criteria may also apply. Sometimes a special "senior discount card" or other proof of age needs to be obtained and produced to show entitlement.

Masset [1] mentioned that due to extreme variability of closure of the cranial sutures, they cannot be considered dependable for precise age estimation. Singh and Gorea [2] found that the changes like lipping of the lumbar vertebrae and its changes in the disc are not of much help as these changes can appear at different times after 40 years of the age.

The age estimation from pubic symphysis is also variable due stresses from pregnancy and parturition.

Material and Methods:

The present study comprises a total of 228 subjects from both sexes (males and females) from age 25 years onwards. 28 cases are discarded because of poor quality X-ray and non-availability of proof of birth. Therefore, 200 cases were taken for analysis. The cases were taken from the general population as patients admitted in departments, their relatives and police personnel visiting the M.M.I.M.S.R. Mullana.

The study cases were divided into nine age groups. Only those cases were considered whose records were available for date of birth from ration card, matric certificate, birth certificate, identity card, driving license, voters card, service record and PAN card etc.

Those who were not having any proof of birth at the time of exposure were given stamped envelopes and advised to send the same by post. The cases, in which their date

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DOR: 01.10.2013 DOA: 28.10.2014

of birth was not certain, were not considered in this study.

The X-Ray Sternum Lateral View was taken of study cases after obtaining their written consent. In this study only bonafide residents, who do not show any disease in respect to anterior chest wall were considered.

The diseased or damaged anterior chest wall cases were discarded. The female cases were taken less because of poor quality of X-Ray film due to over shadowing of the breast tissue. The Status of Fusion of Xiphisternum and Manubrium with the body of sternum was studied. The partial fusion or equivocal (3) was not taken, as it is very difficult to comment from the X-ray about partial fusion. In grade 2 (complete fusion), only those cases were considered which shows complete fusion of the joints.

Where there is doubt of partial or no fusion, such cases were taken in grade 1: not fused. After all this, 10 X-ray showed equivocal fusion at xiphisternal joint which were put in grade E and were not considered for analysis of the fusion of xiphisternal joint.

Table A: Grading of fusion of Xiphisternal Joint

Sr. No	Fusion of Joints	Grading
1	Not Fused	1
2	Complete Fusion	2
3	Equivocal	3

Observations and Results:

The study was conducted during the period of August 2010 to September 2012 and 228 cases were studied that were taken randomly amongst patients, their relatives and police officers visiting M.M.I.M.S.R. Mullana.

Out of 200 cases studied, we can appreciate fusion and non-fusion of manubrium with the body of sternum clearly in all cases while 13 cases shows equivocal findings of fusion at xiphisternal joint.

Present study showed that the earliest age of fusion of the Xiphisternum with the body of the sternum was 26 years in the males and 26 years in the females also. (Table 1) But our study also showed late fusion of Xiphisternum with body of sternum at 81 years in males and 80 years in females.

The average age of fusion of the xiphisternum with the body of the sternum is 54.33 years in males and 57.86 years in females. (Table 2) In our study the earliest age of fusion of the manubrium with the body of the sternum was 29 years in males and 35 years in the females. (Table 3)

But in this study late fusion of the manubrium with the body of sternum was also

occurred at the age of 80 years in both males and females. The average age of fusion of the manubrium with the body of the sternum is 56.40 years in males and 61.09 years in females.

Discussion:

The results of present study are comparable with the research of previous studies. Krogman [3] concluded that xiphoid process fuses with body of sternum after 40 years. Glaister [4] mentioned that xiphoid process fuses with body at 40 and in advanced life the manubrium is occasionally joins the body, only the superficial part of intervening cartilage is converted into bone.

Jit and Bakshi [5] studied 772 male and 208 female and found that non fusion of manubrium could be seen above 60 years of age. Das [6] concluded that the fusion at manubrio-corporal junction the age is above 28 years. Dogra [7] mentioned that firm bony union between first and middle portion of sternum does not occur until late in life. Singh et al [8] noted that earliest age at which fusion of joint start at 26 years in male and 31 years in female.

Gautam et al [9] concluded that manubrium fusion begins at the age of 40 and completed at the age of 50 years. Garg [10] found xiphoid process fusion at 36 years in male and 35 years in female but in the present study we concluded earliest age of fusion is 26 years for both male and female.

Conclusion:

The age estimation of a person should be done from sternum in old age persons. The skull sutures criteria should also be considered along with the general physical examination of a person. The radiation exposure to living persons should be avoided.

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Table 1: Cases According to Age and Sex

Age Grps (Yrs)	Cases for Study		Equivocal		Total Cases
	Male	Female	Male	Female	
25-30	11	2	0	1	14
31-35	7	2	0	0	9
35 - 40	16	0	2	0	18
41 - 45	18	4	1	0	23
46 - 50	22	2	0	0	24
51 - 55	22	1	1	1	25
56 - 60	19	6	2	2	29
61 - 65	17	8	0	0	25
66 onwards	22	8	1	2	33
Total	154	33	7	6	200
	187		13		

Table 2

Relationship between Fusions of Xiphoid Process with the Body of Sternum

Age Grps (Yrs)	Complete Fusion		Partial Fusion		Absent	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
25-30	6 (5.7)	2 (7.4)	0 (0)	1 (16.7)	5 (12.8)	0 (0)
31-35	1 (0.9)	1 (3.7)	0 (0)	0 (0)	6 (15.4)	1 (16.7)
36 - 40	7 (6.7)	0 (0)	2 (28.6)	0 (0)	9 (23.1)	0 (0)
41 - 45	8 (7.6)	2 (7.4)	1 (14.3)	0 (0)	10 (25.6)	2 (33.3)
46 - 50	15 (14.3)	2 (7.4)	0 (0)	0 (0)	7 (17.9)	0 (0)
51 - 55	18 (17.2)	1 (3.7)	1 (14.3)	1 (16.7)	4 (10.3)	0 (0)
56 - 60	17 (16.2)	5 (18.5)	2 (28.6)	2 (33.3)	2 (5.1)	1 (16.7)
61 - 65	17 (16.2)	8 (29.6)	0 (0)	0 (0)	0 (0)	0 (0)
66 onwards	16 (15.2)	6 (22.5)	1 (14.3)	2 (33.3)	6 (15.4)	2 (33.3)

Table 3

Relationship between Fusions of Manubrium Process with the Body of Sternum

Age Grps (Yrs)	Complete Fusion		Partial Fusion		Absent	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
25-30	2 (7.4)	0 (0)	0 (0)	0 (0)	9 (6.8)	3 (10.7)
31-35	0 (0)	1 (9.1)	0 (0)	0 (0)	6 (4.5)	1 (3.6)
36 - 40	3 (11.1)	0 (0)	0 (0)	0 (0)	15 (11.3)	0 (0)
41 - 45	2 (7.4)	0 (0)	0 (0)	0 (0)	17 (12.8)	4 (14.3)
46 - 50	2 (7.4)	1 (9.1)	0 (0)	0 (0)	20 (15.0)	1 (3.6)
51 - 55	3 (11.1)	0 (0)	0 (0)	0 (0)	20 (15.0)	2 (7.2)
56 - 60	3 (11.1)	2 (18.2)	0 (0)	0 (0)	18 (13.5)	6 (21.4)
61 - 65	6 (22.2)	4 (36.4)	0 (0)	0 (0)	11 (8.3)	4 (14.3)
66 onwards	6 (22.2)	3 (27.3)	0 (0)	0 (0)	17 (12.8)	7 (25)

Original Research Paper

Analysis of Asphyxial Deaths Due To Hanging

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Abstract

Violent deaths resulting from asphyxia chiefly includes Hanging. Medico-legal questions likely to arise in case of hanging are mainly, whether the death was caused by hanging was suicidal, homicidal or accidental. Simulated suicidal hanging interferes the investigating process in unnatural deaths. To arrive at conclusion, detailed external examination, internal examination and analysis of samples, plays vital role. Apart from autopsy the ligature material used, place, point of suspension and review of scene of crime may add to the conclusion. Mumbai city it is considered as city of glamour & heart of state and cosmopolitan population. Always with some stress, suicide by hanging is noted in productive age group of youngsters. Present study is conducted at Government Medical College, Mumbai. All cases of alleged history of hanging brought for autopsy examination were studied. After detailed external and internal examination preserved necessary samples. The medico-legal examination records and inquest papers are analyzed. The observations and analysis of the study is presented here.

Key Words: Asphyxia, Hanging, Ligature Mark, Suicide

Introduction:

Hanging is a form of asphyxia death due to constriction of the air passage at the neck, as a result of suspension of the body by a ligature in the form of a noose, applied in such a manner, when weight of the body or other part of the body e.g. head, act as a constricting force. [1] Asphyxia means 'lack of oxygen'.

Hanging is ordinarily presumed to be suicidal unless the circumstantial and other evidences are strong enough to rebut the presumption. [2] When the constricting force of the ligature causes compressing narrowing of laryngeal and tracheal lumen causing blockage of the airway. [3] Suicide is defined by Beck as "a willful self-inflicted life threatening act which has resulted in death". [4]

Statistics show that India has the highest suicide rate in the world, marginally behind China, but ahead of the west. [6] For men 40% of suicides were among people of age group 15-29. For women, it was nearly 60%. About 95-100 people commit suicide in India every day. [8] Mumbai ranks 3rd among cities in suicide rate in India. [6] As per Police statistics 3 lives lost per day due to suicide Mumbai.

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As per police statistics 2 lives lost per day in Navy Mumbai. [7]

Medico-legal questions likely to arise in case of hanging are mainly, whether the death caused by hanging was suicidal, homicidal or accidental, or whether person was intoxicated with any drugs or alcohol. Time since death, any concealed injuries over body, Simulated suicidal hanging interferes the investigating process in unnatural deaths.

To arrive at conclusion, detailed external examination and analysis of samples plays vital role. Apart from autopsy the ligature material used, place, point of suspension and review of scene of crime may add to the conclusion.

Present study comprises examination of victims of asphyxia leading to death and body of who's referred for post-mortem examination and opinion. The Study consists of complete external and internal examination.

The internal examination of neck structures was done to note down rupture of vessels, hemorrhages any fracture of hyoid bone or thyroid cartilage and efforts made to differentiate between suicidal hanging and ligature strangulation.

Material and Methods:

This study is carried out at Government Medical College and Hospital Mumbai. It is a regional referral centre in Mumbai, where various cases are referred for medico-legal post mortem examination and for expert opinion.

Only the alleged history of hanging cases is included in study. The natural deaths,

accidental deaths, deaths due to multiple injuries are excluded in this present study.

A study of hanging cases brought for post mortem at above institute during period of 1st January to 31st December year in 2012.

We have examined 60 cases of alleged history of hanging. The information is gathered from analyzing the police inquest panchnama and ADR report and statements of relatives taken by police during investigation, study of clinical papers in hospitalized deaths of history of hanging, relatives of deceased were interviewed in some cases where relatives present at the time of post-mortem.

Complete external examination which includes general examination of body, physical parameter like total length, physique, and any other injuries on the body.

Neck is examined with respect to the injuries and ligature mark position, situation with respect to anatomical landmarks, color; texture any other injuries on or around ligature mark on the neck. Face is examined for congestion, cyanosis, petechiae, and ecchymosis. Eyes are examined for conjunctival hemorrhages and other orifices are examined for fluid or blood.

Salivary glands were examined for congestion and hemorrhage. Position of tongue either clinched or inside mouth, dribbling of saliva, Semen emission or defecation. In indicated cases photographs were taken. External examination is followed by internal examination included dissection and evacuation of cranial cavity and thoracic cavity.

Then neck dissection is done in bloodless field. Dissection is done layer by layer with respect to skin, neck muscles, vessels, other soft tissue and internal deep structure of neck. Focusing light and magnifying lens is used during internal and external examination.

Common and internal carotid artery is seen for endothelial damage. Thyroid cartilage and hyoid bone examined and dissected to rule out injury or fracture. Simultaneously larynx and trachea dissected. Salivary glands were examined for congestion and hemorrhage noted.

After dissection of block the fracture of hyoid bone is seen, simultaneously larynx and trachea is seen for congestion or edema.

In systemic dissection visceral pleura, pericardium was seen. Also looked for any other injury was present internally.

After completion of autopsy viscera for chemical analysis is preserved and also various samples collected such as blood for grouping, ligature material, cloths with stains, vaginal swab for chemical analysis. Every case is examined

with respect to above points to arrive at as opinion to cause of death.

Observations and Results:

In this study cases are divided in seven age groups and maximum cases 26 cases (43.33%) were found in 21-30 age group followed by 23.33% cases in 31-40 years. six cases were from juvenile tender age group below 18 years. these cases were related to exam results and parents scolding. (Table 1)

Out of 60 cases of hanging 37 were males (61.66%) and 23 were females (38.33%) female. Male female ratio is 1.6:1. (Table 2)

According to marital status in our study 15 cases (25%) were unmarried, 41 cases (68.33%) married and two cases were of whose spouse was dead. No deceased in divorce state found. (Table 3) In present study out of total 60 case 71.66% cases belongs to Hindu religion 25% were Muslim and 3.3% were Christian. (Table 4)

Place of suicide was home in 49 cases (81.66%), custody in two cases (3.3%), work place three cases (5%) and other at various places jungle, truck etc. in five cases (8.3%) in this study. (Table 5) Maximum cases 24 cases (40%) of suicide occurred in morning followed by afternoon in 30% cases. (Table 6)

In our study history of chronic disease was present in 18.33% and mental disorder in 1.6%. History of addiction was positive in nine males out of total 37 cases and only in one female (4.3%). In this research Dupatta was used as ligature material in 38.33% cases, rope in 35% cases. Sari and other materials were used in 13.33% each. (Table 7)

On external examination cyanosis of nails seen in 28% cases, salivary stain was present in 17 cases (28.33%); tongue was protruded and clinched between teeth in 30% cases; semen emission in 20 cases (57%) out of 37 males and menstrual bleeding was seen in two cases out of 23 cases at the time of suicide. (Table 8) On internal examination petechiae were seen on lungs in 48 cases (80%), heart 9 cases (15%) and in eyes 10 cases (16.6%).

Parchmentization of ligature mark seen in 39 cases (65%), hyoid bone fracture in 8.3% and thyroid cartilage fracture in 3.3% cases. (Table 9) In this study Ligature mark was seen above the thyroid cartilage in 52 cases (86%), at the level 2 cases (3.3%) and below in 6 cases (10%). Post-mortem lividity was present over lower limbs, abdomen, and over back in 15% cases. In present study two people with suicidal hanging died after hospitalization and suicide note was found in four cases out of 60 cases.

Discussion:

Most commonly affected age group is between 21 to 30 years. It correlates with other authors studies. [5, 9-11] Suicide by hanging showed male predominance. [5] Productive younger age group is commonly vulnerable.

Prevalence of suicide is more in married people in our study similar with study of Chavan et al and N. Vijayakumari. [5, 11] Out of 21 married women, 10 women had committed suicide within 7 years of marriage.

The summer and winter season contributes equal cases of suicide. Relatively fewer cases occurred in monsoon season. Maximum cases have occurred in morning i.e. 06 to 12 pm. Ill health due chronic disease also contributes to cause of suicide. There is relation between alcohol consumption and suicidal tendency is found. Place of choice for suicide is home in maximum cases. Maximum cases with complete Hanging were found. We found suicide note in 4 cases out of 60 suicidal hanging cases.

Patterned ligature mark is found in all cases. Ligature mark is completely circling the neck in all the cases. Hanging was complete in almost cases. Parchment is seen in 65% cases.

Petechial hemorrhage present in 80% cases most commonly associated feature with hanging. Fracture of hyoid and thyroid is seen in few cases. Negative findings are not a single case with rupture of vessels is seen.

Conclusion:

Hanging is always considered suicidal in nature until contrary is proved. Asphyxia due to hanging is commonly preferred mode of suicide as non-expensive, death is certain. Meticulous external and internal examination can help to arrive at confirm opinion as to the cause of death and also to reply questions of investigating officer answers on different points.

Chemical analysis samples also play vital role, however more detailed study is required with crime scene visits.

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Table 1: Age Wise Distribution of Cases

Age group(yrs)	Cases	Percentage
0-10	0	0
11-20	6	10
21-30	26	43.33
31-40	14	23.33
41-50	6	10
51-60	4	6.6
60 onwards	4	6.6

Table 2: Sex Wise Case Distribution

Sex	Cases	Percentage
Male	37	61.66
Female	23	38.33

Table 3: According to Marital Status

Status	Cases	Percentage
Unmarried	15	25
Married	41	68.33
Divorce	0	0
Spouse dead	2	3.3

Table 4: According to Religion

Religion	Cases	Percentage
Hindu	43	71.66
Muslim	15	25
Christian	2	3.3

Table 5: According to Place of Suicide

Place of Suicide	Cases	Percentage
Home	49	81.66
Custody	2	3.3
Work Place	3	5
Hospital	1	1.6
Other	5	8.3

Table 6: According to Time Period of Suicide

Time	Cases	Percentage
Morning	24	40
Afternoon	18	30
Evening	8	13
Night	7	11.66
Midnight	3	5

Table 7: Ligature Materials Used For Hanging

Ligature material used	Cases	Percentage
Rope	21	35
Dupatta	23	38.33
Sari	8	13.33
Other	8	13.33

Table 8: Positive Findings on External Examination

External Findings	Cases	Percentage
Saliva stain	17	28
Tongue protruded	18	30
Cyanosis	17	28
Seminal ejaculation	20 out of 37	54
Menstruation	2 out of 23	9

Table 9: Positive Findings on Internal Examination

Internal Examination	Cases	Percentage
Petechial hemorrhage	48	80
Parchmentization of skin	39	65
Hyoid or thyroid fracture	5	8.3

Original Research Paper

Analyzing Pattern of Head Injuries Sustained by Patients due to fall from Height: A Prospective Study

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Abstract

We analyzed the pattern of head injuries in patients of fall from a height of 9-10 feet and aged 20-70 years. This prospective study was done at JNMCH, Aligarh, on 100 patients who sustained a fall and came to the casualty for treatment during a 12-month period i.e. from January 1, 2011 to December 31, 2011. Male: female ratio was 2.13:1. Maximum number of cases was in the age group of 30-40 years. Skull fractures were seen in 79 cases (79%) and intracranial injuries occurred in 87 cases (87%). The most common fracture was linear un-displaced fracture and was observed in 62 cases (62/79; 78.48%) and the most common intracranial injury was extra-axial bleed seen in 73 cases (73/87; 83.91%). Skull fractures and intracranial injuries were seen either alone or together. Fall related injuries can be prevented by avoiding excess alcohol intake and multiple self-medications without prescription during working at height, and by using appropriate footwear.

Key Words: Fall from height, Skull fracture, Extra-axial bleed, Contusion, Unprotected rooftops

Introduction:

One of the major causes of accidental injuries is fall from height and is responsible for many serious and fatal head injuries every year. Fall is an underlying cause of 10-15% of all emergency department visits and lead to 20-30% of mild to severe injuries. [1]

Falls can occur at any age and from any surface. The nature and magnitude of the injury in free falls depends upon height of fall, impact of surface, part of the body impacting, distribution of impacting forces, body mass and patient's age which affect tissue tolerance.

If the primary impact is on the head, then a massive skull fracture may occur. [2]

Many work activities involve working at height which includes working using ladders, stepladders, scaffolds, mobile-elevated working platforms and working at the rooftops.

As many workers are exposed to the hazards of fall daily, fall from height is an important topic for occupational safety and health services.

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DOR: 15.02.2014 DOA: 30.10.2014

Material and Methods:

This study was carried out in Department of Forensic Medicine in collaboration with consultant in-charge of Neurosurgery and Casualty section of the hospital. It consisted of 100 cases of head injury due to fall from height in victims aged 20-70 years who came to the casualty of the JNMCH, Aligarh, for treatment between the period from January 2011 to December 2011.

The study was aimed at analyzing the pattern of head injuries sustained by fall from height of 9-10 feet and their relationship, if any, to age and gender.

The information about the patients admitted was obtained from the Department of Neurosurgery and then epidemiological features and injury characteristics were entered on a predesigned proforma, from the medico-legal case sheets of the patients prepared and maintained by the consultants concerned.

Head injury patterns were taken from the reports of non-contrast CT-scan head of the patients. We had not taken the cases of head injury due to fall from height who were either brought dead i.e. death on the spot or died on the way to hospital or were discharged from the casualty after providing first aid and those with incomplete or missing case sheets and LAMA or absconded cases.

Observations and Results:

In the present study on 100 cases of fall from height, it was observed that maximum

number of the cases (30%) was of the age group 30-40 years. (Table 1) Most of the cases (66%) showed both skull fractures and intracranial injuries. (Table 2) Out of total 79 cases of skull fractures, linear un-displaced fracture (78.48%) was the most common skull fracture in this study. (Table 3)

The most common part of the skull bone fractured was parieto-temporal bone (n=21, 26.58%). (Table 4) Out of total 87 cases of intracranial injury, extra-axial bleed (n=73, 83.91%) which included both EDH and SDH was most commonly seen followed by contusion of brain seen in 46 cases (n=46, 52.87%) in present study. (Table 5)

Parieto-temporal lobe was the most common part of the brain injured. (Table 6) In our study most of the cases (n=85, 85%) were treated conservatively and 15% cases were treated surgically. (Table 7)

Discussion:

Fall from standing position can be a normal experience for anyone but fall from a significant height can be dangerous to almost every victim who falls either intentionally or accidentally.

In the present study of total 100 cases, the age of the victims varied from 20-70 years with a male: female ratio of 2.13:1 (68 males and 32 females) as seen in other studies. [3, 4]

The peak incidence was observed in the age group 30-40 years comprising 30% (30/100) of the cases which is in conformity to other studies. [3, 5] The reason was that mostly the injuries occurred at workplace and since it is a productive age group, most peoples fell either from unprotected rooftops of factories, motor vehicle workshops, or step ladders during painting walls. Those who undertake one-off jobs without proper training, planning or equipment also became the victims of fall. Male predominance is because of more exposure of men to outdoor activities.

Females mostly keep themselves indoor either due to cultural background or lack of employment so they are less prone to fall-related injuries but not completely spared from the risk of fall as mostly the roofs of houses at the place of study have no boundary walls.

In maximum number of the cases (66%) both skull fractures and intracranial injuries were seen. There were 79% cases of skull fractures with the linear un-displaced fracture and parieto-temporal bone (26.58%) being the most common skull bone fractured.

This occurred as during sudden and unexpected fall, victims tried to protect their

head from impact to the ground either through hand in front fall, back and elbow in back fall and from shoulders in side falls resulting in frontal bone fracture, occipital bone fracture and parieto-temporal bone fracture respectively due to impact of head on the ground due to inertia of fall. Depressed and comminuted depressed fractures were seen in 11 cases (11%) as their fall was arrested at some point by a projected surface or in cases that fell from stairs and the findings are consistent with other studies. [6-10]

Out of 87% cases of intracranial injuries, extra-axial bleed was the most common (83.91%) followed by brain contusion (52.87%) which is in accordance with other studies. [7, 11-13] Parieto-temporal lobe was the most common part of the brain injured showing 22 cases (22/73; 30.14%) of extra-axial bleed, 13 cases (13/46; 28.26%) of contusion and 8 cases (8/24; 33.33%) of subarachnoid bleed.

Both coup and contra-coup injuries were seen either alone or together. Parieto-temporal lobe coup injuries occurred beneath the site of impact and were usually associated with overlying fracture of the skull.

Most of the cases (85%) were treated conservatively and surgery was performed in 15% cases which are in conformity with other studies. [9, 11, 14, 15] Conservative treatment was provided to those who suffered only simple skull fractures without any associated intracranial hematoma or in cases of mild head injury and self-resolving hematoma.

The cases of depressed fracture in which depressed bone segment impinged on the brain surface and those with non-resolving progressive hematoma were treated surgically. The surgeries performed were craniotomy and elevation of depressed bone segment and craniotomy and evacuation of hematoma.

Conclusion and Recommendations:

This study showed that no age group from adult to old age was spared from the risk of fall related head injuries. As males were more commonly affected than females, economic condition of the families was affected due to the injuries suffered by the earning member of the family. A wide range of skull fractures along with intracranial injuries were seen.

Linear un-displaced fracture of the parieto-temporal bone and extra-axial bleed and contusion of parieto-temporal lobe were the most common injuries. At the time of discharge there was no any neurological deficit in any patient who was treated either conservatively or surgically. From the present study it was concluded that intracranial injuries and skull

fracture can occur as a solitary finding in the absence of each other but the presence of skull fracture increases the chances of intracranial injuries. Falls can be prevented by taking certain precautions both at home and at workplace.

This can be done by reducing certain socio-economic risk factors like adequate housing, protection of rooftops with boundary walls, increasing awareness in the public regarding risk factors and hazards of fall by education and mass campaigns, by reducing environmental risk factors as well-planned building design, sufficient lighting, non-slippery floors and stairs.

There should be proper guidelines for workers working at a height. Fall related injuries can be prevented by avoiding excess alcohol intake and multiple self-medications without prescription during working at height.

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Table 1: Distribution of Age

Age (years)	Cases
20-30	21
30-40	30
40-50	25
50-60	12
60-70	12
Total	100

Table 2: Pattern of Head Injuries

Head injuries	Cases	
	No.	%
Skull fracture	13	13
Intracranial injury	21	21
skull fracture + intracranial injury	66	66
Total	100	100

Table 3: Skull Fractures

Type of Skull Fracture	Cases	
	No.	%
Linear un-displaced fracture	62	78.48
Comminuted fracture	6	7.59
Depressed fracture	3	3.80
Comminuted depressed fracture	8	10.13
Total	79	100

Table 4: Part of Skull Bone Fracture

Bones of Skull Fractured	Cases	
	No.	%
Frontal bone	13	16.46
Parietal bone	15	18.99
Temporal bone	13	16.46
Occipital bone	5	6.33
Frontal bone + Parietal bone	12	15.19
Parietal bone + Temporal bone	21	26.58
Total	79	100

Table 5: Scalp and Intracranial Injuries

Head injuries	Cases	
	No.	%
Scalp hematoma	87	87
Scalp laceration	10	10
EDH + SDH	73	83.91
Subarachnoid bleed	24	27.59
Contusion of brain	46	52.87
Cerebral oedema	13	14.94
Pneumocephalous	8	9.20

Table 7: Treatment

Treatment	Cases	
	No.	%
Conservative	85	85
Operative	15	15
Total	100	100

Table 6: Part of the Brain Showing Intracranial Injuries

Part of the brain	Intracranial Injuries Cases		
	Extra-axial bleed (EDH + SDH)	Subarachnoid bleed	Contusion of brain
Frontal lobe	10	3	6
Parietal lobe	15	4	9
Temporal lobe	12	5	12
Occipital lobe	3	1	2
Fronto-parietal lobe	11	3	4
Parieto-temporal lobe	22	8	13
Total	73	24	46

Original Research Paper

Age Estimation by Clinico-Radiological Examination of Third Molar Teeth: A Study from Delhi

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Abstract

The aim of present study was to estimate the age by studying various stages of eruption and development of third molar teeth of different quadrant in age group of 15-25 years. A total 100 patients including equal number of males and females were examined clinically as well as radiologically (orthopantomograms). Demirjian's staging (A-H) was used for chronological evaluation of the maxillary and mandibular third molars. The study showed that the eruption of the third molar tooth was earlier in males as compared to the females and statistically significant difference in left upper, left lower and right lower quadrants. Using the regression analysis it was concluded that for all four quadrants chronological age had a positive linear relationship with dental stage. The right maxillary molar had the strongest relation than other quadrants. However, values in this study were not found to be statistically significant which may be due to the less number of subjects examined and the higher age taken for the Demirjian's staging.

Key Words: Third molar; Chronological age; Orthopantomograms; Demirjian's staging

Introduction:

Age constitute an important factor in relation to assessment of crimes of varied nature, civil purposes and identity of a person. [1] Age of a person can be determined by physical, radiological and dental examination.

Dental age is usually estimated by clinical examination of the teeth and by radiographic methods. These two methods depend upon the order of eruption and development of the teeth. Teeth erupt in two sets i.e. temporary and permanent teeth.

Temporary teeth may guide for determination of age from six months to thirty-three months while the permanent teeth help from six years to twenty two years. [2] Estimation of age by only clinical examination of teeth is not suitable. By radiographic methods it is possible to follow the formation of crowns and roots of teeth and their calcification.

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DOR: 28.04.2014 DOA: 01.11.2014

In this study we have estimated the age clinically as well as radiologically by studying various stages of eruption and development of third molar teeth and also studied the order of eruption of third molar in different quadrants in both sexes in the age group of 15-25 years.

Materials and Methods:

The study was conducted on a total of 100 cases of either sex between 15-25 years of age. (Table 1) A written informed consent from the person/guardian was obtained. Birth certificate or any other valid documents were considered for age proof.

Persons with malnutrition, any disease affecting the skeletal growth and general development, any congenital anomalies of teeth and impacted or extracted third molar tooth were excluded from the study.

The persons were examined clinically and radiologically (orthopantomograms) and the staging were done as follows:

Clinical Staging:

Stage 1: Not erupted tooth (NE) - tooth yet not perforated the oral mucosa

Stage 2: Partially erupted tooth (PE) – occlusal surface partially visible

Stage 3: Completely erupted tooth (CE) - complete emergence in occlusal plane

Radiological Staging:

After clinical examination and staging, OPG was done for each subject. Based on those radiological findings of third molar teeth,

Demirjian's Staging [3] was done in which the development of teeth was divided in following eight stages:

Stage A: Cusps tips mineralized but not coalesced

Stage B: Mineralized cusps united with well-defined morphology

Stage C: Crown half formed, pulp chamber evident, dentinal deposition occurring

Stage D: Crown formation complete to dentino-enamel junction

Stage E: Beginnings of formation of inter-radicular bifurcation, root length is less than crown length.

Stage F: Root length is at least as great as crown length, roots have funnel-shape ending

Stage G: Root walls are parallel but apices remain open

Stage H: Apical ends of root completely closed and the periodontal membrane has uniform width around the root

The data was analyzed by the statistical software SPSS version 15.0. Mean and 95% confidence intervals was determined using the descriptive statistics. Unpaired students t-test was used to compare the mean age in males and females for each quadrant in not erupted, partially erupted and erupted subjects.

The comparison among male and female with regards to third molar development was done by Mann-Whitney test. Wilcoxon signed rank test was used to compare between the right and left and lower and upper teeth, such as 18 vs. 38 and 28 vs. 48 in males and females separately. Chi-square test was used to compare the proportion of absent teeth in males and females for each quadrant.

To estimate the dental age based on the Demirjian's staging for each quadrant, simple linear regression and then multiple linear regression tests were applied.

Observations and Results:

A. Based on Clinical Staging: (Table 2 & 3)

1. The total numbers of unerupted third molar teeth were more in case of females as compared to males, and more common in age less than 18 years.
2. The total numbers of unerupted third molar teeth were more in mandibular arch, while total number of partially and completely erupted teeth were more in maxillary arch.
3. The percentage for unerupted third molar teeth was more for right side as compared to left, and more for right lower quadrant (55%) as compared to other quadrants.
4. The percentage for partially and completely erupted teeth was more for right as

compared to left and for maxillary arch as compared to mandibular arch.

The Mean Age for Partially Erupted Teeth:

For right and left maxillary teeth, the mean age was 16.835 years for males and 15.0 years for females, but it was not statistically significant. (P value: 0.08) For left and right mandibular, it was 17.40 years for males and 17.0 years for female. (P value: 0.576)

The Mean Age for Completely Erupted Teeth:

For right maxillary teeth, it was 21.57 year males and 21.67 for females. (P value: 0.864) For left maxillary, it was 21.29 years for males and 21.73 years for females. (P value: 0.475)

For left mandibular, it was 21.27 years for males and 21.84 years for females. (P value: 0.304) For right mandibular, it was 21.36 years for males and 21.64 years for females. (P value: 0.669) There was no significant difference in mean age in males and females for each quadrant in partially erupted and completely erupted stages.

B. Based on Radiological Study: (Table 4-6)

• Stage Wise Distribution of Third Molar Teeth for Males:

Stage D and E observed equally in all quadrants and in both arches. Stage F and H observed more commonly in maxillary arch and no left- right asymmetry seen. Stage G was more common in mandibular arch and no left-right asymmetry seen.

• Stage wise Distribution of Third Molar Teeth for Females:

Stage C was more common in mandibular arch and on right side. Stage D was present more commonly in mandibular arch and no left- right asymmetry seen.

Stage E was more commonly present in maxillary arch and on right side. Stage F was present more commonly in mandibular arch and on left side.

Stage G was present more commonly in maxillary arch and on left side. Stage H was present more commonly in mandibular arch and on right side.

• Quadrant wise Distribution of Third Molar Teeth:

The percentage of third molar teeth eruption was more on left side (88%) for males and for females, it was more for right side (84%).

• Arch wise Distribution of Third Molar Teeth:

The percentage of third molar teeth eruption was more in lower arch (mandibular) in both males and females.

- **Sex wise Comparison of Present and Absent Third Molars in Different Quadrants:**

No significant difference found in proportion of absent third molar teeth between males and females. The percentage of missing maxillary and mandibular third molars was found to be 20.0% and 16.0% respectively. In Males this percentage was 19.0% and 13.0% and in females 21.0% and 19.0% respectively.

- **The Estimated Dental Age for Males: (Based on Demirjian's staging)**

The mean age for Stage D was 15 years for all quadrants. The mean age for Stage E in right maxilla was 16 years, for left maxilla was 17 years and for left & right mandible was 21 years.

The mean age for Stage F in right maxilla was 18 years, 18.67 years for left maxilla, 17.60 years for left mandible and 18.17 years for right mandible.

For Stage G, the mean age in right maxilla was 18.55 years, 18.70 years for left maxilla, 18.17 years for left mandible and 18.00 years for right mandible. For Stage H, the mean age in right maxilla was 21.76 years, 21.35 years for left maxilla, 21.81 years for left mandible and 21.73 years for right mandible.

Thus the earliest mean age for the eruption of third molar for males was 15 years and can range up to 21 years.

- **The Estimated Dental Age for Females: (based on Demirjian's staging)**

The mean age for STAGE C was 18 years for right maxilla, 16 years for both mandibular quadrants. For Stage D it was 15.75 years for right maxilla, 15.67 years for left maxilla, 16.88 years for left mandible and 17.14 years for right mandible.

The mean age for Stage E in right maxilla was 19.22 years, for left maxilla is 19.13 years and for left & right mandible are 18 and 19 years respectively.

The mean age for Stage F in right maxilla was 19.5 years, 19.17 years for left maxilla, 20.44 years for left mandible and 20.17 years for right mandible.

For Stage G, the mean age in right maxilla was 20.38 years, 20.31 years for left maxilla, 20.55 years for left mandible and 20.83 years for right mandible.

For Stage H, the mean age in right maxilla was 21.78 years, 21.43 years for left maxilla, 21.63 years for left mandible and 22.00 years for right mandible.

Thus, the earliest mean age for third molar eruption for females was 15.67 years and can range up to 22 years.

The Mann Whitney test:

There was significant difference in eruption of third molar in left upper, left lower and right lower quadrants between males and females. Whereas, right upper quadrant this Stage was not statistically significant. In all the cases, mean for the formation of stages was higher in males as compare to the females.

Wilcoxon signed rank test (arch-wise):

No significant difference was observed in the eruption of teeth in upper and in lower arches for males and females. (Table 7)

Wilcoxon signed rank test (right-left symmetry):

No significant difference was observed in the eruption of teeth in Right and in left for males and females. (Table 8)

Univariate and Multiple Regression Analysis:

For all the four quadrants chronological age had a positive linear relationship with the dental stage, strongest being for the right maxilla. If the subject moves from one stage to next stage there was a proportionate change in the chronological age, of approximately 0.354 year for the 18 quadrant. (Table 9) Stepwise multiple regressions found that only the 18 quadrant was statistically significant while the others were statistically insignificant.

Discussion:

In the present study, the clinical emergence of mandibular third molar was in the range of 15-18 years with no statistically significant sex difference in males and females. Levesque et al (1981) recorded that the clinical emergence of mandibular third molar was between 15 and 19 years of age, bilateral agenesis was seen in about 9% without significant sexual difference and no right-left asymmetry recorded. [4]

This is not in concordance with our study in which right left asymmetry noted. The percentage for unerupted third molar teeth was more for right lower quadrant (55%) as compared to other quadrants. But the percentage for partially and completely erupted teeth was more for right upper quadrant.

Chhokar, Aggarwal and Bhardwaj recorded that in females eruption of third molar was present in 80% cases by 18 years of age. [5] In present study, the total numbers of unerupted third molar teeth were more in case of females as compared to males, and more common in age less than 18 years. This is similar to the results of Chhokar et al. [5]

Levesque et al found that the root development course was faster in males than in females by six months. [4] The study conducted

on American whites by Mincer et al concluded that the root formation was earlier in males than females. [6] Willershausen B et al studied a total of 1202 orthopantomograms and concluded that root development was more advanced among boys than among girls of the same age, with no apparent differences in growth patterns based on national/ethnic background. [7]

Also there was a sudden increase in the percentage of completely erupted teeth from 18-21 years in their study. Mesotten et al studied the people of Caucasian origin found that there was earlier development of 3rd molar in males when compared to females. [8] According to Sisman et al the third molar generation was earlier in males than females. [9] Bai et al also in their study concluded that the third molar was earlier formed in males than in females. [10]

In our present study also we found that the eruption of the third molar teeth was earlier in males as compared to females. This is in concordance with the studies of Levesque, Willershausen, Mincer, Sisman and Yuming Bai. [4, 6, 7, 9, 10]

According to Mincer et al the stages A to D showed that the individual in question was less than 18 years while stage H confirmed him to be over 18 years leaving stages E, F and G as ambiguous. [6]

He did not comment on the sex differences in the stage development. Francesco Introna et al showed a prevalence of stages D to G in the age 16-18 years and a clear predominance of stage H in individuals over 18 years of age. [11]

Finally, an intermediate stage between G & H was demonstrated in subjects aged between 17-21 years. He also did not comment on the sex differences, if any, in the stage development.

In the present study, for the males the Stage D was observed in 14-15 years while stages E, F, G, and H were observed in age group 16-22 years. While for the females, the stages C and D were found in the age group of 15-18 years and stage E, F, G and H were found above 18 years.

This is in accordance with the studies of Mincer and Introna for the Stage H, showing that the Stage H appears in individuals above 18 years of age, and for stage D which appears before 18 years of age. However the stages C, E, F and G show a wide variation. [6, 11]

Conclusion:

The conclusion drawn from the study is that the eruption of the third molar tooth is earlier

in males as compared to the females when examined clinically and radiologically.

There is statistically significant difference in eruption of third molar in left upper, left lower and right lower quadrants between males and females.

Using the regression analysis it is concluded that for all four quadrants chronological age has a positive linear relationship with dental stage such as if the subject moves from one stage to next stage.

There is a proportionate change in the chronological age of approximately 0.354 year for the right upper quadrant.

The right maxillary molar has the strongest relation than other quadrants. Also for the males the Stage D was observed in 14-15 years while stages E, F, G and H were observed in age group 16-22 years.

While for the females, the stages C and D were found in the age group of 15-18 years and stage E, F, G and H were found above 18 years. Though these values were not found to be statistically significant it may be due to the less number of subjects examined and the higher age taken for the Demirjian's staging.

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Table 1: Cases According to Age and Sex

Age grps(Yrs)	Male	Female	Total
15-16	5	5	10
16.1-17	5	5	10
17.1-18	5	5	10
18.1-19	5	5	10
19.1-20	5	5	10
20.1-21	5	5	10
21.1-22	5	5	10
22.1-23	5	5	10
23.1-24	5	5	10
24.1-25	5	5	10

Table 6: Comparison between Males and Females Ordinal Formation Stage for Each Quadrant

Quadrant	Males	Females	Z-value	P-value
Right upper	5.50±3.02	5.26±2.65	-1.246	0.213
Left upper	5.64±2.89	4.70±3.01	-2.045	0.041
Left lower	6.12±2.52	5.00±2.72	-2.714	0.007
Right lower	5.94±2.65	4.84±2.77	-2.580	0.010

Table 2: Sex Wise Distribution of Eruption Third Molar

Age grps (Yrs)	Male			Female		
	NE	PE	CE	NE	PE	CE
15-16	18	2	0	16	4	0
16.1-17	16	4	0	20	0	0
17.1-18	14	6	0	17	3	0
18.1-19	8	10	2	16	0	4
19.1-20	2	0	18	15	0	5
20.1-21	9	0	11	9	0	11
21.1-22	5	0	15	14	0	6
22.1-23	4	0	16	4	0	16
23.1-24	4	0	16	8	0	12
24.1-25	7	0	13	6	0	14
Total	87	22	91	125	7	68

Table 7: Arch Wise Findings of Wilcoxon Signed Rank Test

Upper jaw			Lower jaw	
Quadrant	18	28	38	48
Males	5.50±3.02	5.64±2.89	5.64±2.89	5.94±2.65
Z-value	-0.463		-1.342	
P-value	0.643		0.180	
Females	5.26±2.65	5.00±2.72	5.00±2.72	4.84±2.77
Z-value	-1.682		-1.254	
P-value	0.092		0.210	

Table 8: Wilcoxon Signed Rank Test (Right-Left Symmetry)

	Right		Left	
Quadrant	Upper	Lower	Upper	lower
Males	5.50±3.02	6.12±2.52	6.12±2.52	5.94±2.65
Z-value	-1.837		-0.797	
P-value	0.066		0.426	
Females	5.26±2.65	4.70±3.01	4.70±3.01	4.84±2.77
Z-value	-1.132		-0.071	
P-value	0.258		0.944	

Table 9: Univariate and Multiple Regression Analysis

Univariate Regression	Intercept	Regression coefficients	F-ratio	R-square
Maxillary Right	17.595	0.354	13.441	0.121
Maxillary Left	18.435	0.206	4.626	0.045
Mandibular Left	18.119	0.248	5.540	0.053
Mandibular right	18.254	0.237	5.241	0.051
Multivariate Regression				
Maxillary Right	17.466	0.120	3.406	0.127
Maxillary Left		0.356		
Mandibular Left		-0.074		
Mandibular right		-0.021		

**Table 3
Sex Distribution of Eruption of Third Molar**

		Right upper	Left upper	Left lower	Right lower
Partially Erupted					
F	N	2	2	1	2
	M + S. D.	15.00±0.00	15.00±0.00	17.0±0.0	17.0±0.0
M	N	6	6	5	5
	M + S.D.	16.83±1.17	16.83±1.17	17.40±0.894	17.40±0.894
	P value	0.080	0.080	-	0.576
Completely Erupted					
F	N	23	15	19	16
	M + S.D.	21.67±1.81	21.73±1.98	21.84±1.74	21.63±1.93
M	N	18	24	22	22
	M + S. D.	21.57±1.90	21.29±1.78	21.27±1.75	21.36±1.79
	P value	0.864	0.475	0.304	0.669

Table 4
Sex Wise Distribution of Total Number of Third Molar Teeth according To Demirjian's staging

Stage	Right upper		Left upper		Left lower		Right lower	
	M	F	M	F	M	F	M	F
ABSENT	10	8	9	13	6	9	7	10
C	1	1	0	0	0	1	0	1
D	3	4	3	3	3	8	3	7
E	1	9	2	8	2	4	2	7
F	7	6	9	6	5	9	6	6
G	11	13	10	13	18	11	17	6
H	17	9	17	7	16	8	15	12
TOTAL	50	50	50	50	50	50	50	50

Table 5
The Mean Age (95% Confidence Intervals) For Both Sexes

Stage	Right upper mean(95% CI)		Left upper mean(95% CI)		Left lower mean(95% CI)		Right lower mean(95% CI)	
	Male	Female	Male	Female	Male	Female	Male	Female
C	24(-)*	18				16		
D	15(-)#	15.75 (15.5-16.0)	15(-)#	15.67 (15.33-16.00)	15(-)#	16.88 (16.21-17.54)	15(-)#	16
E	16(-)*	19.22 (18.12-20.33)	17.00 (16.00-18.00)	19.13 (17.88-20.37)	21 (18.00-24.00)	18.00 (16.71-19.29)	21.00 (18.0-24.0)	17.14 (16.44-17.85)
F	18.00 (16.87-19.13)	19.5 (18.88 -20.62)	18.67 (17.46-19.87)	19.17 (18.06-20.27)	17.60 (15.97-19.23)	20.44 (19.63-21.26)	18.17 (16.72-19.61)	19.00 (17.93-20.07)
G	18.55 (17.81-19.27)	20.38 (19.64-21.14)	18.70 (18.02-19.38)	20.31 (19.57-21.04)	18.17 (17.74-18.60)	20.55 (19.66-21.43)	18.00 (17.58-18.42)	20.17 (18.63-21.70)
H	21.76 (21.29-22.24)	21.78 (21.21-22.35)	21.35 (20.88-21.82)	21.43 (20.74-22.11)	21.81 (21.00-22.25)	21.63 (21.31-22.31)	21.73 (21.20-22.26)	20.83 (20.17-21.49)

Original Research Paper

A Medico-legal Study of Unnatural Deaths In Newly Married Females

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Abstract

Crime against women can be traced back to the beginning of human civilization. But it was expected that a more civilized human being will be more respectful to the women but this is not to be seen in society and crime against women are on rise as ever. Present study was conducted with the aim to study the pattern of deaths in newly married females which comprises a significant proportion of all the crimes against women. In this study it was found that most common victims were newly married Hindu brides. Most common age of victim was found to be between 22-25 years. Burns was found to be the most common cause of death. Most of the incidences occurred during 12pm to 6pm. Newly married females within first year of marriage were most common victims. Most of the incidences occurred in in-laws house.

Key Words: Crime, Women, Newly married Burn injuries, Death

Introduction:

History of criminal acts of human is as old as his origin. In the ancient times crimes were there but there were no laws. So it was difficult for the rulers to dispense the justice.

Recent years have witnessed the revolutionary judgments by law makers for the safety and well-being of women in society which generated a hope that time has come when women will get her long due respect and dignity. But crime against women is on rise as ever.

The condition of uneducated and non working class of women is pathetic in many sections of society. They suffer from low self esteem and are soft targets for domestic violence. Studies and common observations had shown that family is the first place where most women suffer from ill treatment and physical and mental violence. [1]

Physical and mental abuse during initial years of marriage is common practice in many Asian countries, including Bangladesh, India, Pakistan, and Sri Lanka. [2-6] In India, incidents of bride burning and dowry death acquired notoriety. When husband and his family started making demands to extract more money and articles by putting pressure on wife, who will then indirectly put pressure on her family and this led to the increase in cases of bride burning and dowry started increasing permanently and getting highlighted.

The payment of a dowry has been prohibited under 'The 1961 Dowry Prohibition Act' in Indian civil law and subsequently by Sections 304B and 498A of Indian Penal Code.

The severity of this can be easily imagined from the fact that every year there are approximately 9000 registered case of dowry demand and deaths.

However different NGO'S claim that, number is well above 9000. On July 25, 2007 India elected its first female president which very well showed the rising power of women in India and this was boosted by the controversial yet historic Women's Reservation Bill, ensuring 33% reservation to women in Parliament and state legislative bodies, was passed in the Rajya Sabha on Tuesday, 9th March 2010.

The current study focuses on the core issues like why newly married females are being harassed despite new and stringent laws. Why social indifference to female does not end even when every tool at lawmakers hands are being used. Why after so much social participation in

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DOR: 28.04.2014 DOA:31.10.2014

the form of websites, 24 hours toll free help lines, NGO'S and other social welfare groups promoting dowry free group marriages this monstrous evil continue to flex its muscles?

With 29 states and 6 union territories mother India give its people, considerable freedom to move from one place to another in search of livelihood and due to other factors in the same state or the other.

This intra and interstate migration, along with acculturation (mixing of cultures), has lead the people to adopt new customs in their families. Urbanization inter-caste marriages and nuclear families are on rise which is also promoted by reality sector boom in both rural and urban areas.

More and more people are shifting from houses to flats thus leading to nuclearization of families due to lack of space at the same time providing them freedom for decision making and liberal thinking at the price of newer economic burdens, tension and stress syndromes unheard and unseen before, leading to the new trifle in the lives of newly married couples.

With late marriages getting positive nod from society, newer kind of problems are arising which psychiatrists and psychologists today are clearly able to visualize in form of rising number of marriage counseling's, early divorces, premature senile disorders, rising, female feticide spouse suspecting each-other's fidelity, late child bearing, rising infertility issues etc.

And to spice up the issue government presents the handy tool in the form of S.498A which gives the women considerable freedom to harass her husband and in-laws at her will with single complaint.

According to NCRB in 2008 alone there were 8147 cases of dowry death reported along with 81344 cases of cruelty against women by husband and relatives with conviction rates as low as 33.4 and 22.4 respectively. It has now become difficult to assess how much the scenario has improved because of the adulteration with the fake allegations due to over awareness of some people.

The present study was conducted to find the incidence and causes of unnatural deaths in women with special reference to death within seven years of marriage in the Ahmedabad district of Gujarat.

Materials and Methods:

The present study was comprised of 318 cases of unnatural female deaths received in the civil hospital mortuary at B.J. Medical College, Ahmedabad for medico-legal autopsy examination during the period from June 2009 to

May 2010. All the cases were studied with reference to history, epidemiological aspects, the nature of injuries, and their medico-legal aspects. The study included the various investigations e.g. X-ray examination, histopathological examination and chemical analysis.

A standardized proforma specially designed for this purpose was used and filled after detailed interviews with investigating officials and parents, relatives, friends and neighbors to gather information regarding incidence, age, socioeconomic background, education, family structure, marital disputes etc. All the data are statically analyzed.

Results:

Considering the cause of death of victim, in this study out of 318 cases studied, 228 (71.7%) were of burns, 29 (9.12%) were of poisons, 43 (13.52%) were of asphyxia, 12 (3.77%) were of accident and 6 (1.87%) were of stabbing.

It was found that the most common cause of death was burns followed by asphyxia. (Fig. 1) With reference to age-wise distribution, most of the deaths occurred in the age group 22-25 years (35.85%) followed by 26-29 years (25.47%). The minimum age of accused was 18 years and maximum age was 33 years. (Fig. 2)

In our study most of the cases were from Hindu families with regard to religion of victim. (Table 1) Most of the cases occurred during 1-3 years of marriage (44.97%). (Table 2)

Present study showed that out of 318 cases, 17 (5.35%) occurred during 12am-6am, 61 (19.18%) occurred during 6am-12pm, 136 (42.77%) occurred during 12pm-6pm and 104 (32.70%) occurred during 6pm-12am With respect to time of incidence.

Most of the cases are commonly happened between 12pm-6 pm followed by 6 pm-12am. (Fig. 3) In our study the most common place of incidence is in laws house followed by husband/ own house. (Table 3)

Discussion:

Unnatural deaths within seven years of marriage are one of the indicators of the level of social and mental health. Responsibility for prevention of violence in our society does not rest only on the law and enforcement personnel.

Public health and other human agencies should assist in preventing primary violence as they have helped to prevent other major causes of morbidity and mortality.

The purpose of the present study is to analyze the present situation of unnatural deaths in Ahmedabad district in Gujarat and to find out

the possibilities of decreasing the incidences of unnatural female deaths in the state.

Distribution and causes of unnatural female deaths in present study are more or less similar to the pattern found in most of the other Indian studies.

This similarity is there in almost all parameters used in this study. Most of the victims in the present study were young Hindu, married females who died due to burns.

This study showed that most of the victims belong to the age between 22 to 25 years which constitute 37% followed by age group 26 to 29 years which constitute 26% of the cases. This observation is inconsistent with the other studies. [7-10]

In this study age distribution of 30 to 33 years show lowest percentage which mostly constitute couples who had married for more than five years. Further it has been observed in the present study that most of the cases are due to burns. This is in accordance with the other reports. [7, 8, 10-12]

Our study showed that more than 95% victims were Hindus. This data is inconsistent with other observations. [7, 8, 13, 14] This trend is the due to accumulative effect of common occurrence of dowry in Hindu families and their higher population. [15] The study shows that most common place of occurrence of the incidence is in-laws house in case of joint family and husband's house in case of nuclear family.

This is constant with other similar studies. [14, 8] This is also consistent with the fact that a major part of Indian population still lives in rural areas where joint family is common feature. [16]

This study also showed that most of the incidences occur in 1 to 3 years of marriage.

This trend is may be due to the fact that newly married women would have taken her time to adjust in new environment and circumstances before taking some bold steps. Similarly for the groom side it may represent the latent period of old or fresh dowry demands.

Conclusion:

Our study showed that out of 318 cases of unnatural female deaths within seven years after marriage reported for postmortem examination in the Department of Forensic Medicine B.J. Medical College, Ahmedabad, most of the deaths occurred in the age group 22-25 years (35.85%).

Majority of married female victims were Hindu females. Most of the death of the victims occurred within 1-3 years of marriage (44.97%). In majority of the victims, the main cause leading

to death was burns followed by asphyxia deaths. Most common place of incidence is in in laws house followed by husband/own house.

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Fig. 1: Cause of Death

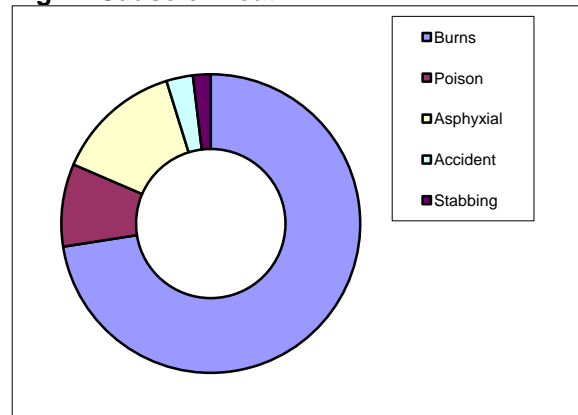
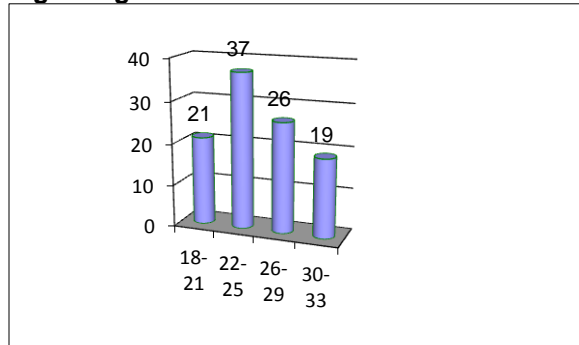
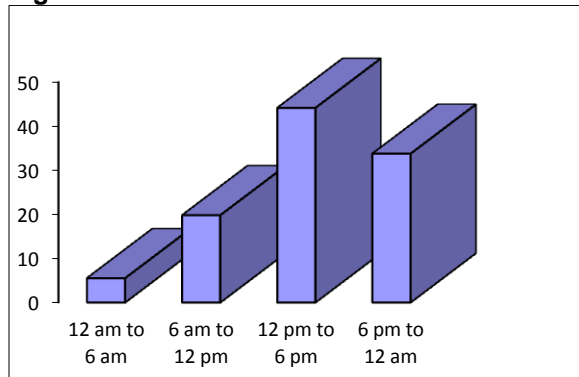


Fig. 2: Age Wise Distribution**Fig. 3: Time of Incidence****Table 1: Religion of Victim**

Religion	Cases	Percentage
Hindu	296	93.08
Muslim	21	6.6
Others	1	0.32

Table 2: Time since Marriage

Years	Cases	Percentage
<1	88	27.67
1 to 3	143	44.97
3 to 7	65	20.44
8 to 10	22	6.92

Table 3: Place of Incidence

Place of Incidence	Cases	Percentage
In Laws House	214	67.30
Own / Husband's House	66	20.75
Parental House	26	8.18
Road Accident	12	3.77

Original Research Paper

A Study on Age at Menarche with its Relation To Pregnancy Induced Hypertension

¹Arista Lahiri, ²Soumyajyoti Bandyopadhyay, ³Shouvanik Adhya, ⁴Somanjana Ghosh, ⁵Sumita Ray, ⁶Swaraj Halder

Abstract

It is a well-established fact that the age at which a girl should attain menarche is dependent not only on hormonal factors of that particular female but a number of genetic, nutritional as well as environmental factors play significant role in the age of onset of the event. Often in our clinical set-up, we observe the similar age of onset of menstruation among girls of the same family. Now in this cross-sectional observational study with a study population of 260 pregnant women of varying age groups, we try to make an attempt to establish a relationship between the age at Menarche of this randomly selected study population with incidence of Pregnancy Induced Hypertension in the same population, though it is a well-known fact that all the three entity pregnancy induced hypertension, preeclampsia & eclampsia have a multi factorial etiology. It has been found out from the present study that there is a statistically significant association between menarche at an early age with occurrence of pregnancy induced hypertension especially in cases of the primigravida.

Key Words: Hypertension, Menarche, Multigravida, Pregnancy, Primigravida

Introduction:

Motherhood is bliss to the mankind since ages. To become a mother has been a dream come true to women. A child born brings new hope and happiness to the concerned family. But he or she is also the future of the country and the community.

So the health of the mother and the new born has remained an important parameter of the health status of each and every state. The balancing act of motherhood and a career, and being a wife, is something that I don't think I'll ever perfect, but I love the challenge of it. (Kerri Walsh) [1] However in the present era, with the development of civilization, and progress of science the working women population has increased in number.

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We have seen due to career and job related constraints the age of first pregnancy is on the rise for most working women. We all know that pregnancy in elderly women is associated with a number of risk factors one of which is PIH. And in the present times we find a lot of mothers face this clinical problem which if not effectively managed poses a significant threat to the life of both mother and the child.

Menarche is the first onset of the menstruation in a girl. It is actually regarded as a girl's transition to womanhood. A number of genetic, nutritional as well as environmental factors play significant role in the age of onset of the event. Also the event has immense importance in the future reproductive as well as health status of the woman in days to come.

Two of the biggest physical milestones in a woman's life are menarche (pronounced "MEN-ar-kee"), the first menstrual period in girls, and menopause, when menstruation stops and female reproductive hormones slow. These milestones are universal and mark the beginning and end of a woman's reproductive cycle. [2]

Pregnancy-induced hypertension (PIH) is a form of high blood pressure in pregnancy. It occurs in about 7 to 10 percent of all pregnancies. [3]

Pregnancy-induced hypertension is also called toxemia or preeclampsia. It occurs most often in young women with a first pregnancy. It is

more common in twin pregnancies, and in women who had PIH in a previous pregnancy.

In some foreign countries celebrating onset of the menstrual period has become a custom of the girls' transition into womanhood by offering gifts or lucky charms.

However in India due to strong conservative social norms this is not commonly observed. In most states of India the tradition goes as such that the mother or any senior woman member explains the events to the girl.

Barring a few exceptions the age of menarche is remembered by the girl throughout.

It has been found that that nearly all girls in the US menstruate by the age of 14, with the median age around 12 and one-half years.

These numbers haven't really changed over the last few decades, although girls today may show signs of puberty (breast growth and pubic hair display) at a younger age. The average age of menarche can vary by ethnicity, though, and African-American girls typically start menstruating before girls of European descent. [2]

Our study focuses on the common link between pregnancy induced hypertension with the age of onset of menarche as well as age of first pregnancy. Both early and delayed menarches have been associated with increased cardiovascular disease (CVD) risk factors (including metabolic syndrome) and disease in adolescent girls and young women. [1, 5–9] Furthermore, women with long and irregular menstrual cycles have been shown to have higher risk for CVD and type-2 diabetes. [7, 9, 10]

Materials and Methods:

This is a cross-sectional observational study conducted by gathering data from a number of pregnant women recorded as booked cases at different hospitals in Kolkata, West Bengal via Recall-Method & Analysis of the Hospital Documents provided by the study population.

The study population consists of 260 pregnant women selected randomly from pregnant women admitted for delivery in different Hospitals in Kolkata, West Bengal in a time period of March, 2013 to August, 2013. Among these 260 women, 155 are primigravida & the remaining 105 multigravida.

Data regarding age at menarche were assembled from the hospital records, mainly the BHT (Bed Head Ticket) available blood reports & OPD ticket (wherever available).

They ascertained that they were not taking any contraceptive precautions & never

took Oral Contraceptive Pills for any other purpose. There is no prior history of any abortions, still birth or intra-uterine fetal deaths in the study group. Their blood test reports revealed a healthy Hb% of > 11 mg% at different stages of their pregnancy with no other sings of any abnormality regarding Lipid Profile, Complete Hemogram, Blood Urea Nitrogen levels, Protein levels or Blood Sugar levels. The routine urine tests were within normal limit in each of the 260 patients as noticed from the documents provided.

Regarding analysis of the collected data ratios & proportions were used to interpret & compare the relationship. Tables & Bar Diagrams depict a comprehensive way of determining the relationship between the age at menarche with incidence of PIH.

Inclusion & Exclusion Criteria:

The major risk factors to be exclude includes, previous history of eclampsia, diabetes, proteinuria, chronic hypertension, renal disease, hypothyroidism, anemia. Only those records were included whose blood test reports revealed a healthy Hb% of > 11 mg% at different stages of their pregnancy with no other sings of any abnormality regarding Lipid Profile, Complete Hemogram, Blood Urea Nitrogen levels, Protein levels or Blood Sugar levels. The routine urine tests were within normal limit in each of the 260 patients as noticed from the documents provided.

Regarding exclusion, those records which showed history of accidental pregnancy despite use of oral contraceptive pills or other contraceptive procedures are excluded. Cases with prior history of any abortions, still birth or intra-uterine fetal deaths were also excluded.

Results:

Amongst the study population about 57.7% had their age at menarche within the range of 12-14 years, followed by 26.9% in the interval of 14-16 years & rest 15.4% population in the interval of 10-12 years. (Table 1)

The lowest age at menarche in the described study population is as early as 10 years (in case of 10 women) & in other 10 women the age of first menstrual bleeding was 15 years, which is the highest age in the study population. The mean age however was 12.7 years for menarche. In the majority of the population, in about 95 women out of this 260 this age was 13 years. (Table 2)

As per the age distribution of the population (Table 3) the women (primigravida & multigravida) in the age group 25-30 years have

the maximum incidence of PIH in their present as well as past pregnancies.

Interestingly the age at menarche within this age group of population ranges from as low as 11 years to a maximum of 14 years with majority having 13 years followed by 11 years, thus depicting a trend of PIH in women with early onset of menstruation.

As in case of Age at First pregnancy the multigravida women of age at first pregnancy in 18-20 years range have less incidence of PIH in their present pregnancy compared to their past pregnancy (es), while it is reversed in women who had first conception in the age group of 20-22 years. Whilst in case of primigravida mothers, the women with first pregnancy in the age range of 24-26 years have maximum incidence of PIH. (Table 4) In a Seattle based study it has been shown that early onset of menarche is associated with an increased risk of preeclampsia and pre-pregnancy weight modifies associations of cycle length with risk of preeclampsia. [10]

Now, again coming back to the age at menarche, primi mothers with age at menarche in the range 12-14 years have maximum incidence of PIH compared to other age ranges of first menstruation.

On the other hand, in case of multigravida mothers the range of 14-16 years has maximum incidence of PIH. (Tables 5A & 5B) Finally, this study clearly depicts the higher incidence of PIH in primigravida mothers having menarche between 12-14 years, however in case of multigravida mothers there is a steady increase in incidence of PIH in their first pregnancy in the menarche age range of 10-12 years, 12-14 years & 14-16 years. (Fig. 1)

Discussion:

In the study group the mean age of menarche was 12.7 years and majority of the population the age of menarche was 13 years.

So our study findings is similar to the data obtained from the US based study which shows that medium age of menarche for US base girls is 12.5 years. [2]

The early age of menarche is seen to be associated with pregnancy induced hypertension. We have found a similar result in the study carried out in Swedish medical centre Seattle where an inverse relationship between age at menarche and increased risk of preeclampsia was established. [2]

Primigravida in the age range of 12-14 years of age at the onset of menarche have been shown to have maximum incidence of pregnancy induced hypertension.

As per observation from other studies young women in first pregnancy and more so in twin pregnancies the incidences of pregnancy induced hypertension is more.

Multigravida mothers in the age range of 14 -16 years of age of menarche has higher incidence of pregnancy induced hypertension. A Karachi based study conducted on 1000 pregnant women showed that pregnancy induced hypertension incidence is more among the primigravida. The next most susceptible group is the elderly multigravida. [12] So our study also corroborated with the finding of Karachi based study.

Another Pakistan based study also concludes that Primigravida, previous pre-eclampsia, diabetes mellitus, chronic hypertension, obesity and large placenta are major risk factors of PIH. HELLP, convulsions and pulmonary edema were recorded as major complication of PIH. [13]

Analysis:

Early age at menarche is evidently common in the study population. With that it is also to be noticed, the incidence of PIH is relatively higher in the population with menarche age range 10-12 years & 12-14 years, though there is a reciprocal variation of incidence of PIH in cases of Primigravida & Multigravida having those age groups of menarche as mentioned earlier. With extremes of menarche age PIH is commoner with more evidence of multigravida mothers. This certainly bears a socio-cultural relevance.

With advancing birth order but comparatively later age range of menarche (14-16 years) there is comparative increase in incidence of PIH (occurrence of PIH in more than one pregnancy in a woman and more incidence of PIH in their first pregnancy). However in primi-mothers maximum incidence of PIH is in the menarche range of 12-14 years.

Conclusion:

Majority of the contributing factors of PIH were set as exclusion criteria for the study population to compare the genetic input in relating the age at menarche & PIH. It is clearly evident from this study that with comparatively earlier age at menarche there is also comparatively higher incidence of PIH.

If we consider birth order then Primigravida females have higher incidence of PIH with earlier age at menarche, while multigravida mothers have it in reverse order.

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Table 2: Variations in Age at Menarche

Parameters		Age (years)
Lowest Age at Menarche		10
Highest Age at Menarche		15
Central Tendencies	Mean	12.7
	Median	13
	Mode	13

Table 3: Relation of Age Distribution in the Population with PIH (n=260)

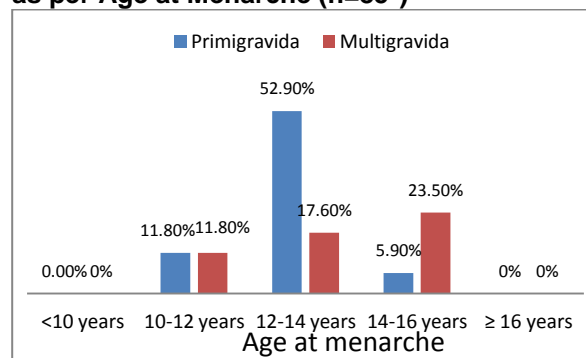
Age of the Population (years)	H/O PIH in at least 1 of the previous pregnancies*	Active PIH*	Both*
<18	0	0	0
18 – 20	0	1.9	0
20 – 25	3.8	9.6	0
25 – 30	11.5	17.3	5.7
30 – 35	1.9	0	0
≥35	0	0	0

* given in % values

Table 4: Relation of Age at First Pregnancy with PIH (n=260)

Age at First Pregnancy (years)	H/O PIH in at least 1 of the previous pregnancies*	Active PIH*	Both*
<18	0	0	0
18 – 20	3.8	1.9	0
20 – 22	5.8	7.7	0
22 – 24	7.7	5.8	5.8
24 – 26	0	9.6	0
26 – 28	0	1.9	0
28 – 30	0	1.9	0
≥ 30	0	0	0

* given in % values

Fig. 1: Comparison of PIH at First Pregnancy as per Age at Menarche (n=85*)**Table 1: Age at Menarche of the Study Population (n= 260)**

Age at Menarche (yrs)	% population
< 10	0
10 – 12	15.4
12 – 14	57.7
14 – 16	26.9
≥ 16	0

Table 5A: Relation of Age at Menarche with incidence of PIH in Primigravida (n=155)

Age at Menarche (years)	Active PIH (in %)
<10	0
10 – 12	6.5
12 – 14	32.3
14 – 16	0
≥ 16	0

Table 5B: Relation of Age at Menarche with incidence of PIH in Multigravida (n=105)

Age at Menarche (yrs)	H/O PIH (%)	Active PIH (%)	Both (%)
<10	0	0	0
10 – 12	9.5	0	0
12 – 14	14.3	4.8	4.8
14 – 16	19.0	9.5	9.5
≥ 16	0	0	0

Original Research Paper

An Epidemiological Retrospective Study of Autopsied Dry Thermal Burn

¹Surendra Kumar Pandey, ²Awdhesh Kumar, ²Mayank Gupta

Abstract

The present retrospective study has been conducted for the period of 5 years i.e. 2009 to 2013 based on autopsy of the unnatural death cases resulting from burn. During study period out of total 10215 unnatural Death cases death due to burn injuries was 1911. These cases brought to the Department of Forensic Medicine, IMS, BHU, Varanasi. Thermal burn injuries were averaging 18.65%. Female burn deaths dominated over male in the ratio of 3.52:1. Predominant age group found to be 21-30 years (48.72%) followed by age group 11-20 (23.11%). Most of the deceased were from the married group (63%) followed by unmarried (15%). Manner of burn death was unknown in most of the cases (96.86%) followed by accidental burn deaths (2.98%) suicidal (0.1%) and homicidal (.05%). Involvement of rural population is more 92.78% than urban population (6.49%). Religion wise Hindu (96.70%) predominated over other religions.

Key Words: Unnatural death; Dowry death; Burn injuries; Executive Magistrate

Introduction:

Man has invented fire since time immortal. The use of fire in various aspects has not only added to his comforts but also added to his misuses by increasing the risk of burns. Fire was perhaps man's first double-edged sword, evidenced throughout history; it has served as well as destroyed mankind. [1]

Burn injuries are dry thermal injury caused due to contact with dry heat such as flame, radiant heat or some heated solid substance like metal or glass, to the body surface. [2] Mammalian tissue can survive only within a relatively within narrow range of temperature, 22-44°C. [3] Thus burning usually occurs due to contact with flame it may be caused due to contact with hot metal or any other hot solid or hot liquid. The severity of burning extremely depends on the degree of heat, period of exposure, intensity of heat and age of the person. Burn deaths have tremendous medico-legal importance as they may be considered to be the commonest cause of unnatural deaths in India.

Often, the manner of burns is closed in mystery, and unreliable statements. The reason behind this action may be personal, domestic, occupational or social tragedy and more recently dowry deaths. Married female burn death where death of female occurs below 30 year and within seven years of her marriage such death cases investigated by Magistrate under 176 Cr.P.C (Dowry death) and other female burn and male burn deaths as routinely investigated by police as per section 174 of Cr.P.C.

In India below 7 year married female burn deaths are linked with Dowry death, where a young married women attempt or commits suicide in consequent to their being subjected to harassment by their husband or in-laws or his relative or cruelty constitute the offence of Dowry death, a monstrous social evil is widely prevalent and deep rooted in society in spite of most of the awareness programmes but this is due to adequate legal system but her implementation and administration are not stringent. [4]

Autopsy has previously been shown to be a useful retrospective diagnostic tool; however we challenge its reliability as a result of our study. [5] Social Forensic Message is Safety first in fire situations and always x-ray burnt human remains. Scene Visit As indicated and felt necessary and crime Scene evaluation report by Police as necessary. [6]

A burn injuries death is very painful but what compels or in what circumstances women or men commits suicide or homicide or those accidentally burned but most heinous is burning

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of newly married women i.e. homicidal burning. In this respect it is very difficult to find out the manner (Suicidal, Accidental and Homicidal) of burn injuries that in what circumstances the burn injuries took place, it can only be possible by meticulous investigation of scene of crime and interrogation of person concerned.

Aims and Objectives:

To find out how dry thermal burn affect incidence, age, sex, habitat, marital status, religious, manner of death and its medico-legal consequence.

Material and Method:

Present retrospective study was carried out on the unnatural burn death cases brought by police to the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, from Varanasi itself and nearby districts and western part of Bihar and Madhya Pradesh for treatment then if death at Varanasi in different hospital occur then the dead body after inquest send to institute of medical science Banaras Hindu university for medico-legal autopsy examination.

Study data was collected from autopsied record register for the duration from 1st January 2009 to 31st December 2013.

During this period out of 10215 medico-legal post-mortem conducted and total 1911 burn death cases were recorded. Data was analyzed retrospectively in respect of incidence of burn deaths in five consecutive year, age group, sex habitat of death religion factor, manner of death and other relevant data.

Observation and Results:

In our study total thermal burn death 1911 (18.71%) of total autopsy 10215 was conducted and the distribution of cases of the total unnatural deaths and thermal burn death reported during the 5 year study period from 2009 to 2013 deaths due to burn injuries were 17.82%, 17.70%, 17.83%, 20.56%, 19.49%, respectively (and average 18.65% per year).

It was more or less steady trend which is almost static. (Table 1) Male comprised of 22.14% of total burn death. Female (77.86%) preponderance was seen in burning with male female ratio equal to 1:3.52. (Table 2)

In present study maximum of the victims of burn deaths were in the age group 21-30 year followed by 31-40 years in the 5 year. Most of the victims of burn deaths were recorded at 21-40 year, which is more than half of the total burn death with peak incidence at 21-30 year (48.72%). Extremes of ages are least involved as compared to adult age group. (Table 3)

In this study married female (81.13%) outnumbered the unmarried female (17.27%), in male unmarried 8.51% outnumber the 0.47 % married male. (Table 4) Regarding marital status and manner of death most of the victims died of unknown manner (83.31%) and are married followed by unmarried group (12.27%).

Accidental unmarried (51%) were more than accidental married (1%), homicidal, suicidal are not differentiated. (Table 5) In our research manner of death in 96.86% case were unknown, accidental in 2.98%, suicidal 0.10% and homicidal 0.05%. (Table 6)

Majority of studied victims (92.78%) were from rural area, 6.49% are from urban area and 0.73% case for which locality is unknown. (Table 7) In this study majority of the burn victims case (96.7%) were Hindu and 2.7% are Muslims but 0.57% of unknown case and their religion was not known. (Table 8)

Discussion:

Incidence of burn death on the basis of 5 consecutive year 2000 to 2013 among cause of total death 10215, death due to burn 1911 which is 2nd most common cause of death after road traffic accident, it is due to more contact with heat. Other studies also similar to this showed burn is major cause of death. [7]

Analysis of sex record in present study showed that female (77.86%) superseded than male (22.14%) i.e. male: female ratio 1:3.52, other study similar to this that female predominate than male. [7, 11-13]. But Mostafa M. et al study was contrast to this i.e. male predominates than female. [8]

As the female burn deaths reported to Police irrespective of its manner and registered under 304B IPC (Dowry death) all the family members of in-laws side alleged in causing death of female are arrested and send to jail. [2]

In our study 21- 30 year is the most commonage group affected by burn death (46%) followed by 21-11 year (21%) with preponderance of female similar to other authors. [7, 10]

The high mortality in this age group 21-30 year can be due to young adolescent in this age group fail to stand the stress of examination and job failure. Present study showed that married female burn death more common than unmarried females and males other study also find similar result i.e. housewives were more common. [7, 11]

Among known manner of death accidental manner was more common than homicidal and suicidal, which are very less number, consistent with others findings. [13-15]

Regarding manner of death most of the case was due to unknown manner and homicidal, suicidal and accident are less number because no adequate criteria for such differentiation during autopsy but they can be differentiated by investigation and inquiry of case regarding fact.

In our study most of the burn death were from rural locality (92.78%) than urban locality other study also find that rural burn death predominant than urban. [13] But Rahul Chawla et al study is contrast to this and showed that urban area much more common than rural. [7]

We also found that majority of the burn death victim were Hindu and only 2.72% belong to Muslim, reason behind it was the Hindu dominant population. These findings confined to other study also. [9, 15]

Conclusion:

- Dry thermal burn death is the 2nd most common cause of death after road traffic death. Male female ratio is equal to 1:3.52.
- 21 to 30 year is the most common cause of burn death (46%) followed by 21 to 11 year (21%).
- Married female burn death more common than unmarried females.
- Regarding manner of death most of the case are unknown manner and homicidal, suicidal and accident are less number.
- Majority of studied victims 92.78% were from rural area.
- Majority of the burn victim's death on the studied case i.e. 96.70% were Hindu.

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Table1: Incidence of Burn Deaths in Medico-legal Autopsy from 2009 to 2013

Year	Total Autopsy Case (%)	Thermal Burn Death (%)
2009	1986(19.44)	354(17.82)
2010	2045(20.01)	362(17.70)
2011	1974(19.32)	352(17.83)
2012	2081(20.37)	428(20.56)
2013	2129(20.84)	415(19.49)
Total	10215(100)	1911(100)

Table 2: Sex wise Distribution of Burn Case

Year	Male (%)	Female (%)	Total (%)
2009	101(23.88)	252(16.94)	353(18)
2010	69(16.31)	293(19.69)	362(19)
2011	70(16.55)	283(19.02)	353(18)
2012	99(23.4)	329(22.11)	428(22)
2013	84(19.86)	331(22.24)	415(22)
Total	423(22.14)	1488(77.86)	1911(100)

Table 3: Age and Sex Wise Distribution (2009 To 2013)

Age Grps (yrs)	Male (%)	Female (%)	Total (%)
0-10	20(5)	44(2.6)	64(3)
11-20	62(15)	344(23.11)	406(21)
21-30	158(37)	725(48.72)	883(46)
31-40	101(24)	244(16.39)	345(18)
41-50	41(10)	66(4.43)	107(6)
51-60	23(5)	26(1.74)	49(3)
61-70	14(3)	24(1.61)	38(2)
>71	4(1)	15(1.0)	19(1.0)
Total	423(100)	1488(100)	1911(100)

Table 4: Marital Status of Burn Death Cases

Marital Status	Male (%)	Female (%)	Total (%)
Married	2(0.47)	1207(81.13)	1209(63)
Unmarried	36(8.51)	257(17.25)	293(15)
Unknown	385(91.01)	24(1.62)	409(21)
Total	423(100)	1488(100)	1911(100)

Table 6: According to Manner of Death

Manner	Frequency	%
Accident	57	02.98
Homicidal	1	00.05
Suicidal	2	00.10
Natural	Nil	nil
Unknown	1851	96.86
Total	1911	100

Table 7: According to Habitat Rural and Urban

Habitat	Frequency	%
Rural	1773	92.78
Urban	124	06.49
Unknown	14	00.73
	1911	100

Table 8: According to Religion

Religious	Frequency	%
Hindu	1848	96.70
Muslim	52	02.72
Christian	Nil	Nil
Unknown	11	00.58
	1911	100

**Table 5
According to Marital Status and Manner of Death**

Marital status	Manner of Death					Total (%)
	Accident (%)	Homicidal	Natural	Suicidal	Unknown (%)	
Married	1(2)	Nil	nil	Nil	1208(65)	1209(63)
Unmarried	51(89)	Nil	nil	Nil	242(13)	293(15)
Unknown	5(9)	1	Nil	2	401(22)	409(21)
Total	57(100)	1	Nil	2	1851(00)	1911(100)

Original Research Paper

Sex Determination from Anthropological Measurements of Thyroid Cartilage in the Population of Punjab

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Abstract

In the era of nanotechnology, with the advancement of scientific technologies, the extraordinary task of establishing identity of an individual has been simplified in the developed countries. However the application of such modern technologies in developing countries is still a distant dream owing to its affordability. In such countries, anthropometric analysis for the identification of unknown bodies is comparatively fruitful and cost effective. The aim of this study was to correlate the anthropological measurements of the thyroid cartilage with the sex of the individual. Thyroid cartilages from 300 cases of Punjab population were studied. A total of seventeen parameters were measured in each thyroid cartilage and the observations were compared between both sexes. Significant difference between two groups was found only in six variables (length of right and left thyroid lamina, breadth of right and left thyroid lamina, ventral thyroid height and angle between thyroid laminae). Discriminant function equation for determination of sex with group centroid value for each gender group was obtained. The measurements were again cross validated with the obtained discriminant function equation and further classified into male and female groups with a success rate of 92.3%.

Key Words: Thyroid cartilage, Anthropological measurements, Sex, Discriminant analysis

Introduction:

Establishing the identity of an individual is the need of the hour in various medico-legal cases and it is the duty of the Forensic expert in establishing the same in a given case scenario.

The various parameters for establishing the identity of an individual that are in current practice are Age, Sex, Height, weight, Race, Religion, caste, General configuration, Congenital peculiarities, Dactylography, Anthropometry, Acquired and personal peculiarities, Photographs, Superimposition test and D.N.A finger printing.

Of these, sex determination of an individual is one of the most basic requirements for establishing the identity of the individual.

Currently most of the studies have relied on the anthropological measurements of long bones for identifying the sex of an individual.

Very few studies [1-10] have compared the anthropometric measurements of thyroid cartilage with the sex of an individual.

It has an added advantage of being present in a superficial anatomical location and does not require tedious process like removal and preparation as in case of any other long bone. The aim of this study was to determination of sex from the anthropometric measurements of the thyroid cartilage.

Materials and Methods:

This was a prospective analytical Study conducted from July 2012 to December 2013 in department of Forensic Medicine, PGIMER, Chandigarh. With a valid informed consent of the legal heirs of the deceased, a total of 300 cases of both genders were studied as per the inclusion and exclusion criteria. Cases above the age of 18 years and Residents of Punjab having at least two generation ancestors from Punjab were included in this autopsy based study.

Cases with traumatic injury to thyroid cartilage, advanced decomposition changes and with discrepancy in history related to residing place were not excluded from this study.

Anthropometric Evaluation:

Layer by layer dissection of the neck was carried out at autopsy and thyroid cartilage was removed with great care avoiding damage to the superior and inferior horns. Manual removal of all the gross attachments was

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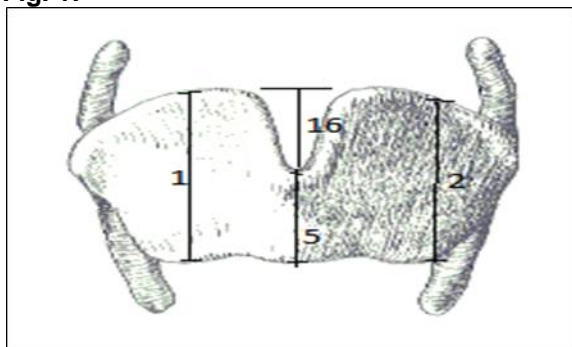
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DOR: 28.05.2014 DOA: 24.06.2014

attempted followed by soaking in warm caustic soda solution until all the remaining muscular and ligamentous attachments were sloughed off.

After completely clearing the attachments on the dissected thyroid cartilage, the following 17 parameters were measured with the help of thread, Vernier calliper and goniometer either singly or in combination. (Table 1, Fig. 1, 2 & 3)

Fig. 1:



Statistical Evaluation:

Statistical analysis was done using IBM SPSS Statistics Version 20 software package. A P value of 0.05 was considered statistically significant. Gender wise correlation of all anthropometric measurements was done based on student t-test statistics.

Discriminant analysis was conducted between variables which showed significant difference between two genders. Group centroid values for each gender groups and discriminant equation for further prediction of group membership were determined.

Fig. 2&3

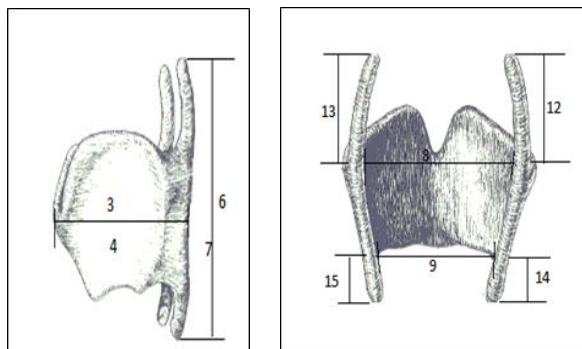


Table 1
Points of Measurement for Each Parameter of Thyroid Cartilage and Instruments Used for Measurement (Fig. 1-3)

S N.	Parameter	Point of measurement -1	Point of measurement -2	Instrument used
1	Length of right thyroid lamina	Midpoint of upper border of right thyroid lamina	Midpoint of lower border of right thyroid lamina	Vernier calliper
2	Length of left thyroid lamina	Midpoint of upper border of left thyroid lamina	Midpoint of lower border of left thyroid lamina	Vernier calliper
3	Breadth of right thyroid lamina	Anterior thyroid prominence	Midpoint of posterior border of right thyroid lamina	Vernier calliper
4	Breadth of left thyroid lamina	Anterior thyroid prominence	Midpoint of posterior border of left thyroid lamina	Vernier calliper
5	Ventral thyroid height	Deepest point of Superior thyroid incisures	Prominent point of Inferior thyroid incisures	Vernier calliper
6	Dorsal right thyroid height	Tip of right superior horn	Tip of right inferior horn	Thread, Vernier calliper
7	Dorsal left thyroid height	Tip of right superior horn	Tip of right inferior horn	Thread, Vernier calliper
8	Upper thyroid breadth	Outermost point of base of right superior thyroid horn	Outermost point of base of left superior thyroid horn	Vernier calliper
9	Lower thyroid breadth	Outermost point of base of right inferior thyroid horn	Outermost point of base of left inferior thyroid horn	Vernier calliper
10	Maximum thyroid Breadth at superior thyroid tubercle.	Outermost prominent point of right superior tubercle	Outermost prominent point of left superior tubercle	Vernier calliper
11	Maximum thyroid Breadth at inferior thyroid tubercle.	Outermost prominent point of right inferior tubercle	Outermost prominent point of left inferior tubercle	Vernier calliper
12	Length of right superior horn	Tip of right superior horn	Base of right superior horn	Thread, Vernier calliper
13	Length of left superior horn	Tip of left superior horn	Base of left superior horn	Thread, Vernier calliper
14	Length of right inferior horn	Tip of right inferior horn	Base of right inferior horn	Thread, Vernier calliper
15	Length of left inferior horn	Tip of left inferior horn	Base of left inferior horn	Thread, Vernier calliper
16	Depth of superior thyroid notch	Highest level of thyroid lamina	Deepest point of superior thyroid notch	Vernier calliper
17	Angle of thyroid	Posterior surface of right lamina	Posterior surface of left lamina	Goniometer

Results:

Out of the 300 samples of thyroid cartilage analyzed, 238 belonged to males and 62 were females. The age at death in males

ranged from 18 to 80 years with a mean of 39.24 yrs. (S.D= 13.63). In females, age at death ranged from 18 to 80 years with a mean of 40.95 yrs. (S.D= 16.35).

The mean values of all the anthropometric measurements in males were correspondingly higher than the mean values of female, except for depth of superior thyroid notch and angle between thyroid laminae. (Table 2, 3, 4) The mean depth of superior thyroid notch was higher in females (10.71) when compared with that of males (10.21) though the difference was not statistically significant. (Table 4) The mean angle between thyroid laminae was also higher in females (87.53) when compared to males (83.88). (Table 4)

A significant difference ($p < 0.05$) between the values of both groups were found only in six variables namely length of right thyroid lamina (LRTL), Length of left thyroid lamina (LLTL), Breadth of right thyroid lamina (BRTL), Breadth of left thyroid lamina (BLTL), Ventral thyroid height (VHT) and Angle between two thyroid lamina (ANGLE). These six variables were further utilized for discriminant analysis for determination of sex.

Discriminant Function Analysis undertakes the same task as multiple linear regression analysis by predicting an outcome. The main purpose of a discriminant function analysis is to predict group membership based on a linear combination of the variables. In our study the discriminant function equation obtained was

$$D = 0.720(LRTL) - 0.358(LLTL) + 0.035(BRTL) + 0.080(VHT) - 0.007(ANG) - 11.379$$

A way of interpreting discriminant analysis results was to describe each group in terms of its profile, using the group means of the predictor variables. In our study, females had a group mean of 1.960 while males had a group mean of 0.511. Cases with scores near to a group means were predicted as belonging to that group. All the data of each variable were applied in discriminant function equation and the output compared with the group centroid values and again classified. With the discriminant function analysis, we were able to classify 92.3% of original data correctly.

Discussion:

Out of the 17 anthropological parameters of the thyroid cartilage studied in the present study, majority of the parameters measured greater in males except for the angle of thyroid and depth of superior thyroid notch.

The mean values of these two parameters were found to be more in females than males. The angle of thyroid lamina was found to be more in females in present study (male 83.88, female 87.53). This was consistent with the findings of the studies conducted by

Ajmani et al [2, 10], Harjeet and Jit [3], Sprinzi et al [5], Pereira et al [7] and Monica and Dhall. [8]

In present study the length of superior thyroid horn was more in males than females. This fact was consistent with other studies conducted by Harjeet and Jit [3], Sprinzi et al [5], Zielinski R [6] and Monica and Dhall. [8] It was conflicting with the studies conducted by Ajmani et al [10], Ajmani et al [2] and Eckel et al [4]

The studies of Ajmani et al [2] and Eckel et al [4] were conducted in Nigeria and Germany respectively. The difference in the geographical location of these studies can be hypothesized to be the reason for the greater length of superior thyroid horn in females. In Ajmani et al [10] study, the total number of samples was 150 with age of samples ranging from 16 to 55 years, whereas in the present study the sample size was 300 with the age ranging from 18 years to 80 years. Moreover in the present study there were 60(25%) samples whose ages were above 55 years. The difference in the sample size as well as the wide age range of the present study could have led to the differences in observations in comparison with other studies.

The depth of superior thyroid notch in present study though not significant was slightly on higher side among females. This observation was not consistent with the studies conducted by Ajmani et al [10], Ajmani et al [2], Harjeet and Jit [3], Eckel et al [4], Zielinski R [6] and Monica and Dhall. [8] The difference in geographical location, the sample size and age range of samples can be attributed to difference in the observations between previous studies and the present study. (Table 6)

Conclusion:

In the era of nanotechnology, with the advancement of scientific technologies like DNA fingerprinting, the extraordinary task of establishing the identity of an unknown individual has been simplified in the developed countries.

However in many developing countries, application of such modern technologies is still a distant dream owing to its affordability. In such countries, anthropometric analysis for the identification of unknown bodies is comparatively fruitful and cost effective.

As per the present study, the sex of any individual, which proves to be a primary data for establishment of identification, can be determined from a single cartilage, which is comparatively easy to study. It has an added advantage of being present in a superficial anatomical location and does not require tedious process like removal and preparation as in case of any other long bone.

Thus to conclude, in the present study all the measurements of thyroid cartilage were more in males than females except for the depth of superior thyroid notch and Angle between thyroid laminae.

Discriminant equation for determination of sex with group centroid values for each gender was derived for all the parameters showing significant gender differences. All the data were further cross validated and classified again with the derived discriminant equation with a success rate of 92.3 %.

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Table 5: Mean Length of Superior Thyroid Horn among Different Genders and Its Comparison with Other Studies

	Male (mm)	Female (mm)
Present study	16.36	15.90
Harjeet and Jit [3]	14.07	12.04
Sprinzl et al [5]	9.0	6.4
Zielinski R [6]	21.5	19.5
Monica and Dhall [8]	19.10	13.10
Ajmani et al [10]	15.40	16.10
Ajmani et al [2]	20.70	20.92
Eckel et al [4]	12.90	13.10

Table 6: Mean Depth of Anterior Thyroid Notch among Different Genders and its Comparison with Other Studies

Studies	Male (mm)	Female (mm)
Present study	10.21	10.71
Ajmani et al [10]	9.50	6.40
Ajmani et al [2]	11.68	10.20
Harjeet and Jit [3]	11.87	8.28
Eckel et al [4]	9.00	6.40
Zielinski R [6]	10.55	9.70
Monica and Dhall [8]	11.20	9.70

Table 2
Gender-Wise Anthropological Measurements of Thyroid Cartilage Measurements

Sex		LRTL (mm)	LLTL (mm)	BRTL (mm)	BLTL (mm)	VHT (mm)	DRRTHT (mm)
Male	Mean	27.42	27.43	36.50	36.48	16.48	34.85
	SD	±2.47	±2.49	±7.56	±7.49	±2.90	±7.59
Female	Mean	21.58	21.58	32.44	32.52	14.04	34.41
	SD	±2.75	±2.82	±8.18	±8.21	±2.20	±8.39
t value		17.647	8.789	3.699	3.628	7.218	0.392
P value		0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.695

L RT L - Length of right thyroid lamina, L LT L - Length of left thyroid lamina, B RT L - Breadth of right thyroid lamina, B LT L - Breadth of left thyroid lamina, V HT - Ventral thyroid height, DR RT L - Dorsal right thyroid height

Table 3
Gender-Wise Anthropological Measurements of Thyroid Cartilage Measurements

Sex		DRLTHT (mm)	UBR (mm)	LBR (mm)	BSTB (mm)	BITB (mm)	RTSHR (mm)
Male	Mean	34.87	45.76	38.70	45.74	29.52	16.11
	SD	±7.66	±7.51	±5.96	±7.61	±5.29	±4.55
Female	Mean	34.58	45.39	38.54	45.37	29.27	15.80
	SD	±8.61	±8.64	±7.77	±8.68	±6.20	±4.97
t value		0.262	0.304	0.148	0.308	0.296	0.460
p value		0.794	0.762	0.883	0.759	0.768	0.646

DR LT L - Dorsal left thyroid height, U BR -Upper thyroid breadth, L BR - Lower thyroid breadth, BR S TB - Maximum thyroid Breadth at superior thyroid tubercle, BR I TB - Maximum thyroid Breadth at inferior thyroid tubercle, RT S HR - Length of right superior horn

Table 4
Gender-Wise Measurements of Different Thyroid Cartilage

Sex		LTSHR (mm)	RTIHR (mm)	LTIIHR (mm)	DEPTH (mm)	ANGLE (deg)
Male	Mean	16.62	10.37	10.38	10.21	83.88
	S.D.	±4.70	±2.67	±2.59	±3.45	±11.38
Female	Mean	16.00	9.80	9.79	10.71	87.53
	S.D.	±4.52	±2.47	±2.42	±2.87	±12.89
t value		0.924	1.522	1.605	1.157	2.183
p value		0.350	0.129	0.110	0.250	0.030*

LT S HR - Length of left superior horn, RT I HR - Length of right inferior horn, LT I HR - Length of left inferior horn, DEP - Depth of superior thyroid notch, ANG- Angle between two thyroid lamina

Original Research Paper

Perceptions of Relatives' towards Medico-Legal Investigation and Forensic Autopsy: A Survey from Rural Haryana

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Abstract

Currently a greater emphasis is being placed on the active participation of patients and their families; it is time that the attitude and feelings of the families with regard to autopsies are investigated. Therefore present study was planned with an objective to analyze deceased family member's attitudes towards medico-legal investigation and Forensic autopsy. An additional objective was to determine factors influencing autopsy refusal by relatives of the deceased. 200 family members or relatives were selected randomly from the list of address and contact number prepared from the autopsy cases from 2010 to 2012. Data of 165 was processed and analyzed. 30.9% of the respondents had a primary level of education while 35.2% of them were illiterates. A high proportion of study subjects considered that autopsy would result in visible disfigurement of the body. Involvement of police/ court (92.1%), no use in knowing the cause of death/ nature of death (88.6%) and autopsy delays funeral (83.4%) were three top most causes responsible for autopsy refusal by family members or relatives of the deceased. The experience and opinions of relatives and family members can be utilized in more effective management of medico-legal cases.

Key Words: Autopsy, Family members, Perceptions, Medico-legal

Introduction:

Autopsy is an indispensable research tool which has been used for centuries. It is of two types: Forensic or medico-legal and clinical or academic autopsies. Forensic autopsy is medico-legal investigation of cases of unnatural and unexplained deaths. This procedure is still under the umbrella of misconceptions, myths, and emotions by the lay people as well as by the physicians. [1] In India, by law, Forensic or medico-legal autopsy is carried out without the consent of the relatives.

In such a scenario response of relatives can vary greatly. Investigation into the experiences of next of kin will help both family and Forensic expert to deal with the borderline situations which are so often encountered. [2, 3]

A recently expressed opinion states that autopsy is not something which should be done as a favour to the family, but more something to which the family has a right, of which they should be informed. [4] Currently a greater emphasis is being placed on the active participation of patients and their families; it is time that the attitude and feelings of the families with regard to autopsies are investigated. [5]

The experiences of deceased family members will teach Forensic fraternity how to handle an autopsy. Therefore present study was planned to conduct with an objective to analyze and ascertain deceased family member's attitudes towards medico-legal investigation and Forensic autopsy. An additional objective was to determine factors influencing autopsy refusal by relatives of the deceased.

Materials and Methods:

The present cross sectional survey was conducted in the Department of Forensic Medicine, MM Institute of Medical sciences during May 2011 to April 2012. The study population consisted of relatives or family members of deceased whose autopsy had been

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performed at the MM Institute of Medical sciences, and that the relatives or family members of the deceased were available.

List of address and contact number was prepared for all the cases on which autopsy was performed from 2010 to 2012. A sample of 200 study subjects was chosen from the list randomly and their family members or relatives were approached. The author visited the household of the deceased to conduct a verbal interview after 3-4 month of autopsy

If a telephone number was available, an advance appointment was made with an appropriate respondent. 18 families could not be traced and contacted hence excluded from the study. Out of 182 families with whom contact, was made, 17 of them did not consent for the participation in the study, were again excluded from study. Finally 165 study subjects participated in the study.

115 family members or relatives accepted that they were not willing for autopsy (Group A) and it was forcibly conducted against their wish and remaining 50 family members or relatives were in the view that autopsy was conducted with their wish (Group B).

Written informed consent was obtained in the local language from every study subject before conducting each interview. They were explained about the nature and purpose of study and requested to participate. To obtain consent, contents of the consent information sheet were read out loud to each respondent, who was given the opportunity to ask the questions.

Results:

Out of 200 study subjects approached, data of 165 was processed and analyzed.

Majority (79.4%) of the respondents were in the age group of 30-50 years. 88.4% of the study subjects were males. Most (80.6%) of them were Hindus. 30.9% of the respondents had a primary level of education while 35.2% of them were illiterates. Out of total 165 autopsied cases, 27 were homicidal, 8 were natural death cases, 98 were accidental cases and remaining 32 were suicidal cases.

Almost 63% and 86% respondents from Group A and Group B respectively correctly said that autopsy will tell us the exact cause of death and the difference was found to be statistically highly significant ($p < 0.001$). A high proportion of study subjects appeared to have a fair understanding of the technical aspects of autopsy, but many considered that autopsy would result in visible disfigurement of the body. Very few i.e. 7% from Group A and 22% from

Group B correctly said that autopsy does not involve court in all the cases.

The difference was found to be statistically significant ($p < 0.05$). (Table 1) Involvement of police/ court (92.1%), no use in knowing the cause of death/ nature of death (88.6%) and autopsy delays funeral (83.4%) were three top most causes responsible for autopsy refusal by family members or relatives of the deceased. 80.0% relatives denied out of fear of disfigurement of body. Refusal on religious ground was least common reason cited by them. (Table 2)

Discussion:

A good number of relatives were interested in knowing the exact cause of death. They were in the view that, knowing the exact cause of death would help them in coping with the catastrophic, unfortunate bereavement of their beloved. The majority of these relatives were literate, and in their view incomplete information about the circumstances of death of their loved one caused them greater apprehension and agony.

Regarding the purpose of autopsy, almost 30% were not able to state any reason for it. Another study from Delhi reported a little lesser proportion of people i.e. 21% was not able to tell the purpose of autopsy. [6] It is very much evident that the awareness level among general public in this geographical area is not as good as national capital Delhi.

Lower literacy rate and awareness among the general public, might be responsible for above finding. The most suitable way to change public perception of autopsy is through education. Media can be used as an effective tool for such educational programme. Another study [1] is also in cohort with our observations.

More than 90% of the relatives of deceased patients refused to consent to autopsy because of fear of involvement of police and court. Majority of the relatives complained of the casual and indifferent attitude of police personnel. In general, somehow they were not comfortable with the police personnel.

Herein lays the importance of way of interaction with members of such families. Training police personnel, the significance of dissemination of adequate information to the affected family members will definitely help in betterment of existing situation.

It was observed in our study that concern about mutilation of the body was the reason cited by eighty percent relatives of deceased patients for refusal to consent to autopsy. It was similar to that found in a study

from Zambia [7], China [8] and Sweden. [9] A similar finding was recorded by McPhee et al in his study on clinical autopsy. [3]

Above finding showed that such concerns about autopsy cut across cultures and races. Furthermore, it is often a layman's perception of the autopsy. The autopsy, however, is a scientific procedure during which utmost consideration is given to prevent the disfigurement of the body. This observation also buttresses the need to step up the public education about the autopsy.

This study has several strengths. First, we have compared the knowledge and awareness among the family members or relatives who were not willing for autopsy and among those who were willing.

According to our knowledge comparison of this aspect has not been closely investigated by the experts in the field. No similar experience is available in the literature. Second, families were chosen randomly which provide protection against selection bias. Third, all the interviews were conducted by single person which creates a sense of uniformity.

The study has some limitations as well. First, some may argue that the results obtained may not be applicable to the general population as baseline data like income, literacy, gender distribution and other socio-demographic-cultural factors tend to vary in different geographical areas. Second, such a community-based study is always susceptible to recall bias.

Conclusion:

The findings of the study highlight the importance of delivery of the sufficient relevant explanations and information to the family members and relatives' in improving the acceptance and giving consent for autopsy.

The experience and opinions of relatives and family members can be utilized in more effective management of medico-legal cases.

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Table 2: Factors Influencing Autopsy Refusal by Family Members or Relatives of the Deceased

Reasons cited for refusal of autopsy	N ⁺ (Percentage)
Fear of disfigurement of body	92 (80.0)
Delays funeral	96 (83.4)
Autopsy is certainly not going to bring them back	89 (77.3)
autopsy would disturb the peace of the deceased person/disturb peace of deceased	89 (77.3)
No use in knowing the cause of death/ nature of death	102 (88.6)
Involvement of police/ court	106 (92.1)
Lack of adequate information on reason for autopsy given by police/ doctors	88 (76.5)
Religious objections	26 (22.6)
Concerns about removal of organs or part of the body	75 (65.2)
Lack of feedback on results of autopsy	69 (60.0)

⁺Response from 115 family members or relatives (Group A) who were not willing for autopsy and it was forcibly conducted against their wish.

Table 1
Knowledge and Perceptions of Family Members or Relatives of the Deceased about Autopsy

Do autopsy involve any of the following?	Correct response from Group A ⁺ N (%age)	Correct response from Group B ⁺⁺ N (%age)	P value
Will autopsy tell you the cause of death	72 (62.6)	45 (86.0)	0.0003**
Is autopsy is examining outside of the body	93 (80.8)	43 (86.0)	0.42
Is autopsy is examining inside of the body	108 (93.9)	48 (96.0)	0.58
Is autopsy is examining the brain, heart, lung etc	61 (53.1)	23 (46.0)	0.40
During autopsy Blood tests are done	32 (27.8)	22 (44.0)	0.04*
During autopsy x rays are taken	26 (22.6)	12 (24.0)	0.85
Post-mortem means visible disfigurement of the body	22 (19.1)	16 (32.0)	0.07
Post-mortem Involves police in all cases	110 (95.6)	41 (82.0)	0.003*
Post-mortem involves going to court in all cases	8 (6.9)	11 (22.0)	0.005*
Autopsy means removing organs from body	36 (31.4)	6 (12.0)	0.008*
Autopsy will emit foul smell	39 (33.9)	24 (48.0)	0.09
Post-mortem will delay in funeral	19 (16.5)	19 (38.0)	0.002*

⁺Group A- 115 family members or relatives who were not willing for autopsy and it were forcibly conducted against their wish.
⁺⁺Group B- 50 family members or relatives were in the view that autopsy was conducted with their wish. *p<0.05 (Significant), **p<0.001 (Highly Significant)

Original Research Paper

Estimation of Postmortem Interval by Measuring Potassium Level in Vitreous Humour

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Abstract

Establishing the postmortem interval is one of the difficult challenges faced by forensic experts, particularly when limited information about deceased is available. Various methods have been tried to find out the time of death. These include study of physical, chemical, biochemical, histological and enzymatic changes which occur progressively in dead body. The chemical changes to determine the postmortem interval have been increased largely in the last few decades, which are based on changes occurring in the body immediately or shortly after death. These changes occur in various body fluids such as whole blood, serum, CSF, aqueous and vitreous humour. In this study vitreous humour potassium concentration were investigated to predict postmortem interval. In this study we have observed linear rise of vitreous potassium (K^+) ion concentration with increasing post-mortem interval that was both arithmetic as well as logarithmic (statistically) significant. No significant differences existed for vitreous potassium concentration in the same pair of eyes at identical post-mortem interval. Factors like age, sex, cause of death and environmental temperature did not influence the vitreous humour potassium values.

Key Words: Postmortem interval, Vitreous humour, Potassium

Introduction:

Estimation of time since death is an important part of medico-legal inferences drawn after post-mortem examination. But in reality, it is extremely difficult because timing of onset and the rates of postmortem changes are usually governed by unpredictable endogenous and exogenous factors. [1]

In most cases in our country, time of death is usually estimated from the physical changes noticeable in the dead body. The analysis of body fluid such as vitreous, blood and CSF in relation to their postmortem chemical changes is a useful supplementary procedure. The present study was conducted in Bikaner with the aim to find out the correlation between potassium concentration in vitreous humour vis-a-vis post-mortem interval.

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DOR: 09.10.2014 DOA: 30.10.2014

Vitreous humour is selected because it is relatively stable, easy to sample during postmortem examination and its composition is quite similar to that of aqueous fluid, CSF and serum. It is relatively free from contamination by blood, bacteria and products of the postmortem autolysis. [2]

Aims and Objectives:

- To establish correlation between post-mortem interval and vitreous Potassium concentration.
- To detect difference between level of vitreous potassium concentration in right and left eye, if any.
- To deduce the rate of increase or decrease of vitreous Potassium concentration per hour.
- To derive co-efficient of correlation between postmortem interval and vitreous potassium concentration.
- To derive a formula for determination of postmortem interval within reasonable time limit by putting vitreous potassium concentration.
- Value of vitreous potassium concentration in relation to age, sex, temperature and cause of death.

Material and Methods:

The present study was carried out in Department of Forensic Medicine, in association

with Biochemistry Department of S.P. Medical College & Associate Group of Hospitals, Bikaner on medico-legal cases, which were admitted in S.P. Medical College & Associated Group of Hospitals, Bikaner and died subsequently. The information regarding time of death was collected from hospital records. The samples were taken immediately and send to Department of Biochemistry.

All the cases where the time of death was unknown or body in advanced stage of decomposition or the extracted sample became hemorrhagic or cases of ocular disorder or cases of head injury involving orbit or amount aspirated is less than 0.5 ml were excluded from this study.

The common methods available for vitreous humour biochemistry are spectrophotometer, auto analyzer and emission flame photo meter but here we used ELITE Electrolyte Analyser for estimating potassium level which uses ion selective electrode and is based on ion exchange phenomenon.

Observations and Results:

In this study 127 (63.5%) were males and 73 (36.5%) were females. (Table 1) The majority of cases were from trauma (43%) followed by poisoning (28.50%), Burn (25.50%) and natural death (03%) respectively. (Table 2)

The overall range of time since death was 0 to 72 hrs of studied cases and maximum number of cases were in the range between 12.1 to 24 hrs (37.50%) followed by 6.1 to 12 hrs (29.50%). None of the case was reported beyond 57 hrs of time since death. (Table 3) There was statistically insignificant correlation of vitreous potassium ion concentration in relation to various causes of death. (Table 4)

Discussion:

In this study we observed that there was considerable rise in the vitreous potassium level with increasing postmortem interval. (Table 5)

This linear relationship of the increase in vitreous potassium (K^+) concentration with increase in postmortem interval was both arithmetic and as well as logarithmic. So potassium (K^+) ion level measurement in vitreous humour, is one of the most accurate methods of estimating post-mortem interval.

This observation was supported by many workers [3-9] This course of rise in potassium level in vitreous was due to the autolysis of the vascular choroids and retinal cells of the eye which release substantial amount of potassium into vitreous humour. [10]

Hughes [11], Coe [12], Adjutantis and Coutselinis [13] found that rise of vitreous

potassium concentration with post-mortem interval was biphasic in which the slope of the first few hours after death was steeper than for more prolonged times after death which was not observed in this study.

In our study we have noticed linear rise of vitreous potassium concentration up to 57 hrs. We could not estimate potassium concentration beyond 57 hrs as none of the case in our study was reported after 57 hrs of post-mortem interval. We have calculated the following statistics:

1. Coefficient of correlation
2. Coefficient of regression
3. Regression equation

1. Coefficient of Correlation:

It was calculated using INDOSTAT software. The objective of this study was to assess the relationship between the Postmortem interval and potassium ion. The data showed that the coefficient of correlation for potassium (K^+) ion concentration in the vitreous humour was 0.831. This indicates high degree of correlation between postmortem interval and potassium (K^+) ion concentration of vitreous humour. Therefore postmortem interval can be calculated, if vitreous potassium (K^+) ion concentration is known.

2. Coefficient of Regression:

The coefficient of regression was calculated using same INDOSTAT software. The value of coefficient of regression was 3.46 meq/l/hr. It appears that 1meq/l potassium (K^+) ion concentration of vitreous increases in 3.46 hrs of postmortem interval.

3. Regression Equation:

The same was calculated by using INDOSTAT software. The regression equation for each variable is: **Post-mortem Interval = - 16.22 + 3.75 x K^+**

This study showed that there was no statistically significant difference in levels of vitreous potassium concentration between the two eyes of body. Our observations were similar to the other workers. [3, 11, 14, 15] Our findings were not consistent with the reports from Balasooriya et al [16], Madea et al [7] and Pounder et al [17] who found relevant differences between the two eyes.

Singh D et al [18] found that mean vitreous sodium/ potassium ratio was slightly more in left eye than in right eye. However this difference was found statistically insignificant.

In the present study we also could not find any relation between vitreous potassium (K^+) concentration and cause of death. Similar reports were given in the works of Hannson et al

[19], Balasooriya et al [16] and Ganesh Govekar et al [20] but this result was not consistent with Madea et al [7] who observed that sudden and traumatic death has better correlation between vitreous potassium (K^+) ion concentration and post-mortem interval.

We observed that age and sex factor has no appreciable role in the changes in level of potassium concentration in the vitreous humour after death. But Blumenfeld [4] found that the vitreous potassium level rise much more rapidly in the infants than in adults.

From this study it is evident that there was no effect of environmental temperature on the levels of potassium concentration in the vitreous humour after death. (Table 6) This observation was in agreement with the results of other workers. [4]

However Coe [12], Farmer [5] felt that higher environmental temperature at the time of death caused marked enhancement of the observed potassium values in the vitreous humour. Singh D [18] et al found that mean vitreous sodium/potassium electrolytes concentration ratio was more in winter than in summer. Coe [21] in his study observed that external and internal factors influence the post-mortem vitreous biochemistry.

The external factors are sampling techniques, instrumentation and the environmental temperature of the body during the postmortem interval.

The major internal factors possibly influencing the post-mortem vitreous biochemistry are the age of individual, the duration of terminal episode, manner of death and presence or absence of nitrogen retention.

Presently the use of post-mortem vitreous biochemistry for the Post-mortem Interval estimation has been limited because of the different conclusions reached by different workers and the lack of uniformity in their equations. So this topic needs further research to bring into use.

Summary and Conclusion:

From this study, We have observed linear rise of vitreous potassium (K^+) ion concentration with increasing post-mortem interval that was both arithmetic as well as logarithmic (statistically significant).

On the basis of computer assisted statistical analysis we have developed following statistics for potassium (K^+) ion concentration:-

- Coefficient of correlation was 0.831
- Coefficient of regression was 3.46 meq/l/hr which suggest that the rate of rise of

vitreous potassium concentration was 0.29 meq/l/hr.

- Regression equation is: Postmortem Interval = $-16.22 + 3.75 \times K^+$, Where K^+ = Potassium ion concentration in vitreous.
- Confidence limit = 7.6

No significant differences existed for vitreous potassium concentration in the same pair of eyes at identical post-mortem interval. Factors like age, sex, cause of death and environmental temperature did not influence the vitreous humour potassium values.

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Table 2: Cases According to Cause of Death

Causes of Death	Male (%)	Female (%)	Total (%)
Trauma	69(54.33)	17(23.28)	86(43.0)
Burn	20(15.74)	31(42.46)	51(25.5)
Poisoning	33(25.98)	24(32.87)	57(28.5)
Natural Death	05(3.93)	01(1.36)	06(03.0)
Total	127	73	200(100)

Table 1: Cases According to Age and Gender

Age groups (yrs)	Male	Female	Total (%)
0-10	03	01	04 (2.0)
11-20	23	12	35(17.5)
21-30	48	37	85(42.5)
31-40	27	12	39(19.5)
41-50	15	07	22(11.0)
51-60	05	03	08(4.0)
61-70	04	01	05(2.5)
71-80	01	00	01(.5)
81-90	01	00	01(.5)
Total	127	73	200(100)

Table 6: Comparison of Vitreous Potassium (K⁺) ion Concentration According to Temperature in Cases having Approximately Same Time since Death

Temp (°C)	Cases	Range K ⁺ Conc. (meq/l)	Mean ± SD
10-20	12	3.9 – 15.2	7.9 ± 3.39
20-30	18	3.9 – 10.2	6.8 ± 1.99
30-40	10	4.1 – 16.5	7.6 ± 3.66

**Table 3
Cases According to Time since Death and Cause of Death**

Time since death (hrs)	Causes of death				Total	%
	Trauma	Burn	Poisoning	Natural Death		
0-1	02	00	00	00	02	01.00
1.1-3	11	06	01	00	18	09.00
3.1-6	17	09	13	00	39	19.50
6.1-12	25	14	17	03	59	29.5
12.1-24	29	19	25	02	75	37.5
24.1-36	01	01	00	00	02	01.00
36.1-48	00	02	00	01	03	01.50
48.1-64	01	00	01	00	02	01.00
64.1-72	00	00	00	00	00	00
Total	86	51	57	06	200	100.00

**Table 4
Vitreous Potassium (K⁺) Ion Concentration vis-a-vis Cause of Death**

Cause of death	Trauma	Burn	Poisoning	Natural Death
No. of Eyes	172	102	114	12
Time since death (hrs)	K ⁺ concentration in meq/l			
0-1	4.10	-	-	-
1.1-3	4.30	4.40	4.20	-
3.1-6	5.40	5.70	4.90	-
6.1-12	7.10	7.00	7.10	7.30
12.1-24	8.50	8.80	8.40	8.10
24.1-36	11.90	12.20	-	-
36.1-48	-	13.90	-	14.30
48.1-72	16.80	-	16.60	-
>72	-	-	-	-

**Table 5
Levels of Vitreous Potassium (K⁺) ion in Different Age Groups vis-a-vis Postmortem Intervals**

Levels of Vitreous Potassium (K ⁺) Ion in Different Age Groups vs. a Vis Postmortem Intervals										
Age (yrs)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	Mean
No. of Eyes	8	70	170	78	44	16	10	2	2	
Time since death (hrs)	K ⁺ concentration in meq/l									
0-1	-	4.10	-	4.00	-	-	-	-	-	4.05
1.1-3	-	3.85	4.40	4.40	4.45	4.15	-	-	3.90	4.19
3.1-6	6.30	5.10	5.45	5.60	4.95	5.45	5.15	-	-	5.43
6.1-12	6.95	6.80	7.30	7.20	6.75	6.65	6.55	7.00	-	6.9
12.1-24	8.50	8.40	8.50	8.75	8.60	8.60	-	-	-	8.56
24.1-36	-	-	12.10	-	-	-	-	-	-	12.1
36.1-48	-	-	15.10	-	12.55	14.30	-	-	-	13.98
48.1-72	-	16.60	16.70	-	-	-	-	-	-	16.65
>72	-	-	-	-	-	-	-	-	-	

Table 8
Statistical Correlation of Vitreous Potassium (K⁺) Ion Concentration Reported By Various Workers

Workers	Statistical Parameters			
	Coefficient of correlation between (K ⁺) ion conc. and Postmortem Interval	Rise of Vitreous Potassium (K ⁺) conc. Up to	Rate of rise of vitreous Potassium (K ⁺) ion conc/ hour	Confidence limit (hrs)
Sturner et al (1964)	0.987	100 hours	Very Slow	+ 4.7 hours
Hughes (1965)	-	100 hours	-	+ 20 hours
Hansson (1966)	-	120 hours	0.17 meq/l	+ 20 hours
Adelson et al (1969)	-	24 hours	0.17 meq/l	+ 10 hours
Coe (1969)	-	24 hours	0.33 meq/l	+ 12 hours
Adjustantis & Coupselinis (1972)	-	12 hours	0.73 meq/l	+ 3.3 hours
Agarwal RL et. Al (1983)	0.985	24 hours	0.52 meq/l	+ 3.39 hours
Stephens & Richards (1987)	-	-	0.238 meq/l	+ 20 hours
Madea et al (1989)	-	120 hours	0.203 meq/l	+ 20 hours
Govekar et al (1990)	0.855	60 hours	0.15 meq/l	+ 5.70 hours
Present Study (2013)	0.831	57 hours	0.29 meq/l	+ 7.6 hours

Original Research Paper

Use of RTI Act, 2005 in Relation to Medical Ethics

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Abstract

Registration to the Medical Council is necessary before practicing the Noble profession almost throughout the world. In India, a medical graduate has to register either with State medical council or Medical council of India before starting practice. On registration, a number is issued to the registered doctor by the respective council which also provides certain rights & duties to the doctor.

As per Indian Medical Council Act 2002, a doctor shall mention his registration number on all the documents he/she issues viz prescription paper, receipts, bills, Medical certificates etc. Also, as per the Drugs Act 1945, it is required by anyone to write the registration number who is prescribing the drugs. Presently, it is seen that many doctors are unaware of these regulations.

The present study was done in view of writing Registration number by the doctors taking the advantage of Right to Information Act, 2005.

Key Words: Medical Ethics, Right to Information Act, 2005, Registration, AIIMS

Introduction:

Registration to the Medical Council is necessary before practicing the Noble profession almost throughout the world. In UK, a fresh medical graduate has to register with GMC [1], with Medical Licentiate in the US & with Australian Medical Council in Australia.

It is almost the same in almost every country. Similarly, in India, a medical graduate has to register either with State medical council or Medical council of India before starting practice. [2] On registration, a number is issued to the registered doctor by the respective council which also provides certain rights & duties to the doctor. [3] As per Indian Medical Council Act 2002, a doctor shall mention his registration number on all the documents he/she issues viz prescription paper, receipts, bills, Medical certificates etc. [3]

Also, as per the Drugs Act 1945, it is required by anyone to write the registration number who is prescribing the drugs. [4]

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Discussion:

The study was done in view to evaluate the status of doctors writing the registration numbers on all the documents they issue including prescription papers, reports & bills. In an attempt to start the study, the most prestigious institute of our country was considered first.

For the purpose of the study the prescription papers & other documents from the All India Institute of Medical Sciences, New Delhi (AIIMS) which is presently ranked as topmost Medical school of the country [5], were collected.

It was revealed from them that many of the doctors were not writing the registration number on their prescriptions. It was also found that in many of the prescription, even the name of the doctor was not written, and just the signature was there at the end.

On the basis of these papers, it was really difficult to say which doctor has seen the patient. The patient was completely unaware of the doctor who has seen him.

This is clearly a violation of Indian medical Council Act, Drugs Act as well as Medical ethics. Following this, a letter of request was send to the Director of AIIMS along with all the necessary documents as supporting proof. There was no reply from his office for over a month even on telephonically contact.

So, in view of this, a RTI was filled with the Public Information Officer under RTI Act, 2005 [6] enquiring about the status of letter send to the Director of the Institute. A reply was received from CPIO of the institute that the RTI

application along with the letter has been forwarded to the Sub Dean (Academics) who is also the CPIO in the case for reply & necessary action. Nothing was received more than this.

Further, even after expiry of statutory 30-35 days as explained in RTI Act, 2005 there was no reply from the concerned CPIO so a First Appeal was filled regarding the same to the Appellate Authority of the institute. The Appellate Authority forwarded the appeal to both the CPIOs to furnish the same within 10 days.

The First CPIO replied that he had already forwarded the application to the concerned CPIO so he is not liable to reply to the appeal. It was seen that there was only exchange of letters going on between the different departments but none of them was replying to any of the letters.

The time bound application to the Appellate Authority was not fruitful & no reply was received from the Appellate Authority other than this that the application has been forwarded & asked to reply the same.

So, keeping everything in view a second appeal was filled under RTI Act, 2005 to the Central Information Commission for getting answer to the queries regarding the writing of the registration no in the most prestigious institute of the country. Nearly after a month, a letter was received from CIC, New Delhi regarding the date fixed for hearing for the case.

Just after two days of this letter, a call was received from the office of Sub Dean (Academics) enquiring about the queries so that they can be answered by them at this stage after receiving notice from the CIC.

As interpreted from the same that this was not taken seriously till now until the interruption from CIC in the case.

Finally, on the day of hearing before Hon'ble Commissioner where the Registrar & PA to CPIO represented from the AIIMS side submitted that "even though the AIIMS does not fall within the jurisdiction of the MCI, action has already been taken on the Guidelines issued by MCI, by circulating the Memorandum one week back on "Registration in OPD card, Prescription and Certificate" to all Chiefs of Centers, all Heads of Departments and all Resident Doctors.

This includes the suggestion given by the Appellant in the light of the Drugs Act, 1945."

The appeal was disposed off by the Commissioner for the appropriate action taken by the AIIMS based on the RTI request. This proved the usefulness of RTI Act 2005 in medical care.

Summary:

The present study was designed in view of the Medical Ethics in the medical fraternity. It is important to write registration number issued by Medical Council of India/ State Medical Council as per the Indian Medical Council Act along with Drugs Act.

But as revealed the medical fraternity has lack of knowledge about the same.

The present study revealed the current practice of writing registration number in top most Medical institution of the country so an attempt was done to bring a change in the current practice of writing registration number on the documents issued by doctors so that Medical Ethics can be properly practices.

In this attempt, the advantage of Right to Information Act, 2005 was taken so that the proper action can be taken in light of appropriate laws.

Conclusion:

The Study takes the advantage of Right to Information Act, 2005 in the field of Medical Ethics in providing proper Health care to the patients. Doctors should not only know about the medical knowledge, Medical Ethics is also important. The most prestigious medical institute of the country should abide by all the rules & regulation laid down in Indian Medical Council Act, Furthermore, it is very important to follow the Medical Ethics which is first & foremost before treating a patient.

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Original Research Paper

Sex Determination Using Fingerprint Ridge Density In South Indian Population

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Abstract

Determination of sex is vital in establishing the identity of human remains and has always been a challenge for forensic pathologists, particularly when a fingerprint recovered from crime scene does not match with any of those available in the records. The present study was conducted on 100 males and 100 females of South Indian Population, aged between 18 and 81 years, to study the possibility of differentiation of gender using fingerprint ridge density. For calculating the finger print ridge density, the upper portion of the radial border of each print was chosen and the epidermal ridges in a defined area counted. Results show that women have a significantly higher fingerprint ridge density than men. Application of Baye's theorem suggests that a fingerprint having ridge density of $<14/25\text{mm}^2$ is more likely to be that of a male, and one having ridge density of $>14/25\text{mm}^2$ is more likely to be that of a female. Discriminant analysis on the study data could derive formulae to predict the sex using fingerprint ridge density. The results show that fingerprint ridge density can be used as a tool for sex determination.

Key Words: Fingerprint, Ridge density, Baye's theorem, Discriminant analysis, Sex determination

Introduction:

Identification using finger prints is absolute and infallible. [1, 2] It is perhaps more significant that never yet in the world's crime records, have identical prints come to light unless from the same finger.

Even a portion of the palm which bulged between a glove worn by a safe breaker has left sufficient detail for the proof of identity. [3] Fingerprints have universal application towards identification, especially in the field of criminology. Since the turn of the century, finger prints have been used as a very effective means of establishing identity of the individual. [7]

Establishing the identity of human remains is a challenge for a Forensic pathologist; determining the sex is of paramount importance in that respect. 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. [4]

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DOR: 09.05.2014 DOA: 02.11.2014

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. [2, 5, 6] Many studies have been carried out on the method of storing fingerprints, for rapid search and matching of fingerprints in computers etc., but very few studies are available on determining gender of an individual from fingerprints.

It has been assumed that the fingerprints of women tend to have fine epidermal ridge detail, while men have coarse ridge detail i.e. women tend to have higher fingerprint ridge density (number of ridges in a defined area) when compared to males.

Very few studies which have examined this hypothesis have clearly demonstrated whether the observed differences in fingerprint ridge density between males and females is statistically significant.

This becomes important in practical use when a chance print lifted from a scene of crime does not match with any of the fingerprints available in the records. If the sex of the individual is established, burden on the investigating officer would be reduced to half.

In this context, the difference in the density of finger ridges between males and females becomes relevant. In this study, an attempt has been made to determine the gender of an individual in South Indian population, using fingerprint ridge density.

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.

Only fresh, identified dead bodies of above 18 years of age brought for autopsy were included in this study. Subjects with any evidence of injury, scars or any alterations of fingertips, or Subjects other than those from South India were excluded from this study.

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.

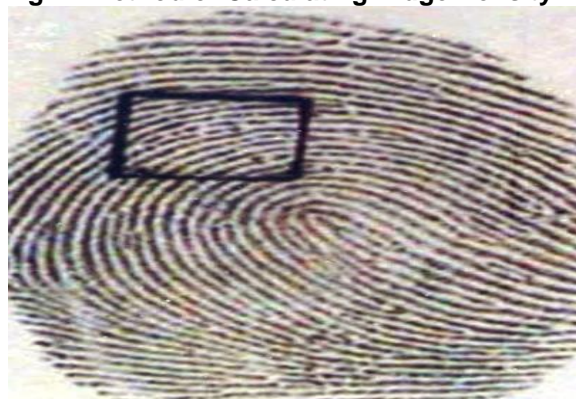
Similarly, prints of entire ten fingertips were prepared for each and every subject. For calculating the finger print ridge density, the upper portion of the radial border of each print (i.e. peripheral ridges) was chosen for data collection because all fingerprint pattern types show a similar ridge flow in this region. [11, 13]

Epidermal ridges in the central core region were not chosen for analysis due to variability of pattern shapes and the potential problem of recurving ridges being counted more than once within these regions. [8]

The epidermal ridges in the selected area were counted carefully within an area of 5mm × 5mm, drawn on a transparent film fixed to the magnifying lens, using a pointer.

Counting was done from one corner of the square to the diagonally opposite corner in a zigzag manner. Dots were not counted. Forks were counted as two ridges excluding the handle and a lake was counted as two ridges (Fig. 1). [11]

Fig. 1: Method of Calculating Ridge Density



Ridge counts were thus taken individually for ten fingers. Ridge thickness and furrows are two important factors which determine density of ridges. Since ridge counting is done within a well-defined area, both these parameters are taken into consideration.

Data analysis was done using SPSS version 17.0. The alpha level of significance was set at 0.05 for all statistical calculations. The likelihood ratio was calculated to obtain the probability inferences of gender, based on ridge density values. Likelihood ratio (LR) is based on the Baye's theorem,

$$\text{LR} = \frac{\text{Probability of a given fingerprint originating from a male (C)}}{\text{Probability of a given fingerprint originating from a female (C}^1\text{)}}$$

Discriminant analysis was used to derive a formula for predicting the gender using ridge density values. A discriminant function was developed for this purpose. The general structure is

$$Z_{jk} = a + w_1X_{1K} + w_2X_{2K} + \dots + w_nX_{nK}$$

Where Z_{jk} = discriminant Z score of discriminant j for object k.

a = intercept

w_i = discriminant weight for independent variable i.

X_{ik} = independent variable i for object k.

Results:

Male subjects showed fingerprint ridge density values from 10 to 16. Female subjects showed fingerprint ridge density values from 11 to 19. (Table 1) The manner in which each of the ridge density value was distributed among males and females was analyzed. Fingerprint ridge density of 10 belonged to males only. Ridge density of 11 belonged to males in 98.7% cases and to females in 1.3% cases.

As the ridge density further increased, the proportion of males gradually decreased and simultaneously the proportion of females increased. Thus, ridge density of 16 belonged to females in 89.7% cases and to males in 10.3% cases. Ridge density of 17, 18 and 19 belonged to fingerprints of females only. (Table 2)

The mean fingerprint ridge density for males and females was derived. The mean fingerprint ridge density for males is 12.79 and that for females is 14.81. Independent sample T-test shows that fingerprint ridge density shows a statistically significant difference between males and females (p value < 0.001). The mean ridge density of each of the ten fingers was also calculated for both males and females. It was found that the fingerprint ridge density differs

significantly between males and females in each of the ten fingers of the study subjects.

In males, the highest mean ridge density was noted in the right ring finger (13.25) and the lowest one was noted in the left thumb (12.41). In females, the maximum ridge density was noted in the left ring finger (15.51) and the minimum value was noted in the right index finger (14.08). (Table 3)

Probability densities derived from the frequency distribution were used to calculate the likelihood ratio (LR) and posterior probabilities of both sex for given ridge density of the subjects, using Baye's theorem. Favored odds of more than 0.7 are considered to be 'most favourable'. For the ridge density values <14, odds ratio is in favour of males.

For values >14, odds ratio is in favour of females. Thus, a fingerprint ridge density of <14/25mm² is more likely of a male (P=0.81) and a ridge density of >14/25mm² is more likely of a female (P=0.9). Ridge density of 10/25mm² is highly indicative of a male (P=1) and there were no females observed in that category. Ridge density of 17, 18 and 19/25 mm² is highly suggestive of a female (P=1) with no males observed in those categories. (Table 4)

Statistical analysis of probability densities and likelihood ratios was done separately for right and left hand. In the right hand, for the ridge density values <14, odds ratio is in favour of males. For values >14, odds ratio is in favour of females.

Thus, a fingerprint ridge density of < 14/25mm² is more likely of male origin (P=0.81) and a ridge density of >14/25mm² is more likely of female origin (P=0.89). In the left hand also, a fingerprint ridge density of <14/25mm² is more likely of male origin (P=0.81) and a ridge density of more than 14/25mm² is more likely of female origin (P=0.91). (Table 5, 6)

Discriminant analysis was done using the fingerprint ridge density values of all the fingers of 100 male and 100 female subjects (i.e. 1000 male prints and 1000 female prints), and an equation was derived for prediction of sex. Box's Test of Equality of Covariance Matrices was done to test the null hypothesis of equal population covariance matrices. p value was 0.071, which indicates that the data do not differ significantly from multivariate normal. This means that discriminant analysis can proceed with the normal data. A formula can be derived of the form,

$y = a + bx$, where 'y' is the discriminant score, 'a' is the constant, 'b' is the discriminant function coefficient and 'x' is the ridge density. Thus,

Formula for predicting the sex from a single fingerprint was given as,

$$\text{Score} = (-9.866) + 0.715 \times (\text{ridge density})$$

If the score is < -0.722, fingerprint is that of a male. If the score is >0.722, it is that of a female. If the score is between -0.722 and 0.722, prediction is inconclusive. This formula could correctly predict the sex in 76.1% of the subjects (confirmed by cross validation method).

Discriminant analysis was also done using mean fingerprint ridge density i.e. mean value of the ridge densities of 10 ten fingers was calculated for the 100 male and 100 female subjects. Using that data, the following formula was derived for prediction of sex.

$$\text{Score} = (-13.815) + 1.001 \times (\text{mean ridge density})$$

If the score is < -1.012, fingerprint is that of a male. If the score is >1.012, it is that of a female. If the score is between -1.012 and 1.012, prediction is inconclusive.

This formula could correctly predict the sex in 84.5% of the subjects. Discriminant analysis was also done using the ridge density of each finger individually. Formulae were derived for the prediction of sex using the ridge density of a specific finger.

The results are summarized and there are ten formulae which can be used for prediction of sex using fingerprint ridge density of each of the ten fingers respectively. (Table 7) The ability to predict the sex correctly is highest for the left ring finger (82%) and lowest for the right thumb (74.5%).

Discussion:

This study confirms the hypothesis that women have higher fingerprint ridge density than men. [8] Thus, the mean fingerprint ridge density is higher in females than males, and the difference between males and females is statistically significant. This is in accordance with the previous studies conducted by other authors. [8-11, 13] But it is exactly opposite to the figures obtained by Reddy CC [14], who got higher mean fingerprint ridge density in males than females in his study. [Table 8]

The mean fingerprint ridge densities of males and females in this study are almost corresponding to those obtained by Gungadin and Nithin, [10, 13] who had conducted the study on South Indian population itself. Acree [8] got lesser values for mean fingerprint ridge density in Caucasian and Afro-American population, whereas Cummins got higher values in American population. This could probably be due to racial differences. In this study, analysis of probability densities and likelihood ratios in this study sample gives:

- Fingerprint ridge density of $<14/25\text{mm}^2$ is more likely to be that of a male.
- Fingerprint ridge density of $>14/25\text{mm}^2$ is more likely to be that of a female.

Hence the ridge density of 14 delineates males from females in the study population. The above conclusion is similar with that of Gungadin S [10] and Nithin MD [13], who had done the study in South Indian population.

According to Gungadin, [10] a ridge density of ≤ 13 ridges/ 25mm^2 is more likely to be of male origin and ≥ 14 ridges/ 25mm^2 is likely to be of female origin. As per the study conducted by Nithin, [13] a fingerprint possessing ridge density <13 ridges/ 25mm^2 is most likely to be of male origin and one having ridge density >14 ridges/ 25mm^2 is most likely to be of female origin. On the other hand, according to Nayak VC [12], who has done his study in Chinese and Malaysian population, 12 was the ridge density value that delineates males from females.

Acree [8] got an even lesser value, who concluded that a fingerprint possessing a ridge density of $\leq 11/25\text{mm}^2$ is most likely to be of male origin, and one having a ridge density of ≥ 12 ridges/ 25mm^2 is most likely to be of female origin, regardless of race. The following conclusions could also be derived from the present study.

- Fingerprint ridge density of $10/25\text{mm}^2$ has 100% sensitivity and positive predictive value for a male, as it was observed only in males.
- Fingerprint ridge densities of $17-19/25\text{mm}^2$ have 100% sensitivity and positive predictive value for a female, as they are observed only in females.
- Fingerprint ridge density of $14/25\text{mm}^2$ is inconclusive in differentiating between males and females.
- Fingerprint ridge density does not vary significantly between the right and left hand.

Discriminant analysis of the study data could derive formulae for predicting the sex from, (1) a single fingerprint, (2) mean fingerprint ridge density of ten fingers and (3) each print of a known finger.

Conclusion:

This study concludes that fingerprint ridge density differs significantly between males and females and can be used as a tool to predict the sex. This can be of practical use for Forensic pathologists and scientists, in situations like retrieval of a severed arm/hand/finger, or of a chance print from a crime scene.

When such a print does not match with any one of those available in records, a clue

regarding the sex of the individual might be of great use in establishing identity.

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Table 1: Ridge Density in Males and Females

Ridge density	Total No.	Males	Females
10	34	34	0
11	152	150	2
12	283	239	44
13	418	281	137
14	425	184	241
15	361	90	271
16	214	22	192
17	69	0	69
18	41	0	41
19	3	0	3
Total	2000	1000	1000

Table 2: Distribution of Ridge Density Values between Males and Females

Ridge density	Total No.	Males		Females	
		No.	% within group	No.	% within group
10	34	34	100	0	0
11	152	150	98.7	2	1.3
12	283	239	84.5	44	15.5
13	418	281	67.2	137	32.8
14	425	184	43.3	241	56.7
15	361	90	24.9	271	75.1
16	214	22	10.3	192	89.7
17	69	0	0	69	100
18	41	0	0	41	100
19	3	0	0	3	100

Table 8: Comparison of Ridge Density of Males and Females from Various Studies

Author	Mean fingerprint ridge density		Study population
	Males	Females	
Cummins	20.70	23.40	American
Reddy	13.41	12.04	South Indian
Acree	11.14	13.32	Caucasian
	10.90	12.61	African American
Gungadin	12.80	14.60	South Indian
Nayak	11.05	14.20	South Indian
Nithin	12.57	14.15	South Indian
Present study	12.79	14.81	South Indian

**Table 3
Group Statistics**

	Males		Females		T	p value
	Mean	Standard deviation	Mean	Standard deviation		
Right thumb	12.64	1.404	14.28	1.272	-8.658	<0.001
Right index finger	12.43	1.200	14.08	1.186	-9.779	<0.001
Right middle finger	13.01	1.251	14.96	1.392	-10.418	<0.001
Right ring finger	13.25	1.336	15.25	1.540	-9.810	<0.001
Right little finger	12.93	1.416	14.94	1.317	-10.395	<0.001
Left thumb	12.41	1.464	14.39	1.449	-9.613	<0.001
Left index finger	12.43	1.281	14.43	1.380	-10.621	<0.001
Left middle finger	12.90	1.291	14.99	1.314	-11.345	<0.001
Left ring finger	13.10	1.299	15.51	1.474	-12.269	<0.001
Left little finger	12.79	1.373	15.27	1.332	-12.964	<0.001
Mean ridge density	12.79	0.979	14.81	1.019	-14.306	<0.001

**Table 4
Probability Densities & Likelihood Ratios derived from Observed Ridge Densities**

Ridge density	Probability density		Likelihood ratio		Favored Odds	
	Males (C)	Females (C')	Males (C/C')	Females (C'/C)	Males	Females
10	0.034	0	-	0	1	0
11	0.15	0.002	75.00	0.01	0.99	0.01
12	0.239	0.044	5.43	0.18	0.97	0.03
13	0.281	0.137	2.05	0.49	0.81	0.19
14	0.184	0.241	0.76	1.31	0.37	0.63
15	0.09	0.271	0.33	3.01	0.10	0.90
16	0.022	0.192	0.11	8.73	0.01	0.99
17	0	0.069	0	-	0	1
18	0	0.041	0	-	0	1
19	0	0.003	0	-	0	1

**Table 5
Probability Densities & Likelihood Ratios for Right Hand**

Ridge density	Probability density		Likelihood ratio		Favoured odds	
	Males (C)	Females (C')	LR (C/C')	LR (C'/C)	Males	Females
10	0.028	0	-	0	1	0
11	0.138	0	-	0	1	0
12	0.238	0.052	4.58	0.22	0.95	0.05
13	0.294	0.144	2.04	0.49	0.81	0.19
14	0.18	0.26	0.69	1.44	0.32	0.68
15	0.096	0.28	0.34	2.92	0.11	0.89
16	0.026	0.164	0.16	6.31	0.02	0.98
17	0	0.06	0	-	0	1
18	0	0.038	0	-	0	1
19	0	0.002	0	-	0	1

Table 6
Probability Densities & Likelihood Ratios for Left Hand

Ridge density	Probability density		Likelihood ratio		Favoured odds	
	Males (C)	Females(C')	LR (C/C')	LR (C'/C)	Males	Females
10	0.04	0	-	0	1	0
11	0.162	0.004	40.50	0.02	0.99	0.01
12	0.24	0.036	6.67	0.15	0.98	0.02
13	0.268	0.13	2.06	0.49	0.81	0.19
14	0.188	0.222	0.85	1.18	0.42	0.58
15	0.084	0.262	0.32	3.12	0.09	0.91
16	0.018	0.22	0.08	12.22	0.01	0.99
17	0	0.078	0	-	0	1
18	0	0.044	0	-	0	1
19	0	0.004	0	-	0	1

(Note: In table 5, 6 and 7, cells are left blank where the likelihood ratio is too large to be determined, as the denominator is zero.)

Table 7
Discriminant Statistics of Ridge Density of Each Finger

Finger	Formula for calculating the discriminant score	Discriminant score		% correctly predicted
		Male	Female	
Right Thumb	$-10.049 + (0.747) \times \text{RD}$	< -0.612	> 0.612	74.5
Right Index	$-11.109 + (0.838) \times \text{RD}$	< -0.691	> 0.691	75.0
Right Middle	$-10.567 + (0.756) \times \text{RD}$	< -0.737	> 0.737	76.0
Right Ring	$-9.885 + (0.694) \times \text{RD}$	< -0.694	> 0.694	76.0
Right Little	$-10.192 + (0.731) \times \text{RD}$	< -0.734	> 0.734	75.5
Left Thumb	$-9.201 + (0.687) \times \text{RD}$	< -0.680	> 0.680	76.0
Left Index	$-10.087 + (0.751) \times \text{RD}$	< -0.751	> 0.751	75.5
Left Middle	$-10.705 + (0.768) \times \text{RD}$	< -0.802	> 0.802	77.7
Left Ring	$-10.299 + (0.720) \times \text{RD}$	< -0.868	> 0.868	82.0
Left Little	$-10.372 + (0.739) \times \text{RD}$	< -0.917	> 0.917	80.5

(Note: RD - ridge density of the finger)

Original Research Paper

Medico-legal Aspects of Firearm Injury Cases in Agra Region

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Abstract

Firearm injury is one of the important causes of morbidity & mortality in India. A detailed study of medico-legal parameters in firearm injuries cases in Agra region is still lacking. The study was conducted in S. N. Medical College & Hospital, Agra. All the firearm injury cases, from October 2006 to October 2008 were included. Victim's biological details, motive of injury, type of firearm used, shots, diurnal variation of injuries, sites of injury, wound examination and cause of death were studied. Out of 1919 injury cases reported, 240 (12.5%) cases were of firearm injury. In total 240 cases, 90% were male victims and the most common age group was 11-30 years (71.8%). Shotgun, country made gun known as 'kattas', were used in 60% cases. Single shot was present in most cases 228 (95%). The most common site of injury was abdomen (30.9%). The fatality rate was 1.2% and hemorrhagic shock (68.9%) as the most common cause of death. In the present study, homicidal motive was the most common in firearm injuries cases and shotgun/kattas was the most common weapon used, as it is indigenously manufactured in Agra region.

Key Words: Firearm injury, Firearms, Homicide, Shotgun

Introduction:

The fire was the greatest invention for the human civilization but the invention & evolution of the firearms has come as a curse to this world. It is one of the most dreaded weapons used by human being to kill themselves. Firearm injury is one of the important causes of morbidity and mortality in our country. There has been a continuous increase in the incidence of these injuries in recent years because of an increase in inter-personal violence dacoity, robberies, caste feuds, terrorism, easy availability of illegal country made guns 'Kattas' and refinement in ballistics- automatic & semi-automatic firearms (rifle, revolver & pistols).

Various medico legal parameters of firearm injuries & fatalities have been studied in different parts of the world & in India.

But a detail study with regional variations of the parameters of medico legal aspects of firearm injuries are still lacking. Therefore our objective was to study the pattern & various parameters of firearm injuries in Agra region elucidating the situation with regard to the extent & severity of the problem and comparing with the pattern seen in other regions.

Aims & Objectives:

- To study the ratio of firearms injury cases in relation with the other injuries
- To study the Victim parameters – sex, age, resident (rural/ urban) in firearm injury cases, motive/intent of firearm injury, type of firearm used, No. of the shots, diurnal variation of the firearm injuries, site of gunshot injuries, result of firearm injury, causes of death

Materials & Methods:

The study was conducted in S. N. Medical College & Hospital, Agra as tertiary health care centre for the entire Agra city and all surrounding rural areas. All the injury cases brought to the emergency department of S. N. Medical College & Hospital Agra, from October 2006 to October 2008 were included in the study. The cases of road traffic accidents and poisoning were excluded.

All the cases were examined and various parameters were noted and cause of death in case of fatality was established by the post-mortem examination.

1. Detailed History

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- Victim's data- age, sex, address
 - Motive – suicidal, accidental, homicidal
 - Suicidal- history of suicidal note, substance abuse, psychiatric disorders, previous suicidal attempts
 - Homicidal- history of robbery, dacoit, interpersonal violence, caste feuds, terrorism, mob or police firing
 - Accidental– injuries due to hunting, defective firearms, unsafe handling (cleaning/repairing, unloading, firing in parties)
 - Type of firearms used
2. Examination
 - General examination of victim
 - Wound examination- number, site, size, number, margins, and presence of singeing, scorching, blackening, tattooing, abrasion collar, bleeding and associated injuries.
- All these findings were noted and photographed. Type of weapon used was assessed by examining the wound in detail.
3. Outcome
 - Hospitalized and discharged/referred
 - Death- cause and manner of death established by post mortem examination.

Results:

A total of 1919 injury cases reported to the emergency department, 240 (12.5%) cases were of firearm injury, 1268 cases (66.1%) of hard & blunt object injury, 85 cases (4.4 %) of sharp & penetrating injury and 326 cases (17%) were due to burns. (Table 1)

In this study out of 240 cases, 216 (90%) victims were males and 28 (10%) were female. Most common age group victimized was 11-20 year (38.4%) and next common age group was 21-30 years (33.4%). (Table 2)

In the present study, 132 cases (55%) victim belonged to rural areas.

In our study out of 240 cases, 212 (88.34%) cases were of homicidal motive, 8 (3.4 %) cases of suicidal intent 16 (6.67%) cases of accidental firing and in 4 (1.67%) cases, intent could not be ascertained due to unavailable history. In all suicidal cases rifled firearm was used. (Table 3)

Shotgun, country made gun known as 'kattas', outnumbered the rifled firearm injuries (144 cases out of 240 cases (60%)). In 88 cases (36.67%) rifled firearm had been used and in 8 cases (3.34%) type of weapon could not be ascertained. (Table 3)

Most of the cases of gunshot injuries 228 (95%) were of single shot and 12 (5%) cases were of double firing. In all cases of

double firing rifled firearm was used. No case was reported with multiple firing. (Table 3)

The maximum numbers of firearm injury cases were reported during night hours 12am-12pm a total of 140 cases (>50%). (Table 4)

On wound examination, the most common site for firearm injury was abdomen, seen in 116 (30.9%) cases, followed by thorax in 21% cases and head in 16 % cases. (Table 5)

Single entry wound was observed in 74.6%, double entry wound were in 6.8% and multiple entry wound in 18.6% of cases.

Exit wound found in 60 cases only. Out of 60 cases of exit wounds single exit wound found in 52 cases (86.7%), while double exit wound found in rest of 8 cases (13.3%).

There was no case with multiple exit wound. In most of the firearm injury cases, it was close shot, 128 (53.3%). Blackening and tattooing were seen in 68 (53.1%) of these close shot cases. Out of 212 homicidal cases, in 120 (56.6%) cases, close shot injury was observed.

Most of the cases 131 (54.6%) were discharged after appropriate treatment. The fatality rate was 1.2% (29 cases). The most common cause of death on post-mortem examination was hemorrhagic shock (68.9%) in this study. (Table 6)

Discussion:

Male outnumber females in cases of firearm injuries. In the present study most common age group victimized was 11-20 year (38.4%) and next common age group was 21-30 years (33.4%), hence the total number of cases in both the group (11-30 yrs) constitute the maximum number of cases (71.8%) reported similar to the findings of other studies. [1-5] (Table 7)

Most of the cases belong to rural areas due less strict law and order, lower literacy and high unemployment rates. In the present study homicidal cases due to firearm injuries were 88.34%. This result was similar to other the Indian studies done by Kohli A et al [4] 92.6%, Singh B P et al [5] 70%, however is much higher than the US statistics. [2]

The incidence of homicidal injuries in our region is due to large usage of unlicensed, country made guns, which are cheap, easy to procure and destroy.

In the present study, Suicidal cases caused by firearm were 3.4%, as seen in other Indian studies Kohli A et al [4] 6.5%, Singh B P et al [5] 3.0%) in contrast to US statistics [2], suicidal cases due to firearm were 56.1%.

In our study, a small proportion of people are committing suicide by firearm

because people tend to use cheaper methods like hanging and poisoning.

Most common firearm used in various studies was rifled firearm in US [2] 82.1%, Kohli [4] 82.2%, Hussain [5] 96.5%). However in our study was shotgun was most commonly used in 60% cases, as indigenously manufactured in our region. Close shot was observed in most of homicidal cases (56.6%) in the present study similar to the finding of other studies. [6]

Most common site of injuries was abdomen in our study, while chest was most common site of injury in other studies. [4-5]

Hussain [3] reported maximum case of head and neck injuries. Death in cases of firearm injuries can be due to hemorrhagic shock, head injuries, septicemia, and respiratory failure. Haemorrhagic shock is the most common cause of death in the present study. [7]

Conclusion:

In the present study, homicidal motive was common in firearm injury cases in Agra region and Shotgun/kattas was the most common weapon used, as it is indigenously manufactured in this region.

Country made firearms are cheap, easily available and easier to be destroyed. Strict laws may help reducing the production of country made firearms. Authorities issuing license for possession of firearms need to be more strict and vigilant. These steps may help in reducing the burden of firearm injury cases.

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Table 1: Firearm Injuries Related to Other Injuries

Types of Injuries	Cases	%
Hard & blunt objects	1268	66.1%
Bum	326	17%
Firearms	240	12.5%
Sharp & penetrating	85	4.4%
Total	1919	100

Table 2: Age and Sex wise Distribution

Age Group(Yrs)	Male	Female	Total (%)
0 -10	12	0	12(5%)
11-20	84	8	92(38.4%)
21-30	68	12	80(33.4%)
31-40	16	0	16(6.7%)
41-50	16	0	16(6.7%)
51-60	8	4	12(5%)
>60	8	4	12(5%)
Total	212 (90%)	28(10%)	240(100%)

Table 3: Parameters of Firearm Injuries

S.N.	Parameters	No.	%
1.	Motive of firearm injuries		
	Homicidal	212	88.34
	Suicidal	08	3.4
	Accidental	16	6.67
	Others (insufficient information)	04	1.67
	Total	240	100
2.	Type of Firearm used		
	Shotgun (smooth bored)	144	60.0
	Rifled	88	36.67
	Cannot be ascertained	08	3.34
	Total	240	100
3	Number of Shot		
	One	228	95.0
	Double	12	5.0
	Multiple	00	0.0
	Total	240	100
4.	Range of Shot		
	Contact	20	8.3
	Close	128	53.3
	Distant	88	36.7
	Undetermined	4	1.7
	Total	240	100

Table 4: Time of Firearm Injury

Time	Cases	%
12AM-6 AM	68	28.3
6AM – 12 PM	72	30
12 PM - 6 PM	40	16.7
6 PM- 12 PM	60	25.0
Total	240	100

Table 5: Distribution of Entry and Exit Wounds on Different Body Parts

Parts of Body	Entry Wound	Exit Wound	Total (%)
Head	56	4	60(16)
Neck	12	4	16(4.3)
Thorax	60	16	76(20.3)
Abdomen	96	20	116(30.9)
Upper limb	52	24	76(20.3)
Lower limb	32	0	32(8.5)
Total	308	68	376

Table 6: Result of Firearm Injury

Outcome (n=240)	No.	%
Discharged after treatment	131	54.6%
Referred to higher center	80	33.3%
Death	29	1.2%
Total	240	100
Cause of Death(n=29)		
Haemorrhagic Shock	20	68.9%
Head injury	5	17.2%
Septicemia	3	10.3%
Respiratory Failure	1	3.4%

Photo 1: Entry wound of 1.5 cm.X1.5cm size at angle of Mandible with inverted margins, Type of fire arm used: Rifled Firearm, Homicidal Motive with Single Close Shot



Photo 2: Exit wound of 3.0 cm X 3.5 cm size near Right Ear (tragus) with everted margins, Type of fire arm used: Rifled Firearm, Homicidal Motive with Single Close Shot



Photo 3: Entry Wound of 2.5 cm. X 2.5cm size on abdomen 18 cm from umbilicus at 2 'o clock position with inverted margins, Type of firearm used: Shotgun, Homicidal Motive & Single Contact shot



Photo 4: Entry wound of 2.5 cm. X 3.0cm size on chest right side of sternal angle with inverted margins and spurting of blood



Table 7
Comparison of Parameters in Different Studies

S.N	Parameters	FBI U.S	Hussain	Kohli A	Singh B	Present study
1.	Sex					
	Male	NA	85.2%	90.7%	78%	90%
	Female	NA	14.8%	9.3%	13%	10%
2.	Rural	NA	63%	NA	NA	55%
	Urban	NA	37%	NA	NA	45%
3.	Most common age group/ Mean Age	15-29 (54%)	16-30 (42%)	21-30 (46.7%)	Male:31 years, Female:24 years	11-30 (71.8%)
4.	Motive					
	Homicidal	40.8%	70%	92.6%	70%	88.3%
	Suicidal	56.1%	-	6.5%	3.0%	3.4%
	Accidental	2.4%	-	0.9%	19%	6.67%
5.	Rifled	96.5%	82.1%	82.2%	-	40%
	Shotgun	5.1%	3.5%	17.8%	-	60%
	Can't be ascertained	13.2	-	-	-	-
6.	Single shot	NA	NA	100%	80%	95%
	Double shot	-	-	nil	8%	5%
	Multiple shot	-	-	nil	5%	Nil
7.	Most common site of injury	Head and neck	Head and neck	Chest	Chest	Abdomen

Original Research Paper

Diagnostic Efficacy of Cardiac Isoenzyme CK-MB in Pericardial Fluid for Post-mortem Diagnosis of Myocardial Infarction

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Abstract

Sudden cardiac death due to acute myocardial infarction is the most prevalent cause of death in adults and constitutes a significant portion of the autopsies that are conducted by Forensic pathologists. Serum cardiac isoenzymes Creatine phosphokinase-MB (CK-MB) has high sensitivity and specificity for cardiac damage and routinely used for clinical diagnosis of myocardial infarction (MI). However, in Forensic Medicine, diagnostic utility of this cardiac marker for post-mortem diagnosis of MI has not been fully established. Present study is carried out with aim to evaluate the diagnostic efficacy of CK-MB in pericardial fluid for autopsy diagnosis of MI. This study included 119 medico-legal autopsy cases selected during a period of two years. Four study groups were formed depending upon final cause of death Biochemical analysis of pericardial fluid was carried out. Highest levels of CK-MB were noted in deaths due to IHD. By this cardiac marker, early infarcts can be predicted in sudden cardiac deaths associated with severe coronary artery disease & inconclusive histopathological findings.

We obtained high diagnostic sensitivity and negative predictive value of CPK-MB for autopsy diagnosis of MI in pericardial fluid comparable to the clinical analyses on serum.

Key Words: Autopsy, IHD, Myocardial infarction, Pericardial fluid, CPK-MB

Introduction:

Ischemic heart disease (IHD) due to coronary atherosclerosis is the most prevalent cause of sudden death in adults over the age of 30 years, but it is not infrequent in younger subjects. [1]

Hence, Coronary artery disease is sometimes called 'The Captain of the Men of death' and it constitutes a significant portion of the autopsies that are conducted by Forensic Pathologists in our country. [2]

'Sudden cardiac death' is defined as, natural death due to cardiac causes, heralded by abrupt loss of consciousness within 1 h of the onset of acute symptoms. [3] In more than 50% of these cases, death is caused due to cardiac arrhythmias induced by myocardial ischemia.

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When autopsy is performed, there may be presence of coronary atherosclerosis without evidence of demonstrable gross or microscopic findings of myocardial infarction (MI).

As survival period of more than 6 hours is required for changes of MI to appear in the heart, infarction is not apparent on gross examination until 12–24 hrs and light microscopic (H&E) changes are not apparent before 4–6 hrs. [4]

Due to limitations of histopathological findings [5], it is necessary to establish diagnostic utility of different biochemical cardiac markers in biological fluids for postmortem diagnosis of MI. Measurements of CK-MB and other cardiac markers in serum are commonly used for clinical diagnosis of acute myocardial infarction. [6-8]

Various authors have investigated role of CK-MB for post-mortem diagnosis of MI in serum and pericardial fluid (PF). [9-18] Few of them have attempted to determine if post-mortem levels of this isoenzyme is significantly higher in deaths because of myocardial ischemia than those because of other causes of death. [9-13]

However, these studies do not mention the overall diagnostic efficacy of this marker as

mentioned in clinical practice. Hence, in the present study, we had investigated diagnostic efficacy & distribution of CK-MB in PF fluids for autopsy diagnosis of MI as compared to other causes of death.

Material & Methods:

We studied 119 cases (91 males and 28 females) selected from total medico legal autopsies from Dec-2010 to June-2012 conducted at dept. of Forensic Medicine, IGGMC, Nagpur. Mean age of subject was 50.77 years (S.D.10.81, range 30-75 years).

Mean post-mortem interval was 13.50 hours (S.D.6.90 hours, range 2-24 hours). All dead bodies were kept in cold compartments prior to autopsy. We have excluded from the study all cases with pericardial disease or haemorrhage in pericardial fluid & cases showing signs of decomposition.

Subjects were assigned into one of the four diagnostic groups depending upon their final cause of death as follows:

- **Group I:** Sudden cardiac deaths due to Ischemic Heart Disease (n=52) subdivided in deaths due to myocardial infarction (n=28) and coronary artery disease (CAD) (n=24). These subgroups were classified upon histopathological confirmation.
- **Group II:** Violent Asphyxial Deaths (n=24) subdivided into deaths due to hanging (n=16) and drowning (n=8).
- **Group III:** Deaths due to Poly-trauma (n=20) included vehicular accident cases with extensive muscle damage without any evidence of chest trauma.
- **Group IV:** Natural deaths not due to cardiac diseases (n=23) included deaths due to pulmonary consolidation (n=10), lung abscess (n=04), non-traumatic intra-cerebral hemorrhage (ICH) (n=04), non-traumatic subarachnoid hemorrhage (SAH) (n=02), sepsis due to infected wounds (n=02) and acute bronchial asthma (01).

Details in each case were obtained from inquest paper, treatment record, death certificate and other relevant documents issued from hospitals in hospitalized cases.

In addition, history particularly important towards diagnosis of cardiac disease was elicited from near relatives or friends. For studying factors affecting CK-MB levels in pericardial fluid, we have included cases of poly-trauma to analyse effect of muscle damage and cases of violent asphyxia to observe the effect of hypoxia on heart and consequent release of

cardiac marker. Whereas, other natural causes of deaths in group IV were assigned as controls.

Survival time (ST) was known in 78 cases & mean ST was 1.21 hours (S.D. 1.01 hours, range=0.10-5 hours). All cases in group II were brought dead to the emergency department. Out of total 119 cases, Cardio pulmonary resuscitation (CPR) was attempted in 45 cases. In group I, cardiac complaints were present in 43 cases, 21 patients were hospitalized & ECG findings of IHD's were present in 8 of these cases.

Pericardial fluid samples were collected from pericardial sac by using sterile syringe after incising parietal pericardium. It was then centrifuged immediately at 5000 rpm for 15 minutes & supernatant was collected for enzyme analysis. Standard laboratory procedures were used for measuring levels of CK-MB in pericardial fluid & biochemical analysis was carried out on an automated analyser using commercial kits.

We used Immunoinhibition/Mod.IFCC [8] method of estimation for CK-MB involving principle of UV kinetic reaction. As the PF showed high enzymatic activities compared to clinical range on initial tests, dilution of fluid was carried with normal saline (0.9%) in the ratio of 1:9 before analysis and results then obtained were multiplied by 10.

Detailed gross examination and dissection of the heart was carried out by short-axis and inflow outflow techniques. Only those cases showing severe coronary artery disease i.e. vessel showing $\geq 75\%$ stenosis of lumen on transverse sectioning [19], were included in final observations.

Histopathological examination (HPE) of heart was carried out in each case with haematoxylin and eosin (H&E) staining. On HPE, findings of MI were divided into acute, healing and healed infarct.

Hearts showing presence of coagulative necrosis with various degrees of nuclear changes and prominent infiltration of neutrophils were diagnosed as acute MI (AMI). Whereas, cases in which heart showed, above changes in various stages with presence of mononuclear leucocytes and fibroblasts without neutrophils were considered as healing MI (HMI).

When, HPE of hearts showed presence of collagenous scarring without cellular infiltration, cases were labeled as old healed MI (OHMI). Presence of features like inter-fibrillar edema/interstitial edema, patchy eosinophilia were considered as inconclusive and these cases were assigned into deaths due CAD.

For statistical analyses of the data, the MedCalc version 13.1.0.0 program was used. Probability level $p < 0.05$ was considered significant. Non-parametric tests i.e. Kruskal–Wallis test & Mann–Withney test (rank–sum test) were used to compare levels of CK-MB in PF amongst four diagnostic groups & to compare pair of diagnostic groups, respectively.

In addition, specific contrasts for variable grouped by diagnostic category were carried out using Mann–Withney test. Receiver operating characteristic (ROC) curve [20, 21] was used for measuring area under the curve for CK-MB, to obtain its cut-off level for evaluating diagnostic efficacy and to discriminate between cases died due of IHD's and non -IHD by using diagnostic cut off value.

Observations & Results:

All 52 cases included in group I, had severe coronary artery atherosclerosis in one or more major epicardial arteries and triple vessel disease pattern was predominantly (48.07%) seen. Coronary thrombosis was found in seven cases of acute MI. (Table 1)

The values (Mean \pm Standard error of mean, S.D. and range) obtained for CK–MB in each diagnostic group. (Table 2) Highest levels were observed in death due to IHD's as compared to cases in other diagnostic groups. Non-parametric Kruskal–Wallis test (Table 2) was used for comparing differences in CK-MB level in PF amongst all diagnostic groups. We have observed statistically high significant difference in activities of CPK-MB ($P = 0.0001$) amongst all four diagnostic groups.

In group I, statistically non-significant ($P = 0.6729$) differences were observed in values (Table 3) of CK-MB between cases of definite MI ($n = 28$) & cases with CAD ($n = 24$). On the Mann–Withney test (Table 4), we observed highly significant ($P < 0.0001$) levels of CK-MB in cases of death due IHD's as compared to deaths due to violent asphyxia, poly-trauma and other natural deaths excluding cardiac causes.

Receiver-operating Characteristic (ROC) Curve Analysis:

For discriminant analyses, we used cause of death as grouping variable, total 119 cases in all groups were divided into deaths due to IHD's ($n = 52$) and that of due to non IHD's ($n = 67$). ROC curve (Fig.1) was established by taking levels of CK-MB as an independent variable with paying special attention to the area (Table 5), which represents the correct diagnosis in two individuals, one with MI and one without MI.

By using ROC curve, we determined the diagnostic cut-off value of 979 U/L for CK-MB in pericardial fluid (Table 5) for post-mortem diagnosis of myocardial infarction in cases of IHD's. At this diagnostic cut off level, we have obtained sensitivity=94.23% NPV=94.1% & specificity=71.64% of CK-MB for diagnosis of MI. No statistically significant correlations were observed between the levels of CK-MB and postmortem interval period included in the study and the use of cardiopulmonary resuscitation.

Discussion:

As mentioned in literature, following acute myocardial infarction, the initial CK-MB rise occurs 4 to 6 hours after the onset of chest pain, peaks at 24 hours, and returns to baseline at 48 to 72 hours ($t_{1/2}$ of CK-2 is 10 to 12 hours). One advantage of CK-MB over other markers is that it remains elevated for longer periods and it is easier to detect re-infarction using serial measurement. [6-8]

In clinical practice, measurement of CK-MB level in serum is routinely used to detect myocardial ischemia. However, use of this cardiac marker in serum for post-mortem diagnosis of MI has limitations due other factors affecting enzyme levels. [11, 13] Hence, we chose pericardial fluid over other biological fluids because, it is an ultra-filtrate of plasma [22, 23] hence, biochemical analysis can be done by using kits standardized for serum.

It lacks RBC's, therefore does not show hemolysis phenomenon that frequently interfere with biochemical determinations in serum. And as pericardial and myocardial irrigations are shared, markers of myocardial ischemia are detectable in PF before they are detectable other biological fluids. [9-18]

We obtained highest values of CK-MB in group of deaths due to IHD's as compared to other diagnostic groups.

Statistically non-significant differences were noted in levels of CK-MB between cases of AMI and cases with inconclusive H&E findings classified as deaths due to severe coronary atherosclerosis in group I. This signifies utility of performing CK-MB test on pericardial fluid for post-mortem diagnosis of early MI, because histopathological finding may be inconclusive in such cases. This finding from our study concurs with the findings of earlier studies. [13, 25]

On Kruskal–Wallis test, highly significant differences were observed for CK-MB amongst all diagnostic groups. On Mann–Withney test, we observed statistically significant levels of CK-MB in group of subjects who died of IHD's (Group-I) in comparison to other groups

represented by the subjects who died due to violent asphyxia (Group-II), poly-trauma (Group-III) and natural deaths excluding cardiac causes (Group-IV).

Findings of our study are in accordance with ones that reported in earlier studies. [9, 10, 15, 17, 25] However, Barabas B [18] found non-significant difference in CK-MB levels between asphyxial deaths and death due to AMI citing intense agony prior to death as probable reason for conflicting results.

On ROC curve analysis, we have observed significant areas under the curve for CK-MB (0.848). Diagnostic cut-off point value obtained for CK-MB showed very high sensitivity and negative predictive value and only 3 cases out of 52 included in IHD's, had values less than cut-off obtained.

These are the cases of MI in healing phase, suggestive of probable decline in enzyme levels after its initial peak during acute phase. Whereas, 19 cases of non-IHD out of 67 were incorrectly classified leading to lower specificity for the marker.

This might be due to other factors affecting its levels, as out of those 19 cases, nine corresponded to violent asphyxia deaths in which there might well have been an intense agony with consequent acute myocardial suffering involving the release of different markers into the cadaver, another seven had died from poly-traumatism in which, too, cardiac traumatism may have been involved. T

Three deaths were from natural causes (2-ICH and 1-SAH) that showed presence of severe coronary artery disease and death may occur due to cardiac arrhythmias in these disease conditions. [26, 27]

We obtained higher diagnostic sensitivity and NPV for CK-MB on ROC curve analysis as compared with the results of Carceles-Perez et al. [10] In clinical practice, sensitivity of the serum CK-MB for diagnosis of MI is from 92 to 100 at 3 hours from the onset of symptoms, whereas diagnostic specificity has been reported to be very close to 100%. [28]

Conclusion:

As we obtained nearly equal diagnostic sensitivity and negative predictive value for the cardiac marker CK-MB in pericardial fluid compared to clinical analysis on serum sample, hence, this cardiac marker in pericardial fluid could be of great help for autopsy diagnosis of MI in combination with histopathological examination.

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Fig.1: ROC Curve of CPK-MB levels in Pericardial Fluid

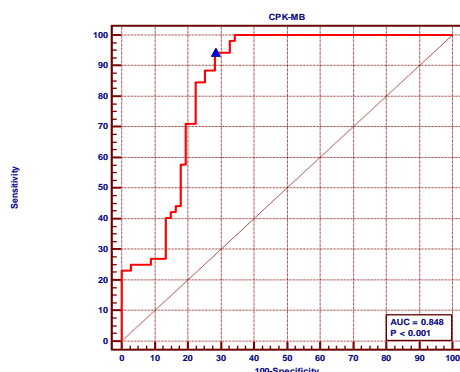


Table 3: Difference in Levels of Enzymes in Definite MI & CAD Cases in Group-I (Mann-Withney Test)

Group I (IHD's)		CPK-MB (U/L)	
Myocardial infarction (n=28)	Mean	5055	
	SD	5968.75	
	Median	2113.1	
	Range	497.82 – 18943.6	
Coronary artery disease (n=24)	Mean	4144.77	
	SD	4050.5	
	Median	2405.5	
	Range	1018 – 15618	
	Z statistics	0.422	
		P value	0.6729

Table 4: Mann-Withney test Between Diagnostic Groups

Variable	Comparison groups	Z statistic value	P value
CPK-MB	I – II	4.101	0.000
	I – II	4.564	0.000
	I – IV	5.538	0.000

(Groups: I-IHD, II-Violent asphyxia, III-Poly-trauma, IV-Natural deaths other than cardiac disease)

**Table 1
Histopathological Findings of Heart in Diagnostic Groups**

Groups	Total cases	AMI or HMI*	AMI+ OHMI**	OHMI	MF#	Interstitial edema	Congestion
I (IHD)	52	AMI-19 HMI-4	5	14	2	46	52
II (Violent asphyxial deaths)	24	-	-	2	0	10	24
III (Poly-traumatic deaths)	20	-	-	-	0	0	20
IV(Non-cardiac natural deaths)	23	-	-		3(2ICH, 1SAH)	3	23

*HMI-healing MI, **OHMI-old healed MI, #MF-myocardial fibrosis

**Table 2
Pericardial Fluid Levels of CPK-MB and Results of Kruskal-Wallis Test in the Diagnostic Groups**

Parameter	Levels	I. IHD	II. Violent asphyxia	III. Poly-trauma	IV. Non cardiac natural deaths	Kruskal-Wallis test
CPK-MB(U/L)	Mean ±SEM*	4635.36± 713	1623.16± 442.3	1088.2± 280.9	858.67±313.5	d.f.=3 test statistics (t)=48.50 P-value=0.0001
	S.D.	5144.92	2166.99	1256.12	1503.65	
	Median	2176.9	458.75	396.5	310	
	Range	497.82- 18943	78 – 8480	52- 4780	115 -6280	

*SEM: standard error of mean, #: degree of freedom

**Table 5
Area under Curve & Diagnostic Cut-Off Levels of CPK-MB Established Using ROC Curve Analysis**

Variable	AUC*	P	SE**	Lower limit	Upper limit	Cut-off level	Sensitivity	Specificity	NPV#
CPK-MB	0.848	0.001	0.036	0.771	0.907	979 U/L	94.23%	71.64%	94.1%

*Area under curve, ** Standard error, #Negative predictive value

Original Research Paper

Study of Ossification Centres Fusion of Elbow Joint in 15 to 17 Years Garhwali Females of Dehradun Region

¹Satya Prakash Dixit, ²R.K. Bansal

Abstract

Age estimation in the living is one of the most important tasks of a Forensic practitioner especially in developing countries where birth records are often not well-maintained. The age between 15 to 17 years is very important medico-legally especially in the females, it is important to differentiate between 14-15 yrs in employment and 17 to 18 in connection with Hindu marriage Act. X-ray study of epiphysis of bones has traditionally been used for age estimation by observing the ossification centers. On the other hand, Ultrasonography is a much safer, effective and non invasive procedure. The study was carried out between 2011 and 2014 on 100 female patients of Garhwali origin. The age of the subjects was from 15 to 17 years which was verified from date of birth certificate. The main focus of the present study was to find out the age of fusion of ossification centers in the upper ends of radius & ulna, and lower end of humerus. In order to narrow down the range of age an attempt has been made to undertake this study by means of Ultrasonography. During the study, encouraging results were discovered.

Key Words: Age Estimation, Garhwali Females, Ultrasonography

Introduction:

Age estimation in the living is one of the most important tasks especially in developing countries where birth records are often not well-maintained. Despite the fact that there are a number of laws requiring registration of births (e.g. Registration of Births and Deaths Act 1969) most births are not properly recorded. There is a variation in the timing of appearance and fusion of the epiphyses of the bones.

Ossification center are seen earlier in the tropical countries and in females. The variation in the appearance and the union of ossification centers is mainly attributed to various factors like climate, heredity, race, nutrition, dietary habits, gender and socio-economic status of population.

Scientific estimation of age of an individual whether living, dead or from human remains is a vexing problem for medical jurist in both civil and criminal matters. Age estimation cases are often referred to Forensic experts as it is a very important issue to the court of law and to common man.

As the age between 15 to 17 years is very important medico-legally especially in the females, it is important to differentiate between 14-15 yrs in employment & 17 to 18 in connection with Hindu marriage Act.

X-ray study of epiphysis of bones has traditionally been used for age estimation by observing the ossification centers. On the other hand, Ultrasonography is a much safer and non invasive procedure.

Moreover, ultrasonographically, we can see the appearance and fusion of various centers dynamically and in a better way by placing the probe on a desired area. Amongst all the parameters of age determination, radiological examination of bone ends has shown accuracy and reliability acceptable to medical profession and the legal fraternity.

But X-ray examination for age estimation is fraught with ionization risks. Also, the informed consent had to be obtained from their guardians who were as expected not forthcoming, it was decided to embark upon the examination of these ossification centres by means of ultrasound study. In the past too age determination by means of ultrasonography has been documented.

Therefore, it was decided in conjunction with the department of radiology to undertake this study through non-invasive means.

This study aims to find out the age of fusion of ossification centers in upper ends of radius & ulna, and lower end of humerus in Garhwali

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DOR: 25.09.2014 DOA: 28.10.2014

females between 15 to 17 years of age. In order to narrow down the range of age an attempt has been made to undertake this study by means of Ultrasonography.

Material Methods:

This study was carried out on 100 Garhwali females of 15 to 17 years during 2011 to 2014 in the Department of Forensic Medicine and Toxicology, SGRR Medical College and Hospital, Dehradun.

All subjects were Garhwali since birth which was confirmed from date of birth certificate issued by the Municipal authority. They should be free from any physical disability involving upper limbs. Physical, dental and ultrasonological examinations were done but the more emphasis was placed on ultrasonological examination.

The cases selected for the study were grouped as per their stated age viz. 15-15.5 years, 15.5-16 years, 16-16.5 yrs and 16 – 17 yrs. Informed consent of each subject so chosen on the basis of criteria as mentioned above was evaluated clinically in detail.

After obtaining the informed consent for the ultrasonological and clinical examination, each subject was examined ultrasonologically for elbow joint of right upper limb in the Department of Radiology of SGRR Medical College, Patel Nagar, and Dehradun and subsequently the ultra sonogram was studied in detail by the radiologist with respect to fusion of various ossification centres.

Result & Discussion:

The present study was undertaken to find out the age of fusion of epiphyses at the lower end of humerus and upper end of radius and ulna in females of Garhwali region.

Ultrasonological study was conducted on 100 females in the age group of 15-17 yrs. in Dehradun, Uttarakhand, India. Courts very often refer the cases particularly those falling in border line category for medical opinion before finalizing their verdict. In most of the cases the result was found to be more reliable and precise as compared to radiological examination.

So the basic aim of this study remains the same. This study has been done by ultrasonographical method which is superior to X-Ray. This study would certainly help the medical professionals, law enforcers, bar, bench and even the public at large more effectively.

In our study fusion of medial epicondyle was found between 15 years to 15.5 years in 92% cases and between 15.5 years to 16 yrs in 96% cases but all the cases i.e. 100% showed fusion between 16 to 17 yrs. (Table 1)

In a similar study done by R.S Jnanesh et al, [1] epiphyseal center for medial epicondyle fuses with shaft at the age of 14-15 years in females. In our study we have observed that Medial Epicondyle of Humerus showed fusion in all cases at the age of 16-17 yrs.

Our findings were consistent with those of Galstaun, [2] Basu & Basu, [3] Hepworth, [4] Lall & Nut, [5] Pillai, [6] Flecker and Franklin. [7]

According to Davies & Parson [8] study fusion occurred at the age of 20 yrs which is at variance with our study, the causes being primarily attributed to geographical position and boys having been included in that study.

Apart from that a host of other factors like state of nutrition, climatic conditions should be taken into consideration. On the other hand, a similar study undertaken by Lal R et al [9] had shown that Medial epicondyle unites by the age of 17 years in 67% cases while the same unites in 90% cases at 18 years of age.

Our study is in stark contrast with this study. The discrepancy again may be attributed to gender selection, exposure time, sample size, geographical location and so on.

In our study we observed that upper end of Radius & Ulna fused at the age of 15 to 16 yrs & 16 to 17 yrs in 96% cases and in 100% cases respectively. (Table 2&3) According to Galstraun [2] study fusion occurred at the age of 14-15 yrs.

Whereas Basu & Basu [3] and Hepworth [4] found fusion at the age of 13-14 yrs. Similar findings were also observed by Flecker, [7] Davies, Parson & Franklin. [8]

The discrepancy could be attributed to a host of factors like ignoring different stages of fusion viz. F3, F4, F5 etc. amid other factors mentioned earlier. If we also take F4 stage as the stage of fusion, our findings become consistent with their findings but we have taken F5 as the complete fusion hence the difference.

Pillai [6] study showed complete fusion around the elbow joint between 14-18 yrs of age. Galstaun G, [2] from his study on Bengalese opined that complete union at the elbow joint occurred at 16 years, Basu SK and Basu [3] recorded fusion at the elbow joint as 17 years.

Lal R and Townsend [9] stated that the fusion around the elbow joint in the north Indian girls was completed by 12-16 years. In this study, at 15 to 16 yrs there is complete union in 96% of the cases. Aggarwal ML and Pathak [10] stated that in Punjabi girls, complete union occurred at the elbow at 16 years, but our study reveals that complete fusion in Garhwali girls can be seen by 17 years which may be due to geographical variation.

Chhokar V et al in their study of 200 female subjects of New Delhi found that complete fusion occurred at 14-16 years, our study further narrows it down to 16-17 years.

Sahni D et al [11] in North West India observed that 100% of the cases in his study showed complete union of the elbow joint epiphyses in the age group of 16-16.9 years and commented that if there is incomplete fusion, the girl is below 16 years of age, even as the present study claims that the age has to be below 16 years in Garhwali females thus further substantiating it helping the law enforcing authorities more effectively.

Conclusion:

We have to some extent been able to show that ultrasound is better than x-ray exposure. It is easy to get subjects because of no risk of radiations. There is no need to take consent from the guardians of these subjects. Rather, the subjects themselves can give consent under sec 89 IPC.

Last but not the least, we can see various ossification centres dynamically by placing the probe on desired orientation. Our study seems to confirm our belief that ultrasound of elbow joint is a potentially promising method to estimate age in persons without exposing them to the undue risk of radiation.

We recommend that this study will help to arrive at a final conclusion regarding the validity of this method in the estimation of age. Since at the outset, our study's focus was x-ray examination of elbow joint between 15-17 years. Later on, we shifted to ultrasonology keeping in view the safety of volunteers and also conducting the examination dynamically unlike invasive and static nature of x-ray examination.

There have been a few studies worldwide involving ultrasound as a means to determining age. So the attempt is to substantiate and compare the findings ultrasonographically.

We have been successful also in bringing out the advantageous role of ultrasonography. It was seen that fusion of ossification centres appeared somewhat earlier on ultrasound than would have been possible radiologically. Moreover, this region of ours being a virgin state wherein no such study was ever undertaken, the present study will be a

benchmark for other researcher in this region to take a cue out of it. Therefore, it is earnestly felt that our study is going to be helpful to solve various medico legal cases connected with ages especially in the Garhwali population. Our successors can endeavor to initiate a similar study taking into its lap more number of cases.

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Table 1: Fusion of Lower End of Elbow

Age In Years	15-15.5	15.5-16	16-16.5	16.5- 17
No. of Children	25	25	25	25
Fusion	23	24	25	25
%	92	96	100	100

Table 2: Fusion of Radius with Shaft of Radius

Age in Years	15- 15.5	15.5-16	16-16.5	16.5- 17
No. of Children	25	25	25	25
Fusion	24	24	25	25
%	96	96	100	100

Table 3: Fusion of Head of Ulna with Shaft

Age in Years	15- 15.5	15.5- 16	16 -16.5	16.5 – 17
No. of Children	25	25	25	25
Fusion	24	24	25	25
%	96	96	100	100

Review Research Paper

Crimes against Women in Matrilineal Meghalaya A Forensic Medical Perspective

Amarantha Donna Ropmay

Abstract

The northeastern state of Meghalaya, located at the foothills of the Himalayas, was once a haven of peace and tranquility. It is home to the Khasi, Jaintia and Garo tribes who follow the matrilineal system, where women have a special position and role in society. However, through the years, progressive degeneration of moral values has resulted in an escalation of illegal activities, crimes against women and gender-based violence. In the present context, the average doctor faces various medico-legal challenges in routine practice. The changing trends in society emphasize the need for forensically trained doctors, who have the expertise to handle cases of medico legal nature. It is imperative to re-orient practitioners on forensic procedures while dealing with victims of sexual assault to ensure that justice is served in such situations. Doctors must also be familiar with laws related to medical practice in order to avoid pitfalls while performing their duties in good faith.

Key Words: Meghalaya, Matrilineal, Medico-legal, Crime against Women, Forensic Medical

Introduction:

Meghalaya, the 'abode of clouds', a hill state nestled at the foot of the Himalayas, was once a quiet and serene place. The indigenous tribes of the state are unique in their matrilineal societal system. [1] It is, therefore, a paradox that in a society where the fairer sex is believed to be emancipated, empowered and accorded respect, crimes against their lot are on the rise.

In the year 2013, a hundred and eighty-three cases of rape were registered in police stations across the state. A progressive degeneration of moral values and large floating population comprising illegal immigrants, through the years, has resulted in numerous illicit activities which include sexual offences, kidnapping and human trafficking.

The sad part is that while some women are 'soft targets' of these kind of crimes because of their vulnerability, others get embroiled in the dirty and shady world of sex, lies, deceit and violence owing to lustful desires of the flesh, which drive them to do what is unimaginable or even criminal.

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There are still some who are lured into clandestine deals because of the attraction to quick and easy money, especially if they are poor and economically hard-up.

It has been said that the psychology of rape is subjugating the woman to establish the man's dominance over her. Gone are the days when chivalrous men treated their ladies politely, kindly and honourably. Respect and regard for the opposite sex seem to be virtues of a bygone era. Thus, there has been a spurt in crimes against women owing to the changing trends and attitudes in society as a whole.

It also appears that the fair gender has had to pay a heavy price for so-called 'freedom' and 'fierce independence'. A school of thought states that women have 'brought it on themselves' because of their liberal lifestyles, modern dress sense and hanging out in places where 'good girls' have no business to be.

One wonders if this is strictly true because women suffer silently even within the "safe" confines of their homes, when their husbands or partners turn aggressive and violent. Hence, crimes against the weaker gender are not committed in the dark and dangerous streets alone, but also in the secure world of their own households.

Crime against Women Reported in Meghalaya:

A glance at the crime statistics of Meghalaya indicate a steady rise in gender-based violence over the past decade, with incidents of rape, molestation, kidnapping and

domestic violence of women showing an increasing trend (Fig. 1 and 2). [2]

Hospital data of alleged victims brought for medical examination during this period also support this fact. Unfortunately, a good number of victims happen to be female children targeted because of their vulnerability and innocence.

One can only imagine how perverted and lustful the perpetrators must be to commit such despicable acts of animalism. In the summer of 2013, a distraught seven year old girl was brought to hospital with a history of alleged sexual assault in a jungle after school hours by men who committed the act and took off. [3]

Till date, the criminals remain untraced by local police. A couple of months ago, there was an incident where a 12 year old girl was molested by policemen, believed to be upholders of the law. [4] Then there are reports of cruelty to women by their husbands or partners within their very own homes.

Although most cases of domestic violence are neither reported nor recorded, a study conducted at our hospital from July 2009 to December 2010 reveals that it does occur from time to time predominantly in rural areas among both tribal and non-tribal communities. [5] During the study period, there were thirteen victims in the age group of 20 to 30 years who presented to the emergency department after sustaining physical injuries.

Among them were two female children who suffered sexual abuse at the hands of their stepfathers. Little wonder that women no longer feel safe anywhere at all, taken into account the dangers and threats that loom large against them round every corner.

Challenges Faced By Government Doctors:

In the present context, the average government doctor not only has to manage sick patients but also face medico-legal challenges in routine practice. According to section 164A of the CrPC, in the course of investigating an allegation of rape, the victim has to be medically examined within twenty-four hours from the time of receiving the information relating to the commission of such offence. [6]

Medical evidence is crucial to confirm, corroborate or disprove the charges. A physician has a dual responsibility, the first being a duty of care towards the patient and secondly, a duty to serve the interest of justice. These two roles have to be effectively combined for a satisfying outcome. Treatment must be given on the basis of fully informed consent.

If this is absent, as in the case of incapacity due to alcohol, drugs or illness, then the doctor proceeds on the basis of the patient's best interests or implied consent. [7] The changing trends in society emphasize the need for forensically trained doctors, who have the expertise to handle cases of medico-legal nature. They must be well-versed on how to treat victims, document important findings and preserve relevant evidence in a scientific manner to render it acceptable and admissible in a court of law. The neglected area of 'forensic examination' of the living has assumed new meaning. Hence, the need of the hour is to re-orient and refresh practitioners on Forensic procedures, especially while dealing with victims of sexual offences and collecting evidence in a clinical setting.

A respect for ethical principles of autonomy and self-determination should form the basis of good medical practice, rather than outdated ideas of 'medical paternalism'. In the past, the doctor was revered and held in high esteem by patients. In every treatment situation, it was believed that the "doctor knows best".

However, times have changed and today, the principles of medical ethics state that any decision regarding treatment is best left to the patient after he is told about the benefits and risks as well as the outcome of not complying with the therapy.

According to Indian law, any person over the age of 12 years who is not suffering from a mental incapacity is capable of giving consent for, or refusing, routine medical treatment, unless there is evidence to the contrary. In the case of invasive procedures, the age of consent is 18 years.

It is only in emergency and life threatening situations that the doctor can go ahead without the patient's consent. [8, 9]

Another relevant ethical principle is that of confidentiality or 'professional secrecy', which is an implied term of contract between the doctor and patient, wherein the former is obliged to keep secret whatever he comes to know about the latter during the course of his professional work. Any information related to the patient must not be disclosed to a third party without his/her consent. Of course, there are exceptions to the rule, such as in cases where the Court of Law requires specific information for the cause of justice, or where the police have to be intimated in suspected crimes as per the law.

According to the Central Information Commission (CIC), the relationship between a doctor and his patient is a 'fiduciary' one that is based on trust. [10]

Hence, the former has a duty to maintain confidentiality in matters pertaining to the latter. The Delhi High Court recently ruled that medical records and tax returns may be exempted from disclosure under Section 8(1) of the Right to Information Act (RTI), unless it is in the larger public interest. [11]

Efforts by Local Organizations:

The Meghalaya State Commission for Women (MSCW) was constituted on 15th October, 2004, extending its jurisdiction to the whole state of Meghalaya, with an objective to improve the status of women and investigate violation of safeguards for women.

It can examine all matters related to violation of the provisions of the Constitution of India and other laws enacted to protect women, such as distinction and exclusion made on the basis of sex, infringement of any right or benefit conferred on women, deprivation of constitutional or human rights, and physical torture or sexual excesses on women including adolescent girls and female children.

Further, it seeks to achieve the objective of equality and evaluate the progress of advancement of women in the state. [12] In a gesture of concern for the problem of crimes against women, the commission has organized programmes for medical officers and police personnel in different districts of the state.

In a recent one-day orientation programme on gender sensitization, professionals from relevant departments, such as police, lawyers, government doctors and social workers deliberated on this important topic. However, the issue is a rather complex one which cannot be solved overnight, but requires a concerted effort by every conscious and concerned citizen over a period of time.

People should be made to realize that it is basically a change in social attitudes, and not just punishment of the perpetrator, which would ultimately lead to the reduction of these crimes. It is essential to inculcate a sense of values and respect for human beings in general and women in particular. The police have a role to play in registering and taking up reported cases of rape, which should be done without any delay.

An insensitive and judgemental approach based on the victim's character and lifestyle must not be entertained. Social workers, lawyers and doctors, on the other hand, have a duty to sensitize the public on these burning issues of today. It is essential for women to be aware of their right to legal services available in order to seek redressal for problems such as domestic violence and child abuse, [13]

In this regard, the Meghalaya State Legal Services Authority (MSLSA) has taken a positive step by organizing various legal awareness cum literacy programmes in different localities and districts of the state, with a view to empowering women to fight for justice when crimes are committed against them.

Recommendations Based on Public Interest Litigation:

In relation to doctors, Dr. I. L. Khandekar, Associate Professor of Forensic Medicine has suggested improvements for the examination of rape victims in a public interest litigation (PIL) filed by him after observing the 'pitiable' and 'horrendous' conditions in which medical procedure is often conducted.

Apart from a lack of privacy, the woman is subjected to further mental anguish by the casual attitude of doctors and undue delay in examination. The Maharashtra Government has issued guidelines for Forensic Medical examination of rape victims after the direction from the Nagpur bench of Bombay High Court on a PIL based on the study report of Dr. Khandekar. The PIL seeks directions to the Central and State governments to frame protocols and guidelines for proper forensic medical examination and collection of medical evidence by specially trained doctors. [14]

A compassionate and humane approach towards the aggrieved party must be adopted by all means, as she has already gone through the physical, mental and psychological trauma of being sexually violated. In a recent judgement, the Supreme Court has held that the two finger test on a rape victim, which is done to inspect the female hymen, violates her right to privacy, physical and mental dignity, and integrity.

The judges stated that rape survivors are entitled to legal recourse that does not re-traumatize them. Medical procedures should not be carried out in a manner that constitutes cruel, inhuman and degrading treatment, and health should be of paramount consideration while dealing with gender-based violence. [15]

Legal Aspects:

"If the law fails to respond to the needs of changing society, then either it will stifle the growth of the society and choke its progress or if the society is vigorous enough, it will cast away the law which stands in the way of its growth. Law must therefore contently be on the move adapting itself to the fast changing society and not behind". - **Justice Bhagwati.**

According to Section 357C CrPC, all hospitals, public or private, shall immediately provide first aid or medical treatment, free of

cost, to the victims of any offence covered under Sections 326A (acid attack) , 376 , 376A, 376B, 376C, 376D or 376E (punishment for rape) of the Indian Penal Code, and shall immediately inform the police of such incident.

The penalty for contravening the provisions of Section 357C CrPC is imprisonment for one year or fine or both (Section 166B of the IPC). [16] Further, if a doctor learns of a serious crime, such as murder, assault or rape in the course of treating the victim or assailant, he is legally bound to give information to the nearest Magistrate or police officer (Section 39 CrPC, Section 176 IPC). [17] The intentional omission to inform is punishable under Section 202 IPC.

A Supreme Court Ruling of 1989 states that all government hospitals and medical institutes should provide immediate medical aid to all cases irrespective of whether they are medico-legal or otherwise. [18]

The practice of certain institutions to refuse even primary medical aid and refer them to other hospitals simply because they are medico-legal cases is not desirable.

Whenever a medico-legal case attends the hospital, the medical officer on duty should inform the duty constable regarding name, age and sex of the patient, place of occurrence of the incident and start the necessary treatment.

The constable on duty will then inform the concerned police station or higher police authority for further action. Treatment of the patient would not wait for arrival of police or completing legal formalities.

The Protection of Women from Domestic Violence Act, 2005 was enacted with a view to providing more effective protection of the rights of women who are victims of violence of any kind within the family. [19] Domestic violence is defined as any act or conduct of the perpetrator that harms, injures or endangers the health, safety and well-being of the aggrieved person, in this case, the woman or child.

It may occur in the form of physical assault, sexual violation, verbal insults, emotional abuse or economic deprivation. The legislation authorizes the State Government to appoint Protection Officers who will assist victims in reporting the incident and getting medically examined if bodily injury has been sustained.

Any recognized voluntary organisation working for the welfare of women can register with the State Government as a service provider for legal aid, medical and financial assistance, and to ensure that the aggrieved person is given shelter in a shelter home.

The Magistrate, after hearing both parties and on being satisfied that domestic violence has taken or is likely to take place, can pass a Protection Order in favour of the victim to prevent the perpetrator from committing, aiding or abetting any act of domestic violence and abuse. Monetary relief may also be granted to the victim for expenses incurred and losses suffered by her and her children as a result of domestic violence.

According to the Legal Services Authorities Act of 1987, weaker sections of society are entitled to free legal services to bear the expenses of lawsuits which they may file or defend in court. [13] It seeks to ensure that justice is not denied to a person just because of financial constraints or disabilities.

The criteria for eligibility under Section 12 of the act include women and children, victims of human trafficking and those whose annual income does not exceed nine thousand rupees. Therefore, even poor women hailing from a low socio-economic background would get an opportunity to present their case in court for legal recourse.

The Sexual Harassment of Women at the Workplace Act, 2013 provides protection against sexual harassment of women, which is a violation of the fundamental right to equality under articles 14 and 15 of the Constitution of India. [20] A woman has the right to live and work with dignity and to practice her profession in a safe environment, free from insecurity and fear. Sexual harassment includes any unwelcome physical contact, verbal or non-verbal conduct of a sexual nature, sexually coloured remarks or showing pornography. Such actions may cause mental trauma, physical pain and suffering, and emotional distress to the victim. She may also have to face economic losses due to medical expenses for physical and psychiatric treatment.

The act provides for the constitution of an Internal Complaints Committee in every organisation, establishment or office, be it in the private or public sector, for the redressal of complaints of affected employees. The committee conducts an inquiry into the allegations against the respondent, and if convinced that they are true, would recommend action against him in accordance with the provisions of service rules, or payment of compensation to the aggrieved woman.

Conclusion:

In conclusion, the past decade has witnessed a steep rise in crimes against women in the matrilineal state of Meghalaya, where

ladies have a special status in society and were once held in high esteem. Proactive groups and women's organizations have stepped forward to create awareness and wage a war against gender-based violence targeted at women and female children in recent times.

Doctors and police officers have well-defined roles in such situations and need to be a little sensitive while dealing with victims. It would not be appropriate to question the character and morals of the woman after the crime has occurred because any assault, be it physical or sexual, brings with it intense emotional and psychological distress.

Therefore, the attitude and treatment of medical and police personnel dealing with her case makes a difference to how she feels and could determine how quickly she recovers from the episode. While a non-judgemental, professional and compassionate approach could heal and restore her, a negative and judgemental attitude could shatter her to pieces.

Good medical practice such as promptly attending to the patient, minimizing delay and proper communication, along with application of acceptable Forensic Medical techniques, would ensure timely delivery of justice in keeping with the law of the land. It would stand doctors in good stead to be aware of the various laws related to their day-to-day practice, which in turn would enable them to give patients their best, and to avoid pitfalls while performing their duties sincerely and in good faith.

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Fig. 1: Crimes against Women Reported in 2013 (Source: State Crime Records Bureau)

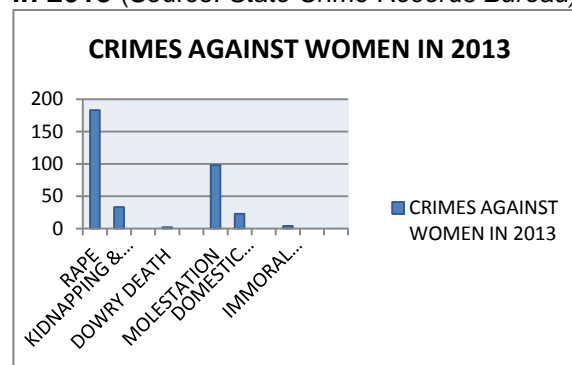
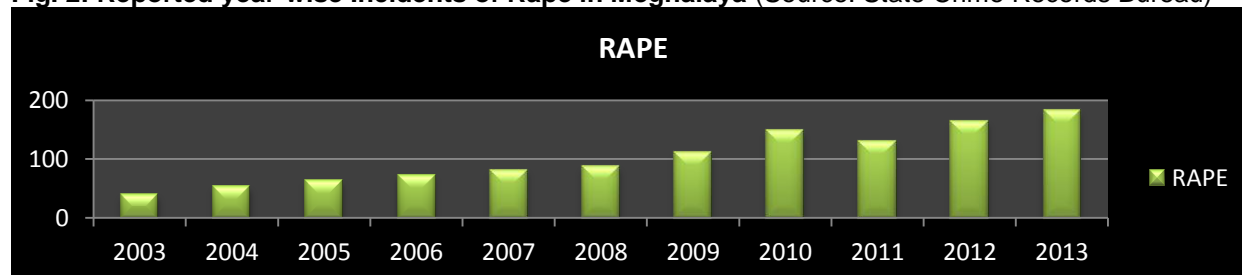


Fig. 2: Reported year-wise Incidents of Rape in Meghalaya (Source: State Crime Records Bureau)



Review Research Paper

Ethical and Legal Issues of Presumed Consent

¹M.S.Vinay Kumar, ²Sameer Valsangkar

Abstract

In India shortage of organ donors is a major health problem with ethical and legal concerns and requires immediate attention. Ever since the first transplants were carried out in the 1950s, there has been an imbalance between the availability of donated organs and the number of recipients. The objective of this article is to address various ethical and legal aspects of presumed consent. Presumed consent takes the onus away from the individual to register in order to become organ donor. Instead the individual must sign a register during his life if he is unwilling to donate. The argument which strongly favours this policy is thousands of healthy organs are destroyed every hour due to burial and cremation whereas innumerable people are dying because of want of these organs. The other side of this argument is organ donation should be the choice of the individual and must not be forced. Before passing legislation on presumed consent ethical and legal issues of presumed consent should be addressed and it is better to implement lesser ethically and legally debatable methods to overcome the backlog of organ donors than to introduce law on presumed consent.

Key Words: Presumed Consent, Organ donors, Ethical/Legal issues

Introduction:

Indians aren't all that generous when it comes to donating their organs. Spain has 35.1 organ donors per million, Britain (27), USA (26), Canada (14) and Australia (11) whereas India's count stands at 0.08 donors per million population. [1] It is estimated that every three minutes, a patient requires an organ transplant. Some experts say more than two lakh Indians require organ transplantation annually. But, unfortunately, not even 10% of them get it. [1]

Current practice across most part of the globe is to take consent of the donor for organ donation during life and consent of the relatives/legal heirs after death of the donor for organ procurement. But this traditional approach is not meeting the demands of organ requirement especially in developing countries like India. This has led to change in school of thought which is to presume every individual as an organ donor after his death unless an objection is made by the individual for donating his organs before death.

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DOR: 07.04.2014 DOA: 26.10.2014

This article is written with an objective to discuss various ethical and legal issues which arises once consent is presumed.

What Is Presumed Consent?

Presumed consent means an institutional policy of granting authority to health personnel to perform procedures on patients or to remove organs from cadavers for transplantation unless an objection is registered by family members or by the patient prior to death. This also includes emergency care of minors without prior parental consent.

Presumed consent takes the onus away from the individual to register in order to become an organ donor. Instead, the individual must sign a register in order to make his views known that he does not want to donate. Therefore everyone is treated as a donor unless they implicitly opt out. [2-5]

Global Scenario of Presumed Consent:

Presumed consent is practised in several countries across the world in two broad varieties. The first variety is soft or lenient system which is carried out in Spain. In this type of system even though consent is presumed, opinion of the family members is taken before procuring body organs of the donor.

The second variety is hard or stringent system as prevalent in Austria in which consultation of relatives/legal heirs after the death of donor is not done for obtaining organs [2]. However in reality even in countries where

hard system is being followed still the views of the family members is considered^[3, 4]. Till today there is no conclusive evidence regarding which of these two widely carried out systems yield in higher organ donation rate.

Issues of Vulnerable Groups:

Presumed consent poses a huge problem in persons who are incapable of making their personal decisions as in children and mentally incapacitated adults.

This can be nullified by applying the law of presumed consent only to autonomous adults who are capable of making their rational choices which will avoid the abuse of these vulnerable groups. However there is danger of discrimination of organs of these vulnerable groups as inferior as compared to others. [5]

In culmination before bringing legislation on presumed consent issues of the vulnerable should be kept in mind. The age at which a child can give consent should be reviewed.

Regarding adults who are incapable of making their choices, the level of mental abnormality, its scope, duration, nature and the effect of external agents like drugs, alcohol which render person incapable temporarily should be considered. [5]

Arguments Favouring Presumed Consent:

- At the very outset it looks very absurd as thousands of hearts, kidneys, lungs and other transplantable organs which are in good condition are destroyed by burial and cremation every day while thousands are suffering due to want of these organs for their survival.
- Shortage of organ donors may not only be due to lack of willingness of the donor but may be due to inadequate access to get register themselves during their lifetime. Presumed consent will certainly alleviate this problem.
- Most people do not expect premature death which may be the reason for not getting registered for organ donation. This can be nullified by passing legislation on presumed consent.
- Most of the times it is the relatives and legal heirs who refuse donation of organs of the dead rather than the donor. [5-11]

Arguments against Presumed Consent:

- Donation of organs should be the choice of the donor and must not be coerced. In fact many recipients will be more satisfied if the organ which they have received was given

voluntarily by the donor and was not due to force.

- Just like people who do not get access to register for voluntary donation, same thing holds true for individuals who wish to register for their unwillingness to donate organs.
- There are lots of controversies regarding criteria for declaration of donor death and time during which organs can be removed for transplantation.
- The state should not presume ownership of an individual's body after death.
- Various religions across the globe have their own beliefs and practices in treating the body after death. Presumed consent would definitely hurt the sentiments of several religions.
- The greatest drawback of presumed consent is it gives right to the state to remove all the organs after death and individuals are deprived of their choice to donate selected organs according to their will. [5, 12-18]

Alternatives to Presumed Consent:

- Increased promotion/ education.
- Paid or compensated donor schemes.
- Priority for transplants given to those that have agreed to donate.
- Mechanical engineered organs.
- Biologically engineered organs.
- Living donors.
- Paired/pooled schemes.
- Required referral.
- Aggressive consent pursuit.
- Forced donation.
- Donation after cardiac death donation (DCD). [5, 19-21]

Conclusion:

Even though presumed consent may reduce shortage of donor organs, it certainly leads to number of ethical and legal complications. The factors that influence organ donation rates have not been clearly identified.

An attitude regarding presumed consent among various sections of the society needs further investigation. Presuming consent implies body organ function has higher priority over consent of the donor which again raises ethical and legal complexities.

Measures to protect the most vulnerable group should be addressed before passing legislation on presumed consent.

Religious and cultural factors which have an impact on acceptance of presumed consent should be given due consideration. In culmination, it is wiser to implement less ethically and legally debatable measures to

increase organ donation before proceeding towards controversial issues like presumed consent.

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Review Research Paper

Mitochondrial DNA: A Reliable Tool in Forensic Odontology

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Abstract

Forensic odontology has emerged as one of the prime tool in Forensic investigations. Tooth being resistant to degrading environmental conditions, is a potential source in solving various criminal cases. Over the last few decades, DNA analysis has revolutionized the Forensic field. There have been several technical modifications and advancements in the DNA analysis. One such advance in the recent past is the use of mitochondrial DNA (mtDNA). Mitochondrial genome exhibit several unique characteristics such as multiple genome copies, heteroplasmy, variable expressivity, mitotic segregation and the threshold effect. These properties affect its inheritance pattern and even the Forensic analysis.

MtDNA differs from nDNA in many ways, including its location, its sequence, its quantity and its mode of inheritance with this technique; it is possible to analyze the DNA even in very small, damaged and degraded samples from where it is unable to analyze the nuclear DNA (nDNA). This article reviews the characteristics of mtDNA and its role in Forensic investigations.

Key Words: Odontology, Criminal cases, DNA analysis, mt DNA, nDNA

Introduction:

DNA is the chemical code and the genetic material found in the cells of the body. [1] It is present in all the cells including white blood cells, semen, hair roots, bone, teeth and other body tissue. DNA traces can be detected in body fluids as well, such as blood, saliva, semen, and perspiration. [1, 2] It is unique to each individual and because of this property it can be used in forensic investigations. [2, 3]

Since its introduction in the 1980s, the DNA analysis has enormously modified the pace of Forensic investigations. Though restriction fragment length polymorphism (RFLP) was the first technique introduced in 1985 by Dr. Alec Jeffreys, the technical advancements, especially the introduction of polymerase chain reaction (PCR) has revolutionized this field. [2, 4]

DNA analysis has several advantages over other techniques used for Forensic investigations. It can be applied to all the biological materials; it is resistant to environmental factors and high temperatures.

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DOR: 28.04.2014 DOA: 03.11.2014

It has tremendous discriminatory potential and a very high sensitivity. Even if DNA is reduced to low molecular weight through progressive fragmentation and degradation, smaller DNA fragments are present for considerable period, which can be obtained easily for DNA testing. [2, 5]

With advancements in technology, the time required for DNA testing has decreased to hours and this has hastened the process of Forensic investigations and judgement.

Mitochondria and Mitochondrial DNA:

Mitochondria are the ovoid or elongated thread like membrane bound organelles of great metabolic significance and form the principle source of chemical energy. [1, 6] The number of mitochondria in a cell differs in relation to their energy requirement. They are situated close to the parts of cell that shows highest energy requirement. [6] They are present in all human cells except mature erythrocytes. [7]

Mitochondria are self-replicating and they increase in number by division throughout interphase, and their division is not synchronized with the cell cycle. [1, 8]

Mitochondria are thought to have originated billions of years ago as primitive bacteria. They have developed from the order of proteobacteria as endosymbionts. This mostly likely has occurred as a result of phagocytosis.

Over thousands of generations, some of the genetic information from these bacteria has migrated into what have become human cell nuclei, while the mitochondria now exist

separately within the cell cytoplasm, retaining their own independently-replicating DNA. [2, 9]

Mitochondria's genetic system, the mtDNA was discovered in 1963. In 1981, the mitochondrial genome became the first complete sequence of a human genome to be published. [6] MtDNA differs from nDNA in many ways, including its location, its sequence, its quantity and its mode of inheritance. [3, 5] (Table 1) Mitochondrial genome contains a ~16.5 kb circular DNA, small sized rRNA and about 3000 genes (Table 2). [5, 9, 10] Only about 3% of the genes (100 of the 3000) are allocated for making ATP and more than 95% (2900 of 3000) are involved with other functions. [11]

Mitochondrial proteins originate mainly from two sources. While most mitochondrial proteins are translated on free cytosolic ribosomes, few other proteins are synthesized by their own genomes. Their membrane lipids are synthesized by endoplasmic reticulum. [12]

Mitochondria are inherited maternally and hence, all maternal relatives have the same mtDNA. [3, 5, 10, 11] Mitochondrial genome exhibit several unique characteristics such as multiple genome copies, heteroplasmy, variable expressivity, mitotic segregation and the threshold effect. [9-11]

These properties affect its inheritance pattern and even the Forensic analysis.

Cambridge Sequence is the standard sequence to which all the human mtDNA are compared. It was sequenced from several different human mtDNAs by a Medical Research Council Laboratory based at Cambridge, UK.

Variations in the mtDNA genome, from the Cambridge sequence are termed polymorphism. Control Region or D-loop is highly polymorphic and hence is used for Forensic purposes in providing a "DNA finger print" of suspects in criminal investigations. This loci spans 1100bp and contains two hyper variable regions, HVI and HVII. [3, 11]

Mitochondrial DNA in Forensics:

MtDNA is a good source of evidence in Forensic investigations and it has been used as a tool for Forensic identification since 1993. [12] The FBI Lab conducted studies to test the usefulness of mtDNA analysis for human identity testing in late 1980s. In 1992, the lab began research on the use of mtDNA in resolving criminal cases. In June 1996, the mtDNA was used as evidentiary sample in the case of State of Tennessee v. Paul Ware.

Since then mtDNA typing has become routine and is used in investigations of missing persons, mass disasters, and other Forensic

investigations such as murder, rape, robbery and drug offences. [12, 13]

MtDNA can be analyzed from samples such as old bones, teeth, hair shafts, and other biological samples where nDNA content is low. [2, 3]

Characteristics of mtDNA:

- 16,569 base pairs
- Encodes - 37 genes
- Codes 13 protein subunits— mainly responsible for certain key components of oxidative phosphorylation pathway
- Genes for 12s and 16s rRNA
- Genes for 22 tRNA
- D loop containing DNA replication and transcriptional promoter sequence
- Maternal inheritance
- Multiple copies
- No effective DNA repair system

mtDNA Analysis Advantages over the nDNA: [5, 13-15]

- High copy number, rapid rate of evolution, haploid nature, lack of recombination and the maternal mode of inheritance, which make the mtDNA better choice in situations where nDNA cannot be used for the analysis.
- Due to the high copy number of mtDNA in the cell, it can be analysed even from the highly damaged, degraded or very small quantity of the samples, when nDNA testing produces no results.
- The subcellular location of mtDNA within the mitochondria offers extra protection through the mitochondrial membranes compared to those surrounding the nucleus.
- Its exonuclease-resistant circular nature also contributes to its molecular stability.
- Since mtDNA is maternally inherited, siblings and all the maternally related family members will have similar mtDNA sequence. Hence, comparisons can be made using a reference sample from any maternal relative, even if the unknown and reference sample are separated by many generations.
- Mitochondrial DNA analysis of hair, bone and teeth is particularly successful in part due to the encapsulation of DNA by the exterior of the tissue and protection of mtDNA within layers of keratin (hair) and hydroxyapatite (bone and teeth).

MtDNA Analysis:

MtDNA analysis as compared to standard DNA analysis is laborious and lengthy.

This analysis is mainly based upon the strategy of polymerase chain reaction (PCR) amplifications that focuses on the Control Region or smaller regions of interest within the Control Region, hyper variable region I (HVI), hyper variable region II (HVII) and hyper variable region III (HVIII), which contain a large majority of the polymorphisms.

The various steps of the mtDNA analysis include primary visual analysis, sample preparation, DNA extraction, polymerase chain reaction (PCR) amplification, post amplification, quantification of the DNA, automated DNA Sequencing and data Analysis. [3, 5]

Visual Analysis:

It is the first step in the analysis which is executed to determine if the sample needs be subjected to DNA analysis or not.

If the sample is hair, it is mounted on to a glass slide and examined under the microscope comparing it with that of the reference sample. If both the samples match, further confirmation is done through molecular level analysis of mtDNA.

If the sample is bone and teeth, the forensic anthropologists or Odontologist inspect the tissue to determine if it is of human origin and then followed by mtDNA analysis. [3, 5]

Sample Preparation:

This step involves cleaning the sample to remove contaminating materials surrounding or adhering to the sample so that the exogenous human DNA sample if any is removed.

Hair sample cleaning involves detergent treatment in an ultrasonic water bath. For bone and tooth sample, their exterior surface is sanded to remove any extraneous material that may adhere to the surface. [3, 5]

DNA Processing:

The prepared sample is mixed with various organic or alkaline chemicals that separate the DNA from other biological materials, such as proteins.

Then it is centrifuged, sedimented and filtered to obtain purified DNA sample. This sample is further subjected to Polymerase chain reaction, where the sample is amplified, quantified and sequenced. [3, 5]

Data Analysis:

The differences and similarities between sequences are read based on the set guidelines. Software can be used for the analysis. [3, 5, 16] PCR is the most common technique employed for mtDNA analysis. It has several advantages.

It is a faster method, it produces more discrete results and it can be performed on cadaveric tissue, formalin fixed tissue, and on

blood that has been exposed to environment for long. [5] Other techniques have also been attempted. The analysis of multiplex mini-sequencing of mtDNA has shown high success rates. It is approximately 80% for shed hairs and in excess of 90% for fecal material. [12]

The corroboration of SNP analysis of mtDNA in the noncoding and coding regions has been found to be useful in Forensic investigations. [17] As hair samples degrade postmortem, levels of amplifiable mtDNA decrease. [18]

A simplified method for mtDNA extraction was described involving alkaline digestion to dissolve a hair in approximately 6 hours. [19] A 5-year retrospective review of mtDNA on 691 hairs from forensic casework found that a full or partial mtDNA profile could be obtained on >92% of the examined hairs. [20]

Denaturing high-performance liquid chromatography (DHPLC) has been tried for mtDNA analysis and it has been found to be advantageous. It is more accurate, rapid, and cost-effective. [13]

Since teeth are highly resistant to degradation from adverse environmental conditions, they form good source for forensic analysis. MtDNA can be analyzed from pulp and dentinal tissues. Dentin can be sampled using techniques such as splitting, crushing, scraping, and filing of the teeth, cryogenic grinding or horizontal sectioning technique. [21]

mtDNA analysis has few disadvantages. The procedure is sensitive and expensive, mtDNA shows heteroplasmy and the discriminatory power is 1:200. [5] Fragmentation and environmental degradation of the DNA and laboratory contamination can complicate analysis. Hence, contamination prevention should be strictly followed in the laboratory.

mtDNA analysis has been successfully used in cases of identifying Romanovs, Anna Anderson and Jesse James. [14, 22, 23]

Conclusion:

Due to its special characteristic features, the mtDNA offers several advantages over nDNA, due to which it can be used even in cases, where nDNA is unavailable for the analysis. It has been pivotal in solving few of the unresolved cases.

Tooth has been proved to be a good source of nDNA. The extraction of mtDNA from tooth has also been done, but needs further research and exploration.

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Table 1
Differentiating Features between Nuclear DNA (nDNA) and Mitochondrial DNA (mtDNA)

	Nuclear DNA	Mitochondrial DNA
Location	Found in nucleus of the cell	Found in mitochondria of the cell
Number	2 sets of 23 chromosomes	Each mitochondria may have several copies of the single mtDNA molecule
Shape	Double helix	Circular
Structure	Bounded by a nuclear envelope	Free of a nuclear envelope
Chromatin	DNA packed into chromatin	DNA is not packed into chromatin
Inheritance Pattern	Both Maternal and paternal	Inheritance - Maternal only
Discrimination	Can "discriminate between individuals of the same maternal lineage"	Cannot "discriminate between individuals of the same maternal lineage"
Mutation Rate	Susceptible for mutation	Susceptible for mutation and is 10 times higher than nDNA
Forensic Evidence	Used with evidence such as saliva, semen, blood	Used with evidence such as hair, bones, and teeth

Review Research Paper

Role of Informed Consent in India Past, Present and Future Trends

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Abstract

There is a need to keep the cost of treatment within affordable limits. Bringing in the American concepts and standards of treatment procedures and disclosure of risks, consequences and choices will inevitably bring in higher cost-structure of treatment. Patients in India cannot afford them. People in India still have great regard and respect for Doctors. The Members of medical profession have also, by and large, shown care and concern for the patients. There is an atmosphere of trust and implicit faith in the advice given by the Doctor. Apex Court observed that "What choice do these poor patients have? Any treatment of whatever degree is a boon or a favour, for them. The stark reality is that for a vast majority in the country, the concepts of informed consent or any form of consent, and choice in treatment, have no meaning or relevance."

This paper deals with the applicability of concept of '**informed consent**' in past, present and future scenario in India, based on the critical review of recent decisions of Hon'ble Supreme Court of India and National Consumer Dispute Redressal Commission, New Delhi.

Key Words: Consent, Real Consent, Informed Consent, Oral Consent, Deficiency of Service

Introduction:

An increasingly important risk area for all doctors is the question of consent. No-one may lay hands on another against their will without running the risk of criminal prosecution for assault and, if injury results, a civil action for damages for trespass or negligence. In the case of a doctor, consent to any physical interference will readily be implied; a woman must be assumed to consent to a normal physical examination if she consults a gynecologist, in the absence of clear evidence of her refusal or restriction of such examination.

The problems arise when the gynecologist's intervention results in unfortunate side effects or permanent interference with a function, whether or not any part of the body is removed.

For example, if the gynaecologist agrees with the patient to perform a hysterectomy and removes the ovaries without her specific consent, that will be a trespass and an act of negligence.

The only available defense will be that it was necessary for the life of the patient to proceed at once to remove the ovaries because of some perceived pathology in them. [1, 7]

Indian Scenario:

In India, majority of citizens, requiring medical care and treatment fall below the poverty line. Most of them are illiterate or semi-literate. They cannot comprehend medical terms, concepts, and treatment procedures.

They cannot understand the functions of various organs or the effect of removal of such organs. They do not have access to effective but costly diagnostic procedures. Poor patients lying in the corridors of hospitals after admission for want of beds or patients waiting for days on the roadside for an admission or a mere examination is a common sight. [7]

For them, any treatment with reference to rough and ready diagnosis based on their outward symptoms and doctor's experience or intuition is acceptable and welcome so long as it is free or cheap; and whatever the doctor decides as being in their interest, is usually unquestioningly accepted. They are a passive, ignorant and uninvolved in treatment procedures. The poor and needy face a hostile

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medical environment - inadequacy in the number of hospitals and beds, non-availability of adequate treatment facilities, utter lack of qualitative treatment, corruption, callousness and apathy. Many poor patients with serious ailments (e.g. heart patients and cancer patients) have to wait for months for their turn even for diagnosis, and due to limited treatment facilities, many die even before their turn comes for treatment. [7]

Is Concepts of Informed Consent having No Meaning or Relevance in present scenario?

What choice do these poor patients have? Any treatment of whatever degree is a boon or a favour, for them. The stark reality is that for a vast majority in the country, the concepts of informed consent or any form of consent, and choice in treatment, have no meaning or relevance. [7]

Position of Doctors in Government and Charitable hospitals:

The position of doctors in Government and charitable hospitals, which treat them, is also unenviable. They are overworked, understaffed, with little or no diagnostic or surgical facilities and limited choice of medicines and treatment procedures. They have to improvise with virtual non-existent facilities and limited dubious medicines.

They are required to be committed, service oriented and non-commercial in outlook. What choice of treatment can these doctors give to the poor patients? What informed consent they can take from them? [7]

Indian Middle Class Public Psyche about Medical Private Commercial Sector:

The private hospitals and doctors prescribe avoidable costly diagnostic procedures and medicines, and subject them to unwanted surgical procedures, for financial gain.

The public feel that many doctors who have spent a crore or more for becoming a specialist, or nursing homes which have invested several crores on diagnostic and infrastructure facilities, would necessarily operate with a purely commercial and not service motive; that such doctors and hospitals would advise extensive costly treatment procedures and surgeries, where conservative or simple treatment may meet the need; and that what used to be a noble service oriented profession is slowly but steadily converting into a purely business. [7]

But unfortunately not all doctors in government hospitals are paragons of service, nor fortunately, all private hospitals / doctors are commercial minded. There are many doctors in government hospitals that do not care about patients and unscrupulously insist upon 'unofficial' payment for free treatment or insist upon private consultations. [7]

On the other hand, many private hospitals and Doctors give the best of treatment without exploitation, at a reasonable cost, charging a fee, which is reasonable recompense for the service rendered. [7]

Who is Responsible for Bad Reputation of Noble Profession?

Some doctors, both in private practice or in government service, look at patients not as persons who should be relieved from pain and suffering by prompt and proper treatment at an affordable cost, but as potential income-providers / customers who can be exploited by prolonged or radical diagnostic and treatment procedures. It is this minority who bring a bad name to the entire profession. [7]

Era of Specialists and Super Specialists:

The proliferation of specialists and super specialists, have exhausted many a patient both financially and physically, by having to move from doctor to doctor, in search of the appropriate specialist who can identify the problem and provide treatment. What used to be competent treatment by one General Practitioner has now become multi-pronged treatment by several specialists.

Factors for Higher Cost of Treatment: Defensive Practice:

Law stepping in to provide remedy for negligence or deficiency in service by medical practitioners, has its own twin adverse effects.

Firstly more and more private doctors and hospitals have, of necessity, started playing it safe, by subjecting or requiring the patients to undergo various costly diagnostic procedures and tests to avoid any allegations of negligence, even though they might have already identified the ailment with reference to the symptoms and medical history with 90% certainty, by their knowledge and experience. [7]

Secondly more and more doctors particularly surgeons in private practice are forced to cover themselves by taking out insurance, the cost of which is also ultimately passed on to the patient, by way of a higher fee. [7] As a consequence, it is now common that a comparatively simple ailment, which earlier used

to be treated at the cost of a few rupees by consulting a single doctor, requires an expense of several hundred or thousands on account of four factors:

- i. Commercialization of medical treatment;
- ii. Increase in specialists as contrasted from general practitioners and the need for consulting more than one doctor;
- iii. Varied diagnostic and treatment procedures at high cost; and
- iv. Need for doctors to have insurance cover.

Answer to Prohibitive Cost of treatment:

The obvious, may be *novae*, answer to unwarranted diagnostic procedures and treatment and prohibitive cost of treatment, is an increase in the participation of health care by the state and charitable institutions. [7]

Doctors themselves could make a Difference:

An enlightened and committed medical profession can also provide a better alternative. Be that as it may. We are not trying to intrude on matters of policy, nor are we against proper diagnosis or specialization. We are only worried about the enormous hardship and expense to which the common man is subjected, and are merely voicing the concern of those who are not able to fend for themselves. We will be too happy if what we have observed is an overstatement, but our intuition tells us that it is an under statement. [7]

What is meant by Consent?

The term '**informed consent**' is often used, but there is **no such concept in English law**. The consent must be real: that is to say, the patient must have been given sufficient information for her to understand the nature of the operation, its likely effects, and any complications which may arise and which the surgeon in the exercise of his duty to the patient considers she should be made aware of; only then can she reach a proper decision.

But the surgeon need not warn the patient of remote risks, any more than an anaesthetist need warn the patient that a certain small number of those anaesthetized will suffer cardiac arrest or never recover consciousness. Only where there is a recognized risk, rather than a rare complication, is the surgeon under an obligation to warn the patient of that risk.

He is not under a duty to warn the patient of the possible results of hypothetical negligent surgery.

In advising an operation, therefore, the doctor must do so in the way in which a competent gynaecologist exercising reasonable

skill and care in similar circumstances would have done. In doing this he will take into account the personality of the patient and the importance of the operation to her future well being. It may be good practice not to warn a very nervous patient of any possible complications if she requires immediate surgery for, say, a malignant condition.

The doctor must decide how much to say to her taking into account his assessment of her personality, the questions she asks and his view of how much she understands.

If the patient asks a direct question, she must be given a truthful answer. To take the example of hysterectomy: although the surgeon will tell the patient that it is proposed to remove her uterus and perhaps her ovaries, and describe what that will mean for her future well being (sterility, premature menopause), she will not be warned of the possibility of damage to the ureter, vesicovaginal fistula, fatal haemorrhage or anaesthetic death." [1, 7]

Consent in the Context of a Doctor-Patient Relationship:

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.

Consent can be **implied** in some circumstances from the action of the patient. For example, when a patient enters a Dentist's clinic and sits in the Dental chair, his consent is implied for examination, diagnosis and consultation. Except where consent can be clearly and obviously implied, there should be **express consent**.

Global Scenario:

There is, however, a significant difference in the nature of **express consent** of the patient, known as '**real consent**' in UK and as '**informed consent**' in America.

Concept of 'valid' and 'real' consent in UK:

In UK, the elements of consent are defined with reference to the patient and consent is considered to be valid and 'real' when:

- i. The patient gives it voluntarily without any coercion;
- ii. The patient has the capacity and competence to give consent; and
- iii. The patient has the minimum of adequate level of information about the nature of the procedure to which he is consenting to.

Concept of 'informed consent' developed by American Courts:

On the other hand, the concept of 'informed consent' developed by American courts, while retaining the basic requirements consent, shifts the emphasis to the doctor's duty to disclose the necessary information to the patient to secure his consent.

'Informed consent' is defined in Taber's Cyclopedic Medical Dictionary thus:

"Consent that is given by a person after receipt of the following information: the nature and purpose of the proposed procedure or treatment; the expected outcome and the likelihood of success; the risks; the alternatives to the procedure and supporting information regarding those alternatives; and the effect of no treatment or procedure, including the effect on the prognosis and the material risks associated with no treatment. Also included are instructions concerning what should be done if the procedure turns out to be harmful or unsuccessful."

Doctor's Duty to Inform:

The United States Courts of Appeals, District of Columbia Circuit, emphasized the element of Doctor's duty in 'informed consent' thus:

"It is well established that the physician must seek and secure his patient's consent before commencing an operation or other course of treatment. It is also clear that the consent, to be efficacious, must be free from imposition upon the patient.

It is the settled rule that therapy not authorized by the patient may amount to a tort - a common law battery - by the physician.

And it is evident that it is normally impossible to obtain consent worthy of the name unless the physician first elucidates the options and the perils for the patient's edification. Thus the physician has long borne a duty, on pain of liability for unauthorized treatment, to make adequate disclosure to the patient." [Emphasis supplied] [1]

The Basic Principle in Regard to Patient's Consent in USA:

The basic principle in regard to patient's consent may be traced to the following classic statement by **Justice Cardozo** in a case, [2]:

"Every human being of adult years and sound mind has a right to determine what should be done with his body; and a surgeon who performs the operation without his patient's consent, commits an assault for which he is liable in damages".

Fundamental Principle on Consent in English Law:

This principle has been accepted by **English Court** also. In a case, [3] the **House of Lords** while dealing with a case of sterilization of a mental patient reiterated **the fundamental principle** that every person's body is inviolate and performance of a medical operation on a person without his or her consent is unlawful.

The **English law** on this aspect is **summarized** thus:

"Any intentional touching of a person is unlawful and amounts to the tort of battery unless it is justified by consent or other lawful authority. In medical law, this means that a doctor may only carry out a medical treatment or procedure which involves contact with a patient if there exists a valid consent by the patient (or another person authorized by law to consent on his behalf) or if the touching is permitted notwithstanding the absence of consent." [4]

The next question is whether in an action for negligence / battery for performance of an unauthorized surgical procedure, the Doctor can put forth as defense the consent given for a particular operative procedure, as consent for any additional or further operative procedures performed in the interests of the patient.

The Supreme Court of BC, Canada, [6] was considering a claim for battery by a patient who underwent a caesarian section. During the course of caesarian section, the doctor found fibroid tumors in the patient's uterus. Being of the view that such tumors would be a danger in case of future pregnancy, he performed a sterilization operation. The court upheld the claim for damages for battery.

It held that sterilization could not be justified under the principle of necessity, as there was no immediate threat or danger to the patient's health or life and it would not have been unreasonable to postpone the operation to secure the patient's consent. The fact that the doctor found it convenient to perform the sterilization operation without consent as the patient was already under general anaesthetic, was held to be not a valid defense.

A somewhat similar view was expressed by Courts of Appeal in England in a case [3] it was held that the additional or further treatment which can be given (outside the consented procedure) should be confined to only such treatment as is necessary to meet the emergency, and as such needs to be carried out at once and before the patient is likely to be in a position to make a decision for himself. [Para 16]

Lord Goff observed:

"Where, for example, a surgeon performs an operation without his consent on a patient temporarily rendered unconscious in an accident, he should do no more than is reasonably required, in the best interests of the patient, before he recovers consciousness. I can see no practical difficulty arising from this requirement, which derives from the fact that the patient is expected before long to regain consciousness and can then be consulted about longer term measures."

Exception to the Rule:

The decision in a case, [6] decided by the Supreme Court of NS, Canada, illustrates the exception to the rule, that an unauthorized procedure may be justified if the patient's medical condition brooks no delay and warrants immediate action without waiting for the patient to regain consciousness and take a decision for himself. [Para 16]

In that case the doctor discovered a grossly diseased testicle while performing a hernia operation. As the doctor considered it to be gangrenous, posing a threat to patient's life and health, the doctor removed it without consent, as a part of the hernia operation. An action for battery was brought on the ground that the consent was for a hernia operation and removal of testicle was not consent. The claim was consent of the patient where it is necessary to save the life or preserve the health of the patient. [6]

The Principle of Necessity:

Thus, the principle of necessity by which the doctor is permitted to perform further or additional procedure (unauthorized) is restricted to cases where the patient is temporarily incompetent (being unconscious), to permit the procedure delaying of which would be unreasonable because of the imminent danger to the life or health of the patient.

Practical or Convenient Reasons, Not Relevant:

It is quite possible that if the patient been conscious, and informed about the need for the additional procedure, the patient might have agreed to it. It may be that the additional procedure is beneficial and in the interests of the patient. It may be that postponement of the additional procedure (say removal of an organ) may require another surgery, whereas removal of the affected organ during the initial diagnostic or exploratory surgery would save the patient from the pain and cost of a second operation. Howsoever, practical or convenient the reasons may be, they are not relevant.

What is Relevant?

What is relevant and of importance is the inviolable nature of the patient's right in regard to his body and his right to decide whether he should undergo the particular treatment or surgery or not.

Therefore at the risk of repetition, we may add that unless the unauthorized additional or further procedure is necessary in order to save the life or preserve the health of the patient and it would be unreasonable (as contrasted from being merely inconvenient) to delay the further procedure until the patient regains consciousness and takes a decision, a doctor cannot perform such procedure without the consent of the patient. [7]

Code of Medical Ethics, Professional Misconduct and Consent:

We may also refer to the Code of Medical Ethics laid down by the Medical Council of India (approved by the Central Government under section 33 of Indian Medical Council Act, 1956). It contains a chapter relating to disciplinary action which enumerates a list of responsibilities, violation of which will be professional misconduct. Clause 13 of the said chapter places the following responsibility on a doctor:

"13. Before performing an operation, the physician should obtain in writing the consent from the husband or wife, parent or guardian in the case of a minor, or the patient himself as the case may be". In an operation which may result in sterility the consent of both husband and wife is needed. [8]

Guidelines of GMC of U.K.:

"S.C also refers to the following guidelines to doctors, issued by the General Medical Council of U.K. in seeking consent of the patient for investigation and treatment: "Patients have a right to information about their condition and the treatment options available to them. The amount of information you give each patient will vary, according to factors such as the nature of the condition, the complexity of the treatment, the risks associated with the treatment or procedure, and the patient's own wishes.

For example, patients may need more information to make an informed decision about the procedure which carries a high risk of failure or adverse side effects; or about an investigation for a condition which, if present, could have serious implications for the patient's employment, social or personal life. x x x x x

You should raise with patients the possibility of additional problems coming to light

during a procedure when the patient is unconscious or otherwise unable to make a decision. You should seek consent to treat any problems which you think may arise and ascertain whether there are any procedures to which the patient would object, or prefer to give further thought before you proceed."

The Consent form for Hospital admission and medical treatment presumed to constitute the contract between the parties. The Consent form for Hospital admission and medical treatment, to which appellant's signature was obtained by the respondent on 10.5.1995, which can safely be presumed to constitute the contract between the parties, specifically states:

"(A) It is customary, except in emergency or extraordinary circumstances, that no substantial procedures are performed upon a patient unless and until he or she has had an opportunity to discuss them with the physician or other health professional to the patient's satisfaction.

(B) Each patient has right to consent, or to refuse consent, to any proposed procedure of therapeutic course."

Nature of Information that is required to be furnished by a Doctor:

The Apex Court next considers the nature of information that is required to be furnished by a Doctor to secure a valid or real consent. In a case, [9] **Scott L.J.** observed: "A man cannot be said to be truly '**willing**' unless he is in a position to choose freely, and freedom of choice predicates, not only full knowledge of the circumstances on which the exercise of choice is conditioned, so that he may be able to choose wisely, but the absence from his mind of any feeling of constraint so that nothing shall interfere with the freedom of his will." [7]

Duty and Liability of Doctor for Providing Information:

In another case, [10] it was held that a physician violates his duty to his patient and subjects himself to liability if he withholds any facts which are necessary to form the basis of an intelligent consent by the patient to the proposed treatment. [7]

Rationale of a Doctor's Duty to Reasonably Inform a Patient:

Canterbury [1] explored the rationale of a Doctor's duty to reasonably inform a patient as to the treatment alternatives available and the risk incidental to them, as also the scope of the disclosure requirement and the physician's privileges not to disclose. It laid down the 'reasonably prudent patient test' which required

the doctor to disclose all material risks to a patient, to show an 'informed consent'.

It was held: "True consent to what happens to one's self is the informed exercise of a choice, and that entails an opportunity to evaluate knowledgeably the options available and the risks attendant upon each. The average patient has little or no understanding of the medical arts, and ordinarily has only his physician to whom he can look for enlightenment with which to reach an intelligent decision.

From these almost axiomatic considerations springs the need, and in turn the requirement, of a reasonable divulgence by physician to patient to make such a decision possible. Just as plainly, due care normally demands that the physician warn the patient of any risks to his well being which contemplated therapy may involve. The context in which the duty of risk-disclosure arises is invariably the occasion for decision as to whether a particular treatment procedure is to be undertaken.

To the physician, whose training enables a self-satisfying evaluation, the answer may seem clear, but it is the prerogative of the patient, not the physician, to determine for himself the direction in which his interests seem to lie. To enable the patient to chart his course understandably, some familiarity with the therapeutic alternatives and their hazards becomes essential a reasonable revelation in these respects is not only a necessity but, as we see it, is as much a matter of the physician's duty. It is a duty to warn of the dangers lurking in the proposed treatment, and that is surely a facet of due care.

It is, too, a duty to impart information which the patient has every right to expect. The patient's reliance upon the physician is a trust of the kind which traditionally has exacted obligations beyond those associated with arms length transactions.

His dependence upon the physician for information affecting his well-being, in terms of contemplated treatment, is well-nigh abject. We ourselves have found "in the fiducial qualities of (the physician-patient) relationship the physician's duty to reveal to the patient that which in his best interests it is important that he should know". We now find, as a part of the physician's overall obligation to the patient, a similar duty of reasonable disclosure of the choices with respect to proposed therapy and the dangers inherently and potentially involve.

In our view, the patient's right of self-decision shapes the boundaries of the duty to reveal. That right can be effectively exercised

only if the patient possesses enough information to enable an intelligent choice.

The scope of the physician's communications to the patient, then, must be measured by the patient's need, and that need is the information material to the decision. Thus the test for determining whether a particular peril must be divulged is its materiality to the patient's decision: all risks potentially affecting the decision must be unmasked.

"It was further held that a risk is material 'when a reasonable person, in what the physician knows or should know to be the patient's position, would be likely to attach significance to the risk or cluster of risks in deciding whether or not to forego the proposed therapy'. The doctor, therefore, is required to communicate all inherent and potential hazards of the proposed treatment, the alternatives to that treatment, if any, and the likely effect if the patient remained untreated. [1, 7]

This stringent standard of disclosure was subjected to only two exceptions:

- (i) Where there was a genuine emergency, e.g. the patient was unconscious; and
- (ii) Where the information would be harmful to the patient, e.g. where it might cause psychological damage, or where the patient would become so emotionally distraught as to prevent a rational decision.

It, however, appears that several States in USA have chosen to avoid the decision in *Canterbury* [1] by enacting legislation which severely curtails operation of the doctrine of informed consent. [1, 7]

Stringent Standards Not Accepted in the English Courts:

The stringent standards regarding disclosure laid down in *Canterbury* [1], as necessary to secure an informed consent of the patient, was not accepted in the English courts. In England, standard applicable is popularly known as the **Bolam Test**. [11]

McNair J., in a trial relating to negligence of a medical practitioner, while instructing the **Jury**, stated thus:

"(i) A doctor is not negligent, if he has acted in accordance with a practice accepted as proper by a responsible body of medical men skilled in that particular art. Putting it the other way round, a doctor is not negligent, if he is acting in accordance with such a practice, merely because there is a body of opinion that takes a contrary view. At the same time, that does not mean that a medical man can obstinately and pig-headedly carry on with some old technique if it has been proved to be contrary

to what is really substantially the whole of informed medical opinion. [7, 11]

(ii) When a doctor dealing with a sick man strongly believed that the only hope of cure was submission to a particular therapy, he could not be criticized if, believing the danger involved in the treatment to be minimal, did not stress them to the patient. [7, 11]

(iii) In order to recover damages for failure to give warning the plaintiff must show not only that the failure was negligent but also that if he had been warned he would not have consented to the treatment. [7, 11]

A **Scottish case [12]** is also worth noticing. In that decision, **Lord President Clyde** held: "In the realm of diagnosis and treatment there is ample scope for genuine difference of opinion and one man clearly is not negligent merely because his conclusion differs from that of other professional men, nor because he has displayed less skill or knowledge than others would have shown.

The true test for establishing negligence in diagnosis or treatment on the part of a doctor is whether he has been proved to be guilty of such failure as no doctor of ordinary skill would be guilty of if acting with ordinary care". [12, 1]

What is the Need of a patient?

He also laid down the following requirements to be established by a patient to fasten liability on the ground of want of care or negligence on the part of the doctor:

"To establish liability by a doctor where deviation from normal practice is alleged, three facts require to be established.

First of all it must be proved that there is a usual and normal practice;

Secondly it must be proved that the defender has not adopted that practice; and

Thirdly (and this is **of crucial importance**) it must be established that the course the doctor adopted is one which no professional man of ordinary skill would have taken if he had been acting with ordinary care". [12, 1]

In a case, the House of Lords, per majority, adopted the Bolam test, as the measure of doctor's duty to disclose information about the potential consequences and risks of proposed medical treatment.

In that case [13] the defendant, a surgeon, warned the plaintiff of the possibility of disturbing a nerve root while advising an operation on the spinal column to relieve shoulder and neck pain. He did not, however, mention the possibility of damage to the spinal cord. Though the operation was performed

without negligence, the plaintiff sustained damage to spinal cord resulting in partial paralysis. The plaintiff alleged that defendant was negligent in failing to inform her about the said risk and that had she known the true position, she would not have accepted the treatment.

The Trial Judge and Court of Appeal applied the **Bolam test** and concluded that the defendant had acted in accordance with a practice accepted as proper by a responsible body of medical opinion, in not informing the plaintiff of the risk of damage to spinal cord.

Consequently, the claim for damages was rejected. The House of Lords upheld the decision of the Court of Appeal that the doctrine of informed consent based on full disclosure of all the facts to the patient, was not the appropriate test of liability for negligence, under English law. The majority were of the view that the test of liability in respect of a doctor's duty to warn his patient of risks inherent in treatment recommended by him was the same as the test applicable to diagnosis and treatment, namely, that the doctor was required to act in accordance with the practice accepted at the time as proper by a responsible body of medical opinion.

Lord Diplock stated: "In English jurisprudence the doctor's relationship with his patient which gives rise to the normal duty of care to exercise his skill and judgment to improve the patient's health in any particular respect in which the patient has sought his aid has hitherto been treated as a single comprehensive duty covering all the ways in which a doctor is called on to exercise his skill and judgment in the improvement of the physical or mental condition of the patient for which his services either as a general practitioner or as a specialist have been engaged.

This general duty is not subject to dissection into a number of component parts to which different criteria of what satisfy the duty of care apply, such as diagnosis, treatment and advice (including warning of any risks of something going wrong however skillfully the treatment advised is carried out).

The Bolam case itself embraced failure to advise the patient of the risk involved in the electric shock treatment as one of the allegations of negligence against the surgeon as well as negligence in the actual carrying out of treatment in which that risk did result in injury to the patient. The same criteria were applied to both these aspects of the surgeon's duty of care.

In modern medicine and surgery such dissection of the various things a doctor has to do in the exercise of his whole duty of care owed

to his patient is neither legally meaningful nor medically practicable.

To decide what risks the existence of which a patient should be voluntarily warned and the terms in which such warning, if any, should be given, having regard to the effect that the warning may have, is as much an exercise of professional skill and judgment as any other part of the doctor's comprehensive duty of care to the individual patient, and expert medical evidence on this matter should be treated in just the same way. The **Bolam test** should be applied". [13, 7]

Lord Bridge stated:

"I recognize the logical force of the Canterbury doctrine, proceeding from the premise that the patient's right to make his own decision must at all costs be safeguarded against the kind of medical paternalism which assumes that 'doctor knows best'. But, with all respect, I regard the doctrine as quite impractical in application for three principal reasons.

First, it gives insufficient weight to the realities of the doctor / patient relationship. A very wide variety of factors must enter into a doctor's clinical judgment not only as to what treatment is appropriate for a particular patient, but also as to how best to communicate to the patient the significant factors necessary to enable the patient to make an informed decision whether to undergo the treatment.

The doctor cannot set out to educate the patient to his own standard of medical knowledge of all the relevant factors involved. He may take the view, certainly with some patients that the very fact of his volunteering, without being asked, information of some remote risk involved in the treatment proposed, even though he described it as remote, may lead to that risk assuming an **undue significance in the patient's calculations**. [13, 7]

Second, it would seem to me quite unrealistic in any medical negligence action to confine the expert medical evidence to an explanation of the primary medical factors involved and to deny the court the benefit of evidence of medical opinion and practice on the particular issue of disclosure which is under consideration. [13, 7]

Third, the objective test which Canterbury propounds seems to me to be so imprecise as to be almost meaningless. If it is to be left to individual judges to decide for themselves what: "a reasonable person in the patient's position' would consider a risk of sufficient significance that he should be told about it, the outcome of litigation in this field is likely to be quite unpredictable". . [13, 7]

The doctor's duty is to answer truthfully and as fully as the questioner requires:

Lord Bridge however made it clear that when questioned specifically by the patient about the risks involved in a particular treatment proposed, the doctor's duty is to answer truthfully and as fully as the questioner requires.

He further held that remote risk of damage (referred to as risk at 1 or 2%) need not be disclosed but if the risk of damage is substantial (referred to as 10% risk), it may have to be disclosed. Lord Scarman, in minority, was inclined to adopt the more stringent test laid down in *Canterbury*. [13, 7]

Applicability and Acceptance of 'Bolam Test' in India:

In **India**, **Bolam test** has broadly been accepted as the general rule. We may refer three cases of this Court. In one case, [14] *Apex Court* held:

"The skill of medical practitioners differs from doctor to doctor. The nature of the profession is such that there may be more than one course of treatment which may be advisable for treating a patient. Courts would indeed be slow in attributing negligence on the part of a doctor if he has performed his duties to the best of his ability and with due care and caution.

Medical opinion may differ with regard to the course of action to be taken by a doctor treating a patient, but as long as a doctor acts in a manner which is acceptable to the medical profession and the Court finds that he has attended the patient with due care skill and diligence and if the patient still does not survive or suffers a permanent ailment, it would be difficult to hold the doctor to be guilty of negligence.

In cases where the doctors act carelessly and in a manner which is not expected of a medical practitioner, then in such a case an action in torts would be maintainable".

"In another case, [15] this Court after referring to *Bolam*, [11] *Sidaway*, [13] and *Achut Rao*, [14] clarified:

"A doctor will be liable for negligence in respect of diagnosis and treatment in spite of a body of professional opinion approving his conduct where it has not been established to the court's satisfaction that such opinion relied on is reasonable or responsible.

If it can be demonstrated that the professional opinion is not capable of withstanding the logical analysis, the court would be entitled to hold that the body of opinion is not reasonable or responsible.

In another case, [16], this Court held:

"The approach of the courts is to require that professional men should possess a certain minimum degree of competence and that they should exercise reasonable care in the discharge of their duties. In general, a professional man owes to his client a duty in tort as well as in contract to exercise reasonable care in giving advice or performing services".

Neither *Achut Rao* [14] nor *Vinitha Ashok* [15] referred to the American view expressed in *Canterbury*. [7]

Apex Courts' Concern:

We are concerned with doctors in private practice and hospitals and nursing homes run commercially, where the relationship of doctors and patients are contractual in origin, the service is in consideration of a fee paid by the patient, where the contract implies that the professional men possessing a minimum degree of competence would exercise reasonable care in the discharge of their duties while giving advice or treatment. [7]

'Bolam Test' Versus the 'Reasonably Prudential Patient' Test:

Having regard to the conditions obtaining in India, as also the settled and recognized practices of medical fraternity in India, we are of the view that to nurture the doctor-patient relationship on the basis of trust, the extent and nature of information required to be given by doctors should continue to be governed by the *Bolam* test rather than the 'reasonably prudential patient' test evolved in *Canterbury*. [7]

Doctors' discretion is important:

It is for the doctor to decide, with reference to the condition of the patient, nature of illness, and the prevailing established practices, how much information regarding risks and consequences should be given to the patients, and how they should be couched, having the best interests of the patient. [7]

Summary and Conclusions:

Global scenario and Trends are shifting from 'real consent' concept evolved in *Bolam* and *Sidaway* to the 'reasonably prudent patient test' in *Canterbury*.

We may note here that courts in Canada and Australia have moved towards *Canterbury* standard of disclosure and informed consent - vide *Reibl v. Hughes* (1980) [17] decided by the Canadian Supreme Court and *Rogers v. Whittaker* - 1992 [18] decided by the High Court of Australia.

Even in England there is a tendency to make the doctor's duty to inform more stringent than Bolam's test adopted in Sidaway. [13]

Lord Scarman's minority view in Sidaway [13] favouring Canterbury, in course of time, may ultimately become the law in England. A beginning has been made in Bolitho v. City and Hackney HA – 1998 [19] and Pearce v. United Bristol Healthcare NHS Trust 1998 [20].

We have however, consciously preferred the 'real consent' concept evolved in Bolam [11] and Sidaway [13] in preference to the 'reasonably prudent patient test' in Canterbury, having regard to the ground realities in medical and health-care in India.

Need of the Hour:

Remarkable developments in the field of medicine might have revolutionized health care. But they cannot be afforded by the common man. The woes of non-affording patients have in no way decreased. Gone are the days when any patient could go to a neighbourhood general practitioner or a family doctor and get affordable treatment at a very reasonable cost, with affection, care and concern. Their noble tribe is dwindling. [7]

Health care (like education) can thrive in the hands of charitable institutions. It also requires more serious attention from the State.

In a developing country like India where teeming millions of poor, downtrodden and illiterate cry out for health-care, there is a desperate need for making health-care easily accessible and affordable. [7]

Many papers published on the issue of consent have given insight into the problem of consent, age of consent [23] and informed consent [24, 25] in Indian context.

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Review Research Paper

Sexual Harassment at Workplace in India Medico-Legal Aspects

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Abstract

Sometimes people in authority misuse their power to harass women. There are many women who have faced sexual harassment at some point of time, maybe in the office or on her way to work. They're forced to keep quiet because if they make a noise about it they are subject to worse crimes like assault (grievous, indecent, etc.) and rape, acid attack, etc especially in India. Thus it's the employers' foremost responsibility and ours too, to develop absolute intolerance against sexual harassment at workplace and elsewhere respectively. We all know the wonderful & important role a woman plays in a traditional Indian family. She is a responsible homemaker and a soft hearted hard worker. She is also the 21st Century woman; independent, confident & making successful forward strides in many fields. But when there are so many crimes against women happening daily, so much gender inequality, sexual harassment and hostile environment at her workplace, does India really want to give her the freedom of equality & safeguard her fundamental rights? Or just expect her to compromise, stay down & back up like a woman is expected of in India?

Key Words: Sexual Harassment at Workplace, Gender Inequality, Fundamental rights

Introduction:

The devaluation of women and social domination of men still prevails in India. Women are viewed as dowry burdens, the weaker gender and worthy of a lower Social status as compared to man. Because of these factors besides myriad others, India has a very poor Gender Inequality Index apart from overall poor Human Development Index in 2013 UN Human Development Report.

India ranks 132 out of the 148 countries polled in Gender Inequality Index and 136 in HDI. [1-3] The Gender Inequality Index (GII) is a composite measure which captures the loss of achievement, within a country, due to gender inequality, and uses three dimensions to do so: reproductive health, empowerment, and labour market participation.

According to a 1998 report by U.S. Department of Commerce, the chief barrier to female education in India are Inadequate school facilities (such as sanitary facilities), Shortage of female teachers and most importantly Gender bias in curriculum.

In curriculum women being depicted as weak, helpless and gullible versus strong, adventurous, and intelligent men with high prestige jobs. [4] Thus women are discriminated socially, economically and even legally in today's India.

Crimes against Women:

Even though women may be victims of general crimes such as robbery, murder, etc. only the crimes directed specifically against women are characterized as '**Crimes Against Women**' against which several laws in the IPC (IPC 376, 363-373, 304 B, 498-A, 354, etc.) and special and local laws (ITPA 1956, DPA 1961, SHW (PPR)2013) are laid down.

According to NCRB (National Crime Record Bureau) in 2012(5), around 2.4lakh women had reported crimes against them i.e. at a national average of 41 per lakh population of women with the highest incidence in Assam of almost 90.

Cruelty by husband and relatives formed nearly half of cases of crimes against women, whereas Sexual harassment in 2012 showed an increase of 7% since 2011 and accounted for 3.8% of total crimes against women.

Reasons for vulnerability are shown here:

- Social & work pressures
- Due to lack of awareness of legislation.
- Economic vulnerability (some women are sole earners of their family, hence are

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subject to more harassment as their bosses know the reason of her silence)

Fig 3: Crime against Women– Percent Distribution during 2011

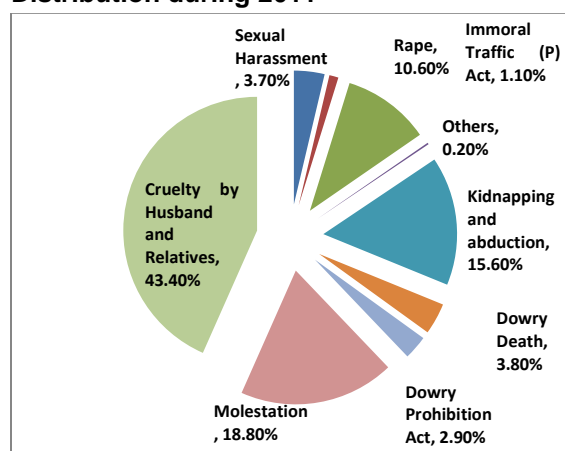


Fig. 2: Crime against Women –Percent Distribution during 2012

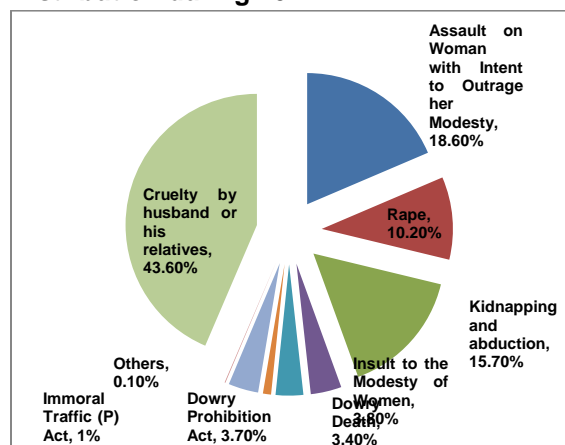
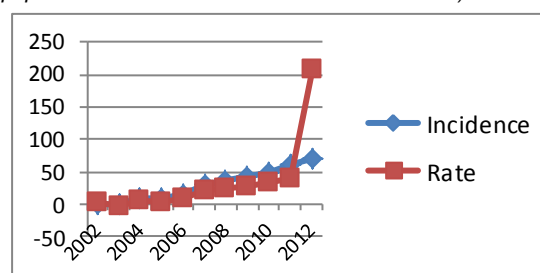


Fig. 4: Incidence and Rate of crime Against Women – Percentage Change from 2002

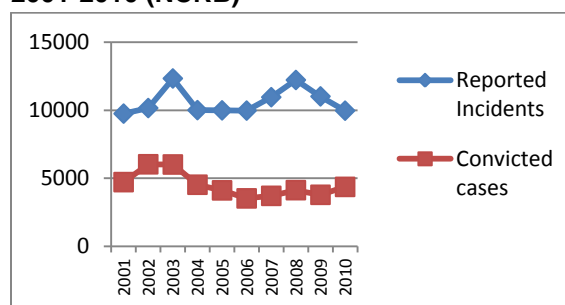
(The Graph predicting the variation in crime rate in 2012 over 2002 has shown a sharp incline due to use of only women population in 2012. Whereas in previous years, total population was used for calculation of crime rate)



Sexual Harassment at Workplace:

Sexual harassment at workplace hampers women's constitutional and fundamental rights to equality, justice and dignity.

Fig. 5: Sexual Harassment Incidents in India 2001-2010 (NCRB)



It sabotages a woman's work performance & progress, affects working environments, results in frustrations & absenteeism.

Table 1:
Incidents of Crimes against Women during 2007-2012 and percentage variation in 2012 over 2011

S. N.	Crime Head	Year					Percent_variation in 2012 over 2011
		2007	2008	2009	2010	2011	
1.	Rape (Sec.376 IPC)	20737	21467	21397	22172	24206	3.0
2.	Kidnapping & Abduction (Sec.363 to 373IPC)	20,416	22939	25741	29795	35565	7.6
3.	Dowry Death (Sec.302/304 IPC)	8093	8172	8383	8391	8618	-4.5
4.	Cruelty by Husband and Relatives (Sec. 498-A IPC)	75930	81344	89546	94041	99135	7.5
5.	Molestation (Sec. 354 IPC)	38734	40413	38711	40613	42968	5.5
6.	Sexual Harassment (Sec. 509 IPC)	10950	12214	11009	9961	8,570	7.0
7.	Importation of Girls (Sec.366-B IPC)	61	67	48	36	80	-26.3
8.	Sati Prevention Act, 1987	0	1	0	0	1	-100
9.	Immoral Traffic (Prevention) Act, 1956	3568	2659	2474	2499	2435	5.3
10.	Indecent Representation of Women (Prohibition) Act, 1986	1200	1025	845	895	453	-68.9
11.	Dowry Prohibition Act, 1961	5623	5555	5650	5182	6619	36.5
	Total	185312	195856	203804	213585	228650	6.8%

These are some prominent cases, including the famous Bhanwari Devi Case which brought word Sexual Harassment into the Indian Legal scenario providing us with landmark Vishaka Guidelines.

1. Bhanwari Devi case
2. Rina Mukherjee vs. The Statesman
3. Rupan Deol Bajaj (IAS officer) vs. Super Cop K P S Gill

Bhanwari Case: [6]

Sexual harassment hit the Indian legal map when Bhanwari, a saathin in Rajasthan, prevented the child marriage within an upper caste community. In doing so she was subjected to unwelcome sexual harassment through words and gestures from men of that community.

When she reported the harassment, the local authority did nothing. That omission was at great cost to Bhanwari.

The feudal patriarchy who were enraged by her (in their words: "a lowly woman from a poor and potter community") 'guts' decided to teach her a lesson and gang raped her repeatedly. After an extremely humiliating legal battle in the Rajasthan High Court the rape survivor did not get justice and the rapists -- "educated and upper caste affluent men" -- citing ridiculous reasons i.e. how can a uncle have sex in front of his nephew, etc.- were allowed to go scot free.

This enraged a women's rights group called Vishakha that filed public interest litigation in the Supreme Court of India leading to her victory & a landmark & visionary judgement in today's times by Late CJI J.S. Verma. [7]

Only after Sixteen years after this landmark Supreme Court judgement, the Government awoke from its slumber and introduced a defective Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act. [8]

The reason it took so long could be because representation of women at the decision making centre is as follows: Women representation in Parliament (both houses) in India averages only 11.4% while Pakistan has a better women representation of 20.4%. Best women representation is in the parliament of Rwanda with 63.8% followed by Andorra with 50%. [10]

The Sexual Harassment at Workplace (PPR) Act 2013 has a total of VIII chapters which could be assessed at its official website and in brief is summarized:

- Chapter I deal with the preliminaries and definitions.
- Chapter 2 deals with complaint made

- Chap 3 & 4 describes constitution of the committee
- Chap 5 deals with inquiry. Chap 6 & 7 with duties of the employer and district officer and the last chap deals with misc sections of the act.

Conclusion:

Whenever any law is drafted its always in its infancy, prone to many flaws and loopholes. These are some suggestions offered by the First author by her own personal experiences to counteract the loopholes.

1. Extensive research and debating on the issue to fill the legal loopholes.
2. Awareness on Sexual harassment has to be raised through Campaigns and presentations all over the country. Special days must be allocated.
3. Fast track courts should be set up to try such cases faster to avoid further harassment to family members especially the woman's children who face discrimination and insults later in life.
4. Strict laws for anonymity of the complaint and proceedings should be enforced.
5. Explicit protection of the victim and witnesses
6. Possibly do away with the concept of the Internal complaints committee as the harasser if in a higher position and power could easily influence the members of his own institution who form the internal complaints committee, which results in further harassment, mental torture and defamation to the victim. Local committees and police maybe a better option.
7. If Complaint committee is formed it should be of the comfort and possibly choosing of the victim so as to protect her from further suffering.
8. Legal counsel should be provided to the victim so as to see that the proceedings/statements of the victim should not be misconstrued, manipulated and jumbled up to suit themselves or concerned parties due to corrupt practices to save reputation of the Institution.
9. Media and persons attached to the media should be given strictest punishments if found guilty of leaking false information or the proceedings and more so if especially involved in the harassment.
10. Malicious statements made by those found guilty of harassment or aiding such people should be subject to strict and severe disciplinary action.

11. Students in educational institutions, especially postgraduate students, should be well protected by universities & higher institutions. These students frequently suffer sexual harassment from their thesis guides and bosses who know very well that if she complains, her thesis, educational growth and career prospects can be thrown down the drain.

These guides and bosses indulge in derogatory and cheap practices of providing false information about the victim to the examiners and other officials so as to lessen her chances of passing from the institution and thereby further subjecting her to FAILURE, humiliation, torture and ridicule resulting in several stress disorders and mental agony.

12. . Ladies should also know that repetition creates a life pattern. So if you endure workplace conduct which sexually demeans, intimidates, offends, excludes and limits women, it's not only about the patterns of sexist behaviour, it is also about the repetitive nature of our own complacency.

We have all become extremely immune to the pervasive harm of sexual harassment and its unconstitutional character. But this only revs up & encourages the harassment from men in different quarters towards our own sisters & possibly future generation of women.

Let's stand up and fight. It's in a woman's nature to be loving, caring and passionate, why not use these qualities to empower our other sisters. We have to muster courage and build up confidence to stand up & speak against harassment and for women empowerment and better overall treatment of women as shown by great legendary personalities like Justice K.S. Verma, Bhanwari Devi, Rina Mukherjee [10] and other countless brave men and women, our true heroes and role models.

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Case Report

Utility of X-Rays in Scar Examination: A Case Report

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Abstract

In Forensic practice scar is utilized for identification purpose. The identification may be of personal identification or to identify any previous injury. In this case report we are reporting the radiological findings of the scar and discuss the utility of such technique. A 32 year male accused was referred by the City Police for examination of scar. Forensic examination of scar provides vital information like type of injury sustained, type of weapon used and probable age of scar. Along with clinical examination, radiological evaluation in suspected of cases of firearm may provide valuable clue like old fractures, deformity, callous formation and firearm residue. If facilities are available like multi-slice spiral CT scan then radiological evaluation become easier. The advantages of such techniques are considerable like one can visualize the image in Bone Window and Volume Render Technique format; one can have three dimensional view and therefore the image can be rotated and visualized in 360 degree. The present case highlights the importance of utilizing the radiological modality while examining the scar for medico-legal purpose.

Key Words: Identification, Scar, Firearm, X-Ray, Radiology

Introduction:

In Forensic practice scar is utilized for identification purpose. The identification may be of personal identification or to identify any previous injury. While relating the scar with previous injury, the appearance and age is considered and accordingly opinion is given.

Scars are permanent and usually assume the shape of wound causing them. Scars produced by firearm wound are usually circular or oval with central depression. In an order to confirm that the given scar was produced by firearm, radiological evaluation may be needed. [1] In this case report we are reporting the radiological findings of the scar and discuss the utility of such technique.

Case Report:

A 32 year male accused was referred by City Police for examination of scar. There was alleged history that about 3 months back he was having a quarrel with his rival and during that the rival had used firearm and wounded him.

Then the accused had visited private surgeon who had treated him and removed the projectile. To take the revenge a week back he had killed that rival. City police had arrested him as an accused. During investigation police came to know the purpose of killing. To confirm the past incident, police asked for medical help. Accordingly the accused was examined at casualty department.

On examination following were noted:

1. Old scar mark of size 0.8cm x 0.6cm, oval shaped, dark brown in colour, centrally depressed with shiny white fibrous tissue at places; present over anterior aspect of left thigh, 10cm above left knee, sensitive to touch with relatively smooth surface. (Fig. 1)
2. Two small circular depressed dark brown old scar mark of size 0.3cm in diameter present near medial and lateral margins.
3. A healed sutured wound present as a linear scar of length 7cm x 0.5cm, present over anterior aspect of left thigh, 7cm above left knee, vertically placed with suture mark impressions six in number.
4. A healed sutured wound present as a linear scar of length 4cm x 0.5cm present over posterior aspect of left thigh, 4cm above popliteal fossa, vertically placed with suture mark impressions, five in number. (Fig. 2)
5. Lateral and Antero-posterior x rays were requested that revealed evidence of old healed fracture of femoral shaft in lower third of left femur with callus formation and

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minimal deformity with dense radio opaque foci seen in lower left thigh suggestive of metal particles. (Fig. 3)

Discussion:

A scar is fibrous tissue produced because of healing of wound. It is formed through a highly organized sequence of physiologic events. [2] It is covered with epithelium and devoid of hair follicles, sweat glands and pigments. Scar tissue is never strong like normal skin.

The primary component of scar is collagen. The period of maximal collagen production is the first 4 to 6 weeks after injury.

During this period the scar appear red, slightly firm and raised. Over the next several months the production and degradation of collagen occurs. Normal healing results in normal type of scar and on the surface the normal healing is noted by the fading of redness and softening of the scar.

However, at times, excessive scar forms as a result of aberrations of physiologic wound healing and manifested as hypertrophic scarring. [3] Historically, early application of X-ray in Forensic Medicine was introduced in 1896 just one year following the X-ray discovery by Prof. Arthur Schuster (1851-1934) of Owens College, Manchester in England, to demonstrate the presence of lead bullets inside the head of a victim. [4] The use of radiology in the investigation of firearm fatalities has been a standard practice since then. However CT offers significant advantages over plain film X-rays.

The evaluation is much easier done in 3D CT-images than in 2D plain radiographs. [5]

Detection of firearm residue in and around the entrance wound is of great help to determine the entry wound. Forensic examination of scar provides vital information like type of injury sustained, type of weapon used and probable age of scar.

Along with clinical examination, radiological evaluation in suspected cases of firearm may provide valuable clue like old fractures, deformity, callus formation and firearm residue. In the present case there was alleged history of firing and the person had taken surgeon's help to remove the projectile.

From the shape of scar it appeared to be caused by firearm and on X-ray there is old healed fracture with callus formation with radio-opaque foci suggestive of metal particles.

Similarly therapeutic suture wounds were noted suggesting a therapeutic intervention. Therefore considering all the

findings it was deduced that the scar mark was because of firearm wound.

Without X-ray finding, it would have been difficult to opine in this case. If facilities are available like multi-slice spiral CT scan then radiological evaluation become easier.

The advantages of such techniques are considerable like one can visualize the image in Bone Window and Volume Render Technique (VRT) format; one can have 3 D view and therefore the image can be rotated. Thus the lesion can be visualised from all sides i.e. anteriorly, laterally and posteriorly.

In conclusion the present case highlights the importance of utilizing the radiological modality while examining the scar for medico-legal purpose.

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Fig. 1 A: Oval Scar Mark and Suture Scar Mark



Fig. 1B: Zoom Picture of Oval Scar Mark



Fig. 2: Suture Scar on Posterior Aspect



Fig. 3: X-Ray AP View Showing Old Healed Fracture of Left Femur with Callous Formation, Minimal Deformity with Dense Radio-Opaque Foci



Case Report

Body beside Turtled Auto: Accident or Homicide

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Abstract

A 27 years old male auto driver's body was brought to the mortuary of Rangaraya Medical College, Kakinada, Andhra Pradesh, by police people along with required documents, for the post-mortem examination U/S 174 Cr.P.C. on 26th October 2012. Post-mortem examination conducted on the same day at 11:00am. As per inquest His body was recovered from a drain at road margin, a beer bottle also present nearer to the body in the same drain, and his auto turtled at the road edge. During the post-mortem examination externally no struggle marks and no defence wounds were found, but the injuries which were found on the body externally and internally are unusual in accident. After thorough investigation it was found that it is a case of homicidal death without any struggle marks and defence wounds because person was under influence of alcohol, which impairs the ability of protection from others.

Key Words: Auto driver, Alcohol, Injuries, Accident, Homicide

Introduction:

With increasing urbanization and traffic, road traffic accidents are escalating steeply.

Hence ever increasing work load on doctors to conduct autopsy. Also the number of homicides being projected as a road traffic accident is increasing. The doctor conducting the autopsy should always use his utmost skill while conducting the autopsies, though it is being brought as a routine road traffic accident, whatever the work load may be, barring all pressures. Besides it, the doctor should always use his scientific skill to bring out more information to aid the investigating officer in probing the case.

Case Study:

A male body aged about 27 years is brought for post-mortem examination U/S 174 Cr.P.C., on 26th October 2012.

As per inquest report the deceased is an auto driver, working in contractual basis for sea port. Last seen alive in his home, at about 5pm the before the day of autopsy, and went out in the evening in a casual way with his auto. He was found dead in a drain at road margin.

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He had injuries over his body and his auto turtled at the road edge, in early hours of morning, in the outskirts of Kakinada. (Fig.1-3)

Autopsy Findings:

Clothes stained with mud and dust. Scalp hair matted with dried blood clots.

External Examination:

1. A bone deep reddish laceration of 4x2 cm size present on forehead extending from eye brow to left nasal bridge. Upper end is situated 6 cm below the hair line and lower end is 2 cm lateral to left eye angle.
2. A reddish abrasion of 2x1 cm size, present on left upper eye lid.
3. A bone deep reddish laceration of 6x1 cm size, present on mid forehead transversely at hair line. It is 5 cms above the nasal angle; right end is 10 cm from the right ear left end is 14 cm from the left ear. (Fig. 5)
4. A bone deep reddish laceration of 10x0.5 cm size is present on the mid parietal region extending from lateral end of the external injury no.3 on to back and top of head.

The front end is nearly attached to the external injury no. 3 with skin tag and back end is 15 cm above the external occipital protuberance. (Fig. 5)

5. A bone deep reddish laceration of 5x0.5 cm size is present on the mid parietal region extending from lower end of the external injury no.4 on to back of head. The front end is 1 cm right to the external injury no. 4 and back end is 10 cm above the external occipital protuberance. (Fig. 5)

6. A bone deep reddish laceration of 4x0.5 cm size is present transversely on parietal region extending to right from front end of external injury no. 5. The lateral end is 10 cm above the right ear. (Fig. 5)
7. A bone deep reddish laceration of 5x0.5 cm size is present on left parietal region obliquely. (Fig. 5)
8. Two bone deep reddish lacerations of each 6x0.5 cm and 5x0.5 cm present obliquely and lower end is on parieto-occipital regions of head 0.5 cm apart from each other. (Fig. 6) Their upper end is 6 cm below the external injury no. 5. Lower end is 4 cm above the external occipital protuberance.
9. Multiple reddish linear patterned contusions of sizes ranging from 8x1 to 10x2 cm present on back of chest over an area of 25x15 cm.
10. Reddish linear contusion of size 10x0.5 cm present on back of lower end of right side of chest.
11. A reddish abrasion of 3x2 cm size present on right side of scrotum.

Internal Examination:

1. A reddish hematoma of 10x6 cm size is present under the scalp of head in mid parieto occipital region.
2. Subdural hematoma of 15x10 cm in left parieto occipital region along with diffuse subarachnoid hemorrhage is present on both cerebral hemispheres.
3. Fracture of right side ribs 8–11 at their lateral angles. Fractured bone edges blood stained. (Fig. 7)
4. Rupture of liver with accumulation of about 450ml of blood and blood clots in the peritoneal cavity.

All the above injuries are ante mortem in nature and sustained due to hard and blunt force by medium to heavy sized blunt objects or weapon and sustained few hours prior to death. (Fig. 8) Routine viscera collected and send for chemical analysis.

The RFSL report said that on chemical analysis of the viscera sent, ethyl alcohol is detected.

Opinion as to the Cause of Death:

The approximate Time of Death was less than 24 hrs prior to PM Examination.

The cause of death to best of my knowledge and belief was due to cranio-cerebral injury (head injury) associated with other multiple injuries due to hard and blunt force by a medium to heavy sized blunt object/ objects, in a person under influence of ethyl alcohol.

Discussion:

Points against It to Be an Accident:

Several lacerations concentrated over head in haphazard way, several contusions over trunk. Pattern of these injuries was unlikely to be caused by a road traffic accident and more likely to be of homicidal in nature. [1-6] Crime scene visit revealed neither big damage to the auto nor grazes on the road to prove it to be an accident.

No Signs of Struggle / No Defence Wounds - Still A Homicide?

Yes it is. The person is intoxicated with ethyl alcohol, and the person might not have had enough consciousness to resist an assault on him. Alcohol intoxication confirmed by the Forensic science laboratory report which showed alcohol in his stomach, intestine, liver, intestine and blood samples. [4]

Probable Weapon:

As per the injuries, the weapon used must be a blunt object with linear striking end of considerable mass and struck with great velocity. [1]

Time of Injury:

All the injuries are red in color. So all the injuries might have been caused at the same time over few minutes and were sustained few hours before death.

Probable Number of Persons:

The body of the deceased is shifted from crime scene to another place in an auto.

For this to be done, at least 2 persons are required. Though the deceased is a young muscular male, as he is intoxicated at the time of assault, 2 persons should be sufficient to carry out the thing. The injuries appear to be caused by a single type of weapon.

However involvement of multiple persons couldn't be ruled out and the probable number of persons involved is two or more.

Motive behind the Incident:

Abrasion on the scrotum is found, which might be caused by a boot hit over scrotum, which points out probability of sexual jealousy behind it. The culprits shifted the body to another site, kept an auto turtled beside him, threw empty alcohol bottles beside him, trying to showcase it as a self accident done in alcohol intoxication.

So the culprits are conscious enough of what they are doing.

Actual Story behind the Crime:

On investigation, the police found out that the deceased, who is a worker under a contractor, got into an illegal affair with the contractor's spouse.

The contractor hired 2 other workers, who were friends of the deceased, to kill him. The culprits took the victim to a private guest house in the pretext of a party, intoxicated him with alcohol and implemented their plot.

They beat him with a cylindrical metal rod (Fig. 9) over his head and trunk. They shifted the body in the auto of the deceased itself to outskirts and tried to mask it as an accident.

Conclusion:

Inquest report should only be a guide and one should never get carried away by it.

Science is unending and one should always put an effort to utilize the available knowledge to the maximum. The doctor should not limit himself to the cause of death, but should try to bring out various truths regarding the case that would be useful to the investigating officer in probing the case.

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Fig. 1: Scene of Crime



Fig. 2: Scene of Crime

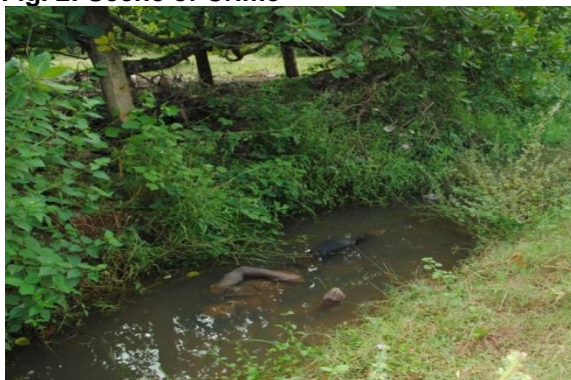


Fig. 3: Body after Recovery from the Water



Fig. 4: Beer Bottle at Scene of Crime



Fig. 5: Laceration over Mid-Parietal Region



Fig. 6: Laceration over Parieto-Occipital Region



Fig. 7: Rib Fracture



Fig. 8: Liver Laceration

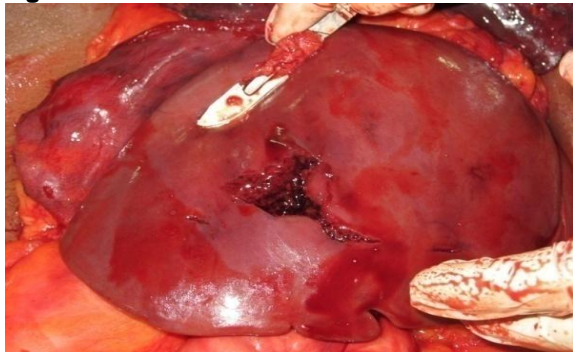


Fig. 9: Metal Rod



Case Report

Alprazolam Poisoning

¹Ankita Kakkar, ²Sushil Kumar

Abstract

Alprazolam is a triazolo benzodiazepine which has antidepressant properties. It is a short acting anxiolytic of the benzodiazepine class of psychoactive drugs. Alprazolam like other benzodiazepines binds to specific sites on the gamma-amino-butyric acid (GABA) receptors. Its therapeutic index being high, it is generally considered a safe and effective drug for the treatment of anxiety disorders and panic attack. Alprazolam has since long been consumed as drug of abuse, however trend to use it for suicidal purpose is recently rising, in which easy availability of this drug plays a significant role. It is available for oral administration in compressed tablet and extended release capsule formulations.

We report one such case of alprazolam poisoning in which the drug was easily available. As is evident from this report documentation, inability to confront persistent domestic problems, and failure to achieve life's goals were the triggering factors in a middle aged female, to compel her to suicide with the help of alprazolam, which was available to her as prescribed by a physician for her ailment.

Key Words: Abuse, Availability, Psychotic, Triggering, Suicide

Introduction:

Alprazolam (8- chloro-1-methyl 6 phenyl -4H-s triazolo (4, 3- α) benzodiazepine, which is one of the most widely prescribed benzodiazepines in India. [1, 4] Alprazolam is commonly used and FDA approved for the medical treatment of panic disorder and anxiety disorders, such as generalized anxiety disorder (GAD) or social Anxiety disorder. [1, 2]

Case Report:

A 37 year old married female, with history of psychiatric problems, came to our emergency in unconscious state, with alleged history of ingestion of 60 tablets of alprazolam (Alprax- Rx) tablets 3 hour back, with the intention of suicide. The relatives of the patient showed us all the empty packs, containing the tablets, found near her body.

There were about 60, 1mg tablets of alprazolam that had been ingested by her.

Further, her relatives gave history that patient had been suffering from panic disorder, since last five years, for which she had been on medication off and on, as advised by a psychiatrist. Her medications included alprazolam and fluoxetine.

Off late, she was also under stress, as she could not conceive in last four years of her marriage, and was pursuing infertility treatments, without any success.

On general examination mild cyanosis and pallor was present. Patient's vitals on admission were as follows-- pulse -100/min feeble, blood pressure-80/mm hg systolic, respiratory rate 30/min regular, temperature - 36.8 C. Neurological examination showed deep coma, bilateral constricted pupils, which reacted minimally to light, diminished tendon reflexes and retention of urine, and plantar reflexes were not elicitable bilaterally. There was no response to painful stimuli.

Her Glasgow coma scale (GCS) was 3. Respiratory system examination was within normal limits. On cardiovascular system (CVS) examination tachycardia was noted, and ECG showed sinus tachycardia. Routine Biochemical and hematological tests were normal.

As suggested by the evidences above, probability diagnosis of alprazolam over dosage was made. Patient was admitted in ICU. A nasogastric tube was placed and catheterization was done. Patient's gastric lavage returned no pill fragments. She was urgently intubated and kept on mechanical ventilation with continuous oxygen administration and parenteral fluids. Rest of her treatment was symptomatic.

Flumazenil, which is the antidote of alprazolam poisoning, could not be used, as it was not available. Patient showed improvement after 10 hours and was extubated thereafter.

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She regained full consciousness in next 24 hours, and revealed that she had gained information about Alprazolam tablets being used as a suicidal agent, via internet. One mg tablets of this drug were already easily available to her, as a part of prescription from a psychiatrist for treatment of her panic disorder.

Thereby, she attempted suicide with the help of alprazolam tablets, out of frustration caused by her long strained marriage and infertility problems. There was no neurological sequelae, and she was discharged after 48 hours.

She was referred to an advanced infertility centre, to help her in conceiving early and successfully. We also recommended her to visit a psychiatrist for possible evaluation as well as counseling of her family problems. We advised her relatives, to give prescribed medications to her under their personal vigilance, and also provide moral support to her, to be able to deal with life's challenges.

Discussion:

Alprazolam possesses anxiolytic, sedative, hypnotic, skeletal muscle relaxant, anticonvulsant, and amnesic properties. [3]

It is an effective anxiolytic agent at doses of 0.75-4mg daily, and doses of 6-9 mg per day are prescribed to treat panic attack and panic disorders. [4] Following oral administration, it is rapidly absorbed with peak plasma concentration occurring 1-2 hours after ingestion. Alprazolam has a short duration of action with an average plasma half-life of 11 hours. [5] It is extensively metabolized by oxidation and conjugation with only 20% of the parent drug appearing unchanged in urine. [6]

Adverse reactions to alprazolam are typically, observed at the beginning of therapy and diminish under continued treatment. The most common effects reports are drowsiness and fatigue. Other adverse reactions include confusion, headache, nausea and vomiting, tachycardia, hypotension and blurred vision. [4]

There are only two reports of fatal intoxications that were due to the ingestion of alprazolam documented in the literature.

Edinboro and Backer [7] reported a blood Alprazolam concentration of 0.177 mg/L in an ante-mortem hospital admission specimen from a depressed and suicidal woman. In another study, Stafford et al [8] reported a postmortem blood alprazolam concentration of

0.122 mg/L in an acute alprazolam intoxication with concomitant ingestion of ethanol (postmortem blood alcohol concentration = 0.15g/dl).

Conclusion:

Poisoning due to alprazolam is associated with very minimal mortality. Psychotic patients of panic disorders, chronic depression, general anxiety disorders, etc are prone to commit suicide.

Alprazolam, being easily available, to them in their medication, plays a significant role in meeting their suicidal intent. Patients of alprazolam poisoning can be successfully managed even with non-availability of its antidote, flumazenil.

In recent times, television channels depicting graphic content in movies, serials, or news contributes to the misuse of this drug. Also, easy access to virtually all knowledge, including medical information, by means of internet, is sometimes hazardous, as was in this case.

Drug abuse of alprazolam is preventable by exercising strict control over its easy availability, at the distributor's end and raising media awareness about the negative depiction of alprazolam being used as suicidal agent.

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Case Report

Suicidal Death due to Stabbing: A Case of Rare Occurrence

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Abstract

Stabbing is one of the commonest means of homicide. Everyone prefers a painless death and stabbing is not a preferred means of suicide, especially for a female. In this paper, a case of an 18 years old girl who was found dead in a pool of blood on a bed inside a locked room under suspicious circumstances with multiple stab injuries to the abdomen is presented. A thorough post-mortem examination plays a crucial role in assisting the investigating agency to arrive at the possible manner of death. In such a case with multiple abdominal stab injuries, only after a meticulous autopsy, it was labelled as a case of suicide. Self-stabbing is comparatively uncommon and there is a male predominance over female and amongst the female self-inflicted stabbing cases, the one with multiple stab injuries is even rarer, and this paper is presented considering extreme rarity of such a case.

Key Words: Suicide, Suicidal stab injury, Self-inflicted, Wound

Introduction:

Suicide means “sui caedere”- to kill oneself (Latin). As per the data provided by the national crime records bureau, the so called “Soft method of committing suicide” such as hanging (37%) and poisoning (29.5%) are the most commonly adopted means of committing suicide in India.

“Hard methods” like self-cutting, self-stabbing, are very rare, being employed in only 0.4% of suicides and having a male predominance. [1, 2] Stabbings have been common throughout human history and one of the most frequent ways of committing homicide is by inflicting injuries with a sharp cutting or stabbing weapon [3]

A commonly used weapon such as a knife is cheap and easy to acquire. However, everyone prefers a painless death and suicide by stabbing is not common. [4]

In the early stages of death investigation, the opinion of a forensic expert may be crucial in initiating or aborting a homicide investigation. Stab injury is usually homicidal and very rarely suicidal.

Proper history, meticulous crime scene investigation and carefully performed autopsy are vital in ascertaining the manner of death in such cases. This paper describes a rare case of female suicide with multiple fatal stab injuries which was labelled as suicide only after a meticulous post-mortem examination.

Case History:

On 11th Oct. 2013 at 2:05 pm, post-mortem examination was conducted on the dead body of an 18-yr old girl at our centre. As per police, the girl stayed in her aunt's place which was located near her parent's house. On the previous evening of the fateful day, she did not come back to her aunt's house and the aunt did not try to contact her parents as she was assuming that the girl was with her parents.

The parents usually did not stay in their house as they mostly stayed at a shop located about 1km away from the house. However, she was found dead in a suspicious manner on a bed inside a room which was locked from inside in her parent's house at about 10:30 am of the fateful day. Neither the parents nor the aunt were aware of what was happening in her personal life viz., any strain in love affairs or history of depression, etc.

Crime Scene Examination:

The dead body was lying supine on the bed, and there was a pool of blood just below and along the sides of the body. A blood stained kitchen knife was found in the vicinity.

The clothing was soaked with blood including the blue “T” shirt, which she was wearing and the abdomen was exposed with

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multiple stab injuries. The initial impression was suggestive of homicide.

However, all the things in vicinity were properly arranged in the room and there were no signs of struggle. Moreover, the door was found locked from inside and there were no grossly visible foot prints or any trail of blood, ruling out the entry of any outsider into the room. [Fig. 1]

Autopsy Findings:

All the clothes were soaked with blood but they were intact, having no cuts or tears.

Both the hands were partially clinched. Rigor Mortis was present all over the body and post-mortem staining was present over back and fixed. The eyes were congested and the body appeared pale. Dried blood stains were observed on the abdomen and the right palm.

On external examination, there were three injuries on the mid-part of the abdomen. The first injury was a wedge shaped stab wound almost obliquely placed and based laterally, situated just left to midline and 100cm above heel, 2cm x 0.3cm, cavity deep with clean cut margins and red in colour. The bevelling of the wound was present on supero-lateral aspect.

The second injury was a scratch abrasion on abdomen in the midline, situated 98cm above heel measuring 0.5cm in length, red in colour. The third injury was a stab wound on umbilicus 97cm above heel, having "<" shaped measuring 1.6cm x 0.2cm, cavity deep with clean cut margins and red in colour. [Fig 2]

There were no defence injuries on the hands or forearms. On internal examination, the abdominal cavity contained blood mixed with clots (about 2 litres). There were cut injuries of skin, muscles, fasciae, peritoneum and small intestines at two places corresponding to external injuries. The mesentery and its vessels were also cut and contused. [Fig 3, 4]

The opinion as to the cause of death was given as haemorrhage and shock resulting from stab injuries to the abdomen produced by sharp cutting pointed weapon. All the injuries were ante-mortem and fresh at the time of death and the death was suicidal in nature.

Discussion:

In medico-legal investigation, when a victim sustains multiple stab wounds, the interpretation is difficult. Even though the cause of death is known, the nature of the injury needs to be established i.e. whether it is homicidal, suicidal or accidental. History or witness's account may be perplexed or even misleading.

So, a thorough analysis of the crime scene and a meticulous examination of

characteristics of the wound may help in determining the nature of the death.

Factors in Favour of Suicide:

The wounds were over accessible area of the body i.e. abdomen. There were no rents/cuts on the clothes worn on the day of the incident. A person who commits suicide exposes his body by opening his clothes and then inflicts the wound, [5] and this was observed in the present case. Vertical stab wounds imply homicide, [6] whereas suicidal wounds are most frequently horizontal i.e. margins bevelled. [7]

The wounds were wedge shaped and bevelling of the margin of the 1st wound on the left supero-lateral aspect imply that the weapon used was probably a single edged pointed sharp cutting weapon like a knife, and the direction of entry of the blade was downward, backward and to the right which is in favour of self-infliction. The depth of a suicidal stab wound is variable and rarely single stroke is fatal. [5]

In this case, the depth of the wound reached only up to the small intestine and mesentery. The right hand of the victim was stained with dried blood; however, there were no defence injuries observed on the hands or forearms, which were indicative of homicide in a victim of assault by sharp edged weapon.

This finding is a fact which strongly supported the hypothesis of self-infliction. [8]

Another important characteristic of self-inflicted sharp force injuries is the presence of "hesitation cuts". "Hesitation cuts" also known as "tentative cuts" are multiple superficial cuts present around the commencement of a main wound. These cuts indicate the divided state of the mind of the victim, as it is normal human instinct to preserve life. [9, 10] Suicidal stab wounds may show hesitation mark surrounding the final fatal wound. [11]

In the present case, the second wound which was a small scratch injury to the abdomen (as described in external findings of post-mortem examination) can be considered as a hesitation cut which is very much in favour of suicide.

Conclusion:

In medico-legal practice, an autopsy surgeon has to give his opinion about the homicidal or suicidal nature of the wound. Homicide might be initially suspected in such a case of female death with multiple stab injuries.

It is very hard to believe from a layman's perspective that a girl could stab several times to commit suicide. This case is of rare occurrence as self-cutting or self-stabbing is employed in only 0.4% of suicides in India and there is a male predominance over female.

Amongst the female self-inflicted stabbing cases, the one with multiple stab injuries is even rarer. Such type of case was never presented in any literature, especially, in this part of the country.

A meticulous analysis of the features of the wound helps in establishing correctly the manner of death in such cases.

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Fig. 1: Crime Scene



Fig. 2: External Injuries



Fig. 3: Internal Injuries



Fig. 4: Internal Injuries



Case Report

A Case of Suicide or Accidental Death Due To Self Stabbing

¹Ravi Rautji, ²Avishek Kumar

Abstract

A twenty-nine year old healthy male, software engineer by profession, had been married for the past three years. He had a strained relationship with his wife. On the fateful day he had an altercation with his wife in the evening on some issue. Subsequently, he came to the drawing room and started having liquor, while his wife was in the bedroom watching TV. After consuming few pegs of liquor he went to the kitchen and stabbed himself on his left thigh and came back to the drawing room and started having liquor again. After sometime his wife saw him lying unconscious in the drawing room. He was immediately taken to a nearby hospital, where he was declared dead on arrival. Cause of death was hemorrhagic shock due to femoral vessel injury.

Key Words: Stab injury, Haemorrhagic shock, Suicide, Femoral vessels

Introduction:

Self-injury by stabbing is uncommon in day to day experience, although it is well documented from ancient times. [1, 2]

Case Report:

A twenty-nine year old healthy male of average build and nourishment, a software engineer by profession, belonging to an upper middle socio-economic class, had a strained relationship with his wife. On the fateful day, Sunday a holiday, he had a verbal altercation with his wife in the evening.

After the altercation he came to the drawing room and started drinking hard liquor, while his wife stayed inside the bedroom in front of TV. After consuming some liquor, he went inside the kitchen. He took a long kitchen knife and stabbed himself on the left thigh, and came back to the drawing room and started having liquor again. His wife came to the drawing room after sometime and found her husband lying unconscious in a pool of blood with blood oozing from his left thigh. He was immediately rushed to a nearby hospital, but was declared brought dead on arrival.

Autopsy Findings:

The body was that of a twenty-nine year old male, with rigor mortis present all over the body.

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Faint post mortem lividity was seen on the back and dependent parts of the body except pressure points. No signs of decomposition were present.

Dried blood stains were present on the lower limbs. A stab wound of size 5 cm x 1.5 cm muscle deep was present on left thigh medial aspect, 21 cm below mid inguinal point. (Fig. 1)

Margins of the wound were clean cut. On dissection it was found that after piercing the skin, fat and muscles, the knife ended up penetrating the femoral vessels.

There were no other injuries on the body. All internal organs were pale. Stomach had about 150 gms of partially digested food material. Smell of alcohol was present. Mucosa of the stomach was healthy.

Discussion:

In most of the studies and case reviews on sharp force suicidal fatalities, stabbing of the chest is the commonest. [3, 4] However, in a study by Assuncao LA et al [5] neck was the anatomical region more often fatally wounded, and kitchen knife was the most commonly used object. Bizarre injury patterns in sharp force injuries are encountered in people suffering from depressive illness, schizophrenia and under the influence of drug and alcohol.

Ueno et al [6] in 1999 had reported a case of suicidal stabbing with a falling weighted dagger. Other unusual cases of suicidal stabbing include stabbing with a wood chisel [7], an iron chisel [8] and self-impalement on a piece of wood. [9]

Lingamfelter DC et al [10] had reported a rare case of suicide, where a man under the influence of cocaine and methamphetamine

used a car antenna to cause self-inflicted, intraoral penetrating trauma to the cervical spine and right vertebral artery. Edirisinghe and Busuttil [11] had reported a case of a 50-year-old male who died from exsanguination due to self-inflicted stabbing injuries to the groin and cut injuries to the neck. He was a medical doctor suffering from depression following treatment for cancer. Post-mortem examination revealed that stab injuries in the groin were directly over the femoral arteries where the femoral pulse is clinically palpated. The injury pattern of this suicidal stabbing is uncommon and the medical knowledge of this person may have well contributed to the choice of the site.

The case presented here differs from the common suicidal injuries by the absence of hesitation injuries and the uncommon and unusual location of the main injury. The main injury inflicted was to the upper part of thigh, which is a very uncommon site to choose, even for a layman, for ending one's life.

Though the deceased was a software engineer, it is unlikely that he was aware of the fact that the injury inflicted by him would lead to his death. He was probably suffering from depression due to regular altercation with his wife on petty issues.

It might be possible that the deceased may not have intended to commit suicide and the injury was inflicted in a sudden fit of anger or depression, the deceased being under the influence of alcohol could not judge the gravity of injury and later he would have become unconscious due to extensive hemorrhage from femoral vessels.

Conclusion:

Suicide by self-stabbing is not a common phenomenon. Very few literatures are available on this. Successful suicide by self-stabbing on unusual sites is extremely rare. The case presented here is unique as the deceased,

without medical knowledge had chosen an unusual site to harm him.

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Fig. 1: Stab Injury over Thigh



Case Report

An Autopsy Twist: Natural Hidden Beneath Unnatural

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Abstract

There is a general belief that most cases sent for autopsy are all sinister unnatural deaths. This, along with overburdened work, constraints of time, disinclination towards tedious detailed autopsies, has led to heavy reliance on the garbled history given by the relatives, friends or police personnel accompanying the body. A happily married, well off, young farmer had gone to the market, where he drank tea, and within minutes of doing so, collapsed and died.

He was rushed to Sri Aurobindo hospital where he was declared dead and sent for autopsy. The cause of death, from the stomach and intestinal findings and corroborating it with the history of alleged consumption of some unknown substance with tea was thought to be poisoning but examination of the heart suggested hypertrophic cardiomyopathy which on histopathology was concluded as a case of myocardial infarction. Forensic experts, many times get biased by the history given by attendants or police, which may lead to misrepresentation and hence inevitably causes mistake in the form of mislabeled opinion of cause of death as unnatural deaths. This calls for a meticulous autopsy supported by ancillary investigations.

Key Words: Sudden death, Hypertrophic cardiomyopathy, Histopathology, Myocardial infarction

Introduction:

There is a general belief that most cases sent for autopsy are all sinister unnatural deaths. This, along with overburden of work, constraints of time, disinclination towards tedious detailed autopsies, has led to heavy reliance on the garbled history given by the relatives, friends or police personnel accompanying the body.

Here we discuss one such case of sudden death. [1, 6] Sudden death is defined by WHO as death within 24 hours of onset of symptoms. In sudden death, the immediate cause is almost always found in cardiovascular system, even though topographically the lesion is not in the heart or great vessels.

Sudden deaths from cardiac disease comprises, most commonly of coronary atherosclerosis, cardiomyopathic enlargement, hypertensive heart disease.

Other common causes are aortic valve disease, anomalies of coronary circulation, congenital heart disease, and other coronary artery disease such as polyarteritis.

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Case Report:

A 34 yrs old male had gone to the market on 10 July 2012 at around 11 AM to purchase vegetables. After making the purchases he drank a cup of tea and some unknown substance and within minutes of doing so, he fell unconscious.

He was immediately brought to Sri Aurobindo hospital where his vitals were not recordable. CPR was performed on him, but despite all best efforts to resuscitate, the patient was declared dead. There was no past history of any illness, hospitalization, or treatment or similar family history.

Patient was apparently a healthy asymptomatic farmer, was happily living with his wife and children and had even recently profited monetarily the patient was then shifted to mortuary as a case of sudden death.

Autopsy Findings:

On external examination the body was of a thin built male of average height, BMI being 19.45 with no signs of any external injury.

On internal examination all vital organs were congested and stomach contained water like fluid mixed with blood, around 100 ml which had a disagreeable smell and the mucous membrane was congested and bright red. [2] The heart was grossly enlarged with a size of 15 cm x 11.3 cm and weight of 380 gms.

The left ventricular wall showed hypertrophy with thickness of anterior wall – 1.7

cm, lateral wall- 2.4 cm, posterior wall – 1.4 cm and interventricular septum- 2.0 cm with hypertrophied papillary muscles and prominent trabeculated surface. (Fig. 1)

Multiple (2 to 3-visible grossly) hyperaemic zones of around 2 cm x 1 cm to 1 cm x 0.5 cm were present in the posterior wall of the left ventricle involving the endocardium and up to 2/3rd myocardium.

The right coronary artery showed 10-15% of eccentric stenosis with the rest of the coronary arteries being patent. (Fig. 4)

Histopathology of hyperemic areas from left ventricle posterior wall showed myocardial muscle with degenerative changes, hypereosinophilic cytoplasm and pyknotic changes in nuclei with oedema and separation of muscle fibers in central area. (Fig. 2, 4)

Blood vessels were congested. It was concluded as Left ventricular wall hypertrophy with early infarction changes (less than 12 hours) in left ventricular posterior wall.

Discussion:

Initially based on the history given by the attendants, the congested organs and disagreeable smell from the stomach contents, poisoning (unnatural cause of death) was thought to be the cause of death but after the gross examination of the heart which showed left ventricular hypertrophy, together with, sudden death in the young individual raised suspicion of hypertrophic cardiomyopathy (natural cause of death) but histopathological features of HCM as were not seen which negated its possibility.

Finally, based on the histopathology of hyperemic areas from left ventricle posterior wall that showed myocardial muscle with degenerative changes, hypereosinophilic cytoplasm, pyknotic changes in nuclei with oedema, separation of muscle fibres in central area and congested blood vessels, it was concluded as myocardial infarction which may have lead to the death in this case.

Some of the poisons which cause sudden death due to cardiac arrest are: potassium, calcium channel blocker, carbon monoxide, cyanide, cocaine, morphine, aconite, quinine, digitalis, beta adrenergic agonist, antiarrhythmic drugs, potassium sparing diuretics etc. [5]

Cardiomyopathy means disease of the myocardium. [3, 7] Hypertrophic cardiomyopathy occurs between ages of 25-50yrs and is an autosomal dominant trait involving the heavy chain of beta myosin. It is one of the most common causes of sudden unexplained deaths in young athletes.

In chronic cases symptoms may include, dyspnea on exertion, harsh systolic ejection murmur and clinical features of CHF. Myocardial ischemia can occur in this even in the absence of concomitant coronary artery disease.

Ventricular arrhythmias are also common in hypertrophic cardiomyopathy. Grossly, the heart is enlarged in size, there is increase in weight, left ventricular hypertrophy, asymmetrical septal hypertrophy which may be obstructive causing sub-aortic stenosis or non-obstructive as in apical septal hypertrophy and microscopically there is haphazard arrangement of abnormally branching hypertrophied myocytes.

Myocardial infarction: coronary atherosclerosis is sometimes called the "*Captain of the men of death*" and almost all myocardial infarcts are caused by atheromatous lesions and their complications. [1]

It is said that the original lumen must be reduced to 20 percent or less before ischemia in the distribution zone is sufficient to cause myocardial necrosis. But there are numerous reports of undoubted infarction in the absence of an 80 percent stenosis.

The contrary is also common: the finding of complete thrombosis of a major vessel with no sign of infarction, due to the development of an effective collateral circulation. [7]

The gross and microscopy findings seen in case of MI are:

Conclusion:

Forensic experts, many times get biased by the history given by attendants or police, which may lead to misrepresentation and hence inevitably causes mistake in the form of mislabeled opinion of cause of death as unnatural deaths.

In this case we see that, initially what we thought to be an unnatural death (poisoning) turned out to be a hidden case of natural death (MI). Hence the autopsy examination should always be meticulous and supported with ancillary investigations.

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Fig. 6: Cut Section of Left Side of the Heart

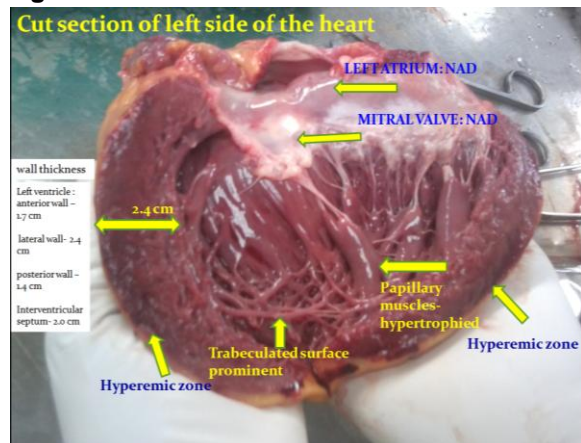


Fig. 2: Section from Left Ventricle Posterior Wall at 10x

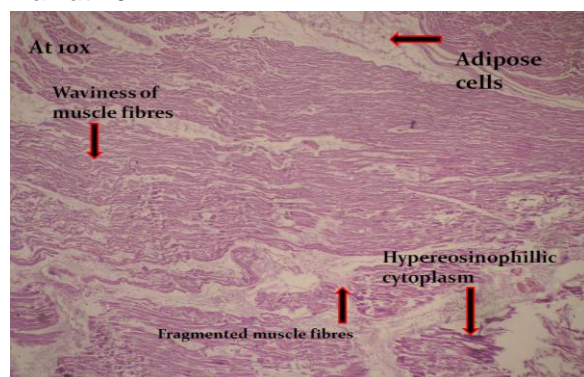


Fig. 3: Section from Left Ventricle Posterior Wall at 40x



Fig. 4: Right Coronary Artery Showing Atherosclerotic Plaque

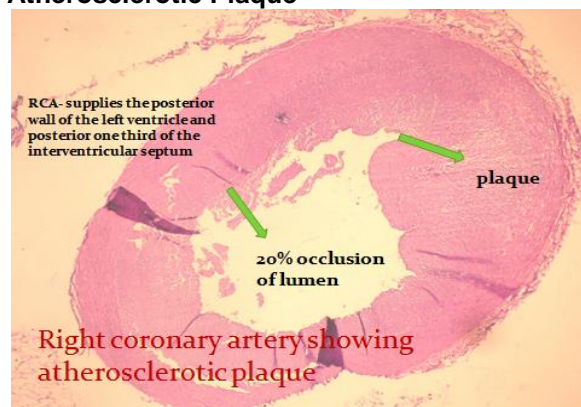


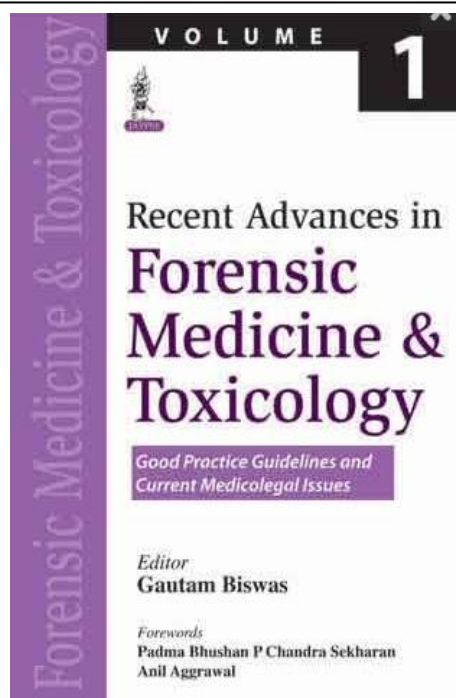
Table 1
Gross and Microscopy Findings Seen In MI

TIME	GROSS CHANGES	MICROSCOPY
0-6 hrs	No change or pale.	Stretching and waviness of fibres or no change
6- 12 hrs	-do-	Coagulative necrosis begins oedema and haemorrhages present
18-24 hrs	Cyanotic red purple areas of haemorrhage	Coagulative necrosis progresses, marginal neutrophilic infiltration, contraction band
48-72 hrs	Pale, hyperemic	Coagulative necrosis complete. Neutrophilic infiltration well developed
3- 7 days	Hyperemic border, centre yellow and soft	Neutrophils are necrosed and gradually disappear, beginning of resorption of necrosed fibres by macrophages, onset of fibrovascular response
10 th day	Red purple periphery	Most of the necrosed tissue removed, fibrovascular reaction more prominent, pigmented macrophages eosinophils, lymphocytes, plasma cells present
14 th day	-	Necrosed muscle mostly removed. Fibrocollagenic tissue present at the periphery
Third week	-	Necrosed muscle removed. Ingrowth of fibrocollagenic tissue
Fourth to sixth week	Thin grey white hard shrunken fibrous scar	Increased fibrocollagenic tissue, decreased vascularity, fewer pigmented macrophages lymphocytes and plasma cells

Book Review

"Recent Advances in Forensic Medicine & Toxicology"

Edited by Dr. Gautam Biswas



This book has been published by **Jaypee Bros** containing 22 chapters & 22 contributors including Nageshkumar Rao, P.C. Chakraborty, V. V. Pillay, SK Verma, Mukesh Yadav, Tapas Kumar Bose, Srinivasa Ragavan, J. Naryanreddy, Bhupesh Khajuria, SK Dhatarwal, Swapnil Agarwal, Anil Kohli, Pradeep Kumar, Virendar Pal Singh, Prateek Rastogi and more.

Quick Overview:

Recent Advances in Forensic Medicine and Toxicology (Volume 1) is designed to provide up-to-date knowledge on some common and special topics in the field, focusing closely on the dynamic and rapidly growing evolution of medical science and law.

An attempt has been made to provide as much information as possible within the book, since the book is meant to be an overview of forensic issues concerned.

The book has been divided into three sections. In this, individual chapters present a problem-oriented approach to a central theme of medical jurisprudence, medical ethics, forensic pathology or toxicology. A comprehensive review of the national and international literature that is otherwise difficult to assimilate, is given in each chapter.

Key Features:

This book has been written in clear and concise language suitable for a wide audience of readers. It is well illustrated with color photographs, diagrams, textboxes, tables and flow charts to emphasize salient features and clear communication of concepts. The book focuses on both practical and scientific aspects of the different areas of expertise within the broad field of forensic medicine and toxicology. The idea is to strengthen and enhance the role of Forensic Medicine in the court room that will subsequently help to solve crimes and bring justice.

Twenty-two chapters comprising of some common forensic topics likely to be encountered in the daily routine, as well as special topics which are not frequently encountered including both legal obligations and ethical responsibilities of those involved in the forensic setting are discussed. The chapters are written by experts who are leading authorities in their field of specialty and each chapter is extensively researched and references are cited at the end. The book is further divided into three sections:

- **Section I** focuses on medical jurisprudence covering legal and ethical issues and essential concepts in the interface between medicine and the law
- **Section II** deals with clinical Forensic Medicine that will help in serving as a practical guide to daily medicolegal work
- **Section III** covers forensic pathology and discusses the current issues and concepts on judicial hanging, dyadic deaths, fat embolism, tattoos, sudden infant death syndrome and post-autopsy reconstruction.

Target Readership:

The book would fill the vacuum for a Forensic book needed by those medical and legal professionals who work alongside or interact with forensic experts. This book is specially meant for postgraduates/senior residents, faculty members and all those medical professionals who are involved in medicolegal work particularly in emergency Department

Dr. Mukesh Yadav
Editor, JIAFM