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## Contents

Sr.		Page
I.	From the Editor's Desk	03-03
II.	Editorial	04-07

## Original Research Paper

1.	Estimation of Age of Ossification of Hyoid Bone by Radiological Examination of Autopsy Specimen <i>K.V.Vinoth.,T.Vedanayagam</i>	08-10
2.	Study of Students' Perceptions on Evidence Based Curriculum of Forensic Medicine <i>Pragnesh Parmar</i>	11-15
3.	Analysis of Profiles of Hanging Deaths in Coastal Odisha <i>Soumya Ranjan Nayak, Subal Kumar Naik, Ashok Kumar Samanta, Manoj Kumar Jena</i>	16-18
4.	Study of the trend of poisoning in a tertiary care hospital in Chidambaram, Tamilnadu <i>Dipayan Deb Barman, Vijaya Kumar Nair. G, R. Karnaboopathy</i>	19-24
5.	Role of Consent in Medical Practice: A Survey Amongst Registered Medical Practitioners <i>Praveen Arora, Ashwini Kumar B. Sapate, A. L. Ghangale, Sandesh B. Datir, Madhusudan R. Petkar</i>	25-28
6.	Determination of Stature from Sternum in Central Delhi Population <i>Mohit Gupta, Anil Kumar</i>	29-32
7.	Use of Tertiary Trauma Survey Sheet to Improve the Quality of Medicolegal Reports <i>Prasad L. Jaybhaye, Ashutosh B. Potdar</i>	33-36
8.	Study of deaths in railway accident in medico-legal autopsy <i>Anil Shandil, Shiv Ranjan Kumar</i>	37-39
9.	Dermatoglyphics as a Preliminary Diagnostic Tool in Leukoplakia, Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma <i>Smitha. V, Ahmed Mujib. B. R, Neethu Telagi, Manjunath. A. B, Divyasri Godavarthy, Shalini.G</i>	40-45
10.	Assessment of Skeletal Maturity by Radiological Study around Wrist Joint in Vidarbha Region <i>Ritika Gaddewar, M.M.Meshram</i>	46-50
11.	Fingerprint Ridge Density – A Tool for Sex Determination <i>Ajay Kumar S, Prasanna S Jirli, Ravindra S Honnunar, Raghavendra Babu Y.P, Vinay kumar M.S</i>	51-54
12.	Sexual Dimorphism of Hyoid Bone- A Study of Adult Population in Bhopal Region of Central India <i>Kumar Gyanendra, Kurveti Priyamvada, Yadav Jayanthi, Dubey BP</i>	55-58
13.	Trends and Patterns of Sexual Offences in Western Odisha <i>Seema Perei</i>	59-62
14.	Endosulfan toxicity: A Retrospective Study and Review <i>Fakhar Alam, Umer Bin Abdul Aziz, Ahmad Nadeem Aslami</i>	63-66
15.	Trends and Reasons of Suicide deaths by Hanging: Analysis of 431 Cases Autopsied at Medical Teaching Institution in India <i>SH Bhosle, NP Zanjad, MD Dake, HV Godbole</i>	67-72
16.	Carpals – The Tiny Markers of Age Estimation by Digital Radiography <i>Saiyed MZ, Shah SS, Jani CB</i>	73- 77
17.	Profile of Cases Booked Under POCSO Act in Chamarajanagar District, Karnataka <i>Yadukul.S, Vidya Sagar, Rajeswari, Kavyashree HS</i>	78- 82

18. **Width of Sternum at Suprasternal Notch and at the Level of Fourth Rib for Determination of Sex in the Population of Delhi: A New & Reliable Tool for Sex Prediction** *Rajendra Baraw, Jyoti Barwa, Monisha Pradhan, S. K. Khanna* 83-87
19. **Estimation of Stature from the distance between two Anterior Superior Iliac Spines** *Viral N Chauhan, Hetal C Kyada, H.M.Mangal, Sunil M Doshi, Viral J Aghera, Dipen M Dabhi* 88-91

## Case Reports

20. **Sudden Death in Young- A Case of Hypertrophic Cardiomyopathy** *Pradeep Kumar Mishra, Mandar R. Sane, Divyesh Saxena, Jitendra S. Tomar, Amit Yadav* 92-94
21. **Jatropha Curcas Poisoning: A Case Report from KEM Hospital, Mumbai** *H.K.Khartade, H.M.Pathak, M.B.Parchake, A. H. Hosmani* 95-97
22. **Death due to an iatrogenic injury to vital organ at the outset of operation: A case of Medical Negligence** *Bhore DV, Chavan GS, Nanandkar SD* 98-100
23. **Death Due to a Rare Complication of USG-Guided Needle Aspiration of Liver Abscess: A Case Report** *Shashank Pooniya, Abhishek Yadav, Chittaranjan Behera, Sudhir Kumar Gupta* 101-103
24. **Neurological Manifestation and Methemoglobinemia in Unintentional Thinner Intoxication** *Vinod Ashok Chaudhari, Shivkumar R. Kolle, Sachin S. Sonawane* 104-106
25. **Sudden Unexpected Maternal Death from HELLP Syndrome: An Autopsy Case Report** *Pawan Mittal, Jai Prakash Soni, S.K. Dhatarwal, Meenu Mittal* 107-110

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## From Editor's Desk

**JIAFM**

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*Dear Friends,*

One year has gone by and we now place the 1st issue of 2017 in your hands. At the Conference at Mumbai, we had successfully distributed around 500 copies of the Journal to the members.

The GB at the Conference was appreciative of our sincere efforts to upgrade the standard of the Journal. However, the standard of any Journal depends on the standard of the manuscripts received. We receive **Very Few interesting** manuscripts. The rest are just 'counting of the dead bodies' in the name of 'Original Research'. We, the Editorial Team, once again request you to kindly send us interesting and 'publish-worthy' manuscripts.

It is further re-iterated that "All original research work should be accompanied by the approval of the Institutional Ethics Committee otherwise they will not be accepted." Again, it was decided in the GBM that non-life-members should pay extra for their manuscripts to be published. **"As per the Mumbai Guidelines, if the 1st and the Corresponding author(s) is/are NOT a life Member(s), the Manuscript Handling Charges would be 1500/- Rupees, instead of 1000/-"**

Please help us to serve you better.

*Jai Hind & Long Live IAFM*

*Dr Dasari Harish*  
Editor

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**Editorial**

## **'Virtopsy' (Virtual Autopsy) - How Far is it Feasible in our Country?**

<sup>1</sup>Dasari Harish, <sup>2</sup>Mandar R Sane

### **Abstract:**

Radiological techniques have been in use in the field of Forensic Medicine for more than 100 years. In the recent past, Computed Tomography (CT) has gained a lot of importance the world over, in our field as an important tool for documentation and analysis of postmortem findings, either on its own or in combination with Magnetic Resonance Imaging (MRI), due to newer innovations and decreasing cost. Newer terms have been coined in this area by researchers in the field - Virtopsy (Virtual Autopsy), Forensic Geomatics, etc. In some of the countries, these techniques have replaced the traditional autopsy methods for postmortem examination purposes.

In our country, it has been made mandatory that a proper and well equipped mortuary of a tertiary care center should have a digital X ray unit. How many mortuaries have complied with this? Are these techniques and innovations of use in our country, where simple basics like gloves/ scalpel blades/ containers for viscera preservation, etc are woefully missing and have to be sourced from the relatives of the deceased? We even lack proper cold chambers in proper working condition in most of our mortuaries. We have to depend on/ are at the mercy of the Dept. of Radiology for even an X ray of the body. We should first strive to make the mortuaries, up to district level self- sufficient, before we can even think of such techniques. May be one or two premier institutes can be provided with these facilities so that further research in this field in Indian conditions can be undertaken.

**Key words:** Virtopsy, Virtual autopsy, CT Scan, MRI, imaging, mortuary.

### **Introduction:**

Human body imaging was first used in 1895 by Wilhelm Conrad Roentgen, a professor at Wurzburg University in Germany, who is credited with the first human X-ray image. The term 'X rays' was also coined by him.<sup>1,2</sup> In the very same year, X-rays were introduced as evidence in a court, demonstrating a bullet in the leg of a person who was shot. Based on the evidence, the perpetrator was sentenced to 14 years in prison.<sup>3</sup> Hence, we can safely state that Radiology has been in use in Forensic Medicine for the last 120 yrs. Newer techniques like CT, MRI, Multi Detector Computed Tomography (MDCT), Multi Slice Computed Tomography (MSCT), high resonance micro-CT and micro-MRI, Magnetic Resonance Spectroscopy, etc have been added to this vast array of scientific investigative tools in the medical field.

It was not long before these advances were put to use in the Forensic field. During the recent past, these imaging techniques have undergone tremendous advancements.

They have also been used successfully in postmortem examinations so much so that now we have a non-invasive branch in Forensic Medicine - Virtopsy. Prof. Richard Dirnhofe, the former head of the Institute of Forensic Medicine at the University of Bern, Switzerland, was the pioneer in this field. It was he who coined the term 'Virtopsy' or Virtual Autopsy to describe a "combination of radiological techniques as an alternative to the traditional autopsy for documentation and analysis of postmortem findings, with an aim to complement or replace the traditional autopsy in selected cases". It is a combination of the two words - 'virtua'l and 'autopsy'.<sup>4</sup>

MRI as an alternative to traditional autopsy was first introduced by Brookes, et al, in 1995.<sup>5</sup> The first publication was in the Lancet in 1996.<sup>6</sup> They examined 20 still born/ aborted fetuses both by the traditional autopsy and by MRI. They found that in 60% cases, MRI yielded better and more extensive information than actual dissection and that in 90% cases, MRI findings were of equal importance. MRI as an alternative, non-invasive technique has also gained importance owing to the fact that the rate of pathological autopsies has dwindled to < 10% in adults, the world over.<sup>7</sup> Since then, non-

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invasive techniques have become the norm for the living and are being advocated as better alternatives for the dead too.<sup>8</sup>

However, other pathologists argue that necropsy/ traditional autopsy is essential, not only for the collection of samples for further studies, but also because an MRI can never replace a pathologist's dissection and sample testing so as to provide better services.<sup>9,10</sup> Even Thali, et al observed that these imaging techniques have not been of much use in detecting vital reactions.<sup>11</sup>

### Virtopsy:

In a number of European and Middle East countries, a complete autopsy, as is done in India, is not required and is decided on a 'case to case' basis. The District Attorney may order just a 'legal inspection' - only external examination or a complete autopsy, based on the circumstances of the case. Most require only a "legal examination" and any other tampering of the body is strictly prohibited. Whether or not a complete autopsy is required is solely decided by the District Attorney, in consultation with the Forensic Pathologist who performed the Legal Examination.<sup>12</sup> The reason for this "legal Examination" is the increasing reluctance by the relatives to allow any mutilation/ tampering of the bodies of the deceased.

Thali and co-workers are pioneers in this field and have conducted several studies on the subject.<sup>11-14,17,19,20,22</sup> According to them, imaging techniques were superior to traditional autopsy in highlighting certain cases of bony and tissue trauma, diagnosing certain vital reactions and in reconstruction. These data can be sent anywhere in the world easily for teaching, quality control, telemedical consultation, etc.<sup>13,14</sup>

Francesca Cittadini, et al, used MDCT scanning in 3 charred bodies and found that MDCT identified several forensically useful findings, including certain injuries caused by means other than fire, vital reaction and foreign bodies in the corpses. They concluded that MDCT is an excellent tool for imaging in postmortem investigations and that it has great potential in the field of forensic medicine.<sup>15</sup>

Stephanie, et al, generated a full body 3D virtual reconstruction of the body of a 7 year old girl, who allegedly died of neglect and starvation, using 3D technology and anthropometry. They generated different models by extrapolating the 3D measurements of the girl to show comparisons between a normal girl of her age and her present condition to demonstrate the degree of neglect and abuse.

This was the first time that such an investigative tool was used in the court. They coined the term "Forensic Geomatics" to describe a discipline which "integrates the acquisition, modelling, analysis, and management of spatially referenced data for the purpose of investigation and prosecution of crime".<sup>16</sup>

The various techniques that are put to use in the 'Virtopsy' are:<sup>17</sup>

- 3D body surface imaging methods
- Multidetector and multislice computed tomography (MSCT)
- Magnetic resonance imaging (MRI)
- High-resolution micro-CT and micro-MRI (MR microscopy)
- Magnetic resonance spectroscopy (time-of-death determinations)
- Image-guided percutaneous biopsy & Postmortem angiography.

It has the following advantages:<sup>17</sup>

- It is observer-independent and gives objective data.
- It is nondestructive
- It is minimally invasive
- It provides actual-size documentation and basis for sound scientific reconstruction
- It provides an additional examination tool for difficult body area autopsy (e.g., face, pelvis)
- It could be used in cultures where autopsy is not tolerated by religion.
- It provides ability to examine bodies contaminated by infection, toxic substances, radionuclides, or other biohazards (i.e., bioterrorism)
- Database of digital archives can be generated for teaching, learning & education)

Virtual autopsy was successfully used in cases involving charred bodies,<sup>15,18</sup> wherein vitality of burns was dispelled; road traffic accident,<sup>19</sup> where a delayed cause of death was investigated; decomposed corpse,<sup>20</sup> involving homicide by head injury; child abuse,<sup>16</sup> where 3D virtual reconstruction of body was employed; identification of unknown by peculiar anatomical traits,<sup>21</sup> evaluation of gunshot wounds and also in a case of hanging<sup>22</sup> in which relatives had concerns regarding classical autopsy.

### The Indian Context:

X rays have been used in the field of Forensic Medicine in our country since long. Age estimation cases, injuries to the bony structures, firearm injuries, etc being a few forensically important situations. With the advent of CT and MRI in the treatment of the living, the same have

been used for giving medicolegal opinions. This is as far as the living go. What about extension of these services to the dead? Here, we are woefully short.

One of the landmark cases where X ray examination was used in the "2nd autopsy" was the Naina Sahni murder case or the 'Tandoor Murder' case, as it was popularly known.<sup>23</sup> Naina Sahni was murdered on the night of 2-3/7/1995 by her husband Sunil Sharma, who allegedly tried to dispose off her body by burning it in the Tandoor of Ashok Yatri Niwas Hotel, New Delhi. Because of the foul smell emanating from the tandoor, people got suspicious and police was informed. The body was taken to the mortuary of Lady Harding Medical College mortuary where the 1st autopsy was conducted. The forensic expert noted various "chop wounds" and amputations on the body and found "no evidence of firearm discharge from internal examination" even though police recovered cartridges, bullet and air pistol from the scene. Cause of death was given as "hemorrhage and shock consequent to various antemortem injuries on the body." The burns were reported to be postmortem.

The second postmortem examination was conducted by a Board which got the body X rayed before the start of the dissection. X ray revealed the presence of 2 bullets, one in the skull and the other in the neck region. These were retrieved and handed over to the police for ballistic examination. Cause of death was given as "Coma consequent upon firearm injuries to the head which were sufficient to cause death in the ordinary course of nature". The Sessions Court severely reprimanded the first doctor.

Since then, it has become a norm to get whole body X ray done at least in cases of Firearm injuries and in 100% burns. It is now being advocated that at least in tertiary care hospital mortuaries, Digital X ray unit should be made an integral part of the mortuary complex.<sup>24</sup>

### Condition of the mortuaries:

On September 16 2015, the Hon'ble Delhi High Court remarked<sup>25</sup> -

*"What the people have to endure" is "disgusting", and the apathy and the situation makes one "want to resign and run away."*

*"Is there any SOP or screening process?"...*

*"You think the mortuary belongs to dead people so everything there should be dead? The people working there are also dying."*

*"These tools belong in a museum"... The dead "cannot be butchered and hammered like this."* [This was after seeing the photographs of

the stained and rusted instruments in use at the 'Sabzi Mandi' mortuary].

This is about the condition of mortuaries in India's capital city and those attached to some of the premier medical colleges in the country.

Archit Watts of the Tribune News Service<sup>26</sup> describes the condition of mortuaries in Punjab and says, "The condition of mortuaries of government hospitals is poor."

According to Roy of the Times of India, Mumbai,<sup>27</sup> "Seventy nine health workers from mortuaries at Bhagwati hospital in Borivli, JJ in Byculla, Cooper in Juhu and Rajawadi in Ghatkopar have narrated their daily struggle to work in conditions where, at every step, they risk contracting biological hazards like bloodborne viruses and other infections, including HIV, hepatitis and TB. The workers have revealed how the four centres put together have over 200 unidentified bodies, which are in various stages of decomposition. Many corpses lie unwrapped on the floors as storage units have run out of space."

This is the condition of mortuaries in most parts of the country. In such a scenario, is it correct to even talk about these new innovations which cost up to 12 crores of Rupees just to set up a Virtopsy Center and then have a running cost of up to 2 crore Rupees per annum per facility?<sup>28</sup> These investigative tools - CT & MRI are still out of reach for most of the living patients in our country, what to say about the dead!!

As we said earlier, may be one or two premier institutes can be provided with these facilities so that further research in this field, in Indian conditions, can be undertaken.

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## Original Research Paper

# Estimation of Age of Ossification of Hyoid Bone by Radiological Examination of Autopsy Specimen

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### Abstract

Identification is essential in living persons, decomposed, mutilated bodies and skeletal remains. The three primary characteristics used for identification of a person are sex age and stature. Visual identification is difficult and impossible in cases of explosions, fires and mass disasters. In a living person, the bones would constantly undergo changes and these changes follow a chronological pattern which is used in Forensic medicine for determining the age of a person. In this study, a total of 155 cases were selected randomly from the cases brought to the Institute of Forensic Medicine, Madras Medical College, Chennai, during the period of 2011 to 2012 for medico legal autopsy. Permission from the Institutional Ethics Committee was obtained. Radiological examination of the hyoid bones was carried out and the data analyzed.

**Key Words:** Hyoid bone, Greater cornu, Fusion, Radiological examination.

### Introduction:

The time of appearance of centers of ossification and the process of union of the epiphysis with the diaphysis have a sequence and time period, which is of importance in age determination. The full permanent dentition and fusion of all ossification centers of long bones occurs by the age of 25 years. Estimation of age after 25 years is difficult both in the living and the dead. The changes that may occur between 40 . 60 years are the fusion of the body with the greater cornu of the hyoid bone, the fusion of the manubrium and xiphisternum with the body of the sternum, the lipping of the vertebrae, fusion of the cranial sutures of the skull bone and calcification changes of the cricoids and thyroid cartilages.<sup>1</sup>The ossification changes resulting in fusion of greater cornu of the hyoid bone with its body occurs in a wide age group. Fusion of the body with the greater cornu of the hyoid bone occurred as early as 18 years and on other end no fusion was found even in 8<sup>th</sup> and 9<sup>th</sup> decades.

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### Anatomy of the Hyoid bone:<sup>1</sup>

The Hyoid bone is U shaped. It develops from the second and third pharyngeal arches. It is positioned in the anterior part of midline of the neck between the chin and the thyroid cartilage and it lies at the level of third cervical vertebra. It consists of a central part called the body and one pair of greater and lesser cornua. The body of the hyoid bone is irregular, elongated and quadrilateral. The body is divided by a median bridge into halves. At the place where the greater horn and body meet, two small conical projections known as lesser cornua are present. The four stages of fusion of the body with the greater horn are non fusion, commencement of fusion, partial fusion and complete fusion.

### Aims and Objectives

- To estimate the age at which fusion of greater cornu occurs with the body of the hyoid bone, using radiological examination.
- To find out the sexual variations in the fusion of greater horn of the hyoid bone with its body.

### Material and Methods

This study was conducted at the Institute of Forensic Medicine, Madras Medical College, Chennai, during 2011-2012, after obtaining the approval of the Institutional Ethics Committee. A total of 155 autopsy cases in the age group of 30 to 60 years were included. The hyoid bone was dissected out from the neck.

After preliminary examination, the bones were subjected for X-ray examination in the antero-posterior view.

## Results

Of the 155 hyoid bones, 133 were of the male sex and 22 were of the female sex. To study the sequence of fusion stages, the cases/bones were subdivided into groups of 5 years age interval. The number of subgroup of 5 years interval was 6.

In the age group of 30-35 years, there were 42 samples, of which 38 were males. In the age group of 36-40 years, a total of 44 samples were collected, of which 36 were of males. There were 86 samples in group 1 & 2 put together, and there were no bilaterally fused bones. In group 1 & 2, there were 33 and 28 bones of bilaterally non fused bones, respectively. The percentage of bilaterally non fused bones were 78.5% and 63.6%, respectively in group 1 and 2. The remaining 9 in group 1 (21.5%) and 16 in group 2 (36.3%) were in various stages of fusion.

In the age group of 41-45 years i.e. group 3, there were 27 bones of which 22 were of males. In this group, 16 bones (59%) were bilaterally fused and only one bone was bilaterally non fused; while 10 bones (37%) were in various stages of fusion. In the age group of 46-50 years, i.e. Group 4, the number of bilaterally fused bones were 13 (72%) of the total 18 bones and the number of bilaterally non fused bone was only one. In group 3, only 4 bones were in various stages of fusion (22%).

In group 5 i.e. age group of 51-55 years, of the 18 bones, 15 (83%) were bilaterally fused and there was no bone in the non fused category and the remaining 3 bones were in various stages of fusion. In group 6 i.e. age group of 56-60 years, there were 6 bones out of which 4 were bilaterally fused and 2 were in various stages of fusion. There is no case of bilaterally non fused bone.

There is no single case of bilaterally fused bone till the age of 40 years and there was no case of bilaterally non fused bone after the age of 50. So the study group was divided into three groups at the interval of 10 years.

## Discussion

The joints connecting the body and greater horn of the hyoid bone is initially cartilaginous, but after the middle age they become ossified with marked individual variation. This study was done to narrow down

the age of ossification of hyoid bone in the South Indian population.

Parson had stated that bilateral fusion may occur between 30-40 years and is quite rare until fifth decade of life.<sup>3</sup> Vij<sup>4</sup> had conducted a study of 110 cases in Indian population and found that 39 subjects had bilateral fusion. The youngest age in whom fusion occurred was 18 years, and on the other end of the spectrum, there were individuals in the eighth decade where no fusion has occurred. Mukherjee, et al, in their study stated that the fusion occurred between 40-50 years.<sup>2</sup>

In the present study, out of 155 cases with an age group from 31-60 years, 48 cases showed bilateral fusion while 63 cases showed bilateral non fusion and 44 cases were in the third category i.e. various stages of fusion on either right side or left side. The percentage of these groups were 31%, 40.6% and 28.4% respectively.

Again, the youngest age at which bilateral complete fusion had occurred was 42 years in 3 cases, of which 2 were male while 1 was female. Proportion of bilateral fused cases was highest in the age group of 51-55 years, [15 cases, 83%]. While Females showed 100% bilateral fusion in the age group of 55-60 years, the males showed only 66% bilateral fusion.

The mean age of bilateral fusion was 42 years in a study by Deepak H D Souza,<sup>5</sup> which comprised of cases ranging from 12-70 years of age. Whereas, in this study, the mean age of bilateral complete fusion was 50 years. This is because majority of the cases were 40 years of age or older, whereas in Deepak H D Souza study the majority of cases were less than 40 years.

In the present study, one case showed unilateral fusion at the age of 57 years and complete non fusion on the other side. This proved that unilateral complete fusion may not be followed by fusion on the other side and there are no set sequential stages in the fusion in both sides. The process of fusion in each side is an independent process.

Again, the mean age of bilateral fusion in men was 50 years and 49 years in females. Statistically, no significant difference was observed between males and females. Hence, fusion of the body and greater cornu of the hyoid bone cannot be regarded as sex indicator. Miller in his study did not find any significant sex difference between male and female with bilateral fusion.<sup>7</sup>

In a study by OqHalloran, et al, females showed high frequency of unilateral non fusion<sup>6</sup> where as in this study, non fusion was seen in

17.3% males and 18.2% females. Thus, females showed relatively higher degree of non fusion than males in all the age groups.

We also observed that of the 155 hyoid bones, 11 were fused only on the right side and 5 were fused only on left side. Similarly, 8 cases from the study population show unilateral non fusion on the right side while 19 cases showed unilateral non fusion on the left side. 19 cases in the study group showed commencement of fusion on the right side while 11 cases showed commencement of fusion on the left side. Based on this, it can be deduced that right side fuses earlier than the left side. This is in contradiction Parson, et al<sup>3</sup> study which showed no specificity in the side of fusion.

**Table-3** shows the clear cut demarcation at 40 years and at 50 years. There was no case of bilaterally completely fused bone up to 40 years. There was no case of bilaterally non fused bone even commencement has not occurred after 50 years.

## Conclusion

- 1) In the South Indian population bilateral complete fusion was not seen below the age of 40 years.
- 2) Bilateral non fusion and not even commencement of fusion is not seen after the age of 50

**Conflict of interest:** None

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**Table-1.**Distribution of different categories of fusion with their percentage.

Age	Total Cases	Category-1 Bilaterally fused		Category-2 Bilateral non fusion		Category-3 Others	
		No	%	No	%	No	%
31-35	42	0	0	33	78.5	9	21.5
36-40	44	0	0	28	63.6	16	36.3
41-45	27	16	59	1	3.7	10	37
46-50	18	13	72	1	5.5	4	22.2
51-55	18	15	83	0	0	3	16.6
56-60	6	4	66	0	0	2	33.3
	155	48		63		44	

**Table-2 :** Cases in various stages of fusion

Age	Total Cases	Unilateral Fused		U. fused R or L	Unilateral NF		U. NF	Partial		Commencement	
		R. Alone	L. alone		R	L		R	L	R	L
31-35	42	0	1	1	2	7	9	0	0	7	1
36-40	44	3	2	5	2	8	10	2	4	9	2
41-45	27	4	1	5	3	2	5	2	3	1	4
46-50	18	2	0	2	0	1	1	2	0	0	3
51-55	18	0	1	1	1	1	2	0	1	2	0
56-60	6	2	0	2	0	0	0	0	1	0	1
	155	11	5	16	8	19	27	6	9	19	11

**Table-3:**Distribution in the age group of 31-40 years and 41-60 years

Age	Total cases	Category-1 Bil. Fused		Category-2 Bil. NF		Category-3 Others	
		No	%	No	%	no	%
31- 40	86	0	0	61	70.9	25	29
41-50	45	29	64.4	2	4.4	14	31.1
51-60	24	19	79.1	0	0	5	20.8

## Original Research Paper

# Study of Students' Perceptions on Evidence Based Curriculum of Forensic Medicine

<sup>1</sup>Pragnesh Parmar

### Abstract

**Background:** Evidence based education system is an innovative practice followed by Sumandeep Vidyapeeth and as a part of it, curriculum of Forensic Medicine is made evidence based. Evidence Based Forensic Medicine (EBFM) is providing platform to create Indian Medical Graduate (IMG) to be competent enough to choose right evidence according to need and develop lifelong learning potential for continuous professional development. Present study was done to know students' perceptions towards evidence based curriculum of Forensic Medicine as they are the beneficiaries of it. **Material and methods:** Consent form and Questionnaire (pretested and validated, Likert type scale) was formed to take the feedback of students on their perceptions regarding existing evidence based curriculum of Forensic Medicine. Questionnaire contained total 30 questions in various parameters like overall competency/evidence based need, educational experience, evidence based teaching, content and quality of syllabus, content and quality of teaching, evaluation/ assessment. Each question had response varied from strongly disagree to strongly agree. Feedback and suggestions given by the students were entered in MS excel sheet and analyzed via SPSS. **Results:** A total of 119 students were given the questionnaire, of which properly filled 100 responses were included for analysis and the rest 19 responses, which were either incomplete or not attempted, were ignored. Frequency and median score of various parameters and pertaining questions were calculated. Assessment or evaluation component of curriculum had median score of 3.5 while rest had median score of 3. There was no statistically significant difference between perceptions of male and female participants. Assessment or Evaluation part of curriculum, content and quality of syllabus were reflected as strength while rest parameters of curriculum like education experience, evidence based teaching, content and quality of teaching did not reflect as strength which inferred to be improved. **Conclusion:** It is acceptable that students' perceptions on evidence based curriculum of Forensic Medicine are very much important as they are the ultimate stakeholders who can in future serve to society in better way. Implementation of perceptions of students at present is in process but future is optimistic.

**Key Words:** Evidence, Curriculum, Forensic Medicine, Perceptions, Students.

### Introduction:

The primary aim of education is to develop professionals who are capable of doing innovative things and not just repeating past methods blindly. They must go beyond what the past generations have done; via evidence based education, which makes them creative, inventive, critical and ready to make discoveries, and they must not accept everything they are offered.<sup>1</sup>

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This innovative way of teaching which is aimed at incorporating skills of gathering and generating evidence, ability to critically appraise, analyze and apply in the right context is named evidence based practice (EBP) and incorporation of same principle in all aspects of teaching and learning process to impart the process more perfect is Evidence Based Education System (EBES).<sup>1</sup> In the present context, technology and science has made it possible to access information about researches immediately after publication via internet, much before they find a place in the text book. Millions of data with flooding of information are available on internet but to choose the right one from them is an art of prudent health professional.<sup>1,2</sup> Evidence Based Forensic Medicine (EBFM) is providing platform to create the Indian Medical Graduate (IMG) to be competent enough to choose right evidence according to need and



develop lifelong learning potential for continuous professional development.

### Aim and objectives

- To study the undergraduate students' perceptions regarding evidence based curriculum of Forensic Medicine.
- To identify strength of existing evidence based curriculum via students' perceptions.
- To identify limitations of existing evidence curriculum via students' perceptions.
- To know either existing curriculum is meeting the requirement of evidence based education system or not.

### Material and Methods

**Step 1:** Consent form and Questionnaire (pretested and validated, Likert type scale)<sup>3</sup> was formed to take feedback of students on their perceptions regarding existing evidence based curriculum of Forensic Medicine. The questionnaire contained a total of 30 questions in various parameters like overall competency/evidence based need, educational experience, evidence based teaching, content and quality of syllabus, content and quality of teaching, evaluation/ assessment. Each question had responses which varied from strongly disagree to strongly agree.

**Step 2:** Approval of SVIECA (Sumandeep Vidyapeeth Institutional Ethical Committee) was taken.

**Step 3:** All the 2<sup>nd</sup> MBBS (end semester batch) students were subjected to voluntary feedback on current evidence based curriculum of Forensic Medicine by pre-formed and pre-validated questionnaire after obtaining their informed written consent.

**Step 4:** Feedback and suggestions given by the students were entered in MS excel sheet and analyzed via SPSS.

**Step 5:** Frequency and median score for each parameter and pertaining question was calculated.

### Results

A total 119 students were given the questionnaire, of which properly filled 100 responses were included for analysis and rest of 19 responses which were either incomplete or not attempted were ignored. Frequency and median score of various parameters and pertaining questions were calculated (Table – 1). Assessment or evaluation component of

curriculum had median score of 3.5 while rest had median score of 3.

Total responses included were 100. Out of which, 49 were female and 51 were male. There was no statistically significant difference between perceptions of male and female participants as per **Table – 2**.

Assessment or Evaluation part of curriculum, content and quality of syllabus were reflected as strength while rest parameters of curriculum like education experience, evidence based teaching, content and quality of teaching did not reflect as strength which inferred to be improve on as per **Table – 3**. Overall evidence based curriculum of Forensic Medicine was reflected as strength.

### Discussion

#### Concept of EBM

The term Evidence Based Medicine (EBM) was coined by Gordon Guyatt,<sup>4</sup> after which many subjects in medical and paramedical field followed the same concept. Evidence Based Forensic Medicine (EBFM) can be possible to practice as an innovation in medical education. All over the world now, hospital administrators, academicians, and clinicians consider this as a high order of need for medical practice. The whole concept of EBM is based on evidence.<sup>5</sup> Formulation of PICO based study design and choosing right comparator may be perplexing in such interventions.<sup>5</sup> The ultimate beneficiaries of EBFM are the patients<sup>6,7</sup> who would reap the rewards of better care. Many authors have stated that EBM aids in clinical decision making in all fields of medicine, including primary care.<sup>8,9</sup>

#### Aim of EBFM

- To prepare and train the undergraduate and post graduate students to be able to access the best contemporary evidence on any matter under consideration.
- To be able to appraise, analyze and apply evidence according to need.
- To initiate, implement and assess the best methods of teaching and learning, as supported by recent evidences in all the academic activities of the subject.<sup>1,2</sup>

#### Stages of implementation of EBFM

##### Stage – 1: Infrastructure upgradation

Basic requirement to practice EBFM is to make entire college campus wifi enabled with facility of computer or laptops to each and every faculty and students.

##### Stage – 2: Faculty Training programs

Every faculty must be trained in concept of Evidence Based Practice (EBP) with hands on

practice of various topics like search engine, search filters, what is evidence, how to search for it, how to appraise, analyse and apply it, core concepts of EBM, traditional vs knowledge generating evidence, etc.

### **Stage – 3: Learning Resource Materials**

College and Departmental library must be equipped with subscription of internationally accepted, reputed databases like PubMed, Scopus, Web of Science etc. with free access to both students and teachers along with subscription of various journals and books.

### **Stage – 4: Teaching – learning methods**

Small group, inter active evidence based tutorials, evidence based seminars, journal club, role modelling, peer teaching, projects etc. must be implemented.

### **Stage – 5: Reform of evaluation methods**

Along with formative and summative evaluation, concept of daily evaluation, 360 degree feedback can be adopted. Traditional practical can be replaced by OSPE. Internet based learning must be encouraged.

### **Stage – 6: Periodic evaluation of curriculum**

Evidence based curriculum must be designed with implementation of all above stages and it must be reform every year via feedback of students, alumni, teachers and experts.<sup>2</sup>

Sumandeep Vidyapeeth has uniquely started evidence based education system and as part of it curriculum of Forensic Medicine was made evidence based with incorporation of various innovative things as mentioned below.

- All students are taught regarding various aspects of evidence based practice like what is evidence, how to search for it via various search engines and search filters, how to appraise, analyze and apply evidence, what if PICO format and how to use it etc.
- Each and every theory lecture and tutorial is followed by incorporation of latest evidence for the same topic. Latest evidence cited in lecture contain name of authors, title of the study, type of study (case control, cohort, case series, case report, review article etc., level evidence, results in brief, indexing database etc. For example while teaching organophosphorus poisoning, research evidence available in concerned region is cited to deal with local community needs in above headings.
- Innovative concept of CCES (Continuous Cumulative Evaluation System) is adopted under which every student is evaluated in every theory and practical class. At the end of theory class, 5 MCQs are displayed

answers of which must be given by every students in MCQ booklet provided to them which is daily analyzed and scoring is given. At the end of practical class, every student is assessed for various parameters depicted in their CCES logbook and scoring is given. Such scoring is carrying 40% of internal assessment.

Present study was carried out to know the perceptions of students for above said various innovations and for the same questionnaire was designed.

## **Conclusion**

Structure framed for evidence based curriculum of Forensic Medicine here is just the beginning and there is a lot left to be done, there is a long ways to go which is not possible overnight but it requires all of us to come together to implement it and analyze it for better tomorrow. It is acceptable that students' perceptions on evidence based curriculum of Forensic Medicine are very much important as they are the ultimate stakeholders who can in future serve to society in better way. Implementation of perceptions of students at present is in process but future is optimistic.

## **Acknowledgement**

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**Conflict of interest:** None

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Dear Students please tick (✓) the appropriate box.

**Objectives/ Competency of Subject**

S No.	Item	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
1	I feel current curriculum of Forensic Medicine is evidence based					
2	I feel current curriculum of Forensic Medicine is competency based					
3	I feel evidence based teaching in Forensic Medicine is helpful					

**Educational experience**

Sl. No.	Item	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
4	Evidence based teaching facilitates covering of updated information					
5	Evidence based teaching improved my critical reasoning and medico-legal problem solving skills					
6	I would like vertical integration of forensic with clinical subject					
7	I would like horizontal integration of forensic with paraclinical subjects					
8	There should be more emphasis on practical application rather than theory					

**Evidence based teaching**

Sl. No.	Item	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
9	I feel confident in understanding evidence in a teaching sessions					
10	I feel confident in Recognizing and Interpreting evidence present in a teaching sessions					
11	I feel confident in performing and practicing evidence based forensic medicine					

**Content and quality of syllabus**

Sl. No.	Item	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
12	I feel the syllabus of Forensic Medicine is adequate					
13	I am able to get material for the prescribed readings easily					
14	Distribution of teaching hours are perfect for the curriculum					
15	Size of syllabus is not overloading in each semester					
16	Self learning component is adequate in the curriculum					

**Content and quality of teaching**

Sl. No.	Item	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
17	All the lectures have incorporated evidence based examples properly					
18	I feel confused when each lecture is showing evidence in it					
19	I am unable to relate learned concepts to be applied effectively during actual practice					
20	I wish there are new ways to discuss evidence					
21	I feel that lecturers could come up with a new method to discuss evidence					
22	I received feedback in time to improve evidence search and application					

**Assessment/ Evaluation/ Resources**

Sl. No.	Item:	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
23	Teacher provided feedback on my performance regularly or in time					
24	My assignments discussed with me always					
25	I face difficulty in downloading and Submission of the evidence based project in PICO format					
26	Continuous Cumulative Evaluation System (CCES) is helpful					
27	CCES improved my learning in the class					
28	CCES improved my understanding of subject content					
29	I recommend use of CCES					
30	Evaluation pattern is perfect in each semester					

Table – 1: Frequency and median score of various parameters

Table – 1. Frequency and median score of various parameters							
Question No.	Frequency of responses (percentage)					Median	Overall Median
	SD	D	NS	A	SA		
Overall competency/ evidence based need (C1)							3
1	13	17	24	27	19	3	
2	19	33	29	14	5	2	
3	15	18	21	25	21	3	
Educational experience (C2)							3
4	9	15	31	27	18	3	
5	12	19	23	29	17	3	
6	18	42	26	9	5	2	
7	19	43	23	13	2	2	
8	17	28	28	18	8	3	
Evidence based teaching (C3)							3
9	6	11	28	31	24	4	
10	6	10	33	33	18	4	
11	19	31	36	9	5	2.5	
Content and quality of syllabus (C4)							3
12	11	18	35	20	16	3	
13	10	13	28	26	23	3	
14	9	12	29	23	27	3.5	
15	7	24	22	21	26	3	
16	7	12	24	26	31	4	
Content and quality of teaching (C5)							3
17	9	14	24	33	20	4	
18	8	13	28	29	22	4	
19	29	29	23	10	9	2	
20	23	38	20	12	7	2	
21	11	7	19	33	30	4	
22	11	12	29	30	18	3	
Assessment/ Evaluation (C6)							3.5
23	9	11	28	30	22	4	
24	7	14	43	25	11	3	
25	24	20	24	21	11	3	
26	6	17	41	14	22	3	
27	1	6	21	35	37	4	
28	5	5	28	35	27	4	
29	0	13	25	23	39	4	
30	4	16	23	25	32	4	

Table – 2: Gender difference in perception. Test Statistics<sup>a</sup>

	c1	c2	c3	c4	c5	c6
Mann-Whitney U	1224.500	1163.500	1081.000	1096.000	1226.000	1197.500
Wilcoxon W	2550.500	2489.500	2306.000	2422.000	2552.000	2422.500
Z	-.180	-.645	-1.278	-1.164	-.166	-.374
Asymp. Sig. (2-tailed)	.857	.519	.201	.244	.868	.708

Table – 3: Statistical analysis of strength and weakness of curriculum via one sample Wilcoxon Signed Rank Test.

Category	Median	P Value in comparison with median 3	Remark
Overall competency/ evidence based need (C1)	3	.308	Not sure
Educational experience (C2)	3	.010	Not sure
Evidence based teaching (C3)	3	.039	Not sure
Content and quality of syllabus (C4)	3	.000	Strength
Content and quality of teaching (C5)	3	.064	Not sure
Assessment/ Evaluation (C6)	3.5	.000	Strength
Total	3	.000	Strength

## Original Research Paper

# Analysis of Profile of Hanging Deaths in Coastal Odisha

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### Abstract

Hanging is one of the ten leading causes of death in the world, accounting more than a million deaths annually. In India, hanging is the second most common method of committing suicide, after poisoning. Hanging is a form of death, produced by suspending the body with a ligature round the neck, the constricting force being the weight of the body (or a part of the body weight). A retrospective study was conducted by the authors on a total 134 cases of deaths due to hanging during 2009 - 2014 at S.C.B Medical College, Cuttack. In this study, the number of female victims 70 (52.2%) were more or less equal to males, 64 (47.8%); 74.3% females, in comparison to 59.4% males, were in the age group 21 - 40 years. 71.4% female victims were married. The present study also showed that ligature mark was detected on the neck between thyroid cartilage and chin in 80% cases and at the level of thyroid cartilage in 20% cases. Saliva dribbling mark was seen in 16.4% cases while 24.6% victims were of typical hanging, by nature. Cloth based ligature materials were seen in 64.3% cases and rope based materials in 35.7% cases.

**Key Words:** Hanging, Asphyxia, Suicide, Ligature mark, Ligature material, Thyroid cartilage.

### Introduction

More than one lakh lives are lost every year in India due to suicide.<sup>1</sup> Hanging is the second most common method of committing suicide after poisoning, in our country.<sup>2</sup> In India, according to report of National Records Bureau, the common methods of committing suicide are poisoning (36.6%), hanging (32.1%), self-immolation (7.9%) and drowning (6.8%).<sup>3</sup> Hanging is that form of asphyxia which is caused by suspension of the body by a ligature which encircles the neck, the constricting force being the weight of the body.<sup>4</sup> When the point of suspension is over the centre of occiput, there is maximal possibility of occlusion of the arteries and this is known as typical hanging, while all other points of suspension are called atypical hanging.<sup>5</sup> The mark of ligature on the neck is the most outstanding and characteristic sign of death from hanging.<sup>6</sup>

The ligature mark is situated above the level of thyroid cartilage between larynx and chin in 80% of cases, at the level of thyroid cartilage in about 15% of cases and below the cartilage in about 5% cases, especially in partial hanging.<sup>4</sup>

Hanging is almost always suicidal or accidental, the former being by far the most common.<sup>7</sup> The hanging mark almost never completely encircles the neck unless a slip-knot is used.<sup>7</sup> A suicide will use any article readily available for the purpose, like a rope, cord, metallic chain and wires, leather strap, belt, bed sheet, scarf, dhoti, saree, turban, sacred thread, etc.<sup>4</sup>

### Materials and Methods

A retrospective study was conducted on 134 cases of deaths due to hanging which were dealt by the authors at S.C.B Medical College, Cuttack, during the period 2009- 2014. In this study, inquest reports of police, dead body challans and post-mortem reports were studied in detail. The present study was aimed at to analyse the various profiles of hanging deaths and to compare those with the findings of previous authors and text books.

### Observations

A total 134 cases of deaths as a result of hanging were studied during the period 2009 to 2014. All the 134 hanging cases were analysed and the following observations were made. Of these, 64 victims were male and rest

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70 were female, the male to female ratio being 1:1.1. (**Fig. 1**) Again, 38 (59.4%) male victims were in the age group of 21 - 40 years and 52 (74.3) females were in the age group of 21 - 40 years. In our study, majority of the victims 90 (67.2%) were in the age group of 21 - 40 years. (**Table 1**) 50 of the female victims out of a total of 70, were married. (**Fig.2**)

#### Position of ligature mark on neck:

Ligature mark was found on the neck, during autopsy, in 133 cases (99.3%) and in only 1 case it was not present. Of these, 107 (80%) victims showed presence of ligature mark between thyroid cartilage and chin and not a single case observed where ligature mark found below the level of thyroid cartilage. (**Table 2**) In all the 134 (100%) cases, ligature mark was found running in oblique direction. Discontinuous ligature marks were detected in 109 (81.3%) cases and continuous mark seen in 25 (18.7%) cases only.

#### Postmortem Findings:

Of the total 134 cases, 33 (24.6%) were of typical hanging, while 101 (75.4%) were of atypical hanging. All the cases were found to be suicidal in nature, according to police investigation and later confirmed from postmortem findings.

Ligature materials were produced by the investigating officer along with the dead body, during autopsy, in 84 cases only. Cloth based ligature materials were seen in 64.3% cases and rope based materials in 35.7% cases. (**Table 3**)

Saliva dribbling mark was seen in 16.4% cases. On internal examination, not a single case showed fracture of hyoid bone or thyroid cartilage. Only in 1(0.7%) case, slight extravasation of blood was detected within the subcutaneous tissue underneath the ligature mark and in all other cases the subcutaneous tissue were white and glistening. Visceral congestion was observed in all cases (100%). Only in 2 (1.5%) cases, the victims were found to have attempted multiple methods of committing suicide. (**Table 4**)

#### Discussion

The present study showed that both males and females were more or less equally affected and the ratio between them was 1:1.1. It was observed that 59.4% male victims and 74.3% female victims were in the age group 21-40 years, which is similar to the observation of Saiyed Mohammed and Modi.<sup>8</sup> This could be due to the fact that 21 - 40 years is the most

active period in life and fluctuation of emotions commonly seen in this age group. People in 21 - 40 years age group are more vulnerable to frustration and breakdown because of increased incidences of unemployment, poverty, dowry torture, failure in love affairs and domestic quarrel in our society. Besides that, as the age advances, Indian females seem to be capable of facing problems of life with more responsibility and courage due to strong bondage with their family and children.

In our study, 50 (71.4%) female victims were found to have committed suicide by hanging, after getting married. This could be due to lack of adjustment with their spouse and in-laws and increasing dowry torture in our society. Ligature mark was found on neck in 99.3% cases in this study which is similar to the observation of J.B Mukherjee, "The mark of ligature on the neck is the most outstanding and characteristic sign of death from hanging".<sup>6</sup> Faces of the victims were found pale in 88 ( 65.7% ) cases, in comparison to congestion, which was found in 46 (34.3%) cases. This is similar to the findings of B. Knight, who has written "many more victims of hanging are found to have pale faces rather than the congested, haemorrhagic appearance of the slower asphyxia type of death".<sup>7</sup>

Our present study showed that in 80% cases, ligature mark was present on neck between thyroid cartilage and chin which is similar to the observation made by Reddy.<sup>4</sup> The mark of ligature was found running in oblique direction in all the cases and was present discontinuously in 81.3% of cases. Saliva dribbling mark which is the surest sign of ante mortem hanging was found only in 16.4% cases, which contradicts the observation of Modi, "Saliva is often found dribbling out of one angle of mouth down on the chin and chest".<sup>5</sup> This could be due to the fact that relatives, in their hurried attempt to resuscitate the victim and save them from dying, might have led to erasure of the mark from the body. In our study, 33 (24.6% ) cases were typical hanging and others were atypical in nature and this is similar to the observation made by Reddy, "The knot is usually on the right or left side of neck and sometimes in the occipital region and rarely under the chin".<sup>4</sup> Ligature materials produced by police for examination were all easily available materials and this finding is similar to the observation of Modi.<sup>5</sup> Soft materials i.e cloth based materials like saree, chunni, towel were used in 54(64.3%) cases and rope based materials were used in 30 (35.7%) cases which is similar to the finding of Naik S K.<sup>9</sup>

There was not a single case in this study where fracture of hyoid bone or thyroid cartilage found which is probably due to majority of the victims were below 40 years as suggested by Modi.<sup>5</sup> Visceral congestion was seen in all the cases in the present study as mentioned by all text books that visceral congestion is a cardinal sign of asphyxia death. Only in 1 (0.7%) case, slight extravasation of blood detected in the subcutaneous tissue underneath the ligature mark and in all other cases subcutaneous tissue was dry, hard and glistening which is similar to the finding of all text books.

## Conclusion

The present study highlights the various profiles of suicidal hanging in coastal Odisha. Most importantly, saliva dribbling mark which is the hall mark of ante mortem hanging was detected only in 16.4% cases and not in a single case, fracture of hyoid bone or thyroid cartilage was found. In 99.3% cases, the subcutaneous tissue underneath the ligature mark was dry, white and glistening. With over half a million people committing suicide in the world and millions more attempting it every year, in spite of all legal, moral, social and religious barriers, suicide today has come to constitute a major public health issue confronting civilized societies throughout the world. Sessions of counselling to couples with history of broken family may be helpful to some extent. Some knowledge on first aid may protect some victims attempting suicide if properly intervened at proper time like loosening of ligature, mouth to mouth respiration, cardiac massage etc. The nearest health centre should be provided with immediate intervention measures. Identifying the underlying factors in the social system which promote suicidal tendencies and improving the mental health of the community can certainly prevent such incidences further.

**Conflict of interest :** None

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**Table 1: Age & Sex-wise distribution of cases**

Age Group(years)	Male		Female	
	No. of cases	Percentage	No. of cases	Percentage
0 -10	0	0%	0	0%
11-20	5	7.8%	8	11.4%
21 -30	20	31.3%	39	55.7%
31 -40	18	28.1%	13	18.6%
41 -50	9	14.1%	5	7.2%
51 -60	6	9.4%	4	5.7%
61 -70	2	3.1%	1	1.4%
71 -80	4	6.2%	0	0%
Total	64	100%	70	100%

**Table 2: Position of Ligature Mark**

Position of ligature mark on neck	No. of cases	Percentage
Between thyroid cartilage and chin	107	80%
At the level of thyroid cartilage	27	20%
Below thyroid cartilage	0	0%
Total	134	100%

**Table 3: Type of Ligature Material Used**

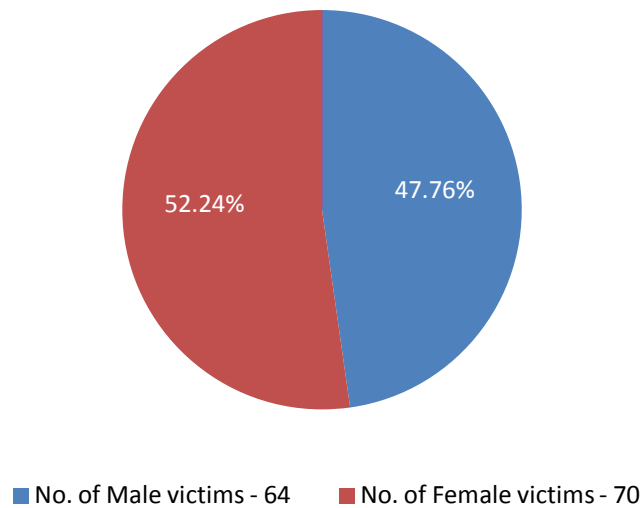
Type of ligature material	No. of cases	Percentage
Chunni	9	10.7%
Towel	12	14.3%
Saree	17	20.2%
Lungi	3	3.6%
Dhoti	9	10.7%
Bed sheet	3	3.6%
Turban	1	1.2%
Rope	29	34.5%
Electric wire	1	1.2%
Total	84	100%

**Table 4: Postmortem findings**

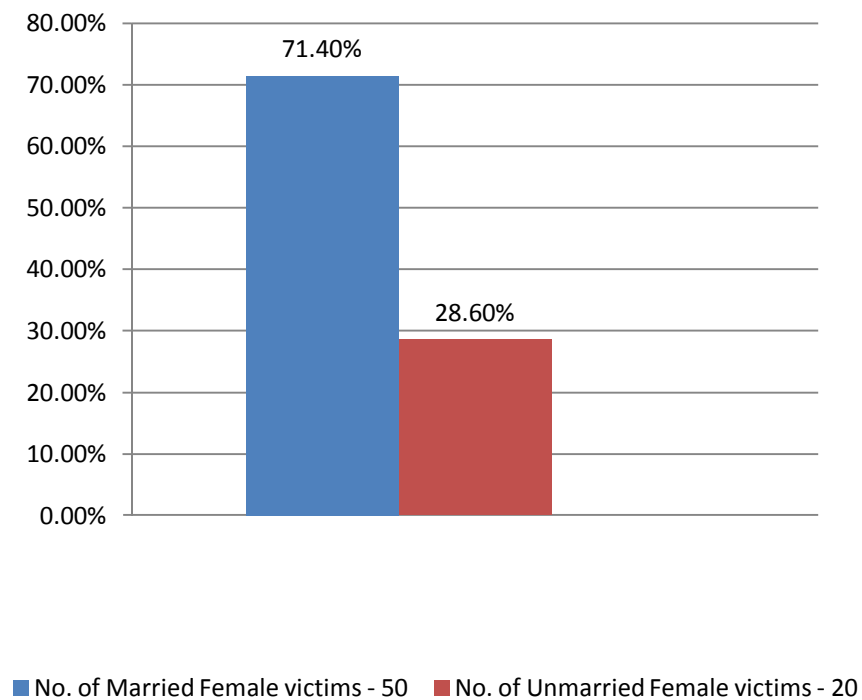
Post Mortem Feature	No. of cases	Percentage
Saliva dribbling mark	22	16.4%
Cyanosis	134	100%
Sub conjunctival haemorrhage	25	18.6%
Protruded and bitten tongue	32	23.8%
Congested Face	46	34.3%
Pale Face	88	65.7%
Glove & Stocking hypostasis	12	8.9%



**Figure 1: Sex wise distribution of Hanging victims**



**Figure 1: Marital status among Female victims**



## Original Research Paper

# Study of the Trend of Poisoning in a Tertiary Care Hospital in Chidambaram, Tamilnadu

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### Abstract

Cases of poisoning are a common and emergency situation everywhere in the world. The burden of cases being referred to the emergency department of a hospital is huge and it takes a lot to salvage the life of the victims of poisoning. Time is seldom a luxury in the management of cases of poisoning. The data in this study was analysed with respect to age, sex, mode and type of poisoning, reporting time to the hospital after poisoning, number of cases referred to the ICU and overall case fatality. Females comprised 71 (57.3%) of the cases of poisoning and males accounted for 53 cases (42.7%). Majority of the incidents occurred in the victim's own house, 91 cases (73.5%). Majority of the victims were of the age group 21-30 years, 106 cases (85.5%). Self employed (33.9%) and housewives (29.8%) constituted the maximum number of cases of poisoning. Majority of the victims were married (68.3%). Cases of insecticide poisoning, mostly with organophosphorus compounds, accounted for the majority with 74 cases (59.7%), and followed by rat poison, comprising 30 cases (24.2%). Of the 124 cases, 52 (41.9%) reported to the hospital within 1 hour after the incident and a total of 27 cases had to be referred to the hospital ICU. Of the total 124 cases of poisoning, 12 cases (9.7%) succumbed to the poisoning. This study was conducted between September 2014 - February 2016 in the Southern part of India in the Chidambaram area of Tamilnadu, from cases of poisoning which reported to the emergency department of Rajah Muthiah Medical College and Hospital.

**Key Words:** Poisoning, Suicide, Insecticide, Mortality

### Introduction:

The magnitude of the burden of poisoning is very large and exists all over the world. From the very beginning of the human civilisation, mankind had been exposed to various poisonous substances. Among many countries worldwide, cases of poisoning account for one of the important grappling health problems. There is a warning which predicts that by the year 2020, cases of poisoning deaths could account for the 10th leading cause of death worldwide.<sup>1</sup> The WHO data shows that around three million cases of acute poisoning cases occur annually and of these cases 2,20,000 victims of poisoning die.

Among these cases almost 90% of the poisoning related case fatalities occur in developing countries with primarily agriculture based economies.<sup>2</sup> Cases of poisoning can be due to intentional or suicidal exposure and ingestion of toxic substances, however it can also be unintentional as due to lack of awareness, especially among people like farmers, factory workers who inadvertently handles different types of poisonous substances and sometimes unintentionally exposes self to toxic substances. Cases of intentional acute poisoning is a major medical emergency and accounts for significant number of mortality. Shadnia, et al, in their study, observed that 79% of the patients have intentionally consumed drugs and chemicals.<sup>3</sup> In most countries, the youth accounted for 30% of the total cases of poisoning and the age group between 20 to 30 yrs is commonly reported in most of the countries of the world.<sup>4</sup> Reports show that the trend in poisoning varies between developed and developing nations, such as in developed countries, most of the cases were with drugs and/or poisons which tend to have a low toxicity, while however in developing countries, most poisonings are mainly due to pesticides and

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these have very high toxicity and are responsible for very high mortality.<sup>5</sup>

In India, data from across the country shows that annually about more than 50,000 patients die from exposure to different poisons.<sup>6</sup> Household and agricultural poisoning cases, snake bite, plant poisons, constitute the majority of the cases in India. Commonly encountered poisoning cases are due to exposure to various agricultural poisons such as organophosphorus, organochlorine compounds and now cases of aluminum phosphide poisoning too has attracted lot of attention, especially in the northern part of India. There has also been significant increase in the incidence of suicidal ingestion of rat poison which contains zinc phosphide, and all anticoagulants (diphacinone, warfarin, bromadiolone). Approximately five million individuals die occurs because of poisons in the USA, yearly.<sup>7</sup> Among the different routes of poisoning, data from the USA shows that in 74.3% of cases, poisoning occurred via the oral route, followed by 9.7% through skin, 7.6% through respiration, 2.6% through eye, and the rest were through due to beating and injection.<sup>8</sup> Among the various age groups, the manner of poisoning is highly variable such as in children it is usually accidental and chemicals, kerosene, drugs, pesticides and garden plants, etc which are common to a household and easily accessible, become a major factor. In the developed countries, the rate of mortality from poisoning varies only from 1 to 2 per cent but in developing countries like India, it varies between 15 to 30 per cent and is the fourth most common cause of mortality especially in rural India.<sup>9</sup>

In adults, the burden of intentional poisoning, especially in women, is a major problem and depend on the cultural and native factors of a region and the local availability of poisons and drugs,<sup>1</sup> with regards to suicidal cases of poisoning. Therefore, it becomes very important to identify the epidemiological factors, including type of poison, most commonly associated with poisoning in a particular geographical area, as it will help to plan a strategy in dealing with such cases.<sup>10</sup>

Apt management of cases of poisoning is also a vital factor. The necessary steps including removal of the patient from the source of poisoning, performing life saving manoeuvres, rapid transportation to a better facility, decontamination measures, specific antidote administration, etc, can significantly influence the overall treatment outcome in poisoning and finally the overall impact of poisoning on healthcare.<sup>11</sup>

## Aims and Objectives:

This prospective study was conducted with an aim to find out the trends of poisoning from all such cases reporting to the Emergency Department of Rajah Muthiah Medical College, Chidambaram, in relation to their demographic pattern, and to effectively put forward a mechanism to reduce the morbidity and mortality from the analysis of factors which plays a crucial role in influencing the overall trend of poisoning.

## Materials and Methods:

The present study was conducted among all the cases of poisoning which reported to the emergency between September 2014 to February 2016. The inclusion criteria in this study were based on confirmed cases of poisoning which was based on history of the case and on the signs and symptoms of poisoning. However cases brought dead and where the record was ambiguous due to improper patient history were not included. In this study, the variables included age, gender, occupation, marital status, type of poisoning, manner of poisoning, reporting time to hospital after poisoning, number of ICU referral and case fatality from poisoning. A detailed history of the case was taken to establish the exact manner of poisoning. The overall outcomes of cases of poisoning were recorded from the management, including resuscitation measures, which was received in the ward after admission.

### Statistical analysis

Both descriptive and analytical statistics were employed to find out the association between the variables and the reasons for poisoning. The quantitative variables were expressed by frequency and percentage. To predict the strength of association between the different variables, Chi-square test was used. For this study  $p$ -value of  $<0.01$  was considered highly significant, whereas the  $p$ -value of  $<0.05$  was considered significant and  $p$ -value of  $>0.05$  was considered insignificant.

## Results and Observations:

Of the total 124 cases of poisoning which reported during the study period to the emergency department of the institute, females comprised 71 (57.3%) of the cases of poisoning and males accounted for 53 cases (42.7%). Majority of the incidents occurred in the victims own house, accounting for 91 cases (73.5%), with females accounting 59 and males 32 cases. The next most common place of poisoning cases occurred outside such as at workplace, school, colleges constituting 23 cases (18.5%)

and this was followed by cases of poisoning in the house of relatives and friends, accounting for 10 cases (8%). This was statistically highly significant with a p value of 0.00. (**Table1**)

Majority of the victims were found to be in the age group of between 21-30 years, with 84 cases (67.7%), followed by 18 cases (14.5%) in the 41-50 years group & 16 cases (12.9%) between 30-40 years. Whereas, in the 51-60 years group, there were 3 cases (2.4%) and the above 60 years and below 20 years groups had 2 and 1 case (0.81%), respectively. (**Fig-1**) This was found to be statistically highly significant with p value <0.01.

Majority of the victims were married (68.3%) with female and male victims accounting for 52 cases and 30 cases, respectively. Again, majority were self employed by profession (33.9%), followed by housewives (29.8%), students (20.2%), farmers (10.5%), while Government job holders accounted for 5.6%, respectively.

Cases of insecticide poisoning, mostly with organophosphorus compounds, accounted for the majority, with 74 cases (59.7%), followed by poisoning with rat poison, comprising 30 cases (24.2%), respectively (**Table - 2**).

The most common manner of the poisoning cases was suicidal, accounting for 116 cases (93.6%), with 50 male and 66 female victims. This is statistically significant with a p value of 0.05. The next was homicidal poisoning, which was seen in only 5 female victims (4.0%). (**Table - 3**)

Among the victims of poisoning, 52 (41.9%), 17 male and 35 female, reported to the hospital within 1 hour of poisoning, while 46 (37.1%) presented within 2 hours, and 13 (10.49%) after more than 8 hours of poisoning. (**Table - 4**)

Of the 124 cases of poisoning, 27 (21.8%) had to be referred to the hospital ICU and among these, 19 were females and 8 males. Of the 27 patients referred to the ICU, 12 (9.7%) victims died due to complications related to the poisoning.

## Discussion:

Death due to poisoning is still a major global health burden. A case of poisoning is an emergency situation where prompt decontamination, and treatment, including administration of specific antidote is considered the gold standard of management. The type of poison consumed varies according to the different countries in the world, as also the

manner of poisoning which varies significantly, depending on the society, and population.

In this study, the number of female victims outnumbered the number of male victims and this differs from the observation of previous workers who found a greater number of male victims.<sup>12-14</sup> However, this particular female dominance of poisoning is similar to that of Tufekci, et al and Kavalci, et al.<sup>15,16</sup> The most common age group in this study was the 21- 30 years group and this is similar to the findings in previous studies by other workers.<sup>13,14,17-20</sup>

Majority of the victims were married, comprising 68.3% of the total cases and this is similar to the findings of other authors.<sup>18,19</sup> The victims own house accounted for maximum number of cases, 91(73.5%), and this is similar to the observation of Tufekci, et al and Panda, et al.<sup>10,15</sup> The most common poison consumed was the insecticides, followed by rodenticides, as a result of the easy availability and use of these agents commonly in the Indian household, and this is somewhat similar to the observation made by other researchers.<sup>10,21</sup> Among the insecticides, organophosphorus compounds accounted for the maximum number of cases and this is similar to the findings of Adalkha, et al, Jaiprakash, et al, Jesslin, et al & Ramesha, et al.<sup>22-25</sup>

Self employed and housewives accounted for the majority of the victims and this is in concordance with the findings of other workers.<sup>26</sup> Suicidal poisoning accounted for the maximum number of poisoning cases and this in agreement with the findings of previous workers.<sup>14,17</sup> Majority of the victims reported to the hospital within the first hour (41.9%). The early reporting to the hospital after poisoning had greatly affected the case fatality and this is similar to the observation of previous workers.<sup>11,13,17,18</sup> Overall, the case fatality accounted for 12 cases which is 9.67% of the total cases and this is somewhat similar to the findings of other workers,<sup>11,20</sup> but differed from the observation of other authors.<sup>10,19</sup>

## Conclusion:

The cases of poisoning which reported to the emergency of the hospital were part of the global burden of the total number of incidents of various types of poisoning in different part of the world. Majority of the poisoning was due to consumption of insecticides and rodenticides, which are easily available over the counter and account for a significant amount of morbidity and mortality in developing countries like India.

There is a need to educate people and increase awareness about the handling of poisonous substances. As suicide tops as the most common manner of poisoning, it is necessary for the society, family, health care agencies to focus on this part of the population who harbour suicidal ideation; and by providing affection, consultation and psychiatric counselling, etc, the magnitude of this problem can be lowered.

The outcome of any case of poisoning can be affected by the management procedure which is undertaken in a hospital on admission of the victim. The time since poisoning and quick reporting to the hospital can serve as an important determinant which can significantly reduce the number of fatalities in a case of poisoning. Decontamination and administration of life saving interventions can improve the quality of outcome of the management. Establishment of well functioning poison information centre in the healthcare institute can come as a great help in this regard.

#### Informed consent:

Informed consent was obtained from the patient or from the nearest relative of the patient, if the patient was unable to give consent. In case of minors the consent of the legal guardian was obtained

**Conflict of interest: None**

**Financial Assistance: None**

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**Table 1 - Comparison of Gender and place of occurrence of poisoning**

Place of Poisoning	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Home	32	25.9	59	47.6
Friend's house	3	2.4	4	3.2
Relative's house	3	2.4	0	0
Outside (workplace school ,college)	17	13.7	6	4.8

Table 2- Comparison of Occupation with type of poisoning

Type of Poisoning	Occupation				
	Housewife	Self Employed	Student	Professional	Farmers
Insecticide	23	28	18	3	2
Rodenticide	12	10	4	0	4
Plant poison	2	2	0	0	10
Snake bite	0	2	1	0	4

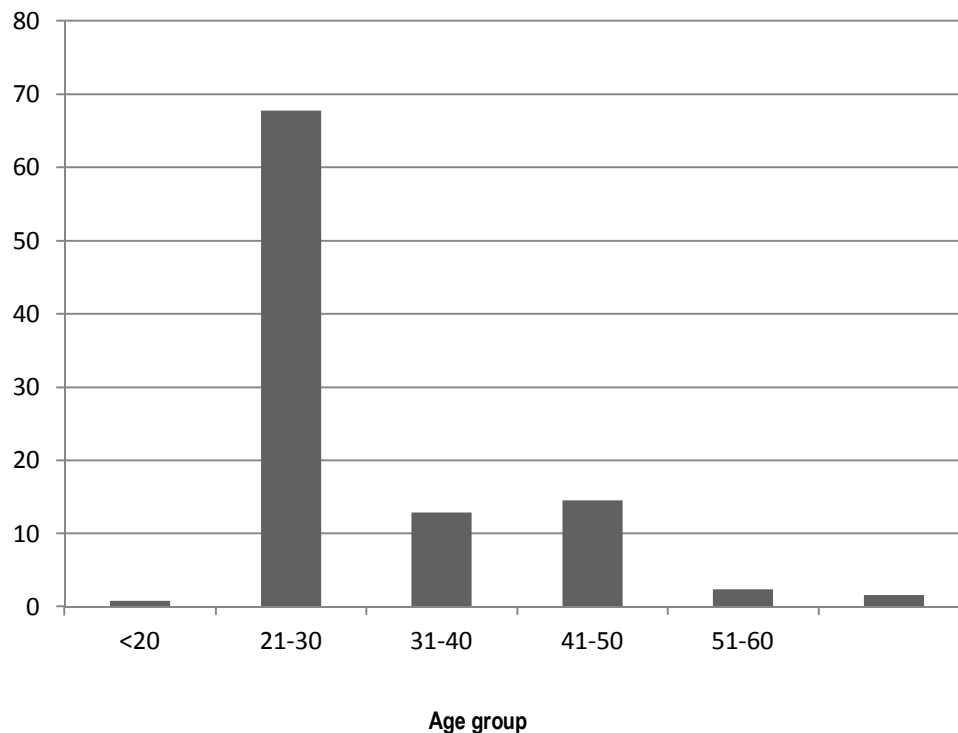
Table 3 - Comparison of Gender and manner of poisoning

Manner of poisoning	Males		Females	
	Frequency	Percentage	Frequency	Percentage
Suicidal	49	39.51	66	53.22
Homicidal	1	0.87	5	4.0
Accidental	3	2.4	0	0

Table 4 - Comparison of Gender and hospital reporting time

Hospital Reporting Time after poisoning	Males		Females	
	Frequency	Percentage	Frequency	Percentage
Within 1 hour	17	13.70	35	28.22
Within 2 hour	23	18.6	24	19.36
Within 3 hour	9	7.25	8	6.45
Within 4 hour	2	1.62	4	3.2
More than 8 hour	1	0.8	1	0.8

Fig-1 Showing most common age group in poisoning cases



## Original Research Paper

# Role of Consent in Medical Practice: A Survey Amongst Registered Medical Practitioners

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### Abstract

Informed consent of the patient is a basic necessity in medical practice. It is an ethical as well as legal requirement before examination and any surgical/non-surgical procedure. From the times immemorial, medical practitioners played a paternalistic role and were trusted with the responsibility of deciding the best treatment for their patients. With time, doctor-patient relationship has changed from paternalistic to service provider and consumer type relationship. Patients, being the consumer of services provided by the medical practitioner, have the right to full information concerning their diagnosis, treatment options, prognosis and possible complications. Thus, they can choose the one which suits them the most. The aim of this survey was to assess the awareness among registered medical practitioners (RMPs) about the importance and requirement of proper informed consent in various clinical situations. A questionnaire-based survey was conducted amongst 342 RMPs (44 Professors, 17 Associate Professors, 50 Assistant Professors, 11 Senior Residents, 24 Tutors and 196 Postgraduate Residents) working in a tertiary health care hospital. The questionnaire comprised of 12 standardized and validated multiple choice questions on various aspects of consent in medical practice. The participants were asked to tick the option(s) which they thought was/were appropriate. The survey revealed that 2/3<sup>rd</sup> of RMPs were unaware/poorly aware of the requirement/procedure of obtaining informed consent in various clinical situations. They were aware of only those situations which are discussed and debated at various forums.

**Key Words:** Consent, Informed consent, Registered Medical Practitioner, Doctor, Paternalistic, Service Provider, Consumer

### Introduction:

Informed consent of the patient is a basic necessity in day to day medical practice and plays a vital role in management of a patient. Informed consent before examination and any surgical/non-surgical procedure is an ethical as well as a legal requirement. The responsibility of the medical fraternity has been clearly defined in the Royal Decree No. 78 of November 11, 1967 concerning the medical practice.<sup>1</sup> With time, the role of medical practitioners (MPs), the ones who decide the best for their patients, has changed from paternalistic to service provider.

This concept implies that the patient, now a consumer, is availing the services of the doctor and has right to full information related to diagnosis, treatment options, prognosis and possible complications of the treatment.

The concept of informed consent of patients has evolved from the best known statement by Justice Cardozo in his famous judgment:<sup>2</sup>

*"Every human being of adult years and sound mind has a right to determine what shall be done with his own body; and a surgeon who performs an operation without his patient's consent commits an assault, for which he is liable in damages."*

It is imperative that informed consent be taken by the treating RMP, as he is the best person to explain the procedure, its risks, complications and outcomes in a balanced way. Many a times it happens that the treating RMP, being the senior professional, is too busy for the process of taking consent and may not realize the importance of counseling and explaining the patient's queries personally.<sup>3,4</sup> Thus, in actual practice it is commonly observed that the consent is obtained by:

- The staff at reception as blanket consent, or

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- Nursing staff during in-patient stay, or
- Assistant/Junior doctors to treating physician.

These professionals themselves might not be aware of the exact procedure, its purpose, complications and consequences, or may explain the procedure in such a way that may discourage the patient.<sup>5</sup> This may lead to patient dissatisfaction and in case of any therapeutic misadventure patient may blame the RMP for negligence and may try to sue him in the Court of Law and/or Consumer Court.<sup>3,4</sup>

On the other hand are the patients' apprehensions about signing the consent form, as many times they are not aware of their legal rights, and thus do not realize that signing a consent form may actually help them. They may get anxious and discouraged by the medical and legal terms and language of consent form and may hesitate to sign.

Although in undergraduate medical curriculum, the subject of consent is given due importance, somehow during actual clinical practice these medical professionals either do not realize its importance or tend to forget its implications.<sup>6</sup>

Various studies have shown that there is a lack of awareness and concern amongst RMPs while dealing with patients' consent and the need to emphasize its importance among various classes of RMPs has been identified.<sup>7-10</sup> Thus, this survey was carried out in a tertiary care hospital to assess the awareness of RMPs regarding the importance of proper informed consent.

### Materials & Methodology:

This prospective cross-sectional study was conducted in a tertiary health care centre during 2015-16. The survey was carried out amongst 342 RMPs including professors, associate professors, assistant professors, senior residents, tutors and postgraduate residents. Prior approval of the Institutional Ethics Committee was taken. Consent of medical professionals, who wished to participate in this study, was obtained. A questionnaire comprising of 12 standardized and validated multiple choice questions (MCQs) was given to all consenting RMPs (**Annexure 1**). Questions were related to the importance and requirement of proper consent in various clinical situations.

The participants were asked to tick (✓) one/more option(s), which they thought was/were appropriate. The data collected was entered, tabulated and statistically analyzed using Epi\_Info\_7 software.

### Results:

A total of 342 RMPs participated in the survey, out of which 57.31% (196) were male and 42.69% (146) were female. Designation wise, there were 13% Professors, 5% Associate Professors, 15% Assistant Professors, 3% Senior Residents, 7% Tutors and 57% Postgraduate Residents. Participants' responses were grouped under two categories: Question wise responses (**Table 1**) and Designation wise correct responses (**Table 2**). **Graph No. 1** depicts the percentage of correct responses to each of 12 questions.

### Discussion:

To assess, whether the RMPs were aware of basic concepts and importance of proper consent in medical practice, percentage of correct responses were categorized as follows:

- |             |                |
|-------------|----------------|
| I. >75%     | . Well aware   |
| II. 51-75%  | . Aware        |
| III. 26-50% | . Poorly aware |
| IV. 0-25%   | . Unaware      |

In the present study we observed that the RMPs were aware (correct responses 51-75%) about the concepts of:

- Implied consent for general examination,
- Importance of fresh consent in unforeseen surgery,
- Exemption of consent in life saving situations,
- Consent of spouse for Medical Termination of Pregnancy and
- Importance of consent for examination of a victim of sexual assault.

RMPs were well aware (correct responses >75%) only about requirement of spouse's consent in procedures carrying risk of impotency/sterility (**Table 1**).

The RMPs were poorly aware (correct responses 26-50%) about:

- The recommended person, who should take the consent,
- Whose consent is required in cases of urgent interventions?
- Who should consent in cases of guardianship of court? and
- Consent of legal heirs in cases of organ donation.

They were unaware (correct responses 0-25%) about the age when a patient can give consent for specific procedures.

Only six questions (viz. Q. Nos. 1, 3, 8, 9, 10, and 11) out of twelve were answered correctly by more than 50% participants, whereas for rest of six questions less than 50% participants answered correctly (**Graph No. 1**).

In the questionnaire, most of the situations given are frequently encountered in day to day practice, with only a few uncommon situations. RMPs were aware about those situations which are mostly debated and discussed at various forums like implied consent, consent for unforeseen surgery, consent in life saving situations, consent for examination of victim of sexual assault etc. Some traditional behavioral practices especially those which they perceive to be less important, are fixed as wrong concepts and practices; e.g. who should take the consent for planned procedures, minimum age of consent for various procedures, consent in urgent or emergency situations and consent for organ donation. RMPs were either unaware or over cautious of legal requirements for consent in such situations.

It was found that about 2/3<sup>rd</sup> (66%) of RMPs were unaware or poorly aware of the various aspects of consent in day to day medical practice. However, only 1/3<sup>rd</sup> (34%) of RMPs were aware or well aware (**Table No. 2**). Designation wise analysis shows that >90% of Senior Residents were unaware; this may be due to small number of these participants in present study. We found that 50% of Tutors were aware to well aware of the facts regarding consent, which was the most aware category amongst all designations followed by Professors (41%) and Assistant Professors (35%) respectively. These findings correspond with those found by Rai, et al.<sup>9</sup>

To summarize:

1. Overall RMPs were unaware or poorly aware of various aspects of consent in day to day situations.
2. RMPs were found to be aware of those aspects of consent which are mostly debated and discussed at various forums.
3. RMPs were unaware or poorly aware of requirements of consent in challenging and uncommon clinical situations.

Considering the findings of this study, the authors recommend:

1. In view of changing clinical scenario more emphasis on medical jurisprudence should be given during undergraduate and postgraduate training.

2. Case discussions, ward postings should be included in undergraduate Forensic Medicine curriculum to expose the students to such clinical situations for better understanding.
3. Medical Jurisprudence should be taught in 3<sup>rd</sup> and 4<sup>th</sup> year of MBBS training, the period, when they are exposed to patient management and need to communicate with the patients and/or their relatives.
4. Compulsory internship posting in Forensic Medicine and Toxicology with special emphasis on Medical Jurisprudence should be included in undergraduate medical curriculum.
5. Postgraduate Residents, during their 1<sup>st</sup> year residency, should be posted in Forensic Medicine and Toxicology Department for training in Medical Jurisprudence.

**Conflict of Interest: None.**

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## Annexure -1

(Please tick ✓ the correct option. You can tick multiple options wherever required)

1. A 16 year old male comes alone to OPD for consultation. The physician needs to do general physical examination to further evaluate him. Is it mandatory to take written consent for the same?
2. A 22 year patient in *compos mentis* is admitted in hospital for a planned procedure as a part of treatment. Who can take consent of such patient?
3. A 40 years old male patient is admitted in hospital. During the course of treatment, patient needs to undergo an unforeseen surgery. A consent form was already filled by the patient at the time of admission, allowing the treating consultant to undertake any required procedure. Is it necessary to take consent for such surgery again?
4. What is the minimum age of patient to give consent for withdrawal of blood for routine investigation?
5. After which age a female patient can give valid consent for examination involving her private parts?
6. A 19 years old patient, in *compos mentis*, presents with acute abdomen, for which urgent exploratory laparotomy is planned. Whose consent is mandatory?
7. A 20 years old patient in *compos mentis*, who is under the guardianship of a person appointed by court, presents with acute abdomen and emergency laparotomy is planned. Whose consent should be taken?
8. A 28 years old *unconscious* male, a victim of road traffic accident, suffered crush injury of right leg, which requires below knee amputation to save his life. Patient is not accompanied by anyone. Is doctor *legally* allowed to proceed for such amputation without consent?
9. In any elective surgery involving the risk of impotency/sterility of patient, is the consent of patient's spouse mandatory along with consent of patient?
10. To perform Medical Termination of Pregnancy on a married female, consent of her husband is mandatory along with consent of female?
11. If a victim of sexual assault is brought by investigating police officer on Court order and victim refuses for examination, should the examination be carried out?
12. An adult person with sound mind has completed the formalities with some authorized organization to donate any organ/tissue after his/her death. After his/her death, the legal heirs refuse for the same. Can the organization go ahead to remove the organ/tissue from the dead body?

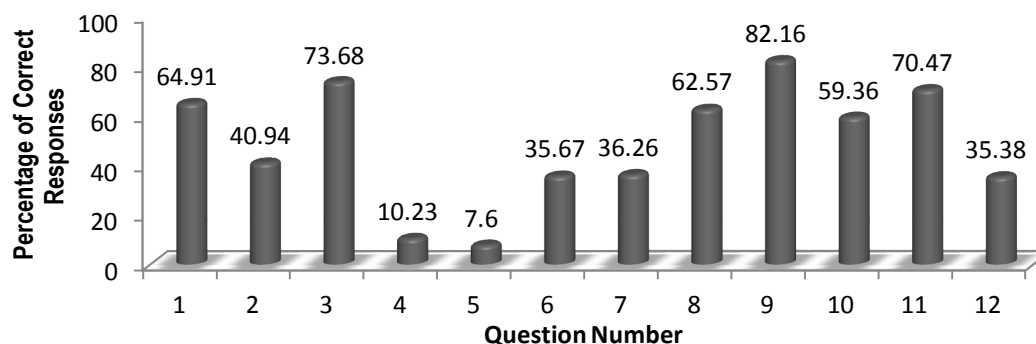
Table 1: Question wise Response

Response	Question wise Response of Participants (in %)											
	1	2	3	4	5	6	7	8	9	10	11	12
Incorrect	28.36	26.61	23.39	84.50	91.23	35.09	31.29	26.32	11.99	38.30	19.59	44.44
Partly Correct	1.75	25.15	0.58	0.88	0.29	26.61	29.82	1.75	0.29	0.29	0.00	0.00
Correct	64.91	40.94	73.68	10.23	7.60	35.67	36.26	62.57	82.16	59.36	70.47	35.38
Do Not Know	4.97	7.31	2.34	4.39	0.88	2.63	2.63	9.36	5.56	2.05	9.94	20.18
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

Table 2: Designation wise Correct Responses:

Designation	Percentage of Participants with Percentage Correct Responses				Total % (n)
	0-25%	26-50%	51-75%	>75%	
PG Residents	6.12	61.74	31.63	0.51	100 (196)
Senior Residents	0.00	90.91	9.09	0.00	100 (11)
Tutors	8.33	41.67	16.67	33.33	100 (24)
Assistant Professors	11.76	52.95	35.29	0.00	100 (51)
Associate Professors	0.00	68.75	31.25	0.00	100 (16)
Professor	9.09	50.00	38.64	2.27	100 (44)
Total	7.01	58.78	31.29	2.92	100 (342)

Graph 1: Question wise Correct Responses by all Participants



## Original Research Paper

# Determination of Stature from Sternum in Central Delhi Population

<sup>1</sup>Mohit Gupta, <sup>2</sup>Anil Kumar

### Abstract

Identification is one important aspect dealt with in forensic anthropology. It is necessary in cases of mass disasters or otherwise when no clue is present regarding the identity of individual. Bones have been used previously for identification by determining race, age, sex and stature. However, limited studies for estimation stature from Sternal bone are available in literature. This study was conducted in population of Delhi, India, to assess the usefulness of sternal bone for determining stature. Results indicated that the length of the Manubrium ( $r=0.716$ ,  $SEE=6.524$ ), length of Mesosternum ( $r=0.604$ ,  $SEE=7.447$ ) and Sternal length ( $r=0.674$ ,  $SEE=6.899$ ) can be used effectively for stature estimation. Regression equations were developed for each parameter. We also found that the regression equations developed by other researchers for other population samples were not useful in our population sample.

**Key Words:** Stature, Sternum, Males, Manubrium, Mesosternum, Sternal Length, regression equation

### Introduction:

Forensic anthropology involves the application of knowledge and techniques of physical anthropology to problems of medico-legal significance.<sup>1</sup> One such problem of significance is identification of individual. Skeletal remains are commonly used for identification as they resist putrefaction and destruction by animals. Estimation of Stature constitutes one of the traditional ~~big four~~ besides age, sex and ancestry.<sup>2</sup> Various researchers have identified and developed different methods of determination of stature from different bones. The best long bone for determining stature is Femur.<sup>3</sup> Long bones and their fragments have been extensively studied for determining stature.<sup>3-6</sup> Since long bones are not always recovered, estimation of stature has been done using other bones like cranium, vertebra and bones of hand and foot.<sup>7-14</sup>

Estimation of stature from sternum was till recently a neglected area, with only Dwight<sup>15</sup>

discussing the use of Sternum as an indicator for age, sex and height. Various reports are published regarding determining age and sex from Sternal bone.<sup>15-18</sup> However, interest in the potential use of Sternum for determining stature is only recent. Different authors Menezes et al,<sup>19,20</sup> Singh J, et al,<sup>21</sup> Marinho, et al,<sup>22</sup> Tumram, et al,<sup>23</sup> Zhang, et al,<sup>24</sup> Macaluso, et al,<sup>25</sup> have studied Sternum for determining stature. The skeletal characteristics vary with gender<sup>7,12,14-18,26</sup> and region. Formulae developed in one region may not be acceptable in other regions. Hence, there is a need for studies to be conducted in each population group and for each gender, so that the developed formulae can be population specific and gender specific.

This study was undertaken with two aims. Firstly, to determine whether Sternum is useful for estimating stature. If yes, then to develop a regression equation that can be used for the population in Central Delhi, India. Secondly, we aim to use the formulae developed by other researchers for our study sample to establish whether these formulae are population specific or not.

### Material and methods:

The present study was conducted in the Department Of Forensic Medicine, Maulana Azad Medical College, Delhi, India during the years 2007-2009. 66 intact male Sternum within age group of 25 . 85 yrs were dissected out by separating them from sternoclavicular joints and rib cage at costochondral junction. Bones that had been damaged or broken were excluded

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from study. These bones were labelled and buried in soil at a depth of about 1-2 feet for 6-8 weeks. They were subsequently retrieved, cleaned and labelled.

Measurements of Sternal bone were taken using manual vernier callipers by technique described by Ashley<sup>[27]</sup>. Length of the Manubrium-**M** (straight distance from the deepest point of incisura jugularis {suprasternale} to the point on the lower margin of the Manubrium in the midsagittal plane), Length of Mesosternum-**B** (straight distance from the lower margin of the Manubrium in the midsagittal plane to the deepest point on the lower margin of corpus sterni) and the Sternal Length- **SL** (Length from incisura jugularis {suprasternale} to the mesosterno-xiphoidal junction) (**Figure 1**).

These measurements were initially recorded in millimetres and later converted to centimetres. Measurement of xiphoid process was not included because of the wide variations in length, appearance and ossification of xiphisternum.<sup>28</sup> Stature (**S**) of individuals was noted in centimetres to nearest 0.1cm using measuring tape.<sup>11</sup> Data collected was analyzed using SPSS inc. version 16.<sup>29</sup> Mean, Range and Standard Deviation of the measurements were calculated (**Table 1**). The Stature of the individual (dependent variable) was regressed on the Length of Manubrium, length of Mesosternum and the Sternal length (independent variables) and linear regression equations were obtained. Correlation between Stature and these measurements was assessed using Pearsons correlations coefficient and its significance was tested using the student t test. A p-value of <0.01 was considered significant (**Table 2**).

## Discussion:

Identification is an integral part of any medico-legal investigation. In criminal as well as in civil matters identification is essential to meet ends of justice. Whether it is mass disaster, flight accidents, railway accidents, bomb blasts or skeletal remains found at a place or simply when a patient is brought dead without any identification documents on his person, the starting point for investigation in all cases is identification of individual.

Role of Sternum in identification has been largely limited to determination of age and sex from the bone. Previously, Menezes, et al,<sup>19,20</sup> Singh J, et al,<sup>21</sup> Marinho, et al,<sup>22</sup> Tumram, et al<sup>23</sup> have developed regression equations by regressing the stature of individual on length of

Sternum. Where Menezes, et al,<sup>19,20</sup> Singh J, et al<sup>21</sup> have conducted their studies on dry macerated Sternum, Marinho, et al,<sup>22</sup> Tumram, et al<sup>23</sup> have studies fresh Sternal bones in estimating stature. In present study, the authors have studied the relation of Length of Manubrium, Mesosternum and the Sternal Length with the Stature of individual using dry sternal bones. In earlier studies, Singh, J et al<sup>21</sup> and Tumram, et al<sup>23</sup> have studied and correlated all these parameters. Menezes, et al<sup>19</sup> and Marinho, et al<sup>22</sup> have only studied the relation of Sternal length and Stature.

In our study, the mean stature (+/- SD) of individual varied from 163.24 (+/-9.27) cm with range of 42. The mean length of Manubrium (+/- SD) was 4.064 (+/- 0.347) cm, mean length of Mesosternum (+/- SD) was 8.731 (+/- .951) cm and mean Sternal length (+/- SD) was 12.795 (+/- 1.22) cm. The regression equations derived by regressing stature of individual on length of Manubrium, length of Mesosternum and Sternal length were found to have a correlation coefficient of 0.716, 0.604 and .674 respectively and standard error of estimate of 6.524, 7.447 and 6.889 respectively. All these measurements were statistically highly significant. Based on calculations, Stature showed 51.2% variation with length of Manubrium, 36.5% variation with length of Mesosternum and 45.5% variation with Sternal length (**Table 1 & Table 2**). These finding suggest that Sternal bone can be used for estimation of stature in individuals. Observations in present study are compared with previous studies in **Table 3**.

The stature of individuals presented with greater range in present study compared to previous studies conducted by Menezes, et al,<sup>19</sup> Singh J, et al,<sup>21</sup> Marinho, et al<sup>22</sup> and Tumram et al.<sup>23</sup> Mean length of Sternum in present study was less than the mean length of Sternum determined by Menezes, et al,<sup>19</sup> Singh J, et al,<sup>21</sup> Marinho, et al<sup>22</sup> and Tumram et al.<sup>23</sup> Correlation coefficient for Sternal length and the variation of stature with Sternal length was more than all previous studies.<sup>19,21-23</sup>

In present study, Mean length of Manubrium (+/- SD) was 4.067 (+/- 0.347). This was less compared to studies conducted by Singh J, et al<sup>21</sup> and Tumram, et al<sup>23</sup>. Also correlation coefficient and variance were found higher compared to other studies.<sup>21,23</sup>

Correlation coefficient for length of Mesosternum was found significantly higher (0.604) than the past study of Singh, J et al<sup>21</sup> (0.255) and Tumram, et al<sup>23</sup> (0.25). The variance

was high but the Mean length of Mesosternum was lower when compared with other studies.

Standard error of estimate (SEE) in our study was 6.889. This is comparable to that reported in studies by Singh J, et al<sup>21</sup> and Marinho, et al<sup>22</sup>. Our results are agreeable with Marinho, et al who suggested that Sternum is ranked below long bones (SEE {Femur: 3.27-3.5,<sup>3,4,9</sup> Humerus: 4.03-4.25,<sup>3,4,9</sup> Tibia: 3.39-3.94,<sup>6,9</sup> Ulna: 4.8-5.59,<sup>6,7</sup> Radius: 4.7<sup>7</sup>}), vertebral column (SEE: 4.38),<sup>11</sup> hand (SEE: 4.27-5.22)<sup>8,13</sup> and foot (SEE: 4.3-6.19)<sup>8,13</sup> bones for estimation of stature.<sup>22</sup>

The regression equation derived by Menezes, et al,<sup>19</sup> Marinho, et al,<sup>22</sup> Singh, J et al,<sup>21</sup> Tumram, et al<sup>23</sup> for determining stature from Sternal length when applied to the data collected in present study, showed that in 19, 59, 47 and 23 out of 66 individuals respectively, estimated stature lied outside 95% confidence interval.

On applying the regression equations for length of Manubrium (M) and Mesosternum (B) derived by Singh, J et al<sup>22</sup> for present study, results were that 25.76% (M) and 25.76% (B) lied outside 95% confidence interval. The results were more favourable for study conducted by Tumram, et al<sup>22</sup> 16.16% (M) and 9.1% (B) cases were lying inside 95% confidence interval. However, statistically these results show that equations derived by both these researchers for length of Manubrium and length of Mesosternum cannot be used for Central Delhi Population.

Hence, as per our study, regression equations developed by Menezes, et al,<sup>19</sup> Singh J, et al<sup>21</sup> and Tumram, et al<sup>23</sup> (all for Indian population but in different regions) and Marinho, et al<sup>22</sup> (Portuguese population) could not give substantive estimate of stature for Central Delhi population. These findings again emphasize that stature estimation is population specific and varies greatly with the population studied.

### Conclusion:

In our study, the Sternal length along with the length of Manubrium and length of Mesosternum correlated well with the stature of male individual. Stature could be estimated using linear regression equations derived by regressing stature on these independent variables. Sternum may be considered for estimating stature if other bones like long bones, vertebral column, hand and foot bones are not available. Stature varies according to the population and region. Hence, formulae developed for one region may not be applicable for other regions. Regional studies should be conducted so that specific formulae may be derived for each population and gender.

**Conflict of Interest: None**

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Figure 1: Sternal Bone

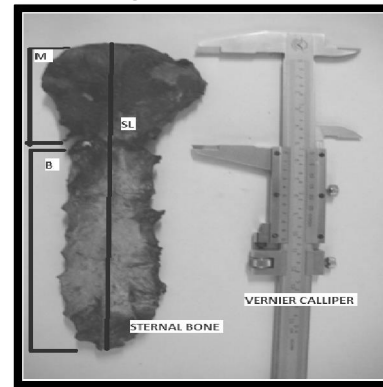


Table 1: Descriptive statistics of Stature, Length of Manubrium, Length of Mesosternum and Sternal Length.

	Mean	Minimum	Maximum	Range	Standard deviation - SD
Stature	163.24	141	183	42	9.27
Length of Manubrium (M)	4.064	3.6	5.11	1.51	0.347
Length of Mesosternum (B)	8.731	6.69	10.65	3.96	0.951
Sternal length (SL)	12.795	10.35	15.64	5.29	1.220

Table 2: Results obtained by Regressing the variables

	Regression equations	Variance (R <sup>2</sup> )	Correlation coefficient (r)	Standard error of Estimate (SEE)	P value (p)
Stature with length of Manubrium	S = 85.657 + 19.091 (M)	0.512	0.716	6.524	<0.001
Stature with length of Mesosternum	S = 111.87 + 5.883 (B)	0.365	0.604	7.447	<0.001
Stature with Sternal length	S = 97.733 + 5.12 (SL)	0.455	0.674	6.899	<0.001

Table 3: Comparison of observations in present study (Sternal length) with previous studies

	Menezes et al <sup>[37]</sup> (n = 35)	Singh J et al <sup>[39]</sup> (n = 252)	Marinho et al <sup>[40]</sup> (n = 45)	Tumram et al <sup>[41]</sup> (n = 92)	Present study (n = 66)
Sample Population	South Indian population, India	North west zone (Chandigarh, India)	Portugal	Central Indian population, India	Central Delhi population, India
Range of stature	148-181	151-185	156-184	147.5-180.5	141-183
Stature mean with SD	166.47 +/- 7.22	168.1 +/- 7.19	167 +/- 6.9	160.82 +/- 8.8	163.24 +/- 9.27
<b>STERNAL LENGTH (SL)</b>					
Mean length of Sternum (+/- SD)	14.2 (+/- 1.34)	14.57 (+/- 1.141)	20.39 (+/- 1.421)	14.59 (+/- 1.0)	12.795 (+/- 1.22)
Regression equation derived	117.784 + 3.429*(SL)	138.93 + 0.20 *(SL)	135.322 + 0.16*(SL) +/- 13.32	90.65 + 4.8*(SL)	97.733 + 5.12*(SL)
Std error of estimate	5.64	6.83	6.59	7.4	6.889
Correlation coefficient	0.638	0.318	.329	0.55	0.674
Variance (R <sup>2</sup> )	-	0.1	0.11	0.302	0.455
<b>LENGTH OF MANUBRIUM (M)</b>					
Mean length of Manubrium (+/- SD)	-	5.21 (+/- 0.521)	-	4.65 (+/- 0.6)	4.064 (+/- 0.347)
Regression equation derived	-	154.38 + 0.26(M)	-	130.84 + 6.44(M)	85.657 + 19.091(M)
Std error of estimate	-	7.08	-	7.9	6.524
Correlation coefficient	-	0.191	-	0.44	0.716
Variance (R <sup>2</sup> )	-	0.04	-	0.197	0.512
<b>LENGTH OF MESOSTERNUM (B)</b>					
Mean length of Mesosternum (+/- SD)	-	9.41 (+/- 1.001)	-	9.39 (+/- 0.87)	8.731 (+/- 0.951)
Regression equation derived	-	150.9 + 0.18(B)	-	135.55 + 2.53(B)	111.87 + 5.883(B)
Std error of estimate	-	6.97	-	8.5	7.447
Correlation coefficient	-	0.255	-	0.25	0.604
Variance (R <sup>2</sup> )	-	0.07	-	0.06	0.365

\*n = number of male Sternum examined, SL – Sternal length



## Original Research Paper

# Use of Tertiary Trauma Survey Sheet to Improve the Quality of Medicolegal Reports

<sup>1</sup>Prasad L. Jaybhaye, <sup>2</sup>Ashutosh B. Potdar

### Abstract

Correct recording and documentation of the injury is extremely important in the clinical management of the trauma, as well as in its forensic and judicial assessment. An injury report is the document prepared by the doctor in all medicolegal cases. A typical medicolegal report consists of 3 parts namely preliminaries, body and opinion. This project was undertaken to evaluate the significance of Tertiary Trauma Survey sheet in improving the quality of medicolegal reports. One hundred medicolegal cases were systematically studied from accident cum wound register.

Body part of the injury report, which comprises of injury description and medical investigation details, has shown definite improvement with the use of tertiary trauma survey sheet. However preliminary part like demography did not show any dependency on tertiary trauma survey sheet indicating role of other possible factors.

**Key Words:** Forensic, Injury, Medicolegal, Trauma

### Introduction:

Good medicolegal records are vital for delivering high-quality, evidence-based healthcare. If crucial information is missing, found to be inaccurate or indecipherable, cases may be lost when they could otherwise have been won.<sup>1</sup> If the medicolegal records are unclear, defective or written in such a way that they are difficult to follow, it could cause errors and misjudgment. In this pilot project, we specifically analyzed the data entered in medicolegal injury reports. Medicolegally important morbidity data is routinely tabulated in the injury report which consists of information like preliminaries, alleged history, injury sustained and expert opinion. These medicolegal reports [MLR] have an important role in the legal system in deciding civil and criminal matters. Most of the times, patients are uncooperative or unresponsive and are unable

to provide valuable event related and medical history. In such cases, preparation of the MLR is delayed till the stabilization of the patient, hence important findings are either lost or not noticeable by the time patient is examined for the purposes of preparing an MLR. Tertiary trauma survey (TTS) is defined by the American college of surgeons as a patient evaluation that identifies and catalogues all injuries after the initial resuscitation and operative intervention.<sup>2</sup> It is typically conducted within 24 hours after admission. In this pilot project, we have used a modified version of tertiary trauma survey (**Fig 1, 2, 3 & 4**) to make it more useful for surgeons as well as the medicolegalist. The present study was performed to assess

- i. Data entered in medicolegal reports to determine how well it provides accurate, comprehensive and useful information.
- ii. Whether there is any significant improvement in medicolegal reports after the introduction of trauma sheets.

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DOR: 25/05/16 DOA: 03/03/17

DOI: 10.5958/0974-0848.2017.00007.0

### Materials and Methodology:

This project was performed in the year 2014. Prior permission from the Institutional ethics committee was obtained. One hundred cases were systematically studied from accident cum wound register. These cases were divided in to two groups, namely, those with TTS sheet and those without TTS sheet. Each case was analyzed for -

1. File Structure

2. Demographic Fields
3. Injury description (Injury Severity, Injury Type, Mechanism of Injury, Injury Outcome, Date, Time and Location of Injury etc)
4. Medical investigation details
5. Contributing Factor

Data thus obtained was analyzed by using statistical test to see significance of TTS sheet.

### Observations and results:

A total of 100 cases from accident cum wound register were analyzed. Among them 50 were without TTS sheet(Group I) while remaining 50 cases were with TTS sheet(Group II). In all cases from group I and II, some demographic data was found to be missing. Complete name was written in 54% of cases in group I and 60% in group II. In the address field, complete address was written only in 12% cases in group I and 16% in group II. In most of the cases, only city or town name was written as address. Detailed description of identification marks was found in 28% of cases in group I and in 36% of cases in group II.

In the injury description details, injury severity was found to be completely explained in all cases (100%) of group II while in group I, none of the cases had injury severity mentioned. Date, time, location and mechanism of injury was found to be properly explained in all cases of group I and II. Most common mistake found in injury description was related to the dimension of the injuries, specifically the depth, which was not mentioned in any of the case of group I and II. In group II, along with the trauma sheet, body charts were also used to describe injuries while same were absent in group I.

Medical investigation details were mentioned in all 100% cases of group II, while same were absent in all 100% cases from group I. However, medical investigation numbers were not mentioned in any of the cases from both groups. None of the cases from group I showed details regarding contributing factor while 60% of cases showed details regarding contributing factors in group II, however these details had not been properly written.

Chi square test and Fisher exact test were used to see significance of TTS sheet. Body part of the injury report, which comprises of injury description and medical investigation details had shown definite improvement with the use of TTS sheet as suggested by the p value less than 0.05. However preliminary part like demography did not show any dependency on

TTS sheet indicating role of other possible factors like experience, work stress etc.

### Discussion:

Correct and complete documentation of all injuries is essential from therapeutic as well as medico-legal, legal, epidemiologic and health system management perspectives.<sup>3</sup> A medicolegal case is a case of injury or ailment where attending doctor after taking history and clinical examination of the patient thinks that some investigations by law enforcing agencies are essential so as to fix responsibility regarding the case.<sup>4</sup>

If the medicolegal records are ambiguous, flawed or written in such a way that they are difficult to follow, it could cause errors and misunderstandings. As per statistics, about 80 percent of medico-legal work in India is done by non-forensic doctors resulting in defective medicolegal records.<sup>5</sup> Recently, In a Public Interest Litigation in the Nagpur Bench of Bombay High Court, it was highlighted, how the poor quality of Forensic medical examination results in inadequate, illegible, incomplete, loose and lackadaisical, not reliable+ medicolegal records.<sup>6</sup>

An incomplete record may lead to uncertainty regarding the mechanism of action of the injury causing force, affecting the physio-pathological understanding of the injury, not only upon presentation at the emergency unit, but also during hospitalization. In addition, full documentation allows forensic experts to evaluate initial lesions and their evolution in time, allowing for relevant assessment of the cause of death, with important legal implications. Tertiary trauma survey developed by the American college of surgeons uses a systematic approach to evaluate the trauma patient to ensure that all injuries are identified. It includes repetition of primary and secondary surveys, proper scrutiny of all laboratory data and radiographic studies.<sup>2</sup>

With the implementation of standardized tertiary trauma surveys, clinically significant missed injuries can be detected within 24 hours of admission.<sup>7</sup> Use of such TTS as a document of medico-legal value can contribute to improving degree of consistency of the records in the clinical medical chart and MLR.

### Who should perform the Tertiary survey?

The literature recommends that a trauma patient be evaluated with serial examinations by a provider with advanced skills. This approach provides care continuity and detects subtle changes that may indicate missed

injuries and their sequelae.<sup>8</sup> As far as possible, the medicolegist should attend these examinations so that he can note down all significant findings in addition to the notes by specialist. This can be achieved by setting clinical forensic department in proximity with casualty.

### Conclusion:

- Use of the tertiary trauma survey sheet showed definite improvement in the medicolegal data collection.
- On analysis of the MLRs, we found that most of the doctors were not aware of the proper collection of the medicolegal data. It may be because of
  - Absence of proper training
  - No clinical forensic medicine department
  - Inadequate forensic staff
  - Stressful work environment

### Recommendations:

- Establishment of clinical forensic medicine department (preferably attached to casualty) in all medical institutions with dedicated forensic medicine staff.
- Emphasis among health professionals of the importance of the TTS sheet as a document of medico-legal and legal value.
- Compulsory training during internship in clinical forensic medicine department.
- Forensic post should be created at all Rural health centers. It can help in

- Improved MLC data.
- Reduced burden of postmortem on tertiary centers.
- Improved management of toxicological emergencies.

Further studies are required on these lines for improvement in medicolegal data collection.

**Conflict Of Interest: None**  
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MEDICAL COLLEGE AND HOSPITAL					
CLINICAL FORENSIC MEDICINE DEPARTMENT					
MODIFIED TERTIARY TRAUMA SURVEY					
Name (Complete).....					
Age.....		Sex.....		Hospital number.....	
Address.....					
Date and time of examination.....					
Brought by whom .....					
Identification mark 1)					
2)					
History of present injury .....					
Status of injured person: Pedestrian/Cyclist/Driver / Passenger/ Pillion rider/ Others (Specify).....					
Smell of alcohol: Present / Absent					
History of drug intake if any: Yes / No					
Past medical history:					
Allergy	Medication	Past illness	Last meal	Event leading to accident	
Vital signs:	Pulse	BP	RR	Temp.	SPO2
Resuscitation:					

Page 1

Airway:	Adequate / Obstructed	
Breathing:	Normal / Laboured	
Circulation:	Adequate / Hypotensive	
General examination:	Fully conscious and oriented- Yes / No	
	Pupils .....	
	Moving all four limbs- Yes / No	
Systemic examination:		
Head and Neck:		
Face:		
Eyes:		
Nose:		
Ears:		
Mouth and pharynx:	Neck spine:	
<b>Glasgow Coma Scale</b>		
<b>Eyes Opening</b>	<b>Verbal response</b>	<b>Motor response</b>
1 - none	1 - none	1 - none
2 - to pain	2 - incomprehensible sounds	2 - abnormal extension
3 - to voice	3 - inappropriate words	3 - abnormal flexion
4 - spontaneously	4 - confused	4 - withdraws from pain
	5 - orientated	5 - localises to pain
		6 - obeys commands
Glasgow coma score: .....		
Examination of chest:		

Page 2

Examination of abdomen:

Examination of skeletal system and spine:

Examination of extremities: Upper limbs

Lower limbs

Investigations findings (with investigation number)

X-ray.....

USG.....

CT Scan.....

Other if any.....

Consultation if any

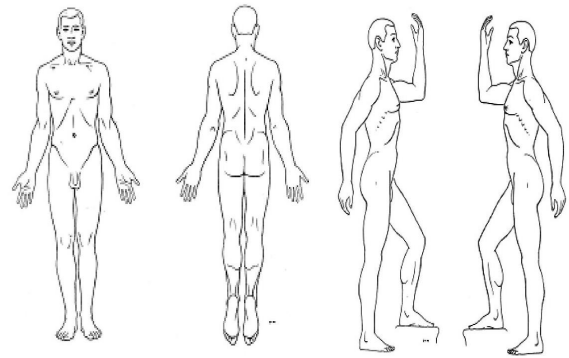
Whether admitted or not

Opinion as to cause of injury

Police intimation: Given / Not given

Signature of doctor

Page 3



Page 4

## Original Research Paper

# Study of deaths in Railway Accident in Medico-legal Autopsy

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

### Abstract

The study was carried out on 500 railway related deaths in order to determine the epidemiological, forensic pathological and medico-legal profile of deceased victims brought to the mortuary of department of forensic medicine PMCH Patna between June 2011 to May 2013. Deaths due to railway accidents were 9.85% of total post-mortem examinations performed during the same period. Majority of victims (87.4 %) were male, aged between 21 . 50 years. Extensive injuries all over the body were seen in almost all the cases. Injuries to head and chest were seen in 53.6 % and chest & abdomen in 32.4 % cases. Most of the victims (86 %) died at the spot and majority of the deaths (62.8 %) were accidental, however, suicidal intension was seen in 15.2 % cases. In accidental deaths, fall from train was the commonest. Decapitation & hemi-section of the body at thoraco-abdominal area were seen in suicidal deaths.

**Key Words:** Railway, Head injury, Decapitation, Fall from train

### Introduction:

Railways is the second largest transport system for the public as well as goods since its inception in 1853 from Mumbai to Thane. Millions of passengers are travelling daily through railway. Patna, the capital city Bihar, is an institutional town of immense importance, situated on one of the busiest rail track Delhi to Kolkata. Besides Patna Junction, Rajendra Nagar, Guljar Bag, Danapur, Patna Saheb & Patilputra are other railway stations in Patna city. Thousands of the passengers approach these stations daily, causing large no. of casualties. Slums have also mushroomed along the railway tracks and their residents frequently use the rail track for defecation and other day to day activities. Their children also play near the track and same times involved in railway accidents.

The present study was carried out focus on the unnatural deaths caused by railway accidents. Attempt is also made to find out the cause of accident and pattern of Injuries so that corrective measures can be advised.

### Materials & Methodology:

The study was conducted at the mortuary of the department of Forensic Medicine, Patna Medical College & Hospital (PMCH) between June 2011 to May 2013 on the victims who allegedly died due to railway accidents that occurred within the municipal limits of Patna and those who were brought for treatment to PMCH & died subsequently. The information regarding the victims and cause of accidents were collected from the parents, relatives and persons accompanying the dead body, as well as from the police and the inquest papers and the hospital records, and from news paper & print media.

During postmortem examination, if it was ascertained that the cause of death was not due to railway accident, but due to some other means, as many a times, the dead bodies are kept on railway track after killing just to divert attention of police and law enforcing agencies; it was not included in the study. All the data related to epidemiology, post-mortem findings, cause and manner of death were recorded, complied and presented in this paper.

### Observation & result:

Deaths associated with railway accidents are a quite sizable percentage of the unnatural deaths. In our study, railway accidents accounted for 9.9 % of the total 5103 cases. (Table -1). More than half of victims (266 - 53.2 %) of the victims remained unknown at the time of postmortem examination. Majority of the

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victims were male (87.4%), the male: female ratio being 6.9:1. Age - wise majority of victims were between 21 - 50 years, with maximum 25.8 % in 31 - 40 years (Table . 2). Cases were very few in the less than 10 years (1.2%) and after 70 years (3.0%).

Though there was no definite trend as regards days of the week or seasonal variations, they were found more frequent (19.2 %) on Wednesdays (Table . 3) and during rainy season, 36.8% (Table . 4). Extensive injuries all over the body were seen in most of the victims of railway accidents. Head injury alone or with chest injury, was seen in 266 (53.2%) cases, followed by chest injury alone or with abdominal injury in 23.8% and lower extremity in 3% cases (Table . 5). In internal injuries, fracture of skull bones was seen in 53.2%, intracranial hemorrhages in 56.2%, contusion/ laceration of brain in 33.8%, transaction of spine in 3.2%, fracture of ribs in 28%, laceration of lungs in 24.6%, rupture of liver in 16.2%, spleen in 24 (4.8%) and amputation of lower limbs in 7 % cases (Table . 6)

Most of the victims (86%) died on the spot, 7.6% on the way to hospital and only 6.4% died in the hospital, after getting some treatment. Haemorrhage and shock (51.2%) due to multiple injuries and Head injury (42.8%) were the two important causes of death in victims of railway accidents. 5.4 % of the victims died instantaneously due to severe damage of vital organs (Table . 7). More than one fourth (28.6%) of the deaths occurred at railway stations in Patna during crossing the rail track to catch train at platform or during getting down from the running train. 5.4% of the victims allegedly fell from the running train but exact manner of accident could not ascertained in 47.8% of the cases (Table . 8). Majority of the deaths (62.8%) were accidental. Suicidal intension was observed in 15.2% cases while the manner of death was not clear in 22% of the cases.

### **Discussion:**

Death from railway accidents occurred since the inception of railways.<sup>1</sup> In this study the death from railway accidents were 9.85 % of total unnatural deaths, which is unexceptionally in Patna city probably due to overcrowding in train and ignorance of traffic rules by the rail users. Males are the commonest victims of railway death which concurs with study conducted by other authors.<sup>2-4</sup> Majority of victims are adult between 21 - 50 years of age is due to their involvement in earning livelihood

for which they travel by train and always in haste. Stress of work and sometimes family dissatisfaction and financial problems compelled them to take extreme decision to end their lives.<sup>2,5</sup>

Majority of the victims of railway accidents died as a result of either multiple injuries, head injury, decapitation, crushing of body in parts, blunt injuries of transaction of body into two parts. There were two main manners of death: suicidal or accidental in nature.<sup>6</sup> Nature of death could not be ascertained in 22 % of the cases.

### **Conclusion**

Though the railways is a cheap, quick and comfortable mode of transport but large number of casualties also occurred due to overcrowding and speed of the train. In this study, majority of the victims were adult males who died during crossing the track or fall from the train. Multiple injuries all over the body especially on the head and upper part of body are the causes of death. Decapitation and transaction of body were seen in suicidal cases. Half of the victims were not identified at the time of post-mortem and cremated as unknown.

### **Suggestions:**

Looking at the large number of cases of un-natural deaths received from railway police where even a large number of it is unidentified lead us to give some suggestions which might help to reduce such incidents.

Install gate on crossing of railway track

People should not be allowed to cross track on railway station, encourage them to use over-bridges/under-bridges instead of using shortcuts of crossing rail-tracks.

To check overcrowding the frequency of the trains should be increased or a few extra wagons may be added or double storied trains should be employed. Travelling on roof of compartment should not be allowed in any way.

The slums around the rail tracks should be shifted to appropriate place. Fencing should be done around the rail track, especially within city limits to prevent suicides/accidents. Railway stations should be kept clean and dry to avoid slipping at the time of getting down from the train. Passengers should be educated for the railway traffic rules. Adequate communication of railway police station with all other police stations of the country, especially sharing of the photographs of the missing persons through internet can help to identify the corpses.

**Conflict of interest:** None

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**Table 1: Incidence of death due to railway accident in medico-legal autopsy**

S. No.	Total Autopsy	Autopsy of Railway accidents	
		Number	%
1.	5103	500	9.85

**Table 2: Age & sex of the victims of railway station**

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
0 – 10	06	1.2	-	0.0	06	1.2
11 – 20	33	6.6	01	0.2	34	6.8
21 – 30	13	16.6	14	2.8	97	19.4
31 – 40	17	21.4	22	4.4	129	25.8
41 – 50	88	17.4	16	3.2	104	20.8
51 – 60	69	13.8	09	1.8	78	15.6
61 – 70	36	7.2	01	0.2	37	7.4
71 – 80	15	3.0	-	0.0	15	3.0
Total	437	87.40	63	12.60	500	100

**Table – 3 Day - wise variation in Railway accidents**

S. No.	Day	No of cases	%
1	Monday	60	12
2	Tuesday	65	13.0
3	Wednesday	96	19.2
4	Thursday	87	17.4
5	Friday	58	11.6
6	Saturday	72	14.4
7	Sunday	62	12.4
	Total	500	100

**Table – 4 Seasonal variation in Railway accidents**

S. No	Season	No	%
1	Summer (March – June)	160	32
2	Rainy (July - October)	184	36.8
3	Winter (November – February)	156	31.2
	Total	500	100

**Table – 5 Major areas injured in Railway accidents**

S. No.	Area injured	No	%
1	Head	102	20.4
2	Head & chest	164	32.8
3	Chest	43	8.6
4	Chest & abdomen	97	19.4
5	Abdomen & pelvis	22	4.4
6	Lower extremity	15	3.0
7	All over the body	57	11.4
8	Total	500	100

**Table – 6 Major injuries in Railway accidents**

S. No.	Injuries	No	%
1	Fracture of Skull bones	266	53.2
	Vault	112	
	Base	31	
	Vault & base both	123	
2	Intracranial Hemorrhage	281	56.2
	Extradural	41	
	Subdural	76	
	Subdural & subarachnoid	136	
	Subarachnoid	15	
3	Intracerebral	13	33.4
	Contusion/laceration of brain	169	
4	Decapitation	08	1.6
5	Transaction of spine	17	3.4
6	Fracture of Ribs	140	28.0
7	Fracture of Clavicle/Sternum	30	6.0
8	Laceration of lungs	123	24.6
9	Transaction of body	07	1.4
10	Rupture of liver	81	16.2
11	Rupture of spleen	24	4.8
12	Intestinal perforation	19	3.8
13	Fracture of pelvis	11	2.2
14	Amputation of upper limbs	18	3.6
15	Amputation of lower limbs	35	7.0

**Table – 7 Causes of death in Railway accidents**

S. No.	Causes of death	No	%
1	Haemorrhage & shock	256	51.2
2	Coma due to head Injury	214	42.8
3	Instantaneous death	27	5.4
4	Secondary infection	03	0.6
5	Total	500	100

**Table – 8 Causes of Railway accidents**

S. No.	Causes of Accident	No	%
1	Crossing the track near platform to catch the train	59	11.8
2	Fall/slip on the platform during getting down from running train	84	16.8
3	Fall from the running train	27	5.4
4	Jump in front of the train	33	6.6
5	Lying of the Railway track	43	8.6
6	Hit by the train	15	3.0
7	Unknown	239	47.8
	Total	500	100

**Table – 9 Manner of death in Railway accidents**

S. No.	Manner of death	No	%
1	Suicidal	76	15.2
2	Accidental	314	62.8
3	Undetermined	110	22.0
4	Total	500	100

## Original Research Paper

# Dermatoglyphics as a Preliminary Diagnostic Tool in Leukoplakia, Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma

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### Abstract

**Introduction:** Dermatoglyphics are the dermal ridge configurations on the digits, palms and soles. They are genetically determined and influenced by environmental forces that operate before birth. Not all the people using tobacco suffer from precancerous and cancerous lesions of oral cavity. Genetic predisposition might explain such an individual variability that can be predicted by using various cytogenetic markers. However, these studies are far more costly and complicated. Several studies have shown an association between dermatoglyphics and different types of cancer. Hence, this study was undertaken to determine whether specific dermatoglyphic patterns exist which help in predicting the occurrence of Leukoplakia, OSMF and OSCC. **Materials and Methods:** Fingerprints of 160 individuals were divided into four groups, 40 patients with Leukoplakia, 40 patients with OSMF, 40 patients with OSCC and 40 healthy individuals were recorded with the help of Korex duplicating ink. Then the finger print patterns were analysed using Stereomicroscope Leica Wild M3Z equipped with Germany Progres Capture Pro Jenoptik Version 8.0.8 Image analysis software. **Results:** Arches and loops were more predominant in Leukoplakia, OSMF and OSCC and whereas in healthy group, whorl patterns were more predominant. Since the data is qualitative type, Chi square test was used for statistical analysis. P value of 0.05 or less was considered for statistical significance. **Conclusion:** Dermatoglyphics can be used to identify high risk group, so that early preventive measures can be instituted in order to prevent the occurrence of these lesions.

**Key Words:** Dermatoglyphics, Oral Leukoplakia, Oral Submucous Fibrosis, Oral Squamous Cell Carcinoma.

### Introduction:

The word 'Dermatoglyphics' indicates the study of epidermal ridge patterns on fingers, palms and soles. The dermatoglyphic pattern forms as early as 10 weeks of intrauterine life. Genetic and environmental factors play an important role in development of ridges. Once these patterns are formed, they do not change throughout one's life.

The fact that skin of palm and soles has ridges that are unique to each individual has been used for personal identification. Study of fingerprint patterns is considered to be the most reliable and absolute method of identification.<sup>1</sup>

Since epidermal ridge patterns form early in fetal development and remain unchanged throughout life, unusual dermatoglyphics may indicate gene or chromosomal abnormalities consistent with diseases such as Leukoplakia and Oral Squamous cell carcinoma.<sup>2</sup>

The basic size, shape and spacing of dermatoglyphics appear to be influenced by genetic factors. Studies suggest that multiple genes are involved, which take part in the control of finger and palmar dermatoglyphic development, and can also indicate towards the development of premalignancy and malignancy. Hence, identifying high-risk people for oral cancer and precancer could be of great value to decrease the incidence of the same.<sup>3,4</sup> The present study was undertaken to evaluate the frequency of specific fingertip print patterns in

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Leukoplakia, Oral Submucous Fibrosis, Oral Squamous Cell Carcinoma and healthy individuals by dermatoglyphic analysis.

### Materials and Methods:

The Institutional Ethics Committee approval was taken for the study. After explaining about the study to the subjects, an informed consent was obtained. The clinically diagnosed and histopathologically confirmed cases of Leukoplakia, Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma were included in the study.

The study sample was divided into four groups: **Group 1:** Patients with Oral Leukoplakia, **Group 2:** Patients with Oral Submucous Fibrosis (OSMF), **Group 3:** Patients with Oral Squamous Cell Carcinoma (OSCC) and **Group 4:** Control group.

Fingertip patterns were studied as: Arches (Plain Arch and Tented Arch), Loops (Ulnar Loop and Radial Loop) (Loops were recorded as ulnar or radial depending on which it opened) and Whorls (Double Loop Whorl, Plain Whorl, Central pocket loop whorl and Accidental Whorl) in each finger tips.

### Procedure:

Korex Black duplicating ink was uniformly spread over the fingers. Satisfactory prints were obtained from the fingers. Then the finger print patterns were analysed using Stereomicroscope Leica Wild M3Z equipped with Jenoptik Germany Progres Capture Pro Version 8.0.8 Image analysis software.

### Results and observations:

A total of 160 individuals fingerprint patterns were studied. Loops were the most common pattern followed by whorls and arches in all digits among all the groups. There was a significant difference in overall distribution of fingerprint pattern in both hands and each digit. Frequency of different fingerprint patterns for individual digits in both hands among 40 patients with Leukoplakia, 40 patients with OSMF, 40 patients with OSCC and 40 healthy individuals is shown in **table 1 to 10**.

Since the data was of qualitative type, Chi square test was used for statistical analysis. P value of 0.05 or less was considered for statistical significance. In patients with Leukoplakia, Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma, there was an increased frequency (11%, 7.5% and 13% respectively) of arches and frequency (59%,

62% and 49.5% respectively) of loops compared to healthy group (5.75% and 49%).

Healthy individuals had whorls (45%) as predominant patterns compared to Leukoplakia (30%), OSMF (30%) and OSCC (37.5%) patients.

In our study, we have observed the following findings in each digit:

There was an increased frequency of ulnar loop pattern in right thumb digit in all groups. Following the ulnar loop, there was also increase in the frequency of plain whorl in healthy group unlike other groups. Whereas in right ring digit, there is an increased frequency of ulnar loop pattern in all groups and increased frequency distribution of plain whorl pattern in healthy individuals and OSCC patients.

There was also an increased frequency of ulnar loop pattern in right little digit in all groups and increased frequency of central pocket loop whorl patterns in healthy individuals next to ulnar loop.

Frequency of ulnar loop pattern in left thumb digit in all groups was predominant and increased frequency of plain whorl pattern in healthy individuals following ulnar loop pattern.

There was an increased frequency of ulnar loop pattern in left index digit in all groups. In healthy individuals, next to ulnar loop pattern, there is an increased frequency of plain whorl pattern.

Similar to other findings, there was an increased frequency of plain whorl pattern in left middle digit in healthy individuals and with predominant patterns in patients with Oral Squamous Cell Carcinoma following ulnar loop pattern.

An increased frequency of ulnar loop pattern in left ring digit was also observed in patients with Leukoplakia and Oral Submucous Fibrosis. But there is equal frequency of ulnar loop pattern and plain whorl patterns in patients with Oral Squamous Cell Carcinoma and there is increased frequency of plain whorl pattern in healthy individuals than ulnar loop pattern.

Frequency distribution of ulnar loop pattern in left little digit was seen in majority of all groups and increase in frequency of tented arch pattern in Leukoplakia patients and increased frequency of plain whorl pattern following ulnar loop pattern in healthy individuals were observed.

### Discussion:

Dermatoglyphics is the study of palmer and plantar dermal ridge carvings on hands and

feet (Derma=Skin, Glyph=Carving). The terminology was coined by Cummins and Midlo in 1926 and Cummins is regarded as the father of Dermatoglyphics.<sup>5</sup> In ancient India, ridge pattern study was known as Samudra Shashtra.<sup>4</sup> The epidermal ridge patterns were classified into Chakra, Shankya and Padma which corresponds with the whorl, loop, and arch system of modern classification. Fingerprints are unique to all individuals and remain unchanged over the lifetime.<sup>5</sup> Development is the progress towards maturity. In intra-uterine period, these processes are dependent on both genetic and environmental determinants. Growth and development takes place by cytoplasmic-nuclear interaction.<sup>6</sup>

Widespread interest in epidermal ridges developed only in last several decades as many patients with Chromosomal aberrations had unusual ridge formations.<sup>7</sup> The key figure in the development of dermatoglyphic study was done by Czech Doctor Jan Purkinje. He suggested that the dermatoglyphic patterns might have both genetic and diagnostic importance.<sup>8</sup> In recent past, a number of investigators have focused their attention in finding out an association of morphological and genetic characters with a number of pathological conditions.<sup>9</sup>

Developmental instability is reflected and reliably measured by fluctuating asymmetry. Fluctuating asymmetry is an indicator of genetic and environmental stress. Inspection of skin ridges, therefore, seemed simple, promising, non-invasive and inexpensive means for determining particular chromosomal defect in patients.

Oral cancer is a multifactorial disorder occurring due to molecular aberrations in a variety of chromosomes and genes. As a result certain individuals exposed to carcinogens with genetic instability might be at a greater risk for developing these lesions. The dermatoglyphic patterns are under genetic control and can give an indication of premalignancy and malignancy.

Thereby, they can form a precious tool in the diagnosis of PMDs and OSCC. As the incidence of oral cancer is on the rise, this study was undertaken to access and investigate any relationship of fingertip print patterns of hands in patients with Leukoplakia, Oral Submucous Fibrosis, Oral Squamous Cell Carcinoma and healthy individuals and to ascertain the genetic contribution in the etiology of the same.

Following significant findings can be considered as genetic markers for Leukoplakia, OSMF, Oral Squamous Cell Carcinoma and

healthy individuals on both hands taken together.

There was more number of male patients in OSMF and leukoplakia groups compared to other two groups. This was in accordance with Prashant. B. Patil (2013) who studied the prevalence of oral mucosal lesions in 2400 subjects and observed that OSMF and Leukoplakia are more common in males than in females.<sup>10</sup>

Gutka chewing, quid chewing and tobacco chewing habits were more common in Leukoplakia, OSMF and OSCC patients. This findings were similar to those previous studies conducted in India.<sup>11-13</sup>

Our study showed that occurrence of OSCC is more common in patients with habit of drinking alcohol. Xinhua Wang who studied the role of cigarette smoking and alcohol consumption in the differentiation of oral squamous cell carcinoma for the males in China found the similar results as our study.<sup>14</sup>

Most studies have shown ulnar loop as having the highest percentage in normal population followed by whorl, arch and radial loop (Oladipo and Akanigha, 2005; Oladipo 2007).<sup>15</sup> Our observation in this study was in agreement with most of these earlier studies as the loop pattern was predominant followed by whorl and the least was arch pattern.

In patients with Leukoplakia, Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma, there was an increased frequency (11%, 7.5% and 13% respectively) of arches and frequency (59%, 62% and 49.5% respectively) of loops compared to healthy group (5.75% and 49%).

Healthy individuals have whorls (45%) as predominant patterns compared to Leukoplakia (30%), OSMF (30%) and OSCC (37.5%) patients. This was in accordance with the Venkatesh E (2008), who studied finger print patterns of 30 in each group of patients with Oral Leukoplakia, OSCC and controls found the similar results. In patients with oral leukoplakia and OSCC, there was an increased frequency of arches and loops whereas in control group there is an increased frequency of whorls. P value is 0.000, which is statistically quite significant.<sup>2</sup> Polt HM (2004) studied fingerprint pattern in 29 oral cancer patients and found the increased frequency of arches in cancer patients compared to normal individuals.<sup>15</sup>

Another study was conducted by Jatti D (2014), who tried to find out the role of dermatoglyphics in potentially malignant and malignant disorders. According to which patients with potentially malignant and malignant

disorders had higher frequency of distribution of arches and loops compared to control group.<sup>16</sup>

In the present study, we also got findings for frequency distribution of finger print patterns in each finger. But very few findings were statistically significant. Only one study is available on this topic where they observed the frequency distribution of fingertip patterns in OSMF patients in each finger.

A study by Tamgire DW in 2013<sup>17</sup> was designed to collect the fingertip patterns of the gutka chewers with or without OSMF. It consisted of 200 subjects divided into two groups. They found few statistically significant findings of frequency distribution of fingertip patterns in patients with OSMF in each finger. But our findings mentioned below were not in line with the observations by Tamgire. This could be attributed to racial differences, as anthropologically, the races within India have evolved differently and the above-mentioned study was conducted in different region and was also in disparity in sample size of the study groups.

None of the earlier researchers have done analysis of frequency distribution of fingertip patterns in patients with Leukoplakia and OSCC in each finger. Hence there are no findings for comparison. By observing the above statistically significant findings of dermatoglyphics, the subjects with chewing gutka, tobacco and quid may be forecasted and motivated strongly to quit the habit.

## Conclusion:

The field of dermatoglyphics holds promising results for determining the genetic susceptibility of individuals to develop Leukoplakia, OSMF and OSCC. The results of this study have further added to the existing importance of dermatoglyphics. As Leukoplakia, OSMF and OSCC are environmentally acquired but are deep rooted in the soil of genetics. With the knowledge of dermatoglyphic patterns, individuals who are prone to develop these lesions can avoid the trigger factors. The relevance of dermatoglyphics is not for diagnosis, but for prevention, by predicting a disease, and not for defining an existing disease, but for identification of people with the genetic predisposition to develop certain diseases.

Although the present study reveals few significant results, the scope for further research remains open as there is a paucity of similar

literature for comparisons. The current study opens newer avenues in the field of dentistry as it holds definite potential to diagnose dreaded diseases at an early stage in a cost-effective manner.

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Table 1:- Frequency distribution of finger print patterns in Right index digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
RIGHT INDEX	Plain Arch	1	2	4	0	7	>0.05
	Tented Arch	2	0	3	1	6	
	Ulnar Loop	24	21	14	20	79	
	Radial Loop	1	1	0	4	6	
	Double Loop Whorl	5	2	3	0	10	
	Plain Whorl	5	9	9	8	31	
	Central Pocket Loop Whorl	1	2	4	4	11	
	Accidental Whorl	1	3	3	3	10	
	Total	40	40	40	40	160	

Table 2:- Frequency distribution of finger print patterns in Right middle digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
RIGHT MIDDLE	Plain Arch	1	0	1	1	3	>0.05
	Tented Arch	1	1	2	0	4	
	Ulnar Loop	25	30	22	26	103	
	Radial Loop	3	0	1	0	4	
	Double Loop Whorl	1	2	3	2	8	
	Plain Whorl	6	5	8	8	27	
	Central Pocket Loop Whorl	0	1	0	3	4	
	Accidental Whorl	3	1	3	0	7	
	Total	40	40	40	40	160	

Table 3:- Frequency distribution of finger print patterns in Right ring digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
RIGHT RING	Plain Arch	1	2	1	0	4	<0.05
	Tented Arch	5	1	2	2	10	
	Ulnar Loop	15	18	11	8	52	
	Radial Loop	0	1	0	1	2	
	Double Loop Whorl	3	5	4	0	12	
	Plain Whorl	11	6	16	24	57	
	Central Pocket Loop Whorl	1	5	3	4	13	
	Accidental Whorl	4	2	3	1	10	
	Total	40	40	40	40	160	

Table 4:- Frequency distribution of finger print patterns in Right ring digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
RIGHT RING	Plain Arch	1	2	1	0	4	<0.05
	Tented Arch	5	1	2	2	10	
	Ulnar Loop	15	18	11	8	52	
	Radial Loop	0	1	0	1	2	
	Double Loop Whorl	3	5	4	0	12	
	Plain Whorl	11	6	16	24	57	
	Central Pocket Loop Whorl	1	5	3	4	13	
	Accidental Whorl	4	2	3	1	10	
	Total	40	40	40	40	160	

Table 5:- Frequency distribution of finger print patterns in Right little digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
RIGHT LITTLE	Plain Arch	0	1	2	0	3	>0.05
	Tented Arch	3	2	0	0	5	
	Ulnar Loop	28	29	28	25	110	
	Radial Loop	2	0	1	0	3	
	Double Loop Whorl	2	0	4	2	8	
	Plain Whorl	2	4	2	4	12	
	Central Pocket Loop Whorl	1	3	1	8	13	
	Accidental Whorl	2	1	2	1	6	
	Total	40	40	40	40	160	

Table 6:- Frequency distribution of finger print patterns in Left thumb digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
LEFT THUMB	Plain Arch	1	2	6	0	9	<0.05
	Tented Arch	2	3	0	3	8	
	Ulnar Loop	23	22	22	20	87	
	Radial Loop	3	3	0	0	6	
	Double Loop Whorl	2	3	5	3	13	
	Plain Whorl	0	5	0	9	14	
	Central Pocket Loop Whorl	2	0	3	0	5	
	Accidental Whorl	7	2	4	5	18	
Total		40	40	40	40	160	

Table 7:- Frequency distribution of finger print patterns in Left index digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
INDEX L	Plain Arch	0	0	5	2	7	<0.05
	Tented Arch	5	4	4	4	17	
	Ulnar Loop	20	20	12	14	66	
	Radial Loop	1	2	7	2	12	
	Double Loop Whorl	4	2	1	0	7	
	Plain Whorl	7	3	8	9	27	
	Central Pocket Loop Whorl	0	4	0	5	9	
	Accidental Whorl	3	5	3	4	15	
Total		40	40	40	40	160	

Table 8:- Frequency distribution of finger print patterns in Left middle digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
LEFT MIDDLE	Plain Arch	1	1	3	1	6	>0.05
	Tented Arch	4	3	4	3	14	
	Ulnar Loop	23	26	17	22	88	
	Radial Loop	2	2	2	0	6	
	Double Loop Whorl	2	1	1	1	5	
	Plain Whorl	5	5	12	9	31	
	Central Pocket Loop Whorl	0	1	0	1	2	
	Accidental Whorl	3	1	1	3	8	
Total		40	40	40	40	160	

Table 9:- Frequency distribution of finger print patterns in Left ring digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
LEFT RING	Plain Arch	1	1	1	1	4	>0.05
	Tented Arch	2	1	1	2	6	
	Ulnar Loop	20	20	17	13	70	
	Radial Loop	1	1	0	0	2	
	Double Loop Whorl	4	4	2	1	11	
	Plain Whorl	11	9	17	15	52	
	Central Pocket Loop Whorl	0	2	1	2	5	
	Accidental Whorl	1	2	1	6	10	
Total		40	40	40	40	160	

Table 10:- Frequency distribution of finger print patterns in Left little digit in all study groups.

FINGER PRINT PATTERNS		Group				Total	p value
		Leukoplakia	OSMF	OSCC	Healthy		
LEFT LITTLE	Plain Arch	0	0	4	1	5	<0.001
	Tented Arch	7	2	2	2	13	
	Ulnar Loop	17	28	22	21	88	
	Radial Loop	5	4	5	0	14	
	Double Loop Whorl	4	0	0	0	4	
	Plain Whorl	4	3	4	14	25	
	Central Pocket Loop Whorl	2	2	0	0	4	
	Accidental Whorl	1	1	3	2	7	
Total		40	40	40	40	160	

## Original Research Paper

# Assesment of Skeletal Maturity by Radiological Study around Wrist Joint in Vidarbha Region

<sup>1</sup>Ritika Gaddewar, <sup>2</sup>M.M.Meshram

### Abstract

Determination of the skeletal age of an individual by radiological observation of the time of fusion of the ossification centers is a subject matter of great medicolegal interest. A total of 107 cases were studied for assessing epiphyseal fusion at lower end of Radius and Ulna by radiography. It was observed that complete epiphyseal fusion occurred at both lower end of Radius and Ulna up to 19 years in males and 18 years in females. Females showed early epiphyseal fusion than in males. Age of epiphyseal fusion was studied and compared with different studies carried out in different populations of India as well as other countries.

**Key Words:** Lower end of radius, Lower end of Ulna, Radiology, Epiphyseal fusion

### Introduction:

In developing countries like India, unawareness regarding importance of registration of births is due to illiteracy or improper maintenance of records. If doubt arises regarding the age of a person in any legal inquiry, Forensic age estimation is promptly requested by authorities to ascertain whether the person concerned has reached the age of imputability. Here, age estimation becomes a valuable tool to assist in administration of many civil and criminal procedures. There are 3 steps for age estimation .

1. Physical examination,
2. Dental examination and
3. Radiological examination.

Physical examination includes measurement of height, weight and body mass. They are closely related to biological maturation, but are not sufficiently accurate due to the wide variations in the body size. Periods of eruption of deciduous and permanent teeth are reliable. But by the age of 15-16 years eruption of all permanent teeth is complete, except the third molar.

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Eruption of third molar (wisdom tooth), if present, shows wide variation from person to person. So, dental examination will not be of much help after the age of 16 years. After puberty, the process of growth in length of the long bones stops at different ages in different parts of different long bones. This stoppage of growth process is indicative on x-ray examination by fusion of the epiphysis with its respective diaphysis, or secondary centre with primary centre. Further, it is found that the age for the fusions is fairly constant with minor variations among different study groups of different geographic areas. The minor differences in the age of fusion could be due to effects of changes in climate, economic, hereditary, dietetic conditions or involving some unknown factors. According to Banerjee KK, et al,<sup>1</sup> the study of epiphyseal fusion of bones is considered a reasonable scientific and accepted method for estimation of age by the court of law all over the world.

Extensive work on the determination of age of epiphyseal fusion has been carried out in different states of India as well as abroad and from the finding of various workers, it is evident that there is not only difference in the age of epiphyseal fusion in India and abroad, but also in the different regions of India<sup>2</sup>. It is also observed that in females the fusion of epiphysis with metaphysis occurs earlier than males<sup>3</sup>. This necessitates separate standards for males and females. So, it is necessary to follow the latest data available for a particular place for estimation of the age of the population of that place.

## Materials and Methods:

A prospective observational study was undertaken in both males and females between the age group of 13-20 years with the Institutional Ethics Committee's Approval. The cases were collected from outdoor patients coming to Radiodiagnosis Department at our institute, Government Medical College, Nagpur.

Accurate age, as far as possible, was determined in each case based on the statements of the subjects, supported by their school leaving certificates. For statistical analysis, the subjects were divided into eight groups as 13, 14, 15, 16, 17, 18, 19, 20 years according to their mean ages. The subjects of age ranging from 12 years 6 months to 13 years 5 months were included in the mean age group 13 years and cases of age 13 years 6 months to 14 years 5 months taken into age group 14 years and so on up to 20 years.

Radiographs of the left wrist joint were taken in Antero-Posterior view at the department of Radiodiagnosis. The following epiphyses were examined:

- At the Wrist joint:**
1. Lower end of Radius
  2. Lower end of Ulna.

Staging of the degree of fusion of the epiphysis around the Wrist joint was done according to Prasad RS, et al<sup>4</sup> and were considered as criteria for epiphyseal fusion.

**Degree 0:** A dark radioluscent line seen throughout the length of the epiphyseal and metaphyseal joining surfaces (Epiphyseal fusion not yet commenced).

**Degree 1:** Radio-opaque area is seen in the middle or on either side of the epiphyseal and metaphyseal joining surfaces (Epiphyseal fusion commenced).

**Degree 2:** Radio-opaque area is more than half of the epiphyseal and metaphyseal joining surfaces (Epiphyseal fusion incomplete).

**Degree 3:** Radio-opaque area is seen in the entire length of the epiphyseal and metaphyseal joining surfaces (Epiphyseal fusion complete).

## Results:

Total 107 cases were studied, of which 54 were Males and 53 were Females.

**Table No.1** shows age of epiphyseal fusion of lower end of Radius. It was observed that complete epiphyseal fusion was seen up to 19 years in males and 18 years in females.

**Table No.2** shows age of epiphyseal fusion of lower end of Ulna. It was observed that complete epiphyseal fusion was seen up to 19 years in males and 18 years in females

## Discussion:

Skeletal maturity as an index for determination of age has got great medicolegal importance. Numerous studies of numerous bones has been carried for determining age. However, it must be noted that skeletal maturity has great biological variations in different parts of World. India being large country has definite biological variations in North, South, East, West and central part of Country. This is due to geographical, nutritional and cultural differences in different parts of country.

In present study the epiphyseal fusion of lower end of Radius and Ulna was studied by Radiography and age of epiphyseal fusion of lower end of Radius was seen up to 19 years in Males and 18 years in Females. In studies carried out on Punjabi,<sup>5,6</sup> Northwest<sup>7</sup> and Bengali<sup>8,9</sup> population it was found that age of fusion of lower end of radius with shaft occurs 1-2 years earlier and 1-2 years later in Vidarbha,<sup>10</sup> Ahmedabad<sup>11</sup> and Uttar Pradesh<sup>12-14</sup> population. The present study showed similar results in Manipuri girls,<sup>15</sup> North-east Indian<sup>2</sup> girls, Delhi,<sup>1</sup> South Indian,<sup>16</sup> Mumbai<sup>17</sup> and Madhya Pradesh population.<sup>18</sup> (**Table No.3**)

Epiphyseal fusion of lower end of Radius with shaft in Egyptian males,<sup>19</sup> Burmese<sup>20</sup> females, Pakistani<sup>21</sup> population and Australian<sup>22</sup> population is almost similar but 1-2 years later in English<sup>23</sup> population as compared to present study. (**Table No.4**)

In the present study, age of the epiphyseal fusion of lower end of Ulna was found to be 19 years in males and 18 years in females, which coincides with findings of the studies on Delhi,<sup>1</sup> South India,<sup>16</sup> Ahmedabad<sup>11</sup> and Madhya Pradesh<sup>18</sup> population and Manipuri<sup>15</sup> girls and North-East<sup>2</sup> Indian girls. Epiphyseal fusion of lower end of Ulna with shaft occurs 1-2 years earlier in Punjabi,<sup>4-6</sup> Bengali<sup>8,9</sup> and Mumbai<sup>17</sup> population and North-West<sup>7</sup> Indian females. Whereas age of epiphyseal fusion found to be 1-2 years later in Vidarbha<sup>10</sup> and Uttar Pradesh<sup>12-14</sup> population as compared to present study. (**Table No.3**)

Epiphyseal fusion of lower end of Ulna with shaft in English<sup>23</sup> population is 1-2 years later as compared to present study whereas in Egyptian<sup>19</sup> males, Burmese<sup>20</sup> females, Pakistani<sup>21</sup> males and Australian<sup>22</sup> population this age of fusion is almost similar. In Pakistani females, age of epiphyseal fusion found to be 1-2 years earlier. (**Table No.4**)

The present study signifies that epiphyseal fusion at lower ends of both Radius

and Ulna in females occurs 1 year earlier than in males. This correlates with previous studies.

### Conclusions:

The complexity of the present subject is discussed and made clear in the relevant literature and it is concluded that:

1. Radiological analysis of lower end of Radius and Ulna can be used for estimation of age.
2. Overall comparison with other provinces in India showed that the ages of epiphyseal fusion varies from region to region and state to state from different parts of India.
3. The ages of epiphyseal fusion vary greatly throughout the World and standard of one region or one population cannot be applied to other and that is why there is need of separate standards of ages of epiphyseal fusion for separate regions.
4. Epiphyseal fusion found to be earlier in females than males.

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### DEGREES OF EPIPHYSEAL FUSION AT WRIST JOINT

(a)- Degree 0 of epiphyseal fusion



(b)- Degree 1 of epiphyseal fusion





(c)- Degree 2 of epiphyseal fusion



(d)- Degree 3 of epiphyseal fusion



Table No. 1 Showing age of epiphyseal fusion of the Lower end of Radius with shaft

Mean Age (yrs)	Sex	Total no.of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	3	0	0	0	0	3	100	0	0
	F	4	0	0	0	0	4	100	0	0
14	M	6	0	0	0	0	6	100	0	0
	F	4	0	0	0	0	4	100	0	0
15	M	7	0	0	0	0	7	100	0	0
	F	6	0	0	0	0	6	100	0	0
16	M	2	0	0	0	0	2	100	0	0
	F	5	0	0	0	0	5	100	0	0
17	M	5	0	0	0	0	5	100	0	0
	F	6	0	0	0	0	2	33	4	67
18	M	12	0	0	0	0	3	25	9	75
	F	11	0	0	0	0	0	0	11	100
19	M	9	0	0	0	0	0	0	9	100
	F	9	0	0	0	0	0	0	9	100
20	M	10	0	0	0	0	0	0	10	100
	F	8	0	0	0	0	0	0	8	100

Table No.2 Showing age of epiphyseal fusion of the Lower end of Ulna with shaft

Mean Age (yrs)	Sex	Total no.of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	3	0	0	0	0	3	100	0	0
	F	4	0	0	0	0	4	100	0	0
14	M	6	0	0	0	0	6	100	0	0
	F	4	0	0	0	0	4	100	0	0
15	M	7	0	0	0	0	7	100	0	0
	F	6	0	0	0	0	6	100	0	0
16	M	2	0	0	0	0	2	100	0	0
	F	5	0	0	0	0	5	100	0	0
17	M	5	0	0	0	0	5	100	0	0
	F	6	0	0	0	0	2	33	4	67
18	M	12	0	0	0	0	3	25	9	75
	F	11	0	0	0	0	0	0	11	100
19	M	9	0	0	0	0	0	0	9	100
	F	9	0	0	0	0	0	0	9	100
20	M	10	0	0	0	0	0	0	10	100
	F	8	0	0	0	0	0	0	8	100

**Table No. 3 Showing comparison of ages (years) of epiphysial fusion around Wrist joint given by various workers in India**

Author	Lower end of Radius		Lower end of Ulna	
	Male	Female	Male	Female
1.Hepworth SM 1929(Punjab)	16-17		16-17	
2.Aggrawal ML and Pathak IC1957(Punjab)	-	17-17.6	-	17-17.6
3.Banerjee KK and Agarwal BB1998(Delhi)	19-20	18-19	19-20	18-19
4.Lall R and Townsend RS 1939 (U.P)	-	19	-	19
5.Loomba SD 1958(U.P.)	20-21	18-19	20-21	18-19
6.DasGupta et al 1974(U.P.)	20-21	19-20	20-21	20-21
7.Singh B 2007(Manipur)	-	18	-	18
8.Sangma WB 2007(North-east India)	-	18	-	18
9.Sahni D andJit I 1995(Northwest India)	-	16	-	16
10.Pillai MJS 1936(South India)	18	-	18	-
11.Saksena JS andVyas SK 1969(M.P.)	19-20	17-18	19-20	17-18
12.Galstun G 1930,1937(Bengal)	18	16.5	18.5	17
13.Patel DS 2011(Ahemadabad)	19-20	19-20	19-20	18-19
14.Bhise SS 2011(Mumbai)	17-18	17-18	17-18	16-17
15.Nemade KS 2010(Vidarbha, M.S.)	20-21	19-20	19-20	19-20
16.Present study 2012 (Vidarbha, M.S.)	19 (18.6-19.5)	18 (17.6-18.5)	19 (18.6-19.5)	18 (17.6-18.5)

**Table No.4 Showing comparison of ages (years) of epiphyseal fusion around Wrist joint given by various workers in other countries with findings of present study**

Author	Lower end of Radius		Lower end of Ulna	
	Male	Female	Male	Female
Paterson RS 1929(English)	21	19-20	21	19-20
Sidhom G and Derry DE 1931(Egypt)	19-20	-	19-20	-
Barrett JH 1936 (Burma)	-	17-18	-	17-18
Ledger LK and Wasson TC 1941(Peshawar)	20	18-19	18-19	16-17
Flecker H 1932 (Australia)	19	18	19	17.5
Present study 2012 (Vidarbha, M.S.)	19 (18.6-19.5)	18 (17.6-18.5)	19 (18.6-19.5)	18 (17.6-18.5)

## Original Research Paper

### “Fingerprint Ridge Density” – A Tool for Sex Determination

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#### Abstract

Fingerprints have been used for civil as well as criminal cases because of their unique pattern of absolute identity. Criminals often leave their fingerprints at the site of crime, unknowingly, which, though not apparently visible, can be subsequently developed and studied successfully. Personal identification through fingerprints has long been recognized and is regarded as the greatest contribution to the law enforcement. Identification of sex by fingerprint ridge density will be helpful to the investigating officer which would save time in nabbing the suspects. Fingerprints of 200 individuals (100 males and 100 females) belonging to South Indian origin within the age range of 18-65 years were included in the study. Ridge count of fingerprints was calculated for the particular individual and the significance of this value was determined. Our study showed that a fingerprint ridge density of  $m15 \text{ ridges}/25 \text{ mm}^2$  is more likely to be of that of a male and a fingerprint with ridge density of  $\sim 16 \text{ ridges}/25 \text{ mm}^2$  will be in favour of a female. ( $P < 0.001$ ).

**Key Words:** Fingerprints, Criminals, Ridge density, Sex determination, South Indian

#### Introduction:

The skin of palm and fingers, sole of the feet and toes is of special type in relation to the skin of the other parts of the body. The skin of these areas contains numerous ridges (lines) and is present in various patterns. The Chinese were the first known to have used friction ridge impressions as a means of identification. Earthenware estimated to be 6000 years old was discovered at an archaeological site in northwest China and found to bear clearly discernible friction ridge impressions.<sup>1</sup>

Many scientific research and studies have been done on the finger ridges, starting from its types, classification (Henry-Galton), methods of lifting prints and methods of recording and different materials.<sup>2</sup>

Fingerprints have been used for civil as well as criminal cases because of their unique pattern of absolute identity. Identification of gender by fingerprint ridge density will be helpful to the investigating officer which would save time in nabbing the suspect. The fingerprint ridge density has shown a real significant difference between both genders.<sup>3</sup>

In the past many studies<sup>2-14</sup> have been conducted on the fingerprint ridges and have found significant fingerprint ridge density<sup>2-11</sup> differences between male and female.

#### Materials and methods:

A cross sectional study was conducted from November 2010 to November 2011 consisting of 200 (100 males and 100 females) subjects, which included students and faculty of J.N.Medical College, Belgaum, belonging to South Indian population (Karnataka, Andhra Pradesh, Tamil Nadu and Kerala). Non-resident Indians and subjects from central, western, northern and eastern India were excluded from the study. The age of sample population ranged from 18-65 years. People with history of coeliac disease, dermatitis, eczema, acanthosis nigricans, scleroderma, dry or atrophic skin, rickets, acromegaly and leprosy were excluded from the study.<sup>15</sup>

The Individuals enrolled for the study were informed and explained about the objectives of the intended study and informed expressed consent taken. A clean plate of about 12x12 inches was uniformly smeared with a thin

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layer of black printer ink by using the roller. After applying their fingers on the smear plate, it was transferred on the duly prepared fingerprint card. In this way, for each and every individual the plain prints of ten fingers was recorded.

After taking the fingerprints, the upper portion of radial border of each print was chosen as an area for data collection because all fingerprint pattern types show a similar ridge flow in this region as the cores of loops and whorls pattern are away from this region. In this selected areas of prints, epidermal ridges of both males and females were counted carefully within a square of 5 mm X 5 mm drawn on a transparent film fixed to the lens. Counting was started from one corner of the square to the diagonally opposite corner, while counting, the dots were excluded and the handle of the fork and lake were counted as two ridges. Hence, the value represented the number of ridges/25 mm<sup>2</sup> and reflected the ridge density value.<sup>2</sup>

### Analysis:

Value of all 10 fingers was recorded and the mean was calculated. This mean represents a single data point for that particular individual. Specific comparison of means was made and analysed using SPSS, version 16.0, statistical analyses programme (SPSS Inc., Chicago, IL, USA). Posterior probability inferences of gender, based on ridge density values was made by calculating the likelihood ratio (LR) based on the Bayes Theorem.<sup>16</sup> The favoured odds were computed.

LR =  $\frac{\text{Probability of a given finger print originating from a male contributor (C)}}{\text{Probability of a given finger print originating from a female contributor (C1)}}$

### Discussion and results:

The present study was conducted to test the reliability of ridge count density as a reliable indicator of sex determination and also to establish the association between sex and the fingerprint ridge density among South Indian population.

Ridge density for females ranged from 14 to 21 ridges/25 mm<sup>2</sup> with a mean of 16.92 ridges/25 mm<sup>2</sup>, and in males from 11 to 17 ridges/25 mm<sup>2</sup> with a mean of 13.56 ridges/25 mm<sup>2</sup> (Table No.1). Females were found to have significantly higher ridge density than males ( $p < 0.001$ ). It was observed that 95% of the males had a mean ridge density of  $\sim 15$  ridges/25 mm<sup>2</sup> and 87% of the females had a mean ridge density of  $\sim 16$  ridges/25 mm<sup>2</sup>. Again, none of

the males had a mean ridge density of more than 18 ridges/25 mm<sup>2</sup> and no females were found to have a mean ridge density below 13 ridges/25 mm<sup>2</sup> (Table No.2).

The statistical analysis of LR (C/C1) and the favoured odds showed that a ridge count of  $\sim 15$  ridges/25mm<sup>2</sup> is more likely to be of male origin. Posterior probability using the Bayes Theorem ( $P=0.72$ ) and a ridge count of  $\sim 16$  ridges/25mm<sup>2</sup> is more likely to be of female origin ( $P=0.71$ ). A print showing a count of  $\sim 11$  ridges/25 mm<sup>2</sup> will have a high probability to be that of male ( $P=0.97$ ), while no female in this study was found to have 11 ridges. Similarly a ridge count of  $\sim 21$  ridges/25 mm<sup>2</sup> will be more in favour of female ( $P=1.0$ ), while there was no male found in this category. The analysis of variance (ANOVA) results show that males have significantly lesser density than females with  $P < 0.001$  (Table No.3).

A study by Nayak VC, et al<sup>5</sup> done on ridge thickness in fingerprints showed that males have coarser finger ridges than females, which suggest that males will have fewer ridges in a given area than females (lesser ridge density) which concurs with our study where males showed coarser ridges than females. Studies by Cummins H,<sup>12</sup> Moore RT,<sup>13</sup> Okajima<sup>14</sup> found that men have coarser epidermal ridge than women and mean ridge to ridge distance is more in males when compared to females, which again concurs with our study, but these studies do not delve with ridge density.

In contrast to our study, the ridge density in males was more than females in two studies done by Steinberg FS,<sup>6</sup> Plato CC,<sup>7</sup> and Reddy GG,<sup>8</sup> respectively. These contradictory results could be due to racial variations and different counting methods used to count the ridges.

Studies done by Cummins H & Midlo C,<sup>4</sup> Acree M,<sup>9</sup> Gungadin S,<sup>2</sup> Suthiprapha I,<sup>10</sup> Nayak VC,<sup>5,11</sup> Nitin MD<sup>4</sup> (Table No.4 & Graph No.1) showed significant difference in the ridge density among both genders; males tend to have lesser ridge density as compared to females; number of ridges per centimeter (which is ridge density) in males is less compared to a female. Our study has shown similar trend in gender differences as compared to other studies in the past in different races. This shows that this trend is universal among all races.

### Conclusion:

Significant difference in fingerprint ridge density exists between males and females. Males have coarser ridges and females have

finer ridges, as a result less number of ridges are accommodated among males where as the number is more among females in the same area. A fingerprint with ridge density of m 15 ridges/25mm<sup>2</sup> is more likely to be of male and fingerprint with ridge density of - 16 ridges/25mm<sup>2</sup> goes in favour of female. Identification by fingerprints is reliable and the identification of sex can be made out by counting of ridges. In fact, the results of this study are to help the authorities concerned to minimize or restrict their field of investigation and concentrate on a particular gender.

**Conflict of interest: None declared.**

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**Table No. 1: Distribution of Ridge Count among Males and Females**

Ridge Count	Male		Female	
	No of Cases	%	No of Cases	%
11	06	06	-	-
12	20	20	-	-
13	23	23	-	-
14	20	20	06	06
15	26	26	07	07
16	04	04	29	29
17	01	01	24	24
18	-	-	22	22
19	-	-	07	07
20	-	-	03	03
21	-	-	02	02
Total	100		100	

**Table No.2: Descriptive Statistics of Dermal Ridges for Male and Female Subjects**

	Male (n=100)	Female (n=100)
Minimum	11	14
Maximum	17	21
Mean RC	13.56	16.92
Standard Deviation	1.38	1.48
Standard Error	0.138	0.149

t = 16.55P < 0.001 (Significant)

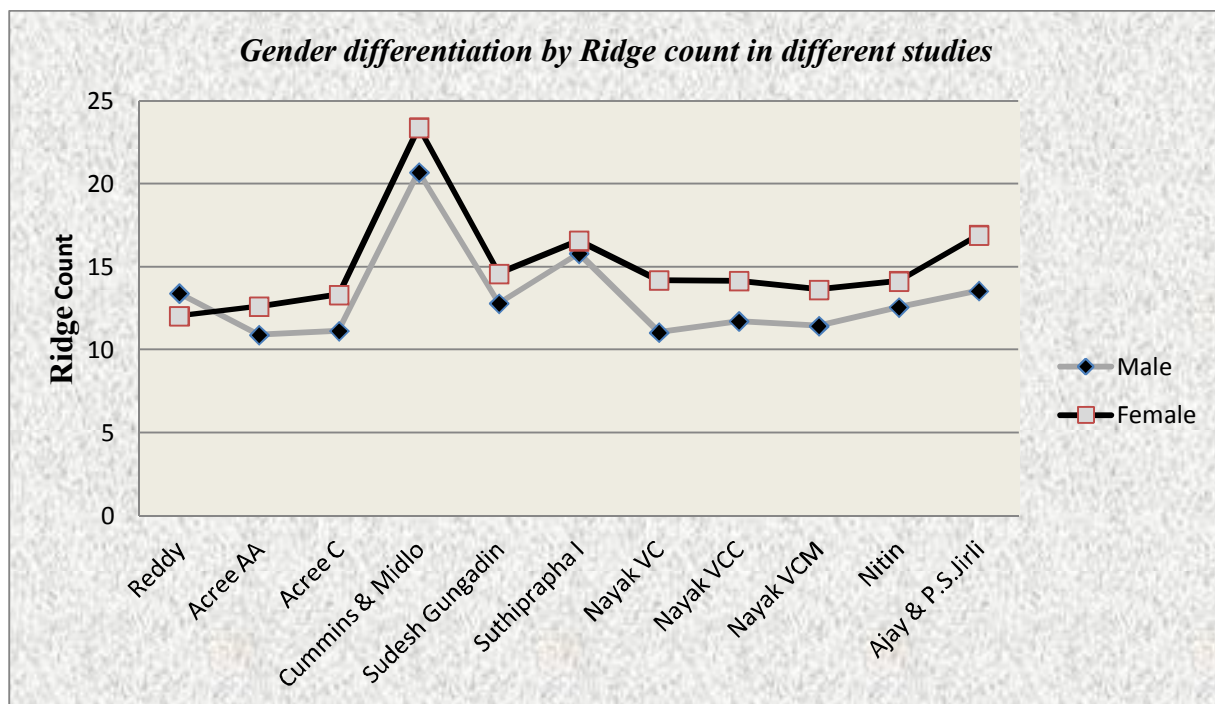
**Table No. 3: Probability densities and likelihood ratios derived from observed fingerprint ridge count**

Ridge Count	Probability density		Likelihood Ratio		Favoured Odds	
	Male (C)	Female (C')	LR(C/C')	LR(C'/C)	M	F
11	0.06	-	-	0	1	0
12	0.20	-	-	0	1	0
13	0.23	-	-	0	1	0
14	0.20	0.06	3.33	0.3	0.91	0.09
15	0.26	0.07	3.71	0.26	0.93	0.07
16	0.04	0.29	0.13	7.25	0.02	0.98
17	0.01	0.24	0.04	24	0.01	0.99
18	-	0.22	0	-	0	1
19	-	0.07	0	-	0	1
20	-	0.03	0	-	0	1
21	-	0.02	0	-	0	1

Table No. 4: Gender differentiation by finger ridge count among various studies

Author	Race	Male	Female
Reddy <sup>8</sup>	Bagatha's of Araku Valley India	13.41	12.04
Acree <sup>9</sup>	(Acree AA)	10.90	12.61
	(Acree C)	11.14	13.32
Cummins & Midlo <sup>4</sup>	Americam	20.70	23.40
Sudesh Gungadin <sup>2</sup>	Karnataka, India	12.80	14.60
Suthiprapha I <sup>10</sup>	Thailand	15.81	16.58
Nayak VC <sup>5</sup>	Karnataka, India	11.05	14.20
Nayak VC <sup>11</sup>	(Nayak VCC)	11.73	14.15
	(Nayak VCM)	11.44	13.63
Nitin <sup>4</sup>	Karnataka, India	12.57	14.14
Ajay & P.S.Jirli (present study)	Karnataka, India	13.56	16.92

Graph No 1: Gender differentiation by Ridge count in different studies



## Original Research Paper

# Sexual Dimorphism of Hyoid Bone- A Study of Adult Population in Bhopal Region of Central India

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### Abstract

Identification of sex from unknown skeletal remains is a challenging issue in forensic casework. Sex determination from long bones, skull and pelvis is well studied and documented. The hyoid bone, however, has remained the least noticed bone for sex determination. In the present study, 100 adult hyoid bones - 72 male and 28 female, removed from corpses [after written, informed consent from the relatives] and buried in soil, were examined using discriminant function analysis (IBM SPSS20). Five discriminant functions were tested and obtained. Discriminant Function =  $1.738 \text{ thl} + (-0.542) \text{ thw} + 1.278 \text{ mlb} + 1.240 \text{ disgrcor} - 11.969$ . Cut off score was -0.410, 84% accurately classified into their groups. Cross-validated results showed correct classification in 83% of the cases.

**Key Words:** Adult, Discriminant function, Hyoid bone, Sex determination

### Introduction:

Determination of sex is an important aspect of the biological profile generated during skeletal analysis in forensic cases involving unknown human remains and also in mass disaster. The degree to which certain bones are useful in sex determination depends upon:-

1. The degree of sex dimorphism exhibited by particular bones,
2. How well those elements tend to get preserve, and
3. The type of burial in which the remains are found.<sup>1</sup>

In humans, the long bones, morphological features of skull and pelvis have been studied by different researchers and forensic experts for sex determination. However, incomplete or fragmentary human remains are often found especially in case of mass disasters and human rights investigations.<sup>2</sup>

There are mainly two methods of sex determination: metric and non-metric. Metric analysis is more precise, provides statistical weight; precision and is preferred to non-metric method because the results of metric method also get recognized in the court.<sup>3-6</sup>

In the present study, hyoid bone has been used for sex determination, because of its uniqueness in size, shape and it being the least noticed bone for sex identifications. The bony fusion of its components is of interest to forensic pathologists because of the vulnerability of the hyoid bone to fracture during neck trauma; and the significance of such fractures in the diagnosis of cause of death e.g. manual Strangulation.<sup>7</sup> Male hyoids are generally larger than female hyoids in almost all dimensions, but particularly in total hyoid length and width.<sup>8-9</sup> Sexual dimorphism of hyoid bone has been established in previous studies using morphometric and radiographic parameters.

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### Material and methods:

The present study was conducted in Department of Forensic Medicine and Toxicology, Gandhi Medical College, Bhopal, in the year 2012-13. The study protocol was approved by the Institutional Ethics Committee. It was carried out on 100 adult hyoid bones of known sex, removed from the corpses during the autopsy.

### Methodology:-

- 1) **Selection of cases:** - The deceased, who were apparently healthy and not suffering from any abnormality and without fracture of

hyoid bone were considered for removal of hyoid bone from the corpse.

- 2) **Consent form:** - before removing the hyoid bone written informed consent was taken from the deceased's relatives/ guardians and P.C. in charge of respective police station.
- 3) **Removal of hyoid bone:-** The hyoid bone was removed during autopsy by a midline incision  $\%I\pm$  shaped was given on neck and the incision was extended from symphysis menti to pubic symphysis. Strap muscles of neck were dissected and were reflected to both sides and the front part of larynx was exposed. Hyoid bone was identified which is present above the thyroid cartilage. It was separated from base of tongue and then it was separated from larynx. The bone was obtained with partial attachment of muscle fibres and ligaments.
- 4) **Numbering of hyoid bone:-** The hyoid bone so removed from the corpse was tagged by a non dissolving thread along with numbering plastic disc. The plastic disc bore the serial number, autopsy number, age and sex of the deceased.
- 5) **Maceration and cleaning of hyoid bone:-** Bacterial action in water was used to clean bone (maceration). This is the simplest method for cleaning bone:

**Step 1:** Any remaining tissue was removed to make maceration faster.

**Step 2:** Bone fully immersed in a container of plain water.

**Step 3:** Container left in a warm location where it would not smell.

**Step 4:** The greasy, smelly water (gardens love it!) was periodically poured and topped off with fresh water, till water remained clear, indicating that the bacteria had finished breaking down any remaining tissue.

**Step 5:** Then these bones, along with their plastic tag bearing the number, were buried in the ground and left for sufficient time. Then bones were taken out and cleaned in plain running water to ensure that no soft tissues were left attached to the bone. At no stage, the plastic number was detached from the bone ensuring proper numbering. Care was taken not to cut or damage the bone.

**6) Drying of hyoid bone:-** The completely macerated and cleaned hyoid bones were allowed to dry in sun for about a week and then left at room temperature. The apparently dry bones were measured twice at the interval of 15 days and when no difference was seen in these

two measurements then these bones were considered as dry bones.

**7) Marking of the hyoid bone:-** Each of these bones was marked with non washable water resistant ink. After labeling, all the bones were separated into different age groups and sex, and stored in separate transparent polythene bags. Then, the five parameters were measured by using Sliding Scientific Vernier Calipers as shown in **Figure 1**

## Result:

Seventy two male and 28 female hyoid bones were studied by us. The mean age of subjects was 33.45 years. The minimum age was 18 years, while the maximum was 90 years. Mean total hyoid length of male was found to be 3.8611 cm, with standard deviation of 0.41403 cm and that of female was 3.3536 cm, with standard deviation of 0.34905 cm, p value was  $< 0.001$ ; which is extremely significant suggesting that definite dimorphism exists between male and female hyoid length.

Mean value of total hyoid width was found to be 4.3083 cm with standard deviation of 0.74828 cm for male; and for female Mean value was 3.5821 cm and the standard deviation was 0.75329 cm. Probability level of  $p < 0.001$  was obtained. (Table 01) Mean & standard deviation in maximum height of body of hyoid in males was 1.2847 cm & 1.29099 cm; and in females it was 0.9857 cm and 0.08483 cm respectively. The probability value was  $p > 0.05$  that is statistically insignificant (**Table 2**).

Mean value and standard deviation of maximum length for body in male were 2.2667 cm and 0.25674 cm, in females 1.9750 cm and 0.20660 cm respectively. The p value for this parameter was  $p < 0.001$ , this value is extremely significant statistically.

Mean value for distance between the distal end of the right and left greater cornua parameter in males was 4.2083 cm with standard deviation of 0.79996 cm and in females mean value was 3.4 cm with standard deviation 0.90390 cm. The probability value for this parameter was found to be  $p < 0.001$  that indicates this value is extremely significant for both variables. (**Table 1**)

## Discussion:

Positive identification involves matching of an  $\%unknown\pm$  individual to a  $\%known\pm$  individual. The identification of skeletal and other decomposed human remains is very important for legal and humanitarian reasons. In identification, sex determination is one of the



main objectives. Determining sex on the basis of the shape of skeletal features is unreliable and can lead to divergent opinions according to individual experiences. Thus, an impartial metric method for sex determination is essential.

Total hyoid length, in this study, which was found to be extremely significant, is consistent with study conducted by many researchers, even from different geographical regions.<sup>8,10-12</sup> Total hyoid width was consistent with the observations of Kindschuh, et al<sup>12</sup> and Walls, et al,<sup>13</sup> who found statistical significant difference between two variables (male and female) of White European biological affinity. This parameter has been analyzed by fewer researchers, but it is extremely significant and has almost similar value in different racial and demographic settings. Maximum length of body in our study is similar to the study conducted by Miller, et al,<sup>8</sup> Seham A. G EL, et al,<sup>11</sup> Kindschuh, et al,<sup>12</sup> and Walls, et al.<sup>13</sup>

Maximum height of body in our study was similar to that observed by Seham A. G EL, et al,<sup>11</sup> and Walls, et al.<sup>13</sup> They also found this parameter to be statistically insignificant. But, the studies conducted by Miller et al,<sup>8</sup> Kindschuh, et al,<sup>12</sup> & Mukhopadhyay<sup>14</sup> found this parameter to be statistically significant in both variables. This difference may be attributed to different demographic profile of these regions. And also, in the study by Mukhopadhyay,<sup>14</sup> where the demographic profile is similar to our study, the difference may be attributed to the method of removal of hyoid. In this study, the soft tissue was removed with minimal handling and stored in 10% formaldehyde, which makes the bone dry. But, in our study, bones were cleaned by burying the bone for at least for 3 weeks; so that the soft tissue was automatically removed without altering the morphology of the bone.

Distance between the distal end of the right and left greater cornua is significant as a study conducted by multiple researchers, even from different geographical regions, showed general anatomic variations between both the sexes i.e. male %A+ shaped and female %B+ shaped.<sup>10,12,14</sup>

In our study, overall 84% of the original grouped cases were correctly classified. Among the individual sex groups, 84.7% male and 82.1% female hyoids were correctly classified.

A study conducted by Kindschuh, et al,<sup>12</sup> on 398 hyoid bones found 90% accuracy rate by using Function-1 discriminate function analysis by using six discriminant functions. While a study by Walls, et al<sup>13</sup> among 134 hyoid bones found sex estimation accuracy rate of 88.1% to

92.3% using four valid discriminant functions on contemporary white European fused and unfused hyoid bones. A study by Mukhopadhyay<sup>14</sup> on 50 adults hyoid bones, a discriminant function analysis was performed using six variables and 90% of the samples were correctly classified into their groups.

## Conclusion:

Total hyoid length, total hyoid width, maximum length of the body of the hyoid, distance between the distal end of right and left greater cornua, maximum length of greater cornua right and left, are all statistically significant parameters for sex differentiation. The accuracy rate for these parameters is 84% and these represent the most significant parameters for sexual dimorphism, irrespective of race or demographic variation. (Table 3)

In the current study, four variables were used as predictors of sex. The following discriminant function was obtained (Table 4 A, B) -

Discriminant Function = 1.738 thl + (-0.542) thw + 1.278(mlb) + 1.240 disgrcor - 11.969

Cut off score was -0.410, suggesting that any Df above -0.410 were male hyoid bone while Df < -0.410 were female hyoid. (Table 5)

Anthropometric analysis showed that female hyoid bones are, on an average, smaller in all dimensional proportions, which was confirmed by t- test that revealed significant statistical difference between sexes.

**Conflict of interest:** - The study was carried out during my postgraduate degree course under the guidance of senior teachers.

**Source of funding:** - None.

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**TABLE 1: Sex-wise analysis of total hyoid length, total hyoid width, maximum length of body, between the distal end of the right and greater cornua**

Group Statistics				
	N	Mean (cm)	SD (cm)	SE Mean
Male	72	Thl	3.8611	.41403
		Thw	4.3083	.74828
		Mlb	2.2667	.25674
		Disgrcor	4.2083	.79996
Female	28	Thl	3.3536	.34905
		Thw	3.5821	.75329
		Mlb	1.9750	.20660
		Disgrcor	3.4000	.90390

P<0.001

**TABLE 2:- Sex wise analysis of maximum height of body**

Group Statistics				
	Group	N	Mean (cm)	S D (cm)
mhb	Male	72	1.2847	1.29099
	Female	28	.9857	.08483

P>0.05

**TABLE 3:- Classification Result <sup>a,c</sup>**

		Group	Predicted Gp Membership		Total
			Male	Female	
Original	Count	Male	61	11	72
		Female	5	23	28
	%	Male	84.7	15.3	100
		Female	17.9	82.1	100
Cross-validated <sup>b</sup>	Count	Male	60	12	72
		Female	5	23	28
	%	Male	83.3	16.7	100
		Female	17.9	82.1	100

84% of original grouped cases were correctly classified.  
Cross validation was done only for these cases in the analysis. In cross validation each case was classified by the function derived from all cases other than that case.

83.0% cross validated grouped cases were correctly classified.

**TABLE 4 A: - Wilk's Lambda**

Test of Function(s)	1
Wilks' Lambda	.583
Chi-square	51.753
Df	4
Sig.	.000

**TABLE 4 B: - Canonical Discriminant Function Coefficients**

	Function	1
thl	1.738	
Thb	-0.542	
Mlb	1.278	
disgrcor	1.240	
Constant	-11.969	

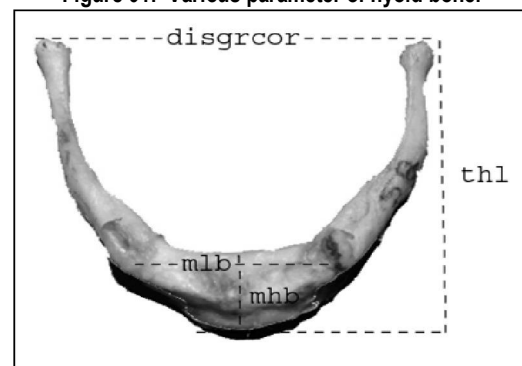
Unstandardized coefficients

**TABLE 05:- Functions at Group Centroids**

Functions at Group Centroids	
Group	Function
	1
Male	.522
Female	-1.342

Unstandardized canonical discriminant functions evaluated group means

**Figure 01:- Various parameter of hyoid bone.**



S No.	Measurements	Definition
1.	Total hyoid length (thl)	Maximum length of hyoid, from anterior surface of the body to the superior ends of greater cornua
2.	Total hyoid width (thw)	Maximum distance between the widest points of the greater cornua
3.	Maximum length of body (mlb)	Length of the distance from the midpoint of the left side of the hyoid body to the midpoint of the right side of the hyoid body measured through the central axis of the hyoid body.
4.	Maximum height of body (mhb)	Width of the hyoid body at its midpoint, measured perpendicular to the surface of the body.
5.	Distance between the distal end of the right and left greater cornua, taken lateral edge (disgrcor)	Between the distal ends of the right and left greater cornua.

## Original Research Paper

### Trends and Patterns of Sexual Offences in Western Odisha

<sup>1</sup>Seema Perei

#### Abstract

The paper examines the trend and pattern of sexual offences in Western Odisha. [covers ten districts of the state along with some portions of Athamalik and Angul. The districts are - Sambalpur, Bargarh, Jharsuguda, Sundergarh, Deogarh, Balangir, Sonepur, Kalahandi, Nuapada and Boudh] Data on various types of sexual offences were collected from the department records from 2007 to 2015. The cases include children as well as adult female victims. The variables considered for discussion are - age of the victim, marital status, relation with the accused, bodily and genital injury, consent of the victim, place and time of occurrence, education level of victim and occupation of accused. Observations: Initially, the number of sexual offences declined from 20 in 2007 to 2 in 2010, then it increased to 25 in 2015, i.e. the finding suggests that sexual offences in Western Odisha increased over a period of time. Further, was observed that 92.2% of the offences occurred in unmarried females and in 57%, without consent. 8%, 17% and 57% of the offences occurred against children, victims of less than 12 years and less than 18 years of age, respectively. There was a strong relationship between age group and sexual offences- females of the age group 13 to 18 years are more prone to sexual/ sex linked offences. Bodily injuries occurred in cases of 'without consent'; bodily injuries were inversely related with age.

**Key Words:** Female Victim, Accused, Sex crime, Western Odisha

#### Introduction:

Sexual offences imply- any sexual act, attempt to obtain attain a sexual act, unwanted sexual comments or advances or acts to traffic, or otherwise directed against a person's sexuality, using coercion, by any person regardless of their relationship to the victim, in any setting including but not limited to home and work.<sup>1</sup> Sexual offences often occur without the consent of the victims and such offences amount to rape. But many a time sexual offences occur with the consent of the victim. When the victim is more than 18 years and having a sound state of mind and has given her consent for sexual intercourse without marriage with a person say A, because he promised to marry her in future, there may be regular sexual intercourse without any injury. But when the accused person A does not keep his promise of marriage, then the victim may take the help of law and such cases are also reported as sexual offences. This type of sexual offences is with consent though there is a 'Breach of Promise', later on.

When consent is obtained by creating fear, fraud (false impersonation) and by blackmailing a person of more than 18 years of old having sound mind also falls in this category.

Rape has been described as an act of violence with sex as primary weapon. Rape and other sexual offence are considered to be heinous crimes. No woman is immune to this heinous crime.<sup>2</sup> Girls are enticed to sex with the false assurance of marriage. The increasing crime of sexual assault has proved to be hazardous to woman's freedom and a menace for the law enforcement agencies.

Many victims suffer from psychiatric problems, some commit suicide, some suffer from venereal disease along with unwanted pregnancy and rape trauma syndrome.<sup>2</sup> After the case becomes known, the victim's family members may also attack the accused. Hence it is necessary to understand the trend and pattern of sexual offences in greater detail. Odisha is one of the Indian states, where sexual offences were either under-reported or rare. But in the recent times, in the western part of the state, particularly in the vicinity of Sambalpur district, sexual offences have increased significantly. Hence, this paper attempts to understand the trends and factors related to sexual offences in this region.

#### Aims and Objectives:

1. To examine the trend and pattern of sexual offences reported in the FMT department of VIMSAR, i.e. in the vicinity of Sambalpur

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district. [VIMSAR is located in Sambalpur district and the referral cases to VIMSAR cover most of the districts of Western Odisha. Hence it may be considered that the paper attempts to study the sex offences in western Odisha.]

2. Examine the contributing factors to sexual offences, including any specific relationship or age group.
3. To study the other characteristics of the victim and accused of sexual offences, including instances of gang rape and incest, if any.

### Materials and Methodology:

For the present study, data was compiled from the records of the department over a period of nine years, i.e. from 2007 to 2015, after taking the approval of the Institutional Ethics Committee. There were 116 cases related to sexual offences during this time period. The data was compiled from police forwarding letters, history revealed by the victims, findings from physical examinations, radiological reports and dental examination. A standard medical procedure was followed to gather the information. The extracted data was analysed using SPSS statistical package. Simple frequency distribution and cross tabulations were carried out and presented here.

### Observations:

Two types of observations have been presented here - the trend analysis and the pattern analysis. **Table-1**, presents the trend analysis of sexual offences. It shows that though the number of sex offences was declining from 20 in 2007 to 2 in 2010, since then it has increased to 25 in 2015. Such increasing trends in sexual offences are matter of concern from society point of view. Further, the table shows that . in recent times, the number of sexual offences 'without consent' has increased. Such cases were found, especially after 2011 and 2012. From the overall cases, it was found that 92.2 percent of the sexual offences occurred in case of an unmarried female, 57 percent of the offences occurred with without consent; 8 percent of the offences occurred with child, 17 percent with less than 12 years and 57 percent of the offences occurred with less than 18 years. (**Table 1**)

### Different features of sexual offences:

This section examines different characteristics of the victims of the sexual offences. **Tables 2 to 5 show** the level of education of the victim, relationship of the victim with the accused if any; bodily injuries sustained

by the victim, if any, and place of occurrence of the sexual offences, respectively.

**Table - 2:** Most of the victims were of the level of either 10<sup>th</sup> or 12<sup>th</sup> standard, education wise, 58%. 18% victims did not complete 10<sup>th</sup>. If counselling at this age group can be provided then sexual offences due to ignorance of the victim can be checked to a greater extent. Girl child must be taught about good touch and bad touch in the school and in the house or by any counsellor.

The victim may be counselled to reveal the incident to her parents at the first instant itself so that before the offence take place steps may be taken if the offences take gradual process. Self defence mechanism may be promoted in these age groups. So, sex education may be introduced in the school. **Table - 3** examines the type of relationship the victim has with the accused. It was found that in majority of the cases, 67.2%, the accused were from the same residential area. Not known or unknown cases, together, constituted around 10%. **Table - 4** presents the magnitude of bodily injury, including genital (in form of abrasions, bruises, bite marks, burns, tears in the perineum, lacerations in vagina) in victims. It was inferred from the table that out of the 116 cases, bodily injuries were found in 30 cases, 25.9%.

**Table 5** depicts the place of occurrences of the sexual offences. From the table it is clear that most of the cases (around 85 percent) occurred either at out skirts (49.1%) or at home (34.5%).

### Exploring relationship of Sex offences:

The study on sexual offences may show different statistical relationships. Here we statistically explored two types of relationship - (1) Do bodily injuries have statistically significant relationship with age group? (2) Does consent of the victims matter for bodily injuries? **Table - 6** presents the cross tabulation between age groups and bodily injuries. It shows that there is a statistically significant relationship between bodily injuries and age groups - in 90.9% cases, bodily injuries were found in case of 6 to 12 age groups. Similarly, **table 7**, depicts in case of 'without consent', bodily injuries were found in 45.5% of victims but in case of with consent, no injury was found in the victims.

### Summary and Discussion:

The present paper attempts to understand the trend and pattern of the sexual offence cases in western Odisha during 2007-2015, using the data from FMT department of VIMSAR, Burla. The trend analysis shows that

there is an increasing trend of sexual offences in this region. The pattern of the sexual offence case shows that 92.2% of the sex offences occurred in case of unmarried female, 57% without consent, 8% with children, 17% with < 12 years and 57% with less than 18 years. The levels of education of most of the victims was either 10<sup>th</sup> or 12<sup>th</sup>. Together, they constituted around 58%. Further 18% of the victims were below 10<sup>th</sup>. Relationship of the victims with the accused shows that majority of the accused were from same residential area, followed by relatives. In 25.9% cases, the study found bodily injury on the victims, most of the cases occurred either at the outskirts, or at home.

Now a days, sex related crimes are increasing. Many female victims give history of voluntary sexual intercourse with their lovers or of elopement to get married. The cases are filed by their parents or guardians who did not approve of this relationship. Tailor, et al, in their study observed that 83.7% cases had sexual intercourse with mutual consent.<sup>3</sup> There are also true cases where girls are enticed to marriage by a man under a false name and religion or given false assurance of marriage. Sukul Chatopadhyay and Bose observed in their study that most of the cases had consented act of

intercourse over a period of time followed by refusal to marry and leading to lodging of complaint.<sup>4</sup>

However, the study also found some statistics which are more important from policy points of view - 50% of the victims belonged to the age group 13 to 18 years, which is a vindictive age group. Hence, policies may be targeted at these age groups to protect them from sex offences. Further 8 & 17% cases occurred with children and girls with less than 12 years and in two cases, it was incest. These findings call for ethical transformations of people - they may be educated in different forms so that they may refrain themselves from such acts.

**Conflict of interest:** None

**Financial Assistance:** None

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**Table No-1, Trend in Sex offences in Western Odisha during 2007 to 2015**

Year	No of cases	Marital Status			Consent		Age Group			
		Unmarried	Married	Widow	Without	With	< 5 yrs	6-12 yr	13-18 yr	> 18 yrs
2007	20	20	0	0	11	9	0	1	13	6
2008	15	14	1	0	6	9	2	3	4	6
2009	15	14	1	0	7	8	1	2	6	6
2010	2	2	0	0	0	2	0	0	1	1
2011	3	3	0	0	2	1	0	0	2	1
2012	14	13	1	0	10	4	2	1	8	3
2013	16	14	2	0	7	9	1	2	7	6
2014	6	4	1	1	3	3	1	1	1	3
2015	25	23	1	1	20	5	2	1	16	6
Total	116	107	7	2	66	50	9	11	58	38
Percent	100	92.2	6	2	57	41	7.8	9.5	50	32.8

**Table No-2, Level of education of the victims**

Level of Education	Number of cases	Percentages
Illiterate	11	9.48
Below 10th	21	18.10
10th	34	29.31
12th	33	28.45
All others	17	14.66
Total	116	100

**Table No-3, Relationship of victims with the accused**

Relation with accused	Number of cases	Percent
Boss, HOD	1	0.86
College fellow	1	0.86
Father	2	1.72
Fellow mate	5	4.31
House owner	1	0.86
Relative	13	11.20
Political Leader	1	0.86
Not known	3	2.59
Same Residential area	78	67.24
Paying guest	1	0.86
Politician	1	0.86
Tuition master	1	0.86
Unknown	8	6.90
Total	116	100

Table No-4, Sign of Bodily injury with the victims

Injury	Frequency	Percent
Nil	86	74.14
Present	30	25.86
Total	116	100

Table No-5, Place of Occurrence of Sex Offences

Place of Occurrences	Frequency	Percent
Bath place	1	0.86
Department	1	0.86
Eloping	17	14.66
Home	40	34.48
Outskirt	57	49.14
Total	116	100

Table -6, Percentages distributions of 'bodily injuries' across 'age groups'

		Bodily Injuries	
		Presents	Nil
Age Groups	Within five years	55.56	44.44
	6 to 12 years	90.91	9.09
	13 to 18 years	22.41	77.59
	More than 18 year	5.26	94.74
Total		25.86	74.14

Table -7, Percentages distributions of bodily injuries across 'Consent' of the victim

		Consent		
		Without Consent	With Consent	Total
Bodily Injuries	Nil	54.54	100	74.13
	Presents	45.45	0	25.86
	Total	100	100	100

## Original Research Paper

# Endosulfan toxicity: A Retrospective Study and Review

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### Abstract

Endosulfan is a chlorinated insecticide that causes CNS hyper-stimulation state. Mortality and morbidity rates are high and there is no specific treatment for this toxicity. A retrospective study of endosulfan poisoning cases was conducted in the NIMS Medical College & Hospital, Jaipur, Rajasthan to assess endosulfan poisoning cases and to find out the association between seizures and mortality. Data was retrieved from clinical records and laboratory files. Diagnosis was based on history and clinical findings. Blood samples of all the patients were sent for toxicological analysis. Out of 42 cases, 36 (85.7%) were males and 6 (14.3%) were females. Mean age of the victims was 34 years. 76.2% patients were farmers. The most common mode of poisoning was suicidal (95.2%). The total mortality rate was 78.6%. Generalized Tonic Clonic (GTC) type seizures were recorded in 83.3% cases. The association between mortality and GTC Seizure was found to be significant ( $p < 0.0001$ ). This study seeks to draw special attention from the government and implementation of strict legal guidelines to curb the menace of endosulfan poisoning.

**Key Words:** Endosulfan poisoning, insecticide, seizures, mortality

### Introduction:

Endosulfan is an organochlorine insecticide and acaricide. All routes of exposure can be hazardous (stomach, lungs, skin). India is currently touted the world's largest user of endosulfan.<sup>1</sup> Poisoning by chlorinated hydrocarbon insecticides is well known. One such insecticide is endosulfan and has been widely used in agriculture since 1960.<sup>2</sup>

Accidental and suicidal poisoning with endosulfan is reported sparsely in literature.<sup>3</sup> Endosulfan is a widely used insecticide that is associated with a high fatality rate in humans when ingested accidentally or with the purpose of suicide. It is a very lethal poison that produces CNS stimulation and status epilepticus<sup>4</sup>. The commonest manifestations are neurological along with other organ dysfunctions.

There is no specific therapy for this poison and management of endosulfan poisoning is only supportive. Especially, in the rural areas, cases with acute generalized seizure suggest its intoxication when etiology is unclear even in absence of signs of intoxication.<sup>5</sup>

As there are limited studies done on endosulfan poisoning, the present study was aimed to assess endosulfan poisoning cases coming to a tertiary care teaching hospital in Rajasthan and to find out the association between seizures and mortality due to endosulfan.

### Materials and Methods:

A retrospective study was conducted in the emergency department of NIMS Medical college & Hospital, Jaipur, Rajasthan, after approval from the Institutional Ethics Committee. Data was retrieved from clinical records and laboratory files. Patients presenting with endosulfan poisoning from January 2013 to December 2015 were enrolled for the analysis. Diagnosis was based on history and clinical findings. Blood samples of all the patients were sent for toxicological screening.

Data regarding demographic characteristics such as age and gender were recorded. Etiology of poisoning - whether suicidal or accidental, was also noted. Clinical characteristics such as nausea, vomiting, diarrhea and seizures were also noted. Biochemical parameters (Blood urea, serum

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creatinine, serum electrolyte, Liver function test, serum bilirubin levels) and complete blood counts (CBC) was also noted.

### Results:

A total of 42 case records were analyzed. Among them, 36 (85.7%) were males, giving a male: female ratio of 6:1. Mean age of the victims was  $33.97 \pm 10.76$  years (range 18 to 61 years). The age group affected most (73.8%) was 20-40 years. According to occupation, 32 (76.2%) patients were farmers, 6 (14.3%) were students while 4 (9.5%) were unemployed. The patients presented with initial symptoms of nausea (66.7%) and vomiting (64.3%), while 4.8% complained of diarrhoea. The most common mode of poisoning was suicidal (95.2%), followed by accidental (4.8%) (**Table 1**). All the 36 male victims committed suicide by ingesting endosulfan.

All patients died within 6-36 hours after ingestion. We recorded 33 (78.6%) deaths among them, giving a total mortality rate of 78.6% due to endosulfan poisoning. Seizure was noted in 35 (83.3%) cases, which was of Generalized Tonic Clonic (GTC) type. Of these, 31 (88.6%) died while only 2 (28.6%) patients who died had no seizures on presentation. The association between mortality and GTC Seizure was found to be significant ( $p < 0.0001$ ). (**Table 2**)

According to the time of initiation of symptoms, 57% of the patients had complained of symptoms within one hour of ingestion of endosulfan while 38% developed symptoms within two hours. (**Figure 1**) Complete blood count (CBC), Blood sugar, Urea, Creatine and electrolytes were normal except Liver Function Tests in the form of aspartate amino transferase (AST) and alkaline amino transferase (ALT), which were abnormal in 30 (71.4%) patients.

Tonic-clonic convulsions were treated with Diazepam, Phenytoin and Phenobarbital. Supportive care to these patients was provided that included decontamination of skin, gastric lavage, active charcoal, lidocaine for arrhythmia. Almost all significant complications including shock, hepatic toxicity, acute renal failure (ARF), Rhabdomyolysis and cardiac injury developed in these patients which led to their deaths. All the patients were admitted in Intensive care units (ICU) and ventilator support was provided to them. An important postmortem finding in nearly all deceased was marked congestion of meningeal vessels.

### Discussion:

Endosulfan toxicity could precipitate enormous jeopardy and may result in

irreversible and fatal damage. The spectrum of involvement may range from mild nausea, vomiting and anxiety to convulsions and multi-organ damage resulting in death.<sup>6</sup>

In this study, 85.7% were males. A study done by Karatas AD, et al showed that of the total cases of endosulfan poisoning, 78.3% were males.<sup>7</sup> We observed that most of the patients in our study were young male farmers who committed suicide. In India, it is estimated that nearly 16,000 farmers die due to suicide each year, and at rates far above those of the general populations. Socio-economic factors are associated with farmer suicides, with increase indebtedness playing the predominant role. It has led to agrarian crisis affecting the most vulnerable farmers.<sup>8</sup> Deliberate self poisoning by ingesting pesticides is serious health problem among farmers. Pesticide storage in households is unsafe and this may lead to associated self injury, both unintentional and intentional.<sup>9</sup>

The patients presented with initial symptoms of nausea (66.7%) and vomiting (64.3%), while 4.8% complained of diarrhoea. The most common mode of poisoning was suicidal (95.2%), followed by accidental (4.8%). Nausea and vomiting were the most common symptoms experienced by the patients in this study, similar to other studies.<sup>10</sup> Endosulfan, being an organochlorine readily crosses the intestinal barrier (oral absorption > 90%) and the blood brain barrier ( $\log BB > 0.4$ ), causing prompt symptoms in patients.<sup>11</sup>

The predominant toxicological effect in endosulfan poisoning is over-stimulation of CNS. Most of the patients had symptoms within an hour of ingestion. The seizures were of GTC type in all the cases. Other studies also showed similar results.<sup>7,12-14</sup>

Liver function tests were abnormal in 71.4 % patients. LFT, in the form of AST or ALT could be abnormal in endosulfan toxicity.<sup>15</sup> The mainly affected organ in endosulfan toxicity is liver. Gross examination in endosulfan poisoning showed swollen and pale liver.<sup>16</sup>

The association between mortality and GTC Seizure was found to be significant ( $p < 0.0001$ ). This study showed a significant association between development of seizures and mortality. Seizures were the most common cause of death in endosulfan poisoning, as seen in other studies. Seizures may lead to status epilepticus. Post mortem examination carried out on the individuals who died due to status epilepticus confirmed that the deaths were due to asphyxia.<sup>15,17,18</sup>

Endosulfan can cause cerebral edema along with other complications including heart



failure, acute renal failure and disseminated intravascular coagulation (DIC). It may also cause liver, kidney and lung toxicity.<sup>19-21</sup>

### Conclusion:

Poisoning is a very common health menace in this part of country, Endosulfan being one of the main culprits. Most often poisoning is either suicidal or may be accidental. Commonest manifestations of endosulfan poisoning are neurological along with other associated organ dysfunctions. This retrospective study analyses 42 suspected endosulfan poisoning cases. Most of the cases in our study had GTC seizures, majority of them expired in less than 36 hours.

Endosulfan is banned in most of the developed and developing countries whereas it is still used in India extensively. Though a ban on Endosulfan exists in the south Indian state of Kerala (imposed through a court order), it still awaits a pan India ban. Its use should be banned under strict legislation and steps be taken to educate and create awareness regarding the use of pesticides in agricultural community as well as the population in general. Moreover healthcare personnel should be specifically trained to provide immediate remedial measures to combat emergency situations arising out of pesticide use in high risk areas.

**Conflict of interest:** None

**Financial Assistance:** None

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**Table 1: The demographic and clinical characteristics of the cases**

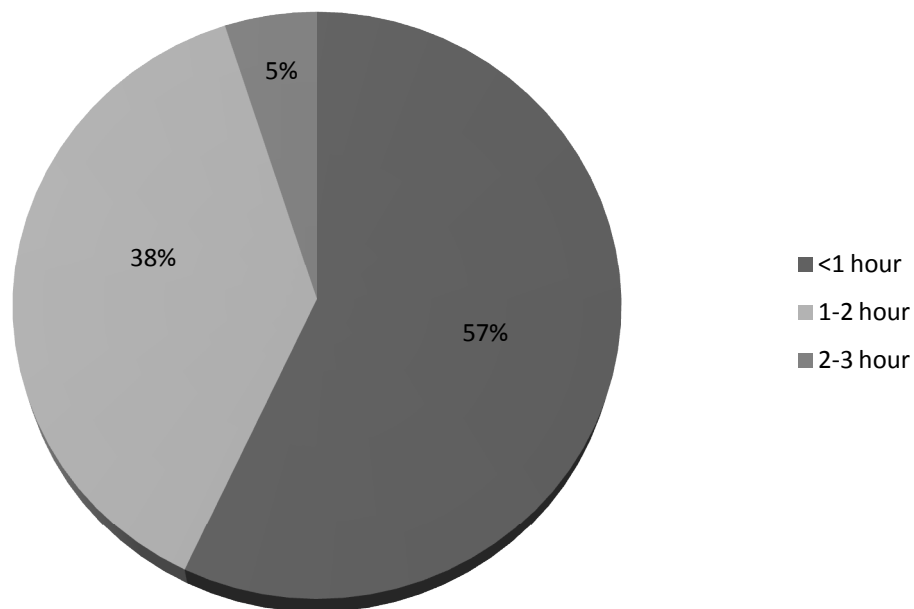
Characteristics	N	%
<b>Age (years)</b>		
<19	1	2.38
20-40	31	73.80
41- 60	8	19.05
>60	2	4.76
<b>Gender</b>		
Male	36	85.71
Female	6	14.29
<b>Profession</b>		
Farming	32	76.19
Student	6	14.28
Unemployed	4	9.52
<b>Aetiology</b>		
Suicidal	40	95.24
Accidental	2	4.76
<b>Clinical</b>		
<b>CNS</b>		
Seizure (GTC)	35	83.33
<b>General</b>		
Nausea	28	66.67
Vomiting	27	64.29
Diarrhea	2	4.76

Table 2: Association of seizures with mortality

Seizures	Mortality	Mortality Rate (95% CI)	Z	p	Rate Ratio (95% CI)
Yes (n=35)	31	88.6 (73.3-96.81)	1.737	0.08	3.1 (0.9551-10.0619)
No (n=7)	2	28.6 (3.68-70.98)	8.061	<0.0001	1
Total (N=42)	33	78.57 (63.19-89.70)	4.886	<0.0001	

$\chi^2 = 12.5$ ; df=1;  $p < 0.0001$ ; Highly significant

Figure 1: Time of initiations of symptoms after ingestion of Endosulfan



## Original Research Paper

# Trends and Reasons of Suicide deaths by Hanging: Analysis of 431 cases autopsied at Medical Teaching Institution in India

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### Abstract

The present study is aimed at analyzing the current trends of and reasons of suicidal deaths by hanging so as to identify the areas for intervention. We retrospectively reviewed 431 definite cases of suicidal hanging autopsied at a Medical Teaching Institution in Maharashtra during the period of 1<sup>st</sup> January 2001 to 31<sup>st</sup> December 2014.

We observed that the majority, 84.3% of victims were of the age group 10-39 years, females outnumbered males among 10-19 years age group, contrary to the predominance of males in all other age groups. The most common place of suicidal hanging was home. The common documented risk factors observed for suicide among married victims were marital disharmony, physical/ psychological illnesses, alcohol abuse, dowry dispute and financial stress. While, among unmarried victims the common risk factors were academic problems/ failure, domestic strife and physical/ psychological illness.

**Key Words:** Suicidal hanging, Trends, Reasons, India.

### Introduction:

Suicide is the deliberate act of taking one's own life. It is the final outcome of the complex interaction of biological, genetic, psychological, sociological and environmental factors.<sup>1</sup> It is a global phenomenon occurring in all regions of the world, with 75% of the global contribution by low and middle income countries.<sup>2</sup> In India, more than one lakh persons commit suicide each year; the majority, 70.4% of victims being below 45 years leading to emotional, functional and economic losses to the country.<sup>3</sup> Incidence of suicides and the methods used vary from country to country due to the variations in cultural, religious and social background.<sup>4</sup>

Hanging is a traditionally recognized and one of the most preferred methods of committing suicide in India. Furthermore, Indian immigrants contribute to the majority of hanging deaths in other countries.<sup>5-7</sup> Hanging is a type of violent asphyxial death secondary to compression or constriction of the neck structures by a noose or other constricting band tightened by the weight of the body.<sup>8</sup> Its selection as a method for committing suicide leaves little opportunity to change one's mind as generally death occurs quickly after suspension.

Consumption of poison, self Immolation and drowning are the other prominent means of committing suicide in India.<sup>3</sup> The non-reporting, under-reporting/ misclassification due to deficient/ misleading information about the manner of death are seen among these methods. Conversely, the deaths caused by hanging being sudden, unexpected and prima facie certainly unnatural could hardly ever concealed; rather, they are almost always reported to the legal authority. Also, hanging deaths are investigated in detail and routinely subjected to medico-legal autopsy to determine and/or confirm cause and manner of death. Hence, the deaths by hanging are the most reliable indicator for suicides occurring in the community.

According to National Crime Record Bureau (NCRB) of India,<sup>3</sup> Maharashtra has reported the highest number of suicidal deaths in the year 2013. A detailed knowledge of the various socio-demographic factors associated

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with suicidal deaths is very much helpful to know the psychological state of the people and for developing suicide prevention strategies. The aim of current study was to examine trends in suicide deaths by hanging and to identify the associated risk factors in this geographical region.

### Materials & Methodology:

The present study was conducted at Dr. Shankarrao Chavan Government Medical College, Nanded. We reviewed medico-legal autopsy record from 1<sup>st</sup> January 2001 to 31<sup>st</sup> December 2014 retrospectively and identified a total of 439 cases of death due to hanging. All these cases were categorized as suicidal, accidental or homicidal on the basis of the autopsy and police reports and information gathered from the Investigating Police officers. Further, all the distinct cases of suicidal hanging were analyzed in detail with respect to their personal data (sex, age, and marital status), month, year and predisposing/ precipitating risk factors for committing suicide. The data of suicidal cases were compiled, coded into charts and analyzed in detail.

### Observations:

During the study period, a total 439 cases of death due to hanging were autopsied by the Department. One was identified as homicidal, 7 as accidental and the remaining 431 as suicidal. We observed a trend of year-wise increase in the number of suicidal hanging, except in 2006, 2007 and 2010. Male preponderance was noted with 2.17:1, as the average sex ratio (male: female). The highest sex ratio (5.6:1) seen in year 2011 and lowest (1.14:1) in year 2006. (Fig. 1)

The highest number of cases was observed in the age group of 20-29 years, 39.7%, followed by 30-39 years, 24.8% and 10-19 years, 16.5%. The age group 20-29 years was the most common, except in 2001, 2006 & 2008. No specific trend or change of trend in relation to age group was observed during the study period. (Table 1)

Male preponderance was observed among all age groups except among adolescents (10-19 years), where female victims outnumbered males (M:F ratio - 0.73:1). Also, among the female victims, the contribution by adolescents was significantly large (30.2%). In consequent age groups, there was proportionately more decrease in female victims as compared to males. (Fig. 2) May, July and November months had the highest number of

cases (45, 44 & 46, respectively); whereas January & February had the lowest number of cases (28 each). (Fig. 3)

In relation to the marital status, hanging as a method of committing suicide was common among married persons, 71.2%. According to the information given by the relatives and/ or friends during inquest, the single most common risk factor for suicide among married females was dowry dispute, 20 cases; and among married males, was alcohol abuse, 28 cases. Physical and psychological illnesses together accounted for 54 married victims while marital disharmony was the predisposing factor in 16. Whereas, in unmarried victims the common documented risk factors were academic problems/ failure, 11 cases, followed by domestic strife, 9 cases. Physical/ psychological illnesses were reported in 14 unmarried victims. Other factors observed among married victims were financial stress, unemployment and impotence. Whereas, other reasons among unmarried victims were failure in love, unemployment and alcohol abuse. (Table 2)

### Discussion:

Hanging is a highly lethal method of suicide with an estimated fatality rate of 77.5%.<sup>9</sup> The method used by the victims to commit suicide depends on the victim's knowledge, availability and accessibility of suicide means and his/ her motivation and intent. In view of the easy availability of ligature materials & accessible suspension points in places unlikely to get detected before completion of the act, hanging has been adopted as the method of certain, swift and painless suicide. In recent years, hanging is the leading method of suicide in India, outnumbering all other methods.<sup>3</sup>

During the study period, the trend of increase in the numbers was observed each year, except 2006, 2007 & 2010. No specific reason could be attributed to this finding. Male preponderance was noted among the hanging cases with average male: female ratio being 2.16:1. This signifies that males commit suicide by hanging more often than females. The finding of male predominance among victims of hanging was also reported by one of the author in other region of Maharashtra.<sup>10</sup> Similar findings among the victims of suicidal hanging was also reported by researchers from India<sup>11,12</sup> and other parts of the World.<sup>4-7,13,14</sup> According to the National Crime Record Bureau of India,<sup>3</sup> the number of male victims was more than females for all means of suicides except those committed by Self immolation, where the share of female

victims was more, 65.2%. Conversely, Naik, et al<sup>15</sup> and Vijaykumari N<sup>16</sup> reported different findings. It is well recognized that males tend to use hanging as method of suicide more often than females do.<sup>4,10</sup> However, nearly equal sex ratio was observed in year 2006. The increase in number of adolescent female victims in this year could be the reason for this.

The age group 10-39 years (81%) is the most vulnerable age period of life for hanging with 20-29 age group being most common, 39.7%. The high incidence of hanging in the middle age group was reported in many studies.<sup>4,7,10-12,14-16</sup> While, some researchers reported preponderance among older age groups.<sup>5,6,13</sup> The most common age group reported by NCRB is 15-29 years.<sup>3</sup> Worldwide, suicide is the second leading cause of death among 15-29 year olds.<sup>2</sup> The fact that suicides are more common among young population can be explained by incomplete spiritual development, failure dealing with the problems in daily life, being daunted by problems easily, perceiving issues more important than they actually are and priority of emotionality in outlook on life.<sup>4</sup> Adolescents, 10-19 years, were the third most common age group among these victims contributing a significant percentage, 16.5%. During adolescence, person has to face the pubertal changes, hormonal variations, the hard realities and ever increasing competitions in almost all fields of life.

In the present study, females outnumbered males among 10-19 years, which could be attributed to the biological and social factors accounting to the greater prevalence of psychological disorders in girls.<sup>17</sup> There was a proportionately higher drop in the number of female victims in subsequent older age groups. In Asian countries including India, impulsiveness plays an important role among suicides.<sup>18</sup> The women, being more acquainted to cooking/ kitchen with concomitant easy access to means required for self immolation, often tend to set themselves on fire during impulse of suicide. The use of this accustomed method and easily available other simple means for suicide by women could be the reason for this drop in subsequent older age groups. The most common place of committing hanging was home, 70.2%, including tree in the premises, followed by farm and ground. The unusual places of hanging noted during present study period were rod in a well, toilet in the train, hotel-room and toilet of school. The victims choose any secluded place suitable for completion of his/ her act.

The month-wise variation in the present study showed the highest numbers of cases in May, July and November. Climate is very hot and humid in this region during summer months, with temperature reaching to 47°C in May. The majority of population in this region is engaged in agricultural work and the dependence of the Kharif farming on rainfall is a very crucial problem. The burden of raising money for farming, loss / failure of crops, thereby increasing financial adversity and distress in farmers and subsequent suicides might have raised the incidence of suicidal hanging in the month of July. Also, the most important educational examinations are held and/ or results displayed in May, June and July. The students committing suicide due to academic failure/ problems have added numbers in these months. The higher number of cases was also observed during month of November. Every year in this month or just before, the one of the most important festive of Hindu culture Diwali is celebrated which confronts additional financial burden on the families. The distress caused by inability to celebrate this festival due to financial problem in low socio-economic class could be the reason for rise of incidence in this month. Even, dyadic death involving all members of a poor family had been reported where the reason behind was the distress of not satisfying economic needs for celebration of the Diwali festival.<sup>19</sup>

The reasons for suicide among 42.4% married victims were documented at the time of inquest. Dowry dispute and marital disharmony were the most important reasons for committing suicide among married females. Strict law against Dowry is being enforced since many years; still this deadly social evil is prevalent in Indian community since ancient time. Alcoholism is the single most common reason reported among male victims. Physical/ psychological illness, financial stress, unemployment/ loss of job were the important reasons observed among married males. Failure of crops due to floods or droughts, poverty and bankruptcy are the important reason leading to financial stress and subsequent frustration and suicide.

The age among unmarried males ranged from 10 years to 28 years and in females from 10 to 25 years. Among unmarried victims, the predisposing/ precipitating factors behind committing suicide were documented in 40.9% cases. The most common factor observed was the academic failure/ problems. The peer pressure, high competition for education and employment, high expectation of parents, inability to attain their goals causes distress

among them. Psychiatric illness, alcohol abuse, failure in love and physical illness were the other reported reasons for committing suicide by hanging by unmarried victims. Psychiatric illness was not the main documented reason for suicide, unlike in many developed countries.<sup>20,21</sup> However, this may not be accurate as the social stigma attached with the psychiatric illness might have prohibited the disclosure by the relatives and/or friends attending the inquest. In some of the victims of suicidal deaths by hanging in which no definite reason was reported, the associated with psychiatric illness and/ or emotional instability along with some trigger might have played key role.

With easily available ligature materials and suspension points, person usually commits hanging in secluded place making these suicides very difficult to prevent. Most Indians lack community and support services for the prevention of suicide and have limited access to care for mental illnesses associated with suicide.

To have more reliability of suicidal manner, we studied the absolute cases of suicidal death by hanging. There is an urgent need for a national strategy to decrease the burden of suicide. It should not only include the development of prevention strategies focusing on socio-economic development of high risk peoples, strict implementation of laws and increasing availability of diagnosis, treatment and follow up facilities of patients suffering from mental disorders, but it should also include community awareness regarding suicide and improvement of problem-solving and coping skills. Public and voluntary organizations also play an important role by providing interventions and rehabilitation services, supporting families of mental patients, and promoting research on mental health. There is urgent need for proper studies on suicide in different settings to measure reliable information on reasons of suicide and efforts should be made for implement appropriate and specific prevention strategies.

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Table 1: Year-wise distribution of age groups in suicidal deaths due to hanging.

Years	Age groups in years						
	10-19	20-29	30-39	40-49	50-59	60-69	≥70
2001	05	02	04	03	01	01	01
2002	03	08	05	02	01	00	00
2003	03	10	04	02	01	00	00
2004	04	11	07	03	00	00	00
2005	06	15	10	02	01	00	00
2006	10	06	07	03	02	01	01
2007	04	07	04	02	03	00	00
2008	03	08	10	02	01	01	01
2009	09	10	06	05	01	01	01
2010	02	16	07	03	00	02	00
2011	05	14	10	04	00	01	00
2012	05	15	07	06	01	00	00
2013	08	19	13	06	03	02	01
2014	04	30	13	05	03	02	00
Total	71	171	107	48	18	11	05

Figure 1: Year-wise distribution of suicidal deaths by Hanging.

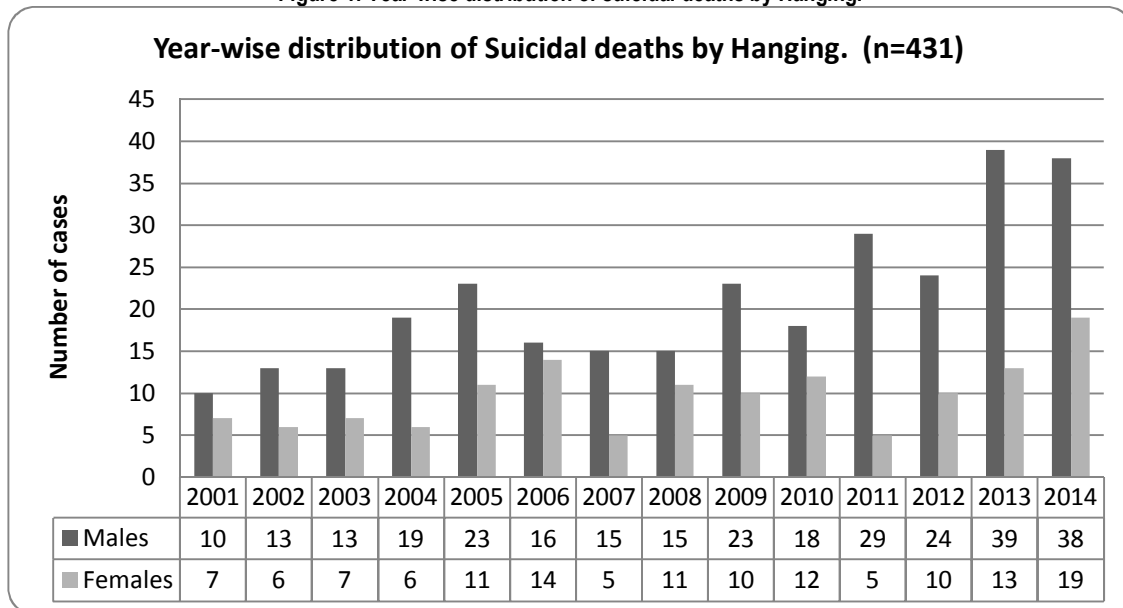


Figure No. 2: Sex-wise distribution of age groups in suicidal deaths due to hanging

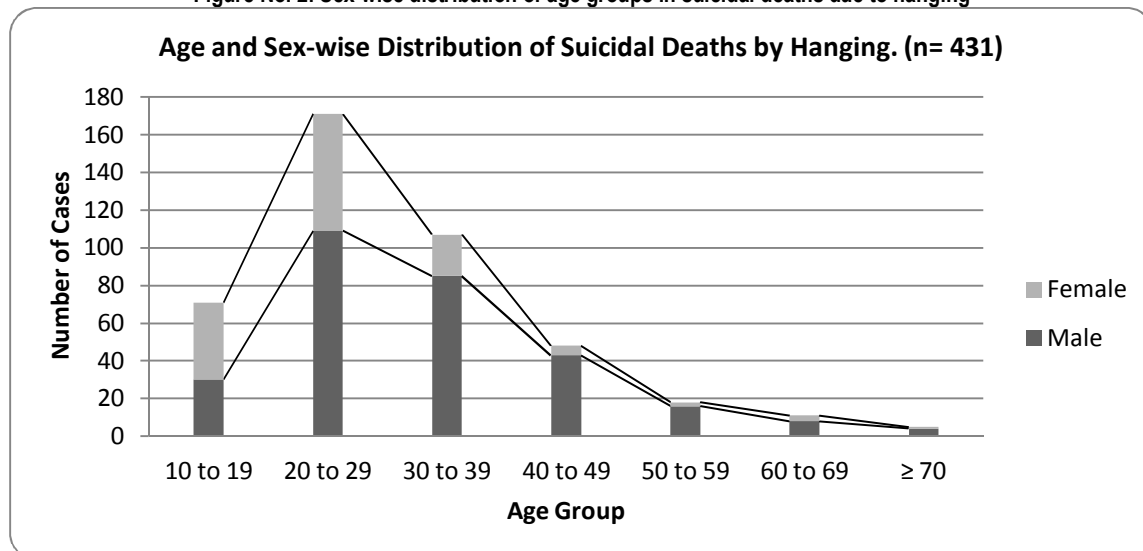


Figure No. 03: Month-wise distribution of Suicidal Deaths due to Hanging.

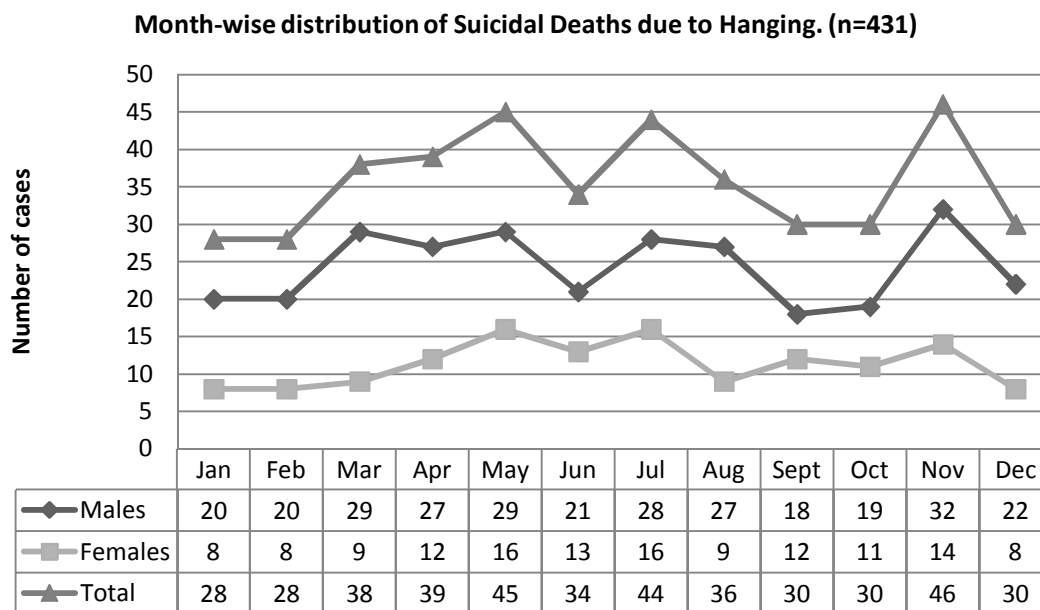


Table No. 02: Reasons of Suicide in relation to marital status

Marital status	Sex	Reasons/ Predisposing Factors (Male/ Female)
Married (n=307)	M = 219 F = 88 M:F = 2.49:1	Marital disharmony (09/ 07) Dowry dispute (00/ 20) Financial stress (10/ 00) Physical illness (24/ 09) Psychological illness (12/ 09) Alcohol abuse (28/ 00) Infertility (00/ 02) Loss of job/ unemployment (02/ 00) Not known (136/ 41)
Unmarried (n=120)	M = 74 F = 46 M:F = 1.61:1	Physical illness (05/ 03) Psychological illness (04/ 02) Alcohol abuse (03/ 00) Academic problem/ failure (05/ 06) Failure in love (01/ 06) Domestic strife (04/ 05) Unemployment (05/ 00) Not known (47/ 24)
Divorced/ widow / single	M = 02 F = 02 M:F = 1:1	Loneliness (01/ 01) Grief of spouse death (00/ 01) Fear of legal action (01/ 00)



## Original Research Paper

# Carpals – The Tiny Markers of Age Estimation by Digital Radiography

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### Abstract

Responsibilities of an individual increase as the age advances. Paediatric age group is very vulnerable to suffer as well as commit the crime. Estimating the age of a child plays crucial role in solving many medicolegal problems. Many studies have been carried out in the past for estimating age from conventional radiographs but very few have been done using digital radiographs. In present study, we used digital radiographs of wrist & hand in paediatric populations for estimating age by appearance of ossification centres of carpal bones. The results of the study show consonance with some studies but some difference with others. This shows that individual variations may be observed as a result of various factors like genetic make-up, geographical habitat and diet. So, an institutional database is to be formed by doing such study so that medico legal problems related to age estimation of children can be solved by comparing the findings of local database with the findings of a case in question, which shall make the exercise more accurate.

**Key Words:** Age Estimation, Carpals-the Tiny Markers, Digital Radiographs, Ossification

### Introduction:

The responsibilities of an individual increase as the age advances. Criminal responsibility of an individual is an important area to be concentrated upon. Indian law has suggested certain ages; attaining which an individual is considered responsible for his act. In recent times, crimes against & by the children are on the rise. The paediatric age group is of great medico-legal importance with regards to infanticide (1 year), in deciding criminal responsibilities of a child (5 years, 7 years & 12 years) according to Sec. 127-130 of Indian Railways Act, 1890<sup>1</sup> and Sec. 82, 83 of Indian Penal Code (IPC), 1960<sup>2</sup>, kidnapping of a child for valuables (10 years) according to Sec. 369 of IPC, oath taking in court of law (12 years) according to Oath Amendment Act of India, 1939<sup>3</sup>, giving consent for physical examination

12 years) according to Sec. 89 of IPC and employment of a child (14 & 15 years) according to the Factories Act 1948.<sup>4</sup>

Dentition and ossification of bones play a major role in determination of age in paediatric population. Nevertheless, age can usually be assessed more accurately in younger age group by dentition and ossification along with epiphyseal fusion.<sup>5</sup> There are various methods of determining the bone age by radiological assessment, of which the most widely accepted method is that of Greulich-Pyle,<sup>6</sup> described in "*Radiographic atlas of skeletal development of the hands and wrist*" - an atlas derived from the American white children of upper socio-economic class during 1930s.

Bones at wrist and hand play crucial role in determining age of a child. Many studies on age estimation from appearance of ossification centres at wrist and hand have been carried out in past.<sup>7-9</sup> Although the time of these ossifications is relatively well documented, it can show a considerable degree of person to person variation. It may depend on multiple factors like genetic, geographical, racial, dietary habits etc.<sup>9-11</sup> That is why it is essential to form a regional database of age of appearance of ossification centres and hence this study has been carried out in Ahmedabad region of Gujarat and it was found that ossification centres at wrist form a good indicator of age in paediatric age group.

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### Aims & Objectives:

1. To observe the average age of appearance of centre of ossification of Carpals.
2. To compare the findings of present study with different other studies.
3. To look for scientific explanation for variations; if any.
4. To evaluate medico legal application of observation in exercise of age estimation.

### Materials & Methods:

**Ethics:** According to ICMR guidelines, this study falls under category of 'No more than minimal risk' & 'Expedited review'. It is a retrospective study involving use of radiographs already collected in past for non-research purposes.

This study was carried out after approval from Scientific Research Committee and Institutional Ethics Committee.

**Study design:** A retrospective cross-sectional study was carried out on digital radiographs of wrist & hand collected in various outdoor patient departments at GCS Medical College, Hospital & Research centre for clinical purposes (Non research) during 1-1-12 to 31-12-12.

#### Inclusion criteria:

- Subjects of known gender & age ranging from 0-16 years, living in Ahmedabad, since birth.

#### Exclusion criteria:

- Subjects with undefined gender & age in question or doubt (undefined gender & unknown age).
- Subjects with history of trauma or diagnosed disease or pathology at wrist &/or hand.
- Subjects with congenital abnormality.

Total 200 cases of age group 0-16 years underwent X-ray examination of hand & wrist during the period mentioned above, amongst which 76 cases (70 cases of trauma at or around wrist & 6 cases of unknown age) were excluded and rest 124 cases were included in the study.

After blinding, the radiographs were studied in digital form in .jpg format+in Microsoft Office Picture Manager 2007 version in 2505x3015 resolution with 60% zoom in. Appearance and non-appearance of the carpal bones were given code %A+ and %NA+, respectively. Master chart was prepared and tabulated as per code given above. It was classified, analysed and compared with known standards. Data analysis was done in P4 computer using Microsoft Office Excel software. At the end of the study, conclusions were drawn

which were compared with available results of various previous studies.

### Results:

The results are presented in the tables below and the findings in the tables are self explanatory.

**Table 1:** Age and sex wise frequency distribution of subjects

**Table 2:** Frequency distribution of Ossification of Carpal bones (Appearance)

**Table 3:** Statistical parameters for appearance of ossification centres of Carpal bones

### Discussion:

Radiographic study of shoulder, elbow, wrist, hip, knee and ankle regions is accepted for age estimation world-wide. Many studies have been carried out in past in various regions of the world using conventional radiographs<sup>7-9,11</sup> but research with digital radiographs of hip joint was first reported in biomedical literatures of India in 2012 only.<sup>12</sup> This study was aimed at age estimation through digital radiographs of wrist and hand.

On segregation of data by different authors region-wise, (**Table 4**), it is safe to interpret the facts as under:

#### Table 4: Comparison of age of appearance of Carpal bones amongst different studies

According to a study by Davies & Pearson, as quoted by Modi,<sup>9</sup> in **English population**, all the carpal bones start to appear earlier than the present study except Lunate and Pisiform which appear at the same time as shown by present study.

According to Flecker, as quoted by Modi,<sup>9</sup> in **Australians** all the carpals start appearing earlier than the present study except Triquetral and Pisiform in males which appear at the same time as shown by present study. As per the study done by Galstaun, as quoted by Modi,<sup>9</sup> on **East Indian population (Bengalis)**, Capitate, Trapezium and Trapezoid tend to appear earlier than the present study in both sexes along with Lunate, Scaphoid, Triquetral and Pisiform in Bengali females. Lunate and Scaphoid in Bengali males show appear at the same time as that shown in present study. Triquetral & Pisiform in Bengali males along with Hamate in both sexes of Bengalis appear later than the present study.

According to the study done by Srivastav A, et al,<sup>7</sup> **Rajasthanis** show appearance of Capitate and Hamate at the same time as shown by present study. Pisiform in Rajasthanis appeared earlier than present

study. Other carpal bones like Triquetral, Lunate, Trapezium, Scaphoid and Trapezoid appeared later than present study.

**Central Indian population** studied by Wankhede PA, et al<sup>8</sup> show that only Triquetral appeared at the same age as that shown in present study. Trapezium, Scaphoid, Trapezoid and Pisiform showed their appearance earlier than present study. Capitate and Hamate appeared later than present study in central India's population.

**In south Indian population**, only Triquetral appeared at the same age as that shown in present study but Capitate, Trapezium, Scaphoid, Trapezoid and Pisiform appeared earlier while Hamate and Lunate appear later than the present study as mentioned by KS Narayan Reddy<sup>13</sup> and VV Pillay.<sup>14</sup>

The co-efficient of variation values for different carpal bones indicate that age for appearance of Trapezium, Scaphoid, Trapezoid and Pisiform show less variation than Lunate, Triquetral, Hamate and Capitate thus, making Trapezium, Scaphoid, Trapezoid and Pisiform more reliable than rest of the carpal bones for age estimation.

## Conclusion:

We concluded that for the population of Ahmedabad city, Capitate and Hamate appear between age of 0-1 years (6 months  $\pm$  6 months). At the age between 2½ - 3½ years (3 years  $\pm$  6 months) Triquetral appears. 3-4 years (3½ years  $\pm$  6 months) of age group shows appearance of Lunate. During 7-8 years (7½ years  $\pm$  6 months) of age Scaphoid tends to appear. 7½ - 8½ years (8 years  $\pm$  6 months) of age group shows appearance of two bones namely Trapezium and Trapezoid. Between 11-12 years (11½ years  $\pm$  6 months) of age Pisiform appears.

Present study also concludes that almost all the carpal bones appear earlier in population of western countries than in India. It can also be concluded that there is difference in ages of appearance of various carpal bones in different regions of India. This can be explained by racial and geographical as well as nutritional differences.<sup>5-7</sup> Of the medicolegally important ages in India, our study is more reliable for deciding 7 years of age as there is appearance

of three carpal bones namely Scaphoid, Trapezium and Trapezoid surrounding this age. For deciding 5 years of age, appearance of Lunate in addition to findings of Scaphoid, Trapezium and Trapezoid play crucial role. 12 years of age can be decided after incorporating appearance of all the carpal bones in addition to Pisiform.

Thus, such study can be helpful in solving problems like deciding age of a child in case of proving criminal responsibility (provided a child understands the nature and consequences of the act), consent for physical examination, oath taking at deposition etc., It is suggested to the department of Forensic Medicine at all medical colleges to carry out such study in local population and form a local database which can be helpful at local level as we can notice considerable variations in appearance of such ossification centres even in a single country.

**Conflict of interest:** None

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Table 1: Age and sex wise frequency distribution of subjects

Age group (yrs)	Male	Female	Total
0-1	2	4	6
1-2	6	4	10
2-3	12	4	16
3-4	6	2	8
4-5	2	6	8
5-6	4	0	4
6-7	2	2	4
7-8	4	0	4
8-9	6	2	8
9-10	8	0	8
10-11	10	0	10
11-12	6	0	6
12-13	4	0	4
13-14	4	0	4
14-15	6	2	8
15-16	12	4	16
Total	94	30	124

Table 2: Frequency distribution of Ossification of Carpals (Appearance)

Age group (yrs)	Total number of cases n	Capitate n(%)	Hamate n(%)	Triquetral n(%)	Lunate n(%)	Trapezium n(%)	Scaphoid n(%)	Trapezoid n(%)	Pisiform n(%)
0-1	6	2 (33.33)	2 (33.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
1-2	10	10 (100)	10 (100)	4 (40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
2-3	16	16 (100)	16 (100)	10 (62.5)	2 (12.5)	0 (0)	0 (0)	0 (0)	0 (0)
3-4	8	8 (100)	8 (100)	4 (50)	2 (25)	0 (0)	0 (0)	0 (0)	0 (0)
4-5	8	8 (100)	8 (100)	3 (37.5)	1 (12.5)	0 (0)	0 (0)	0 (0)	0 (0)
5-6	4	4 (100)	4 (100)	4 (100)	2 (50)	0 (0)	0 (0)	0 (0)	0 (0)
6-7	4	4 (100)	4 (100)	1 (25)	1 (25)	0 (0)	0 (0)	1 (25)	0 (0)
7-8	4	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	2 (50)	4 (100)	0 (0)
8-9	8	8 (100)	8 (100)	8 (100)	8 (100)	4 (50)	8 (100)	6 (75)	0 (0)
9-10	8	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	2 (25)
10-11	10	10 (100)	10 (100)	10 (100)	10 (100)	10 (100)	10 (100)	10 (100)	2 (20)
11-12	6	6 (100)	6 (100)	6 (100)	6 (100)	6 (100)	6 (100)	6 (100)	0 (0)
12-13	4	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	0 (0)
13-14	4	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	4 (100)	2 (50)
14-15	8	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)	8 (100)
15-16	16	16 (100)	16 (100)	16 (100)	16 (100)	16 (100)	16 (100)	16 (100)	16 (100)
Total	124								

Table 3: Statistical parameters for appearance of ossification centres of Carpal bones

Statistical parameter	Capitate	Hamate	Triquetral	Lunate	Trapezium	Scaphoid	Trapezoid	Pisiform
Range (years)	0-2	0-2	1-8	2-8	7-10	7-9	6-10	9-15
Mean	0.62	0.62	3.14	3.63	8.2	7.66	7.83	11.25
SD	0.5	0.5	1.83	1.68	0.76	0.49	1.09	1.83
Mean $\pm$ 3SD	-0.88 to 2.12	-0.88 to 2.12	-2.35 to 8.63	-1.41 to 8.67	5.92 to 10.48	6.19 to 9.13	4.56 to 8.92	5.76 to 16.74
% beyond demarcating point	0	0	0	0	0	0	0	0
Co-efficient of variance (SD/Mean)	0.80	0.80	0.58	0.46	0.09	0.06	0.13	0.16

Table 4: Comparison of age of appearance of Carpal bones amongst different studies

STUDIES	Capitate	Hamate	Triquetral	Lunate	Trapezium	Scaphoid	Trapezoid	Pisiform
KSN Reddy <sup>[13]</sup> (South Inds)	2 mths	2 yrs	3 yrs	4 yrs	6 yrs	4-5 yrs	4-5 yrs	10-12 yrs
VV Pillay <sup>[14]</sup> (South Indians)	2 mths	1-2 yrs	3 yrs	4-5 yrs	4-6 yrs	6-7 yrs	7-8 yrs	9-11 yrs
JP Modi <sup>[9]</sup>								
Galstaun (Bengalis -East Indians)								
Males	6 mths	8-14 mths	3-4 yrs	3-4 yrs	4-7 yrs	7-11 yrs	4-7 yrs	12-17 yrs
Females	6 mths	8-14 mths	2-3 yrs	2-3 yrs	5-6 yrs	6 yrs	5-6 yrs	9-12 yrs
Flecker (Australians)								
Males	6 mths	6-10 mths	3 yrs	4 yrs	5 yrs	6 yrs	6 yrs	11 yrs
Females	6 mths	6-10 mths	1½ yr	---	5 yrs	5 yrs	5 yrs	9 yrs
Davies & Pearson (English)	3-5 mths	4-5 mths	2-4 yrs	3-4 yrs	6-7 yrs	6-8 yrs	7-8 yrs	12 yrs
Srivastav A et al <sup>[7]</sup> (Rajasthanis - North Indians)								
Males	0-12 mths	0-12 mths	3-4 yrs	4-5 yrs	9-10 yrs	9-10 yrs	9-10 yrs	9-12 yrs
Females	0-12 mths	0-12 mths	3-4 yrs	4-5 yrs	8-9 yrs	8-9 yrs	8-9 yrs	10-12 yrs
Wankhede PA et al <sup>[8]</sup> (Central India)	1 yr	1 yr	3 yrs	4 yrs	5-6 yrs	5-6 yrs	5-6 yrs	9-10 yrs
Present Study (Ahmedabadis -Western India)	0-1 yr	0-1 yr	2½ - 3½ yrs	3-4 yrs	7½ - 8½ yrs	7 - 8 yrs	7½ - 8½ yrs	11-12 yrs

## Original Research Paper

# Profile of Cases Booked Under POCSO (Protection of Children from Sexual Offences) Act in Chamarajanagar District, Karnataka

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### Abstract

**Background:** In India, the rising number of cases of children who are being reported to be sexually abused is a matter of grave concern. Child sexual abuse is a serious affront to our nation's dignity. The law on child sexual abuse in India is not found in a single instrument but is scattered across several legislations, with the Protection of Children from Sexual Offences Act, 2012 (POCSO Act) being the most significant statute covering the issue. The POCSO Act is the first legislation in India to cover the entire ambit of child sexual abuse.

**Methodology:** The present study was done in the Department of Forensic Medicine & Toxicology, Chamarajanagar Institute of Medical Sciences, Chamarajanagar. A detailed information regarding the cases booked under POCSO Act in Chamarajanagar District for a period of 3yrs (2013-2015) were sought from the office of the Superintendent of Police, Chamarajanagar and were critically analyzed and interpreted using latest statistical software.

**Results:** A total number of 35 cases were booked under POCSO Act, during the study period in various police stations across the district. The age group 13-18yrs constituted 91.4% of cases booked with most of the alleged incidents taking place in the living room (home) which accounted for 42.9% cases. Not even a single male victim was registered. In 54.5% of cases, the medical examination was done more than 1 week after the alleged incident. 80% of the assailants were strangers to the child. The conviction rate stood at a dismal 5.7%.

**Conclusion:** It is hoped that this resource will be instrumental in enabling not just more successful litigations against the alleged offenders, but also a comprehensive approach by the appropriate authority to effectively prevent child sexual abuse in this region.

**Key Words:** Sexual Offence; Child Abuse; POCSO Act; Chamarajanagar

### Introduction:

The Protection of Children from Sexual Offences Act (POCSO Act), 2012<sup>1</sup> is the first legislation in India to exclusively cover the ambit of child sexual abuse. It was enacted to not only protect children from offences of sexual assault, sexual harassment and pornography, but also to

ensure a child-friendly procedure for the trial of these offences.<sup>2</sup> The other important legislations that also contain offences in relation to child sexual abuse are:

- ❖ The Indian Penal Code (IPC), 1860. [Please give the respective Act Nos.; IPC is Act No. 45 of 1860, so on]
- ❖ The Immoral Trafficking Prevention Act (ITPA), 1956. [?or 1986??]
- ❖ The Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989.
- ❖ The Information Technology Act (IT Act), 2000.
- ❖ Code of Criminal Procedure (CrPC), 1973.
- ❖ The Indian Evidence Act (IEA), 1872
- ❖ The Juvenile Justice Act (JJ Act), 2000.
- ❖ The Criminal Law (Amendment) Act, 2013.

In order to comprehend the legal framework covering the ambit of child sexual abuse in India, it is important to understand these legislations as well.<sup>2</sup>

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### POCSO Act:

The POCSO Act came into force on 14<sup>th</sup> November 2012, through a gazette notification dated 9<sup>th</sup> November 2012 after it received the assent of the President of India on 19<sup>th</sup> June 2012. The Act applies to the whole of India, except the state of Jammu and Kashmir. Under the POCSO Act, the power to make rules has been vested only with the Central Government. Therefore, the central rules apply to all the states.<sup>1</sup>

**Offences under POCSO Act:** The POCSO Act, 2012 prescribes following sexual offences against children-

1. Penetrative sexual assault.
2. Aggravated penetrative sexual assault.
3. Sexual assault.
4. Aggravated Sexual assault.
5. Sexual harassment.
6. Use of child for pornographic purposes
7. Storage of pornographic materials involving a child.
8. Abetment of an offence or an attempt to commit an offence.

These offences are gender neutral vis-à-vis the perpetrator as well as the victim. A child can also be charged with a sexual offence under POCSO Act. The POCSO Act is a special law and does not prescribe whether or not an offence is cognizable.

**Recording of offences:** the state police manual or circulars will have to be considered to identify the rank of police officers who can undertake investigation in POCSO cases.<sup>3</sup> Cases reported by the child must be recorded by the police/SJPU (Special Juvenile Police Unit) in simple language, so that the child understands what is being recorded. If it is recorded in a language other than the preferred language of the child, a qualified translator or interpreter must be provide to the child.<sup>4</sup>

**Medical Examination:** Medical examination can be conducted irrespective of whether a FIR/complaint has been filed. The privacy of the child must be respected, and medical examination must be conducted in the presence of parent/ guardian/ person the child trusts. If the victim is a girl, medical examination must be conducted by a woman doctor.<sup>4</sup>

**Trial:** All the questions by the special public prosecutor or the lawyer of the accused must be posed to the child through the judge. Though the child must not be exposed to the accused at any point during the legal process, the accused does have the right to hear the testimony of the victim. The special court must create a child friendly atmosphere by allowing a

family member/ guardian/ friend or relative in whom the child has trust.

**Punishment:** At times, certain acts may be offences under more than one law. When such a situation arises, the court decides the punishment based on the mandate of each law. According to the POCSO Act, in such a situation the person will be awarded punishment that is higher in quantum. Punishment for sexual offences under the POCSO Act is summed up in **Table 1.**<sup>1-4</sup>

Chamarajanagar has a population of about 10,20,962 people, Total geographic Area of the district is 5676 SqKms, divided into 4 Taluk (Yelandur, Gundlupet, Kollegal & Chamarajanagar) & has 14 police stations.<sup>5</sup>

### Materials and Methodology:

The present study was a retrospective descriptive study for a period of 3 years i.e., from 1<sup>st</sup> January 2013 to 31<sup>st</sup> December 2015, done in the Department of Forensic Medicine & Toxicology, Chamarajanagar Institute of Medical Sciences, Chamarajanagar. All the cases booked under POCSO Act were collected from all the Police Stations coming under the Chamarajanagar District. The details of each case were recorded in a proforma which had details of the persons involved, age, sex, demographic details, relation with the accused, date of the incident, and medical examination details among others which was tabulated and studied scientifically using latest statistical software.

### Results and Observations:

A total number of 35 cases were booked under the POCSO Act at various police stations under Chamarajanagar District during the study period. Among the 4 talukas that come under Chamarajanagar district, maximum number of cases i.e., 51.4% (n=18) were booked in Chamarajanagar Taluk, (**Table 2**) followed by Gundlupet taluk (25.7%) and Kollegal taluk (17.1%). The age group 13-18yrs (**Table 3**) constituted 91.4% of cases booked under POCSO Act, with no cases booked below 5yrs of age. Not even a single male victim was registered during the study period.

Religion wise, (**Table 4**), Hindus constituted 94.3% (n=33) of cases while only 2 cases were muslims. Most of the alleged incidents took place in living room (home) which accounted for 42.9% (n=15) cases, closely followed by Open field, 37.1% (n=13). (**Table 5**) Among the type of assailants involved in the case, (**Table 6**), 80% (n=28) were strangers to

the child, 11.4% (n=4) were neighbors and 8.6% (3) were family members.

As regards the number of assailants involved in a case, (**Table 7**), in 97.1% (n=34) of the cases, only a single person was involved & only in 1 case were two assailants booked for the charges. In the year wise distribution of cases, (**Table 8**), 2014 had the highest number of cases booked under POCSO Act amounting to 40% (n=14), followed by 2013 (n=11) and 2012 (n=10).

Among the time interval between the alleged incident and the medical examination done (**Table 9**), in 54.5% (n=19) cases, the medical examination was done more than 1 week after the alleged incident and in 17.1% (n=6) cases the examination was carried out within 24 hours of the alleged incident. Coming to the status of the case (**Table 10**), 71.4% (n=25) of the cases are pending trial in court while 22.9% (n=8) of cases have been acquitted and only 5.7% (n=2) of cases have been convicted in the court.

## Discussion:

Child sexual abuse is an under-reported offence in India, which has reached an epidemic proportion. Determining a definitive estimate of the prevalence of child sexual assault in our society is highly difficult. It is thought that the cases reported to police stations are just the tip of the iceberg. Here, we discuss the cases booked under POCSO Act in Chamarajanagar District. In the present study, a total number of 35 cases were booked during the study period of 3 years in Chamarajanagar District.

World Health Organization estimates that 150 million girls and 73 million boys under 18 have been subjected to forced sexual intercourse or other forms of sexual violence.<sup>6</sup> Data from a study on child abuse: India 2007, an empirical research undertaken by the Ministry of Woman and Child Development, revealed that 53.2% of children had faced one or more forms of sexual abuse, of which 52.9% were boys and 47.1% girls.<sup>7</sup> Highest sexual abuse was reported in Assam (57.3%), followed by Delhi (41%), Andhra Pradesh (33.9%) and Bihar (33.3%).<sup>7</sup> A recent study on prevalence of sexual abuse among adolescents in Kerala, reported that 36 per cent of boys and 35 per cent of girls had experienced sexual abuse at some point of time.<sup>8</sup> In the last two decades, an increase in the prevalence of sexually transmitted diseases has been shown among children.<sup>9</sup>

In our study, among the type of assailants involved in the case, 80% were

strangers to the child, 11.4% were neighbours and 8.6% were family members. Strangers have been reported as the common assailant in studies done by Okonkwo, et al<sup>10</sup> (34.8%), Riggs, et al<sup>11</sup> (39%) and Dumont, et al<sup>12</sup> (49.2%). However, in contrast to this, Malhotra, et al<sup>13</sup> reported that rape by person acquainted with victim is common among girls < 10 years.

Karthiga RK, et al<sup>14</sup> reported that children who are victims of sexual abuse often know the perpetrator in some way. Rape or assault by strangers increases significantly with age. In addition, variations may result due to different lifestyle and social customs. This variations may have resulted due to population and time variation of victims due to the difference in the regions of study. Coming to the age of the victim, age group of 13-18 yrs constituted 91.4% of cases booked under POCSO Act, with no cases booked below 5 yrs of age. The study by the Ministry of Woman and Child Development found that Children between the ages of 5-12 are at the highest risk for abuse and exploitation.<sup>7</sup>

Among the time interval between the alleged incident and the medical examination done, in 54.5% cases the medical examination was done >1 week after the alleged incident and in 17.1% cases the examination was carried out within 24 hours of the alleged incident. Studies done by Aparna, S et al<sup>15</sup> shows that maximum (21.57%) victims were brought for medical examination after 2nd week- 3rd week of the incident and only (3.92%) victims were examined on the day of the incident. Sarkar SC, et al<sup>16</sup> observed that quarter of the victims were brought to the hospital within 5-7 days and Tamuli RP, et al<sup>17</sup> reported that 23% of the victims presented within 72 hours. The reason for the delay in medical examination may be attributed to the fact that the assailant had a friendly relationship with his victim and after having mutual sexual activity, there was no immediate lodgment of complaint. FIR was filed only when both the parties failed to have mutual settlement. This further delayed the lodgment of complain and thus the medical examination.

Among the conviction rate in our study, 71.4% of the cases are pending trial in court while 22.9% of cases have been acquitted and only 5.7% of cases have been convicted in the court. In an annual report from Delhi Commission of Protection of Child Rights, the average conviction rate among POCSO cases stands at just 2%<sup>18</sup>. The main reason for this low conviction rate among POCSO cases may be attributed to the fact that most of the victims turn hostile. The reason for this is because of the fact



that in majority of the cases, the victim and the accused would have been in a relationship and the victims' parents are the ones who would have given the complaint. That apart, there might be cases which are settled and end in marriage.

### Conclusion:

To conclude, it is hoped that this resource will be instrumental in enabling not just more successful litigation against alleged child sex offenders, but also a comprehensive approach by the appropriate authority to effectively prevent child sexual abuse in this region.

**Conflict of interest:** None

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**Table 1: Punishment for Sexual Offences under the POCSO Act, 2012.**

S No	Offence	Min. punishment	Max. punishment	Fine
1.	Penetrative sexual assault.	7yrs	Life imprisonment	Yes
2.	Aggravated penetrative sexual assault.	10yrs (rigorous imprisonment)	Life imprisonment	Yes
3.	Sexual assault.	3yrs	5yrs	Yes
4.	Aggravated Sexual assault.	5yrs	7yrs	Yes
5.	Sexual harassment.	-	3yrs	Yes
6.	Use of child for pornographic purposes	-	5yrs	Yes
7.		-	2 <sup>nd</sup> conviction: 7yrs	Yes
8.	Storage of pornographic materials involving a child.	-	3yrs	And/or
9.	Abetment of an offence	If offence abetted is committed, punishment for abetment is same as that provided for the offence		
10.	An attempt to commit an offence.	Half of imprisonment for life, or Half of the longest term of imprisonment provided for that offence, or Fine, or Fine and imprisonment		

**Table 2: Distribution of cases among talukas in Chamarajanagar.**

S no.	Taluka	No. of cases	%age
1	Yelandur	2	5.7%
2	Gundlupet	9	25.7%
3	Kollegal	6	17.1%
4	Chamarajanagar	18	51.4%

**Table 3: Age and Sex wise distribution of cases**

Sl no.	Age (in years)	Total no. of cases		%age	
		Male	Female	Male	Female
1.	0-5yrs	0		0%	
		0	0	0%	0%
2.	6-12yrs	3		8.6%	
		0	3	0%	8.6%
3.	13-18yrs	32		91.4%	
		0	32	0%	91.4%
Grand total		35		100%	
		0	35	0%	100%

Table 4: Religion wise distribution of cases

S No.	Religion	No. of cases	%age
1.	Hindu	33	94.3%
2.	Muslim	02	5.7%
3.	Christian	00	0%
4.	Others	00	0%

Table 5: Place of occurrence of the alleged incident.

Sl no.	Place of occurrence	No. of cases	percentage
1.	Home	15	42.9%
2.	Hotel/Resort	3	8.6%
3.	Workplace	2	5.7%
4.	Field	13	37.1%
5.	Others	2	5.7%

Table 6: Type of assailant involved in the case

Sl no.	Type of assailant	No. of cases	%age
1.	Parent	0	0%
2.	Guardian	0	0%
3.	Family member	3	8.6%
4.	Neighbour	4	11.4%
5.	Friend/Known person	0	0%
6.	Stranger	28	80%

Table 7: Number of assailants booked in the case

Sl no.	Type of assailant	No. of cases	%age
1.	1 person	34	97.1%
2.	2 persons	1	2.9%
3.	>2 persons	0	0%

Table 8: Year wise distribution of cases

Sl no.	Year	Total number of cases	Percentage
1.	2013	11	31.4%
2.	2014	14	40%
3.	2015	10	28.6%

Table 9: Time interval between the incident and medical examination

S no.	Time interval	Total no. of cases	Percentage
1.	<24hrs	6	17.1%
2.	24-48hrs	4	11.4%
3.	48-72hrs	3	8.6%
4.	72hrs-1week	3	8.6%
5.	>1 week	19	54.3%

Table 10: Status of the cases booked under POCSO Act

Sl. No	Status	No. of cases	%age
1.	Convicted	2	5.7%
2.	Acquitted	8	22.9%
3.	Pending trial in court	25	71.4%

## Original Research Paper

# Width of Sternum at Suprasternal Notch and at the Level of Fourth Rib for Determination of Sex in the Population of Delhi: A New & Reliable Tool for Sex Prediction

<sup>1</sup>Rajendra Baraw, <sup>2</sup>Jyoti Barwa, <sup>3</sup>Monisha Pradhan, <sup>4</sup>S. K. Khanna

### Abstract

Determination of sex of a person is an important aspect of identification and is required in the living as well as the dead. The sternum bone on its own has shown considerable sexual dimorphism and its various dimensions have been used for this purpose. Studies have shown significant sexual variation in the length and width of the sternum. This study was conducted to find out sexual variation in the width of the sternum at the level of 4<sup>th</sup> rib (WS4) and at the suprasternal notch (WSN). Though variation in width at different levels of the sternum have been studied but variations at all levels has not been explored in the past. We also studied the sternum in two states viz. the wet state i.e the freshly removed (F) and dry state i.e after processing the sternum (D). One hundred sternums with equal sex distribution were studied. The discriminant function analysis from sternum for sex variation using the combined width (WS4 + WSN) was quite high, ranging from 69% for wet sternum and 64% for dry sternum. These measurements were found to be more accurate in case of females, where the accuracy for sex determination was the highest for WS4 (D;76%), followed by WSN (F; 72%), followed by WS4 (F; 68%), and by WSN (D;66%), respectively. In males, the discrimination function was the highest with WSN in both wet and dry specimens, 64%, followed by WS4 (D; 62%) and WS4 (F; 60%), respectively. We concluded that determination of sex by means of width of sternum at supra-sternal notch and 4<sup>th</sup> rib is a reliable indicator in both wet and dried state of the bone having higher accuracy rate with examination of wet sternum and in case of females.

**Key Words:** Identification, sternum, sexual dimorphism, width of supra sternal notch, width of sternum at 4<sup>th</sup> rib

### Introduction:

Identification is the determination of the individuality of a person based on certain physical characteristics.<sup>1</sup> Determination of sex via examination of sexually dimorphic features has focused primarily on the pelvic girdle, long bones, and the skull.

However, in cases where the pelvis and skull are not always available for study, or are too damaged for examination, alternative methods of sex determination are required; then even a single bone, like sternum becomes important from a forensic anthropological view point.<sup>2</sup> The sternum has drawn considerable attention in studies related to sexual dimorphism and application in estimation of stature. Like other skeletal remains, it also represents population specific morphometric features.<sup>3</sup>

The present study was designed to identify these morphological features (predictors) and examine the sexual dimorphism of adult sternum in the population of Delhi, applying linear discriminant function analysis. Since, the fragmentary skeletal remains that are usually bought for anthropological examination are in the dried state, we conducted this study by measuring the parameters both in wet condition as well as after drying the sternum by means of boiling in water.

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## Materials and Methods:

The study was conducted on 100 sternums (50 male; 50 female) recovered from the medicolegal autopsies conducted in the mortuary of Department of Forensic medicine & Toxicology, Maulana Azad Medical College, New Delhi. Cases above 18 years and fractured, diseased or deformed sternums were excluded from the study. For each of these selected cases, written informed consent was duly obtained from the legal guardian of the dead body. The thorax was opened and sternum was recovered using routine standard autopsy technique. The measurements were taken immediately after recovery in the wet state (F) keeping the bone on a flat surface and using Verniercalipers with readings up to one mm. The width of suprasternal notch (WSN) i.e distance between sterno-clavicular joints and width of sternum at level of 4th rib (WS4) was measured. The sternum was then processed by boiling in a solution containing sodium chloride and detergent for 15 minutes or until the muscular coverings were removed. It was then cleaned and dried at room temperature. Measurements were taken again in the dry state (D). Data was analyzed using SPSS software, discriminant function analysis evaluated and student's t-test applied. P value of less than 0.05 was considered significant

## Results:

In all the 100 cases examined, it was observed that the width of suprasternal notch (WSN) and width of sternum at level of 4th rib (WS4) was larger in males as compared to female in both wet and dry state. (Table no.1) It was also observed that the p value was <0.05 for the width of supra sternal notch and the width of sternum at 4<sup>th</sup> rib which means that the null hypothesis is rejected and the values are found to be significant. (Table no. 2 & 3)

Among the two variables examined, p value for WSN (0.093), WS4 (0.140) ribs in wet sternum and WSN (0.161), WS4 (0.266) in dry sternum was >0.05 (Table no.4 & 5); thus fulfilling the assumption and requirement of discriminant function analysis.

Discriminant functional (DF) score was calculated individually for each of the parameter in SPSS software version 20 and result were shown in Table No. 6. Among them, width of sternum at 4<sup>th</sup> rib in wet state was the most predictive indicator for differentiating male and female, which have classified 69% cases correctly, followed by width of suprasternal notch in dry state (68%), width of suprasternal notch in

wet state (65%) and width of sternum at 4<sup>th</sup> rib in dry state (64%), respectively. Also, in both wet and dry state of the sternum, females were classified with a higher accuracy when the sternum were measured at suprasternal notch (WSN) as well as at the level of 4<sup>th</sup> rib (WS4), being highest for WS4 in wet state i.e. 76%.

## Discussion:

To the best of our knowledge, measurement of parameters such as WSN and WS4 has not been used much as a potential predictor for sex determination; the only study available for comparison was that done by Mukhopadhyay,<sup>3</sup> performed on wet sternums only. In our study, the mean width of suprasternal notch (WSN) in wet sternum was less ( $3.65 \pm 0.35$  cm and  $3.3 \pm 0.37$  for male and female, respectively) as compared to those obtained by him ( $5.70 \pm 0.39$  cm and  $4.79 \pm 0.30$  cm for male and female, respectively). Similarly, for measurement of WS4, the values were found to be higher in the study conducted by him. Again, the accuracy for predicting the sex by measuring width of sternum at suprasternal notch and 4<sup>th</sup> rib in present study was less (65 % and 69% respectively) as compared to the study done by Mukhopadhyay, which was 100% each for both these sites. However, in all of the studies conducted by various authors,<sup>2,3,5,6,8,9</sup> the mean width of the sternum was found to be higher in males as compared to females. (Table no. 7)

Most of these studies<sup>2,5,6,8,9</sup> conducted in the past have used width of the sternum at different points such as width of the 1<sup>st</sup> or the 3<sup>rd</sup> sternbrae, but we have instead selected the measurement of sternum at the level of suprasternal notch because of the convenience in measurement and at 4<sup>th</sup> rib, as it is almost the centre of the body of sternum. Also, in few of the studies,<sup>5,6,8</sup> the width of sternum at particular sites were not found to be useful in the determination of sex. In the previous studies<sup>2,3,5,6,8,9</sup> accuracy for predicting sex was found to be more in males while present study showed sex prediction to be more accurate in females for WSN as well as WS4 in both wet and dry state of the bone.

For width of wet sternum at the level of 4<sup>th</sup> rib, DF score was estimated by the equation,  $2.535WS4 - 10.051$ ; similarly WS4 for dry sternum, the DF score was calculated by  $2.583WS4 (DRY) - 9.591$ . Hence, sex can be estimated with an accuracy of about 69% and 64% for wet and dry sternum by placing the values of width of sternum at the level of 4th ribs

in the discriminant function analysis equation. Mukhopadhyay<sup>3</sup> had studied this particular parameter and observed that mean of WS4 in his study was found out to be  $5.3 \pm .31$  cm and  $4.4 \pm .33$  cm for males and females, respectively which has larger mean as compared to our study (Male= $4.11 \pm 0.43$  cm, Female= $3.81 \pm 0.34$  cm).

For width of suprasternal notch in wet sternum, DF score was estimated as  $DF = 2.55WSN - 10.051$ . Similarly, for WSN for dry sternum, DF score was  $DF = 2.75WSN(DRY) - 9.043$ . Thereby, sex can be estimated with accuracy of about 65% and 68% for wet and dry sternum by placing the values of width of suprasternal notch in the discriminant function analysis equation.

### Conclusion:

Based on the observations and results of the sternal measurements, it can be concluded that mean of width of suprasternal notch and width of sternum at level of 4<sup>th</sup> rib is higher among males as compared to the females. Also, female sternum can be sexed with a higher accuracy rate; when fragmentary remains of sternum are received for examination, WSN and WS4 can be a reliable indicator for sex determination in both wet and dried state of the bone especially during examination of wet sternum.

**Conflict of interest:** None

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**Figure 1**  
Measurement of Sternum at the level of 4<sup>th</sup> rib of female sternum



**Figure 2**  
Measurement of Suprasternal notch of female sternum



**Figure 3**  
Measurement of width of supra sternal notch in dry sternum



**Figure 4**  
Measurement of width of sternum at 4<sup>th</sup> rib in dry sternum



Table No.1: Width of suprasternal notch and width of sternum at 4<sup>th</sup> rib in wet and dry state

Sex		Width of Supra Sternal Notch (Dry)	Width of Sternum at 4th rib (Dry)
Male	Mean	3.4378	3.8738
	N	50	50
	Std. Deviation	.36098	.44631
	Minimum	2.86	2.96
	Maximum	4.43	4.66
	Range	1.57	1.70
Female	Mean	3.1280	3.5520
	N	50	50
	Std. Deviation	.36503	.31705
	Minimum	2.56	3.03
	Maximum	4.13	4.26
	Range	1.57	1.23
Total	Mean	3.2829	3.7129
	N	100	100
	Std. Deviation	.39330	.41773
	Minimum	2.56	2.96
	Maximum	4.43	4.66
	Range	1.87	1.70

Table no 2: Independent Samples Test for wet sternum

A= Equal variable assumed B= Equal variable not assumed	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Width of A Supra Sternal Notch B	.037	.848	4.103	98	.000	.30040	.07321	.15511	.44569
			4.103	97.837	.000	.30040	.07321	.15511	.44569
Width of A Sternum at 4th rib B	7.361	.008	3.856	98	.000	.30420	.07889	.14765	.46075
			3.856	93.614	.000	.30420	.07889	.14755	.46085

Table no.3-Independent Samples Test for dry sternum

A= Equal variable assumed B= Equal variable not assumed	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Width of A Supra Sternal Notch (dry) B	.058	.811	4.267	98	.000	.30980	.07260	.16572	.45388
			4.267	97.988	.000	.30980	.07260	.16572	.45388
Width of A Sternum at 4th rib (dry) B	12.3921	.001	4.156	98	.000	.32180	.07742	.16816	.47544
			4.156	88.417	.000	.32180	.07742	.16795	.47565

Table 4&5: Test of Normality i.e. Kolmogorov-Smirnov test with p-value for wet sternum& dry sternum respectively  
Table 4: For wet sternum

N		Width of Supra Sternal Notch (wet )	Width of Sternum at 4th rib (wet )
		100	100
Normal Parameters	Mean	3.5016	3.9645
	Std. Deviation	.39425	.42117
	Absolute	.124	.115
	Positive	.124	.115
Most Extreme Differences	Negative	-.058	-.076
Kolmogorov-Smirnov Z		1.239	1.153
Asymp. Sig. (2-tailed)		.093	.140

Table 5: For dry sternum

N		Width of Supra Sternal Notch (dry )	Width of Sternum at 4th rib (dry )
		100	100
Normal Parameters	Mean	3.2829	3.7129
	Std. Deviation	.39330	.41773
	Absolute	.112	.100
	Positive	.112	.100
Most Extreme Differences	Negative	-.052	-.086
Kolmogorov-Smirnov Z		1.123	1.003
Asymp. Sig. (2-tailed)		.161	.266

Table 6: DF scores for all four parameters of sternum  
M= male, F= Female (If DF score < 0=female and MALE= > 0).

CONDITION OF STERNUM	SITE OF MEASUREMENT	DF SCORE	% CORRECTLY CLASSIFIED
WET	WS4	2.53WS4-10.051	69%(M-62%, F-76%)
	WSN	2.55WSN-10.051	65%(M-64%, F-66%)
DRY	WS4	2.58WS4(DRY)-9.591	64%(M-60%, F-68%)
	WSN	2.75WSN(DRY) -9.043	68%(M-64%, F-72%)

Table No.7: Comparison of studies on width of sternum at various sites (WS1-Width of first sternbrae, WS3-width of third sternbrae, WS4-width of sternum at 4<sup>th</sup> rib)

Studies by various experts	Level of sternum	Male(cm)	Female(cm)	Accuracy	Region
Jit et al [5]	WS1	2.74±0.37	2.43±0.39	Not useful for sexing	Chandigarh
	WS 3	3.25±0.58	2.91±0.55		
Dahiphale et al[6]	WS1	2.11±3.89	2.44±4.13	Not useful for sexing	Maharashtra
	WS 3	3.19±0.41	2.82±4.72		
Atal et al[8]	WS1	2.58±2.01	2.193±0.164	M-71.42%, F -95.45%	Delhi
	WS 3	2.85±0.26	2.46±0.19	Not useful for sexing	
Jagmahender Singh et al. (2012)[2]	WS1	2.70±0.35	2.31±0.28	M-80%, F-68%	Chandigarh
	WS 3	3.35±0.54	2.80±0.48	M-73%, F- 69%	
Dr.PP Mukhopadhyay[3]	WS4	5.3 ± 0.31	4.4± .33	M-100%, F-100%	West Bengal
	WSN	5.70±0.39	4.79± 0.30		
SirishaPuttabanthi et.al (2012)[9]	WS 1	5.33 cm	2.77	M-89.4%, F-54.5%	Andhra Pradesh
	WS3	3.34 cm	3.06	M-96.4%, F-68.18%	
Present study	WS4(wet)	4.11± 0.43	3.81 ± .34	M-62%, F-76%	Delhi
	WS4(dry)	3.87± 0.44	3.55 ±0 .31	M-60%, F-68%	
	WSN(wet)	3.65 ± 0.35	3.3± 0.37	M-64%, F-66%	
	WSN(dry)	3.45± .36	3.1±0.36	M-64%, F-72%	

## Original Research Paper

# Estimation of Stature from the distance between two Anterior Superior Iliac Spines

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### Abstract

The use of anthropology by forensic experts for identification is increased day by day. With increasing frequency of mass disasters due to nature and man, the number of deaths are increasing, which pose a threat for identification due to mutilation. Similar situation is encountered in cases of murder, where there is destruction of identity. Such situations give rise to studies which estimate the stature from different body parts. Hence, present study was carried out to evaluate the anthropometric relationship of distance between anterior superior iliac spines (ASIS) with the stature of an individual in study population and to derive regression formulae to estimate stature from these dimensions. Total of 208 individuals were selected for study, 105 males and 103 females, from 10 to 60 years of age. Regression equation with significant correlation was derived. Eventhough other parameters of human body like foot length, arm span, hand length etc can be used for estimation of stature, interspinous distance (ISD) can also be used when only part of torso or pelvis is brought for autopsy.

**Key Words:** Stature, ISD, regression equation

### Introduction:

For medicolegal studies, examination of human skeleton has an utmost importance for the identification purpose, which is the prime component of Corpus Delicti.

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Personal identification is an integral part of the investigation and the stature estimation occupies relatively a central position in the identification necessitated by the medico-legal experts.<sup>1</sup>

Mass disasters like earthquake, cyclone, landslide, floods, high impact transportation injuries, explosions etc where disintegrated and amputated parts are found very frequently, reconstruction of living stature from skeletal remains is useful to the forensic experts.<sup>1,2</sup> Similar scenario also applies in case of murder as the mutilation of dead body is done by a criminal who wants to destroy all traces of identity and thus facilitate the disposal of the dead.<sup>3</sup>

It is an established fact that stature bears a direct relation to the length of various bones. However, intact long bones may not be present in every instance. So, establishment of alternative methodologies for personal height estimation is important. In such a situation, measurements of various remains of body like torso, pelvis or available portion of limbs provide useful data to estimate the stature. With this view, the present study was carried out to evaluate the anthropometric relationship of distance between anterior superior iliac spines with the stature of an individual in study population and to derive regression formulae to estimate stature from these dimensions.



## Materials and Methods:

The present study was conducted in the Department of Forensic Medicine and Toxicology during the period of March, 2011 to July, 2012. This was an observational study which included total of 208 individuals, 105 males and 103 females. Age group selected for the study was 10-60 years. The individuals for the study were normal healthy volunteers from Rajkot region. Measurements were taken at a fixed time of the day (2:00 pm to 4:00 pm) to avoid errors in relation to diurnal variation. The aim and procedure of examination were explained before measurements. Cases from both urban and rural areas were included in the study. None of the individuals had any injury or deformity of the body that might have had an influence on the measurements of the pelvis or stature. History of dietary habits and any hormonal or metabolic disorder was also taken to rule out any dietary deficiencies. Stature was measured with the subjects barefoot, standing erect, the feet pointed outward at 60° angle and head oriented in the Frankfurt plane. Anterior superior iliac spine (ASIS) is an important landmark of surface anatomy which is at the anterior extremity of the iliac crest of the pelvis. Measurement of the inter-spinous distance (ISD - distance between anterior superior iliac spines) was performed using spreading caliper (Galaxy informatics, New Delhi) with the subjects in supine position. The data obtained was analyzed statistically to find out the mean and standard deviation for each of the above measurements in both the sexes using Microsoft Excel and Statistical programme for social science (SPSS) Version 17 to derive a linear regression equation and multiplication factor for stature estimation. **Figure 1.**

## Results:

The data obtained was recorded in the proforma and analyzed statistically. To assess the correlation between stature and inter-spinous distance, Pearson's correlation coefficient was calculated and its significance was tested.

Of the 208 subjects, 105 (50.5%) were male. (**Table 1**). **Table 2** shows the mean and standard deviation of ISD for respective stature. The difference between stature and ISD among males and females is evident from the table. As the stature increases above 150 cm, ISD in males is more than that of females. **Table 3** shows that the average stature and ISD for males are greater than that for female subjects.

**Diagram. 1** shows the scatter distribution of Stature v/s ISD. Maximum number of subjects were within 95% confidence interval indicating significant correlation between the parameters ( $r^2=0.818$ ).

Pearson's correlation coefficient,  $r^2$  values, standard error of estimate and regression formula for either sex, male and female are depicted in **Table 4**. Pearson's correlation coefficient for stature with all the parameters was obtained and it was found significant ( $p < 0.05$ ). The correlation coefficient indicates the strength of association and it varies from -1 (negative correlation) to +1 (positive correlation). The relationship of ISD with stature is more significant in male than female which is also implied by  $r^2$  values. The mean multiplication factor for estimation stature for either sex as well as male and female separately is given in **Table 5**. It is calculated as the ratio of the stature to inter-spinous distance.

Multiplication factor = Actual Stature / ISD Results shown in **Table 6** indicate more accuracy of estimation of stature from regression equation against multiplication factor having more deviation from average stature.

## Discussion:

We selected more subjects for the study than that conducted by Nachiket, et al,<sup>5</sup> which was conducted in on South Indians. The age in present study varied from 11 to 60 years with maximum number of subjects in the age group of 21-30 years (26.4%). Present study included 50.5% males. However, the error of estimation in study of Nachiket, et al is less than the present study. The regional differences in stature and ISD are evident from values given in **Table 7** pointing towards regional differences by increased stature and ISD.

According to **Table 8**, the study conducted by Suskewicz, et al<sup>6</sup> for estimation of weight from inter-spinous distance and stature showed mean stature and inter-spinous distance to be more than the present study but mean age is almost similar indicating that this difference might be due to difference in race, nutrition, genetic and environmental factors etc. However, proportion of difference between stature and inter-spinous distance is similar, which indicates correlation between both the parameters.

This type of study is important for identification when fragmentary and dismembered human remains are recovered from crime scene. In modern times, the incidence of transportation deaths and mass disasters resulting from natural calamities are substantially increased. Criminals

resort to mutilation of body to prevent identification causing delay in judicial procedure. These incidences promote such type of studies. Whenever isolated pelvis is recovered, it can give reliable data for identification as sex can be accurately determined from it which will narrow down the application of regression equation. It is obvious that there are no universally applicable formulae for stature and ISD as the relationship between them is largely variable in relation to age, sex, race, nutritional, genetic and environmental factors of an individual. Thus, the need for race and region, age and sex specific stature estimation formulae is proved beyond doubt.

- Regression equation derived for **either sex**  
 $\text{Stature} = 42.560 + 5.527 \times \text{ISD}$ , with Standard Error  $\rightarrow 4.966$  cm and strength of association  $\rightarrow 0.818$ .
- Regression equation derived for **male sex**  
 $\text{Stature} = 51.116 + (5.182 \times \text{ISD})$ , with Standard Error  $\rightarrow 4.535$  cm and strength of association  $\rightarrow 0.838$ .
- Regression equation derived for **female sex**  
 $\text{Stature} = 42.926 + (5.458 \times \text{ISD})$ , with Standard Error  $\rightarrow 5.193$  cm and strength of association  $\rightarrow 0.707$ .
- Mean multiplication factor for estimation of stature from inter-spinous distance for either sex, male and female is 7.549, 7.529 and 7.570 respectively.

**Conflict of interest:** None

**Financial Assistance:** None

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**Table 1: Sex Wise Distribution of Subjects**

Sex	No. Of Subjects
Male	105 (50.49%)
Female	103(49.51%)
Total	208 (100%)

**Table 2: Stature and Sex-wise Mean and Standard Deviation (Sd) Of Isd (° → Both male and female)**

Stature (Cm)	ISD (Cm)		
	Either Sex*	Male	Female
120-130	15.91 ± 0.24	15.90±0.26	15.92±0.26
130-140	16.20 ± 0.43	16.10±0.45	16.40±0.42
140-150	20.05 ± 0.74	19.63±0.71	20.11±0.74
150-160	20.52 ± 0.82	21.00±0.32	20.46±0.85
160-170	21.93 ± 0.95	22.16±0.98	21.44±0.69
170-180	23.25 ± 0.82	23.28±3.68	22.93±0.21

**Table 3: Descriptive Statistics of the Study Sample According to Sex :-**

Parameter	Either Sex	Male	Female
	MEAN ± SD	MEAN ± SD	MEAN ± SD
Age (Years)	33.04 ± 14.37	32.84 ± 14.02	33.25 ± 14.78
Stature (Cm)	159.88 ± 11.60	165.01 ± 11.21	154.65 ± 9.50
ISD (Cm)	21.23 ± 1.90	21.98 ± 1.98	20.49 ± 1.47

**Table 4: Level of Significance of Different Measurements of ISD and Linear Regression Formula For Estimation of Stature**

Parameter	N	PCC	R <sup>2</sup>	SEE	Regression Formula
Either Sex	208	0.904	0.818	4.966	$S = 42.560 + 5.527 \times \text{ISD}$
Male	105	0.915	0.838	4.535	$S = 51.116 + 5.182 \times \text{ISD}$
Female	103	0.841	0.707	5.193	$S = 42.926 + 5.458 \times \text{ISD}$

N – Number of cases PCC – Pearson's correlation coefficient SEE = Standard Error of Estimate

**Table 5: Mean Multiplication Factor for Estimating Stature From ISD**

Parameter	Mean Multiplication Factor		
	For Either Sex	Male	Female
ISD	7.549	7.529	7.570

Table 6: Estimated Stature From Regression Equation and Multiplication Factor

Parameter	Either Sex	Male	Female
	MEAN $\pm$ SD	MEAN $\pm$ SD	MEAN $\pm$ SD
STATURE (Cm)	159.88 $\pm$ 11.60	165.01 $\pm$ 11.21	154.65 $\pm$ 9.50
Reg. Eq (Cm)	159.89 $\pm$ 10.49	165.10 $\pm$ 10.26	154.61 $\pm$ 7.98
MF (Cm)	160.27 $\pm$ 14.33	165.50 $\pm$ 14.91	154.90 $\pm$ 11.07

REG. EQ  $\rightarrow$  Estimated stature from regression equation MF  $\rightarrow$  Estimated stature form multiplication factor

Table 7: Comparison Between Mean Stature and ISD

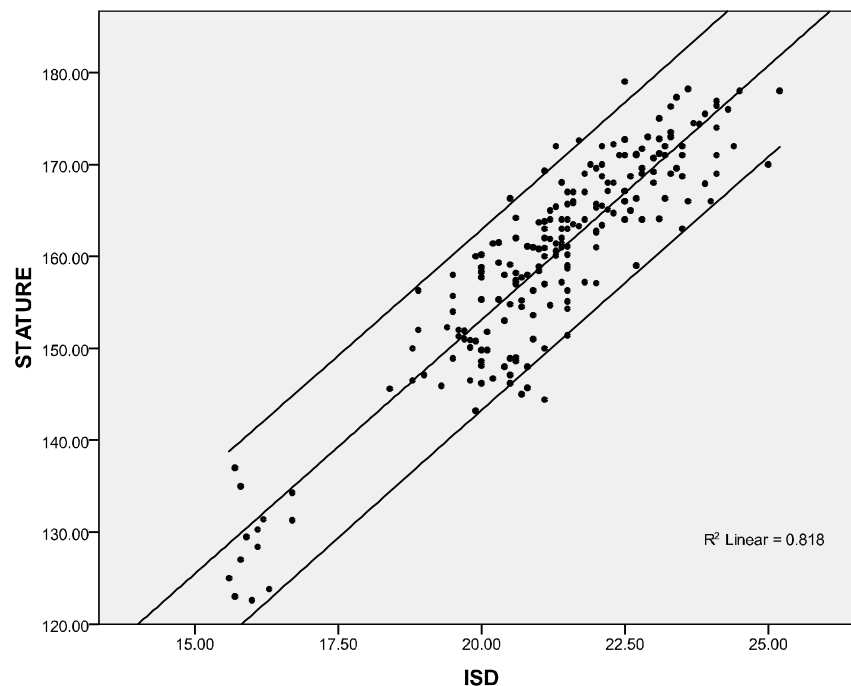
Parameter	NACHIKET et al <sup>44</sup>			Present Study		
	Either Sex (MEAN $\pm$ SD)	Male (MEAN $\pm$ SD)	Female (MEAN $\pm$ SD)	Either Sex (MEAN $\pm$ SD)	Male (MEAN $\pm$ SD)	Female (MEAN $\pm$ SD)
STATURE(cm)	164.76 $\pm$ 10.03	172.82 $\pm$ 5.65	156.70 $\pm$ 6.24	159.88 $\pm$ 11.60	165.01 $\pm$ 11.21	154.65 $\pm$ 9.50
ISD (cm)	21.84 $\pm$ 1.67	22.26 $\pm$ 1.24	21.42 $\pm$ 1.93	21.23 $\pm$ 1.90	21.98 $\pm$ 1.98	20.49 $\pm$ 1.47

TABLE 8: Comparison Between Mean Stature and ISD

PARAMETER	SUSKEWICZ et al <sup>65</sup> (n=85)			PRESENT STUDY (n=208)		
	MIN	MAX	MEAN $\pm$ SD	MIN	MAX	MEAN $\pm$ SD
AGE (years)	20.00	80.00	32.22 $\pm$ 13.51	11.00	60.00	33.04 $\pm$ 14.37
STATURE (cm)	147.32	193.04	172.72 $\pm$ 9.16	122.60	179.00	159.88 $\pm$ 11.60
ISD (cm)	20.00	30.00	24.88 $\pm$ 1.99	15.60	25.20	21.23 $\pm$ 1.90

n  $\rightarrow$  Number of cases

Diagram. 1 Shows scatter distribution of Stature v/s ISD Maximum number of subjects are within 95% confidence interval indicating significant correlation between the two parameters ( $r^2=0.818$ ).



## Case Report

# Sudden Death in Young- A Case of Hypertrophic Cardiomyopathy

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### Abstract

A 16 year old healthy young student suddenly fell down while playing football on school ground at about 4 pm and was suddenly rushed to hospital where he was declared 'brought in dead' by doctors. The case was brought to mortuary of Gandhi Medical College, Bhopal, and next day for medicolegal autopsy where diagnosis of Hypertrophic cardiomyopathy (HCM) was made. HCM is an inheritable autosomal dominant disease of heart muscle, characterized by a small left ventricular cavity and marked hypertrophy of myocardium with myofibril disarray. It has traditionally been considered a major cause of sudden death in physically active young person. The various aspects of the case are discussed in detail in this paper.

**Key Words:** Hypertrophic cardiomyopathy, Sudden death.

### Introduction:

Hypertrophic cardiomyopathy (HCM) is an inheritable autosomal dominant disease of the heart muscle, characterized by a small left ventricular cavity and marked hypertrophy of myocardium with myofibril disarray.<sup>1</sup>

HCM represents one of the less common forms of primary cardiomyopathies. The condition is being increasingly recognized in India and yet, there is little data available regarding the incidence and the rates of mortality. Recent studies indicate that the disease is familial in 50% to 60% of cases and sporadic in the remainder. Hypertrophic cardiomyopathy (HCM) is a primary myocardial disease characterized by hypercontracting, hypertrophic, non-dilated ventricle and this inappropriate myocardial hypertrophy is without

any obvious cause such as hypertension or aortic stenosis.

It was studied systematically in late 1950s, though first time described nearly a century ago.<sup>2</sup> Most distinctive morphologic features are disproportionate hypertrophy of ventricular septum, disarray of myofibril in ventricular septum and left ventricular free wall, reduced volume of left ventricular cavity and dilated atria, mitral valve thickening and abnormal intramural coronary arteries.<sup>3</sup>

### Case Report:

A 16 year old healthy young student suddenly fell down while playing football on school ground at about 4 pm and was suddenly rushed to hospital where he declared dead by doctors. The case was brought to mortuary of Gandhi Medical College, Bhopal by next day for medico legal autopsy.

As per history given by relatives, the boy was absolutely normal since birth and there was no any history of cardiac or related disease or any specific treatment for the same. Body was subjected for post-mortem examination.

### Autopsy Findings:

Body was average built. Rigor mortis was present all over body and hypostasis was present on back and fixed. No significant marks of injury were present on the body. Other findings were unremarkable.

Internal examination revealed enlarged heart, globular in appearance, weighing about 550 grams. Ventricles were hypertrophied. Thickness of the right ventricular wall was 1 cm, left was 2.3 cm and inter-ventricular septum was

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4 cm, and it was hard and gritty on cut-section (**Pic. 1**). Few pale, hard and fibrous areas were evident at places. The left ventricular cavity was small. Coronaries were patent and heart valves were normal and healthy. All other internal organs were congested. Viscera were preserved for chemical analysis and heart was sent to Pathology department for histopathology.

Toxicology screen was normal. Microscopic examination of heart revealed extensive myocyte hypertrophy with hyperchromatic big nucleus (**Pic. 2**). There was haphazard disarray of bundle of myocytes (myofiber disarray). There were interstitial and replacement fibrosis at places. All the findings were consistent with Asymmetric Hypertrophic Cardiomyopathy.

The final cause of death was given as death due to cardiac failure as a result of Hypertrophic Cardiomyopathy.

## Discussion:

The etiology of hypertrophy was unclear in the past. The basis of disease was ascribed to multiple etiologies, such as an abnormality of calcium metabolism, a neural crest disorder, or an abnormal response to catecholamine stimulation.<sup>1</sup> However, in 1989, investigators first mapped the genetic mutation for HCM to chromosome.<sup>1</sup> HCM subsequently has been shown to be a highly heterogeneous disease with a diverse pathology, pathophysiology and clinical course.<sup>1</sup>

The first anatomic description of this entity was by Teare in 1958, when he reported the pathologic findings in 8 young patients, 7 of whom had died suddenly. He found massive hypertrophy of ventricular septum with a small ventricular cavity. The gross picture was associated with microscopic evidence of myocardial disarray of individual muscle fibers.<sup>[REF?]</sup> Braunwald et al. in 1960s defined the specific disease process, in which asymmetric hypertrophy, myofibril disarray, and a dynamic subvalvular pressure gradient was documented.<sup>1</sup>

Since these initial descriptions, the disease process has come to be known by a wide variety of names. This disease has been called asymmetric septal hypertrophy (ASH), idiopathic hypertrophic subaortic stenosis, muscle subaortic stenosis, and hypertrophic obstructive cardiomyopathy. The World Health Organization has designated the term *hypertrophic cardiomyopathy* to describe this unique process of primary muscle hypertrophy, which may exist with or without a dynamic left ventricular outflow tract gradient.<sup>1</sup>

HCM is a primary disease of myocardium in which a portion of myocardium is hypertrophied without any obvious cause.<sup>4-9</sup> In HCM, sarcomere, which is a contractile element in muscles, increases in size and causes hypertrophy of heart muscles. It also disrupts electrical activity of heart muscles. Familial HCM is inherited as an autosomal dominant trait and is attributed to mutations in one of the 9 sarcomere proteins.<sup>1</sup>

The deceased was a young 16 years young. We ruled out other pathology in view of thickened myocardium at such an early age. The histopathology report was rewarding, which revealed extensive myocyte hypertrophy with hyperchromatic big nucleus. There was haphazard disarray of bundle of myocytes (myofiber disarray) with interstitial and replacement fibrosis at places. All the findings were consistent with Hypertrophic Cardiomyopathy (HCM). HCM is a disease in which a portion of myocardium is hypertrophied without any obvious cause.<sup>4-9</sup> It is leading cause of sudden death in young adult.<sup>10</sup>

Recent studies have suggested that this disease is more common now a day than previous. HCM is frequently asymptomatic until sudden cardiac death, and for this reasons some suggest routine screening of certain high risk population.<sup>11</sup> The prevalence of HCM is about 0.2 to 0.5% of general population.

HCM can be detected with echocardiogram with 80% accuracy, which should be preceded with an ECG to test for heart abnormalities. Cardiac MRI is considered the gold standard for determining physical properties of left ventricular wall. Left ventricular hypertrophy may be absent in children less than 13 years of age. This undermines the result of pre-adolescent echocardiogram.<sup>12</sup>

## Conclusion

HCM is a genetic disease (autosomal dominant), almost asymptomatic till young adult age. It runs in families. By ECG, 2D-echo, MRI of heart, exercise test and clinical examination may detect the condition. The other family members should be screened for the disease. High risk groups like unexplained sudden death in families and athletes should be routinely screened and followed up for better life.

Sudden death in apparently healthy young adult raises many questions of forensic importance. High index of suspicion of HCM, meticulous autopsy and histopathological examination may help to determine cause of death.

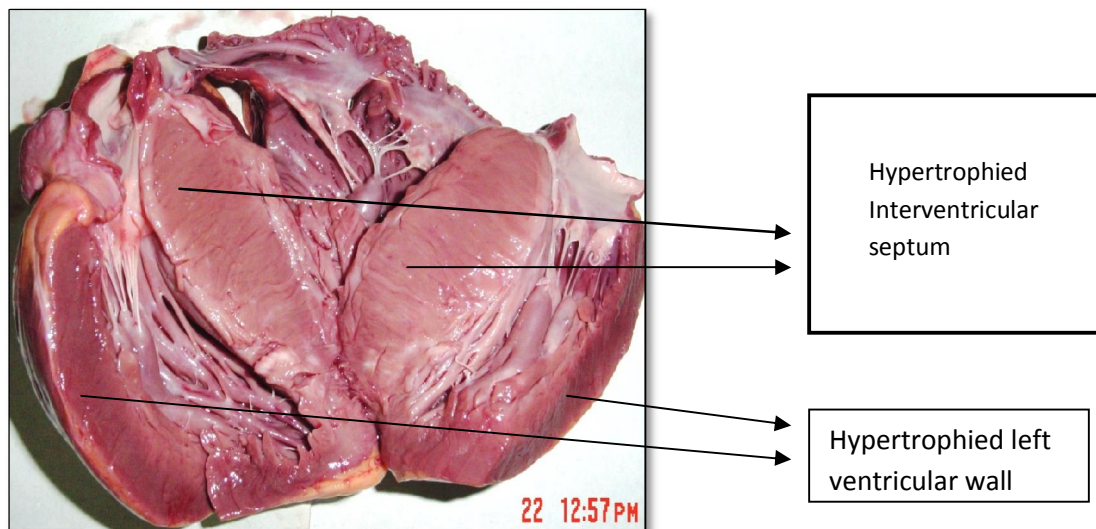
**Conflict of interest:** None

**Financial Assistance:** None

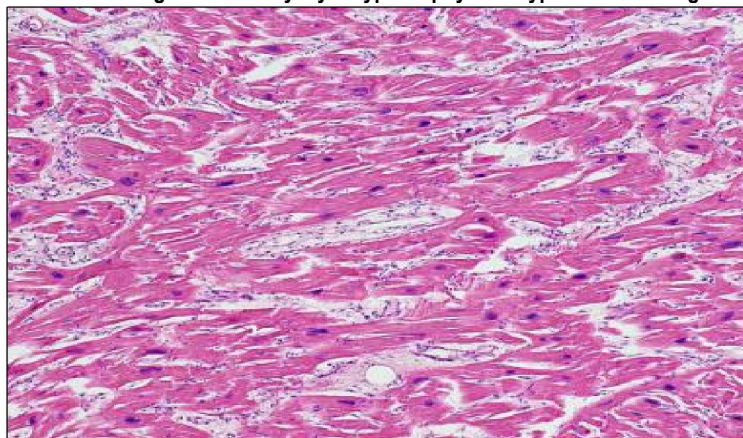
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**Picture 1. Showing hypertrophied IVS and left ventricular wall.**



**Picture 2. Showing extensive myocyte hypertrophy with hyperchromatic big nucleus**



## Case Report

# Jatropha Curcas Poisoning: A Case Report from KEM Hospital, Mumbai

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### Abstract

A 4 year old male child was brought to the Emergency department in our medical college, with complaints of repeated vomiting and diarrhoea. On further questioning, the child revealed history of consumption of some greenish brown seeds. It created great panic amongst the relatives of child and paediatricians were also not sure about the line of management in this case, as identity of culprit seeds was not established. Consultation of Department of Forensic Medicine and Toxicology was sought to identify the seeds and advice further management by Department of Paediatrics. On examination, these seeds were identified to be of *Jatropha curcas* and patient was advised symptomatic management. Present case is a good example of multidisciplinary approach of a poisoning condition and hence discussed in detail.

**Key Words:** *Jatropha curcas*, poisoning, forensic toxicology

### Introduction:

*Jatropha curcas*, commonly known as Ratanjyot, Chandrajyot or Jungli erandi, is a small tree about 5 metres tall belonging to family Euphorbiaceae. The leaves are lobed, green and smooth. The flowers are small, yellow and are mostly hidden by the leaves. The stem is thick, green, glabrous becoming woody at the base. The fruit is ovoid, oblong and contains 3 lobes with each lobe containing a seed. The seeds become mature, when the capsule changes from green to yellow. *Jatropha curcas* seeds resemble castor seed in shape and are black in colour. With recent increase in cultivation of *Jatropha curcas* for its use as bio-fuel, there is possibility of increase in accidental poisoning, especially in children<sup>1</sup>. Therefore, it is essential for the medical fraternity to gather epidemiological data, signs, symptoms and treatment of *Jatropha curcas* poisoning. Considering the facts, we are reporting a case of *Jatropha curcas* poisoning, as this case is a good example of multidisciplinary approach of a poisoning condition.

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### Case Report:

A 4 year old male child was brought in emergency department, Seth G.S. Medical College and KEM Hospital, Mumbai, on 12/01/2016 at 2.00 A.M. with alleged history of 10 to 15 episodes of vomiting and 10 to 15 episodes of loose motions. Vomiting was non-bilious, non-projectile. Diarrhoea was not associated with blood or mucous in the stool. He did not have any history of convulsions, altered sensorium or difficulty in breathing. On general examination, the child was conscious, afebrile, with heart rate 142 of beats per minute, respiratory rate 36 cycles per minute, blood pressure 96/60 mm Hg. No abnormality was detected on cardiovascular, respiratory or abdominal examination. Pupils were normal, reacting to light equally, bilaterally. Tone and power in all muscles and reflexes were normal. On further questioning, child revealed history of consumption of 2 seeds of fruit of a plant in nearby vicinity. One fruit and 3 seeds were found in the pocket of child. Consultation of Department of Forensic Medicine and Toxicology was sought for identification of fruit and seeds. On examination, these seeds were identified to be of *Jatropha curcas* and the child was advised symptomatic management. He was given intravenous fluids to correct fluid deficit and injection Pantop to control vomiting. He responded to treatment well and recovered within 6 hours of admission. He was kept under observation for 24 hours after which he was discharged, as the results of liver function tests, kidney function tests and electrolytes measurements were all within normal range.



## Discussion:

*Jatropha curcas* is a common plant found all over the world. Today, it is cultivated in almost all tropical and subtropical countries as protection hedges around gardens and fields, since it is not browsed by cattle.<sup>1</sup> The Central Salt and Marine Chemicals Research Institute (CSMCRI), a Government-owned industrial research institute, is aiming to cultivate *Jatropha* plant for the production of biodiesel.<sup>2</sup> The black seed of *Jatropha curcas* is known as physic nut or purging nut since it is a strong purgative. The seeds possess a toxalbumin named curcin. It contains pale acrid oil and has the active principle curcanoleic acid. Apart from being used as laxative, the oil is also applied to painful joints and is said to have beneficial effects. However, the crude oil when applied externally, causes irritation and when ingested causes severe diarrhoea.<sup>3</sup> Accidental poisoning in children due to consumption of seeds is common because of attractive looks and pleasant taste of seeds.<sup>1</sup>

Ingestion of seeds results in burning sensation in throat, excessive thirst, vomiting, diarrhoea and pain in abdomen. Occasionally, there may be dehydration, muscular twitching, deafness, impairment of sight and loss of memory.<sup>4</sup> Kosam A and Nahrel R<sup>1</sup> in their 10 years retrospective study over 169 children of acute *Jatropha* poisoning found that vomiting was the most common symptom present in all children, followed by abdominal pain (58%), weakness (21%), and dehydration (13%). Diarrhoea was present only in 11% children. Hypovolaemic shock was documented in 6 children with acute *Jatropha* poisoning. Kulkarni et al<sup>5</sup> encountered mass casualty of 20 children of acute *Jatropha* poisoning. They observed that vomiting was the predominant symptom (95% of cases), followed by diarrhoea (50%) headache (40%) and fever (40%). Abdominal pain was dominant in 25% and 5% of cases were asymptomatic. In a study of five cases of acute *Jatropha* poisoning, Viral Shah and Jayesh Sanmukhani<sup>6</sup> observed vomiting as the main presenting symptom followed by diarrhoea and colicky abdominal pain. These findings are consistent with findings in our case as the main presenting symptoms were vomiting and diarrhoea. Kosam A<sup>1</sup> and Kulkarni et al<sup>5</sup> observed that the time interval between consumption of seeds and appearance of symptoms varied between 30 minutes to 2 hours. Viral Shah and Jayesh Sanmukhani<sup>6</sup> found that all patients had colicky abdominal pain and vomiting within 15-20 minutes of eating the seeds. In our case, symptoms developed after 20 minutes of consumption of two seeds. In

the study done by Kulkarni et al<sup>5</sup>, all children were treated symptomatically with intravenous fluids and antiemetics. Within 6 hours, all of them recovered. All children with acute *Jatropha* poisoning required IV fluids, IV anti emetics and ORS in study performed by Kosam A. Gastric lavage was performed in only 39% of cases.<sup>1</sup>

All patients in a study done by Viral Shah & Jayesh Sanmukhani<sup>6</sup> were treated symptomatically with rehydration salts and intravenous fluids and recovery was quick. In our case also, the child recovered only by antiemetics and intravenous fluids within 6 hours of admission. He was kept under observation for 24 hours and then discharged. According to Kulkarni et al,<sup>5</sup> toxic dose in acute *Jatropha* poisoning is not known. In some instances, consumption of as few as 3 seeds has produced toxic symptoms; while in others, as many as 50 seeds produced relatively mild symptoms. Minimum number of seeds producing clinical manifestations of acute *Jatropha* poisoning was 1-2 seeds as per Kosam A.<sup>1</sup> Ingestion of only one to two seeds causes toxic symptoms of short duration without any lethal complications according to Viral Shah.<sup>6</sup> Four seeds act as violent cathartic.<sup>4</sup> In the case discussed above, only 2 seeds have produced severe symptoms. Although *Jatropha curcas* ingestion caused severe gastrointestinal symptoms, it was not associated with any mortality. Recovery was uneventful for all cases.<sup>1,5,6</sup>

## Conclusion:

Multidisciplinary approach should be followed in treatment of poisoning cases for effective management. Cases of *Jatropha* poisoning are increasing since the seeds are good to taste, the plants are available ubiquitously and its cultivation as a source of bio-fuel is on the rise. Though most children who have ingested *Jatropha* seeds developed only gastrointestinal symptoms but life threatening hypovolaemic shock can occur in some children. There is a need to create awareness among the medical professionals as well as lay public about the *Jatropha* poisoning so as to minimize the accidental paediatric poisoning emergencies.

**Conflict of interest:** None declared.

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**Photograph 1: Stem of Jatropha curcas bearing unripe (green) and ripe (yellow) fruits.**



**Photograph 2: Transverse section through fruit of Jatropha curcas having 3 lobes with each lobe containing one seed.**



**Photograph 3: Dried seeds (black) and fresh seeds (greenish) of Jatropha curcas**



## Case Report

# Death due to an iatrogenic injury to vital organ at the outset of operation: A case of Medical Negligence

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### Abstract

Medical negligence is a broad term which came to light due to development in Forensic Medicine; it has now become the duty of the Forensic Pathologist to explore and maintain the transparency between the doctors, patients and the law, in order to bring a high degree of standard in the ethical aspects of medical practice. In the present case, a patient who is alleged to have been diagnosed with gall bladder stone, was posted for laparoscopic cholecystectomy. She was given general anaesthesia and operation started, but soon after she developed bradycardia and collapsed on the OT table. She could not be revived and died. Later on, her body was brought to our hospital for post-mortem examination. It was found that the cause of death was haemorrhagic shock due to haemoperitoneum as a result of laparoscopic puncture of left lobe of liver. All events and history regarding case were given by the autopsy surgeon to police. Deceased's relatives were completely in dark about what exactly had happened. Moreover, they were told by the police not to get the post-mortem examination done as according to the surgeon told them that she died before starting of the surgery.

Importance of meticulous autopsy by a forensic expert is indispensable in such cases. It was only through postmortem examination that the exact cause of death could be confirmed and medical negligence established. In this way only, justice could be conferred to patient's relatives. Could doctrine of *res ipsa loquitur* be applied to operating doctor?

**Key Words:** Medical Negligence, *Res ipsa loquitur*, Liver puncture, Haemoperitoneum, Haemorrhagic shock, Death

### Introduction:

The term medical negligence and medical litigation are nowadays coming in print and electronic media and making highlights in the news. Instances of medical negligence are increasing in day to day medical practice, despite stringent laws. In spite of public awareness and increased standard of medical care and skill, it is growing in India. Hospitals and their management are increasingly facing complaints regarding the facilities, standards of professional competence and appropriateness of their therapeutic and diagnostic methods.

Sometimes it may occur inadvertently by doctors, but it suggests casual approach and professional incompetence on the part of doctor. This acts result in vital damage to the patient, including loss of life.

Medical negligence is defined as absence of reasonable care and skill, or wilful negligence of a medical practitioner in the treatment of a patient, which causes bodily injury or death of the patient.<sup>1</sup> The present case is of gross medical negligence in the form of laparoscopic liver puncture that occurred at the start of the surgery, which resulted in death of the patient.

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### Case Summary:

As per case record, a 61 year old female patient came with complaints of high grade fever and vomiting; so treating doctor advised her admission. Patient was a known c/o hypertension and diabetes mellitus. During her stay in the hospital, all investigations were done and she was diagnosed with gall bladder stone i.e. cholecystitis. She was conservatively managed for four days till the commencement of surgery. On 5th day, she was posted for laparoscopic cholecystectomy under general anaesthesia.

On the day of the surgery, at 12:25 pm, patient was induced, at 12:35pm after induction, vitals were normal. At 12:45pm, within 2-3 minutes of starting CO<sub>2</sub> insufflation, she developed bradycardia - HR being 30/min & central pulse absent. Chest compression was started according to ACLS guidelines. Inj. Sodabicarb 100cc IV, Inj. Adrenaline 1 amp every 3 minutes, given. At 1pm, ECG showing atrial fibrillation with HR 81/ min, BP 130/60 mmHg and central pulsation present. At 1:20pm same resuscitation procedure continued with HR 78/ min, BP 80 systolic. At 1:30pm, HR was 78/min, regular, SPO<sub>2</sub> untraceable, BP was not recordable manually. At 1:40pm, she was shifted to ICU. At 2pm, she went in asystole, 36/min after IV atropine and adrenaline. At 2:20pm pt. went in ventricular tachycardia, shock given. At 2:30pm once again pt. went in asystole. At 2:40pm pt. continuously in asystole and could not be revived and was declared dead.

### Autopsy Findings:

#### External Examination:

- Surgically induced laparoscopic puncture wound of size 0.6cm x 0.2cm on epigastric region, cavity deep. On dissections margins clear cut, blood infiltration noted around margins, dark red in colour.

#### Internal Examination:

- On opening the abdomen, about two litres of fluid and clotted blood was present in the peritoneal cavity, suggestive of haemoperitoneum. Evidence of umbilical hernia was noted.
- In order to search for source of bleeding, the puncture mark corresponding to external injury of epigastric region was explored. Puncture mark is in the form of laceration of size 0.5cm x 0.3cm was appreciated over anterior surface of left lobe of liver. It was through and through, cutting the whole thickness of left lobe of liver, measuring 4cm in length and dark red in colour. Tract of the wound was directed from anterior to posterior. Tract was confirmed by probing. Liver was enlarged, friable and adherent to diaphragm. On cut section, it was nutmeg in appearance. Gall bladder showed multiple stones of varying in size, wall thickened.
- Lungs were severely oedematous and pale in colour. Faint pink coloured froth was seen in the trachea.
- Heart was of normal size, petechial haemorrhages were noted on surfaces of ventricles. Spleen and kidneys were intact,

but were pale on cut section. Brain was oedematous..

Cause of death was opined as: %Evidence of peritoneal haemorrhage due to laparoscopic puncture of liver.+

### Discussion:

In present case, the patient was posted for laparoscopic cholecystectomy with medical fitness. At the commencement of the surgery, she developed bradycardia and both the surgeon and anaesthesiologist could not recognise the exact cause. Though surgeon documented that, immediately after CO<sub>2</sub> insufflation, patient developed bradycardia and only an attempt to remove CO<sub>2</sub> gas from the already created pneumoperitoneum, the injury to liver might have occurred as emergency situation was developed and it was part of emergency treatment.

But the real fact regarding the liver injury was not justified. When and how did it occur? Whether the surgeon showed gross professional incompetence in this case? Why did the surgeon not tell the real facts to the patient's relatives? Why were the relatives insisting that police not get autopsy conducted? Moreover police also did not mention the external laparoscopic puncture wound over epigastric region in inquest when it was easily appreciated. It was only mentioned in inquest after we directed them to do so. Whether doctrine of *res ipsa loquitur* would be applied against surgeon?

The insertion of the pneumoperitoneum needle and the first trocar is considered by many to be most dangerous step in Laparoscopic Cholecystectomy, as it is essentially a blind step of the operation. As this initial step is common to all laparoscopic operations, it has been reviewed extensively by various authors; and as mentioned earlier, the majority of bleeding complications occur in this phase of the operation.<sup>2</sup> The placement of the epigastric trocar through the falciform ligament fixing the liver to the abdominal wall, facilitated the injury.<sup>3</sup> Blood coming out through the Veress needle is a sure indication of puncture of a major vessel, and time must not be lost in converting to a formal laparotomy to assess the nature of injury and salvage the patient.<sup>4</sup>

Though it had happened unknowingly by surgeon, why could he have not anticipated the consequences so that he could have saved the patient's life. In this way, it has been observed that surgeon tried to conceal the condition and misled the patient relatives in that context.

Surgeon's gross professional incompetence is appreciable in this case.

### Conclusion:

It is clear that the treating doctor had committed medical negligence. Medical negligence is bound to happen when doctors fail to exercise reasonable care and skill in the treatment and complications. Incidence of negligence can be avoided by following standard medical protocols. Though the doctors are well protected by laws and Supreme Court guidelines, they should not take advantage of this and they should admit their mistakes and execute duties properly.

**Fund resources:** No funding.

**Conflicts of interest:** None declared

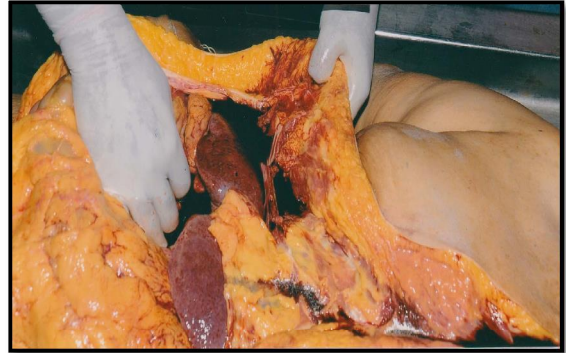
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**Fig 1: - Surgically induced laparoscopic puncture wound over epigastric region.**



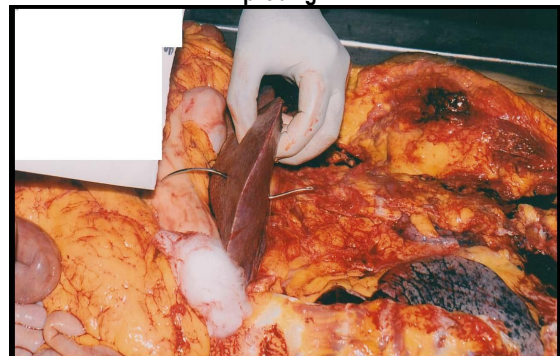
**Fig 2:- Blood fluid and clotted blood around liver and in peritoneal cavity s/o Haemoperitoneum**



**Fig 3: - Laceration over anterior surface of left lobe of liver.**



**Fig 4:- Wound tract in left lobe of liver confirmed with probing.**



### Corrigendum

As per the first author, the List of Authors for the Article: "**Forensic Anthropological Examination of Lip-Print Pattern Types among Northwest Indians Subjects: A Pilot Study**", published in the 38(4):449-454 of the Journal is amended as : -

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## Case Report

# Death Due to a Rare Complication of USG-Guided Needle Aspiration of Liver Abscess: A Case Report

<sup>1</sup>Shashank Pooniya, <sup>2</sup>Abhishek Yadav, <sup>3</sup>Chittaranjan Behera, <sup>4</sup>Sudhir Kumar Gupta

### Abstract

Liver abscesses (LA) are common in tropical countries, having significant morbidity or mortality. The image-guided percutaneous techniques play a very important role in the management of liver abscesses and are considered to reduce mortality rates in liver abscess. Percutaneous Needle Aspiration (PNA) is the least invasive, inexpensive procedure and much safer as compared to the other surgical methods. We present an autopsy case of a patient of amoebic liver abscess who died of hemorrhagic shock because of bleeding from rupture of liver abscess during PNA. The authors intend to increase the awareness of treating clinicians about this rare and unforeseen complication of a seemingly less risky procedure of PNA for the betterment of patient care.

**Key Words:** Percutaneous Needle Aspiration, Amoebic Liver Abscess, Hemorrhage, Shock.

### Introduction:

Liver abscesses (LA) are common in tropical countries with significant morbidity and mortality.<sup>1</sup> They are mainly of two types: Pyogenic (bacterial origin) and Amoebic (caused by *Entamoeba histolytica*).<sup>2-4</sup> Fungal and mycobacterial abscesses are also increasing due to increase in patients with acquired immunodeficiency syndrome (AIDS) and other immunosuppressive diseases.<sup>2</sup> The treatment of hepatic LA is both, conservative with antibiotics and with surgical techniques like needle aspiration, catheter drainage and laparotomy drainage.<sup>2-4</sup> The Image-guided percutaneous techniques play a very important part in the management of hepatic abscesses and are considered to reduce mortality rates in liver abscesses.<sup>2</sup>

Percutaneous Needle aspiration (PNA) is the least invasive, inexpensive procedure and much safer as compared to the other surgical methods.<sup>3,5-7</sup> Discomfort and secondary infections are the complications which are encountered during the procedure.<sup>3</sup> The treating clinician should be aware of all the complications associated with percutaneous invasive procedures. We present an autopsy case of a patient of amoebic liver abscess who died due to the complications of percutaneous needle aspiration procedure.

### Case History:

A 26 year old male was admitted at the Emergency Department of a tertiary care centre with complaints of fever, headache, vomiting, weakness, swelling of lower limbs, right upper quadrant pain & distension of abdomen for 15 days. He was a chronic alcoholic and smoker. The vital signs and systemic examination on arriving at the Emergency were in normal range. Further clinical examination revealed right hypochondrial tenderness, for which ultrasonogram (USG) abdomen was advised. All other systems appeared to be normal in clinical examination. USG abdomen revealed hepatomegaly and liver abscess. On USG, two cavities of volume 247 cc and 94 cc were seen present in V<sup>th</sup> and VII<sup>th</sup> segment of liver respectively.

Laboratory investigations revealed anaemia, neutrophilia and reduced platelet count. SGOT to SGPT ratio was increased to 1.7. Alkaline Phosphatase levels were

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increased. Renal function tests, serum protein and bilirubin were in normal range. Treatment was started with I.V. metronidazole, cefoperazone, ranitidine and fluids. USG guided aspiration of liver abscess was planned and was performed under aseptic precautions on the third day of admission. The vitals were stable before the procedure. Reddish brown color anchovy sauce pus of thick consistency was aspirated. After the procedure, the patient was put on conservative management but his condition started deteriorating within 3 hours. He was shifted to ICU where he succumbed within 5 hrs of the procedure. Treating doctor gave cause of death as alcoholic hepatitis with amoebic liver abscess. But the relatives complained to the police with allegation of medical negligence. Police registered the complaint and the body was brought for autopsy as a medico-legal case.

### Autopsy Findings:

Deceased was well built and the body orifices were normal. There were three intravenous injection marks over right cubital fossa, dorsum of right hand and dorsum of left hand. There were three needle prick marks over right lateral wall of chest, corresponding to 7<sup>th</sup> intercostal space. Exploration of these needle prick marks showed hematoma along the tracks. Tracks were leading to liver, passing through skin, subcutaneous tissues, intercostal muscles and right dome of diaphragm. On exploring the chest cavity, about two liter of blood clot was found adhering to inner surface of chest wall, corresponding to the needle prick tracks (**Image-1,2**). About 500 ml of blood mixed fluid was also present in chest cavity. On gross examination of liver, two fluctuating swellings containing pus were present in the right lobe of liver (**Image-3**). Another open cavity with pus was present in right lobe of liver suggesting the rupture of liver abscess thus explained the source of bleeding in the chest and abdomen. (**Image-4**). Peritoneal cavity exploration revealed about 500 ml of reddish brown color pus like material (**Image-5**). Liver was enlarged with a weight of 1420 gm. Other solid organs like brain, heart, spleen, lungs and kidneys were pale on gross examination. Walls of intestine were also pale. Spleen was enlarged with a weight of 420 grams. Stomach was empty and was having normal healthy mucosa. Final opinion of the cause of death was given as %Shock due to hemorrhage and ruptured liver abscess.+

### Discussion:

The patient presented to the hospital with characteristic signs and symptoms of liver

abscess such as fever, headache, vomiting, weakness, hepatomegaly, right upper quadrant pain & tenderness and abdominal distension.<sup>8,9</sup> The USG scan further confirmed the diagnosis and reddish brown anchovy sauce like thick material was aspirated suggesting amoebic etiology of the liver abscess. The deceased was a chronic alcoholic and alcoholism is a known risk factor of Amoebic Liver abscess.

The treatment of amoebic liver abscesses is primarily conservative and aspiration is done in conditions like a threat of rupture, large abscess, suspected pyogenic abscess, multiple lesions, left lobe abscess etc.<sup>4,8,10</sup> The deceased had two large abscesses in the right lobe of liver of sizes 94 cc and 247 cc, necessitating the need of abscess drainage.

The hospital records of the patient revealed that his vitals were stable before the USG guided aspiration of liver abscess but he collapsed within three hours of the procedure and died two hours later. The postmortem findings of the patient like an open abscess cavity (**Image-4**), blood clot in the abdominal cavity (**Image-1,2**), blood in chest cavity, pale visceral organs along with the clinical course of the patient after the procedure clearly indicate that the patient died of shock due to hemorrhage and intraperitoneal rupture of liver abscess during PNA. The liver functions of the patient were compromised with deranged prothrombin time (36.7) and INR ratio (1.23). It would have been a contributing factor towards excessive bleeding and shock. Thus, we can conclude that although PNA of liver abscess is a procedure of minimal complication, but life threatening complication like hemorrhage and shock can take place due to intraperitoneal rupture of LA. The patient should be actively monitored particularly for the complications associated with the rupture of abscess after PNA.

### Conclusion:

It is pertinent to mention that the case had allegation of Medical Negligence and the authors by reporting this case had no intention of interfering or influencing the investigation of the case. The only aim of contributing this case to the Medical Literature is to increase the awareness of treating clinicians about this unforeseen rare complication of a seemingly less risky procedure of percutaneous needle aspiration (PNA) for the betterment of patient care.

**Funding:** There was no funding involved with the study.

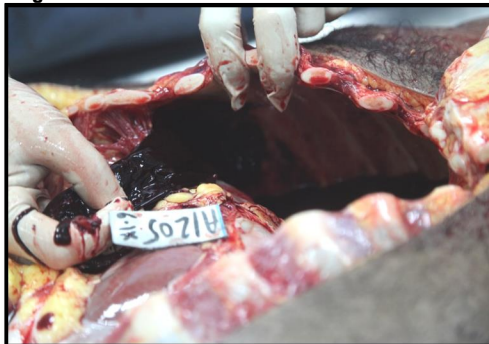


**Conflict of Interest:** There is no conflict of interests of any of the author.

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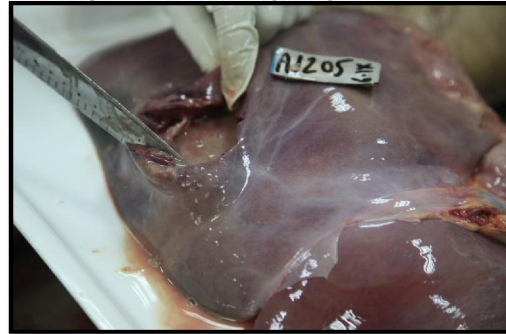
**Image2: Blood clot on the inferior surface of chest wall**



**Image3: Blood clot removed from inferior surface of chest wall on right abdomen**



**Image 3: Abscess Cavity in right lobe of Liver**



**Image- 4: Open Cavity with pus in right lobe of Liver.**



**Image 5: Reddish brown pus mixed fluid in Abdominal Cavity.**



## Case Report

# Neurological Manifestation and Methemoglobinemia in Unintentional Thinner Intoxication

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### Abstract

Thinner contains aromatic hydrocarbons, toluene, xylene, and naphtha. It is commonly used for household paints and manufacturing chemicals.

A 7 year old child came to the Emergency department of a tertiary care hospital, Mumbai, with history of accidental ingestion of some transparent liquid in a cold drink bottle. On inquiry, he had consumed the liquid under the impression of cold drink. He had neurological manifestations like tremors and bilateral ptosis with cyanosis and methemoglobinemia. He was treated with methylene blue and recovered within 48 hours of the treatment. Children are always at the risk of such type of poisoning in the household. We emphasize that labeled and attractive containers like a cold drink bottle, water bottle, glass, and household utensils should not be used for the storage of poisonous substances. Such compounds should be kept away from the reach of children and stored in locked cabinets.

**Key Words:** Thinner, toluene, ptosis, tremors, neurological, methylene blue

### Introduction:

Thinner compounds are useful in removing household paints and known to cause methemoglobinemia. They contain various concentrations of toxic aromatic hydrocarbons (toluene, xylene, benzene) and halogenated hydrocarbons (carbon tetrachloride, trichloroethylene).<sup>1</sup> Thinners are used for the production of plastics, varnish, paint, and glue. Frequent abuse or misuse of solvents leads to chronic intoxication. The common route of exposure is inhalation and ingestion. They may have neurotoxic, myotoxic, hepatotoxic, nephrotoxic, and cardiotoxic effects.<sup>2,3</sup> Toluene toxicity from glue, paint thinners, and petrol (gasoline) sniffing results in neurotoxic effects, the pathogenesis of which is still unclear.<sup>4,5</sup>

We report a case of unintentional thinner intoxication in a child, who had neurological manifestations and methemoglobinemia.

### Case report:

A 7 year old child came to the emergency department of tertiary care hospital, Mumbai, with a history of accidental ingestion of some transparent liquid in a cold drink bottle. The child had nausea and vomiting after ingestion of the liquid and was brought to the hospital within half an hour of ingestion. On examination, he had cyanosis in the nail beds of both hands and lips [Fig.1 & Fig. 2]. He had tachycardia (HR: 132 bpm), tachypnea (RR: 42/min), and blood pressure (94/60 mmHg). His mouth and shirt had aromatic smell. He was drowsy, confused and with Glasgow coma scale of 12/15 (E<sub>3</sub>V<sub>4</sub>M<sub>5</sub>) and exaggerated tendon reflexes. In both hands, tremors were present [Fig.2], and he had bilateral ptosis [Fig.1]. On inquiry, he had consumed about 4-5 teaspoons of the liquid under the impression of cold drink. His father had transferred thinner in the cold drink bottle from original labeled container for painting. He had no previous history of the neurological and psychiatric disorder. Arterial blood gas revealed mild hypoxemia and metabolic acidosis (pH: 7.33, pO<sub>2</sub>: 92 mmHg, pCO<sub>2</sub>: 34 mmHg, HCO<sub>3</sub>: 18mEq/L). Methemoglobin levels in the blood were 16 %. Methylene blue injection (20 mg) was given over

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5 minutes and repeated on hourly basis. Oxygen therapy and vitals monitoring was carried out. He recovered within 48 hours of the treatment.

### Discussion:

Toluene and xylene get distributed throughout the body following inhalation and ingestion. They are absorbed preferentially in well-perfused and lipophilic tissues such as the brain, liver, lungs, and body fat. After ingestion and inhalation, toluene accumulates in the liver and brain, respectively.<sup>6</sup> Acute thinner intoxication with ingestion of excessive amounts is relatively rare and usually fatal. Oral ingestion of thinner, 45-50 ml, is enough to cause severe complications.<sup>3</sup> The neurological manifestations may be due to toluene as it is highly lipophilic and readily crosses the blood-brain barrier. It has action on voltage-gated and ligand-gated ion channels.<sup>7</sup> Toluene inhibits nAChR function and is concentration-dependent. NMDA receptors, display a subunit-dependent sensitivity to toluene,<sup>8</sup> and it results in neurobehavioral effects.<sup>8</sup>

Usually, thinner poisoning victims present with features of methemoglobinemia, cyanosis, neurological manifestation, mild hypoxia and metabolic acidosis.<sup>7,9</sup> Rahimi<sup>10</sup> studied 37 cases of paint thinner intoxication. He observed the mean age to be  $34.35 \pm 14.15$  years and mean consumed dose in cases was  $246.70 \pm 390.72$  ml. The most frequent clinical features were nausea, vomiting, asthma, sore throat, stomach ache, drowsiness, dizziness, etc. He observed levels of alkaline phosphatase (ALP,  $233.84 \pm 122.06$ ) and lactate dehydrogenase enzymes (LDH,  $749.33 \pm 471.03$  IU/l). Adult patients showed acidosis without hypoxia in arterial blood gas. Zaidi<sup>11</sup> reported death due to unintentional inhalation of thinner. He observed late complication of multi-organ toxicity. Ghanei<sup>12</sup> reported a case of inhalational paint thinner intoxication and he observed rhabdomyolysis, renal failure, skin and nerve lesions.

In our case, we observed neurological manifestation and metabolic acidosis similar to other studies.<sup>7,9,10</sup> Thinner intoxication resulted in methemoglobinemia and neurological manifestations were prominent. It was successfully treated with methylene blue and all clinical complications subsided.

### Conclusion:

Children are always at the risk of such type of poisoning in the household. We emphasize that the labeled and attractive containers like a cold drink bottle, water bottle,

glass, and household utensil should not use for the storage of poisonous substances. Thinner should be out of the reach of children and kept in the locked cabinet. Treat thinner poisoning with prompt administration of methylene blue, oxygen therapy, and an early exchange transfusion.

**Funding:** There was no funding involved with the study.

**Conflict of Interest:** There is no conflict of interests of any of the author.

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Fig. 1: Bilateral ptosis and cyanosis in lips.

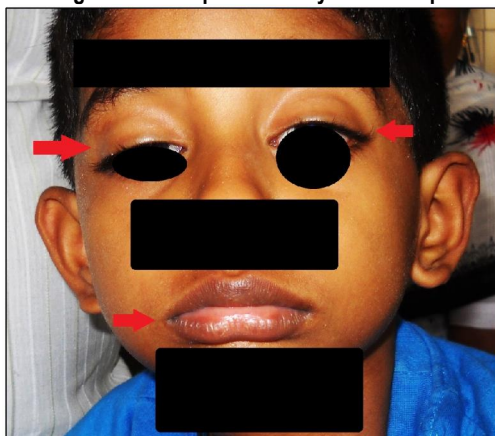


Fig. 2 Cyanosis in nail beds and demonstration of tremors of both hand



## CONTRIBUTOR'S FORM

(To be Modified as Applicable and one Signed copy Attached with the Manuscript)

### Manuscript Title

I / We certify that I / we have participated sufficiently in contributing to the intellectual content, concept and design of this work or the analysis and interpretation of the data (when applicable), as well as writing of the manuscript, to take public responsibility for it and have agreed to have my / our name listed as a contributor.

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## Case Report

# Sudden Unexpected Maternal Death from HELLP Syndrome: An Autopsy Case Report

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### Abstract

Hemolysis, Elevated liver enzymes, Low platelet count (HELLP) syndrome is a life threatening complication of pregnancy seen predominantly in pre-eclampsia cases. Only a few autopsy reports are available in literature due to the scarcity of such cases in forensic pathology as well as the current declining trend of such cases. The importance of the syndrome lies in its sudden, unexpected onset and fulminant course. The non specificity of the symptoms and absence of clinical signs of pre-eclampsia in a few cases may confuse the clinicians in making a definitive and timely diagnosis of the condition which may become the subject of suspected medical malpractice. In the medico legal context, it is important to gain sound understanding of the clinical and pathological aspects of the condition. The forensic diagnosis in cases of HELLP syndrome should be based on medical history, accepted laboratory criteria, autopsy findings and the characteristic histopathological alterations.

**Key Words:** HELLP Syndrome, Disseminated intravascular coagulation, Hematoma, Preeclampsia, Malpractice

### Introduction:

Hemolysis, elevated liver enzymes, low platelet count [HELLP] syndrome develops in a subset of pre-eclamptic/ eclamptic female patients, occurring in approximately 0.2 to 0.6 percent of pregnancies.<sup>1</sup> The syndrome represents a life threatening complication of pregnancy and carries marked fetal and maternal morbidity and mortality rate. The known maternal complications are: DIC, abruptio placentae, acute renal failure, ascites, pulmonary edema, pleural effusions, cerebral

edema, retinal detachment, laryngeal edema, subcapsular liver hematoma and acute respiratory distress syndrome [ARDS].<sup>2</sup> Liver pathology findings are the hallmark in the postmortem diagnosis of HS.<sup>3</sup> Subcapsular liver hematoma and rupture in the course of DIC has been considered to be the most serious and life challenging maternal complication in HS and is associated with maternal mortality rate of 50 to 77%.<sup>4</sup> A substantial number of clinical case reports are available regarding HS but autopsy reports are present on a fringe,<sup>4,5</sup> as most cases are either diagnosed or managed timely or death occurs as an unforeseen complication of an already diagnosed condition. The situation becomes of forensic relevance when a rapid and unexpected death occurs without any clinical suspicion.

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### Case Report:

A 28 years old female, G3P2L2A0, with 38 weeks gestational age, was brought to a local District Hospital in labor pains and leaking per vagina. On presentation, the general condition and vital signs were stable. Marked fetal bradycardia was discovered on clinical examination. Diagnosis of severe fetal intrauterine distress lead to the decision of emergency lower segment caesarian section [LSCS]. A healthy female child weighing 3.1 kg was delivered. Operative and immediate postoperative periods were uneventful. No

recent or remote history of hypertension or abnormal edema was present.

After about 6 hours of delivery, the patient developed mild epigastric pain which gradually worsened in intensity. On clinical examination, vitals remained relatively stable and a single parenteral dose antacid and antispasmodics were administered. However the abdominal pain was not relieved and the patient became irritable along with altered sensorium. This was followed by gradually progressive dyspnoea and an episode of vomiting over next few hours. Oxygen was administered and radiological and blood investigations were ordered. Chest X-ray revealed bilateral pleural effusions. Abdominal sonography revealed free fluid in abdomen and slight hypodensity in the right hepatic region labeled as subcapsular liver hematoma. Blood investigations were as follows: Hb: 7.8 gm%, TLC: 8000/mm<sup>3</sup>, DLC: Neutrophils/PMNs-70%, Lymphocytes-25%, Monocytes-2%, Eosinophils- 2% and Basophils: 1%, Absolute platelet count: 90,000, LDH - 1800 U/L, Aspartate Aminotransferase (AST)-1600 U/L, Alanine Aminotransferase (ALT)-1200 U/L. Intravenous fluids were administered and two units of whole blood were transfused. However, the general condition of the patient deteriorated and the case was referred to a higher centre. The patient was declared dead on arrival at the higher centre, after about 3 hours of referral. No resuscitation procedures were carried out. Diagnosis of Coagulopathy with liver failure and DIC and hypovolemic shock was made in the clinical case summary.

A medico-legal autopsy was performed to ascertain the cause of death.

### Autopsy presentation:

Medico-legal autopsy was performed after a postmortem interval of about 12 hours.

#### External examination:

The female was moderately built with a body mass index of 23.05 (body weight-62 kg, height-164 cm), having generalized pale appearance. Post mortem hypostasis was faintly visible over dorsal and lateral aspects of body and was fixed. Multiple hyper-pigmented patches were noticed over the back of the trunk, distributed randomly in hypostatic as well as non-hypostatic regions. The abdomen was tense. No evidence of external trauma was found. Signs of putrefaction were absent.

#### Internal Examination:

No soft tissue or musculoskeletal trauma was present. On opening of the skull, the dura mater was tense. The brain was pale and oedematous (Weight- 1414 gm).

On opening of other body cavities, showers of petechial hemorrhages and random foci of bleeding ecchymoses were present on bilateral parietal pleura, parietal pericardium, diaphragm, jejunum serosa (**Figure 1**) and broad ligament of the uterus. No gross cardiac pathology was observed. Changes of DIC were apparent in the form of massive hemorrhagic effusions in all the body cavities. The liver was grossly enlarged, weighing 2000 gm. It showed an area of dark red subcapsular hematoma along with multiple confluent blackish brown patches distributed predominantly over its superior surface (**Figure 2**). Cut surface was pale-brownish with tiny confluent hemorrhagic foci suggestive of haemorrhagic necrosis (**Figure 3**). Bilateral shock kidneys were present. The endometrium was hemorrhagic, showing specks of adherent blood clots.

Histopathological examination of liver showed periportal haemorrhagic hepatocellular necrosis along with regions of fibrin deposits and oedema (**Figure 4**). No fatty changes were observed. The lungs showed areas of congestion, intra-alveolar oedema and hemorrhages. Both kidneys showed changes of acute tubular necrosis along with evidence of fibrin laden glomerular capillaries (**Figure 5**). Toxicology report of viscera and body fluids did not reveal any poison.

### Discussion:

HELLP syndrome usually occurs with pre-eclampsia. However, in a subset of cases, it may be an entity on its own without any evidence of preeclampsia before or during labour, as happened in the present case. The syndrome develops postpartum in about 30% of cases.<sup>6</sup> In such cases, the onset is seen mostly within first 48 hours. However, signs and symptoms may not become apparent until as long as a week after delivery. HS usually follows a rapid and fulminant course.<sup>7</sup> The clinical course of the condition might be extremely rapid and the medical history may be uneventful in such cases. The non-specificity and the vague nature of symptoms too often lead to either misdiagnoses or a diagnostic delay. The clinical profile usually simulates other conditions such as diarrhea, gastritis, gastroenteritis, fatty liver of pregnancy, etc.<sup>8</sup> The abdominal pain, typically located in the epigastric region, although nonspecific, is the most frequent symptom, seen in 80-90% of the cases. It is due to stretching of the Glisson's capsule from an enlarging subcapsular hematoma.<sup>5</sup> The sudden and unexpected onset along with fulminant course of this syndrome carries essential forensic

significance in the context of alleged medical malpractice. The non specificity of the symptoms may confuse physicians who then lose precious time before reaching a confirmed diagnosis.

The etiology regarding origin of HELLP syndrome remains unclear. The imbalance in vasoactive substances causing intense systemic vasospasms and endothelial damage in multiple organs causing multiple organ failure has been proposed.<sup>9</sup> No consensus on this theory is available, however. Abnormal platelet activation and the alteration of plasminogen activation have been found to be primarily involved in the pathogenesis of the syndrome.<sup>10</sup>

Diagnosis of HS is based on the classical signs of preeclampsia, clinical symptoms of disease and laboratory abnormalities, as proposed by Sibai, et al.<sup>8</sup> However, it is pertinent to mention here that the HS does not occur exclusively in pre-eclampsia, rather the predisposing risk factors differ for both conditions.<sup>11</sup> This fact has special forensic significance as the absence of obvious signs of preeclampsia may significantly affect the practice of an inexperienced practitioner who might not predict the development of HS. The literature reveals that in about 20% of the cases of HS, signs and symptoms of preeclampsia may be absent or too minimal (before delivery) to raise suspicion of the impending fatal condition.<sup>8,12</sup>

Changes of DIC are present in 4% to 38% of the cases with HS.<sup>13</sup> The platelet count, in addition to clinical practice, also has a forensic value as a red flag in development and severity of the disease. Based solely on the platelet count, Martin, et al,<sup>14</sup> have classified maternal patients with HS into three classes: class 1 (Count  $<50 \times 10^9/l$ ), class 2 (between  $50.100 \times 10^9/l$ ), and class 3 (between  $100.150 \times 10^9/l$ ). Although there may be apparent correlation between the degree of laboratory changes of DIC and HS with maternal complications, the manifestations of DIC appear as secondary pathophysiological process. The autopsy findings similar to our case have been reported in a previous study comprising of three maternal deaths from HS.<sup>3</sup> Simic, et al have described a similar case of postpartum death from HS along with its forensic implications. There was discovery of well defined subcapsular hematoma at autopsy and the diagnosis of HS was further confirmed from histopathological changes in the liver and alterations in the laboratory parameters.<sup>15</sup>

A firm conclusion of HS at autopsy is made from gross changes in the liver, which are

often characteristics and are diagnostic of the condition. Further confirmation is obtained from alterations in the laboratory parameters and histopathological examination for which characteristic changes have been described in the forensic literature.<sup>3,16</sup> During autopsy in such cases, differential diagnoses of liver hematoma and/or rupture should be kept in mind and trauma must be ruled out at first instance.

Although the fatal maternal incidents in the course of HS are seen in few postpartum cases, in the present case the course of the syndrome was further complicated with secondary DIC and subsequent multiple organ failure. The development of life threatening complications after delivery due to HS may occur without adequate clinical and laboratory findings, especially if the diagnosis of HS was not made timely. The fact that development of complications cannot usually be predicted is of special forensic significance in considering timely medical interventions.

**Cause of death:** The cause of death was given as DIC with multiple organ failure complicating HELLP syndrome. The question of alleged medical malpractice was refuted on the basis of rare occurrence, non-specific nature and fulminant course of the disorder.

### Conclusion:

While performing autopsy in sudden and unexpected maternal deaths, the pathologist should be aware of HS irrespective of the available clinical history (which is usually atypical) and investigations. This entity is often neglected by the treating doctors due to the vague and non-specificity of the symptoms which does not warrant specific intervention. The syndrome has unclear etiology, may develop in itself and carries significant lethal potential. The gross features of liver pathology and DIC at autopsy and histopathological alteration in the liver and kidneys are characteristic of the disease. All these facts may enable the forensic pathologist to make a definite autopsy diagnosis of HELLP syndrome even in the presence of scanty history.

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Figure:1

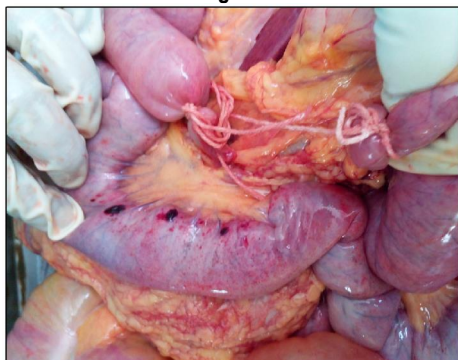


Figure 2

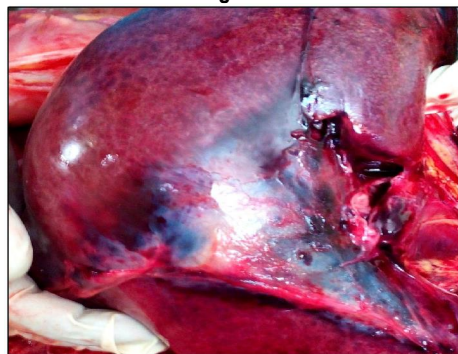


Figure: 3

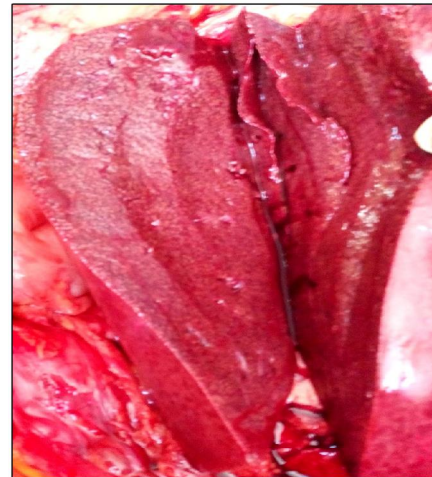


Figure: 4

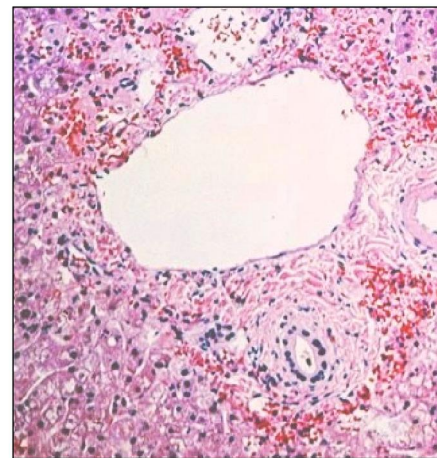
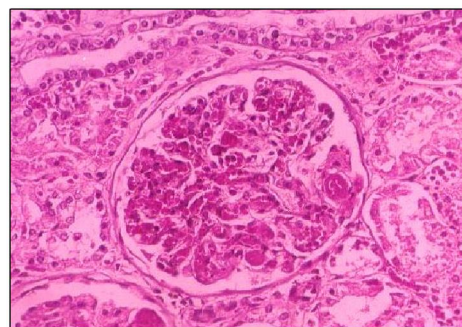


Figure: 5





Audience at the  
Inaugural function

The E C Members  
after the EC Meet



Prof Shiv Kochar handing  
over a cheque to the  
Treasure Dr S. K. Dadu  
during the GBM

