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# **Journal of Indian Academy of Forensic Medicine (JIAFM)**

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## From Editor's Desk

# JIAFM

A Quarterly Publication

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I feel immense pleasure to present before you the third 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

### Investigation in Rape Cases: Need for Proactive Approach

In India heinous crime against woman are on the rise in spite of post Nirbhaya amendment in criminal law in 2013. Seeing the NCRB statistics about 'Rape Cases' it appears that desired deterrent effect of stricter and harsh prolonged punishment is not percolated in the society at gross root level. There is need for not only creating awareness about these new provisions of law but also about improving infrastructure leading to use of modern investigation tools and techniques, training of forensic medicine practitioners and investigating officers and prosecuting agencies, etc.

Obsolete and traumatic tests like 'Two Finger Test' should not be allowed to be practiced in view of pain and suffering of rape survivors, international guidelines and court directions in this regard.

There is also need to take strict action against those who are violating new provisions of the law and in doing any negligence in handling of medicolegal cases of rape and like offences.

#### Case Law Referred:

As held in *Santosh Kumar Singh vs. State*, (2010) [1], **that the conclusions of the DNA report cannot be doubted and must be accepted as scientifically accurate as DNA finger printing is an exact science.**

In *Santosh* the trial Court had not relied on the DNA report and held that the vaginal swabs and slides and the blood sample of the accused had been tampered with, and had relied on some text books for this purpose. **The High Court and the Supreme Court however held that there was no reliable evidence for suggesting that the sample had been tampered with, and even criticized the trial Court for relying on text books which were not put to the expert.**

Recently the same position regarding the **value of the DNA profiling** has been reiterated in *Dharam Deo Yadav vs. State of U.P.*, (2014) [2], wherein, **modern forensic techniques for criminal investigations** such as DNA profiling have been lauded, because of reliable witnesses failing to give testimony, or turning hostile due to intimidation, though it is conceded that the DNA testing may in a particular case not be cent percent accurate, as that would depend on the **quality of the analysis** and whether the sample collected was **kept free from contamination**. Thus the law report observes in **paragraph 30**: [27]

*"30. The criminal justice system in this country is at crossroads. Many a times, reliable, trustworthy, credible witnesses to the crime seldom come forward to depose before the court and even the hardened criminals get away from the clutches of law. Even the reliable witnesses for the prosecution turn hostile due to intimidation, fear and host of other reasons. The investigating agency has, therefore, to look for other ways and means to improve the quality of investigation, which can only be through the collection of scientific evidence. In this age of science, we have to build legal foundations that are sound in science as well as in law.*

*Practices and principles that served in the past, now people think, must give way to innovative and creative methods, if we want to save our criminal justice system. Emerging new types of crimes and their level of sophistication, the traditional methods and tools have become outdated, hence the necessity to strengthen the forensic science for crime detection. Oral evidence depends on several facts, like power of observation, humiliation, external influence, forgetfulness, etc. whereas forensic evidence is free from those infirmities.*

*Judiciary should also be equipped to understand and deal with such scientific materials. Constant interaction of Judges with scientists, engineers would promote and widen their knowledge to deal with such scientific evidence and to effectively deal with criminal cases based on scientific evidence. We are not advocating that, in all cases, the scientific evidence is the sure test, but only emphasising the necessity of promoting scientific evidence also to detect and prove crimes over and above the other evidence."*

In the aforesaid law report where the skeleton of the deceased a female from New Zealand was exhumed from the house of the appellant after a year of its burial there on the pointing out of the appellant and all the skin had even disappeared by then, it was observed that as the humerus and femur bones corresponded biologically with the blood sample of her father, it was held sufficient for establishing the identity of the deceased, looking to the specialized skill of the DNA analysts and the laboratory (CDFD, Hyderabad), which had carried out the DNA analysis in that case. In the present case also the

DNA analysis was carried out by the same CDFD, Hyderabad on our orders, and no reasons were suggested by the learned counsel for the appellant for showing why the report could not be relied upon.

With this DNA affirmation that the hair of the appellant was the same as the hair found between the fingers of the deceased, this identify cannot be explained on the contradictory stances on this aspect in the defence suggestions to witnesses and in his answers given to the questions put under section 313 Cr.P.C. statements before the lower Court and this Court.

It has been rightly observed in *State of U.P. vs. Krishna Master and others, (2010) [3]* and *State of U.P. vs. Anil Singh, (1988) [4]* **that if the evidence read as a whole has a ring of truth, then discrepancies, inconsistencies, infirmities or deficiencies of a minor nature not touching the core of the case cannot be a ground for rejecting the evidence.**

### **Adverse Comments on Manner of Investigation and Trial**

Before parting however **Division Bench expressed their unease with the casual manner in which the investigation and trial in this case has been conducted.**

Bench observed that no doubt this Court relying on the observations in *Zahira Habibullah Sheikh (5) vs. State of Gujarat, (2006) [5]*, recommending to Courts not to act as mute spectators and mere recording machines, this Court had in the interest of justice for the accused, victim and society acted proactively and called for and examined the samples of hair of the deceased and appellant and other materials collected in this case on 29.10.13 which were thereafter sent to the C.D.F.D., Hyderabad for DNA analysis.

As mentioned above, according to the DNA report the hair of the deceased, which was cut by the doctor conducting the post mortem examination, was of the same person whose hair was found in the room and bed in possession of the appellant Also the hair, which was taken from between the fingers of the deceased matched with the hair of the appellant, which has been cut in jail on the orders of this Court. The said material as we have shown above has gone a long way for establishing the complicity of the appellant in this offence.

However, Division Bench found gross negligence in the I.O. and ineptitude on part of the trial Court in not themselves sending the hair samples, which were collected at the place of occurrence and from the deceased, for D.N.A. examination which were crucial for establishing the complicity of the appellant in this offence. We also see negligence on part of the I.O. in not examining Dr. R.K. Singh, who had initially taken the hair samples and blood sample of the appellant and also in not keeping the sample in a proper condition causing us to find that the seal and bottle of the sample were damaged. We had therefore directed that fresh sample of hair of the appellants be cut and collected in the jail where he was lodged by the order dated 29.10.13. It is also a source of anxiety to us that in a case of such gravity as the present case, the Investigating Officer has only examined two witnesses of fact viz. P.W. 1 Baise Ali and P.W. 2 Afzal and only three other witnesses P.W. 3 Dr. Amit Kumar, P.W. 4 Constable Parul Yadav and himself PW 5 S.I. Ashok Kumar Singh.

Division Bench stated categorically that this is not the manner to prove a charge of rape and murder of a 12 year old girl, and actually if we had not ourselves sent the samples of hair of the deceased and the hair found at the place of incident which had been collected and got a fresh sample of the hair of the appellant cut and got the same sent for DNA matching to the CDFD, Hyderabad, the order of conviction may have suffered from some infirmities in view of the improbabilities alluded to by the learned counsel for the appellant, and there was a risk that such a grave case of rape and murder a 12 year old girl may have resulted in undeserved acquittal, eroding the confidence of the victim and the public in our system of justice.

### **Unwarranted Acquittal and Remedy for Prevention:**

It may be noted that Allahabad High Court has earlier also adversely commented against negligent investigations in cases of rape and murder of minor girls, viz. *Bhairo vs. State of U.P. (2011) [6]* and *Chhotu @ Ajay vs. State of U.P., (2013) [7]* which had **ended in unwarranted acquittals** because D.N.A. samples were not collected or the accused not subjected to medical examination or where witnesses did not appear or support the accused after being won over, and other grave lacunae were inadvertently or designedly left by inept or dishonest investigations.

Allahabad High Court had issued directions in those cases to the Director General of Police, U.P. to improve the process of investigations, especially in cases of rape and murder of minor girls. Which have been reiterated in the on-going PIL, *Qasim vs. State of U.P. [8]*, where this Court has been taking steps and issuing directions for improving the techniques and procedure for investigations in the State of U.P.

Division Bench mentioned that in the case of *Dayal Singh vs. State of Uttaranchal, 2012 [9]*, where the deceased and injured were said to have been assaulted with lathies, but it appeared that the doctor conducting the post mortem examination and the Investigating Officer had colluded with the accused and no blunt object injury had been shown on the deceased in the postmortem report. Also although the viscera of the deceased were preserved for sending to the Forensic Science Laboratory, it deliberately appeared not to have been sent.

The Apex Court noted with approval **that the trial Court and High Court relying on the evidence of the eyewitnesses in preference to the medical report had held the accused guilty.**

The trial Court had even recommended action against the doctor and the police officer to the Director General (Health) and DGP. The Apex Court even initiated contempt proceedings against the Director General Health Services of U.P. / Uttarakhand and Director General of Police, U.P./ Uttarakhand under the provisions of the Contempt of Court Act for not complying with the directions of the trial Court and in failing to take action against the errant Medical Officer and Investigating Officer for dereliction of their duties and also directed that disciplinary proceedings be initiated against them.

It was further clarified that in case the I.O. and the Medical officer had retired, action could be taken against them even by withdrawal of their pensions. It was further observed in *Dayal Singh (2012) [9]* that *"if primacy is given to such designed or negligent investigations, omission and lapse by perfunctory investigation or omissions, the faith and confidence of the people would be shaken not only in the enforcement agency, but also in the administration of justice."*

Court shown his anguish in following words that we are also disturbed by the manner, in which the trial Judge has recorded the 313 Cr.P.C. statement, which **only consisted of six questions** compositely putting the case, the witnesses and documents to the accused and simply questioning him as to why he was prosecuted and whether he had anything else to say or defence to lead, instead of seeking the explanation of the accused on each of the incriminating circumstances which appeared against him in the evidence on record, which is the requirement of law.

Court was therefore constrained to re-framed detailed questions against the accused with the assistance of the learned G.A. on all the existing incriminating circumstances on the record, in addition to the further specific questions which were framed regarding the DNA analysis and other co-related material when the accused was re-examined under section 313 Cr.P.C by this Court on 27.1.14.

In a recent case before the Division Bench of the Allahabad High Court directions were issued to concerned authorities for improving investigations and trials in rape and murder cases. Division Bench of Allahabad High Court after finding it imperative issued the **following directions:**

#### **Collection of Circumstantial Evidence:**

That in cases of **rape and murder of minor girls**, which are based on **circumstantial evidence**, as far as possible, material which is collected from the deceased or the accused for example hair or blood of **the victim or the accused**, which is found on **the persons or clothes of the victim or the accused or at the spot**, seminal stains of the accused on the clothes or body of the victim, Seminal swabs which may be collected from the vaginal or other orifices of the victim and the blood and other materials extracted from the accused which constitutes **the control sample** should be sent for D.N.A. Analysis, for ensuring that **forensic evidence for establishing the participation of the accused in the crime**, is available.

#### **Mandatory Examination of Accused, Collection of Evidence, Training to Examining Forensic Medical Practitioners:**

Court also directed the Director General Medical Health U.P., Principal Secretary Health, U.P., and D.G.P., U.P. **to mandate sending the accused for medical examination in each case for ascertaining whether he has any injuries caused by the resisting victim, or when he attempts to cause harm to her** as is provided under section 53 A of the Code of Criminal Procedure Code, which was introduced by Act 25 of 2005, (w.e.f. 23.6.2006).

Court further noted that in particular if the rape suspect is apprehended at an early date after the crime, **it should be made compulsory to take both dry and wet swabs from the penis, urinary tract, skin of scrotum or other hidden or visible regions, after thorough examination for ascertaining the presence of vaginal epithelia or other female discharges** which are also a good source for isolating the victim's DNA and **necessary specialized trainings be imparted to the examining forensic medical practitioners for this purpose.**

#### **Prohibition of Finger Test on Rape Survivors:**

Division Bench of Allahabad High Court further directed the Principal Secretary (Health), U.P., Director General (Health and Medical Services) U.P. **to prohibit conducting the finger insertion test on rape survivors**, and to employ modern gadget based or other techniques for ascertaining whether the

victim has been subjected to forcible or normal intercourse. These finger insertion tests in female orifices without the victim's consent have been held to be degrading, violative of her mental and physical integrity and dignity and right to privacy and are re-traumatizing for the rape victim.

Relying on the International Covenant on Economic, Social, and Cultural Rights, 1966 and the United Nations Declaration of Basic Principles of Justice for Victims of Crime and Abuse of Power, 1985 it was further held in *Lillu vs. State of Haryana, (2013) [10]* that no presumption of consent could be drawn *ipso facto* on the strength of an affirmative report based on the unwarranted two fingers test.

#### **Establishment of Modern Forensic Sciences Laboratory:**

We find that there is absence of an adequately equipped D.N.A. Laboratory in U.P. which has advanced mitochondrial DNA analysis facilities, comparable to the CDFD, Hyderabad, (from where we were able to obtain positive results in this case, after unsuccessful DNA matching in an earlier case, *Bhairo vs. State of U.P. [6]* where this Court had sent the sample of vaginal smear slides and swabs and appellant's underwear to the U.P. DNA laboratory, viz. Forensic Science Laboratory, Agra), and we direct that such a DNA centre comparable to the CDFD be established in the State of U.P. at the earliest so that Courts and investigating agencies are not compelled to send DNA samples at high costs to the specialized facility of the CDFD at Hyderabad.

#### **Thorough Investigation by Efficient Investigation Officers:**

**The Director General of Prosecution, U.P., the Director General of Police U.P. and Director General Medical Health** should ensure that **blind cases of rape and murder of minor girls or other complicated cases are thoroughly investigated by efficient Investigating Officers. Effective steps should be taken for forensic investigations** by collecting and promptly sending for DNA analysis all possible incriminating material collected from the **deceased, victim, accused, and at the scene of the crime etc.** which may give information about the identity of the accused and his involvement in the crime, after taking precautions for preventing the contamination of the material.

#### **Protection of Witnesses:**

Court observed that this is necessary **to prevent Courts being rendered helpless** because the prosecution and investigating agency are lax in producing witnesses or because witnesses have been won over or are reluctant to depose in Court. Steps should also be taken for preventing witnesses from **turning hostile**, by prosecuting such witnesses, and even by cancelling bails of accused where they have secured bails where it is apparent that efforts are being made to win over witnesses and by providing witnesses with protection where ever necessary so that they can give evidence in Court without fear or pressure.

#### **Strict Action against Investigating Officers, Medical Officers and Other:**

Court observed that in case there is reason to think that the Investigating Officers or medical officers or others have colluded with the accused, strict action be initiated against the colluding officials as was recommended in the case of *Dayal Singh vs. State of Uttaranchal (2012) [9]*.

#### **Development of Policies and Protocols:**

Court further observed that It is necessary that **policies and protocols be developed** by the DGP, U.P., Principal Secretary Health, Director Medical Health U.P., Director of Prosecutions, U.P., for the aforesaid purposes.

#### **Proper Training is given to Judicial Officers:**

The Judicial Training and Research Institute (JTRI), Lucknow must ensure that proper training is given to Judicial Officers on framing proper questions for 313 Cr. P. C. examinations, so that the entire circumstances of the case are put to the accused and they cannot claim the benefit of being inadequately questioned about the incriminating circumstances of the case.

There is need for proactive approach to investigate rape cases by using modern tools and techniques in the letter and spirit of these court directions by all the stake holders to bring these cases to final conclusion and thus, help in serving the ends of justice in larger public interest.

**Dr. Mukesh Yadav**  
**Editor, JIAFM**

## Original Research Paper

# Retrospective Analysis of Pattern of Poisoning in Uttarakhand

<sup>1</sup>V Saxena, <sup>2</sup>DK Atal, <sup>3</sup>S Das

### Abstract

Poisoning cases are important part of medico-legal cases coming to a health care centre. This paper presents the study of cases of poisoning received in the casualty of Himalayan Institute of Medical Sciences, Dehradun during a span of 2 years (2011-2012). The cases were then analysed on various epidemiological parameters, feeding the information in the predesigned Performa prepared for this purpose. It was concluded that there is not much gender difference, however, majority of victims were married and most commonly among people from the age group of 21-30 years. Maximum number of cases took place in the month of November and May. During the span of the study, poisoning due to insecticide were predominant, constituting about 57 percent of all poisoning cases, while poisoning through unknown compounds was the second most common fatal poisoning.

**Key Words:** Poisoning, Pattern, Uttarakhand, Gender difference, Fatal

### Introduction:

Poisoning cases can be deliberate or accidental. Poisons are silent weapons, which can be easily used without violence and often without arousing suspicion.

Modern development in all fields leads to newer poisonous substances and more number of poisoning cases. Advanced medical treatment and awareness cannot wholly control this issue. [1] Poisoning pattern of a region is very crucial in determining the health need of the society and planning the infrastructure and manpower requirement for dealing these cases effectively and efficiently.

This pattern depends on the availability of poisons in that region, occupation, culture, beliefs, demography, socio-economic status, education and customs of the region. Studies of these factors will be useful not only in management of poisoning cases but also identify administrative requirement and help in planning appropriate preventive measures.

In this context the present study was carried out with the objective to investigate the pattern of acute poisoning cases in a tertiary care hospital in Uttarakhand state.

### Materials and Methods:

The study was conducted as a part of Short Term Research Project at the Himalayan Institute of Medical Sciences. Hospital records of all the patients of all age groups admitted to the hospital during the study period (2011-2012) with diagnosis of poisoning constituted the study material for the retrospective analysis. The cases of food poisoning were excluded from the study. Data was collected in a predesigned case study form.

### Observations and Results:

In the present study the Male: Female ratio is 1.2:1 (56 Males and 49 Females). Male outnumbered the females. Poisoning is most common among people from the age group of 21-30 years and then shows a progressive fall as the age progresses with the geriatric age group showing least vulnerability to poisoning.

The poisoning in extreme of ages are least observed. (Fig. 1) Our study clearly showed vulnerability of poisoning among different sections of the population. Married Females are more vulnerable than married males for poisoning. Unmarried Males are at least risk for poisoning. (Fig. 2)

This study showed that Maximum poisoning takes place because of Organophosphates. The second most common cause of poisoning is unknown poisoning. These poisons can be indigenous plant products like Dhatura or other plants or other local products. Drug Overdose is the third most common cause of poisoning. (Fig. 3)

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Regarding Route of Poisoning Oral route is the route of choice for suicidal as well as homicidal purpose because of the ease of administration of the poisoning agent and no need for trained personnel to conduct the act. In the present study also the oral route is the most preferred (99%). Inhalational route is usually accidental or homicidal but rarely suicidal. In current study only 1% of total cases are due to inhalational poisoning.

In his study it was observed that Maximum poisoning is attributed to suicidal reasons (89%) with accidental (8%) being the second. Accidental poisoning is prevalent among children as they are vulnerable to consume unknown substances. Homicidal poisoning is still rare and account for only 3% of total. (Fig. 4)

In the present study, in 56% of cases the reason of poisoning couldn't be determined. However, family problems were a leading cause of suicides. It was also observed that conflict with spouse was a major cause of family problems in young age group of 20-30 years.

Moreover, from the age group of 50 and beyond conflict with children was a major cause family problem. Depression was the second leading cause of suicides. The major causes of depression in this region are family problems, financial problems, etc. Substance abuse is the third leading cause of suicides. Substance abuse includes alcohol and drug abuse. (Fig. 5)

Maximum number of cases took place in the month of November and May. In present study, it was observed that gastric lavage is performed as first line of management in 95% cases. However, in 5%cases the gastric lavage has not been done at all. Extensive research has made it possible for us to deal with almost all kinds of poisoning cases resulting in a very low mortality rate. In present study, only 6% mortality was observed because of poisoning. (Fig. 6)

It was observed that maximum cases received help within first 4 hours of ingestion or exposure of poisonous substance.

However, most notable finding was that all cases of deaths were the ones who got their first help within 1-2 hrs. This clearly indicated that apart from the interval between ingestion of poison and first help received outcome of poisoning is also determined by a number of other factors. Moreover, very few but cases are there who received help after 24 hour but then too survived. (Fig. 7)

### **Discussion:**

Many retrospective studies on poisoning pattern were done by various authors of different

parts of India. And they observed and emphasized a strong relationship between social parameters and the pattern of poisoning. The present study also highlights the fact that not only the availability of a poison in a region is a sole determinant but also the social parameters play an important role in pattern of poisoning. Gargi et al observed that male to female ratio was nearly 3:1, majority of the victims were in the age group of 21-30 years (45.59%), and 69.12% were married. [2] Dhanya et al stated that the male: female ration is of 1.27:1 and maximum victims were from the age group 15-30 (58.58%). [3]

Ali et al also found that majority of the cases was young people from the age group 16-40 years (about 80%). [4] The current study has come up with very similar findings i.e. maximum victims were from the age group of 15-30 years. However, the male: female ratio is 1.2:1 and in agreement with Dhanya et al. This age range is a period in which a person is most active in all respects be it family life, professional life, or social life, which increases the stress and often leads to devastating outcomes.

Pokhrel et al found that females were more susceptible to the intentional poisoning than male. Intentional poisoning for unmarried male was found to be more (34%) than for female. On the contrary, intentional poisoning in female was high in case of married subjects (57%). [5] The present study also clearly shows vulnerability of poisoning among married females more than married males. However, unmarried females are also more vulnerable than unmarried male's subjects.

Dhanya et al observed that Organophosphorus (OP) poisoning constitute maximum number of cases (37.25%) followed by unspecified drugs in Calicut. [3] Gupta et al confirmed through chemical analysis report that insecticide was the commonest poison (72.44%) followed by aluminum phosphide (14.28%) and acid (0.63%). [1]

Garg et al reported that Aluminium phosphide is leading cause of poisoning (36.8%) followed by insecticides (31.6%) in South-West Punjab. [6] Gargi et al also reported that Aluminium phosphide (38.23%) followed by Organophosphorus compounds (17.64%) were the commonest poison in Amritsar during 1997-98. [2] However, the present study was in agreement with Dhanya et al and Gupta et al and observed that Organophosphorus poisoning constitute major chunk of total cases (57%) in Uttarakhand region.

It appears that OP poisoning constitutes majority of cases because of easy availability,

low cost, unregulated sale and also presence in majority of households in this region.

Gupta et al emphasized that childhood poisoning constituted 2.1 % of the total paediatric admissions and 1.2% of total deaths. Non-medicinal compounds were the largest contributors (69.2%), of which kerosene alone was responsible for 47% of cases. [7] Singh et al found that in 164 children, poisoning was accidental whereas in 50 it was suicidal and in three homicidal. Routine household items accounted for 27.6% cases with kerosene being the commonest agent. Chemicals, pesticides and fumigants were involved in 35.5% cases. [8]

The present study observes that the contribution of kerosene (2%) in childhood as well as accidental poisoning has gone down. This clearly indicates awareness among parents about the household poisons. However, the childhood poisoning as a result of consuming any unknown substance is still common.

Suicide was the commonest manner of poisoning and many authors made this observation on the basis of history provided by the investigating officers or relatives. Ali et al. in a study on clinical pattern and outcome of OP poisoning showed that suicide is the most common modes of poisoning and reported in 65% cases, followed by accidental (27%) and homicidal (8%). [4]

The current study has also come with a similar pattern in overall poisoning cases i.e. 89% suicidal, 8% accidental and 3% homicidal poisoning. Therefore suicide is still the leading cause of poisoning followed by accidental and homicidal. Many studies including study conducted by Pokhrel et al and Batra et al states that the rainy season is the most common period for suicides among the rural population due to failure of crops. [5, 9] However, the current study couldn't find any increased number of suicides during the rainy season. Moreover, most of the suicides were attributed to family problems and depression, none due to crop failure.

Roberts et al mentioned that use of a poison for a purpose is determined by a number of factors including its easy availability in the market, price and popularity among the masses and appropriate laws concerning the poisonous agent. [10] Nigam et al reported that maximum incidence of OP Poisoning is seen in persons engaged with agricultural fields (39.60 %) followed by house wives (20 %) and students (16.85 %). [11]

The current study is in complete agreement with Roberts et al and found that availability, price and laws influence the use of an agent as a poison to a great extent.

Dhanya et al. mentioned that general measures like Gastric lavage (83%) and Ryles Tube Aspiration (80%) were mainly used for management of poisoning cases. [3] The current study has come up with very similar findings.

Maximum poisoning victims underwent gastric lavage as a general measure. However, remaining 5% cases in which gastric lavage was not at all done include cases of acid ingestion, carbon-monoxide and mercury poisoning. So, Gastric lavage and Ryle's Tube aspiration is still the mainstay of treatment in maximum of cases.

Maiti et al conducted a review study and conclude that use atropine and oximes derivatives in OP poisoning remains conflicting and controversial. They have no effect in moderate and severe poisoning and do more harm than good.

However, Pralidoxime (PAM) is more effective in OP poisoning than atropine. [12] The current study clearly shows that all cases of OP poisoning have been dealt with atropine and PAM and shows good result. So, Atropine and PAM are effective in OP poisoning cases.

Dhanya et al stated that out of the total poisoning cases, 205 patients (10.85%) died of poisoning, of which Organophosphorus poisoning accounted the maximum (88.78% of total mortality). [3] Ali et al graded the Organophosphorus poisoning cases into mild (12%), moderate (60%) and severe (28%) and reported mortality in 20% cases. [4] The present study also showed similar findings. OP poisoning accounted for 57% of poisonings which is the maximum and 6% victims died.

### **Conclusions:**

The present study was a part of Short Term Research to study the pattern of poisoning in the state of Uttarakhand, The Male: Female ratio for poisoning in this region was 1.2:1 and 43% of victims were married. Maximum cases of poisoning came from the age group of 21 – 30 years of age and OP poisoning (57%) is still the leading cause of poisoning in this region followed by drug overdose (10%).

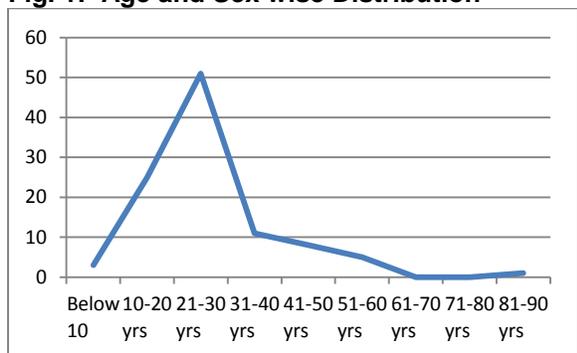
Suicidal poisoning was responsible for 89% of poisoning followed by accidental. Family problems and depression were leading causes of poisoning in this region. Mortality due to poisoning was low with only 6% deaths. General measure for management of poisoning was gastric lavage which was done in 95% of cases.

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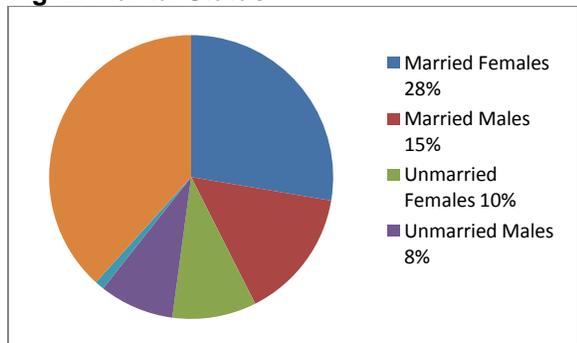
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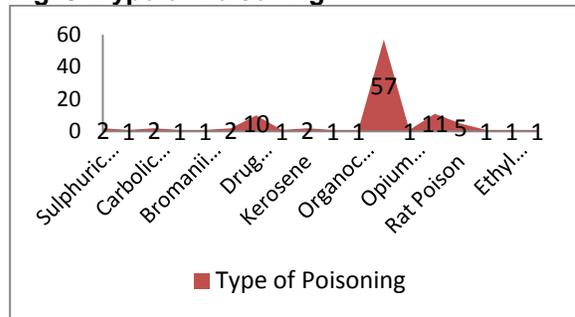
**Fig. 1: Age and Sex wise Distribution**



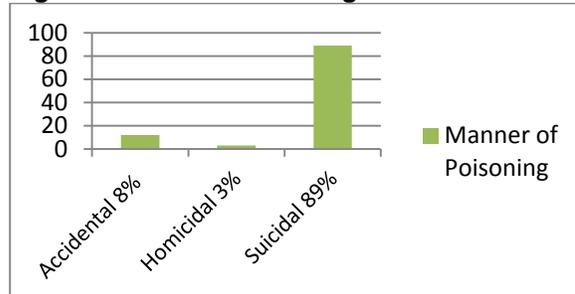
**Fig. 2: Marital Status**



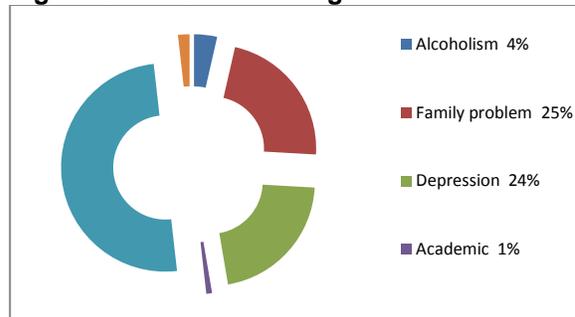
**Fig. 3: Type of Poisoning**



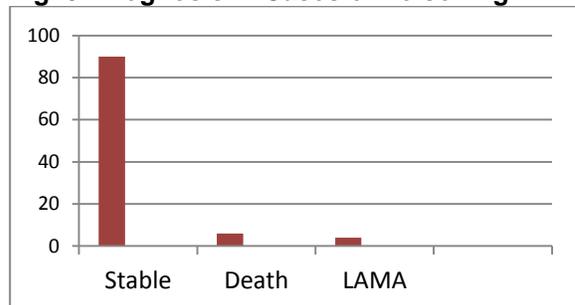
**Fig. 4: Manner of Poisoning**



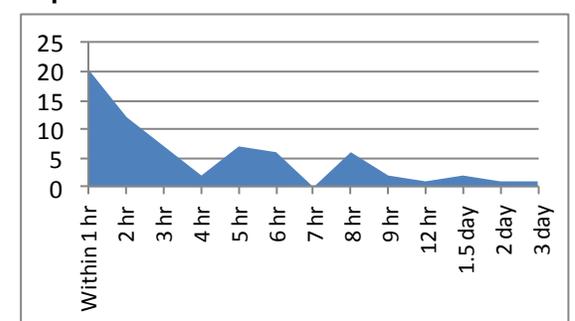
**Fig. 5: Cause of Poisoning**



**Fig. 6: Prognosis in Cases of Poisoning**



**Fig. 7: Interval Between Poisoning and first Help**



## Original Paper

# Determination of Sex from Sternal Bone In Central Delhi Population

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### Abstract

Identification of deceased is an essential part of post-mortem examination. A number of parameters are used for identification however the determination of sex is statistically the most important criteria. It immediately excludes almost half the population, in comparison to age, stature and race which provide wide number of variables. There have been a number of studies regarding sexing of the sternal bone throughout the world but the studies in India especially Delhi, the capital city of India are virtually non-existent. The present study was an attempt to determine the sternal parameters that can be used to identify the sex of an individual, where sternal bone is available.

Length of the manubrium was found to be the most reliable criteria of determining sex from sternal bone. Other parameters i.e. Length of mesosternum, Combined length of manubrium and mesosternum, Breadth of first sternebra at its waist, Breadth of third sternebra at its waist, Manubrio-corpus index and Relative width index of first and third sternebrae were not found to be useful. The use of multivariate analysis technique was found to increase the probability of determining the sex of individual by sternum.

**Key Words:** Length, Sternum, Mesosternum, Sex, Individual

### Introduction:

Identification is recognition of an individual by means of various physical features and biological parameters, which are unique to each individual. Since the bone resists putrefaction and destruction by animals, they can be used for identification and can lead to a reliable determination of age, sex, race [1], stature of the individual. The determination of sex is statistically the most important criteria as it immediately excludes almost half the population, in comparison to age, stature and race which provide wide number of variables. [2]

Where the entire skeleton or skull or pelvis is available, identification of sex can be done with reasonable degree of certainty. However, when a single bone is presented for examination, it becomes difficult to determine the sex of the individual accurately.

Though, many studies are available using a number of long bones, the data related to sternum in the determination of sex is very limited in Indian population. Determination of sex from human skeletal remains is an essential element of any medico-legal investigation.

This work has been done in an attempt to obtain certain parameters by which the subsequent distinction of sex of individual is possible in event of such a requirement. Since the study is conducted in Delhi the subjects selected were only from Central Delhi as the race and built may affect the dimensions of the sternum.

### Materials and Methods:

The present study was conducted in the Department of Forensic Medicine, Maulana Azad Medical College, Delhi during the years 2007-2009. 100 cases of both sexes were taken between the age group of 25 – 85 yrs.

The sex of the individuals was noted. The sternum were dissected out and buried in the soil for 6-8 weeks. Subsequently the following measurements were taken from it:

- Length of the manubrium (M), Length of mesosternum (B), Combined length of manubrium and mesosternum = M + B,
- Breadth of first sternebra at its waist = S<sub>1</sub>, Breadth of third sternebra at its waist = S

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- Manubrio-corpus index ( $I_1$ ) =  $M/B \times 100$ ,  
Relative width index of first and third sternbrae ( $I_2$ ) =  $S_1/S_3 \times 100$ .

Subsequently the data obtained was analyzed using various statistical methods like measurement of mean, the difference of means, standard deviation, independent t test, discriminant functions and Pearson's coefficient for correlation.

### Observations and Result:

In our study the mean lengths of the manubrium were 40.639 mm and 37.286 mm for males and females respectively. The level of significance of the difference between the means was statistically significant ( $p < 0.000$ ) for the length of the manubrium. (Table 1)

The t test for equality of the means gave a value of 6.819 with statistically significant p value ( $< 0.000$ ). The length of Manubrium can be considered to be a reliable parameter for the determination of sex from sternum.

The maximum length in case of females was 40.44 mm and the minimum length of the manubrium in case of males was 36.56 mm.

Hence it can be concluded from this study that if the length of the manubrium is less than 36 mm it is of a female and if the length is more than 41 mm then it is of males in the population of central Delhi.

In spite of the statistically significant p value ( $< 0.003$ ) (Table 1) the length of mesosternum cannot be considered to be a reliable criteria for sexing of sternum due to the high percentage of overlapping cases of males and females. (Table 2) (Fig.2)

As a result of the excessive overlapping of the specimens of male and female sterna (Table 2), in spite of the significant p value (Table 1) the combined length of manubrium and mesosternum cannot be considered a reliable parameter in determining sex of the sternum. (Fig. 3)

Our study showed considerable overlapping between the Sternal index in male and female cases (table 2) and the absence of significant p value (table 1), so the Sternal index could not be considered as a reliable parameter for determination of sex from the Sternal bone in the central Delhi population. (Fig. 4)

There was a high degree of overlapping present between the male and female sternal bones (Table 2) due to which the breadth of the first sternbrae was not found to be reliable criteria for determining sex from sternum in spite of having a statistically significant p value. (Table 1)

It was deduced from the observations that the width of third sternbrae could not be considered a reliable parameter for sterna sex determination due to the high overlapping zone though the p value was significant. (Fig. 6)

The relative width of the first and the third sternal vertebrae was not considered a reliable parameter for sexing of sternum due to the insignificant p value and the high degree of overlapping. (Fig. 7)

A multivariate linear discriminant analysis technique was applied to the data and discriminant functions were generated. Based on this discriminant function the probabilities of classification in different groups were calculated and based on those probabilities the individual was assigned to their respective groups.

It was found that through the discriminant analysis technique 89.4% male and 58.8% female could be sexed correctly. (Table 3)

### Discussion:

In the present study it is found that the length of manubrium is reliable for sexing the sternal specimens in central Delhi population. These findings are not in accordance with the works of Ashley, Jit et al and Dahiphale et al which showed that manubrium cannot be considered to be a reliable parameter for the sexing of sternum. [5-7]

The length of the mesosternum and the combined length of the manubrium and mesosternum were not found useful parameters in the present study. This is however not in concordance with the study of Ashley, Jit et al and Dahiphale et al, [5-7] which deduced that these parameters were useful in sexing the sternum. That the sternal index, the breadth of the first sternal vertebra, the breadth of the third sternal vertebra are not useful parameters for sexing the sternum is in accordance with the studies of other authors. [5-7]

The relative width index of the first and third sternal vertebra was not found useful as a determinant for sexing the sternum. This is corresponding with the findings of the other author's studies. [5]

Jit et al and Dahiphale et al [6, 7] applied the discriminant function to increase the accuracy of sex determination of sternum. Jit et al found that 89% male and 82% female sterna could be sexed correctly and Dahiphale et al found that 92% male and 87% female sternum can be sexed correctly using discriminant functions (Multivariate Analysis). [6, 7]

In the present study also, the discriminant function were generated, with prior

probability considered equal (that is male = 0.50 and female = 0.50). It was found that by using discriminant functions 89.4 % male and 58.8 % female can be sexed correctly.

**Conclusion:**

The present study showed that length of Manubrium is the only reliable parameter in sexing the sternal bone. Use of multivariate analysis technique by generating discriminant functions can further increase the possibility of identifying the sex of individual by sternum. However, further studies are required over larger population to ascertain the reliability of sexing criteria.

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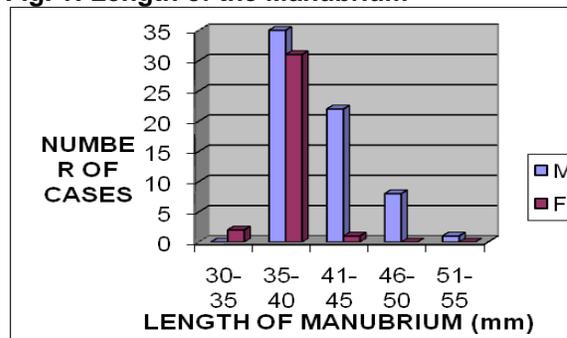
**Table 2: Cases Falling In Overlapping Zone**

Parameters	Sex	Cases	Cases in Overlapping Zone (%)
Length of the manubrium(X)	M	66	35(53.03)
	F	34	22(64.7)
Length of the mesosternum(Y)	M	66	53(80.3)
	F	34	33(97.05)
Combined length (X+Y)	M	66	62(93.93)
	F	34	33(97.05)
Manubrium- Corpus Index (X/Y* 100)	M	66	66(100)
	F	34	33(97.05)
Breadth of first sternebrae	M	66	53(80.3)
	F	34	32(94.11)
Breadth of third sternebrae	M	66	61(92.42)
	F	34	31(91.17)
Relative width S1/S3*100	M	66	64(94.96)
	F	34	33(97.05)

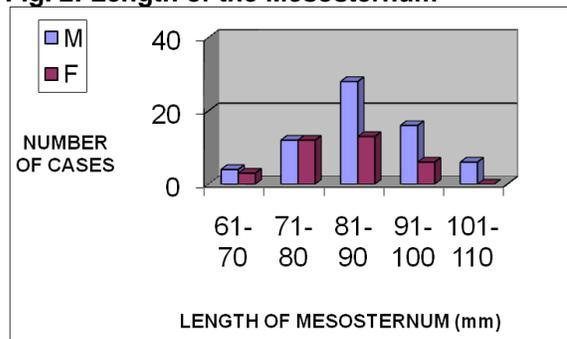
**Table 3: Discriminate Analysis for Sex Identification**

	Sexed correctly	Sexed Incorrectly
Males	59 (89.4%)	7 (10.6%)
Females	20 (58.8%)	14 (41.2%)

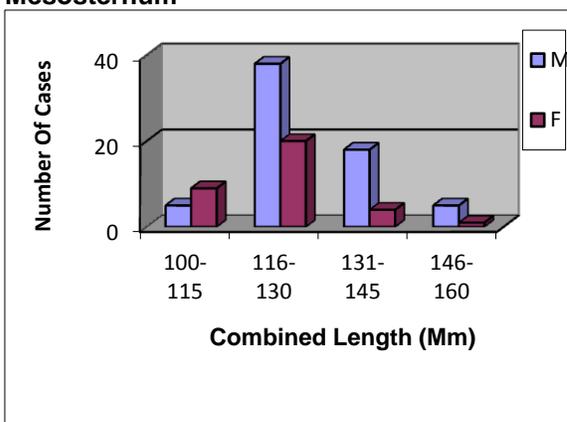
**Fig. 1: Length of the Manubrium**



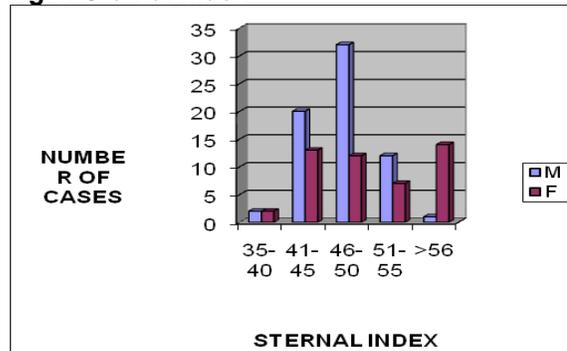
**Fig. 2: Length of the Mesosternum**



**Fig. 3: Combined length of Manubrium and Mesosternum**



**Fig 4: Sternal index**



**Fig. 5: Breadth of First Sternal Vertebrae**

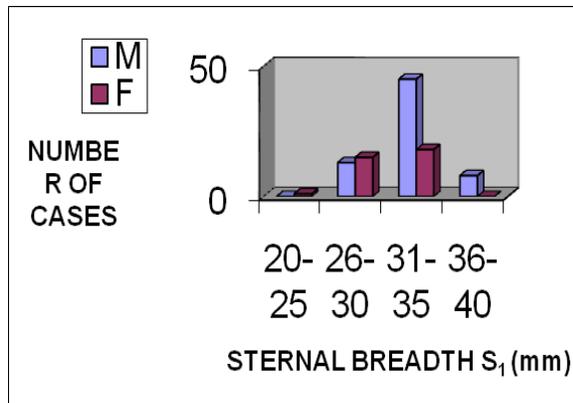


Fig 6: Breadth of Third Sternal Vertebrae

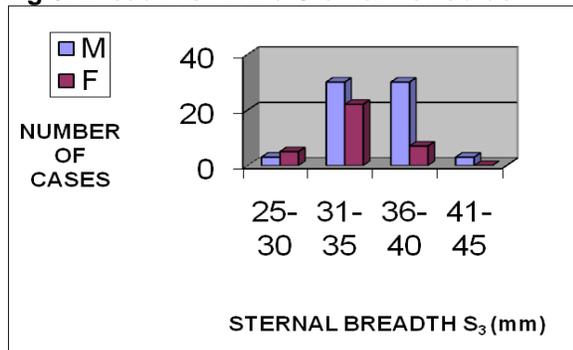


Fig 7: Relative Width Index of First and Third Sternebrae

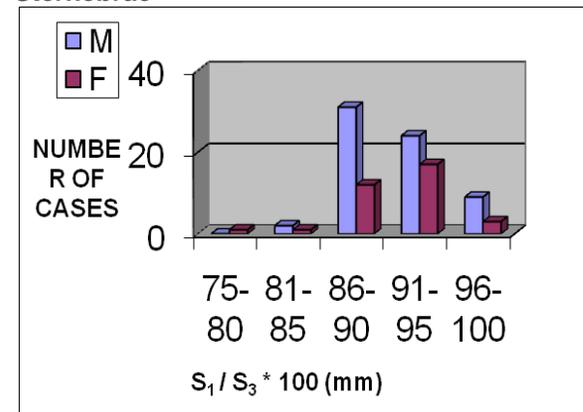


Table 1

Measurements of the Sternum in Both Sexes

Parameters	Sex	Range (Mm)	Mean (Mm)	S.D.	Level of Significance For The Difference Between The Means
Length of the manubrium(X)	M	36-52	40.639	3.47	P<0.000
	F	34-41	37.386	1.41	
Length of the mesosternum(Y)	M	66-107	87.31	9.51	P<0.003
	F	65-97	81.57	8.13	
Combined length (X+Y)	M	104-157	127.95	12.12	P<0.002
	F	100-150	120.09	9.99	
Manubrium- Corpus Index(X/Y* 100)	M	39-55	46.809	3.73	P<0.477
	F	37-56	46.181	4.35	
Breadth of the first sternebrae	M	26-39	31.767	2.39	P<0.001
	F	24-34	29.99	2.22	
Breadth of the third sternebrae	M	29-43	35.165	2.80	P<0.001
	F	28-39	33.163	2.74	
Relative width S1/S3*100	M	83-99	90.44	3.53	P<0.877
	F	79-98	90.56	3.62	

Table 4

Gender Differences Recorded By Various Workers

		Strauch (1881)	Dwight (1881) <sup>3</sup>	Dwight (1890) <sup>4</sup>	Ashley (1956) <sup>5</sup> (European)	Ashley (1956) <sup>5</sup> (African)	Jit (1986) <sup>6</sup>	Dahiphal (2002) <sup>7</sup>	Gautam (2003) <sup>8</sup>	Present Study
Length Of The Manubrium(X)	M	-	51.8	53.7	52.2	45.9	51.73	48.458	53	40.639
	F	-	46.7	49.4	47.9	44.2	48.42	43.781	48	37.386
Length Of The Mesosternum(Y)	M	110	105.9	110.4	104.7	96.5	95.35	94.427	95	87.31
	F	90	89.4	91.9	90.8	82.9	78.6	70.191	76	81.57
Combined Length (X+Y)	M	-	-	164.1	156.9	142.6	147.08	142.196	149	127.95
	F	-	-	141.3	138.7	127.1	127.02	113.172	124	120.09
Breadth Of First Sternebrae	M	-	-	-	-	-	27.45	27.166	21-62	31.767
	F	-	-	-	-	-	24.32	24.44	24-51	29.99
Breadth Of Third Sternebrae	M	-	-	-	-	-	32.58	31.947	-	35.165
	F	-	-	-	-	-	29.19	28.236	-	33.163

## Original Research Paper

# Autopsy Study of Organ Weights in Relation to Body Weight and Body Length of Adult Cases in Jamnagar Region

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### Abstract

This study was conducted at mortuary of M. P. Shah Government Medical College Jamnagar during the period of February 2010 to November 2010. In the present study 449 cases (272 Male, 177 Female) were included. Body weight (BW), body length (BL), body mass index (BMI) and body surface area (BSA) was measured to correlate with organ weights. Statistical analysis was done and compared with standard Indian texts and the earlier studies. In males, there were 5 organ weights except spleen that have positive correlation with BW. In females, weights of all organs except spleen were correlated positively with BW. In males, weights of both lungs had positive correlation with BL and weights of the brain, liver, spleen and both kidneys have negative correlation with BL. In females, heart and both lungs had positive correlation with BL. All organ weights were positively correlated with BMI and BSA except weight of spleen.

**Key Words:** Organ weights, Body weight, Body length, Body mass index, Body surface area

### Introduction:

Human body organs play a significant role in almost all the ancestral branches of medical sciences including Forensic sciences, as any deviation in weight from the normal range suggests some pathological change in the organ and thus helps in interpreting the opinion regarding the cause of death in various pathological conditions. [1, 2]

The reason for this is the variation in the dietary habits, climatic conditions, daily water, intake, customs and genetic predisposition of different population groups. Hence the normal organ weights of a particular region may not be accurate enough for another. Organ weights also play a significant role in estimation of body height and weight of an individual. [1]

Weighing of organs at autopsy is not merely an exercise but has great medico-legal importance. [2] Standard textbooks of foreign authors [3, 4] give the organ weights of the western population, which are not suitable for Indian population.

Some textbooks by Indian authors [5-9] mentioned the organ weights, among them only Mathiharan & Kannan [5] quoted the Indian population organ weights with its reference.

Parikh [6] mentioned the organ weight of Indian population but did not mention any reference. Remaining authors [7-9] did not clarify that organ weights belongs to Indian or western population. So in our study, we tried to generate the Indian data from Jamnagar region. Adding of data of this study in pool of India data may in the end modify prevailing Indian data.

### Material and Method:

This study was conducted at mortuary of M. P. Shah Govt. Medical College Jamnagar during the period of February 2010 to November 2010. In the present study 449 cases of adults (272 Male, 177 Female) were included. Body weight, body length, BMI and BSA were measured to correlate with organ weights.

In the present study all the cases were included except those cases in which studied organ were injured or decomposed. The organs which were included in the study were brain, heart, liver, spleen, both lungs and both kidneys.

Standard autopsy protocol and procedure as described in standard textbook [3, 7] were employed for removal of various organs.

After removing the extraneous tissues and draining of the blood, the organs were washed with water and then weighed using an electronic weighing machine. Body was weighed along with stretcher & worn clothes then the weight of stretcher & worn clothes were

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deducted from that weight to get exact weight of the body. The body length was measured from head to heel by measuring distance between wooden block kept on both end of body. Body length was measured by standard measuring tape.

Body surface area (BSA) and Body mass index (BMI) was calculated by using following formulas: [10-12]

- $BSA (kg/m^2) = 0.007184 \times \text{body weight (kg)}^{0.425} \times \text{body length (cm)}^{0.725}$
- $BMI (kg/m^2) = \frac{\text{Body weight (kg)}}{\text{Body length (m)}^2}$

The data were collected and Statistical analysis was done by SPSS (version17.0) program. The Pearson's correlation was performed in analyzing the relationship of organ weights with BW, BL, BSA and BMI.

### Observation:

In this study we record mean weight of various organ with SD of both male and female in grams. (Table 1) Correlation of organ weights and BW of male were shown in the value of r and p, there were liver, spleen and left kidney weight of male and spleen weight of female that p value were higher than 0.05, therefore they were not related with the BW. (Table 2)

Present study showed that in male there were 5 organ weights that have positive correlation with BW. Out of that brain, heart, right lung were significant at  $p < 0.01$  and left lung and right kidney were significant at  $p < 0.05$ .

While in female except spleen, all other organ weights have been shown positive correlation with BW and they were significant ( $p < 0.01$ ). In our study correlation of organ weights and BL of female were shown in the value of r and p, there were heart weight of male and brain, liver, spleen and both kidney weight of female that p value were higher than 0.05, therefore they were not correlated with the BL.

In male, weight of both lung have positive correlation with BL and were significant at  $p < 0.01$ . Weight of the brain, liver, spleen and both have negative correlation with BL and significant at  $p < 0.01$ . (Table 3) In female, heart and both lung have positive correlation with BL and they were significant at  $p < 0.01$ . All organs weights were positive correlated with BMI and BSA except spleen weight. There were significance at  $p < 0.01$ . (Table 4)

### Discussion:

#### 1) Correlation between Organ Weights and Body Weight

- **Brain:** In our study brain weight was positive correlated to BW in both sexes, which were statistically significant at  $p < 0.01$ .

According to Mathuramoon et al [13] and Chirachariyavej et al, [14] brain weight was positive correlated to BW in case of males only, which was statistically significant at  $p < 0.01$ . But in females, brain weight was not correlated to BW.

- **Heart:** In our study heart weight was positive correlated to BW in both sexes, which were statistically significant at  $p < 0.01$ . [13] According to Chirachariyavej et al, [14] heart weight was positive correlated to BW in case of males only, which was statistically significant at  $p < 0.01$ . But in females, heart weight was not correlated to BW.
- **Liver:** In this study liver weight was positive correlated to BW in case of females only, which was statistically significant at  $p < 0.01$ . In males, liver weight has negative correlation with BW, but it was not significant statistically contrary to Mathuramoon et al [13] and Chirachariyavej et al, [14] liver weights were positive and statistically significant correlation to BW in both sexes.
- **Spleen:** Present study showed that spleen weight was negative correlated to BW in male and positive correlated to BW in females. But they were not significant statistically. According to Chirachariyavej et al, [14] spleen weight was positive correlated to BW in both sexes, which was statistically significant at  $p < 0.05$  in male and significant at  $p < 0.01$  in female.

Sprogoe-Jakobsen et al, [11] study showed that the spleen weight was correlated to BW while Mathuramoon et al [13] found that spleen weight was positive correlated to BW in male only, which was statistically significant at  $p < 0.01$ .

- **Lungs:** In our study right lung weight was positive and statistically significant ( $p < 0.01$ ) correlation to BW in both sexes.

But left lung weight was positive correlated to BW in both sexes, which was statistically significant at  $p < 0.05$  in males and significant at  $p < 0.01$  in females.

According to Chirachariyavej et al, [14] lung weights were positive correlated to BW in male only, which was statistically significant at  $p < 0.05$ . It might due to inter individual variation and terminal pulmonary edema and congestion, which differ from one individual to other.

Mathuramoon et al [13] study showed that lung weights were positive correlated to BW in males only, which was statistically significant at  $p < 0.01$ .

- **Kidneys:** Right kidney weight was positive correlated to BW in both sexes, which were statistically significant at  $p < 0.05$  in males and significant at  $p < 0.01$  in females in this study and left kidney weight was positive correlated to BW in females only, which was statistically significant at  $p < 0.01$ . this is similar to other studies. [13, 14]

## 2) Correlation between Organ Weights and Body Length

- **Brain:** In our study brain weight was negative correlated to BL in both sexes, which was statistically significant at  $p < 0.01$  in males. But it was not significant statistically in female, consistent with other studies. [13,14]
- **Heart:** In this study heart weight was positive correlated to BL in both sexes but it was statistically significant at  $p < 0.01$  in males only. According to Chirachariyavej et al, [14] heart weight were positive correlated to BL in both sexes, but it was not statistically significant.

Mathuramoon et al [13] found that heart weight was positive correlated to BL in males, which was statistically significant at  $p < 0.01$  but it was negative correlated to BL and was not statistically significant in females.

- **Liver:** Liver weight was negative correlated to BL in males, which was statistically significant at  $p < 0.01$ . But in case of females, it was positive correlated to BL and was not significant statistically in this study.

While other studies showed that liver weights were positive correlated to BL in both sexes, but it was statistically significant at  $p < 0.01$  in case of males only. [13, 14]

- **Spleen:** In our study spleen weights were negative correlated to BL in both sexes, but it was statistically significant at  $p < 0.01$  in males only contrary to Chirachariyavej et al [14] who found that spleen weights were positive correlated to BL in both sexes, but was not significant statistically.

Mathuramoon et al [13] showed that spleen weights were positive correlated to BL in both sexes, but it was statistically significant at  $p < 0.01$  in case of males only. According to Sprogoe-Jakobsen et al [11] the spleen weight was correlated to BL.

- **Lungs:** In this study both lung weights were positive correlated to BL in both sexes, which were statistically significant at  $p < 0.01$ . According to Chirachariyavej et al [14] both lung weights were positive correlated to BL in both sexes, but it was statistically significant at  $p < 0.05$  in case of

males only. But Mathuramoon et al, [13] showed that both lung weights were positive correlated to BL in males, which was statistically significant at  $p < 0.01$  in males only. In case of females, both lung weights were negative correlated to BL and was not significant statistically.

- **Kidneys:** Both kidney weights were negative correlated to BL in males, which were statistically significant at  $p < 0.01$ .

In case of females, both kidney weights were positive correlated to BL, but it was not significant statistically. According to Chirachariyavej et al [14] both kidney weights were positive correlated to BL in both sexes, but it was statistically significant at  $p < 0.05$  in case of males only.

Mathuramoon et al [13] found that both kidney weights were positive correlated to BL in both sexes, which were statistically significant at  $p < 0.01$  in case of male and significant at  $p < 0.05$  in case of female.

## 3) Correlation of Organ Weights with BMI and BSA:

In our study, all organ weights were positive correlated with BMI and BSA except spleen weight. There were significance at  $p < 0.01$ . According to Sprogoe-Jakobsen et al [11] the spleen weight was positive correlated with BMI and BSA in both sexes.

### Conclusion:

Present study concluded that in males, there were 5 organ weights except spleen that have positive correlation with BW. Out of these, weights of brain, heart and right lung were significant at  $p < 0.01$  and weights of left lung and right kidney were significant at  $p < 0.05$ . In females, weights of all organs except spleen were correlated positively with BW and significant at  $p < 0.01$ .

Weights of both lung had positive correlation with BL and were significant at  $p < 0.01$  in males while weights of the brain, liver, spleen and both kidneys have negative correlation with BL and significant at  $p < 0.01$ .

In females, heart and both lungs had positive correlation with BL and they were significant ( $p < 0.01$ ).

All organ weights were positively correlated with BMI and BSA except weight of spleen. They were significant at  $p < 0.01$ .

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**Table 3: Correlation between Organ Weights with Body Length**

Organ	Male (n=272)		Female (n=177)	
	r	p-value	r	p-value
Brain	-0.166**	0.006	-0.143	0.057
Heart	0.017	0.783	0.157**	0.037
Liver	-0.227**	0.000	0.072	0.338
Spleen	-0.265**	0.000	-0.109	0.150
Right Lung	0.229**	0.000	0.431**	0.000
Left Lung	0.171**	0.005	0.330**	0.000
Right Kidney	-0.161**	0.008	0.058	0.444
Left Kidney	-0.206**	0.001	0.059	0.438

**Table 4: Correlation of Organ Weights with BMI and BSA**

Organ	BMI	BSA
	R	r
Brain	0.445**	0.368**
Heart	0.597**	0.575**
Liver	0.180**	0.097**
Spleen	0.090	-0.34
Left lung	0.162**	0.292**
Right lung	0.184**	0.354**
Left kidney	0.258**	0.168**
Right kidney	0.264**	0.188**

\* Correlation is significant at p<0.05, \*\* Correlation is significant at p<0.01, - = Negative correlation, r= Correlation coefficient

**Table 1: Organ weight in the form of Mean ± SD of male and female (n=449)**

Organ	MALE	FEMALE
Brain	1115 ± 84.14	1058.20 ± 79.50
Heart	283.79 ± 58.01	237.71 ± 49.05
Liver	1235.09 ± 209.54	1145.98 ± 103.45
Spleen	98.25 ± 60.49	85.18 ± 26.52
Right Lung	550.68 ± 126.07	503.84 ± 108.04
Left Lung	463.88 ± 121.51	419.76 ± 99.23
Right Kidney	122.61 ± 26.62	113.37 ± 25.10
Left Kidney	116.64 ± 24.21	108.15 ± 24.19

**Table 2: Correlation between Organ Weights and Body Weight**

Organ	Male (n=272)		Female (n=177)	
	R	p-value	r	p-value
Brain	0.318**	0.000	0.480**	0.000
Heart	0.549**	0.000	0.634**	0.000
Liver	-0.031	0.611	0.387**	0.000
Spleen	-0.063	0.304	0.113	0.136
Right Lung	0.203**	0.001	0.364**	0.000
Left Lung	0.134*	0.027	0.356**	0.000
Right Kidney	0.148*	0.014	0.252**	0.001
Left Kidney	0.086	0.158	0.307**	0.000

## Original Research Paper

# Pattern of Head injuries in Homicidal deaths at Jaipur During 2012-13, India: An Autopsy based Study

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### Abstract

Inflicting injury to the head is one of the most effective methods of homicide. The aim of the present study was to evaluate the pattern of head injury among homicidal death victims. In present study 72 cases of homicidal deaths were studied. Males were victimized Three and half times more than females. Majority of cases were in 21-40 years of age comprising of 34 cases (47.43%). Majority of victims were married in 55 cases (76.38%). Injuries were inflicted by blunt weapons in significant number of cases; 48 cases (66.67%) which were followed by injuries by sharp weapons in 14 cases (19.45%).

The skull was fractured in 75% of victims. Most common pattern observed was combination of SDH & SAH along with skull fracture in 32 cases (44.44%). The majority of the victims (55.5%) died instantly or within 24 hours. Defense wound were present in 47.2% of the victims. The information gained from this type of analysis can be used by law enforcement authorities to curtail the amount of violence present in today's society.

**Key Words:** Head injury, Defense wound, Blunt weapon, Skull fracture

### Introduction:

Head injuries are one of the most effective methods of homicide. The recent rise in the trend of murder cases involving head injury is a serious concern to society. Homicide is prevalent widely almost all over the world.

The head is a vital organ and the most exposed part of body to receive injuries. A cranio-cerebral injury due to blunt trauma causes more homicidal deaths as compared with blunt trauma injury to other areas of the body. Presence of defense wound implies that the victim was able to put some resistance to an assault, at some stage during that assault. [1]

In an assault, the natural reaction of the victim is to protect oneself and certain vital parts of the body like eyes, face, chest and head. Forearms, hands, elbows and legs are raised instinctively; hence defense wounds are more common on these parts of body.

Young offenders are becoming increasingly violent and this is a cause for concern, as they are tomorrow's generation.

The pattern of homicide may be a useful indicator of the social stresses in a community and may also provide useful information for law-enforcement strategies.

Investigation of a homicidal death can never be complete without a detailed post-mortem examination. The detailed analysis and scientific interpretation of autopsy finding is imperative to reconstruct the crime scene.

The main objective of this analysis was to analyze the information to determine trends of head injury in homicide cases in Jaipur region during the study period.

### Materials and Methods:

A prospective autopsy study of 72 cases of head injury resulting from assault was conducted at the Department of Forensic Medicine, Government Medical College and Hospital, Jaipur India over a period of one year.

Out of 102 homicidal deaths, 72 cases (70.58%) were due to fatal head injury. Those who died by suicide or by accidental and natural causes were excluded. Information regarding the victims was collected from the inquest report, interviewing the family members and a proper and detailed autopsy examination was done. All observations were then transferred to a Microsoft Excel sheet.

Descriptive statistics for qualitative type of data was summarized and tabulated using frequency and percentages with summarization of all findings.

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### **Observation and Results:**

A total of 72 cases of homicidal deaths were included in this study, of which more than three-fourths were males with only about 22% females succumbing to episodes of homicide.

This is quite explainable by the pattern of Indian societies where males are the active members. (Table 1) In our study majority of the homicidal attacks were committed by blunt weapons (66.67%). The use of blunt weapons for an episode of homicidal attack was reported significantly in this study.

Sharp weapons and firearm weapons were put to use in 14 cases (19.45%) and 10 cases (13.88%) respectively. (Table 2)

Present study showed that in more than half of the cases death occurred within twenty four hours of the attack, reflecting the infliction of an injury which was sufficient to cause death in nature thus constituting the crime of murder; although spot deaths were reported to be less than 5% probably due to immediate attention given to the criminal episode. (Table 3)

In this study total head injury cases were 72, of which 54 (75%) cases were having fracture. Most common pattern observed was combination of SDH (Subdural Hemorrhage) & SAH (Sub arachnoid Hemorrhage) along with skull fracture in 32 cases (44.4%).

Next common was combination of EDH, SDH & SAH along with skull fracture in 18 cases (25%). (Table 4) Defense wounds were present in only 34(47.2%) cases out of total 72 cases of homicide in this study. Incised wound were present in 12 cases (16.6%) followed by abrasion in 8 cases (11.1%). (Table 5)

Present study showed that in 75% cases of fatal head injuries there was associated fracture skull. In 18 cases (25.0%) there was fracture of a single bone with depressed fracture in 30% cases. The most common bone to be fractured was frontal and parietal bone followed by temporal bone. Occipital bone was fractured in 3 cases only. No fracture of skull was present in 18 cases. (Table 6)

### **Discussion:**

This study was undertaken to study the pattern of head injuries in culpable homicidal deaths excluding deaths due to rash/ negligent act at Jaipur region, India.

In our study, male: female (M: F) ratio was 3.5:1. Among the 72 victims included in study population, there were 56 males (77.77%) and 16 females (22.23%). Similar findings were observed in various other Indian studies [2, 3] and considerably lower than 6:1. [4]

In our study, the most commonly affected age group was 21-30 years (29.17%) followed by 41-50 years (20.84%) and 31-40 years (18.06%). Most of the other contemporary studies also reported 21-30 years to be the most commonly affected age group. [5-7]

Majority of the victims in our study belonged to the most productive age groups between 21-50 years (68%). Most of the victims i.e. 55 (76.38%) were married and unmarried victims were 17(23.62%).

Present study reports the use of blunt weapons as a means of committing homicide in a significant number of cases (66.67%). Similar findings have been reported by other Indian studies. [6, 8, 9, 11] However, our results are contradictory to many other studies where sharp weapons were used as the most common weapon for commission of homicide. [10, 12]

While other studies clearly shows the preponderance of the use of firearms and their effectiveness as a murder weapon. [15, 17]

Fingerhut et al [18] also reported firearms to be the most common murder weapon in the United States. Being light, handy and easy to use, they are far more effective than blunt objects or sharp weapons.

In our study, about 55.5% victims died within 24 hours of infliction of injury; however, among them spot deaths were seen in only 5.5% cases which is an inconsistent finding in homicidal deaths. This trend has probably resulted as most cases in our study may have been executed without an organized pre planning for the event.

This is quite low as compared to Vij A et al [13] (61.8%) with the event being pre planned in 52.8% cases; Shah JP et al [2] in 65% cases in Karthik SK et al [8] in 56% cases.

Most studies report a very low hospitalization rate of victims of homicidal event in contrast to ours where about 58.3% people were hospitalized following the attack and later succumbed to the episode though within a day in majority of the cases.

In our research Most common pattern observed was combination of SDH & SAH along with skull fracture in 32 cases (44.4%). Next common was combination of EDH, SDH & SAH along with skull fracture in 18 cases (25%). Brain injury was present in 25 cases (34.72%).

All three head structures, i.e. scalp, skull and intracranial structure are involved in most of the cases. A similar trend has also been observed by other study. [14-16] This indicates that the use of strength by the assailant/s is maximum during the material moment to make sureness of the death of the victims.

Defense wounds are of great significance in differentiating manner of unnatural deaths i.e. Homicide, Suicide and Accident.

The presence of defensive or violence associated traumatic wounds is indicative of a homicide. [19] These wounds are mainly seen on the upper limbs because these are the body parts with which a defendant raises to save himself. Presence of defense wounds indicates that victim was conscious, partly mobile and was not taken completely by surprise or was not taken unawares. Absence of defense wounds in few cases of homicides does not mean that defensive activity did not take place and hence does not rule out the possibility of homicide. [20]

Out of 72 cases, only 34 cases (47.22%) showed defense wounds. Male victims were more defensive than the female victims. Metter and Benz [21] in his study found, defense injuries in 48% of Homicidal cases.

Karlsson [22] in his study identified defensive injuries in 41% of homicide victims, Katkici et al found defense injury in 38.5% of cases. [20] Schmidt and Pollak found in 45.9% of cases. [23] Various studies show that the prevalence, location and effective factors associated with defense wounds vary worldwide and can be an indication of the country and the region where they would have taken place. [20]

It is the instinctive behavior of the victim to raise his/her arm to ward off an attack and to protect vital organs such as the brain.

The presence of such injuries indicates an assault by some other person or persons. Depending upon the type of weapon producing the most number of defense wounds, we concluded that assault by sharp cutting weapon produced more defense wounds as compared to assault with hard and blunt objects similar findings were noted by Inoue et al. [25]

Our study clearly pointed out to the fact that the chances of fatality following head injury are greater when multiple cranial bones are involved. Overall in 50% cases multiple bone fracture was detected. This also pointed toward the amount of force applied to the head.

In single bone involvement, Frontal and Parietal was the site of fracture in most of the cases. Yavuz et al [24] also reported linear fractures to be most common in the frontal and temporal region. The occipital bone (2.78%) showed the least involvement in fracture, as it is the thickest among the cranial bones.

Fracture of the occipital bone requires a great amount of force, hence when the occipital is fractured the magnitude of the force is

considerable and sufficient to cause death in the ordinary course of nature.

### Summary and Conclusion:

The pattern of homicide may be a useful indicator of the social stresses in a community and may also provide useful information for law-enforcement strategies. Fatality among attack victims with firearm injuries to the head is very high. The type and site of skull fracture and the number of cranial bones involved is an indirect indicator of the severity of force of impact which leads to damage to the underlying brain and results in fatality.

The location of meningeal hemorrhage whether in single or multiple layers has little influence on the outcome while hemorrhage in the deeper layers has higher fatality. Thus these may be considered as high risk factors in violent attacks to the head.

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**Table 1: Age and Sex wise Distribution of Victims of Homicidal Deaths**

Age Grps ( yrs)	Victims		Total Victims (%)
	Male	Female	
< 10	00	02	02 (2.77)
11-20	07	03	10 (13.88)
21-30	16	05	21(29.17)
31-40	11	02	13(18.06)
41-50	14	01	15 (20.84)
51-60	05	02	07 (9.73)
61-70	02	01	03 (4.17)
> 71	01	00	01 (01.38)
<b>Total (%)</b>	<b>56 (77.77%)</b>	<b>16(22.23%)</b>	<b>72 (100%)</b>

**Table 2: Distribution of Victims According to the Weapon Used to Inflict the Attack**

Weapon	Cases	Total (%)
Blunt	48	66.67
Sharp	14	19.45
Firearm	10	13.88
<b>Total</b>	<b>72</b>	<b>(100%)</b>

**Table 3: Distribution of Victims According to the Period of Survival after the Attack**

Period of survival after attack	Cases	Total (%)
Spot death	04	(5.55%)
< 6 hrs	21	(29.17%)
6-24 hrs	15	(20.84%)
1-2 days	07	(9.72%)
2-7 days	14	(19.45%)
> 7 days	11	(15.27%)
<b>Total (%)</b>	<b>72</b>	<b>(100%)</b>

**Table 4: Pattern of Head Injury in Homicidal Death**

Pattern of Head Injury	Cases	Percentage (%)
Fracture Of Skull	54	75.0
EDH	0	0
SDH	4	5.55
SAH	6	8.33
EDH+SAH	4	5.55
SDH+SAH	32	44.44
EDH+SDH+SAH	18	25.00
Brain injury	25	34.72

EDH = Extradural hemorrhage, SDH = Subdural hemorrhage, SAH = Subarachnoid hemorrhage

**Table 5: Types of Defense Wound**

Type	Cases	Percentage (%)
Abrasion	8	11.11
Bruise	7	9.72
Incised Wound	12	16.66
Lacerated Wound	7	9.72

**Table 6: Distribution of Fracture of Skull in Victims of Homicidal Deaths**

Bone fractured	Cases	Percentage (%)
Frontal bone	06	8.33
Parietal bone	06	8.33
Temporal bone	04	5.55
Occipital bone	02	2.78
Frontal+ parietal	7	9.74
Frontal +temporal	13	18.05
Parietal + temporal	04	5.55
Parietal +occipital	03	4.17
Multiple skull bones	9	12.6
No fracture	18	25.0
<b>Total</b>	<b>72</b>	<b>100</b>

## Original Research Paper

# Prevalence of Oppositional Defiant Disorder and Conduct Disorder in Primary School Children

<sup>1</sup>Ambrish Mishra, <sup>2</sup>S. P. Garg, <sup>3</sup>Samir N. Desai

### Abstract

There is a lacuna of studies on Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) in the Indian context. Present study is undertaken as a cross sectional study of school aged children selected from four different schools in Indore district. Nine hundred children aged between 6 and 11 years were selected from four schools of Indore city after obtaining informed consent from their parents and the school authorities. The presence of ODD and CD was assessed by using Rutter CBQ and those who were screened positive were subjected to DSM-IV-TR criteria for the final diagnosis.

The prevalence of ODD among primary school children was found to be 7.73%. Prevalence was found to be equal among male and female. The prevalence of CD among primary school children was found to be 5.48. Prevalence was found to be higher among the males (66.67%) as compared to that of females (33.33%). The present study shows a high prevalence of CD among primary school children with a higher prevalence among the males than the females and in ODD no difference was found.

**Key Words:** Oppositional Defiant Disorder, Conduct Disorder, Child Behavior Questionnaire (CBQ), Diagnostic Statistical Manual-IV-Text Revised (DSM-IV-TR)

### Introduction:

Children under the age of 15 years constitute about 40% of the population of the developing countries. [1] While infant and childhood mortality rates are declining, rising rates of intellectual and psychological morbidity has been observed. [2] As a result child psychiatric epidemiology is on the threshold of an important future in its capacity to investigate the psychological health of large aggregate of children. [3]

The family, the school and other social institute exercise a significant influence on the process of child development. [4] During middle childhood, children increasingly separate from parents and seek acceptance from teachers and from peers. Self esteem becomes a central issue as children develop the cognitive ability to consider at the perception of how others see them.

For the first time, they are judged according to their ability to produce socially valued output i.e. good academic grades and desirable behavior. The focus on accomplished as described by Erickson, Crisis between industry and inferiority. [5]

Psychiatric morbidity in children as defined by Rutter et al [6] comprises abnormality in developmentally inappropriate and of sufficient duration and severity to cause persistent suffering or handicap to the children and/ or distress to the family or community.

Further handicap or impairment is defined in form of poor relationship with family members, neighbors, peer and teachers. Though Rutter pointed out that psychiatric disorder in childhood is quantitative departure from the normal qualitative abnormalities in reciprocal social interaction and communications are manifested in pervasive developmental disorders do not consist of disease entities and most behavioral disturbances also occur in otherwise normal functioning children. [7]

Cameron put forward the 'Principle of continuity' [8] and stated that abnormal behavior should not be alienated from the spectrum of normal behavior and all attitudes and responses found in the behavioral pathology are in some way related to and derived from normal social behavior. The differences in prevalence in these types of problems in community are in part due to differences in extent to which practitioners

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diagnose problems that are poorly addressed in medical education like situational disturbances, social maladjustment and parent child problem. Pediatricians are often likely to miss psychiatric disorders. Dulcan et al in 1990 [9] reported that 8.3% of 52 children with a psychiatric diagnosis were not identified by the pediatrician as having a psychiatric disorder.

The school is an important catchment area and therefore, school mental health survey can provide an excellent opportunity for estimating prevalence of childhood psychiatric disorders. The learning situation in school is full of problems like coping up with school work, scholastic backwardness, or loss of face in front of peer group.

Education has been considered as a foundation of human resource development but unfortunately rather than focusing on a more holistic approach to child development, most of the focus is on academics. All these can precipitate or aggregate emotional or behavioral deviance. However schools often deal with such students with a disciplinary approach, least realizing about the existing psychiatric morbidity and significance of early intervention.

Ideally, school is a specialized setting for child development can obviate the need for the clinic proper attention paid here will be fruitful in preventing psychiatric and social morbidity. Along with facilities of positive mental health, early diagnosis and proper treatment of psychiatric morbidity will enable these children to remain in the main stream of education system and deal with their disability positively.

This study is planned at a point of time when government policies are being framed regarding educational problems and disabilities in children and it may further provide the database for possible consolidation of other similar studies.

There is only a limited source of information regarding the prevalence of ODD and CD in the Indian context. Hence, the current study aims at selecting primary school children from a community sample.

The objectives of the study were:

- (i) To identify the prevalence of ODD and CD in primary school children,
- (ii) To identify the gender difference in the prevalence of ODD and CD.

Oppositional, negativistic behavior, in moderation, is developmentally normal in early childhood and adolescence. Epidemiologic studies of negativistic traits in nonclinical populations found such behavior in 16 to 22 percent of school age children.

According to the text revision of the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR), prevalence rates for this disorder range from 2 to 16 percent. Although oppositional defiant disorder can begin as early as 3 years of age, it typically is noted by 8 years of age and usually not later than adolescence.

Oppositional defiant disorder has been reported to occur at rates ranging from 2 to 16 percent. The disorder seems more prevalent in boys than in girls before puberty and the sex ratio appears to be equal after puberty.

One authority suggests that girls are classified as having oppositional disorder more frequently than boys because boys more often receive the diagnosis of conduct disorder. No distinct family patterns have been noted, but many parents of children with the disorder are themselves overly concerned with issues of power, control, and autonomy.

Occasional rule breaking and rebellious behavior is common during childhood and adolescence, but in youth with conduct disorder behaviors that violate the rights of others are repetitive and pervasive. Estimated rates of conduct disorder among the general population range from 1 to 10 percent, with a general population rate of approximately 5 percent.

The disorder is more common among boys than girls, and the ratio ranges from 4:1 to as much as 12:1. Conduct disorder occurs with greater frequency in the children of parents with antisocial personality disorder and alcohol dependence than in the general population. The prevalence of conduct disorder and antisocial behavior is associated with socioeconomic factors.

### **Material and Method:**

Approval from Institutional Human Ethical Committee (IHEC) was obtained before conducting the study. This is a cross sectional study involving 900 primary school children aged between 6 and 11 years (3<sup>rd</sup> to 5<sup>th</sup> std.) selected on a random basis from four different schools in Indore district. After obtaining permission from the school Principals, the written informed consent form was given to the parents through the children. Parents of 900 children gave consent for allowing their children to participate in the study.

Children's Behavior Questionnaire (CBQ, Rutter) was given to the teachers of the children identified in the study as having ODD and CD. It consists of two separate questionnaires, namely (i) CBQ-A, (ii) CBQ-B. CBQ-A is used for assessing their academic

performance, reading and writing difficulties, and need for psychiatric guidance, and CBQ-B is used for assessing their behavioral difficulties, if any.

The diagnostic criteria of DSM-IV-TR given by American Psychiatric Association were followed. Information regarding the nature of the study was communicated to the school authorities. The consent cooperation and active participation of principals and teachers was ensured after allaying their apprehensions about the nature and implication of this study.

Consent of parents was obtained after briefing them during multiple parents-teachers meetings spread over three months. During these meeting the scope and benefits of this study was explained to them and their informed consent was taken. The names of the schools as well as students were kept confidential as per the requests of school authorities and parents. They were given code as School A, School B, School C and School D.

Our Study is a two stage study. In first phase child behavior questionnaire was used, as a screening tool (to be completed by teachers), for the purpose of screening the 'disturbed' from 'non-disturbed' children in the school setting. CBQ was proposed by Rutter in 1967.

**Proforma A**

Consisted of 9 items which seek information about educational performance, consistency in academic work, attendance, sports, reading and writing difficulties nick names, physical handicap and teachers opinion about the need of psychological help.

**Proforma B**

It consisted of 26 items, tapping the behavioral and emotional problems, shown by children in school. It was rated in a three step response scale 2, 1, 0 for certainly applies, 'somewhat applies' and 'does not apply'. A score of 9 (total) or more is considered to show evidence of some disorder as suggested by Rutter et al.

For all the children screened positive were asked to follow up in psychiatry department of SAIMS with their parents and diagnosis was made by psychiatrist using DSM IVTR criteria given by American Psychiatric Association.

Statistical analysis was done using SPSS (Statistical Product and Service Solutions) 10 Software. Mean and Standard Deviation and Chi Square Test were used for analysis.

**Results:**

A total of 900 students of class III, IV & V were screened through child's behaviour

questionnaire and 230 were found to be having some psychiatric morbidity.

On further interviewing children along with parents, final diagnosis of psychiatric disorder was made according to DSM-IV-TR criteria. 25.45% of the total subjects were having psychiatric morbidities.

Of the total students in the study population, those who are found positive through Rutter's B Scale total males were 137 and females were 93. The prevalence of Oppositional Defiant Disorder was found to be 7.73%, Conduct disorder 5.48%.

**Discussion:**

Mental health is the balanced development of an individual's personality and emotional attitudes which enable him to live harmoniously with his fellow men, mental health is not exclusively a matter of relation between persons, it is also a matter of relation of the individual towards the community he lives in, towards the society of which the community is a part and towards the social institution which for a large part guides his life, determine his way of living. Working leisure and the way he earns and spends his money, the way he sees happiness, stability and security. [10]

Children are the most important asset and wealth of a nation. Healthy children make a healthy nation. The children under 15 years of age constitute about 40% of the population and school aged children i.e. 6 to 14 years age constitute 22% of children population. [11] The child is not a miniature, but an individual in his own right. The quality of childhood one has lived will determine the ultimate nature of adulthood. The foundations of child's social attitude and skills are laid in the home. Now days, because of the rapid industrialization and urbanization, majority of young couples are employed, so unavoidably they get less time to look after their children. Under these circumstances, emotional, behaviour and psychiatric problems arc on the rise. [12]

A child is born and brought up in a family. Family dynamics plays a vital role in mental health and illness. Psychologically and physically broken home has been reported in both the depressive and schizophrenic psychopathology. Child rearing practices can retard or accelerate development of child health. Schizophrenogenic parents and refrigerator parents who are cold and apathetic, produce autistic and psychotic child behavior. [13-16]

In our study, 25.45% of the total subjects were having psychiatric morbidities. Of the total students in the study population those

who are found positive through Rutter's B Scale total males were 137 and females were 93. The prevalence of Oppositional Defiant Disorder was found to be 7.73%, Conduct disorder 5.48%.

Gender wise estimation of psychiatric morbidities in study population is as follows:-

ODD	Males	Female	Chi square	P Value
Present	41 (8.89%)	30 (6.83%)	1.313	0.252 Significant
Absent	420 (91.11%)	409 (93.17%)		

When this data was analyzed statistically it was found to be insignificant: (**P = 0.252 > 0.05**) Epidemiologic studies of negativistic traits in nonclinical populations found such behavior in 16 to 22 percent of school age children. According to the text revision of the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR), prevalence rates for this disorder range from 2 to 16 percent. The disorder seems more prevalent in boys than in girls before puberty and the sex ratio appears to be equal after puberty.

CD	Males	Female	Chi square	P Value
Present	36 (7.81%)	13 (2.96%)	10.265	.001 Significant
Absent	426 (92.19%)	426 (97.04%)		

Estimated rates of conduct disorder among the general population range from 1 to 10 percent, with a general population rate of approximately 5 percent. The disorder is more common among boys than girls, and the ratio ranges from 4:1 to as much as 12:1.

**Summary and Conclusion:**

Behaviour or emotional problems cause discomfort in childhood and disrupt family and social activities. Children with behaviour or emotional problems are more likely to have similar problems later in life. It is said that *Quality of life one has lived in childhood, will determine ultimate nature of adulthood it gets differentiated into.* Thus, behavioural problem in childhood could be the stepping-stones to more serious problems in the form of adult psychiatric disorders. However, unlike physical illness, which in most of the cases has clear-cut symptomatology, any deviation from normal mental development or behaviour in children may not be easily identified by the parents except from grave observable changes.

Studies done in both developing and developed countries have shown similar prevalence rates of psychopathology among children emphasizing the universality of the problem. In a community setting, poor response for such studies has been a major limitation and therefore, majority of the studies on the

magnitude of mental health problems have been conducted either on adult population or some specific group of children like those attending child guidance clinics.

On summarizing the study total of 900 students of class III, IV & V were screened through child's behaviour questionnaire and 230 were found to be having some psychiatric morbidity. On further interviewing the child along with parent's final diagnosis of psychiatric disorder was made using DSM-IV-TR criteria's. Study was carried out in four schools of Indore district. Appropriate statistical tests were applied to the result obtained and found that 25.45% of the total subjects were having psychiatric morbidities.

Of the total students found positive in the screening test of the study population total males were 137 and females were 93. The prevalence of Oppositional Defiant Disorder was found to be 7.73%, Conduct disorder was found to be 5.48%. In this study group students were not having any intellectual disabilities, as mental retardation in children was excluded from the study.

In our country where we have limited resources, the approach mentioned in this study would minimize the financial and skilled manpower required for detection of problem children. Feed backs from the study can be used as a pilot project for sensitizing and training all school teachers and also for larger community based studies to prevent psychiatric morbidity and create a more resilient society.

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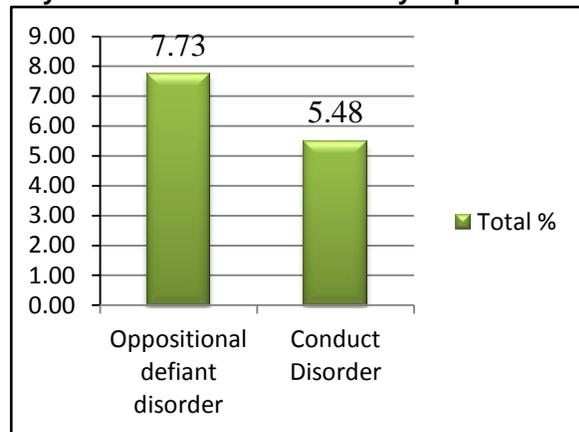
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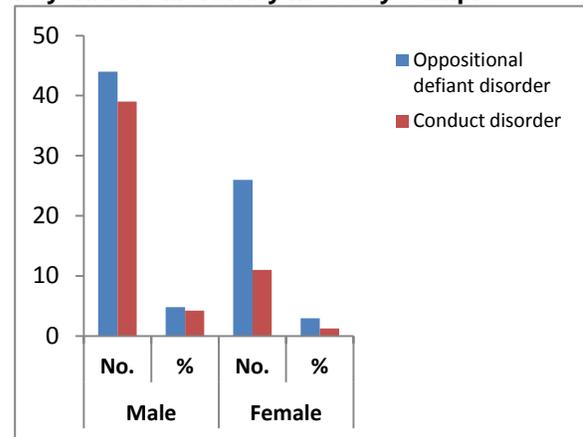
**Table 1: Sex wise Distribution of Cases**

Sex	No. of Children	Percentage
Male	137	59.56%
Female	93	40.43%
Total	230	100%

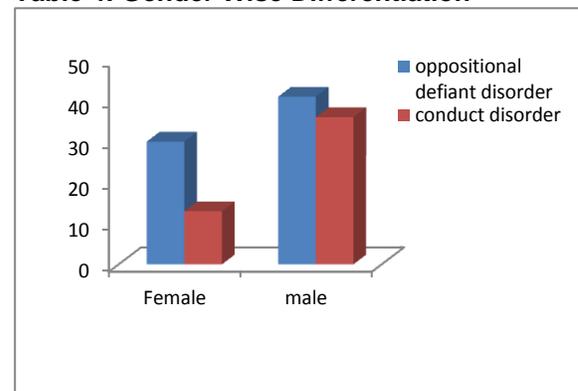
**Table 2: Prevalence of Various Types of Psychiatric Morbidities in Study Population**



**Table 3: Gender wise Estimation of Psychiatric Morbidity in Study Sample**



**Table 4: Gender Wise Differentiation**



## Original Research Paper

# Gross and Histopathological Changes in Fatal Poisoning

<sup>1</sup>Sushim Waghmare, <sup>2</sup>S.C. Mohite

### Abstract

Prospective two year study period, from 1<sup>st</sup> August, 2008 to 31st July, 2010, a total of 1,374 autopsies were performed at the centre, 70 cases were suspected cases or confirmed poisoning & those persons declared dead on arrival in the causality and suspected to be a case of poisoning. Incidence of deaths due to poisoning was 5.09 %. Insecticide was commonest poison (22 or 31.42%), followed by alcohol intoxication 16(22.85%). Maximum deaths were due to cerebral edema 18(30.50%) cases. Cyanosis was present in maximum number (24 or 34.28%) of cases.

On gross examination, Stomach mucosa was congested in maximum number or 36(51.42%) cases. Sub mucosal hemorrhages in stomach were commonly seen in (12 cases) insecticide poisonings. On histopathological examination, in liver, fatty changes were seen in maximum number of (13 or 59.09%) cases followed by ballooning degeneration in 3(13.63%) cases. In kidneys, cloudy degeneration was seen in maximum (12 or 54.54%) cases followed by acute tubular necrosis in 8(36.36%) cases.

**Key Words:** Poisoning, Autopsy, Histopathological changes, Intoxication, Cynosis

### Introduction:

According to WHO, three million acute poisoning cases with 2, 20, 000 deaths occur annually. Of these 99% of fatal poisonings occur in developing countries, particularly among agriculture workers. [1] The exact incidence of this problem in India is uncertain, but it is estimated that about 7 to 10 million cases of poisoning are reported every year, of which about 10,000 happen to die.

Every year 5 to 6 persons per lakh population die due to poisoning. [2] At present Aluminium phosphide tops the list in northern part of India while insecticide heads the list in southern part of India. [3]

The pattern of poisoning varies from region to region depending on variety of factors such as availability of the poisons, socioeconomic status of the population, religious and cultural influences.

Acute poisoning is one of the most common causes for emergency hospital admissions. The patients of poisoning need careful thorough assessment, early diagnosis, monitoring and aggressive supportive management in the intensive care setting. [4]

In this study we attempt to correlate the signs and symptoms, gross findings and histopathological examination to ascertain the cause of death in case of poisonings.

### Material and Methods:

This prospective study was carried out in Departments of Forensic Medicine, Pathology and Postmortem Center attached to T.N.M.C & B.Y.L. Nair hospital, Mumbai, Maharashtra. All deaths with history of suspected or confirmed poisoning & those persons declared dead on arrival in the causality and suspected to be a case of poisoning were sent for medico-legal postmortem.

Seventy such cases out of a total number of 1,374 autopsies during a 2 year period i.e. from 1<sup>st</sup> August 2008 to 31th July 2010 were selected for the present study except deaths due to natural causes and undetermined causes. Viscera for the chemical analysis were collected during postmortem examination.

These viscera sent to Forensic Science Laboratory, Kalina, Mumbai. Each poisoning case has been studied in detail using specific pro-forma. All data were documented and statistically analyzed. Histopathological examination slides were done by routine method and reporting was done under the guidance of senior pathologist.

After evaluation of brief history, causal factors, indoor paper finding, post mortem examination, chemical analysis report, histopathological examination report the final cause of death was ascertained.

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## Results:

In this study it was observed that most of the victims (22 or 31.42%) were in the 21-30 of age group, followed by 13(18.57%) in the 51-60 age group. (Table1)

Regarding external signs and symptoms Cyanosis was present in maximum number (24 or 34.28%) of cases followed by frothing from mouth and nose which was seen in 19(27.14%) cases. Maximum number (22 or 31.42%) of cases were due to insecticides followed by alcohol intoxication 16(22.85%). Deaths due to rodenticides were 4(5.71%) and Carbolic acid, alcohol and Phenobarbitone, Chloroquine, sedative overdose and snake bite poisoning were seen as a one case of each. (Fig. 1)

Maximum deaths were due to cerebral edema 18(30.50%) cases including insecticide and alcohol poisoning. It was observed on gross examination that, in brain, congestion was seen in maximum number (39 or 55.71%) cases followed by cerebral edema in 25(35.71%) cases. In lungs, congestion was seen in maximum number (32 or 45.71%) cases followed by intrapulmonary hemorrhages in 15(21.42%) cases.

In liver, congestion was seen in maximum number (35 or 50%) cases followed by fatty changes in 16(22.85%) cases.

In stomach, kerosene like odour was present in 15(21.42%) cases, alcoholic odour in 9(12.85%), mucosa congestion of stomach was seen in maximum number (36 or 51.42%) of cases followed by Inflammation of wall in 17(24.28%) cases and mucosa was hemorrhagic in 12(17.14%) cases.

## Discussion:

In the present study, males outnumbered the females and the peak incidence of deaths due to poisoning was in the age group of 21-30 years with 22(31.42%) cases. This particular age group is the most active phase of life for men who are involved mentally, physically and socially and exposed to maximum hazards. They are exposed to day to day stresses of life than females and the peak coincides with the studies of N.K. Aggarwal et al and Kiran et al. [4, 5] It does not coincide with the study of B.D. Gupta et al. [6]

It was observed that, cyanosis was present in maximum number (24 or 34.28%) of cases followed by frothing from mouth and nose as seen in 19(27.14%) cases due to abundant accumulation of secretion in the respiratory passages. Odour from mouth and nose was present in 17(24.28%) cases consistent with other studies. [7]

In our study maximum number (22 or 31.42%) of cases were due to insecticides followed by alcohol intoxication 16(22.85%).

Owing to easy availability, low cost and high toxicity, comparatively painless death than other violent methods, insecticides have always been extremely popular in India for committing suicide. [5, 9] Maximum deaths were due to cerebral edema in 18 (30.50%) cases of insecticide and alcohol poisoning cases. This coincides with study of Gupta S.K. et al. [10]

In this study, stomach changes were commensurate with the effects of causative agent. Most of the agents cause congestion and inflammation of the stomach mucosa that is why the congestion and inflammation of mucosa was seen maximum.

Hemorrhages were commonly seen in (12 cases) insecticide poisonings. Combination of corrosion, perforation and softening of wall was seen in cases (3) of acid poisoning.

Although there were 22 cases of insecticide poisoning, kerosene like odour was present in only 15 cases. Alcoholic odour was present in 9 out of 16 cases of alcohol poisoning. In 43 (61.42%) cases there was no specific odour similar to other studies. [8]

## Gross Changes in Visceral Organs of Insecticides Poisoning:

In present study brain congestion was seen in maximum number 11(50%) of cases followed by edema in 9 (40.90%). In lungs congestion and intrapulmonary haemorrhages were seen in equal number 6 (27.27%), in heart and liver; congestion was seen in maximum number (17 or 77.27%) and (13 or 59.09%) of cases respectively.

This coincides with findings quoted in textbook of Reddy [8] and also with study of Sutay et al. [9] In stomach and kidney, congestion was seen in maximum number (13or 59.09%) and (42 or 60%) cases respectively.

## Histopathological Changes in Visceral Organs of Insecticides Poisoning:

In brain, edema was seen in maximum number (13 or 59.09%) of cases. In lungs, congestion and intrapulmonary haemorrhages were seen in equal number (6 or 27.27%) of cases. In heart, congestion was commonly seen in 17( 77.27%) cases.

In liver, fatty changes were seen in maximum number of (13 or 59.09%) cases followed by ballooning degeneration in 3(13.63%) cases. These were similar with study of Sutay et al. [9] In stomach congestion was seen in maximum number (14 or 63.63%) cases followed by hemorrhagic mucosa in 6(27.27%) cases. In kidneys, cloudy degeneration was

seen in maximum (12 or 54.54%) cases followed by acute tubular necrosis in 8(36.36%) cases similar to other studies. [7, 9]

**Gross Changes in Visceral Organs of Alcohol Intoxication:**

In brain, cerebral edema was seen maximum number 10(62.5%) of cases. In lungs, congestion and intrapulmonary haemorrhages were seen equal number 5(31.45%) of cases.

In heart, congestion was seen maximum number (13 or 81.25%) cases. In liver, congestion was seen maximum number in 7(43.45%) cases followed by fatty changes in 6(37.5%) cases. [9] In stomach congestion was seen in maximum number (10 or 62.5%) cases followed by inflammation of mucosa in 4(25%) cases. In kidneys, congestion was seen in maximum number (9 or 56.25%) cases followed by necrosis in 4(25%) cases.

It coincides with findings quoted in textbook of Reddy [8] as alcohol causes dilatation and congestion of blood vessels.

**Histopathological Changes in Visceral Organs:**

In brain, cerebral edema was seen maximum number (10 or 62.5%) of cases. In lungs, pulmonary edema and intrapulmonary haemorrhages were seen equal number in 5(31.45%) of cases. In heart, congestion was seen maximum number (13 or 81.25%) cases.

In liver, fatty changes were seen maximum number (7 or 43.25%) cases followed by congestion in 6(37.5%) cases. These findings are consistent with other studies. [9]

In stomach congestion was seen in maximum number (12 or 75%) cases followed by hemorrhagic mucosa and congestion in 2(12.5%) cases. In kidneys, cloudy degeneration was seen in maximum number (6 or 37.5%) cases followed by acute tubular necrosis in 5(31.25%) cases. [8]

**Gross Changes in Visceral Organs of Rodenticide Poisoning:**

In brain, congestion was seen maximum number 3(75%) of cases and edema was seen in 1(25%) case.

In lungs, congestion was seen in 2(50%) cases and intrapulmonary haemorrhages and pulmonary edema was one case each. In heart, congestion was seen all cases(4 or 100%). In liver, congestion was seen maximum number in 2(50%) cases followed by enlargement.

In stomach, hemorrhagic mucosa was seen in 50% cases. Congestion and inflammation of mucosa was seen in one case of each. [8] In kidneys, congestion was seen in

maximum number (3 or 75 %) of cases followed by enlargement in one case. [9]

**Histopathological Changes in Visceral Organs:**

In brain, congestion was seen maximum number ( 3 or 75%) of cases followed by edema in 1(25%) case. In lungs, pulmonary edema was seen in 2(50%) cases followed by congestion and intrapulmonary haemorrhages in one case each. In heart, congestion was seen in all cases(4 or 100%).

In liver, fatty changes were seen in (2 or 50%) cases followed by centrilobular necrosis and sinusoidal dilatation one case each.

In stomach congestion and sub mucosal hemorrhages were seen in equal number (2 or 50%) cases. In kidneys, acute tubular necrosis was seen in three cases and cloudy degeneration in one case and with findings quoted in textbook of Reddy. [8]

**Gross Changes in Visceral Organs of Sulphuric Acid Poisoning:**

All the visceral organs were congested. In stomach, combination of corrosion, perforation and softening of wall was also seen. [8] These are due to corrosion and distraction the tissues coming in contact with the acid and coagulative necrosis by precipitating proteins.

**Histopathological Changes in Visceral Organs:**

Brain and heart congestion and necrotic changes in stomach were seen in both the cases(100%). Pulmonary edema and intrapulmonary haemorrhages, fatty changes and sinusoidal dilatation of the liver, acute tubular and cloudy degeneration of the kidneys were seen in 1(50%) case of each.

**Gross changes in visceral organs of carbolic acid poisoning**

Congestion was commonly seen in brain, heart, lungs, liver. In stomach, leathery appearance was seen. [8] In kidneys, enlargement was seen. The stomach mucosal folds are swollen, thickened and covered by opaque, coagulated, grey or brown mucous membrane looks leathery due to corrugative action of carbolic acid.

**Histopathological Changes in Visceral Organs:**

In brain and heart congestion was seen. In lungs, pulmonary edema was seen. In liver, ballooning degeneration was seen. In stomach sub mucosal hemorrhages was seen. In kidneys, tubular necrosis was seen.

**Conclusion:**

The present study helps to interpret the effect on body of poisons used. In this study,

there is an increasing frequency of insecticide poisoning in urban population including younger age group and male sex.

Cerebral edema was most common immediate cause in death due to poisoning. Congestion was common gross visceral organ finding and cerebral edema was common histopathological findings.

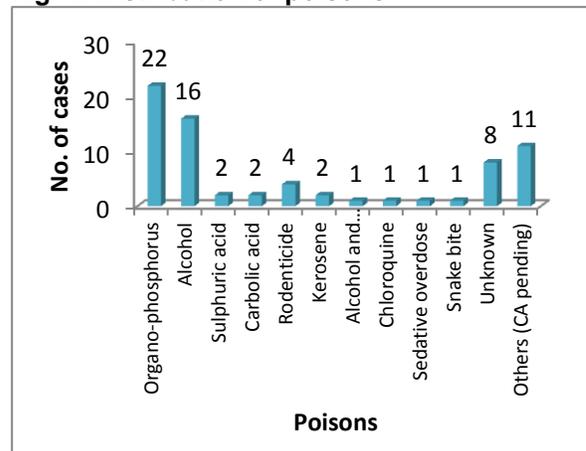
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**Table 1: Age and Sex Wise Distribution**

Age grps(Yrs)	Sex		
	Male (%)	Female (%)	Total (%)
0-10	0(0)	2(2.85)	2(2.85)
11-20	2(2.85)	4(5.71)	6(8.87)
21-30	17(24.28)	5(7.14)	22(31.42)
31-40	10(14.28)	4(5.71)	14(20)
41-50	6(8.87)	3(4.28)	9(12.85)
51-60	10(14.28)	3(4.28)	13(18.57)
61-70	3(4.28)	0(0)	3(4.28)
71-80	0(0)	0(0)	0(0)
>81	1(1.42)	0(0)	1(1.42)
Total	49(70)	21(30)	70(100)

**Fig. 1: Distribution of poisons**



**Table 2  
Relation between Poisons and Histopathological Changes in Stomach**

Name of poisons	Congestion	Gastritis	Necrotic changes	Sub mucosal hemorrhages	Total
Pesticides	14(63.63%)	2(9.09%)	0	6(27.27%)	22
Alcohol	12(75%)	2(12.5%)	0	2(12.5%)	16
Sulphuric acid	0	0	2(100%)	0	2
Carboic acid	0	0	0	1(100%)	1
Rodenticide	2(50%)	0	0	2(50%)	4
Kerosene	2(100%)	0	0	0	2
Alcohol and Phenobarbitone	0	0	0	1(100%)	1
Chloroquine	1(100%)	0	0	0	1
Sedative overdose	1(100%)	0	0	0	1
Snake bite	0	0	0	1(100%)	1
Unknown	6(75%)	0	0	2(25%)	8
Others(CA report awaited)	8(72.72%)	0	0	3(27.27%)	11
Total	46(65.71%)	4(5.71%)	2(2.85%)	18(25.71%)	70

## Original Research Paper

# Profile of Death due to Road Traffic Accidents Brought to Dr. S. N. Medical College & Hospital, Jodhpur

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### Abstract

Accident in general is a sudden, unplanned, unfortunate mishap or unexpected, unintentional event resulting from carelessness, unawareness, ignorance or a combination of factors and causing injury or loss, a decrease in value of the resources, or an increase in disabilities. It is estimated that 10 millions motor vehicle crashes (MVC) occur annually in the world. Deaths from (RTAs) have been characterized as a hidden epidemic affecting various sectors of society all over the world. In India over 80,000 person die in road traffic crashes annually, over 1.2 million are injured seriously and about 30,000 disabled permanently. No such, study has so far been carried out in Jodhpur region. Therefore, present study was undertaken to study epidemiological factors, profile of victim and pattern of road traffic accident, to draw public attention, awareness towards road safety and prevention of mortality due to road traffic accidents.

**Key Words:** Road Traffic Accidents, Death, Disability, Haemorrhage

### Introduction:

Amongst all transportation accidents, road traffic accidents claim largest toll of human life and tend to be most serious problem worldwide, a counter product of modernization and fast life. Road Traffic accidents (RTAs) are the major public health problem all over the world where society and decision makers still accept death and disability at large scale among young people.

This human sacrifice is deemed necessary to maintain high levels of mobility and is seen as a necessary "externality" of doing the business. [1] RTAs are usually caused by human errors including ignorance, overtaking, rash & negligence driving, use of mobile phones while driving, least knowledge about traffic rules as well as defective roads, poor maintenance of the vehicles, improper light, diminished visibility due to certain atmospheric conditions.

Violation of the traffic rules also plays the significance role, thus highlighting the strict implementation of the road safety measures. [4]

The increasing frequency of road traffic accidents is causing incalculable loss in developing and developed countries and has got an overall direct effect on progress of National economy. Road accidents constitute a modern day epidemic calling for control and prevention of accidents, which are no longer considered accidental events.

Problem related to vehicular injuries and eventually death of victims may call upon the entire spectrum of Forensic expertise. The present Prospective study was conducted in Jodhpur region.

### Aims and Objectives:

1. To study the incidence of road traffic accidents in Jodhpur region among cases brought to Mortuary of Dr S.N. Medical College, Jodhpur
2. To study pattern of road traffic accidents in terms of:-
  - a. Cause of death.
  - b. Profile of victim.
  - c. Age and Sex distribution.
  - d. Time and Month distribution.
  - e. Duration of survival.
3. To evaluate various factors responsible or road traffic accidents in Jodhpur region, and recommend the preventive measures of Road Safety.
4. To know effect of protective measures, e.g. Helmet, Seat belt.

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### **Material and Methods:**

The present study was carried out at the mortuary complex of Department of Forensic Medicine & Toxicology and Dr. S.N. Medical College and Hospital, Jodhpur from 01.09.2011 to 31.08.2012. During this period total 824 medico-legal Autopsies were conducted, out of which 153 Autopsy case of Road Traffic Accident were studied in details.

General particulars of each case were taken from police personnel accompanying the victims, relatives. Attendants of deceased and other relevant information obtained.

### **Observation and Result:**

According to the study conducted by National Transportation Planning and Research Centre, New Delhi, a person is killed or injured in every 4 min in traffic accidents in India. [5]

Accidents constitute a modern day epidemic, a counter product of modernization and fast life. Studies by different authors conducted in India showed that the pattern of road traffic accidents and deaths are quite different in developed countries as compared to developing countries. Increased urbanization and industrialization has led to tremendous growth in road transport sector.

Inadequate traffic planning control is one of the causes in India. The rise in number of vehicles and rate of vehicular accidents could be judged on the basis of the heavy postmortem rate, reported in India in recent years.

The maximum numbers of cases were observed in the age group 21-30 years, 52 (33.9%) Cases followed by age group 40-41 years 30 (19.6%) Cases Least incidence was found in the age groups of >70 years no case (1.4%). Higher incidence was observed in male 47 (34.3%) in the age groups of 21-30 years as compared to female 05 Cases (31.2%). (Table 1) In this study maximum number of cases was observed in the month of July 19 Cases (12.4%), followed by August 16 cases (10.4%).

In the month of January & November incidence observed was relatively less with 5 cases (3.5%) of road traffic accident. (Table 2)

In our study maximum number of incidences was observed during time between 12.01 p.m. to 6.00 p.m. 58 cases (37.90%), followed closely during time of 6.01 am to 12.00 noon 51 cases (33.3%).

Relatively fewer incidences were observed at night hours from 12.01 a.m. to 6 a.m. 22 cases (14.37%). (Table 3) Maximum no. of incidence was observed in motorcyclist 58 (40.8%), out of which 17 (100.0%) were slipped, followed by pedestrian in 30 (21.1%), out of

which 15 (39.5%) were affected by side impact.

It was also observed that incidence of vehicular turn over occurred in 23 cases (100.0%), out of which in 12 cases (52.2%) involved vehicle was rickshaw.

In distribution of cases according to type of collision, it was observed that maximum 38 (100.0%) were occurred by side impact collision, out which motorcycle involved in 16 (42.1%) followed by 26 (100.0%) resulted from front impact collision, out of which motorcycle involved in 10 (38.5%). (Table 4)

Present study showed that maximum incidences of road traffic accidents were observed in two-wheeler (motorcycle) involving 80 cases (52.3%), followed by pedestrian in 37 cases (24.1%). Minimum incidence was observed in Bicycle 05 cases (3.2%). (Table 5)

Maximum numbers of victims were observed when brought to hospital and declared dead in 58 cases (37.9%), followed by 28 cases (18.8%) that died within 6 hours of event time.

Only 03 cases (2.1%) were observed who survived for 6 to 12 hours of hospital admission. (Table 6) Maximum incidence with heavy vehicle (Bus, Luxury, Truck, and Tractor) was found in 54 cases (35.2%). With involvement of heavy vehicle as an offending vehicle maximum were in motor cyclist 22 cases (14.4%) in this study. (Table 7)

Incidence of head injury was observed as a single and most prominent cause of death in 95 cases (62.1%), followed by death due to shock and hemorrhage on account of poly trauma in 39 cases (25.5 %) and died on account of septicemic shock in 04 cases (2.6%).

Further incidence of chest injury (with or without head injury) and abdominal injury (with or without head injury) was observed in 08 cases (5.2%) and 06 cases (3.9%) respectively.

In one case (0.6%) cause of death was associated with heart disease. (Table 8)

### **Discussion:**

All studies including present study shows head injury as a major cause of death involving around 62.1% of cases out of total fatalities (varying in range 35% to 62%). The higher incidence of head injury as a cause of death can be explained by the fact that most of the cranio-cerebral injuries were not the result of primary impact but due to secondary impact or secondary injuries or both. (Table 9)

### **Conclusion:**

Major outcome of this study is "Accidents don't just happen; they are caused. Therefore preventable, But following major challenges should be taken in to consideration

for better results. Above mentioned pitfalls conclude that accidents are a complex phenomenon of multiple causation, which require inter-sectoral approach to both prevention and care of the injured.

The various measures comprise such as Data collection, Safety education, Promotion of safety measures, Alcohol and other drugs should be avoided; planning, organization and management of trauma treatment and emergency care services, Elimination of causative factors, Enforcement of laws, Rehabilitation services and Accident research are required for prevention of RTAs.

**Think! Advice - Top Ten Road Safety Tips:**

1. **Don't use your mobile phone whilst driving:** Making or receiving a call, even using a hands-free phone, can distract your attention from driving and could lead to an accident.
2. **Belt up in the back:** In a collision, an unbelted rear seat passenger can lead to serious injury to the driver or a front seat passenger or may even cause death,
3. **Don't drink and drive:** Any alcohol, even a small amount, can impair your driving ability, so be a safe driver don't drink and drive.
4. **Slow down:** At 35 km/h you are twice as likely to kill someone as you hit as at 30 km/h.
5. **Children:** Children often act impulsively; take extra care outside schools, near buses and ice cream vans when they might be around.
6. **Take a break:** Tiredness is thought to be a major factor in more than 10% of road accidents. Plan to stop for at least a 15-minute break every 2 hours on a long journey.
7. **Walk safely:** When crossing a road always use a pedestrian crossing if there is one nearby. Help others to see you by wearing fluorescent or reflective clothing in poor light conditions.
8. **Anticipate:** Observe and anticipate other road users, use your mirrors regularly and don't forget to glance into your blind area before altering your course.
9. **Use child seats:** Child and baby seats should be fitted properly and checked every trip.
10. **Keep your distance:** Always keep a two second gap between you and the car in front.

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**Table 1: Age and Sex Distribution**

Age Grps (Yrs)	Cases (%)	Male (%)	Females (%)
0-10	6(3.92)	05 (3.6)	01 (6.25%)
11-20	18 (11.8)	16 (11.7)	02 (12.5%)
21-30	52 (33.9)	47 (34.3)	05 (31.2%)
31-40	23 (15.03)	20 (14.6)	03 (18.7%)
41-50	30 (19.6)	27 (19.7)	03 (18.7%)
51-60	19 (12.4)	19 (13.8)	00 (0%)
61-70	04 (2.6)	02 (1.4)	02 (12.5%)
>70	00 (0)	00 (0)	00 (0%)
<b>Total</b>	<b>153</b>	<b>137</b>	<b>16</b>

**Table 2: Month Wise Distribution**

Months	Cases	Percentage (%)
January	5	3.26
February	12	7.84
March	14	9.15
April	14	9.15
May	15	9.80
June	14	9.15
July	19	12.41
August	16	10.4
September	11	7.8
October	13	8.49
November	5	3.26
December	15	9.8
<b>Total</b>	<b>153</b>	<b>100.0</b>

**Table 3: According to the Time of Event**

Period of Event Time	Cases	Percentage (%)
6.01 a.m. to 12.00 noon	51	33.3
12.01 p.m. to 6.00 p.m.	58	37.90
6.01 p.m. to 12 midnight	21	13.72
12.01 a.m. to 6.00 a.m.	22	14.37
Not known	01	0.6
<b>Total</b>	<b>153</b>	<b>100.0</b>

**Table 5: According to the Type of Victim**

Category of Victim	Cases	Percentage (%)
Pedestrian	37	24.1
Bicycle	5	3.2
Two Wheeler (Motorcycle)	80	52.5
Three Wheeler (Chhakdo/Rickshaw/Tempo)	12	12.4
Light four wheeler (Car/Van)	10	6.5
Heavy vehicle (Bus/Truck/Tractor)	9	5.6
<b>Total</b>	<b>153</b>	<b>100.0</b>

**Table 6: According to the Duration of Survival**

Duration of Survival	Cases	Percentage (%)
Spot Death	05	3.2
Brought and Declared dead	58	37.9
0 to 6 hours	28	18.3
>6 to 12 hours	03	1.9
>12 to 24 hours	16	10.4
>24 to 48 hours	08	5.2
>2 to 7 days	21	13.7
>7 to 14 days	10	6.5
>14 days	04	2.6
<b>Total</b>	<b>153</b>	<b>100.00</b>

**Table 8: According to the Cause of Death**

Cause of Death	Cases	Percentage (%)
Head Injury (1) Cranio-cerebral injuries (2) Shock and hemorrhage (3) Complication	95	62.09
Shock and haemorrhages due to Poly trauma	39	25.5
Chest injury	8	5.2
Abdominal Injury	6	3.9
Septicemic shock	4	2.6
Heart disease	1	0.6
<b>Total</b>	<b>153</b>	<b>100.0</b>

**Table 4  
Cross-tabulation between Mode of Event and Vehicle affected**

Mode of Event	Vehicle Affected								Total (%)
	Bicycle (%)	Bus (%)	Car (%)	Motorcycle (%)	Pedestrian (%)	Tempo (%)	Tractor (%)	Truck (%)	
Front Impact	01(3.8)	08(26.9)	06(15.4)	12(38.5)	04(14.5)	02(3.8)	00(0.0)	04(15.4)	37(100.0)
Fall from vehicle	00(0.0)	00(0.0)	00(0.0)	04(57.1)	00(0.0)	01(14.03)	00(0.0)	00(0.0)	09(100.0)
Hit from behind	02(8.3)	00(0.0)	00(0.0)	06(25.0)	16(58.3)	00(0.0)	00(0.0)	00(0.0)	24(100.0)
Not known	00(0.0)	03(0.0)	01(14.3)	04(57.1)	01(14.3)	00(0.0)	01(14.3)	00(0.0)	13(100.0)
Side Impact	03(7.9)	00(0.0)	01(2.6)	16(42.1%)	15(39.5)	00(0.0)	00(0.0)	00(0.0)	43(100.0)
Slip	00(0.0)	00(0.0)	0(0.0)	15(100.0)	00(0.0)	00(0.0)	00(0.0)	00(0.0)	15(100.0)
Turn Over	00(0.0)	00(0.0)	04(17.4)	01(4.3)	00(0.0)	04(17.4)	00(0.0)	01(4.3)	12(100.0)
<b>Total</b>	<b>06(4.2)</b>	<b>07(4.9)</b>	<b>10(7.0)</b>	<b>58(40.8)</b>	<b>30(21.1)</b>	<b>06(4.2)</b>	<b>01(0.7)</b>	<b>03(2.1)</b>	<b>153(100.0)</b>

**Table 7  
Co-relation between Type of Victim and Vehicle Offending**

Type of Victim	Vehicle Offending							Cases (%)
	Motorcycle	Three wheeler	Car	Heavy Vehicle	Animal	Not known	Not applicable	
Pedestrian	14(37.8)	02(5.4)	08(21.6)	10(27.0)	00(0.0)	02(5.4)	01(2.7)	37(100.0)
Bicycle	02(40)	01(20)	01(20)	01(20)	00(0.0)	00(0.0)	00(0.0)	05(100.0)
Two Wheeler	06(7.5)	06(7.5)	01(8.7)	30(37.5)	03(3.7)	06(7.5)	22(27.5)	80(100.0)
Three Wheeler (Rickshaw/Chhakdo /Tempo)	00(0.0)	00(0.0)	01(8.3)	05(8.3)	01(8.3)	00(0.0)	9(75)	12(100.0)
Light four wheeler(Car/Van)	00(0.0)	00(0.0)	00(0.0)	05(50.0)	01(10.0)	00(0.0)	04(40)	10(100.0)
Heavy vehicle (Bus/Truck/Tractor)	00(0.0)	01(11.2)	00(0.0)	09(77.8)	00(0.0)	00(0.0)	01(11.2)	09(100.0)
<b>Total</b>	<b>22(14.4%)</b>	<b>10(6.5)</b>	<b>17(11.2)</b>	<b>54(35.2)</b>	<b>05(3.2)</b>	<b>08(5.2)</b>	<b>37(24.2)</b>	<b>153(100.0)</b>

**Table 9  
Comparison of the Causes of Death**

Cause of Death	Study Author			
	Lau [6]	Biswas [7]	Ghangale [8]	Present Study
Head Injury	41.8%	47.3%	35.5%	62.1%
Shock and Hemorrhage due to Multiple Injuries	49%	41.8%	46.6%	22.5%
Chest Injury	21.1%	0%	11.1%	5.2%
Abdominal Injury	2.6%	0%	0%	3.9%
Others	1.1%	5.5%	0%	3.1%

## Original Research Paper

# Study of Fatalities due to Lightning in Nagpur Region of Maharashtra

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### Abstract

In Nagpur region of Maharashtra (India), many deaths were reported due to lightning strikes. In most cases of deaths due to lightning, bodies of deceased persons were found in remote areas with torn clothes and burn injuries. The injuries present over body may apprehend the relatives and raise suspicion of foul play. In this study total 31 cases were studied which were brought for medico legal post-mortem with history of lightning of which 87% were farmers and farm labourers.

Twenty nine percent of cases belonged to the age group of 41-50 years. Most of the cases were found in the months of June, July and October. Filigree burns were found only in 4 cases. Careful examination of victims along with history of thunderstorm in the vicinity will help the autopsy surgeon to confirm the diagnosis of lightning.

**Key Words:** Lightning Deaths, Autopsy, Filigree Burns, Fatalities, Thunderstorm, Victim, Dagnosis

### Introduction:

Lightning is a naturally occurring global phenomenon. It is estimated that a lightning flash occurs approximately 8 million times per day throughout the world [1, 2] As per centre for disaster mitigation and management, Vellore (India), average number of thunderstorm days per year in Nagpur region of Maharashtra state is 45 and it is placed in the category of moderately hazardous zone. [3]

In Vidarbha region of Maharashtra (India), many deaths were reported due to lightning strikes. Figures say, as many as 28 deaths were reported due to lightning in a single day in Vidarbha region. [4] In most cases of deaths due to lightning, bodies of deceased persons were found in remote areas with torn clothes and burn injuries.

The injuries present over body may apprehend the relatives and raise suspicion of foul play. Absence of visible external injuries in some cases of lightning is an infrequent and interesting finding.

During lightning in the vicinity of striking areas, people try to fabricate the natural deaths as deaths due to lightning for monetary benefits.

Here comes the role of autopsy surgeon to fix the cause and manner of deaths so as to give proper justice to each case. Autopsy surgeon should be careful while dealing with such type of cases because his report can give proper guidance to the investigating authority.

Few studies have been carried out on victims of lightning in the past. But those studies were retrospective studies carried out by just analysing the autopsy records of the victims of lightning. The present study was undertaken to note the pattern and circumstances of injuries in lightning deaths.

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DOR; 15.04.2014 DOA; 22.08.2014

### Materials and Methods:

The present study was carried out at Departments of Forensic Medicine and Toxicology, Indira Gandhi Govt. Medical College and Govt. Medical College, Nagpur (Maharashtra, India), from January 2007 to December 2010. In this study total 31 cases of deaths due lightning were studied which were brought for medico-legal post-mortem examination.

A standard proforma was prepared which included all the preliminary data of the

victim including name, age, sex, address, occupation, date and place of incident. Condition of clothes of victim and location and pattern of injuries over body were also noted in standard proforma. Detailed post mortem examination was carried out and internal injuries were noted.

Activity of the deceased during the lightning strike and place of incident were collected from police records and relatives. Other corroborative evidences from the place of incident were also analyzed from spot inquest provided by investigating authority.

### Results:

The study consisted of 31 cases comprising 19 males (61.29%) and 12 females (38.71%). Most of the cases belonged to the age group 41-50 years (29.03%) followed by 11-20 years (25.81%). (Table1)

As far as occupation was concerned, 27 (87.10%) victims were farmers. (Table 2) Highest number of cases (n=20, 64.51%) were observed in the month of June. (Fig. 1) Considering the activity of the victim during lightning strike and the place of incident, it was noted that 16 (51.61%) victims had taken shelter under the tree. (Table 3)

In the present study, singeing of hairs was present in 16 cases (51.61%), torn or melted clothes and fabrics was seen in 19 cases (61.29%), blackening and or scorching of skin and clothes was observed in 09 cases (29.03%) and magnetization of metals was seen in 02 cases (6.45%). Bleeding through one or both ears was found in 10 cases (32.26%). Surface burns injuries were present in 29 (93.5%) cases.

Out of the 31 cases, surface burn injuries were present in 29 cases (93.55%). Front of trunk was the most common site for surface injury (61.29%) followed by lower limbs (58.06%). (Fig. 2) Filigree burns or fern tree like appearance was found in 04 (12.9%) cases. (Fig. 3) In two cases (6.45%) lacerations of spleen were observed. (Fig. 4)

### Discussion:

Lightning causes damage to the body as a result of electrical current passing through the body on the way to the ground. Sometimes it causes burns, as air nearby is heated by passing lightning with clothing being set alight or by explosive effect of the air being heated up to 20000 °c in a fraction of a second.

Approximately thirty to fifty percent of the lightning strikes are fatal.

In this study majority of the victims were males comprising of 61.29% of total cases while rest 38.71% were females. Male to female ratio of 3:2 was observed. This ratio was closely

similar to the one observed by Chattopadhyay S. et al [5], in which it was 3:1. Murty O. P. et al [6] reported that 92.59% cases were males and 07.41% cases were females, in their study conducted in Malaysia. Other studies carried out in U.S., Singapore, England and Wales report the male to female ratio as 4.6:1. [7]

In our study relatively greater involvement of females might be due to the fact that more number of females traditionally being involved in the farm works in this region.

In current study, the age group of victims most affected by lightning was between 41-50 years, comprising of 29.03% of cases, followed by 25.81% of cases from age group of 11-20 years. The victims in the age group of 31-40 years were 16.13%.

Majority of the victims were in the age group of 31-50 years, comprising of 45.16% cases. This finding closely resembles with that of Chattopadhyay S. et al [5] who found 62% of the victims in the age group of 31-50 years.

This corroborates with the fact that the age group of 31-50 years is the one which is mainly involved in earning livelihood for family.

The difference in the findings of our study and the one conducted by Murty O. P. et al [6] in Malaysia, in which the age group 31-40 years consisted of 61.54% cases, might be due to socioeconomic and geographical differences of two countries. In our region at the start of monsoon, the whole family is involved in the farm work, which is reflected in the finding that younger age group of 11-20 years is the second most common affected age group comprising of 25.81% of cases. With 87.10% of total victims being farmers, our study reveals that farmers are the most common victims of lightning strikes.

Chattopadhyay S. et al [5] reported the similar findings of farmers being the victims of lightning in 72.23% of total cases. As farmers work in rainy conditions and stay at farm during rain and thundershowers, which predispose them to major risk of lightning accidents. We also found three students being struck by lightning when they were playing at various places like football ground, terrace and farm.

This represents the fact that population which is involved in recreational activities is also more prone to be hit by lightning strikes.

In this study, most of the cases were reported during the months of May to October with peak incidence being reported in the month of June. June is the month for onset of monsoon in this part of country, which usually is associated with heavy rains, thundershowers and lightning. Chattopadhyay S. et al [5] reported the similar findings of maximum

incidence of lightning accidents during the months of May to September.

In present study majority of victims were taking shelter under the tree during heavy rainfall, comprising of 51.61% of cases, while 29.03% victims were working in field. Similar findings were observed by Murty O. P. et al [6], where most common activity of victims at the time of lightning accident was taking some type of shelter, followed by working. The place of shelter during lightning accidents in our study was nearby the victims' work fields.

As our study consisted mostly of rural population with low socioeconomic status these people are forced to work in conditions of rain and thundershowers and if possible they take shelter nearby. During thunderstorms people take shelter under isolated trees because they believe erroneously that a tree offers protection from lightning.

In our study superficial burn injuries were seen over front of trunk in 61.29% of cases followed by lower limbs (58.06%), head, neck & face (41.93%), upper limbs (22.58%), back of trunk (19.35%) and genitals (12.90%). [6]

Filigree burns or fern tree like appearance or arborescent marks were found only in 04 cases. All the four deceased females were sitting under the tree during thunderstorm and during autopsy no other damage was seen except filigree burns and melted clothes. This finding correlates with that of various authors that the filigree burns are not so common. [8-12]

Bleeding through one or both ears was found in 32.25% cases. This was due to blast effect of lightning which causes rupture of tympanic membrane and hemotympanum.

This finding is similar to the one reported by Murty O. P. et al [6] (29.63%), and Chattopadhyay S. et al [5] (35.18%). In two cases we found magnetization of metals worn by the deceased. This is an important corroborative evidence of lightning.

In two cases lacerations of spleen were found, which are rarely reported in lightning accidents. This might be the result of mechanical trauma due to blast effect of lightning.

In our study we found one incidence in which five females along with one bullock were struck by lightning while they were taking shelter under a solitary tree. In another incidence a person was struck by lightning while he was swimming in a pond.

These two incidences show that taking shelter under a solitary tree and swimming in a pond are risk factors for lightning strikes in conditions of thunderstorms.

## Conclusion:

Though lightning accidents are unpredictable, the deaths and the casualties resulting from the same can be prevented by some simple precautionary measures, like staying indoors during thunderstorms and taking shelter under a safe and strong solid structure. Various vulnerable circumstances, such as being in an open field, on top of a building, under a solitary tree, swimming in a pond, predispose a person to the lightning strikes.

Such circumstances should be avoided during thunderstorms. In urban areas lightning protection devices for buildings are used which along with protection provided by tall buildings, may be the reason for low incidence of lightning accidents in urban areas.

There is a need for development of similar lightning protection devices which can be effective in the fields, from where we encounter most of the cases of lightning deaths. General awareness of common man along with some precautionary measures is the key in prevention of lightning accidents.

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**Table 1: Demographic data of Lightning Victims**

Age grps (yrs)	Victims			Percentage
	Male	Female	Total	
0-10	01	01	02	6.45
11-20	04	04	08	25.81
21-30	02	01	03	9.68
31-40	04	01	05	16.13
41-50	06	03	09	29.03
51-60	02	02	04	12.9
Total	19 (61.29%)	12 (38.71%)	31	100

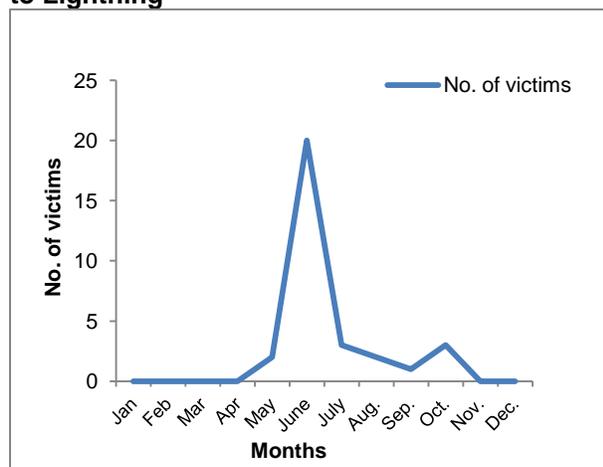
**Table 2: Occupation of Victims**

Occupation	Victims	Percentage
Farmer/farm labourer	27	87.10
Construction worker	01	03.22
Student	03	09.68
Total	31	100

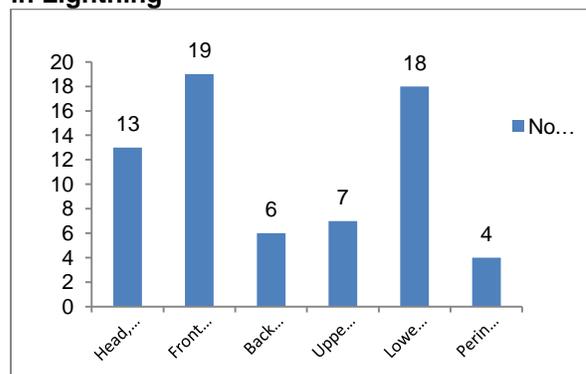
**Table 3: Place of Incidence and Activity of Victim at the time of Lightning**

Activity of Deceased/Place of Incidence	Victims	Percentage
Standing /sitting under tree	16	51.61
Working in field	09	29.03
Playing in open space	03	9.68
Walking on road	02	6.45
Swimming in pond	01	3.23
Total	31	100

**Fig. 1: Month wise Incidence of Deaths due to Lightning**



**Fig. 2: Distribution of Surface Burn Injuries in Lightning**



**Fig. 3: Filigree Burns due to Lightning Stroke**



**Fig. 4: Rupture of Spleen due to Blast Effect of Lightning**



## Original Research Paper

# Significance of Defence Wound in Homicidal Death

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### Abstract

The present study was carried out prospectively on 111 homicidal victims coming for medico-legal autopsy to the mortuary of SCB Medical College, Cuttack, Odisha from October 2010 to September 2012 to know the significance of defence wound by determining its incidence and pattern of wound. Out of the 111 homicidal deaths, 31 cases (27.92 %) were found with defence wound. Males were approximately 1.43 times more defensive than females. Most common age group showing defence wound was 21-30yr. Sharp weapon was used in 45.16% cases where as blunt weapon in 38.71% cases. Most common type of defence wound was incised wound (29%), followed by bruise (22.58%).

Most common site involved in upper limb was forearm, followed by hand and arm. Active defence wound were found in 16.12% cases and passive defence wound in 64.51% cases. Left hand showed most defence wound (41.93%) as compared to bilateral hand involvement (32.25%) and right hand involvement (25.8%). A careful and thorough post-mortem examination of defence wound may give clues to the circumstances prior to death of the victim.

**Key Words:** Defence wound, Homicidal death, Post-mortem examination

### Introduction:

Defence wounds are the result of immediate and instinctive reaction of the victim to save himself. [1] These defence wounds may be of considerable medico-legal significance, as they indicate that the victim was conscious, at least partly mobile and not taken by surprise. [2]

Traditionally it may be active or passive defence wound. Active defence wounds occur when the victim grasps the knife with hand and the injury thus located on palmer aspect of hand. The passive wound is sustained when the victim raises their hands or arms to protect the attacked body region and in this case the injuries will primarily be located on the extensor side. [3]

As a result of defence the wounds produced are bruises, abrasions, lacerations, incised wounds over the extensor or ulnar surface of forearm, wrist, back of hand, knuckle, palm and lateral / posterior aspect of upper arm. Fracture of the carpal, bones, metacarpals, digits, and ulna may occur.

Defence wound may also be found in lower limbs. [1, 2] The type of injury will depend upon the type of weapon used and site involved. Bruises, abrasions and lacerations are produced by blunt object while in stabbing with a single edged weapon, if the weapon is grasped a single cut is produced usually on the palm of the hand or on the bends of fingers or thumb.

If the weapon is double edged, cuts are produced both on the palm and fingers. The cuts are usually irregular and ragged. A typical knife defence wound may be seen in the web space between the base of the thumb and index finger, when the blade is grasped. [1, 2]

Defence wound indicate homicide. But its absence does not rule out homicide as it may be absent in unconscious victims, when taken by surprise, attacked from back or under the influence of alcohol or drugs. [4] In females defence wound at times indicate sexual assault apart from homicide. [1] Also defence wound forms a valuable evidence for reconstructing the fatal incidence in homicidal deaths. [4]

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### Aims and Objectives:

1. To know the pattern of defence wound.
2. To know the type of weapon used.
3. To know the site involved in defence wound.
4. To know the active or passive wound.

### Materials and Methods:

The present study was carried out prospectively on homicidal victims consisting of 111 cases brought for medico-legal postmortem examination to the mortuary of S.C.B. Medical

College, Cuttack, Odisha from October 2010 to September 2012. Cases of homicide are selected by history, police inquest and autopsy findings. Out of these homicide victims the cases with defence wounds were considered and interpretations of these wounds were done after careful and complete consideration of all circumstances surrounding the offence and death. Defence wound cases selected in this series have non-fatal injuries over upper limb along with other fatal wound over body until otherwise excluded by history.

Defence wound present over palmar aspect of hand were considered active and all other sites of upper limb were considered as passive in this study. In this study each case of homicide showing defence wound were examined to determine the age, sex, type of injury, weapon used, site and side involved.

### **Observations:**

In present prospective study among 111 homicidal cases, only 31 cases (27.92%) showed defence wound. (Table 1) Amongst 31 victims of homicide with defence wound, 26 cases were male and rest belongs to female. Males are approximately 1.43 times more defensive than females. (Table 2)

In our study out of total 31 cases of defence wound the age group 21-30 yrs showed maximum number of cases (38.71) followed by 31-40 yr. group. This study showed that the most common type of injury found in defence wound was incised wound (29%), followed by bruise. Sharp and pointed weapons were found in most of the cases (45.16%) to cause the defence wound followed by hard and blunt weapon (38.71%). (Table 4)

In present study we observed maximum number of defence wound over forearm (32.25%), followed by arm (22.58%) and over multiple sites (19.35%). (Table 5) Most of the defence wounds were passive type, followed by mixed and active type. Passive wounds are approximately four times more common than active type. (Table 6) Left hand showed most number of defence wound cases followed by both hands and right hand in our study. (Table 7)

### **Discussion:**

The present work was undertaken on examination of 31 homicidal cases with various types of defence wound. The incidence of defence wound is 27.92% amongst the homicidal deaths. This finding support the study made by other authors. [4-8] Absence of defence in other cases may be due to the causes as described in the introduction. However higher incidences were also found by

many authors. [9-11] High incidence in these studies may be due to regional variation and physical build.

Males outnumbered females and males are approximately 1.43 times more defensive than females similar to other studies. [6, 10] This may be due to the dominant and outdoor works of males. Contrast to this study female had more defence wound than males in some studies [1] may be due to alertness of the victim.

Most of the defensive wound belongs to 20-30 yrs age group, which is supported by many authors. [6-9] It is the age of active and violent activities and thus making it the most susceptible age for defence also. Commonest age group 31-40 year was also found in Chattopadhyay S. study. [10]

In our study sharp and pointed weapons are most common weapon, followed by blunt weapon causing defence wound.

Most common type of injury found in defence wound is incised wound, followed by bruise. These are supported by authors. [4, 6-8, 10] It solely depends on the type of weapon used by the assailant at the time of crime. However in other study hard and blunt injury was the commonest type of defence wound. [9]

The commonest site involved in defence is forearm, followed by hand and the arm in this study. Forearm is the commonest site both in sharp cutting and blunt weapon similar to others. [6-8, 11] Forearm is the most movable part of upper arm and its extensor surface is more resistant to trauma as compared to other surfaces. In present study passive defence wounds are commonest, followed by mixed and then active type. [11] It shows reflex reaction of victim to save himself at the time of incidence.

Left side is commonly involved in defence wound followed by both sides and then right side. [4, 6, 10-11] This may be due to that most assailants are right handed and attacked from that side. Another possibility is that the victim will try to rescue his body through its weaker part i.e. usually left hands. In contrast to other study which showed right side is the most common side involved in defence wound. [7,8] This may be due to circumstantial and regional variation.

### **Conclusion:**

Defence wound in homicidal cases is not only indicating the alertness of the victim but also the relative position of assailant and victim and types of weapon used.

A meticulous autopsy with the knowledge of common sites of defence wound

along with the circumstantial evidence plays a great role in determining the defence wounds.

So by considering the defence wound, manner of death and reconstruction of scene can be deducted to some extent and thus helps in better justice to the victim.

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**Fig. 1: Bruise over Palmer Aspect of Left Hand shown by an Incision**



**Fig. 2: Incised Wound over the First Web Space of Left Hand**



**Table 1: Incidence of Defence wound**

Incidence	Period of Study
	October 2010 to September 2012
Total Homicidal Cases	111
Defence wound Present	31(27.92%)
Undetermined	14 (12.61%)

**Table 2: Sex wise Distribution of Defence Wound (n=111)**

Sex	Cases	Percentage
Male	26 / 87	29.88%
Female	05 / 24	20.83%

**Table 3: Age wise Distribution**

Age groups (yrs)	Cases of Defence wound	Percentage
< 10	00	0
11 – 20	3	9.67
21 – 30	12	38.71
31 – 40	10	32.25
41 – 50	02	6.45
51 – 60	03	9.67
> 60	01	3.22

**Table 4: Types of Injury in Defence Wound**

Weapon Type	Injury Type	Cases (%)	Total (%)
Hard and Blunt	Abrasion	01 (3.22)	12 (38.71)
	Bruise	07 (22.58)	
	Laceration	04 (12.9)	
Sharp, Pointed	Incised wound	09 (29)	14 (45.16)
	Stab wound	05 (16.12)	
Mixed Type		05(16.12)	05 (16.12 )

**Table 5: Site Involved in Defence Wound**

Site	Blunt Weapon	Sharp and pointed weapon	Total
Dorsum of hand	02	01	03 (9.67)
Palm	02	03	05 (16.12)
Forearm	04	06	10 (32.25)
Arm	03	04	07 (22.58)
Multiple Site	-	-	06 (19.35)

**Table 6: Active or Passive Defence wound**

Wound Type	Cases	Percentage
Active	05	16.12
Passive	20	64.51
Mixed	06	19.35

**Table 7: Side involved in Defence wound**

Side	Cases	Percentage
Right hand only	08	25.8
Left hand only	13	41.93
Both hands	10	32.25

## Original Research Paper

# Time Passed since Death from Degenerative Changes In the Lung

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### Abstract

Time since death is made out from gross postmortem changes like cooling of the body, postmortem staining, rigor mortis, decomposition etc. In the present study Histological changes in the lung tissue were studied at various postmortem intervals in the human body died due to road traffic accidents. This study is conducted in the Department of Forensic Medicine in collaboration with Department of Pathology, G.S.V.M. Medical College, Kanpur, U.P. A total of 45 cases are taken belonging to both sexes i.e. 36 males and 9 females were studied. These are of different age groups.

All road traffic accidents are taken into account. In this study control cannot be taken because the histological changes of tissue after death is influenced a great deal by atmospheric temperature and humidity besides other external and internal factors. Therefore these must be taken into account in all studies of postmortem interval whether histological, biochemical or physical.

**Key Words:** Lung, Interstitial oedema, Alveoli, Bronchiolar epithelium, Hyaline cartilage

### Introduction:

Estimation of time since death is one of the most important object of post-mortem examination. Time passed since death continues to be a major problem for the Forensic pathologist and its determination plays an important and vital issue in medico-legal cases because of the fact that Forensic experts are very often required to answer questions relating to time of death in the courts of law.

The traditional methods of ascertaining the time since death based on naked eye observations of the gross changes in a dead body occurring after death to provide a rough approximation of post mortem interval, at best only and would appear to be still the closest approximation of the time passed since death in a given case.

These various gross changes in the body after death are loss of corneal reflex and changes in eye, cooling of the body, post mortem hypostasis, rigor mortis, decomposition and other putrefactive changes.

Some clue of time of death is also gathered from the condition of food in stomach, intestine and urine in bladder. Attempts have also been made to determine time passed since death by studying biochemical changes in blood, CSF and intraocular fluids. The biochemical methods have been found to be of not much use once the decomposition changes start.

The problem worsens when body is mutilated, skeletonized or invaded by animals. Time bound histological and histo-chemical study of degenerative changes in various organs and tissues may be a good solution. [1-3]

Forensic pathologist throughout the world are trying to establish time passed since death by studying degenerative changes in organs and tissues at different intervals but definitive conclusion is still awaiting.

The histological studies on various tissues after death have been mostly confined to single organ or tissue by individual workers at different atmospheric conditions. [4]

Moreover very few workers works based on histological studies of post mortem tissue changes appears to have been undertaken by Indian and more so in Utter Pradesh. Since only a single organ was studied by most workers, any comparative evaluation of the varying rate of

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decomposition of the different organs and tissues cannot be made out.

**Material and Method:**

Material for the present study is lung, taken directly from the dead bodies during post-mortem examination.

Only those cases where the time of death is known and verified either by the doctors or by relatives & friends present at the time of death and also supported by postmortem changes, have been taken for the study.

Thus, bodies found unnoticed will not be Studied, precautions will also be taken to exclude the cases having pathology affecting the cellular architecture or biochemical constituent of the material. Such tissues thus collected, sliced and fixed in 10% formalin for histological study.

Total 45 cases, in which 36 male and 9 female were studied. These are of different age and sex. All road traffic accidents are taken into account.

**Collection of Organs:**

These organs were then kept in 10% formalin for 24-48 hrs for fixation. Small pieces or blocks of tissues each 1-2 mm thick were taken for histological examination and were processed by the routine methods of processing for histological studies by fixation, dehydration followed by embedding in paraffin wax. [4-6]

The paraffin sections of tissues were labeled during the process of block making in the following manners from case:

1st case to 45<sup>th</sup>: lung from the blocks of tissues, sections were cut at 4-5 mu thickness with a rotating microtome. The sections were then placed in warm water at 50°C in a tissue floatation bath for spreading out and were then mounted on glass slide smeared with albumin glycerin solutions. The slides were stained by reactive haematoxylin and eosin stain.

The stained slides were examined under light microscope for studying the various histological changes that take place in lung tissue at different time intervals after death. [7-9]

**Plan of Study:**

In this study total 45 cases of road traffic accident are taken. These cases are of different age and sex. The case in which time passed is known has taken.

The environmental temperature and humidity is recorded from newspaper from which average temperature is drawn. The average temperature ranges between 20°C to 35°C, humidity between 45% to 92% and duration range was 7-34 hrs. Now this temperature range and Duration is divided in 4 and 5 groups respectively (Table 1 & 2)

Now these 45 cases are studied with the effect of temperature and duration. First gross changes in lung studied. Then they were preserved in 10% formalin for microscopic study.

**Table 1: Temperature Range**

Group	Temperature	Cases
I	20°C	9
II	21-25°C	6
III	26-30°C	11
IV	31-35°C	19
Total		45

**Table 2: Duration Range**

Group	Temperature	Cases
I	Up to 12 hrs	5
II	13-18 hrs	13
III	19-24 hrs	14
IV	25-30 hrs	9
V	31-34 hrs	4
	Total	45

**Observations:**

All cases are divided in groups according to temperature and duration which is discussed earlier.

**Degenerative Changes in Lungs:**

Points which are considered are:

1. Alveoli – collapse and edema. Breaking of alveolar wall and septa.
2. Bronchi – a. Pattern (Disturbed / maintained).  
b. Desquamation of bronchial epithelium.
3. Blood vessels – lysis.
4. Complete loss of architecture.

Grading of degenerative changes is done as follow–

**G0:** No Change.

**G1:** Mild Change (Architecture maintained, few edemas in alveoli)

**G2:** Moderate change (Architecture is maintained, more oedema in alveoli, bronchial epithelium disruption)

**G3:** Severe change (Architecture disturbed, marked oedema in alveoli and breaking of alveolar wall & septa, bronchial epithelium disruption)

**G4:** Very severe Change (Complete disorganization)

**Discussion:**

In the present study 45 cases of different age and sex are taken in which 36 male and nine females. These all cases are of road traffic accidents. Average environmental temperature ranges between 20-35°C, humidity between 45-92% and duration range was 7-34hrs. We have divided these cases in groups according to temperature and duration which is discussed earlier. In human body besides environmental temperature, humidity, other factors also play role on both gross and microscopic changes.

**Discussion on Microscopic Observation:**

In this study, the sequence of various microscopic changes in different organs and tissues are compared with those of gross changes. In some cases there are some differences between gross and microscopic change. The earliest microscopic changes are observed in liver followed by lungs, kidney and skeletal muscle. These microscopic post-mortem changes are studied in different organs and tissues at on average temperature of 21-25°C, 26-30°C and 31-35°C with duration of up to 12 hours, 13-18 hrs, 19-24hrs, 25-30hrs and 31-34 hrs. The findings which are observed are as follows:-

**In Lungs: (Table 3-5)**

It was observed that within 12 hrs after death with temperature range of 26-30°C all type of changes are seen. (No change, mild and severe). (Table 6, Fig. 3) In 13-18 hrs and at higher temperature severity of changes increased. (Fig. 2) In 24 hrs with higher temperature severe changes are more prominent. (Fig.1)

But with the duration of 34 hrs and temperature is 35°C only mild to moderate changes are seen. These all cases fall in adolescent age group, so severe changes are not observed. A study done by Dr. Rakesh Tandon also showed the same sequence of histological changes in lungs at 20°C, 30°C and 40°C but in different time as to their appearance.

In that study at 30°C after 12 hrs mild autolytic changes such as focal collapse of alveoli, interstitial oedema and desquamation of bronchial epithelium at places were seen. [10]

By 24 hrs these changes were diffused and could be seen throughout the lung parenchyma. In our study inn 36 hrs there was moderate degree of autolysis, complete loss of lung architecture, only vogue outlines of bronchi being visible and there was heavy bacterial infiltration. At the end of 48 hrs only cartilage could be seen and the remaining areas show granular pink appearance, there was heavy bacterial growth. After 72 hrs the lungs had completely liquefied.

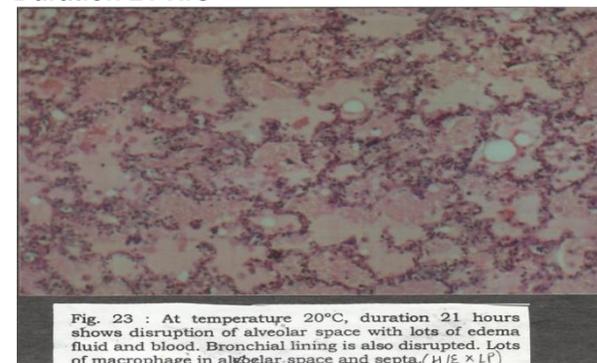
At 40°C lungs showed mild changes at 12 hrs, moderate degree of autolysis by 24 hrs, advanced autolysis after 36 hrs and complete liquefaction was seen in 48 hrs. While at 20°C, lungs had not liquefied even after 72 hrs but showed moderate to severe autolytic changes.

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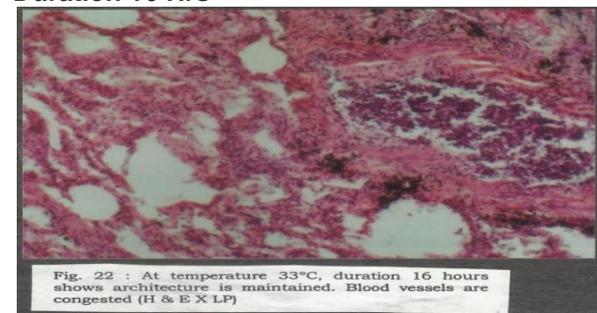
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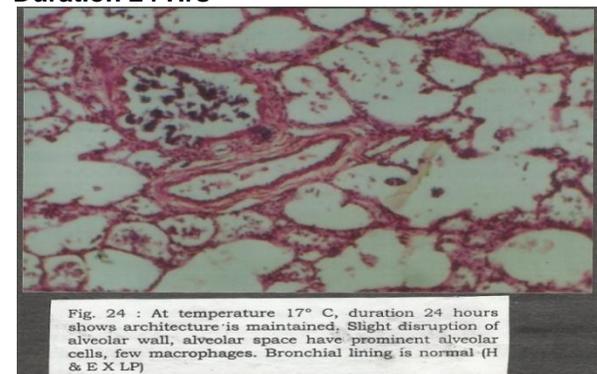
**Fig. 1: Changes in Lung at Temp. 20°C & Duration 21 Hrs**



**Fig. 2: Changes in Lung at Temp. 33°C & Duration 16 Hrs**



**Fig. 3: Changes in Lung at Temp. 17°C & Duration 24 Hrs**



**Table 3**  
**Degenerative Changes in Lungs (According to Duration)**

Duration	G 0		G1		G 2		G 3		G 4	
	No	%	No	%	No	%	No	%	No	%
Up to 12hrs( 5 cases)	2	40	2	40	-	-	1	20	-	-
13-18hrs(13cases)	4	30.8	3	23	5	38.5	1	7.7	-	-
19-24hrs(14Case)	-	-	5	35.7	3	21.4	6	42.9	-	-
25-30hrs(9 cases)	-	-	5	55.6	3	33.3	1	11.1	-	-
31-34hrs(4 cases)	-	-	1	25	3	75	-	-	-	-

(-) No case available

**Table 4**  
**Degenerative Changes in Lungs (According to Temperature)**

Duration	G 0		G1		G 2		G 3		G 4	
	No	%	No	%	No	%	No	%	No	%
Upto 20°C( 9 cases)	2	22.2	4	44.4	3	33.3	-	-	-	-
21-25°C(6cases)	-	-	5	83.3	1	16.7	-	-	-	-
26-30°C(11Case)	2	18.2	3	27.3	4	36.4	2	18.2	-	-
31-35°C(19 cases)	2	10.6	5	26.3	5	26.3	7	36.8	-	-

(-) No case available

**Table 5**  
**Relation between Temperature and Duration**

	12hour(5 cases)	13-18hours(13 cases)	19-24hours(19cases)	25-30hours(9 cases)	31-35hours(4 cases)
Upto 20°C(9 cases)	-	2 cases	2 cases	2 cases	3 cases
21-25°C(6 cases)	-	-	3 cases	3 cases	-
26-30°C(11Cases)	5 cases	3 cases	3 cases	-	-
31-35°C(19cases)	-	8 cases	6 cases	4 cases	1 case

(-) No case available

**Table 6**  
**Relation between Temperature and Duration**

	12hours(5cases)		13-18hours(13cases)		19-24hours(9cases)		25-30hours(9 cases)		31-35hours(4 cases)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Upto 20°C(9 cases)	x	X	Go-2	100	G1-2	100	G1-2	100	G2-3	100
21-25°C(6cases)	X	X	X	X	G1-2 G2-1	66.67 33.33	G1-3	100	X	x
26-30°C(11cases)	Go-2 G1-2 G3-1	40% 40% 20%	G1-1 G2-2	33.33 66.67	G2-2 G3-1	75 25	X	X	X	X
31-35°C(19Cases)	X	X	GO2 G1-2 G2-1 G3-1	25 37.50 25 12.50	G3-5 G1-1	83.33 16.67	G2-3 G3-1	75 25	G1-1	100

## Original Research Paper

# Age Estimation from Sternum for Age Group 25 Years Onwards

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### 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.

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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

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)	19(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

# Study of Fingerprinting In Patients with Schizophrenia

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### Abstract

In the recent decades, a considerable improvement has been achieved in the concept of relation between the types of pattern of lines on the fingers and psychiatric disorders. The study was conducted with the aim to find out association of fingerprint pattern and ridge count between schizophrenic patients and normal individuals. In this study we had examined fingerprint pattern and ridge count of right and left index finger. A total of 76 known cases of schizophrenic patients based on DSM-V diagnostic criteria were selected from out-patient psychiatry department and 76 controls were selected randomly from the staff and students of the North Bengal Medical College, Darjeeling. It was observed that loop pattern is overall commonest in both case and control group but arch pattern is comparatively more common in schizophrenic patients than that of the control group. Significant difference found between left and right index finger ridge counts between the case and control groups and men with schizophrenia had higher mean ridge count for both index fingers than normal men ( $p < 0.05$ ) while for women this difference was not significant.

**Key Words:** Schizophrenia, Fingerprint Pattern, Ridge Counts, Dermatoglyphic

### Introduction:

The type of fingerprint is unique based on the genetical characteristics of each individual. In the recent decades, a considerable improvement has been achieved in the concept of relation between the types of pattern of lines on the fingers and psychiatric disorders. Dermatoglyphics may be affected by both genetic and environmental factors.

A relationship exists between embryonic stress and distortion of dermatoglyphic patterns. [1] Schizophrenia is a chronic, severe and disabling brain disease. Approximately 1% of the general population suffers schizophrenia in their life time. Based on the pattern of ridge configuration, several criteria have been proposed to classify fingerprints into different pattern groups. These include the three-pattern system (loop, arch, whorl), the six-pattern system (plain arch, tended arch, ulnar loop, radial loop, whorl or combined figure).

It also include the eight-pattern system (plain arch, tended arch, ulnar loop, radial loop, plain whorl, double loop whorl, central pocket loop whorl, and accidental whorl) adopted by the FBI. The finger ridge count (FRC) is defined as the number of ridges intersected by a line between the triradial points (also called the delta point) to the point of core.

Some fingers may have more than one triradial point and these results in multiple ridge counts. To resolve this problem, the largest ridge count is typically chosen as the FRC. [2, 3]

Epidermal ridges are formed between 11<sup>th</sup> and 24<sup>th</sup> week of gestation; after this period epidermal ridges do not change. [4]

The critical growth of the brain is also occurring during this period. Since both the ridges and the brain are derived from the ectoderm, it seems reasonable to use unusual dermatoglyphic patterns to characterize disturbances of brain development. [5]

Cerebral and epidermal tissues share some aspects of development, such as similar ectodermal origin, rapid development during the second trimester of gestation, and susceptibility to neuronal growth factor.

Daily et al suggested that males tend to be at greater risk for a neurodevelopmental subtype of schizophrenia than females. [6] Preliminary experimental results have successfully demonstrated the association between dermatoglyphic and cerebral structural measures in patients with schizophrenia.

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## Materials and Methods:

This study examined fingerprint pattern and ridge count of right and left index finger. A total of 76 known cases of schizophrenic patients were selected from out-patient psychiatry department of North Bengal Medical College, Siliguri. The controls were selected randomly from the staff and students of the N.B.M.C.H. who had no psychiatric disorders.

All subjects were diagnosed as schizophrenia based on the DSM-v diagnostic criteria. Finger prints were recorded on a plain white unglazed paper with a black stamp pad by plain and rolled method.

Ethical clearance was obtained from the institutional ethical committee.

Patients of either sex diagnosed as a case of schizophrenia and subjects having any ridge pattern of finger prints were included in this study. Patients suffering from any chronic skin disease e.g. Eczema, leprosy and chronic dermatitis and having scars, congenital or acquired anomalies due to trauma on fingers were excluded from this study.

A proforma was designed in which data including name, age, sex and family history of schizophrenia were recorded. Screening of finger prints were done by using magnifying lens and scanner. All analysis was performed using the SPSS statistical software.

## Observation and Results:

In present study data showing loop pattern is overall commonest in both case and control group but arch pattern is comparatively more common in schizophrenic patients than that of the control group. (Table 1) In this study mean of both index finger ridge counts was  $15.5 \pm 4.3$  and  $13.6 \pm 6.3$  for the case and control groups, respectively. The t-student test showed a significant difference between left and right index finger ridge counts between the case and control groups ( $p < 0.001$ ). (Table 2)

Our study observed significant differences in mean ridge count of both index fingers between control and case groups but these differences were contributed only to males. Men with schizophrenia had higher mean ridge count for both index fingers than normal men ( $p < 0.05$ ) while for women this difference was not significant ( $p > 0.05$ ). (Table 3)

## Discussion:

Dermatoglyphics analysis has been investigated as a useful diagnostic and research tool in medicine and provides valuable insight on the inheritance and embryologic formation of many known clinical disorders. [7] Ridge count is increased in Turner's syndrome and decreased

in klinefelter's syndrome, chromosome 5p deletion syndromes [8, 9], beta- thalassemia [10] and rheumatoid patients. [11]

Fingerprint pattern of both index finger of the two groups show no statistically significant difference but arch pattern is comparatively more common in case group which is consistent with the findings of Van Valen. [12]

Case and control groups showed a statistically significant difference in terms of their both index finger ridge counts and this count was higher in patients with schizophrenia ( $p < 0.001$ ) and this finding is consistent with previous dermatology reports by the HS Bracha et al [13] and F. Shakibaei, G. A. Asadollahiet al. [14]

## Conclusion:

These results suggest that there may be an association between early developmental disturbances, occurring during prenatal life, and the later onset of schizophrenia.

These findings are important in screening by providing a biological marker which may help in prediction and early diagnosis of Schizophrenia. Our result encourages further studies to explain the exact role of both genetics and environmental factors.

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**Table 2: Mean of Both Index Finger Ridge Counts in Two Groups**

Mean Index Ridge Count	Control Group (n= 76)	Case Group (n=76)	P-Value
Right Index	13.9 ± 6.6	15.9 ± 4.1	
Left Index	13.3 ± 6.1	15.1 ± 4.5	
Mean of both	13.6 ± 6.3	15.5 ± 4.3	< 0.001

**Table 3: Mean Ridge Count of Both Index Finger in Male & Female**

Gender	Index Finger	Group	Mean + SD	P- Value
Male	Right	Control	13.7 ± 6.75	< 0.001
		Case	16 ± 4.26	
	Left	Control	13.3 ± 6.17	0.008
		Case	15 ± 4.85	
Female	Right	Control	14.6 ± 6.14	0.423
		Case	15.4 ± 3.23	
	Left	Control	13.2 ± 5.8	0.071
		Case	15 ± 3.70	

**Table 1  
Frequency Distribution of Index Fingerprint Pattern**

Finger Pattern	Groups	Simple Arch		Tented Arch		Whorl		Loop		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%
Left Index	Case	10	13.16	9	11.84	21	27.63	36	47.37	76	100
	Control	7	9.21	3	3.94	19	25	47	61.84	76	100
Right Index	Case	8	10.53	6	7.89	23	30.26	39	51.32	76	100
	Control	5	6.57	4	5.26	22	28.95	45	59.21	76	100

## Review Research Paper

### Stem Cells: An Update

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#### Abstract

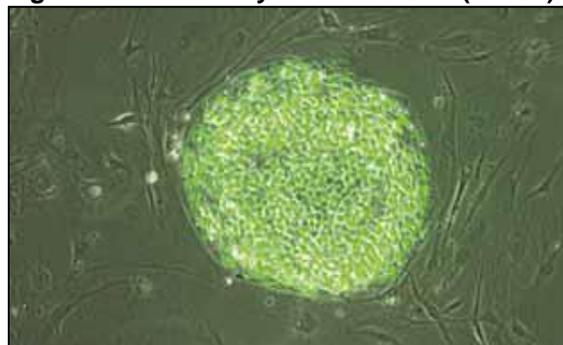
Stem cells are unspecialized cell. They are capable of continuous self-renewal. They can give rise to specialized cell types. Since the discovery of stem cells till now, for years scientists have been working on the numerous possibilities that the stem cells have and studies carried out to channelize their sources to the best for benefit of mankind. Starting from the knowledge of only embryonic stem cells as the source of stem cells, now it is known that they can be extracted from cord blood and mature adult tissue. Likewise, their applications earlier limited to restoration of diseased and damaged tissue or organs have also found their place in Forensic science investigations as well. More recently use of stem cells have been found to be useful in the research arena allowing the scientists to develop models for studying human biology, pathology and genetics. This article is a general update on stem cells, their properties, sources and current applications in Medicine.

**Key Words:** Stem cells, Embryonic stem cells, Adult stem cells, Mesenchymal stem cells

#### Introduction:

Stem cells are unspecialized cells in the human body that are capable of becoming specialized cells, each with new specialized cell functions. [1] The term stem cell was proposed for scientific use by Russian histologist Alexander Maksimov in 1908. [2] Fluorescent markers can be used to identify stem cells hidden among ordinary adult cells. [3] Human embryonic stem cells are recognized by the marker proteins they express (green). (Fig.1)

**Fig. 1: Human Embryonic Stem Cell (Green)**



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#### Terms Related to Stem Cells: [3]

**Adult Stem Cell:** A stem cell derived from the tissues or organs of an organism after birth (in contrast to embryonic or fetal stem cells).

**Embryonic Stem Cell:** Embryonic stem cells are derived from the inner cell mass up to the stage of blastocysts. These cells can be cultured indefinitely under in vitro conditions that allow proliferation without differentiation, but have the potential of differentiating into any cell of the body.

**Fetal Stem Cell:** a stem cell derived from fetal tissue, including placenta. A distinction is drawn between the fetal germ cells, from which the gametes develop, and fetal somatic cells, from which rest of the organism develops.

**In Vitro and In Vivo:** outside and inside the body; in vitro (literally, in glass) generally means in the laboratory.

**Mesenchymal Stem Cells:** Stem cells present in human bone marrow and umbilical cord that

have been shown to differentiate into a variety of cell types.

**Multipotent:** Multipotent stem cells are those which are capable of giving rise to several different types of specialized cells constituting a specific tissue or organ. For example, blood-forming (hematopoietic) stem cells are single multipotent cells that can produce all cell types that are normal components of the blood.

**Oligopotent:** Stem cells can differentiate into only a few cells, such as lymphoid or myeloid stem cells.

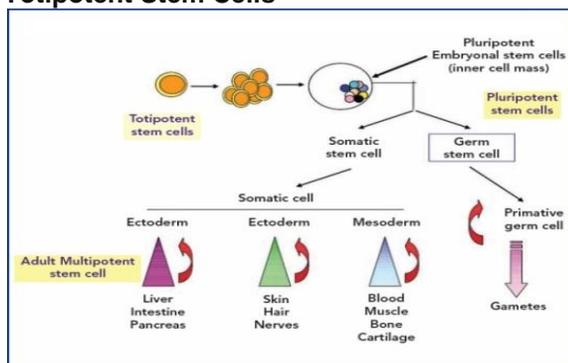
**Pluripotent:** Pluripotent stem cells have the ability to give rise to various types of cells that develop from the three germ layers (mesoderm, endoderm and ectoderm). They have the potential to generate into every cell type in the body, but cannot develop into an embryo on its own.

**Somatic stem cell:** an undifferentiated cell found among differentiated cells in a tissue or organ, which can renew itself and can differentiate to yield the major specialized cell types of the tissue or organ.

**Totipotent:** Capable of giving rise to all tissues and organs, including placenta.

**Unipotent:** Cells can produce only one cell type, their own, but have the property of self-renewal. They have the lowest differentiation potential.

**Fig. 2: Stem Cell Lineage Starting From Totipotent Stem Cells**



**Properties of Stem Cells:**

Stem cells have three general properties:

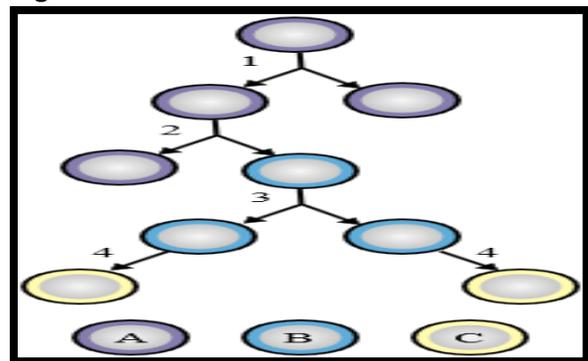
1. They are unspecialized,
2. They are capable of continuous self-renewal,
3. They can give rise to specialized cell types. [4, 5]
4. Stem cells can divide either symmetrically (allowing the increase of stem cell number) or asymmetrically. Asymmetric divisions keep the number of stem cells unaltered and are responsible for the generation of cells with different properties.

These cells can either multiply (progenitors or transit amplifying cells) or be committed to terminal differentiation. Progenitors and transit amplifying cells have a limited lifespan and therefore can only reconstitute a tissue for a short period of time when transplanted. In contrast, stem cells are self-renewing and thus can generate any tissue for a lifetime. This is a key property for a successful therapy and use in Regenerative medicine. [6]

Fig. 3 shows the process of stem cell division and differentiation where A is the Stem cell, B is the Progenitor cell and C is the Differentiated cell. First symmetric division gives rise to two stem cells, second asymmetric division forms one stem and one progenitor cell, third progenitor division gives rise to progenitor cells while the fourth is the terminal differentiation.

5. Adult stem cells are believed to reside in a specific area of each tissue, i.e., a “stem cell niche”. Many types of adult stem cells reside in several mesenchymal tissues, and these cells are collectively referred to as mesenchymal stem cells or multipotent mesenchymal stromal cells (MSCs). [7]

**Fig. 3: Process of Stem Cell Division**



- (A: Stem cell; B: Progenitor cell; C: Differentiated cell  
 .1:Symmetric division-give rise to two stem cells ;  
 2:Asymmetric division- forms one stem and one progenitor cell ;  
 3:Progenitor division: gives rise to progenitor cells ;  
 4:Terminal differentiation)

**Classification of Stem Cells:**

Stem cells can be divided into two categories: **Embryonic and Adult**. [4, 5]

**Embryonic Stem Cells** are totipotent cells capable of differentiation into virtually any cell type, as well as being propagated indefinitely in an undifferentiated state. The use of embryonic stem cells generates several ethical concerns regarding the consumption of blastocysts. This makes postnatal stem cells a more feasible approach for translation into clinical practice. [8]

**Adult Stem Cells:** are not totipotent, and they can be further classified depending on their origin and differentiation potential.

These are further classified as follows:  
[2, 4-11]

- **Embryonic Stem Cells (ECS):** They are derived from the inner cell mass of the blastocyst. They can make all the cell types in the body and can self-renew (copy themselves) almost forever, so large supplies can be made. However, they have ethical issues associated with their use and their rate of differentiation is difficult to control and they might as well form tumors after injection.
- **Embryonic Germ Cells:** Human embryonic germ (EG) cells share many of the characteristics of human ES cells, but differ in significant ways. Human EG cells are derived from the primordial germ cells, which occur in a specific part of the embryo/fetus called the gonadal ridge, and which normally develop into mature gametes (eggs and sperm).

Their isolation requires the generation of embryoid bodies from EG cells, which consists of an unpredictable mix of partially differentiated cell types. The embryoid body-derived cells resulting from this process have high proliferative capacity and gene expression patterns that are representative of multiple cell lineages. Advantages of these cells are that they are non-tumorigenic unlike embryonic stem cells but at the same time their isolation requires destruction of foetuses thus limiting their use till now on mice experiments.

Also, they have less population doubling (70-80 cells doublings) as compared to Embryonic stem cells which can make 200-300 cell doublings per sample.

- **Amniotic Fluid / Fetal Stem Cells:** They are derived from aspirates of amniocentesis during genetic screening without any damage to embryo. They are used to make adipocytes, chondrocytes, osteoblasts, myocytes, endothelial cells, neuron-like and live cells. They are easier to obtain than other embryonic cells and have the same pluripotency as embryonic stem cells but are not tumorigenic. Their therapeutic value remains to be discovered and at times their retrieval can lead to loss of pregnancy and risk to unborn child (0.06% cases).
- **Induced Pluripotent Stem Cells (iPS):** They refer to adult or somatic cells that have been coaxed to behave like embryonic cells. They can make all types of cells in the body.

They could provide patient specific treatment but they can have a carcinogenic / tumorigenic potential. Also, it has not yet been

established how reprogramming works in these cells and their need further comparison with embryonic stem cells.

- **Umbilical Cord Blood Stem Cells:** They are taken from cord blood after the birth of the baby. They can differentiate into several cell types like liver cells, skeletal muscle, neural tissue and immune cells and can be frozen and stored. Their limitations lies in fact that there is still a need to know how to them and a limited number of cells can be procured from umbilical cord. Also, graft reaction/rejection is a possibility. They are only proven of use in blood disorders.
- **Adult Stem Cells/ Tissue Stem Cells / Mesenchymal Stem Cells (MSCs):** They are somatic /postnatal stem cells in several mesenchymal tissues. They are used to make only the types of cells that belong in their own tissue and they find application in transplantation therapy.

Since, they are already partly specialised, it makes more straightforward to obtain the particular specialised cell type required. But, customising these stem cells is not possible and tissues must be 'matched' or come from the patient's own body for use in treatments. Scientists are still learning how to multiply; control and use different types of tissue stem cells.

- **Bone Marrow Mesenchymal Stem Cells (BMMSC):** Their source is bone marrow of adult bones. They can make cells of the skeletal tissues: bone, cartilage, fat and support blood stem cells to make new blood cells. They are easily obtained from the bone marrow of patients used for efficient generation of skeletal tissues in the body. In vitro expansion capability appears to be lower. Donor age is important consideration for clinical efficacy of bone formation.

### **Applications of Stem Cells:**

Knowledge about stem cell science and their potential applications has been accumulating for more than 30 years. Limited types of stem cell therapies are already in use.

The most well-known therapy is the stem cell transplant (a form of a bone marrow transplant) for cancer patients. But it has been only recently that scientists have understood stem cells well enough to consider the possibilities of growing them outside the body for long periods of time. Today stem cells have found applications in varying arena of Medicine ranging from therapeutics to replacement of lost tissues. [12]

Some of the Medical conditions where stem cells have found their use are as follows: [12-19]

- Type 1 Diabetes in Children
- Nervous system diseases like Parkinson's disease and Alzheimer's disease
- Immunological diseases like severe combined immunodeficiency disease (the "bubble boy" disease), Wiskott-Aldrich Syndrome, and the autoimmune disease lupus
- Diseases of bone and cartilage like osteogenesis imperfecta and chondrodysplasias
- Cancer, Cardiac diseases, Spinal cord injury
- Blindness
- Treatment of urological disorders like complicated bowel resection and possible complications, such as adhesions, mucus secretion, metabolic derangements and even malignant transformation
- Age -related functional defects
- Lung diseases like Pulmonary idiopathic arterial hypertension, chronic obstructive pulmonary disease
- Chronic liver injuries
- Digestive disorders like Crohn's disease
- Arthritis, Inflammatory skin diseases and Muscular diseases

Stem cells are also used in the field of Medical research: [12-19]

- Study of human developmental biology
- Models of human disease that are constrained by current animal and cell culture models
- Transplantation and Gene Therapy
- Forensic DNA profiling and Correlation and collection of Ante-mortem and Post-mortem data

**Conclusion:**

A silhouette of the potential use of stem cells for the treatment of human disease is now perceptible. [12] Documentation of complete history of the cells, and their characterization, for use in therapy is essential to safeguard against potential risks of biological therapy.

This is particularly important when human Embryonic/somatic Stem Cells are used for this purpose. [20] The field of Medicine caters to wide range of diseases, disorders and congenital defects along with cases of trauma which may result in single or multi-organ failures.

Current alternative approaches to treatment of these diseases and defects

incorporate the use of stem cells from the patient himself (autologous sources).

This saves the need for the use of organ donations which are always short at the supply end and subsequently improves the patient acceptance of the replaced organ.

More recently use of stem cells have been found to be useful in the research arena allowing the scientists to develop models for studying human biology, pathology and genetics.

The coming years will undoubtedly usher in new developments and technologies that would translate the envisioned therapeutic potential of stem cells to bedside medicine for patients suffering from devastating and debilitating diseases. [21]

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## Review Research Paper

## Medico-Legal Aspects of Dying Declaration in India

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### Abstract

A dying declaration is a statement made by a dying person as to the cause of his death or as to any circumstances of the transaction that resulted in his death. The dying declaration forms the sole basis of conviction if it is free from any kind of doubt and if it has been recorded in the manner as provided under the law. It should inspire full confidence in its truthfulness and correctness. Not recording of dying declaration will result in miscarriage of justice because the victim being generally the only eye-witness in a serious crime, the exclusion of the statement would leave the court without a scrap of evidence. It is for the court to see that dying declaration inspires full confidence as the maker of the dying declaration is not available for cross examination.

This article focus on the medico-legal and ethical aspects encountered while recording dying declaration and its weightage in the court of law.

**Key Words:** Compos mentis, Courts, Dying declaration, Magistrate, Police officer

### Introduction:

A dying declaration is “a statement, written or verbal made by a person as to the cause of his or her death or as to the circumstances of the transaction resulting in his or her death”. [1]

It is based on the principle that dying declarations are made in the extremity when the party is at the point of death, and every hope of this world has gone, when every motive to falsehood is silenced and the mind is induced by the most powerful considerations to speak the truth. A situation so solemn and so awful is considered by the law as creating an obligation equal to that which is imposed by a positive oath administered in a court of justice.

Thus the oath is not administered when dying declaration is recorded. Its admissibility has been explained in the **section 32 (1) of Indian Evidence Act**. [2]

There is a clear distinction between the evaluation of dying declaration under the Indian law and the English law.

The credence and relevancy of dying declaration under the English law is only when the declarant is in hopeless condition and under the expectation of death.

However in Indian law it is not necessary that the deceased at the time of giving the statement should be under the expectation of death and the dying declaration is admissible not only in the case of homicide but also in civil suits. Under the English law, the admissibility of dying declaration is confined to criminal charges of murder or manslaughter only. [3, 4]

### Compos Mentis:

It is essential that the declarant must be in a sound state of mind (**compos mentis**) at the time of making the declaration. The doctor is required to certify that the patient is in a sound mental condition to make a statement before it is recorded. Most suicidal cases will have predisposing medical conditions and psychiatric illness, which may trigger the victim to succumb to death. The doctor who is giving fitness should make a note of his/her predisposing medical illness and state of consciousness during the statement or else its validity remains questionable. [5]

Most important point of consideration is that victim was in a fit condition of mind to give the statement when recording was started and remained in fit condition of mind till the recording of the statement finished. Merely stating that patient was fit will not serve the purpose.

This can be best certified by the doctor who knows best about the condition of the patient. But even in conditions where it was not possible to take fitness from the doctor, dying

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declarations have retained their full sanctity if there are other witnesses to testify that victim was in such a condition of the mind which did not prevent him from making statement.

Medical opinion cannot wipe out the direct testimony of the eyewitness stating that the deceased was in fit and conscious state to make the dying declaration.

Recording of the statement should not be under the influence of anybody or prepared by prompting, tutoring or imagination. Even if any one of these points is proved then dying declaration is not considered valid. If it becomes suspicious then it will need corroboration.

Ideally the treating doctor should give fitness for statement as he knows best about the condition of the patient keeping in mind the pre-existing diseases of the declarant.

He should also record date and time of giving *compos mentis*. Most important point of consideration is that declarant was in a fit state of mind to give the statement when recording was started and remained in fit condition till the recording of the statement finished.

Merely stating that patient was fit will not serve the purpose. But the court has held that even if no certificate was affixed that the declarant was under fit state of mind, the recorded statement still carries validity as the sense of impending death produces in man's mind to make true statement. [5]

### **Recording of Dying Declaration:**

Indian law doesn't provide any prescribed manner, format or procedure for recording dying declaration. But ideally it is recorded in local dialect in narrative form.

It gives less chance of asking leading questions and nothing is being prompted. In question and answer forms, most of the points will be missed and the declarant concentrates only on the questions which he was asked.

Calcutta High Court has ruled that where a dying person is unable to speak and can make only signs to the questions put to him, such questions and signs put together might be regarded as '*verbal statement*' made by a person as to the cause of his death within the meaning of S 32 of Indian Evidence Act, and are therefore admissible in evidence. [1]

The accuracy of such verbal statement and the investigating officer having influence on declarant, recording such verbal statement remains questionable.

### **Who Can Record Dying Declaration?**

The law does not provide direction on who can record a dying declaration. The Supreme Court Bench of justices B S Chauhan and Dipak Misra while reversing an acquittal in a dowry death case ordered by Madhya Pradesh High Court said that any member of the public can record the statement of a dying declaration, but he should make sure that the one making the statement should be conscious and his mental status are normal. [6]

But ideally, magistrate should record the statement in all cases and if not possible at least in allegation cases, so that exact cause of death from the declarant can be elicited on the spot and long waiting trails can be avoided. It cannot be said that a statement recorded by a police officer is always invalid.

The practice of investigating police officer himself recording a dying declaration during the course of investigation is ideally not to be encouraged as he may influence on the declarant statement. Dying declaration should be recorded in the presence of independent witnesses by recording the date and time of starting and ending of statement.

Declarant should not be under the influence of anybody nor prepared by prompting, tutoring or imagination.

Even if any one of these points is proved then dying declaration is not considered valid. Court has held that, if an investigating officer records dying declaration not in local dialect to which the deceased belonged makes the dying declaration suspicious. [5]

But the court did not mention anything on the validity of the recorded declaration where declarant is illiterate and investigating officer not understanding the local language of declarant.

The declaration after being recorded should be read over to the declarant, who should affix his or her signature/ thumb impression to it and if not, then should mention the reason for not taking it in the end of the statement. If the declarant writes his statement himself, the statement should be signed and attested by both the witness and investigating officer. If the declarant becomes unconscious while the statement being recorded, person who is writing it must elicit as much as information and sign it.

When concluded, it should be signed by the person who is recording along with date and time of recording it, and also obtain the signature of the independent witness who can corroborate the content of the document.

Such declaration will be truthful and reliable. If a victim loses consciousness in the middle of recording statement, the evidentiary

value of such incomplete declaration is again questionable. Law does not provide any information on this issue. After recording statement its confidentiality is maintained.

It should be sealed in a proper envelope with a seal and sent to the concerned authorities and a photocopy should be kept in case file, but are usually not followed in routine. If a declarant has made more than one dying declarations and if these are not at variance with each other in essence, they retain their full value. If these declarations are inconsistent, such dying declaration loses their value. [5]

### **Conclusion:**

Great importance is attached to a dying declaration by courts, and if properly recorded keeping in mind all the essential ingredients, can form the basis of conviction.

Verdicts of higher courts on dying declaration shows it is used as corroborative evidence as most of the recorded statements have incomplete details which make it invalid. All the hospitals should have their standard dying

declaration Performa, so that all the statements can be precisely recorded in it.

The purpose behind this is, no single data will be missed and the procedure will be recorded in an ideal way.

Most of the errors in dying declaration are due to lack of knowledge among police officers, which could be minimized by training them. The court has to give proper guidelines for recording dying declaration by clearly defining grey areas. This will improve the validity and reliability of the statement to a far more extent.

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## Compensation and Rehabilitation of Rape Survivors A Constitutional Right

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### Abstract

Supreme Court of India recently observed that no compensation can be adequate nor can it be of any respite for the victim but as the State has failed in protecting such serious violation of a victim's fundamental right, the State is duty bound to provide compensation, which may help in the victim's rehabilitation. The humiliation or the reputation that is snuffed out cannot be recompensed but then monetary compensation will at least provide some solace.

Cases of rape and sexual violence against women and children are increasing throughout India inspite of post Nirbhaya amendments in the Criminal Law in 2013 and enactment of other special statute.

This paper deals with modern approach of penology and victimology which is striking a balance between rights of accused, victim and society. Various statutory provisions and decisions of the Supreme Court have been studied and analysed to highlight the need for compensation and rehabilitation of rape survivors as a constitutional obligation for human rights cause. Factors considered for deciding quantum of compensation, mechanism to fast track for delivery of compensatory relief and long term rehabilitation has been discussed and recommendation for implementation. Critical analysis of Victim Compensation Schemes (VCS) in various states after amendments and insertion of Section 357 A, in Criminal Amendment Acts, 2009 and 2013 was done in this paper.

**Key Words:** Compensation, Rehabilitation, Restitution, Rape, Crime against Women, Sexual Harassment of Women

### Introduction:

Article 21 of the Constitution guarantees 'right to life', which includes protection of life and liberty of all members of the society. 'Vigilantism' as a phenomenon is on a rise in our [Indian] society. This is dangerous and can pose serious threat to the Rule of Law and peace in society.

However, the desire for retribution leading to the victims taking 'law in their own hands' can be effectively checked only where the victims perceive that the criminal justice system will assure them justice and protection.

The need to address cry of victims of crime, for whom the Constitution in its Preamble holds out a guarantee for 'justice' is paramount. The victims have right to get justice, to remedy the harm suffered as a result of crime.

This right is different from and independent of the right to retribution, responsibility of which has been assumed by the State in a society governed by Rule of Law. But if the State fails in discharging this responsibility, the State must still provide a mechanism to ensure that the victim's right to be compensated for his injury is not ignored or defeated.

Right of access to justice under Article 39-A and principle of fair trial mandate right to legal aid to the victim of the crime. It also mandates protection to witnesses, counselling and medical aid to the victims of the bereaved family and in appropriate cases, rehabilitation measures including monetary compensation.

It is a paradox that victim of a road accident gets compensation under no fault theory, but the victim of crime does not get any compensation, except in some cases where the accused is held guilty, which does not happen in a large percentage of cases.

In **S. S. Ahluwalia vs. UOI** (2001) 4 SCC 452, Hon'ble Supreme Court held that in expanded meaning attributed to Article 21 of the Constitution, where the State fails to protect the life of the people, it could not escape the liability to pay compensation to the victims.

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### Global Scenario:

**Scenario in UK:**

Set up in 1964 the Criminal Injuries Compensation Authority is responsible for administering the Criminal Injuries Compensation Scheme throughout England, Wales and Scotland.

From 1996 each injury was awarded a specific fixed compensation ranging from 1000 UK Pounds to 250000 UK Pounds. Apart from these; the applicants are also eligible to get compensation for earnings and special expenses for up to UK 250000 Pounds. [5]

The Ministry of Justice now funds the entire scheme; it was formerly funded by the Home Office. Victims as well as their relatives/dependants are entitled for compensation for personal injuries as well fatal injuries. Compensation is awarded to cover costs of medical expenses, funeral expenses, and loss of earnings, mental stress and trauma, medical expenses for special care and also for loss of reputation.

While arriving at the decision to award compensation the Authority looks into the previous criminal record of the applicant, the relevant police reports, and medical reports among other criteria. A right to appeal against the decision of the Authority is also provided. [5]

**Scenario in Canada:**

Several provinces in Canada have enacted laws ensuring victims of crimes are compensated. The Ontario Compensation for Victims of Crime Act, 1990 provides for the establishment of a Criminal Injuries Compensation Board. In its terms, victims their dependants or by persons looking after them can claim compensation.

Heads of compensation cover expenses actually and reasonably incurred or to be incurred as a result of the victim's injury or death; pecuniary loss incurred by the victim as a result of total or partial disability affecting the victim's capacity for work; pecuniary loss incurred by dependants as a result of the victim's death; pain and suffering; support of a child born as a result of rape and other pecuniary loss resulting from the victim's injury and any expense that, in the opinion of the Board, it is reasonable to incur.

Apart from these, the Board is also entitled to award compensation in lieu of any common law rights accruing to the victim. Interestingly, under this enactment, compensation can be awarded irrespective of the *factum* of conviction, thereby signalling the change from a deterrent/retributive model to a rehabilitative one. The compensation can be

administered through a lump sum payment or instalments or under directions of the Board. [5]

**Scenario in USA and Australia:**

A similar regime is prevalent though state legislations in the United States and Australia as well, where several states have enacted legislations and through their respective budget allocations ensured that victims of crimes are compensated accordingly.

In Western Australia for example, under the *Criminal Injuries Compensation Act 2003*, compensation can be sought for an incident reported to the police regardless of whether a person has been identified, charged or convicted of the offence. Compensation can be awarded for suffering bodily harm, mental or nervous shock, or pregnancy, resulting from an offence.

Compensation may cover: pain and suffering; *loss of enjoyment of life*; loss of income; medical expenses and other incidental expenses, such as travel for medical treatment or damage of clothing. [5]

**Indian Scenario:**

**Compensation and Constitution:**

Rape involves violation of fundamental rights under Article 21 of the Indian Constitution. Compensation for the violation of fundamental rights is given by way of penalizing the State for violating the fundamental rights guaranteed by the Constitution of India and for the breach of its public law duty. This compensation is in the nature of 'exemplary damages' awarded against the wrongdoer for the breach of a public law duty. This is apart from and in addition to compensation granted for the loss or injury under the law of torts.

**"It is a weakness of our jurisprudence that the victims of the crime, and the distress of the dependants of the prisoner, do not attract the attention of the law. Indeed, victim reparation is still the vanishing point of our criminal law. This is a deficiency in the system which must be rectified by the Legislature. We can only draw attention in this matter." - Justice Krishna Ayyar, 1980 [Source: "Rattan Singh vs. State of Punjab" AIR 1980 Supreme Court 84]**

Thus, modern approach of victimology acknowledge that a crime victim has right to be adequately compensated, rehabilitated and repaired irrespective of identification and prosecution of offender and the payment of such compensation should be made by state.

**Compensatory Justice:**

Criminal jurisprudence has moved beyond the traditional domains of retributive and deterrent values. The shift is increasingly

towards victim centric compensatory models of justice. Many societies have forged mechanisms to address these issues.

The idea underlying **compensatory justice** is not merely to rehabilitate the victim, but also leads to a *regime* where societal values in seeing such crimes as aberrations, entitling the victim to some form of compensation due to the stark intensity of the crime.

Therefore, the concept of a publicly funded and administered body to compensate victims of violent crime has been in practice in many countries across the world for quite a while. Compensation is granted not merely when the State is at fault but also when the crime is violent and serious; and thus the role of the State assumes the welfare hue.

### **Scheme drafted by the NCW:**

In India, pursuant to the Supreme Court directive in the Delhi Domestic Working Women's Forum case [6], the National Commission for Women drafted the Scheme for the Rehabilitation for Victims of Rape, 2005.

The scheme provided for the setting up of Criminal Injuries and Rehabilitation Board at the District and State level and a National Criminal Injuries and Rehabilitation Board.

The scheme gives details about the constitution, functions and the budgetary allocation of the Authorities constituted under it.

It provides for compensating rape victims, irrespective of whether the perpetrator has been brought to justice. It provides for legal aid and other measures that will help such victims. However, there is nothing suggestive of any further thinking on these issues, or executive will to take the thought further.

SC in **Bodhtswa case, 1996, recognized the right of the victim for compensation:** Court referred previous judgment of **Delhi Domestic Working Women's Forum, case of 1994. This decision recognises the right of the victim for compensation** by providing that it shall be awarded by the Court on conviction of the offender subject to **the finalisation of Scheme by the Central Government. If the Court trying an offence of rape has jurisdiction to award the compensation at the final stage**, there is no reason to deny to the Court the right to award interim compensation which should also be provided in the Scheme.

On the basis of principles set out in the aforesaid decision in **Delhi Domestic Working Women's Forum**, the jurisdiction to pay interim compensation shall be treated to be part of the overall jurisdiction of the Courts trying the

offences of rape which, as pointed out above is an offence against basic human rights

### **Justifications for Compensation:**

Various justifications for compensation have been used, such as:

1. Benefit to the victims,
2. Symbolic social recognition for the victim's suffering,
3. Deterrent effects on the offender as also the reformatory effects on the offender as the **paying of compensation has an "intrinsic moral value of its own"**. [5]

### **SC Views on Compensation: Need for long-term Rehabilitation:**

"Survivors of rape should be compensated by giving them half of the property of the rapist(s) as compensation in order to rehabilitate them in Society. - **P. Sathasivam, CJI, 23<sup>rd</sup> Jan 2014** Court further added that "Merely providing interim measures for their stay may protect them for time being but long-term rehabilitation is needed as they (Family Members) are all material witnesses and likely to be socially ostracized.- **P. Sathasivam, CJI, 23<sup>rd</sup> Jan 2014**

### **Mandatory Duty of the Court:**

In "**Ankush Shivaji Gaikwad vs. State of Maharashtra**", 2013 [7] the Supreme Court emphasized that victim is not to be forgotten in criminal justice system and Section 357 Cr.P.C. should be read as imposing mandatory duty on the Court to apply its mind to the question of awarding compensation in every case.

### **Interim Compensation and Vicarious Liability:**

In addition, compensation may be given for mental harassment, pain, suffering, and for loss of earnings. The State is also liable for fundamental rights violations committed by its servants, and should pay compensation for such injuries. In cases of SHW, women may seek compensation for the violation of their fundamental rights.

### **Vicarious Liability of Government:**

It was held that the Government will be vicariously liable for the tortuous act of its employees. It was on the basis of the above facts that the High Court had awarded a sum of Rs.10 lacs as compensation for Smt. Hanuffa Khatoon as the High Court was of the opinion that the rape was committed at the building (Rail Yatri Niwas) belonging to the Railways and was perpetrated by the Railway employees.

Many states are yet to finalise a scheme for compensation of victims of crime, including violence against women, nearly four years after

the Centre notified the provision for providing relief by amending the Cr.P.C. After the notification of a new section in the Cr.P.C. in December 2009, the Union Home Ministry had initiated the process of making states notify the Victim Compensation Scheme in September 2010 but **only four states came up with a scheme within one year. Sikkim was the first to launch a scheme in June 2011, while Karnataka notified it in February, 2012.**

According to senior Home Ministry official the seven states yet to fall in line are Jammu and Kashmir, Kerala, Tamil Nadu, Madhya Pradesh, Maharashtra, Nagaland and Uttarakhand. The Ministry had conducted seven co-ordination meetings through video conferencing with Home Secretaries of these states since May 2011.

“The ministry is overseeing the notification and implementation of Victim Compensation Scheme in states and Union Territories,” the official said. As of now, 17 states and seven Union Territories have notified the scheme while four are on the verge of doing it. The Ministry has **received the draft notifications** from Andhra Pradesh, Punjab, Uttar Pradesh and Meghalaya.

The official said the ministry would be asking the seven remaining states to speed up the process. The provision came into being after the CrPC was amended by adding a new Section 357A which dealt with the modalities for compensating victims of crime.

According to an analysis of the notifications issued, **Goa has fixed the maximum compensation for rape at Rs ten lakh**, followed by seven Union Territories at Rs 3 lakh. The Sikkim State government has framed a scheme to provide compensation to victims who have suffered loss or injury as a result of a crime. Called the **“Sikkim Compensation to Victims or his Dependents Schemes”**, this was instituted in **mid-2011** and not only provides for compensating victims but also their dependents according to the nature of loss or injury suffered. The compensation amount ranges from a minimum of Rs. 20000 [for simple loss or injury to a child victim], to Rs.2 lakh as compensation for loss of life due to crime. The scheme has been framed under the Code of Criminal Procedure.

### **Status of Victim Compensation Scheme in India:**

#### **Scheme in place:**

1. Rajasthan (Rs.2.00 Lakhs)
2. Assam (Rs.1.75 Lakhs)
3. West Bengal (Rs.20000 to 30000)

4. Union Territories (Rs.3.00 lakhs)
5. Goa (Rs.10 Lakhs)
6. Haryana (Rs.3.00 Lakhs)
7. Delhi (Rs.3.00 to Rs.5.00 Lakhs)

#### **Yet to take initiative for drafting the Scheme:**

1. Jammu and Kashmir,
2. Kerala,
3. Tamil Nadu,
4. Madhya Pradesh,
5. Maharashtra,
6. Nagaland
7. Uttarakhand

Delhi is now after Delhi High Court intervention and amendment proposed in 2014 has enhanced compensation up to Rs. 5 Lakh.

#### **Scenario in State of Rajasthan, 2011:**

In an appeal arises from a decision of the Rajasthan High Court in a PIL filed by a Legislator and social activist complaining of arbitrary and discriminatory disbursement of relief under the Chief Minister's Relief Fund (for short 'Relief fund') under the Rajasthan Chief Minister's Relief Fund Rules, 1999 (for short, 'the Relief Fund Rules'). [Para 2]

The respondent alleged that during the period January 2004 to August 2005, challans/charge-sheets were filed in 392 cases relating to rape of minor girls; that out of them, 377 minor girls, did not get any relief or assistance from the Relief Fund, 13 were granted relief ranging from Rs.10000 to 50000. One victim (minor 'K') was given Rs.395000 on 11.8.2004 and another victim (minor 'S') was given Rs.500000 on 25.6.2005. [Para 2]

Prayer was made for a direction to the appellants to give to all rape victims, who had not been granted any monetary relief or who had been granted a negligibly small relief, **monetary relief of Rs.5 lakhs** and failure to give monetary relief, or failure to give a uniform monetary help, to all victims of rape from the **Relief Fund** is illegal, arbitrary and unconstitutional.

#### **Scenario in Haryana:**

In exercise of the powers conferred by section 357-A Cr.P.C. 1973 (Act 2 of 1974), the Governor of Haryana in co-ordination with the Central Government framed the Haryana Victim Compensation Scheme, 2013 for providing funds for the purpose of compensation to the victim or his/her dependents who have suffered loss or injury as a result of the crime and who require rehabilitation The Scheme was notified Vide Notification dated the 3rd April, 2013, No.S.C. 41/C.A. 2/1974/S.357-A/2013.

### Scenario in Delhi:

The Delhi Victim Compensation Scheme, 2011 and (Amendment) 2014 has made provisions related to following issues:

- Role of various authorities
- Delhi State Legal Service Authority
- Role of Police
- Role of Divisional Commissioner
- Role of High Court
- Role of Victim

Delhi High Court has shown serious concern related to compensation and rehabilitation of rape victims. Following issues need special consideration:

- Man Power Shortage
- Infrastructure and Equipment Shortage
- Role of Forensic Sciences (including Forensic Medicine) in the criminal investigations process and the justice dispensation system
- Issue of Compensation

Terming the **delay in paying compensation to victims of sexual violence as "unacceptable"**, the Delhi high court ordered payment of nearly **Rs.1.7 crore** lying with the government. On 16.04.2014, a **Division Bench of Acting Chief Justice B D Ahmed and Justice S Mridul** asked the Delhi government **to ensure that the money is disbursed to the 221 survivors within two weeks**, after the issue is decided by authorities including the **Delhi State Legal Services Authority (DSLISA)**.

The court was upset that despite its clear orders, **the state government had delayed in compensating the victims**. It warned that if the government doesn't fall in line, **it will be constrained to treat the failure as contempt of court**. The Delhi High Court also **pulled up DSLISA for delaying the release of compensation, and for taking long in deciding prima facie if the case is genuine**.

HC also issued other key directions while hearing a case it **initiated suo moto after the Nirbhaya incident**. The court is monitoring steps to improve the overall safety of women in Delhi, including compensation to survivors of sexual violence such as rape, setting up more CFSL facilities, and induction of more women policemen.

### Lengthy Process, Little Action:

- **Only 483 of 3000 cases referred for relief in 2 years**; Of the 483 cases, compensation was awarded in 304 cases till April 2014
- **Fund Disbursal Slow**
- **Why the delay?**

- **Lack of awareness** among **survivors, police** and **lawyers** about **survivor's right to be compensated**
- Involvement of **multiple agencies**-police, Delhi State Legal Service Authority (DSLISA)
- **Divisional Commissioner**-who often **blame each other for delay** and **files keep shuttling among agencies**
- Most of the times, victims don't get compensation as **police fail to forward cases to DSLISA**, the sanctioning body.
- Files get stuck with divisional commissioner who is responsible for disbursing funds
- In past two and a half years, Govt. has used only Rs.2.06 crore of the allotted Rs.15Crore
- **Step 1:** Police after FIR has to inform (recommend) to the DSLISA for award of Compensation
- **Step 2:** DSLISA has to hold an Inquiry to see the suitability of case for award of Compensation and submit recommendation to the Divisional Commissioner
- **Step 3:** Divisional Commissioner has to disburse the Compensation Awarded to Rape Victim Survivors/Legal Kins
- **Step 4:** Victim and/or her representative can approach the High Court for award of Compensation (within 3 years of incident)

### Limitations:

- DSLISA can't award compensation on its own, recommendation by police a must
- Courts can give compensation or refer it to DSLISA only if survivor or family moves an application before it
- If the offender is absconding or unidentified, survivor has to claim compensation within 3 years of the incident

### Solutions:

- Creating awareness and sensitizing police, survivors and lawyers
- Notification of the amended scheme which aims at expediting the process
- Make it a one-window facility
- DSLISA should decide within a month if a case is fit for compensation
- Compliance of a recent Delhi High Court order according to which Divisional Commissioner should not take more than two weeks to disburse compensation

### Making the Scheme Better:

- Amended Delhi Victim's Compensation Scheme aims at expediting the process of providing compensation to rape and other assault victims
- Amended scheme will help in rehabilitating all sexual victims

- Victims of rape will be categorized under Sub-categories of gang rape and unnatural sexual assault
- Victim of unnatural sexual assault can get Rs.2-5 lakh

### **Enhanced Compensation and Speedy Disbursement**

- Gang rape victims can get a compensation of Rs.3-7 lakh
- Maximum compensation for loss of life up from Rs.5 lakh to Rs.10 lakh
- Maximum compensation for rape increased from Rs.3 lakh to Rs.5 lakh
- Relief amount for other injuries also up by Rs.1-2 lakh
- Victims of acid attacks and burning will be compensated, depending upon nature of injuries.
- Victims of acid attacks and burning will be compensated, depending upon nature of injuries.

### **Scenario in West Bengal:**

In exercise of the powers conferred by Section 357A by the Code of Criminal Procedure 1973 (2 of 1974) the Governor is pleased to declare the West Bengal Victim Compensation Scheme, 2012 for providing compensation to those victims of crimes or his/her dependents who have suffered loss or injury and who require rehabilitation vide notification **No.5299-PL, Dated 1<sup>st</sup> November, 2012, the Kolkata Gazette Notification dated 8<sup>th</sup> November 2012**, Registered No.WB/SC-247, No.WB (Part-I)/2012/SAR-408.

The West Bengal Government has announced that the state will provide monetary compensation to women who are raped. In a decision taken on Thursday, it said that minors, who are raped, will be given compensation of Rs. 30,000 and adult women will be given Rs. 20000. The state cabinet approved a compensation scheme for victims of criminal cases and natural disasters.

Compensation will also be given in case of deaths and injury causing handicap. The decision to provide compensation will be taken by committees headed by district magistrates.

### **Scenario in U.P.:**

The Scheduled Caste and Scheduled Tribe (Prevention of Atrocities) Act, enacted in 1989, provides monetary compensation to victims of rape. In Uttar Pradesh, a law is in existence since the 1970s, gives compensation of Rs. 5000 if the woman raped is from a scheduled caste or tribe.

### **Scenario in Punjab:**

Victim Compensation Scheme of Punjab Government virtually non-functional, as no funds released by the Government to the District Legal Services Authority in Punjab- the Courts also do not appear to be sensitized towards this Scheme. RTI information procured from the various District Legal Services Authorities in Punjab reveals that these District Legal Services Authorities have not received any grant from the State Government.

The information received from Secretaries of District Legal Services Authorities of Ludhiana, Faridkot, Kapurthala, Fatehgarh Sahib, Barnala, Sri Muktsar Sahib, Bathinda and Fazilka have stated in their reply to RTI applications that these Authorities have not given any compensation for the loss of life/murder/Rape/loss of limb etc. to the victim under the Compensation Scheme, 2011, later on modified vide notification dated 17.6.2013.

### **Domestic Violence against Women Act, 2005 reads Compensation Order:**

“Section 22: In addition to other reliefs as may be granted under this Act, the Magistrate may on an application being made by the aggrieved person, pass an order directing the respondent to pay compensation and damages for the injuries including mental torture and emotional distress, caused by the act of domestic violence committed by that respondent.

### **Need for creation of ‘Victim Compensation Fund’**

The ‘Victim Compensation Fund’ shall comprise the following:

1. Budgetary allocation for which necessary provisions shall be made in the Annual Budget by the (Concerned) Government.
2. Receipt of amount of fines imposed under section 357 Cr.P.C., and ordered to be deposited by the courts in the Victim Compensation Fund
3. Amount of compensation recovered from the wrongdoer/accused under clause 9 of the scheme.
4. Donations/contributions from International /National/ Philanthropist/ Charitable Institutions /Organizations and Individuals.

Only few States has made these provisions for creation of “Victim Compensation Fund”. State of Haryana and Delhi are few examples in this regard.

### **Compensation & Rehabilitation Provisions in POCSA, 2012 [15]:**

In appropriate cases, the Special Court may, in addition to the punishment, **direct**

**payment of such compensation** as may be prescribed to the child **for any physical or mental trauma** caused to him or **for immediate rehabilitation of such child**. [Chapter VIII, 33 (8)] [1]

### **Rulemaking Power of Central Government:**

The **Central Government** may, by notification in the Official Gazette, make rules for carrying out the purpose of this Act. [Chapter IX, 45 (1)] [1]

Provisions further emphasize that in particular, and without prejudice to the generality of the foregoing powers, such rules may provide for all or any of the following matters, namely:

- a. The qualifications and experience of , and the fees payable to, a translator or an interpreter; a special educator or any person familiar with the manner of communication of the child or an expert in that field, under sub-section (4) of section 19; sub-sections (2) and (3) of section 26 and section 38; [Chapter IX, 45 (2) (a)] [1]
- b. Care and protection and emergency medical treatment of the child under sub-section (5) section 19; [Chapter IX, 45 (2) (b)] [1]
- c. The payment of compensation under sub-section (8) of section 33; [Chapter IX, 45 (2) (c)] [1]
- d. The manner of periodic monitoring of the provisions of the Act under sub-section (1) of section 44. [Chapter IX, 45 (2) (d)] [1]

### **Provisions of Compensation in the SHW at Workplace Act, 2013 [16]:**

On the completion of an inquiry under this Act, the Internal Committee or the Local Committee, as the case may be, shall provide a report of its findings to the employer, or as the case may be, the District Officer within a period of ten days from the date of completion of the inquiry and such report be made available to the concerned parties. [Para 13 (1)] [2]

Where the Internal Committee or the Local Committee, as the case may be, arrives at the conclusion that the allegation against the respondent has been proved, it shall recommend to the employer or the District Officer, as the case may be:

- To take action for sexual harassment as a misconduct in accordance with the provisions of the service rules applicable to the respondent or where no such service rules have been made, in such manner as may be prescribed; [Para 13 (3)(i)] [2]
- To deduct, notwithstanding anything in the service rules applicable to the respondent, from the salary or wages of the respondent

such sum as it may determine, in accordance with the provisions of section 15; [Para 13 (3)(ii)] [2]

Provided that in case the employer is unable to make such deduction from the salary of the respondent due to his being absent from duty or cessation of employment it may direct to the respondent to pay such sum to the aggrieved woman;

Provided further that in case the respondent fails to pay the sum referred to in clause (ii), the Internal Committee or, the Local Committee as the case may be, may forward the order for recovery of the sum as an arrear of land revenue to the concerned District Officer.

The employer or the District Officer shall act upon the recommendation within sixty days of its receipt by him. [Para 13 (4)] [2]

### **Determination of Compensation:**

For the purpose of determining the sums to be paid to the aggrieved woman under clause (ii) of sub-section 13, the Internal Committee or the Local Committee, as the case may be, shall have regard to:

- (a) The mental trauma, pain, suffering and emotional distress caused to the aggrieved woman;
- (b) The loss in the career opportunity due to the incident of sexual harassment;
- (c) Medical expenses incurred by the victim for physical or psychiatric treatment;
- (d) The income and financial status of the respondent;
- (e) Feasibility of such payment in lump sum or in instalments. [Para 15 (a, b, c, d, e)] [2]

### **Criminal Law Amendment Act, 2013 [17]:**

**376D.** Where a woman is raped by **one or more persons constituting a group** or **acting in furtherance of a common intention**, each of those persons shall be deemed to have committed the offence of rape and shall be punished with **rigorous imprisonment** for a term which shall **not be less than twenty years**, but which **may extend to life** which shall **mean imprisonment for the remainder of that person's natural life**, and **with fine**:

**Provided that such fine shall be just and reasonable to meet the medical expenses and rehabilitation of the victim:**

**Provided further that any fine imposed under this section shall be paid to the victim**

### **Provision of Free Treatment:**

After section 357A of the Code of Criminal Procedure, the following sections shall be inserted, namely:

"357B: The **compensation payable by the State Government under section 357A shall be in addition to the payment of fine to the victim under section 326A or section 376D of the Indian Penal Code, 45 of 1860. [Para 23] [3]**

357C. All hospitals, public or private, whether run by the Central Government, the State Government, local bodies or any other person, shall immediately, provide the **first-aid or medical treatment, free of cost, to the victims of any offence** covered under section 326A, 376, 376A, 376B, 376C, 376D or section 376E of the Indian Penal Code, 45 of 1860 and **shall immediately inform the police of such incident.**" [Para 23] [3]

### Summary and Conclusions:

It appears that Courts do not appear to be adequately sensitized towards the Scheme, due to which cases in which compensation has been awarded are very few.

From the above line of cases, it becomes very clear, that, a sentence of imprisonment can be granted for default in payment of compensation awarded under Section 357(3) of Cr.PC. **The whole purpose of the provision is to accommodate the interests of the victims in the criminal justice system.** Sometimes the situation becomes such that there is no purpose is served by keeping a person behind bars. Instead directing the accused to pay an amount of compensation to the victim or affected party **can ensure delivery of total justice.**

Therefore, this grant of compensation is sometimes in lieu of sending a person behind bars or in addition to a very light sentence of imprisonment. Hence on default of payment of this compensation, there must be **a just recourse.** Not imposing a sentence of imprisonment would mean allowing the accused to get away without paying the compensation and imposing another fine would be impractical as it would mean **imposing a fine upon another fine and therefore would not ensure proper enforcement of the order of compensation.**

While passing an order under Section 357(3), it is imperative for the courts **to look at the ability and the capacity of the accused to pay the same amount** as has been laid down by the cases above, **otherwise the very purpose of granting an order of compensation would stand defeated.** [Para 27] Compensation and Rehabilitation of survivors of rape is need of the hour in view of

the violation of fundamental rights of the victim under Article 21 of the Indian Constitution. Court can play a great role in delivery of justice by awarding compensation and directions for rehabilitation of the victims.

Ends of justice can be served if all the stakeholders do their duty in letter and spirit of the Indian Constitution and other relevant Statutory provisions related to compensation and rehabilitation of victims of crime especially victim of rape. There is need to create awareness and education about these rights among all the sections of the society by organizing CMEs, Seminar and Conferences.

In the words of *Sawami Sivananda* "Every effect has a cause. Every consequence has an antecedent. There must be perfect balance between the cause and effect, between the antecedent and consequence. The law of compensation keeps up the balance, and establishes peace, concord, equilibrium, harmony and justice in Nature."

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17. The Criminal Law (Amendment) Act, 2013 (Act No. 13 of 2013 [2<sup>nd</sup> April, 2013] It shall be deemed to have come into force on the 3<sup>rd</sup> day of February, 2013.

## Review Research Paper

# Anaesthetic Deaths: A Medico-Legal Scenario

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### Abstract

Anesthetic practice is always at high risk in medical profession. Most of the time there is only a little interaction between the patient and the anaesthesiologist and people are not much aware about the anaesthesia & the risks involved. In perioperative deaths, anesthetists are also blamed and patient or his relatives react in a hostile manner towards the anaesthesiologist and many a times they seek redressal in a police station/courts of law. To avoid negligence anaesthetist must do pre-anesthetic checkup, take informed consent, check the equipment/monitors/drugs, attends the patient till he comes out from the effect of anaesthesia. Improved monitoring especially the greater use of pulse oxymetry and capnography has undoubtedly decreased the complications. If death occurs, discussion between Forensic pathologist, surgeon and anesthetist is the right solution for investigation of such deaths which may more fruitful than a bare autopsy.

**Key Words:** Anesthetic death, Pre-anaesthetic checkup, Medical Negligence, Cardiac arrest

### Introduction:

Anaesthetic death is defined as death occurring within 24 hours of administration of anaesthesia due to causes related to anaesthesia. However, death may occur even afterwards due to its complications. [1,2]

The incidence of actual anaesthetic deaths is quite low in comparison to surgical deaths. In a survey conducted by Lunn & Mushin found that where 1 in 166 surgical patients die within 6 days, only 1 in 10,000 is actually due to the effects of the anesthesia alone. The survey also showed that the causes have not changed significantly during the last 30 years in spite of marked changes in anaesthetic technology. [3, 4] In another study of peri-operative deaths, the most common (56%) cause of death is disease/injury for which the operation was done, which is followed by shock & inevitable risks of the operation (30%).

The risk and complication of anaesthesia contributes only 08% of total deaths of which overdose, maladministration, bad choice of anesthetic agent & equipment failure are the important reason behind such casualties.[5, 6]

Anaesthetic death is one of the most stressful events as experienced by anaesthetists who may vary from person to person or even from case to case. For some it may be the emotional trauma and for others it may be the impact on their professional functioning.

This article explores the ways by which we can learn to identify and anticipate the causes of peri-operative deaths and if it is inevitable how to defend himself. It also outlines the medico-legal aspects including autopsy protocol and current litigations relevant to the anaesthetists in relation to a perioperative death.

### Causes of Anaesthetic Deaths: [4, 6, 7]

1. **Death due to Anaesthetic Agent:** Hypersensitivity or adverse effects of anaesthetic agents causing cardiac arrhythmia/arrest or respiratory failure due to mayo-neuronal blockage and rarely by liver necrosis and malignant hyperthermia as in cases of halothane administration.
2. **Death due to Anaesthetists (Human Error):** Improper techniques & equipments, lack of experience, gross negligence in precautions, careless in method, accidents during intubation/bronchoscopy, over dose of drugs and improper pre-anaesthetic medication.
3. **Deaths due to Equipment Failure:** Malfunction of apparatus, kinked pipes, cross tubes, explosion etc.
4. **Deaths due to Functional Problems:** Vagal inhibition, obstruction to glottis, cardiac arrhythmia, hypotension, sluggish reflex action as in unconscious patients.

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5. **Death due to factors other than Anaesthesia;** Disease/injury for which anaesthesia and operation is being done, surgical mishapening (unintentional cutting/tearing of large blood vessels), postoperative events (pneumothorax, pulmonary embolism, aspiration), physical condition of patient (old age/diabetes/hypertension), inadequate communication between staff and unforeseeable conditions e.g. haemoglobinopathies (sickle cell anemia), occult coronary artery disease, transfusion hepatitis, and AIDS.

This all leads to **cardiac arrest or asphyxia due to respiratory failure.** Cardiac arrest is the commonest, occurs due to oxygen depletion or carbon dioxide accumulation due to fault/failure in technique. Most of cardiac arrest occur under relative light anaesthesia and therefore tend to occur at either the start of operation or at the end of surgical procedure.

Asphyxia of myocardium, overdose of anaesthetic agents & reflex vagal stimulation are the three most common patho-physiological events by which cardiac arrest become supervenes.

Respiratory failure usually occurs during and/or after the anaesthesia/surgical procedure due to overdose of premedication drugs (Barbiturates, Benzodiazepines, morphine etc.) or anaesthetic agents, administration of opiates during postoperative period, laryngospasm/bronchospasm of varying reasons, hypoventilation and subsequent hypoxia due to hyperventilation by anesthetic agents.

**Medico-legal Aspects related to Anaesthetic Deaths and Malpractice:**

**Doctor's duty in Anaesthetic Practices:** Anaesthetist must attend the patient a day before surgery, do Pre Anaesthetic Check-up and investigate the patient for any alarming situations if required. He must record everything on the case sheet.

1. **Informed Consent:** Before administration of anaesthesia, the Anaesthetist must take the consent in writing from the patient or his legal guardian/parents if he/she is unconscious or below 18 years of age. Before consent, anaesthetist must explain the procedure of anaesthesia, type & nature of anaesthetic agent, its side effects, complications & risks involved in the procedure clearly to the patient in local language, so that he can understand the nature and consequences of giving consent.

It is the ultimate right of the patient to accept or refuse the medication. Nothing should be decided against the patient's will.

2. **Reasonable Degree of Skill & Care:** The duty of Anaesthetist starts when the patient, his surgeon or nursing home/hospital approaches the anaesthetist and he accepts the work. It is the duty of the anaesthetist to attend the patient, assess him and optimize the patient with necessary investigations and treatment.

He must apply reasonable degree of skill and care in the selection of anaesthetic agent and the procedure. It is the duty of the hospital management to provide adequate and trained hands. They must provide all necessary latest functioning equipment. Trainee should be regularly supervised by the seniors. Anaesthetic must adhere to standard practice and follow the protocols of the institution.

Any act or omission by anaesthetist causing bodily injury, disease or death of the patient is negligence for which he/she can be sued in the civil court or in consumer forum for compensation or can be punished under Sec. 304-A IPC in criminal court. Negligence against an anaesthetist can be proved when injury has occurred only from anaesthetic procedures due to deviation from the standard protocol.

**The burden of proving** that the anaesthesiologist was negligent falls on the complainant. Court allows both parties to prove their case by means of producing evidence. This may include records, books, journals or expert witnesses.

But when the negligence is gross and obvious to even a lay man, it comes under the doctrine of *res ipsa loquitur*, for example, when pre-anaesthetic evaluation is not done before giving anaesthesia, unexplained cardiac arrest during anaesthesia leading to death is negligence. [8] Where an explosion occurred during the course of administering anaesthetic to the patient when the technique had been frequently been used without any mishap. [9]

Here the burden of proof does not lie on the plaintiff but defendant physician has to prove that the accident did not occur due to his negligence. [10] In a case patient developed meningitis after spinal anaesthesia, court found that anaesthetic agent was not contaminated and the staff had taken the usual precautions to disinfect themselves before the operation, acquitted anaesthetist and passed sentence against hospital for some fault in sterilization procedure. [11]

3. **Precaution & Defense:** Anaesthetist should update his professional knowledge all the

time, keep full and accurate records of his patients. He must check the instruments prior to use do the sensitivity test for a drug known to cause anaphylactic reactions and do not leave patient till recovered from effect of anaesthesia.

When an anaesthetist is sued for negligence, he can defend himself by proving that he has applied reasonable degree of skill & care during anaesthetic procedures. A doctor is not negligent if he is acting in accordance with a practice accepted as PROPER by responsible body of medical men skilled in that art even though other doctors adapt a different practice". This is the Bolam's Law. [12]

The damage to the patient may also occur due to error in judgment, therapeutic misadventure, medical mal-occurrence, unforeseeable harm or when a new disease appears but doctor is not liable as long as he applied a reasonable standard of skill and care.

### Investigation and Examination of Anesthetic Death:

As per Sec.39 CrPC all deaths occurring in due course of surgery and anaesthesia should be treated as unnatural deaths and should be reported to the police.

Failing of which the doctor can be punished under **Section 202 IPC** for intentional omission to give information of offence to police by the person who is bound to inform.

In investigation and examination of anaesthetic death a Forensic person should take several factors into consideration. The American Society of Anesthesiologists (ASA) has devised a classification system to grade the preoperative condition of the patient. [4]

- **ASA1:** Those with no pre-existing serious disease and have a minor, localized condition requiring surgery e.g. fit man with inguinal hernia.
- **ASA2:** Those with a serious disease but have no limitation of their activities (the condition may be pre-existing or the result of the condition requiring surgery), e.g. mild angina, mild hypertension, chronic bronchitis.
- **ASA3:** Those with a serious disease causing some limitation of their activities, e.g. moderate angina, previous myocardial infarction (heart attack), severe chronic bronchitis.
- **ASA4:** Those with a serious disease that limits their activities and is already a threat to life, e.g. severe angina at rest, acute myocarditis, chronic bronchitis with respiratory failure, perforated peptic ulcer.

- **ASA5:** Moribund patient with little chance of survival, submitted to surgery as a last resort, e.g. ruptured aortic aneurysm, severe trauma, massive pulmonary embolism, severe peritonitis due to perforated colon.

Class 1 - 3 requires full medico-legal investigation. Class 4 and 5, where death is anticipated, there is less need for full investigation.

### Autopsy Examination & Procedure: [6, 7, 13]

A number of difficulties are encountered during the examination and interpretation of anaesthetic deaths such as naked eye changes may be minimal or absent in autopsy examination, the findings of surgery and anaesthesia may superimposed on pre-existing natural disease or trauma and no communication between forensic person conducting autopsy with concerned anaesthetists and surgeons, especially in Indian scenario.

It is advised that:

1. Autopsy is performed without delay. Medical intervention should be left intact by medical & nursing staff.
2. Relevant clinical case notes, x-rays, laboratory tests etc. should be studied prior to autopsy.
3. Professional first hand discussions with anaesthetist and surgeon involved are encouraged. They should be invited to attend autopsy and to discuss the findings politely.
4. For further investigations relative specimens e.g. toxicology, histology, biochemistry, and microbiology should be retained appropriately.

Surgical mistakes are gross and anatomical and hence are observable at the postmortem, while Anaesthetic mistakes being physiological/biochemical are no longer appreciable after death except there overdose with specific drug is involved.

So look for or exclude some of the natural disease or mechanical obstruction. Autopsy must be preferably done by a Forensic expert and it must, however, be remembered that the findings of the autopsy surgeon alone will not be sufficient to explain death.

It is imperative to hold a discussion across the autopsy table involving Forensic expert/autopsy surgeon, anaesthetist and the surgeon concerned. It is often stated that deaths under anaesthesia were more often the fault of the anaesthetist than the anaesthesia alone.

### Post-mortem Examination:

Autopsy in a case of an anaesthetic death must be performed methodically adopting all the standard procedures. Note the odor,

specific odor of anaesthetic agent will help in detection at autopsy. Examine all the body cavities in situ & measure the contents or fluids if any and preserve for analysis. Examine the site of surgical intervention in situ, dissect all the organs and inspect every surgical suture, look for any evidence of pulmonary embolism, hemorrhage, peritonitis, retained swabs/instruments, asphyxia due to aspiration of regurgitated material or hypersensitivity reaction.

Though the evidences of vagal inhibition, fall in blood pressure, cardiac arrhythmias, spasm in coronary arteries and laryngeal spasms, etc. could not be detected during an autopsy, they should be cared off.

Collect the sample from all viscera for histo-pathological study particularly to exclude any cardiovascular disorder including occult conditions like myocarditis as well as relevant specimens for assessing the severity of disease for which the operation was carried out.

Histological examination of the brain is imperative which is primarily intended to demonstrate the effects of hypoxia, particularly in the region of Sommer's area of the hippocampal gyrus and the cerebellum, where changes are expected even if the victim suffers hypoxia for short period.

Morphological changes in the brains of victims, who suffered hypoxia for a short period but survived for long periods after anaesthesia, are diffuse, severe leuco-encephalopathy of cerebral hemispheres with sparing of the immediate sub-cortical connecting fibers.

Demyelination and obliteration of axons was also observed and at times, infraction of the basal ganglia. Damage appeared limited to the white matter, which is explained on the basis of greater glycolysis in the white matter during hypoxia as compared with the grey matter.<sup>[14]</sup>

### **Chemical Analysis:**

Prior to autopsy to avoid loss of gases due to exposure of the tissues to the air, it may be necessary to obtain samples of every viscera by the biopsy techniques and frozen immediately. Collect the alveolar air with a syringe by pulmonary puncture before opening the chest. A lung is removed and collected by clamping the main bronchus and retained in a nylon bag and sealed so that the headspace gas can be analyzed. At autopsy some portion of fat from the mesentery, skeletal muscle tissue, brain, liver, half of each kidney are retained. Blood should be collected under liquid paraffin.

Urine should be collected in containers with as little headspace as possible, sealed and immediately refrigerated or frozen.

Blood, urine and other body fluids should also be collected for bacteriological examination. Beside these residual solutions, medication containers, samples of gases used for the anaesthesia and samples of the operating room air may have to be collected in occasional cases.

### **Conclusion:**

Anaesthesiologist must know and follow a reasonable standards expected of them by the public, their profession and the law. [15]

He should assess, optimize and assure the patient before taking up for surgery. It is expected from anaesthetist to take pre- and postoperative rounds, develop good patient relationships, take valid and informed consent; keep the things which are necessary during and after the operation; check the equipment and monitors; label all the drugs, supervise the juniors & avoid critical incident sand maintain up-to-date records.

By the introduction of the ASA "Standards for Basic Intra-Operative Monitoring" a decrease in the number of anaesthesia-related liability claims. Improved monitoring, especially the greater use of pulse oxymetry and capnography, has undoubtedly contributed to the decrease in severe complications and associated large awards.

Threat of law suits against anesthesiologists seems to have declined somewhat in the USA and it can be accounted for in-part by greater attention to monitoring and other standards of anaesthetic practice, including continuing medical education. [16]

For the investigation of cause of death discussion between forensic pathologist, surgeon and anaesthetist may arrive at an amicable conclusion that will be the best consensus of opinion to offer the investigating authority and courts of law.

The Indian Society of anaesthesiologist must come out with protocols to be followed by its members in different clinical situations. Once this is done the courts will decide the issues of medical negligence by the fact whether the protocol was followed or not. This will also improve the patient care and the outcome.

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## Review Research Paper

# Mercury Poisoning: Analytical Aspects with Brief Overview

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### Abstract

Mercury (quicksilver) comes under the class of metallic poisons. At room temperature the metal is in liquid form. Although metallic mercury is not poisonous, but it causes poisoning when inhaled in its vapour form, swallowed or rubbed into skin. The toxicity of mercury depends on its chemical form and route of exposure. It affects the immune system, alters genetic and enzyme systems, and damages the nervous system, including incoordination and the tactile, gustatory and visual hallucinations. Clinical features of mercury poisoning along with differential diagnosis have been presented. The pre-hospital, hospital and post-hospital management will help in providing the proper care to the patient along with the treatment which can be done using BAL, DMSA etc. The qualitative as well as quantitative determination of mercury levels can be done with the help of various sophisticated techniques.

**Key Words:** Mercury, Toxicity, Analysis, Immune system, Nervous system

### Introduction:

Mercury is a heavy metal that occurs in several forms, all of which can produce toxic effects in high doses. It is a liquid metal, bright silvery in appearance and is volatile at room temperature. Metallic mercury is not poisonous if swallowed, but in case if it is breathed in a vapour form or applied on skin; it causes poisoning. It occurs in two forms - mercuric and mercurous compounds. Mercuric are soluble and intensely poisonous when compared with mercurous compounds. [1, 2]

### Sources & Uses of Mercury:

- Elemental Mercury has been used in thermometers and Sphygmomanometers (Blood pressure measuring apparatus) since long however recently these are being gradually phased out.
- Mercuric chloride is used in electrochemical measurements and in medicine as a purgative and in preservation of anthropological and biological specimens Mercuric oxide is used as a material for cathodes in mercury batteries and skin ointments.

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- Mercuric sulphide is used by married Hindu females as vermillion.
- Mercuric cyanide is used in germicidal soaps, photography and cyanogen gas.
- Mercury fulminate is used as a detonator. [2-4]

### Mercury Exposure:

- Domestic mercury use such as thermostats, thermometers, batteries etc.
- Dental amalgam
- Consumption of fish and Persons associated with mercury mining. [2-4]

All forms of mercury can accumulate to some extent. Methyl mercury is absorbed and accumulates to a greater extent than other forms. The levels of methyl mercury increase along the food chain and with age. It can be absorbed quickly by the organism and accumulate in fishes. [2-4]

### Mechanism of Toxicity:

Corrosive sublimate causes coagulation of the albumen of the tissues with which it comes in contact. The result is the immediate destruction of cells. Toxicity depends upon exposure due to:

- (a) Elemental mercury
  - (b) Inorganic mercury compounds
  - (c) Organic mercury compounds [5,6]
- (a) **Elemental Mercury:** such as quicksilver, it is poorly absorbed by ingestion and skin contact. It is hazardous due to its potential to release mercury vapour after heating. Cases of systemic toxicity from accidental swallowing are rare, but in case of attempted suicide via intravenous injection

may result in systemic toxicity. In humans, 80% of inhaled mercury vapour is absorbed via the respiratory tract where it enters the circulatory system and is distributed throughout the body. Chronic exposure by inhalation, at low concentrations range between 0.7–42  $\mu\text{g}/\text{m}^3$ , causes effects such as tremors, impaired cognitive skills, and sleep disturbances.

(b) **Inorganic Mercury Compounds**

**Poisoning:** such as mercuric chloride; it affects the gastro-intestinal tract and kidneys. As they can't enter blood-brain barrier easily, mercury salts inflict neurological damage without continuous or heavy exposure. Mercuric salts are usually more toxic because their solubility in water is greater; thus, they are more readily absorbed from the gastrointestinal tract.

Mercuric cyanide can enter the body via inhalation, ingestion, or passage through the skin. Inhalation of mercuric cyanide irritates the throat and air passages. Heating or contact with acid or acid mist releases toxic mercury and cyanide vapours that can cause bronchitis with cough and phlegm and/or lung tissue irritation.

(c) **Organic Mercury Compounds:** tend to be much more toxic than the element itself and have been implicated in causing brain and liver damage. [7,8]

**Onset & Duration:**

The symptoms appear in about ten minutes. If taken in large quantity and under favorable conditions death may occur within few hours. In fair proportions death is not due to the immediate effects of poison but due to the secondary effects on the organs. The duration may extend to five or more days. [7]

**Normal Levels:**

The normal level of mercury in whole blood concentration is  $< 5\mu\text{g}/\text{L}$ . The normal level of mercury in 24-hour urinary excretion is  $< 50\mu\text{g}/\text{day}$ .

Blood mercury level confirms whether the exposure was recent, because the initial half-life for the elimination of blood mercury is 3 days. Urinary mercury levels indicate the total mercury in body since it is largely excreted by the kidneys.

The half-life of elimination for whole body mercury is 60-90 days. Urinary mercury levels are generally below  $10\mu\text{g}/\text{L}$ . According to OSHA (Occupational Safety & Health Administration) exposure limit for workers is 0.01  $\text{mg}/\text{m}^3$  of alkyl mercury over an 8-hours shift. [9, 10]

**Table 1: Levels of Mercury in Biological Material**

Matrix	Normal Level	Toxic Level
Blood	$< 2 \mu\text{g}/\text{L}$	$> 3\mu\text{g}/\text{L}$
Urine	$< 10 \mu\text{g}/\text{L}$	$> 20\mu\text{g}/\text{L}$
Nails	$< 1 \mu\text{g}/\text{g}$	$> 2\mu\text{g}/\text{g}$

**Fatal Dose and Fatal Period:**

The acute lethal dose of mercury compounds for an adult is 14–57  $\text{mg}/\text{kg}$ . The minimum lethal dose of methyl mercury, the organic form of mercury, is 20–60  $\text{mg}/\text{kg}$ .

The fatal dose of corrosive sublimate is about 1-2 gm. The average fatal dose of mercuric cyanide is 0.6-1.3 gm and that of mercuric nitrate is 4 gm. An intravenous injection of 0.06 gm of metallic mercury proved fatal in case of adult and 20 mg proved fatal in case of child. [7, 8] The usual fatal period is 3-5 days, but death may take place much sooner or later.

**Clinical Features/Symptoms:**

In case of acute poisoning, the symptoms include an acrid, metallic taste and a feeling of constriction or choking sensation in the throat and difficulty in breathing. Mouth and tongue becomes corroded, swollen and appears greyish-white in colour. Burning sensation in the mouth down to stomach and abdomen, followed by nausea and vomiting. Urine is suppressed or scanty, containing blood and albumin. Pulse becomes quick, small and irregular which lead to circulatory collapse. [9, 10]

In case of chronic poisoning, the symptoms are nausea, digestive disturbances, vomiting and diarrhea. Salivation accompanied by foul breath, swollen and painful salivary glands with inflamed gums. Nephritis may be observed. A brownish blue line may appear at junction of gums and teeth. Brownish reflex formed on the anterior lens of both eyes, which can be seen upon slit-lamp examination. [11, 12]

In addition, different compounds produce specific sign and symptoms of poisoning as under:

**(a) Elemental Mercury Poisoning:**

- Tremors, Changes in nerve responses, Neuromuscular changes (such as weakness, muscle atrophy, twitching), Disturbances in sensations
- Emotional changes (e.g., mood swings, irritability, nervousness, excessive shyness)
- Insomnia, Headache
- Performance deficits on tests of cognitive function.

**(b) Methyl Mercury Poisoning:**

- Impairment of the peripheral vision

- Disturbances in sensations ("pins and needles" feelings, usually in the hands, feet, and around the mouth)
- Lack of coordination of movements
- Impairment of speech, hearing, walking and muscle weakness.

**(c) Inorganic Mercury:**

- Skin rashes, mood swings, memory loss, mental disturbances, muscle weakness.

**Diagnosis:**

It may be difficult to distinguish between poisoning by mercurial compound and oxalic acid. In case of organic mercury poisoning whole blood or hair analysis is more reliable than urinary mercury levels especially in chronic poisoning. 24-hour collections are more reliable than spot collections. [9]

**Laboratory Findings:**

1. Blood and urine samples are used to determine recent exposure to elemental and inorganic forms of mercury.
2. Chest x-rays reveals collection of mercury from exposure to elemental mercury or a pulmonary embolism containing mercury. Abdominal x-rays can reveal swallowed mercury as it moves through the gastrointestinal tract.
3. Scalp hair is used in testing for exposure to methyl mercury. Liver and kidney function tests are done for severely exposed persons.
4. Long-term exposure to mercury can be estimated from levels in hair.
5. If large-volume ingestion is suspected, abdominal radiographs should be conducted to detect and follow the transit of mercury in the gastrointestinal tract.
6. Neuropsychiatric testing, nerve conduction studies, and urine assays for N-acetyl-B-D-glucosaminidase and  $\beta$ 2-microglobulin have been used to assess delayed and chronic nervous system and renal toxicity. [12]

**Analytical Toxicological Methods:**

**1. Spot Test/Screening:**

**A. Reinsch Test:**

1. About 20 ml of conc. HCl and 100 ml of water is taken in a porcelain basin.
2. Bright copper strip is placed in it with one of the end fixed on the edge of the basin.
3. The solution is boiled for about half an hour to see if the strip, basin and the acid are free from the metal to be tested.
4. If a stain is observed on the strip, then blank experiment is to be carried out again with fresh materials.
5. Suspected material is added to the basin.

6. The solution is again boiled for an hour or more with the addition of water and acid.
7. Shining silvery stain obtained on the copper strip.
8. Shiny silvery stained copper strip is placed in a Reinsch tube and heated slowly.
9. Shining round globules of metallic mercury are observed on the cooler side of tube when viewed under microscope. [13]

**B. Micro Test:**

1. A portion of the stained copper strip from Reinsch test is taken in a test tube.
2. Few drops of conc. nitric acid are added to it. Solution is evaporated.
3. The residue obtained is taken in dilute hydrochloric acid and spotted on a Silica gel G plate (of thickness 0.2mm).
4. Mercury presence is observed by spraying the chromatogram with dithizone. [14]

**C. Test with Diphenylcarbazone:**

1. A filter paper impregnated with a freshly prepared 1% alcoholic solution of diphenylcarbazone.
2. A drop of test solution is added to the impregnated filter paper.
3. According to the concentration a violet or blue fleck appears on the filter paper which shows the presence of mercury. [13,15]

**D. Test with Cuprous Iodide:**

1. One drop of potassium iodide-sodium sulfite solution is taken on a filter paper.
2. A drop of copper sulphate solution is added to it.
3. A drop of test solution is added with the help of a capillary.
4. According to the concentration Red or orange colour is observed which shows the presence of mercury. [15]

**E. Test with Stannous Chloride and Aniline:**

1. A drop of test solution is taken on filter paper.
2. Few drops of freshly prepared stannous chloride solution followed by a drop of aniline are added to it.
3. A black to brown colour is observed which shows the presence of mercury. [15]

**2. Quantitative Analysis:**

Quantitative estimation of Mercury can be done by using specific methods of different sophisticated techniques viz. Spectroscopy, Voltammetry & Polarography, Chromatography & Neutron Activation Analysis.

**A. Spectroscopy:**

Spectroscopy is the interaction between radiation and matter. The methods employed in spectroscopy are based on the measurement of

amount of radiation absorbed or produced by molecular or atomic species of matter.

The spectroscopic methods can be classified according to the involvement of the region of electromagnetic spectrum. [16]

Quantitative determination of mercury can be done by using various instrumentation technique involving spectrometry viz. Atomic Absorption Spectrometry, Inductively coupled plasma- atomic emission spectrometry, Inductively coupled plasma-optical emission spectrometry, Inductively coupled plasma- Mass spectrometry, UV-Visible Spectrometry, Energy Dispersive X- Ray Fluorescence Spectrometry. [13, 17-20]

#### **B. Voltammetry & Polarography:**

In an electrochemical cell a time dependent potential is applied and the current flowing as a function of that potential through the cell is measured. In Voltammetry the applied potential produces a change in the concentration of an electro active species at the electrode surface by reducing or oxidizing it. Mercury can be determined by an instrument Trace Metal analyzer using the above technique. [21, 22]

#### **C. Chromatography:**

Chromatography is separation technique for molecular mixtures wherein separation is achieved by relative affinity or interaction of solutes with stationary phase (adsorbent), mobile phase and equilibrium attained thereof. Mercury can be analyzed by using Ion Chromatograph coupled with multidimensional detectors achieving high sensitivity and selectivity. [23]

#### **D. Neutron Activation Analysis:**

In this technique the sample is bombarded with neutrons, which generates a range of radio isotopes and as these radioisotopes decay they emit radiation which can be measured using  $\beta$  -ve or gamma -ve counters, which is a characteristic for a particular element. Neutron activation analysis is very sensitive and can be used to measure several elements simultaneously but it is very expensive and an access to an atomic reactor is required hence it is used very rarely. [24] In India this facility is also available at Bhabha Atomic Research Centre, Mumbai.

#### **Pre-Hospital Management:**

Victims exposed to mercury vapour do not pose for secondary contamination risks to surroundings. Victims whose skin or clothing is visibly contaminated with liquid mercury can contaminate rescuers' equipment, clothing, or the indoor environment. Contamination of clothing or equipment can result in subsequent

chronic inhalation hazard to others as the elemental liquid mercury off-gasses.

- **Respiratory Protection:** Positive-pressure, self-contained breathing apparatus is used in situations that involve exposure to potentially unsafe levels of elemental mercury.
- **Skin Protection:** No special clothing is needed unless mercury vapour is being heated; in that case chemical protective clothing is recommended to avoid contamination. Gloves and foot protection are recommended as mercury spreads under nails. Any clothing that comes in contact with liquid mercury should be properly decontaminated or disposed of to prevent further exposure.
- **Eye exposure:** Eyes should be washed immediately with large amount of water by lifting lower and upper lids. Contact lenses should not be worn while handling mercury and its compounds.

#### **Hospital Management:**

##### **Basic Decontamination:**

Victims who are able to move may assist in their own decontamination. Contaminated clothing and all personal belongings of the individual should be removed and kept in double bag. Exposed skin and hair should be washed with mild soap and water.

Caution should be taken to avoid hypothermia when decontaminating in case of children & elderly. Exposed or irritated eyes should be flushed with plain water or saline for at least 5 minutes. Contact lenses should be removed carefully without causing additional trauma to the eye. If pain or injury is evident, irrigation should be continued while transferring the patient to the Support Zone.

Elemental mercury is not readily absorbed from the gastrointestinal tract and generally does not produce acute toxicity, it will be excreted out through faeces hence emesis is not advised.

- **Transfer to Support Zone:** As soon as basic decontamination is completed, the victim should be transferred to the Support Zone.
- **Support Zone:** Victims who have undergone decontamination or have been exposed only to vapour pose no serious risks of secondary contamination. In such cases, Support Zone personnel require no specialized treatment.
- **Skin Exposure:** Elemental mercury does not cause a chemical burn. Washing the exposed skin with soap and water should

remove any residual liquid mercury if present.

- **Eye Exposure:** Adequate eye irrigation must be ensured. Eyes should be examined for conjunctiva or corneal damage. Patients should be referred to an ophthalmologist in case of apparent or suspected corneal injury.
- **Ingestion Exposure:** Emesis may not be induced and activated charcoal should not be given since elemental mercury is not usually absorbed from the gastrointestinal tract and does not produce acute toxicity.

However, if an individual with gastrointestinal perforation ingests an extremely large amount, mercury might be retained for a long period in the GI tract and decontamination should be considered. [25]

### Treatment:

Patient should be approached cautiously for stomach wash with warm water along with magnesium carbonate. Albumin in any form or vegetable gluten mixed with skimmed milk can be used.

Demulcent drinks may be administered for the protection of stomach wall. 3-4 tablespoons of activated charcoal should be administered along with 20 gm of magnesium sulphate which hastens the removal of ingested poison. The standard dosage of BAL for inorganic mercury poisoning is 3 mg/kg IM every 4 hours for 2 days, and every 12 hours thereafter for 7 to 10 days or until 24-hour urinary excretion levels are less than 50 µg/L.

Dimercaprol must not be administered in patients with glucose-6-phosphate dehydrogenase deficiency, because it can produce haemolysis. Oral agents such as 2, 3-dimercaptosuccinic acid (DMSA) used as alternatives when dimercaprol toxicity or intolerance develops. Penicillamine is useful as an antidote in the dose of 250 mg to 2 g each day. In children dose is 20 mg/kg body weight.

Hemodialysis is used in severe cases of toxicity when renal function has declined. The ability of regular hemodialysis to filter out mercury is limited because the mode of distribution is through erythrocytes and plasma.

However, hemodialysis, with L-cysteine compound as a chelator, has been found successful. Neostigmine may help motor function in methyl-mercury toxicity. This toxicity often leads to acetylcholine deficiency.

Polythiol is a non-absorbable resin that can help in facilitating the removal of methyl-mercury, which is then excreted in the bile after enterohepatic circulation. Gastric lavage with 5%

solution of sodium formaldehyde sulfoxylate reduces mercury chloride to metallic mercury. Egg-whites, milk or animal charcoal can be used to precipitate mercury. High colonic lavage with 1:1000 solution of sulfoxylate twice daily is also effective. [7, 8, 10]

### Some Case Reports:

#### A. Case 1:

A 7 yrs old was referred to hospital for pain in his legs, neck and abdomen for a period of 2.5 months and experienced pain in his extremities for 20 days. The patient had no fever, vomiting or diarrhea, but had reduced appetite and had lost 2-3 kg weight. He had a history of measles and charcoal poisoning.

Body weight was 26 kg and height was 128 cm. The general condition was moderate. On examination other systems were found to be normal. Laboratory test results included routine urinary and blood studies, liver and renal function tests which were normal.

Creatine kinase: 71 IU/L, lactate dehydrogenase: 316 IU/L, antistreptococcal antibody (ASO): 57 TU, C-reactive protein (CRP): <3 mg/dL, ANA: negative; antiDNA: negative, C3: 1.14, agglutination test: negative, Gruber-Widal agglutination test: negative, thyroid function tests were within the normal limits. The patient's history showed the chronic mercury intoxication due to clinical features and high mercury levels in blood sample.

Therapy with D-Penicillamine was started. In the second month of the therapy, abdominal pain was diminished and the patient's extremity pain was also reduced. The patient showed no complaints and therefore his blood mercury levels were assessed together with 2 months intervals. After receiving D-Penicillamine for a period of 8 months, the patient showed no symptoms. [20]

#### B. Case 2:

The 13-year-old patient was diagnosed with **chronic mercury intoxication**. He came with complained of abdominal pain, extremity pain, and dermal eruptions.

The patient's blood mercury level was 13.8ug/dL. Body weight of patient was 50.5 kg and height 154 cms, blood lead level: 2.20ug/dL, blood mercury level: 12.8ug/dL.

D-Penicillamine therapy was started. Naproxen and carbamazepine was also administered in order to reduce the diffuse body pain. Due to increase in the liver enzyme levels accompanied with proteinuria, D-Penicillamine therapy was stopped and replaced with dimercaprol for a period of 10 days. After liver and renal function tests turned out to be normal;

D-Penicillamine therapy was restarted. 3 weeks after the patient was discharged from the hospital, pain in the extremities and head was reduced and abdominal pain was eliminated. In the second month of therapy, all the symptoms eliminated. The patient received D-penicillamine for a total of 7 months, and then the blood mercury level was carefully monitored during bi-monthly controls for a period of 12 months. [26]

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## Review Research Paper

# Bite Marks: An Indispensible Forensic Odontological Evidence in Rape Cases

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### Abstract

Forensic odontology has gained wide acceptance in the field of criminal justice because no two people have identical teeth. **Presence of physical evidence such as** bite-marks in cases of rape, murder and violence are considered very valuable. These are considered to be an expression of dominance, rage and animalistic behavior. Bite-marks are the commonest form of dental evidence presented in criminal court in rape cases. These marks are also valuable in determining the type of physical abuse and age bracket of the criminal. To deal with bite-mark evidence a Forensic dentist is called. Exclusion of a suspect in rape cases based on the specific tooth patterns and opening range is also possible. With increase in criminal cases like rapes the use of bite-marks as Forensic odontological evidence in nailing the culprits truly points out the important role odontology plays in field of criminal justice. This review highlights the importance of bite-marks as indispensable Forensic odontological evidence in rape cases.

**Key Words:** Forensic odontology, Bite marks, Rape, Identification, Crime

### Introduction:

Forensic **Odontology** is a branch of forensic medicine that in the interest of justice deals with dental evidence presented in the courts of law. [1] The basis that Forensic odontology has gained wide acceptance in the field of criminal justice is because no two people have identical teeth. [2]

A Forensic Odontologist is involved in the analysis of bite marks on victims and presentation of bite mark evidence in court as an expert witness. As no two fingerprints are alike, neither are two bite-marks. [3]

Bite-marks form crucial evidence in case of violent rapes against women which is considered a heinous crime. These marks are seen when teeth are used as weapons of anger, excitement and destruction. During struggles between assailants and victims, mostly skin of victims bear bite marks. The specific pattern of marks on victim's body gives a clue about the type of abuse.

The age bracket of the criminal can also be analyzed through these marks. Bite marks can also exclude a suspect on basis of tooth pattern and opening range. [4]

During sexual attacks including sexual homicide, rape and child sexual abuse, bite marks are clustered around parts of body associated with sexuality. Females are usually bitten on the breasts, nipples, abdomen, thighs, buttocks and pubis, while men are usually bitten on the back, arms, shoulders, chest and penis. [5] In cases of homosexual assault in male victims bite-marks are found on the back of the shoulder, arm or armpit, chest and penis. In cases of self-defense the victim can bite on the hands and arms of an assailant. [6]

### Definition:

ABFO defines bite-marks as "a pattern left in an object or tissue by the dental structures of an animal or human," [3] whereas Mac Donald described it as a mark caused by the teeth either alone or in combination with other mouth parts. [2] The size, shape and pattern of the biting edges of the anterior teeth in the upper and lower dental arches are considered to be specific to an individual.

Hence a bite mark shows unique pattern of an individual's teeth, also it can help in excluding suspects to whom the mark does not belong to. [2]

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**Historical Review:**

Bite mark evidence has slowly gained acceptance as a Forensic tool. The earliest recorded bite mark case in the United States was Ohio vs. Robinson in 1870. Ansil Robinson was suspected of murdering his mistress, Mary Lunsford. His teeth matched to bite marks on the victim's arm, but Robinson was acquitted. [7]

The most famous bite mark case was of Ted Bundy (raped and killed more than 30 women) who was convicted of rape and murder of Lisa Levy and Martha Bowman. He had left a bite mark on Lisa Levy's buttock.

While investigation, the mark was photographed with a ruler kept alongside.

Bundy's teeth were photographed, the bite mark was matched against his teeth and he was convicted. This case also highlighted the importance of photographing the bite-mark with a ruler at the scene, as the bite-mark may degrade with time but the photograph may reveal the original size and shape of mark which can be used for comparison with transparent overlay of victim's teeth in future. [8]

Many other rapists and serial killers have been convicted based on bite mark testimony over the years. [9]

**Classification of Bite Marks:**

**A. Cameron And SIMS Classification:**

This is based on the type of agent producing the bite mark and material exhibiting it.

**1. Agents:**

- a) Human
- b) Animal

**2. Materials:**

- a) Skin, body tissue
- b) Food stuff
- c) Other materials

**B. Mac Donald's Classification:**

a) **Tooth Pressure Marks:** Marks produced on tissues as a result of direct application of pressure by teeth. These are generally produced by the incisal or occlusal surfaces of teeth.

b) **Tongue Pressure Marks:** When sufficient amount of tissue is taken into mouth, the tongue presses it against rigid areas.

c) **Tooth Scrape Marks:** These are caused due to scraping of teeth across the bitten material. They are usually caused by anterior teeth and present as scratches or superficial abrasions. [2]

**C. According To Degree of Impression:**

- a) **Clearly Defined** - significant pressure

- b) **Obviously Defined** - first degree pressure
- c) **Quite Noticeable** - violent pressure
- d) **Lacerated** - skin violently torn from body. [10]

The severity of the injury gives indications of the mental state of the offender. Accordingly there may be presence of hemorrhage, abrasion, contusion, laceration, avulsion or artefact.

**Location:**

A study done to evaluate the anatomical location of bite-marks in 101 cases from United States courts of appeal found that human bite-marks can be found at almost every anatomical location, with a bias towards certain areas.

The crime type, age and sex of the subject affect anatomical location of a bite injury. Biting is seen in crimes like homicide, rape, sexual assault, robbery and child abuse.

The study also revealed that females are four times more likely to be bitten than males, and the bites are concentrated on the breasts, arms, and legs. In case of female children bite marks are seen on the face, legs, and arms. Males are most frequently bitten on the arms, back, and hands. Also more than one bite-mark in a different anatomical location from the first can be found in a victim. [11]

**Factors Affecting Bite Marks in Skin:**

1. The size and shape of bite-mark is affected by its location on the body, because certain areas of the body bend distorting the surface area of the skin due to high viscoelasticity.
2. Some marks are made through clothing. Hence clothing is considered a potential source of bite mark impressions and biological evidence from transferred saliva.
3. Loose skin/subcutaneous fat lead to a poor bite mark. Whereas areas of fibrous tissue or high muscle content bruise less easily and demonstrate good bite mark. Infants, elderly and females tend to bruise more easily. [5, 12]

**Mechanism of Bite Marks:**

A bite mark occurs mainly due to pressure of teeth on skin. It is accompanied by mandibular closure and suction of skin (as a negative pressure).

Upper jaw is usually stationery and holds and stretches the skin and lower jaw is moveable and gives the most biting force. A human bite mark is an elliptical or circular injury with specific characteristics of the teeth.

If there is a single "C" shaped mark, then only one jaw (lower jaw) was involved. The diameter of injury ranges from 25-40 mm.

Bruising within the marks is caused by pressure from the teeth as they compress the tissue inward. [13]

### Physical Characteristics of a Bite Mark Pattern:

The amount and degree of detail recorded in the bitten surface varies from case to case. First it is important to determine which teeth made the marks. The term 'characteristic', is a distinguishing feature, trait, or pattern within the mark. It is of two types, class characteristic & individual characteristic.

Class characteristic is a feature, pattern, or trait which reflects a given group and is not related to a particular individual. The biting surfaces of teeth are related to their function like incising, tearing or grinding. Front teeth are the primary biting teeth in bite marks.

The two upper central incisors are wide, lateral incisors are narrower and cuspids are cone shaped. The two lower centrals and two laterals are uniform in width and lower cuspids are cone shaped. The upper jaw is wider than the lower jaw. The characteristics of individual teeth are

- 1) **Incisors:** Rectangular shaped mark, sometimes with perforations at the incisal angle areas
- 2) **Canines:** Triangular markings with apex towards labial and base towards lingual
- 3) **Premolars:** Single or dual triangle with bases of triangles facing each other or coming together as diamond shaped
- 4) **Molars:** Rarely leave bite marks, usually quadrilateral markings. [14]

An individual characteristic is a feature, pattern, or trait that represents a variation from the expected finding in a given group, like a rotated, damaged, or broken tooth that differentiates two different dentitions and is helpful in determining the dentition that caused the bite injury or mark.

Cases with class characteristics are used to confirm the events of a crime & those with individual characteristics can identify an individual source. [15]

Thus depending on the characteristics it is possible to use terms like "unique", "possible bite mark", "definite bite mark", "positive match", "consistent with" and "probable biter".

For a positive identification to be made there must be marks left by four or five approximate teeth. [16]

### Types of Distortions:

Two associated terms are primary and secondary distortion. Primary distortion depends on dynamics of the bite. Secondary distortion is

of three types: time related distortion, posture distortion, and photographic distortion. The longer the time interval after the mark is made, the less distinct the mark will be in both living and dead. In the living, bruising occurs. In the dead, the body begins to decompose and shrinkage by rigor mortis occurs. [16, 17]

### Bite Mark Analysis:

Any analysis involves two steps, first the discovery and preservation of evidence and second involves evaluation, comparison and findings of the recovered evidence.

In analyzing bite-marks, first it should be determined if the injury is a bite-mark and whether it is caused by human teeth. Consistency of marks with the time of the crime should be determined.

To standardize the analysis of bite marks the American Board of Forensic Odontology (ABFO) established the following guidelines in 1986:

- 1) **History:** Thorough history of any dental treatment carried out after the suspected date of the bite mark should be taken.
- 2) **Photography:** Extra oral photographs including full face and profile views, intraoral should include frontal views, two lateral views and an occlusal view of each arch, a photograph of maximal mouth opening.
- 3) **Extra-oral Examination:** Soft tissue and hard tissue factors that may influence biting dynamics. Measurements of maximal opening and any deviations on opening or closing should be noted
- 4) **Intraoral Examination:** Examination of tongue and periodontal status like mobility of teeth. In case of recent marks, they should be swabbed for DNA from saliva left in the wound.
- 5) **Impressions:** Two impressions of each arch using materials that meet the American Dental Association (ADA) specifications. The occlusal relationship should be recorded.
- 6) **Sample Bites:** Sample of suspects bite in centric occlusion using wafer of base plate wax or silicone putty material. The sample is photographed immediately & used for future comparison
- 7) **Study Casts:** are prepared using type II stone. [18, 19]

### Collection of Bite Mark Evidence from Rape Victim:

In living and deceased victim the information to be collected from the bite mark is

- **Demographics:** Name, age, sex, race, case number, date of examination and name of the examiners should be recorded.
- **Location of the Bite Mark:** Describe the anatomic location, indicate the contour of the surface (flat, curved or irregular) and state of the tissue characters. Underlying tissue-bone, cartilage, muscle or fat
- **Shape of the Bite Marks:** whether it is round, ovoid, crescent or irregular in shape.
- **Colour and Size of the Mark:** Both vertical and horizontal dimensions should be recorded in metric system.
- **Type of Injury:** due to bite mark may be Petechial haemorrhages, Contusion, Abrasion, Laceration, Incision, Avulsion, Artefact etc.

Whether the surface of the skin is smooth or indented should be noted. [20]

### **Photographing the Bite Mark:**

This is an important step during investigation as the photograph of bite-mark should be accurately produced. The use of digital camera instead of traditional allows the Odontologist to reduce the margin of error.

A life size dimension of the photograph is then recreated. If much time has lapsed after the mark was made then alternative photographic methods using ultraviolet light can be used to make images of the tips of the penetrated area. [8]

### **Comparison Techniques:**

According to ABFO (1994) the most widely used methods for comparison of bite mark evidence are generation of overlays (acetate), test bite media e.g. wax exemplars, and Styrofoam. Recently software program Adobe Photoshop is being used to compare dental profiles. With its use transparent overlays can be created which are then laid over the bite marks.

The advantages of using computerized system are accurate measure of physical parameters of the evidence, less photographic distortion, eliminates any examiner subjectivity, good image visualization, standardization of comparison procedures and reproducibility of results. [21]

### **Problems in Bite Mark Analysis:**

- 1) Doubts have been raised about the accuracy of the bite imprint as skin is considered a poor medium for accurate impressions due to curves and other irregularities producing intrinsic distortion.

Thus comparison of a person's teeth to bite-mark on a victim's body is prone to error

leading to false implications of persons in crimes they did not commit.

- 2) Unlike fingerprints, which are stable over the course of an individual's life, the dentition is capable of major changes in configuration, with and without professional intervention.

Teeth lost due to extraction, trauma or exfoliation, changes in size and relationship of the arches due to growth or orthodontic procedures, alteration of biting surfaces by restorative materials, caries and changes in position of teeth due to periodontal disease.

- 3) The uniqueness of human dentition has not been definitely established. Also a bite mark is not an overall accurate representation of the teeth, tongue and jaw movements are also involved.
- 4) Questions about reliability of bite mark investigations arise due to different examiners arriving at opposite conclusions. Till date there is no standard comparison procedure for bite marks. Ultimate outcome depends on an examiner's objectivity and methods used. [22-24]

### **Conclusion:**

The importance of bite marks providing valuable information in nailing a rape accused is based on the fact that the majority of rapists leave bite marks on their victims. Bite marks carry a high Forensic value based on the characteristics of the bite marks that are similar to the defendant's. Such evidence is as conclusive as DNA and fingerprint evidence in rape cases.

With technological advances and recent use of ultra violet lighting to detect human bite marks on rape victims **Odontology** has proved to be boon. To conclude it is rightly said 'while the criminal may lie through his teeth, his bite marks reveal all, and do not lie'.

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## Case Report

### Chaos created by CHAOS!! : A Case Report

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#### Abstract

A 22 years old unbooked primigravida with 18 weeks amenorrhea came to the department of obstetrics and gynecology at Sri Aurobindo hospital for a routine checkup. On her sonography, the fetus was found to have multiple congenital malformations. The post abortus fetus, on autopsy, turned out to be **one of the extremely rare cases of CHAOS. CHAOS** (Congenital High Airway obstruction Syndrome) is a rare and commonly fatal abnormality pertaining to innate obstruction of the fetal airway. Most authors postulate that this malformation is related to a cessation of the embryological development of the Sixth brachial arch at different gestational junctures. In our case of CHAOS, a confirmation of the preliminary diagnosis, with location of the precise site, level and degree of obstruction was attained with the help of an autopsy. Foetal autopsies should be encouraged as they symbiotically benefit the parents and the clinicians to a more clear and precise diagnosis.

**Key Words:** CHAOS, Foetal autopsy, congenital malformation, Embryological Development

#### Introduction:

A foetal autopsy is one that is performed on a dead born or still born foetus. Among the foetal autopsies performed in our department, we have come across several rare cases like, Meckel Gruber syndrome, Prune Belly syndrome, umbilical stricture and meconium peritonitis.

**CHAOS** (Congenital High Airway obstruction Syndrome) is a rare and commonly fatal abnormality pertaining to innate obstruction of the fetal airway. The obstruction may be partial or complete. [1]

A. C. Vidaeff et al [2] conducted a literature search between 1965 and January 2006 using the Pubmed bibliographic database. Their search yielded 36 prenatally diagnosed cases of upper airway obstruction.

Our Radio-diagnosis department conducted a literature research, also using Pub med Bibliographic database, between 2007 and December 2012. The key words used for the search were CHAOS, laryngeal stenosis, laryngeal atresia, ultrasonography and prenatal.

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The research concluded that there were **three** prenatally diagnosed cases of laryngeal atresia in this stretch. Laryngeal atresia is the most common etiology of CHAOS.

Other causes comprise of laryngeal or tracheal webs, subglottic stenosis or atresia, laryngeal cyst, tracheal atresia, or tracheal agenesis. In majority of the cases, the subglottic portion of the airway (laryngeal) or proximal trachea is atretic or stenotic.

A thick web may also be noticed, obstructing the proximal airway. [3]

The definitive cause is not known. Most authors postulate that this malformation is related to a cessation of the embryological development of the Sixth brachial arch at different gestational junctures.

Genetic, sporadic, and vascular causes have also been suggested. [4] The obstructed airway causes a diminished clearance of fluid produced by the fetal lungs which in turn causes an increase in intra-tracheal pressure that result in lung hyper-expansion and abnormal development. [3, 5]

The hyper-expanded lungs then compress the heart and inferior vena cava, reducing the venous return and precipitating intrauterine fetal congestive heart failure and non-immune hydrops. [3, 5, 6]

#### Case History:

A 22 yrs old unbooked primigravida with 18 weeks amenorrhea came to the Department of Obstetrics and gynecology of Sri Aurobindo hospital for a routine check-up. On her sonography, the fetus presented with multiple

congenital malformations. The patient was advised Medical termination of pregnancy and the post abortus fetus was sent for autopsy.

### Autopsy Findings:

Before performing the autopsy a written informed consent was taken from the parents in their vernacular language. A team of doctors including Forensic experts, a pathologist and a radiologist, was formed.

### External Examination:

The foetus presented with **Iniencephaly and anencephaly with rachischisis. The brainstem and spinal cord were seen exposed and cerebrum and cerebellum was absent.** (Fig.1) The foetus weighed 160 gm with a crown rump length of 8 cm, rump heel length of 7 cm, chest circumference of 14 cm and abdominal circumference of 14 cm.

Eyes, ears, nose, mouth, anus, external genitalia, placenta were all grossly normal. Skin was translucent and edematous.

Umbilical cord showed two umbilical arteries and a single umbilical vein. The pleural surface was grossly normal and fluid was present in both pleural cavities. The peritoneal surface was grossly normal. Fluid was present in the peritoneal cavity. The diaphragm was everted. The liver weighed 6.6gm. The spleen weighed 0.1 gm.

Stomach, small intestine, large intestine were all grossly normal. The pericardial surface and pericardial cavity were grossly normal. The oesophagus was patent and no trachea-oesophageal fistula was noted.

On examination of the respiratory system, **larynx was completely blocked on probing with guide wire (4mm below the epiglottis) with post stenotic dilation of trachea and bronchus.** (Fig. 2, 3)

The left and right **lungs weighed 7.4 g and 7.8 g respectively and were enlarged in size with rib notching seen on right lung up to 11<sup>th</sup> rib. The heart was compressed and weighed 0.2gm.**

The great vessels arising from the heart and arising from the aortic arch did so in the normal position. Myocardium, mural and valvular endocardium; Foramen ovale; Ductus arteriosus; all the valves; Coronary ostia and coronary sinus; thoracic and abdominal aorta were grossly normal.

The gastrointestinal system, genitourinary system, hematopoietic system, musculoskeletal system were all grossly normal.

Hence, from the positive findings in the given foetus, the final diagnosis was given as **"Iniencephaly and Anencephaly with**

**CHAOS."** CHAOS presents with massively enlarged lungs and a small compressed heart, as can be seen below in a comparative analysis of the given foetus with a normogram, of different organs at the same gestational age.

### Discussion:

CHAOS is a rare congenital abnormality which in majority of the cases has a lethal outcome. It presents with a range of abnormalities, as obstruction or severe narrowing of upper airway which maybe in the form of laryngeal atresia, laryngeal web, subglottic stenosis, laryngeal cyst or tracheal obstruction; massively enlarged lungs; a flattened/everted diaphragm; a dilated trachea-bronchial tree.

Other abnormalities are a compressed small heart; ascites/pleural effusion, hydrops in utero; any tracheo-oesophageal fistula and may also present with other structural abnormalities for example laryngeal atresia with cryptophthalmos, renal agenesis, syndactyly, genital abnormalities which constitute the **FRASER syndrome.** [1-3, 5- 9]

We are reporting a case of CHAOS which presented with a primary abnormality of complete intrinsic foetal airway obstruction due to laryngeal atresia and also had associated findings of iniencephaly, a term that was derived from the **Greek word "inion"** for nape of the neck. It is a rare type of cephalic disorder that was first described by **Etienne Geoffroy Saint-Hilaire in 1836.** [10]

Those afflicted with the disorder share three common characteristics: [10] Occipital bone defect, partial or total absence (rachischisis) of Cervico-thoracic vertebrae and fixed fetal head retroflexion.

### So what is the need for Foetal Autopsy?

The usefulness of foetal autopsy cannot be definitively calibrated. For instance, lethal skeletal dysplasia is a condition where an autopsy can metamorphose the final diagnosis from Jeune's syndrome, (which has a high recurrence risk), to thanatophoric dysplasia (which presents with low recurrence risk), where prenatally only a presumptive diagnosis can be made. [12, 14]

Similarly, in renal cystic disease histological examination helps to differentiate between cystic renal dysplasia (recurrence risk 3%) and infantile polycystic kidney disease (recurrence risk 25%), which may otherwise be missed on ultrasonography scan owing to scarcity of amniotic fluid.

In our case of CHAOS, a confirmation of the preliminary diagnosis, with location of the precise site, level and degree of obstruction can only be attained with the help of an autopsy.

MTP Act 1971 allows termination of pregnancy if there is substantial risk that if the child were born it would suffer from such physical or mental abnormalities as to be seriously disabled. Some parents, in accordance with the act, may request termination of pregnancy, on the basis of prenatal investigations.

It imply that the unborn fetus will almost certainly suffer from a anomaly with a lethal outcome, for example, inencephaly, or one which would compromise the lifestyle of the baby with its persistent morbidity, for example Down's syndrome. Sometimes routine USG misses condition like umbilical stricture which results in sudden second trimester intrauterine deaths and is detected only on autopsy. [13]

An autopsy examination will not only provide parents with a confirmation of a doubtful prenatal prediction but also help ascertain the implications of a similar condition in future pregnancies. An autopsy leads to the refinement in the risk of recurrence, as was evident from a retrospective study done on 57258 deliveries, which showed that, when the final prenatal diagnosis was made by ultrasound scan, in 27% of the cases the autopsy added information that led to a decrement in the risk of recurrence. [14]

In cases where a definitive diagnosis cannot be made even by autopsy, genetic analysis and chromosomal studies is carried out to reach an accurate conclusion, and when a prenatal diagnosis is made then an autopsy may reveal some additional malformation which may help in forming a syndrome and addressing the same in successional pregnancy tests.

On a broader spectrum, a foetal autopsy not only improves the diagnostic quality, but is also valuable for the field of research, teaching and in discovering evolving anomalies.

**Conclusion:**

The autopsy findings of the given foetus were consistent with Iniencephaly and Anencephaly with CHAOS. Foetal autopsies should be encouraged as they symbiotically benefit the parents and the clinicians to a more clear and precise diagnosis.

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**Fig.1: Iniencephaly and Anencephaly with Rachischisis**

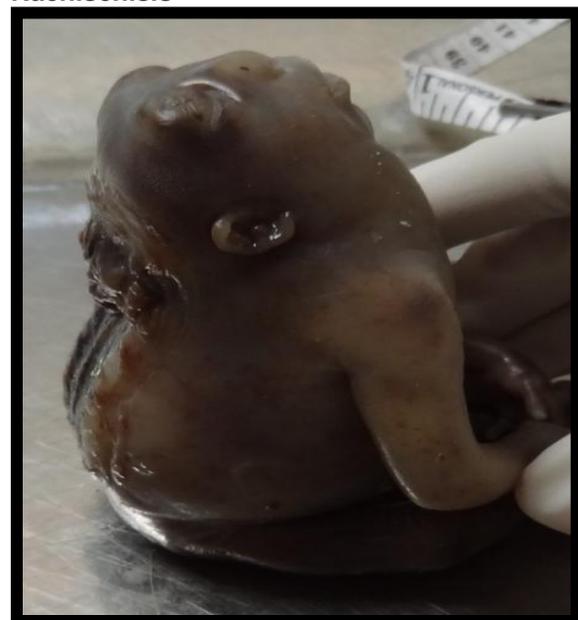


Fig 2: Eliciting Stenosis on Probing With Guide Wire



Fig 3: Complete Blockage of Larynx 4 Mm Below Epiglottis



Tab 1: Normogram of Different Organs at 18 Weeks of Gestation

In the given fetus:  
age- 18 wks; body wt- 160 gm; lungs- 7.4 gm (L) +7.8 gm (R); heart- 0.2 gm

Age (wk)	Body	Brain	Thymus	Lungs	Heart
12	20.9 ± 6.6	3.20 ± 1.44	0.01 ± 0.01	0.50 ± 0.28	0.15 ± 0.01
13	31.2 ± 10.1	5.19 ± 1.95	0.03 ± 0.01	1.08 ± 0.45	0.20 ± 0.01
14	49.1 ± 14.5	8.14 ± 2.58	0.05 ± 0.02	1.79 ± 0.67	0.31 ± 0.01
15	74.7 ± 19.8	12.0 ± 3.3	0.09 ± 0.04	2.64 ± 0.92	0.50 ± 0.01
16	108 ± 26	16.9 ± 4.2	0.14 ± 0.06	3.61 ± 1.21	0.76 ± 0.01
17	149 ± 33	22.8 ± 5.2	0.20 ± 0.08	4.70 ± 1.55	1.10 ± 0.01
18	197 ± 42	29.7 ± 6.3	0.28 ± 0.08	5.92 ± 1.92	1.50 ± 0.01
19	255 ± 51	37.2 ± 7.6	0.41 ± 0.17	7.30 ± 2.34	1.88 ± 0.01
20	319 ± 61	45.7 ± 8.9	0.54 ± 0.23	8.84 ± 2.80	2.41 ± 0.01

Age- 18 wks; Liver- 6.6 gm; spleen- 0.1 gm; kidneys- 0.5 + 0.5 gm

Age (wk)	Liver	Spleen	Adrenals	Pancreas	Kidneys
12	1.01 ± 0.38	0.01 ± 0.01	0.10 ± 0.03	—	0.16 ± 0.04
13	1.38 ± 0.57	0.01 ± 0.01	0.15 ± 0.05	—	0.22 ± 0.07
14	2.18 ± 0.84	0.03 ± 0.02	0.23 ± 0.08	—	0.36 ± 0.13
15	3.41 ± 1.18	0.05 ± 0.03	0.33 ± 0.12	—	0.59 ± 0.19
16	5.06 ± 1.60	0.09 ± 0.05	0.47 ± 0.16	—	0.90 ± 0.28
17	7.14 ± 2.10	0.15 ± 0.07	0.64 ± 0.22	—	1.30 ± 0.39
18	9.65 ± 2.66	0.21 ± 0.10	0.84 ± 0.30	—	1.79 ± 0.51
19	12.8 ± 3.3	0.30 ± 0.14	1.03 ± 0.34	—	2.36 ± 0.65
20	16.5 ± 4.0	0.41 ± 0.18	1.29 ± 0.41	0.50 ± 0.14	3.00 ± 0.81

Quantitative Standards for Fetal and Neonatal Autopsy

John G. Archie et al

## Case Report

### Sudden Death In Advance Twin Pregnancy: A Case Report

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#### Abstract

Pregnancy is the condition of having a developing embryo or foetus in the female, when an ovum is fertilized by spermatozoa. In twin pregnancy there are two developing foetus in the uterus. The present case is a 29 years old lady with 33 weeks twin pregnancy, who died suddenly and brought for medico-legal autopsy. On examination all the organs were found pale. Heart was found enlarged. Left lung was found to be adherent to the under surface of lungs and chest wall. Post-mortem hypostasis was faint and not fixed. Heart, lungs and liver has been send for Histo-pathological examination. Opinion regarding cause of death was kept pending till the receipt of histopathology report.

This is a case of sudden death in advanced pregnancy coming to the mortuary of Forensic Medicine, Gauhati Medical College and Hospital. Such cases emerging as a major burden now days and needs thorough discussion. Hence this case was discussed in details.

**Key Words:** Pregnancy, Sudden death, Autopsy, Twin pregnancy

#### Introduction:

Pregnancy is a condition which occurs in the female when an ovum is fertilized by a spermatozoon and she carries a fertilized ovum within the uterus. [4, 6] About seven days after fertilization, the ovum reaches the uterine cavity and implants itself in the uterine wall. [5]

Children born at or after 210 days of uterine life are viable. [6] When more than one foetus develops in the uterus, it is called multiple pregnancies. [1] In twin pregnancy there are two developing foetus in the uterus and this is the commonest form of multiple pregnancy. [1, 6]

In India the incidence of twin pregnancy is about one in 80. [1] The commonest presentation in twin pregnancy is both vertex (60%), followed by first vertex and second breech (20%). [1] The duration of pregnancy can be determined by: [2, 3]

- Measuring the level of the height of fundus of uterus from symphysis pubis. Up to 12 weeks the uterus cannot be felt above the level of pubic symphysis. At 16 weeks it can be felt just above pubic symphysis, at 20 weeks it reaches midway between the pubic symphysis and the umbilicus.

At 24 weeks at the level of umbilicus, at 28 weeks midway between the umbilicus and Xiphoid tip and at 32 weeks it can be felt at the level of Xiphoid tip. Thereafter during the last 8 weeks uterus tends to fall forward and sinks in pelvis.

- Macdonald's rule, i.e. the number of lunar months of pregnancy = height of fundus of uterus above symphysis pubis in cms/ 3.5cm. [3]

#### Case Report:

On 7<sup>th</sup> December' 2013 a case was brought to the mortuary for autopsy by the Dispur police (a local police station of Guwahati).

On examination it was found to be a female dead body of average built wearing a nightie. The present case is a 29 years old lady with 33 weeks twin pregnancy, who died suddenly and brought for medico-legal autopsy.

History reveals that she had also hypothyroidism, diabetes and her Hb% at 28 weeks was 7gm%. The attendant also gives history of uterine fibroid detected in her early pregnancy.

#### Autopsy Findings:

On external examination fundal height is 32 cms above symphysis pubis, so using Macdonald's formula the duration of pregnancy is around Nine months. (Fig. 1)

Post-mortem hypostasis is faint and not fixed. Rigor mortis is present and fully developed. On internal examination all the organs are found to be pale. Heart is found to be enlarged and contains liquid blood about 30 ml.

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Petechiae are seen at places. (Fig. 2) Weight is 320gms. Pleura is found adherent to the chest wall and lungs on left side.

Size of the uterus is found to be 40cm×28cm. Three tumour like masses (fibroid) were found in the uterus, one anteriorly and two posteriorly. (Fig. 3) On dissection of the uterus two female fetuses were found in the uterus, one in the vertex and other in the breech position.

Both the placenta was found attached to the fundus of the uterus. (Fig. 4) Both the cords were found to be attached to the placenta and the fetuses. (Fig. 5) The length of the fetuses was found to be 48 cm and 50 cm respectively. (Fig. 6) The heart, lungs and the uterine masses has been send to the Department of pathology for Histo-pathological examination. The finding of the heart shows ventricular thickening, the lung finding was not significant, and the uterine masses were sub-mucus fibroids.

Death was opined to be due to **Anaemic Heart Failure**. Time since death was approximately 12-24 hours.

**Discussion:**

Sudden death during pregnancy is emerging as a major burden in our society now days. This can be easily prevented by regular medical checkups and proper education to the patients and their attendants.

In twin pregnancy as the demand is more, the mother requires more care and should seek medical attention at an early period.

The Hb% was 7 during 1<sup>st</sup> checkup and also there were three fibroids detected during the 1<sup>st</sup> checkup. The patient also had diabetes and hypothyroidism detected during pregnancy.

These patients should be referred to the higher centres for further treatment.

But in this case the patient was neither send nor was advised. These cases require more attention and care. The private practitioner should refer the cases beyond their limitation to the respective specialist at an early period.

The private practitioner use to keep even the cases is beyond their scope and branch. **So the main question is whether it is a case of ignorance, negligence or a mishap.** So it is our duty to prevent such kind of catastrophes.

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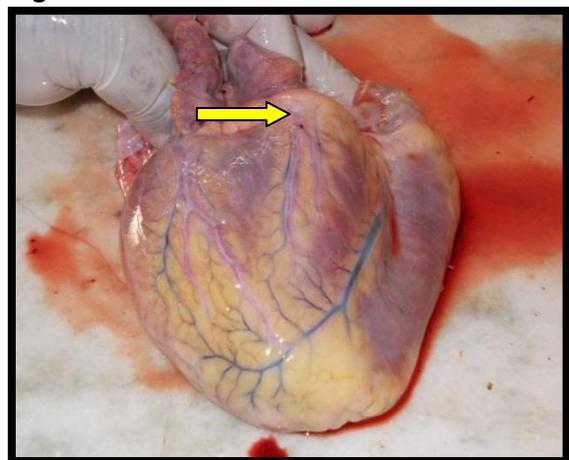
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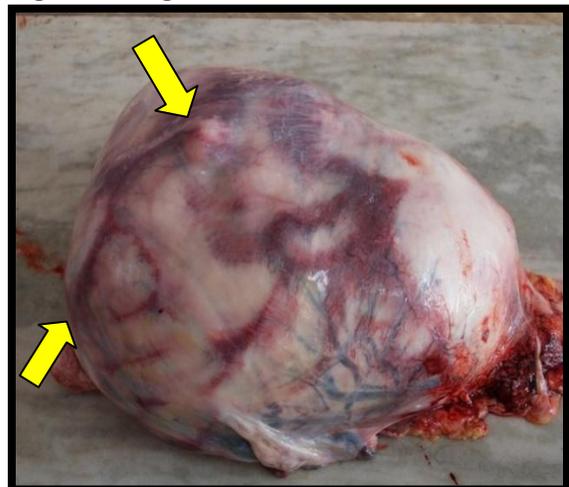
**Fig 1: Enlarged Abdomen**



**Fig 2: Petechiae in the Heart**



**Fig. 3: Enlarged Uterus**



**Fig. 4: Two fetuses' one in Vertex and other in Breech Position**



**Fig. 6: Both Fetuses**



**Fig. 5: Showing the Fetuses**



## Case Report

### Neurotoxic Snake Bite Poisoning

<sup>1</sup>Ankita Kakkar, <sup>2</sup>Sushil Kumar

#### Abstract

Snake bite is a significant health problem in India, particularly in the rural regions of the country. In general about 70% of bites are due to snakes which are not poisonous, of the rest, 15% are dry bites and only 15% cause envenomation. Venom is the saliva of snake ejected during the act of biting, from the poison apparatus (the modified parotid glands). It can be, neurotoxic, vasculotoxic, or myotoxic in its action. Neurotoxicity is a key feature of some envenoming, and there are many unanswered questions regarding its manifestations. The polyvalent antsnake venom serum available in India is effective against most common poisonous snakes. Therefore, a prompt diagnosis and timely administration of polyvalent antsnake venom, in a case of snake bite can not only be life saving, but also prevent morbidity to a great extent. Neurotoxic snakes for example common krait hunt nocturnally, and are quick to bite people sleeping on the floor, often without waking their victims, since the venom is painless. Victims wake up later, paralyzed or die in their sleep.

In the present case report, we discuss the neurological manifestations, disease course and its outcome in one such patient of snake bite.

**Key Words:** Envenomation, Mortality, Morbidity, Manifestations

#### Introduction:

Snake bite is a neglected tropical disease of global importance. [1] Data from the million deaths study in India estimates that snake bite deaths are more than 30 fold higher than recorded in official hospital returns. [2]

According to toxicity, they are categorized as haemotoxic, neurotoxic, and myotoxic. Among the neurotoxic groups, the majority of bites are due to *Ophiophagus hannah* (king cobra), *Naja naja* (common cobra), and *Bungarus caeruleus* (Krait) in India.

There are many challenges to the study of neurotoxicity after snake bite. There is considerable variation between individual patients in the clinical manifestations following envenoming by any particular species.

Clinical presentations of neurotoxicity are likely to be colored by the emotional response to a snake bite; other neurological changes are related to hypotension, shock and other organ dysfunction (such as renal impairment).

Neurological manifestations of envenoming by the non-neurotoxic are such as those due to coagulopathy. Comparing findings from different studies is difficult as there is a lack of uniformity in description or grading of neuromuscular weakness, or in assessment of response to treatment.

Interpretation of neurophysiological findings is also difficult as different methodologies have been used between studies. [3]

However, timely administered antsnake venom and ventilatory assistance can prevent the mortality and morbidity of the victims.

#### Case Report:

An 18 year old male, student presented to the emergency department of our hospital in the early hours of morning, with history of sudden onset difficulty in walking and difficulty in deglutition followed by unconsciousness of 4 hours duration.

He went off to sleep at night, but was woken up at dawn, as he was thirsty. He got up to fetch water from the kitchen, but experienced difficulty in walking. Further, when he tried to sip water, he found difficulty in drinking it too.

A few hours later, he suddenly became unconscious and was rushed to our hospital. His relatives gave past history of minor injury sustained in the left knee, seven days ago.

On general examination, patient was unconscious, unresponsive to deep painful stimuli with a normal pulse and blood pressure

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and depressed respiratory rate. Pallor, icterus, cyanosis clubbing, edema and lymphadenopathy were absent.

On systemic examination, cardiovascular respiratory and abdominal examinations were essentially normal. Central nervous system examination revealed generalized hypotonic but power could not be assessed, due to his unconsciousness.

All cranial nerves were normal. Light and superficial reflexes were present. Pupil was normal in size, with normal reaction.

Patient was mechanically ventilated because of poor respiratory efforts, and given antibiotics, along with anti tetanus serum (ATS) as there was previous history of injury sustained in left knee. Further, he was investigated for complete blood profile, CT scan head and CSF examination.

On 2nd day, the reports of all above investigation were normal. But the patient had not responded to the medications given to him.

On the 3rd day, he slightly regained consciousness, but was not well oriented.

A thorough physical examination was done. His neurological examination revealed bilateral drooping of eyelids, which suggested us that it could probably be a case of neurotoxic snake bite. Thereby we administered six vials of antsnake venom (ASV) diluted in 500 ml of normal saline to him, after sensitivity testing.

Another dose of antsnake venom was administered, in the form of four vials, after 6 hours, followed by four more vials after 12 hours. Myo-pyrolate 5ml diluted in 100 ml normal saline was also given slowly 8 hourly for three days. Next day, patient started showing improvement. Drooping of eyelids slowly reverted, and patient regained complete consciousness in one day's time.

On becoming conscious, he was able to recollect that while sleeping on the terrace at night, he was bitten near his right ankle by some insect (which he had not seen) .He ignored the bite and continued to sleep.

Fifth day, his respiratory efforts had improved considerably, so he was extubated. However recovery in muscular power of his lower limbs was not much satisfactory.

This patient of snake bite had fairly stable intensive care unit stay of seven days, after which he was discharged, and advised physiotherapy for the residual weakness in his lower limbs.

### **Discussion:**

Snake venom contains several types of polypeptide toxins, of which the neurotoxins

produce paralytic effect by binding to presynaptic and post synaptic sites at neuromuscular junction. [4]

Common neurological symptoms in decreasing order of frequency include ptosis (85.7%), ophthalmoplegia (75%), limb weakness (26.8%), respiratory failure (17.9%), palatal weakness (10.7%) and neck muscle weakness (7.1%). These are experienced usually within 6 hours of bite. (5) Following administration of antivenom, the signs of recovery become evident within a few hours to several days. [6]

However, in our patient, palatal weakness developed first, which was followed by weakness in lower limbs. Subsequently, he had difficulty in respiration, followed by drooping of both eyelids, a couple of days later.

Prompt recognition of envenomation and timely administration of antsnake venom (anti-sera) is a life saving measure and is the only effective treatment for neutralization of toxins that has entered the circulation. [7]

Polyvalent antivenom has no significant benefit in reversing respiratory paralysis and preventing delayed neurological complications. Polyvalent ASV is relatively safe, and allergic reactions after ASV injection can be prevented by premedication with adrenaline, IV hydrocortisone and antihistaminic. [8]

Anticholinesterases are beneficial against the postsynaptic toxins that induce myasthenia like block. [9] In animal models, subjected to high dose of snake venom, anticholinesterases have proven their efficacy as antidote in extending expected survival time. [10] However, despite their proven efficacy anticholinesterase, and antsnake venom forms mainstay of therapy, and dose up to 400 ml have been used. In our case, 14 vials of polyvalent antsnake venom were used.

Ventillatory support forms a cornerstone of envenomation therapy. Incidence of complication is directly proportional to the duration of venom in blood. Respiratory failure is the most common cause of mortality and morbidity in victims bitten by snakes. A mortality rate of 7.6% was observed in patients on intensive care management.

A prompt recognition of respiratory failure and timely mechanical ventilation can decrease morbidity and mortality .But due to poor availability at periphery and at larger district centre ASV, still remains mainstay of therapy. [8]

### **Conclusion:**

It is concluded, that even in the absence history of snake bite, cases presenting with sudden onset of neurological symptoms, such

as, weakness in limbs, respiratory paralysis and drooping of eyelids, a possibility of snake envenomation should be considered. Timely, administration of intravenous polyvalent ASV, along with Ventilatory support proves to be life saving in all such cases.

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## Case Report

### Sudden Death due to Diseased Intestines A case report of Crohn's Disease

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#### Abstract

Here we will present a case report of sudden, suspicious death of a truck handyman from Haryana who was on his way to Guwahati. He complained of fever and pain abdomen since last 2 days and was found unconscious in the morning after reaching Guwahati. External examination during autopsy did not reveal any injury. On opening the abdomen, multiple perforations in small and large intestines were found. Histopathology findings were found to be suggestive of Crohn's disease, an inflammatory bowel disease (IBD). Crohn's disease can affect any part of gastrointestinal tract and is rare in Asia but its incidence is increasing now. Peak age of onset of IBD is 15-30 years and a 2nd peak b/w 60-80 years. Highest mortality in IBD patients is during 1st years of disease. Intestinal perforations are known cause of sudden deaths but Crohn's disease causing perforations is a relatively rare entity in our country, India.

**Key Words:** Crohn's disease, Intestinal Perforation, Autopsy, Inflammatory bowel disease

#### Introduction:

Two types of Inflammatory Bowel Disease (IBD) are Crohn's disease (CD) and ulcerative colitis. Crohn's disease, an eponym based on the 1932 description by Crohn's, Ginzburg, and Oppenheimer, has existed for centuries. [1] In Asia and South Africa IBD is rare. Peak age of onset of IBD is 15-30 years and a 2nd peak b/w 60-80 years. Highest mortality in IBD patients is during 1st years of disease. [2] Earlier males were said to be more prone to the disease but now Crohn's disease is more common in females. [1,3]

#### Case Report:

Dead body of a 26 years old male, a truck handyman from Haryana, was received in Dept. of Forensic Medicine and Toxicology, Gauhati Medical College and Hospital (GMCH) for autopsy.

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As per history given by the attendant, they were coming from Haryana to Assam in truck and the deceased complained of fever and pain abdomen since last 2 days. After coming to Gauhati he was admitted in Gauhati Medical College and Hospital and died before investigations completed and diagnosis reached.

#### Autopsy Findings:

Externally he had thin built and there was no external injury. On opening the abdomen, the peritoneal cavity contained fecal matter. Stomach was empty and its mucosa was congested. Mucosa of the small intestines was congested and edematous. There were multiple perforations of varying sizes. Perforations were oval shaped and margins were erythematous.

Mucosa of the large intestines was congested and edematous. There were multiple perforations of varying sizes. Perforations were oval shaped and margins were erythematous. All other organs are congested. Specimen preserved for chemical analysis gave negative result.

#### Histopathology Examination:

In histopathology examination report the small intestines showed diffuse mixed inflammatory infiltrates, focal collections of polymorphs (micro abscesses), inflammatory necrosis and vascular proliferation in serosal layer. The large intestine showed mixed inflammatory cell infiltrate in all layers and focal collection of polymorphs (micro abscesses) in serosal layer with granulation tissue reaction. Kidneys showed cloudy swelling.

### **Cause of Death:**

The death was declared to be due to peritonitis as a result of perforation of small and large intestine following Crohn's disease (natural death)

### **Discussion:**

There is transmural inflammation in Crohn's disease. During the disease course bowel wall becomes thickened, narrow and fibrosed. This leads to chronic and recurrent bowel obstruction.

Microscopically the earliest lesions are aphthoid ulcerations and focal crypt abscesses and then non-caseating granulomas in all layers of bowel wall from serosa to mucosa (though these are pathognomic features of CD but are rarely found on mucosal biopsies).

Crohn's disease can affect any part of Gastro-intestinal tract from mouth to anus. In 40-55% cases both small and large intestines are involved. It is a transmural process. Free perforations occur in 1-2% of cases, usually in ileum but occasionally in jejunum or as a complication of toxic mega colon.

Peritonitis of free perforation, especially colon, may be fatal. [2]

I have not found any case report of sudden death due to Crohn's disease in India, however case report from Japan was found. [4]

### **Conclusions:**

Meticulous autopsy in such cases of sudden death helps in eliciting cause of death and removing suspicion from the minds of relatives of deceased as well as investigating agencies.

These types of cases give opportunities to the autopsy surgeons to be familiar with the various diseases which cause sudden death. Histopathology report is very useful in eliciting cause of death in such cases. So, it is imperative that histopathology report mentions the impression of the disease at the end of report.

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## Case Report

# Homicide by Gagging: A Case Report

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### Abstract

Gagging is a form of asphyxia which results from forcing a gag such as rolled up cloth, paper etc. deep in to the mouth or oropharynx. As such asphyxia by gagging is rare in occurrence and usually seen in infants and children as homicidal act or in adults suffering from psychiatric disorder as suicidal form of gagging. As young ones and elder people are easily overpowered due to least resistance offered by them, the homicidal gagging is more common in this age group.

We report a case of gagging in unknown newborn male which was found in polythene bag in open garbage area. During autopsy a rolled up cloth was observed in buccal cavity and on internal examination the gag was seen deep inside the mouth surrounded by mucus. In such cases, meticulous examination of nasopharynx, oropharynx and gag material is important.

**Key Words:** Gagging, Homicide, Asphyxia, Homicide

### Introduction:

Asphyxia is one of the common modes of death encountered in medico-legal practice. Asphyxial deaths by hanging & drowning are most common with varying percentage of other causes such as ligature strangulation, throttling, smothering etc. Asphyxial death by gagging is observed very infrequently.

Gagging is a form of asphyxia which is caused when pad or piece of cloth is thrust into the mouth. It is commonly used to prevent the victim from shouting for help and death is usually not intended. Sometimes it may be homicidal particularly when victims are infants, children, females or individuals incapacitated by alcohol or drug etc. [1]

### Case Report:

An unknown male new born, about 10 days old, was found in polythene bag near garbage area and was brought for post-mortem examination at Dr. Shankarrao Chavan Government Medical College, Nanded.

### Autopsy Findings:

On external examination, body was covered with blue lined dress.

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The weight of newborn was 2.4kg, crown to heel length was 50cm, umbilical cord was 3 cm in length & was dried, shriveled with white thread seen tied at the end. Scalp hairs were long and black; nails were projecting beyond tip of fingers.

Ossification center for lower end of femur, upper end of tibia, talus and sternum were present. Signs of decomposition were observed in the form of foul smell, brownish green discoloration of skin, distension of body & abdomen due to gases of decomposition and peeling of skin at places.

Examination of buccal cavity showed rolled up greenish-blue cloth seen deep inside the mouth & some part of cloth was present outside the mouth. (Fig. 1)

On internal examination, the part of cloth was seen reaching up to posterior wall of the pharynx occluding completely oropharynx & nasopharynx. (Fig. 2) Sticky, mucoid, whitish material was present adherent to cloth and surrounding the rim of cloth in contact with oropharyngeal tissue. (Fig.3)

Tongue was pressed below rolled up cloth. Rest of the internal visceral organs showed signs of decomposition.

Final opinion as to cause of death was issued as '**Death due to Gagging**'.

### Discussion:

Gag means rolled up cloth or other soft material pushed into the mouth sufficiently deep to block the pharynx will cause asphyxia. [2]

In the present case, cotton cloth (soft material) was used as gag thrust deep inside mouth completely blocking oropharynx and

nasopharynx. Commonly soft material is used as gag but other substances such as toilet paper, tissue paper can also be used for gagging as reported by authors. [3, 4]

Gagging is mostly homicidal in nature and rarely suicidal. Homicidal gagging is common in children, females and old age group where least resistance is offered by victims.

The present case showed newly born fetus abandoned in open space with rolled up gag completely blocking mouth. Considering the rolled up gag inside mouth and the age of new born in this case, we can very well say that the manner of death was none other than homicide.

Saint-Martin P. [3] reported homicidal gagging in 91 year old female by using toilet paper as gag. Though homicidal gagging is rare in healthy adult, Kurihara K. [4] reported a case of 29 year old male where tissue paper was thrust inside his mouth but the man was suffering from mental illness.

Yadav A. [5] reported a case of homicidal gagging which was concealed by fire and the rolled up cloth used as gag was found in mouth up to the root of tongue.

Suicide by gagging is usually observed among persons suffering from psychiatric disorder. Saint-Martin P. [6] reported a case of suicide in 30 year old male suffering from borderline disorder where death resulted from an obstruction of the upper aero digestive tract after inurgitation of pellets of toilet paper.

At times cases are presented with sudden death raising reasonable doubt as to manner of death. The gag used may be completely thrust deep inside mouth and may not be visible on external examination.

Thus high lightening the importance careful examination of nasopharynx and oropharynx during autopsy will provide valuable evidence as to cause of death. Rastogi P. [7] reported a case of an apparently healthy, intoxicated male died of gagging in suspicious circumstances.

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**Fig. 1: Appearance of Gag (soft cloth) on External Examination**



**Fig. 2: Appearance of Gag on Internal Examination**



**Fig. 3: Gag (Cloth) with Mucus**



## Case Report

### Suicidal Hanging Masquerading as a Homicidal Hanging

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#### Abstract

It is true that hanging in its face value goes in favour of being suicide in nature and it is relatively easy for an autopsy surgeon to establish cause and manner of death at autopsy provided there is a clear ligature mark with typical features of asphyxial stigmata. However, difficulty arises when there is an allegation, an unusual ligature mark or associated with other bodily injuries. Moreover, post mortem artefacts or changes of decomposition may pose a great challenge especially at the hands of inexperienced autopsy surgeons. In the present case report, we discuss the importance of thorough and meticulous post mortem examination and crime scene visit which were ignored during the first autopsy done at a Taluk Hospital. Another important aspect of this case report is scientific documentation of persistence of ligature mark (of hanging) in an exhumed cadaver with decomposition.

**Key Words:** Hanging, Ligature mark, Suicide, Homicide, Exhumation, Post-mortem artefact

#### Introduction:

Hanging is a common method of committing suicide all over the world and the incidence is even high among young men. [1]

It is comparatively easy to establish a case of suicidal hanging at autopsy if there is presence of its characteristic oblique & interrupted ligature mark, dribbling of saliva, asphyxial stigmata and absence of other signs of physical violence. However, difficulties arise in cases of advanced decomposition, presence of atypical ligature marks or absence of ligature mark and of course in those cases where there is bleeding from natural orifices with a high suspicious surrounding history.

Sometimes, in India, it is a common practice to kill a person and then suspend the body from a tree or anything to avert suspicion and such a post mortem hanging may simulate suicidal hanging. In such instances not only careful and thorough post mortem examination of the deceased but also examination of scene of crime and other related circumstances surrounding the death, etc. would help to arrive at a proper diagnosis avoiding miscarriage of justice in the administration of law.

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#### Case Report:

It was a case of second autopsy conducted on an exhumed body of a 24 years old Hindu male who was buried about 11 days back. The first autopsy was done at a government hospital. There was an allegation of physical torture and subsequently leading to killing as the victim was wanted in a case of elopement with a girl to a neighbouring district.

After completing all formalities, exhumation was commenced at about 10.30 am in the presence of magistrate, police investigating officer and relatives of the victim.

The site was dry and the soil was light brown in colour and sandy in nature. On removal of the heap up top soil the size of the grave was found to be about 1.7m long and 65 cm broad.

On further digging about 90cm deep the body was found wrapped in a mat made of palm tree leaves and white cloth but without any dresses or coffin. The body was recovered and shifted to the G.R.H. Mortuary for the second autopsy examination.

#### Autopsy Findings:

Though the body was in a state of decomposition most of the external features were well preserved except the eyeballs which were sunken and liquefied. The total length of the body was 170 cm with an average built.

The scalp hairs and other body hairs were intact but they were loose and easily pluckable. Epidermis was peeled off irregularly and slippery with degloving and destocking of skin over both hands and feet respectively. However, dermis was intact all over the body.

Incisions of previous autopsy were seen in the head and neck-chest-abdomen region.

A faint oblique ligature mark of about 2.5 cm broad and 19 cm long was noted around the neck below the chin and above the thyroid cartilage. We examined the ligature mark after cleaning the loosely attached epidermis and beard. (Fig. 1)

This ligature mark was placed 8 cm below the right mastoid prominence and it ran obliquely upwards just behind the left mastoid.

The ligature mark was very faint on the back side of the neck and it was absent just behind and above the left mastoid prominence (knot mark area).

The underlying subcutaneous tissue was found to be relatively hard and decomposing without any bruising. Soft tissues of the neck along with the hyoid bone, thyroid cartilage and carotid vessels were missing (due to first autopsy). Other autopsy findings were non-informative.

It was followed by crime scene visit. The incident took place inside a small tiled roof house which is situated at the outskirts of a village. Even after the 12<sup>th</sup> day of the incident, we were able to elicit the dust disturbance on the beam and on further examination we spotted adherence of few green fibers which later on found to be matched with the used ligature material retrieved by the police.

In addition to all these, we examined 13 photographs taken at the scene of crime before the body was brought down by the police. (Fig. 2) One of the photographs showed presence of trickling of saliva (dry stain) from the right angle of the mouth to the corresponding front aspect of the chest. In another photograph we observed dripping of fluid blood from the anus down to the lower portion of the inner aspect of the left knee.

From some of the photographs we also come to know that there were emission of seminal fluid and urination.

### **Discussion:**

In the present case the relatives of the victim alleged homicidal hanging because of the bleeding from the nose and anus when they saw the dead body on the next day just before the first autopsy. Their suspicion grew even more because of the prevailing circumstance. So, they filed a police case and accordingly a magisterial inquest was done leading to the exhumation and the second post-mortem examination.

In hanging there may be frank bleeding from the nose, and more so from the ears due to massive venous congestion of the mucous membranes of the nose or eardrum. [2]

This may be even more prominent with the onset of decomposition. Sometimes, bleeding from the mouth can also be due to injuries to the mucous membranes of the tongue or lips due to convulsions, with corresponding biting injuries, the convulsions resulting from cerebral hypoxia. [2] In the present case bleeding from the nose seems to be an artefact due to venous congestion and changes of decomposition as there was no evidence of bleeding when the body was in hanged position (as per available crime scene photographs).

Available literature mentions frequent observation of discharge of faeces, urine and semen in hanging cases. [2] However, we do not come across any literature mentioning bleeding per anus in hanging cases though it is quite possible that post mortem slow trickling of blood from engorged veins of the muco-cutaneous junction of anus as the body remained suspended for a long time.

Another possibility is the presence of anal fissures or ant bites which facilitate passive bleeding due to rupture of highly engorged veins due to prolonged body suspension though we could not rule out due to changes of decomposition. We were sure that it could not be due to an injury because we examined the surrounding area by giving multiple incisions during our second autopsy. (Fig 3)

Moreover, there was no soiling of blood on the worn lungi which was intact and the pattern of bleeding was very self-explanatory as it formed a single trail along the line of gravitational pull (as noted from one of the crime scene photographs).

So, after looking into all these findings and based on their scientific explanation we concluded that it was a case of suicidal hanging. The second aspect of this case report is the persistent ligature mark in an exhumed body.

The ligature mark of hanging resist putrefaction due to the displacement of blood from the area which retards the access and activities of the bacteria [3, 4] and it has been seen in bodies exhumed 6 days after death. [3]

However, this range of persistence of ligature mark in such exhumation cases may vary widely from 3 to 20 days as reported by Rajesh Bardale et al [5] and up to 2 months by Grellner W and Glenewinkel F [6] respectively.

This longer duration of persistence of ligature mark in the western scenario may be due to better body preservation because of use of coffin and deep burial which delay the rate of putrefaction.

**Conclusion:**

From the police and the relatives we came to know that the victim was hiding with his fiancé in a secluded house located at the outskirts of a remote village. After dropping her near to a local police station he returned and committed suicide as there was no hope of escape and fear of impending police arrest. This theory of suicidal hanging is also quite consistent with the pattern of the ligature mark, crime scene findings and the corroborative evidence derived from the photographs taken before the body was removed and in addition to all these, the point of suspension was also easily approachable by the suicide.

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**Fig. 1: Persistent Ligature Mark after Cleaning Epidermis**



**Fig. 2: Ligature as seen in one of the Photographs taken by Police**



**Fig. 3: Multiple Incisions to Rule out Physical Violence**



## Case Report

# Self Destruction by Using Multiple Methods in a Single Episode: A Case Report

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### Abstract

Suicide means taking away of one's own life. India being a developing country adopts various means and methods for commission of suicide. Although the prevalence of suicide throughout the world is not accurately available, however, the reported rate of suicides is consistently higher among men as compared to women irrespective of age group. Employing multiple successive attempts and using various methods ultimately leading to suicidal death is rare in occurrence. Complex suicide refers to a suicide in which more than one suicide methods is adopted. Complex suicide is further subdivided into two types Primary (planned) and secondary (unplanned).

In the Forensic literature, complex suicides have been reported to account for about 1.5%–5.0% of all suicides. A young mentally disturbed person in the background of multiple substance abusers, with history of previous suicide attempt, which are the markers of severe psychopathology, adopted multiple means in the same occasion for commission of suicide is presented.

**Key Words:** Suicide, Multiple Methods, Substance Abuse, Psychopathology

### Introduction:

Suicide means taking away of one's own life voluntarily. [1] Suicide is a significant public health problem in the world because many precious lives are lost every year by self-destruction. Reported rates of suicides are consistently higher among the men than women regardless of the age group. India being a developing country adopts various methods for commission of suicide.

Suicides are divided into two categories: simple and complex. Complex suicide refers to a suicide in which more than one suicide methods is adopted. [2] Complex suicide is further subdivided into two; Primary (planned) and secondary (unplanned). [3]

A case employing multiple successive attempts and using various methods, ultimately leading to suicidal death is presented here.

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### Case History:

The deceased was a 24 year old young unmarried and unemployed Muslim male from a lower socio-economic status.

The man was distraught over his girlfriend cheating on him and was depressed. He was addicted to ganja and alcohol; he attempted suicide twice before by slashing his wrist and by hanging but failed. He was missing for last one day when his decapitated body was discovered by the nearby railway crossing. The dead body was sent to N.R.S. Medical College for autopsy.

### Autopsy Findings:

1. The head was grossly mutilated by traumatic avulsion laceration and multiple fractures of all cranial bones and mandible in piece meals; some pieces were lost and gross mutilation of face caused inability to reconstruct facial appearance
2. Meninges were torn and brain matter was completely extruded out and lost.
3. Few pieces of upper and lower jaw with teeth were available
4. The neck was severed at level 2.5" above suprasternal notch and severed margin of skin beard pressure abrasion, bruise, and rusty stain. The severed end of soft tissue under skin extends 4" above skin margin, i.e. the wound at severed neck was 6" (T. l.) x 4" (ht) x 5" (A.P) depth, causing severance of muscles, vessels, pharynx, larynx,

oesophagus, fracture of C-1 vertebra through and through separating all the structures at that level.

5. One transverse linear clean cut incised wound 1.5" long upto the depth of subcutaneous tissue placed 4.5" proximal to left wrist on ventral surface of left forearm.
6. Another similar linear transverse incised wound 1.8" long and muscle deep, slightly spindle like appearance, ½" above wound no. 5
7. Similar linear transverse incised wound parallel to injury no.5 & 6; placed ½" above injury no. 6. These are fresh ante mortem injuries, show vital reactions.
8. Old glistening linear transverse parallel scars about 15 in no. present in same forearm above and below injury no.5, 6, and 7.

**Discussion:**

In the Forensic literature, complex suicides have been reported to account for about 1.5%–5.0% of all suicides. Using multiple methods for self-destruction in a single episode occurs very rare. The victim intentionally uses a variety of backup (simultaneously or chronologically) methods to ensure a successful suicide. [4]

In planned complex suicides two or more methods are employed simultaneously in order to make sure that death will occur after failure of previous attempt. [5-7]

In unplanned complex suicides, several other methods of suicide tried after the first chosen method either failed or was too painful.

**Conclusion:**

Friends or Relatives of the victim may provide background information such as history of depression, substance abuse, marital, social, or financial problems, previous suicide attempts, from which incidence can be interpreted in favour of suicide.

Autopsy processes should be performed carefully in complex suicides in which more than one method is used. A young mentally disturbed person in the background of multiple substance abusers, with history of previous suicide attempt, which are the markers of severe psychopathology, [8, 9] adopted multiple means in the same occasion for commission of suicide.

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**Fig. 1: External Appearance of Body**



**Fig.2: Both Old & Fresh Cut Marks over Lt Forearm**



## Case Report

### A Conflicting Case of Strangulation: A Case Report

S. D. Wakde

#### Abstract

A female aged 25 year was brought with a history of found unconscious at home, the body was sent to Government Medical College and Hospital, Aurangabad, Maharashtra for a medico legal post mortem. Deceased was having a ligature mark over anterior aspect of neck suggesting it as a case of hanging accompanied by few external injuries like abrasions over face and chest consistent with fall at ground level. On conclusion of autopsy, the cause of death was found to be strangulation.

The process of strangulation, whether by hand (manual) or by ligature, results in blunt force injury of the tissues of neck. The pattern of these injuries allow us to recognize strangulation as a mechanism, and to distinguish strangulation from other blunt injuries including hanging, traumatic blows to the neck, and artifacts of decomposition. These classical finding were absent in this case. Absence of these characteristic findings could easily misinterpret such a case as that of hanging. Therefore I am presenting this case.

**Key Words:** Ligature mark, Abrasions, Neck tissue injuries, Homicide

#### Introduction:

The process of strangulation, whether by hand (manual) or by ligature, results in blunt force injury of the tissues of neck. The pattern of these injuries allow us to recognize strangulation as a mechanism, and to distinguish strangulation from other blunt injuries including hanging, traumatic blows to the neck, and artifacts of decomposition. [1-7]

With its relatively small diameter, lack of bony shielding, and close association of the airway, spinal cord, and major vessels, the human neck is uniquely vulnerable to life-threatening injuries.

Throughout recorded history, various methods of strangulation (i.e. disruption of normal blood and air passage in the neck) have been used by both assailants and penal systems to produce injury and death. [8]

“Strangulation is the condition of violent asphyxia death in which, the exchange of air between the atmosphere and the lungs is prevented by way of constriction of neck by means of a ligature material or by some other means, without suspending the body of the victim, where the force of constriction is applied from outside (exogenous in origin) and is not the weight of body or the head of the victim. [9]

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#### Case Report:

On 17<sup>th</sup> October 2012, female aged 25 year with a history of found unconscious at home, was brought dead to Government Medical College and Hospital, Aurangabad Maharashtra. She was subjected to strangulation by use of sari, the body was sent for a post-mortem.

#### Autopsy Findings:

The body was of normal built female. There were following injuries over the body:

- Ligature mark at front of the neck above the level of thyroid cartilage which was running horizontally backwards and upwards.
- Abrasion of size 0.4 x 0.5 cm at the tip of nose.
- Multiple abraded contusions ranging from 0.2 x 0.2 to 1 x 1.6 cm over inner aspect of lips.
- A small linear abrasion of length 1.cm over right para-sternal region of chest, near xiphysternum.
- Abrasion over right mid submandibular region of size 1x0.6 cm.
- Contusion observed over upper one third of esophagus, over an area of 3x3 cm, which was the only significant internal autopsy finding going in favor of strangulation.

At the end of autopsy the cause of death was attributed to **asphyxia due to ligature strangulation.**

#### Discussion:

Strangulation is differentiated from hanging by findings of superficial subcutaneous

neck tissue injuries. The ligature mark is at or below the level of the thyroid cartilage. It is circular, continuous, abraded and contused and sometimes parchmentized. The mark of knot is usually in front but may be at any place. In many cases, ligature material is left around the neck after death of the victim.

The face is highly congested and cyanosed. The eye may be partly open and the eyeballs and the tongue are protruded. Tardieu's spots are more abundant than in case of hanging and are present on the forehead, temples, eyelids, and under the conjunctiva. There may be wide areas of sub conjunctival hemorrhage. There may be bleeding from the nose. Involuntary discharge of urine and fecal matter is more common in cases of strangulation than hanging.

Strangulation, being mostly homicidal, in most cases there may be presence of marks of resistance on the body. The most important internal findings lie in the neck. The subcutaneous tissue underneath the ligature mark is contused, often torn at a few places with gross extravasations. In case of strangulation by ligature, fracture of the superior horn of thyroid cartilage or subluxation between the two sides may be expected. [9]

These classical finding were absent in this case. Absence of these characteristic findings could easily misinterpret such a case as that of hanging.

**Conclusion:**

Deaths due to compression of neck are one of the most important areas of investigation of unnatural deaths encountered in day to day medico legal works. The nature of violence at neck is so wide and varied that is challenging task for autopsy surgeon on many occasions. Therefore careful and meticulous study of every case is mandatory to bring out comprehensive / wide verities of observations in deaths due to compression of neck and also to differentiate the manner of deaths.

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**Fig.1: Ligature Mark over Anterior Neck**



**Fig. 2: Abraded Contusions over Inner Lips**



**Fig. 3: Neck Dissection Show Clear Field**



**Fig. 4: Contusion over Upper Esophagus**



## Case Report

### Reconstruction of a Shotgun Injury: A Case Review

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#### Abstract

Every firearm case is unique in the sense that the behavior of the missile from the movement it leaves the gun barrel till it ends its journey. According to the internal ballistics interpretation of which is the task before carrying post-mortem examination, of every firearm injury is very interesting and specific to the case. This is so because of innumerable variables affecting the entire process. Crime scene reconstruction is the process of determining or eliminating the events and actions that occurred at the crime scene through analysis of the crime scene pattern, the location and position of the physical evidence including deceased body and the autopsy findings and laboratory examination of the physical evidence. Here with we are reviewing case of muzzle loading shotgun injury resulting in death in which investigating officer has suspicion about death as deceased sustained multiple firearm injuries.

This case highlights the importance of posture of the victim interpreting the resultant injuries and recreating the scene of occurrence. A meticulous autopsy, examination of weapon and reconstruction of scene of crime in order to elucidate the manner of death are of great importance in firearm cases.

**Key Words:** Muzzle loading shot gun; Reconstruction of scene of crime; Autopsy

#### Introduction:

Gunshot injuries occur when someone is shot by a bullet or other sort of projectile from a firearm. Peace time gunshot injuries occur in a variety of different situations: criminal and terrorist incidents (including shots fired by law enforcement agents), attempted suicides as well as unintended firearm 'accidents' (both civilian and amongst the armed forces). [1]

Only few percent of firearms-related deaths each year are caused by accidental shootings. Unintentional firearm injuries constitute a small but significant fraction of all firearm injuries in developing countries. Contrary to what many people believe, having a gun in your home doesn't make you safer but instead endangers you and your loved ones.

A gun in the home makes the likelihood of homicide three times higher, [2] suicide three to five times higher, [3, 4] and accidental death four times higher. [5]

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The majority of deaths from firearms are suicides or homicides. It should be noted that Guns contribute only a small proportion of accidental deaths in our country compare to other accidental deaths like road traffic accident, asphyxia, poisons etc. The direction of firing may become a point of great medico legal interest towards determining the relative position of the victim at the material movement. So during autopsy of firearm cases complete and careful examination of entry and exit wounds plays the major importance.

In this paper the importance of reconstruction of scene of crime including autopsy, when dealing with the firearm death is emphasized.

#### Case Report:

Deceased 45 years old male was brought to our mortuary with history of shot gun injuries. Weapon of offence is muzzle loading gun was also brought by the police for examination. (Fig. 1) At scene of crime body was lying on floor with dismantled muzzle loading shot gun beside dead body.

Investigating officer had suspicion about cause of death as deceased sustained multiple shotgun injuries over lower half of body. Before autopsy whole body X ray was taken. X ray showed few pellets (bicycle ball bearing) in the left hand, left leg and left thigh and a lead shot with multiple pellets in pelvic cavity.

### Autopsy Findings:

On external examination, two lacerated slap wounds (Fig.1) were noted one over dorsum of left thumb of size 3cm X 1.5cm X Tendon deep and another over front of left leg at its middle one third of size 5cm X 4cm X Muscle deep. Both slap wounds were surrounded by scorching of skin, singeing of hairs, blackening and tattooing. Oval shape entry wound of size 2.5cm X 1.5cm was present over inner aspect of left thigh and surrounding skin showed scorching, singeing of hairs blackening and tattooing. Multiple exit wounds of few pellets noted over left inguinal region. (Fig. 1) Lead shot over sacral region could be palpable.

On internal examination peritoneal cavity filled with blood, iliac vessels lacerated, coils of ilium at pelvic cavity were lacerated and S-3 vertebra fractured and lead shot (slug) was lodged below skin at sacral area. Other organs were pale and unremarkable. Bicycle ball bearings used as pellets were found around pelvic cavity. Coconut coir used as wad found at exit wound at left inguinal area.

The track of the entry wound was slap wound over left thumb and left leg, entry wound over inner aspect of thigh, runs upwards towards left groin, lacerating femoral and iliac vessels, coils of intestines, fracturing of S-3 vertebra, lead shot lodged subcutaneously over sacral area. (Fig. 2) Whole track was lacerated and hemorrhagic. After autopsy weapon involved in the act was examined. It is old single barrel muzzle loading shotgun in which barrel was separated from breech of shotgun.

Rod used for loading gun powder, lead shots and wad (coconut coir) was also examined. Before conducting autopsy clothes and multiple swabs from both hands were collected for ballistic examination. Coir and pellets recovered from body were also preserved for ballistic examination.

### Discussion:

A firearm is an instrument or device, which forcefully ejects out a projectile through its muzzle because of expansive force of gases generated by combustion of explosive gunpowder particles. Firearms can broadly divided into rifles which discharge bullets and smooth bored or shotgun which discharge pellets. [6] A shotgun consists of one or more metal barrels of relatively wide diameter, which are smooth on the inner surface.

The ammunition for the shotgun is a cartridge made of a cardboard or plastic cylinder fitted into a metal base. They fire a variable number of spherical lead shot (pellets), which

emerge from the end (muzzle), from where they gradually diverge in the form of a long, narrow cone. Sometimes, a shotgun may fire a few large projectiles or even a single slug, but these are rarely met with in forensic practice, the usual load of pellets totaling scores of hundreds. [7]

Wound ballistics is study of the injuries produced in the body by the firearms. For a medico legal expert, an elementary knowledge of structure of firearms and ammunitions, together with an idea about the mechanism of discharge of projectiles, will be essential for proper understanding and interpretation of injuries caused by firearms. [6]

Self-inflicted gunshot wounds show a male predominance, although women are frequent victims in some jurisdictions. [8]

In most cases, the deaths occur at home or its vicinity. [9] In cases of accidental firearm injuries, often the door is not secured from the inside (e.g., locked, wedged by chair), and finding a firearm, particularly in proximity to the deceased, is supportive of accidental with any unusual circumstance. Sometimes the suicide victim may attempt to create a "gun cleaning" or "hunting" accident. [10]

Careful investigation is needed to determine whether discharge of a gun under these circumstances was an accidental death. Suspicions are aroused when handguns are involved in a hunting incident. [11]

There are various reasons why multiple shots are fired in a suicide or accident lacking anatomical knowledge, the victim misses vital organs; the victim's hand flinches when the trigger is pulled; defective, improper, or low-velocity ammunition is used and penetrates the body (e.g., skull) superficially; and certain types of weapons are used. [10, 12-14]

Certain features on the hands support the circumstances of accidents, particularly in multiple shot cases. [15] In such cases some of the investigation to be carries out like:

- 1) The hands need to be covered by paper bags to protect evidence, particularly if there are suspicions surrounding the death [10]
- 2) Fingerprinting and hand washing, as part of body preparation prior to the pathologist's examination must not be done
- 3) Primer residues, not visible to the naked eye, are deposited on the hands that should be collected. [10, 16]
- 4) Jeopardize the documentation and collection of evidence. [10, 17]

Blood and/or tissue (e.g., brain matter, if a head wound) owing to blowback ("backspatter") may be found on the dorsum of the hand that fired a pistol/revolver (firing hand)

and the hand that steadied the muzzle (non-firing hand). [10, 13, 17]

If the non-firing hand is used to steady the end of the muzzle of the handgun, rifle, or shotgun, and the muzzle is not tightly opposed to the skin, then soot can be deposited on the thenar aspect of the palm, i.e., the index finger and thumb ("muzzle gap effect"). [10, 15]

Postmortem radiography is an essential component of firearm injury examination. Antero posterior and lateral radiographs assist in determining the location, nature, and path of projectiles in the body. [21]

Lateral radiographs are particularly helpful if there is an anterior torso entry and the bullet does not exit from the back. Reliance on only antero-posterior radiograph leads to a mistaken assumption that a bullet is deep within the body, resulting in a time-consuming search.

The posterior location of the projectile, indicated on the lateral radiograph, means that simply palpating and incising the skin on the back allows easy recovery. More sophisticated radiological techniques (MRI, CT) may play a role in the assessment of firearm injuries. [18]

The direction of the wound track in relation to the deceased must be documented. The trajectory can favor self-infliction. [19]

Unusual trajectories require reconstruction based on different body positions. [20] Apparent hunting accidents, masking suicides, have contact wounds. After every case of firearm injuries, examination of firearm plays a major role. Firearms need to be examined by other experts for evidence of misfiring. [21]

There may be a need to reconcile an apparent discrepancy among the autopsy, scene findings, and circumstances of the death. [22]

Fingerprints of the deceased may be seen on the cartridge or firearm. [23, 24] In one study, fingerprints were found on the gun in 12% of cases. [25] On perusal of crime scene report, examination of weapon, postmortem and ballistic report following conclusion was drawn.

In our case deceased was found inside the house and he has not secured or bolted his door. Weapon of offence was found beside body which was dismantled. No history of depression or suicidal note.

The range of firing was close range. Single round of shot was fired. Track of entry and exit wound gave the idea about posture of victim during incident. Deceased was sitting on floor with flexing his left leg at knee, holding the muzzle end with left hand loading his old muzzle loading gun using the rod with right hand, when shot gun accidentally got fired.

The cause for accidental firing may be the friction in barrel by rod while loading gun powder and pellets which ignited the gun powder, since loading of barrel is very sensitive technique. Homicide and suicidal motive was ruled out. All the above findings concluded that it was an unintentional or accidental firearm injury. A vigilant crime scene investigation, meticulous autopsy, recreation of scene of crime and circumstances of death in order to elucidate the manner of death are of great importance in such cases.

### Conclusion:

The distinction between homicide, suicide and accident is a complex and central issue in Forensic Medicine.

Detailed examination of the crime scene, careful and complete autopsy of the deceased person, anamnesis, collaboration and information exchange among investigators and Forensic specialists will help for the correct interpretation of these interesting cases.

Every firearm cases are unique in the sense that the behavior of the missile and the injury produced by it. This firearm injury resulting in death highlights the importance of posture of the victim.

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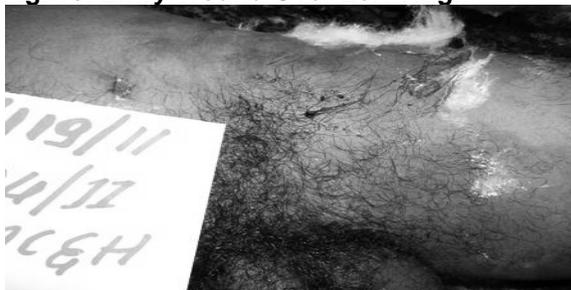
**Fig. 1 a: Entry Wound Over Left Thumb**



**Fig. 1b: Entry Wound over Left Leg**



**Fig. 1c: Entry Wound Over Left Thigh**



**Fig. 1d: Few Exit Pellets Wound at Left Groin**



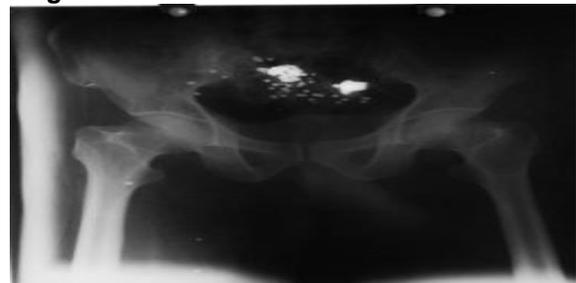
**Fig. 2a: Track of Entry Wound**



**Fig. 2b: Dismantled Muzzle Lading Shotgun**



**Fig. 2c: Pellets in Pelvic Cavity and Left Thigh Area**



**Fig. 2d: Pellets in Left Thumb Area**

