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# Medico-Legal Update

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## Trends of Hanging Deaths in Vadodara- An Autopsy based Prospective Study

Aditya B. Itare<sup>1</sup>, Sunil B. Bhatt<sup>2</sup>, Hardik R. Prajapati<sup>3</sup>, Jenish Kacchadia<sup>4</sup>, Devang Dave<sup>5</sup>

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### Abstract

The position of knot (typical/atypical) and type of hanging (complete/partial) play an important role in the causation of death in hanging. Ligature material and ligature mark also provides information regarding manner and cause of death. Total 1803 medicolegal autopsies were performed during one year study period, out of which 189 (10.48%) cases were of hanging.

In our study, 134 (70.89%) were male and 55 (29.10%) cases were female with male to female ratio of 1:0.4. We observed that in 104 (55.03%) cases the hanging was complete whereas 85 (44.97%) cases the hanging was partial. The typical hanging cases were 62 (32.8%) and atypical hangings cases were 127 (67.2%). Soft ligature materials were used in 143 (75.66%) cases. Hard ligature materials were used in 46 (24.34%) cases. Dupatta, a soft-ligature material most commonly used in all cases.

**Key words:** Hanging; Ligature materials- soft, hard; Position of knot; Complete & Partial hanging.

### Introduction

Asphyxia is a frequent cause of death in many pathological processes. Mechanical asphyxia is characterised by mechanical occlusion of external air passages leading to anoxia and death. According to the cause, four fundamental variants can be identified: hanging, strangulation, suffocation and drowning. Recently hanging has risen as common mode of committing suicide<sup>1</sup>.

In many cases ligature mark is the only evidence present and its characteristics are well defined and explained in many literatures. However descriptions of the ligature material are not frequently reported for study. The position of knot (typical/atypical) and type of hanging (complete/partial) play an important role in the causation of death in hanging. With this background, the present study attempted to focus only on the characteristic features of the ligature

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material and type of hanging (typical/atypical, complete/partial).

### Material and Methods

**Ethical Permission-** Medical College and SSG Hospital, Vadodara IECBHR/14-2020, DATED-31/01/2020.

The present study is prospective observational study and has been carried out at Department of Forensic Medicine and Toxicology, Govt. Medical College & S.S.G. Hospital, Vadodara, during period from November 2019 to October 2020. Ethical clearance was obtained from the institutional ethical committee.

The medico-legal death cases are which occurring under unnatural (including suicidal, homicidal, and accidental), suspicious or unknown circumstances. During the study period, total of 189 cases of hanging were reported and autopsy were conducted at mortuary complex of Forensic Medicine and Toxicology, Govt. Medical College & S.S.G. Hospital which examined in detail for ligature material, type of hanging- complete, partial, typical, atypical. Decomposed hanging cases were excluded from the study.

### Result

During this one-year period total 1803 medicolegal autopsies were performed, out of which 189 (10.48%) cases were of hanging. As shown in table 1, out of 189 cases of hanging 134 (70.89%) were male and 55 (29.10%) cases were female.

Considering, the age group 21 to 30 years constituted most of cases (n=61; 32.27%). It was observed that out of 32 cases from age group of 11 to 20 years 27 cases belongs to 16 to 20 years of age

group. The youngest victim was 14 years old while oldest was 83 years old.

We observed that the age group 21 to 30 years constituted highest number of cases in males (n=44, 32.84%), followed by 31 to 40 years with 38 (28.35%) cases. In female maximum cases 19 (34.54%) were from 21 to 30 years of age group followed by 11 to 20 years of age group with 17 (30.90%) cases. Most common ligature material used in all age group is Dupatta. (Table-2)

Complete hanging is seen in 104 (55.03%) cases where no part of body was touching ground in which 72 were male and 32 were female, whereas 85 (44.97%) cases the hanging was partial where at least one body part was touching the ground in which 62 were male and 23 were female.

As described in table 2, out of total 189 cases of hanging typical hanging were in 62 (32.8%) cases out of which 44 were male and 18 were female. Atypical hangings were in 127 (67.2%) cases out of which 90 were male and 37 were female. Dupatta is most common material used in all types of hanging cases. (Table-3)

As shown in Table-4, soft ligature materials were used in 143 (75.66%) cases, out of which 93 (65.03%) cases were male and 50 (34.96%) cases were female. Most common soft ligature material is Dupatta, used by 110 (58.2%) victims (males-69 and females-41). Hard ligature materials were used in 46 (24.34%) cases, of which 41 (89.13%) were male and 5 (10.87%) cases were female, most common was nylon rope which was used by 25 (13.2%) cases (male-22, female-3), followed by cotton rope which was used by 20 (10.6%) cases and least common was belt used by 2 cases.

**Table 1: Distribution of cases according to sex and age group**

Age group (Years)	Hanging		
	M (%)	F (%)	T (%)
0 to 10	00	00	00
11 to 20	15 (11.19)	17 (30.90)	32 (16.93)
21 to 30	44 (32.83)	19 (34.54)	61 (32.27)
31 to 40	38 (28.35)	11 (20)	49 (25.92)
41 to 50	21 (15.67)	03 (5.45)	24 (12.69)
51 to 60	08 (5.97)	02 (3.63)	10 (5.29)
61 to 70	06 (4.47)	02 (3.63)	08 (4.23)
71 to 80	01 (0.74)	01 (1.81)	02 (1.05)
81 to 90	01 (0.74)	00	01 (0.52)
Total	134 (70.9)	55 (29.1)	189

**Table-2 : Distribution of cases according to ligature material used in age group.**

Ligature Material	0-20 Years		Total	21-40 Years		Total	≥41 Years		Total
	Male	Female		Male	Female		Male	Female	
Dupatta	8	15	23	40	20	60	21	7	28
Sari	1	1	2	10	6	16	6	1	7
Bed Sheet	3	0	3	4	0	4	0	0	0
Nylon rope	1	1	2	16	2	18	5	0	5
Cotton rope	1	0	1	11	2	13	5	0	5
Belt	1	0	1	1	0	1	0	0	0
Total	15	17	32 (16.9%)	82	30	112 (59.2%)	37	8	45 (23.8%)

**Table-3: Distribution of cases according to type of hanging and ligature material**

Ligature Material	Complete Hanging		Total	Partial Hanging		Total	Atypical Hanging		Total	Typical Hanging		Total
	Male	Female		Male	Female		Male	Female		Male	Female	
Dupatta	36	23	59	33	19	52	49	29	78	20	13	33
Sari	8	6	14	9	2	11	11	5	16	6	2	8
Bed Sheet	3	0	3	4	0	4	5	0	5	2	0	2
Nylon rope	11	1	12	11	2	13	13	1	14	9	2	11
Cotton rope	12	2	14	5	0	5	11	2	13	6	0	6
Belt	2	0	2	0	0	0	1	0	1	1	0	1
Total	72	28	104	62	23	85	90	37	127	44	17	61

**Table-4: Distribution of cases according to ligature material**

Ligature material	Male		Female		Number	Type of ligature material- total no. (%)
Dupatta	69	93 (69.4%)	41	49 (89%)	110 (58.2%)	Soft- 142 (75.13%)
Sari	17		8		25 (13.2%)	
Bed sheet	7		0		7 (3.7%)	
Nylon rope	22	41 (30.6%)	3	06 (11%)	25 (13.2%)	Hard- 47 (24.86%)
Cotton rope	17		3		20 (10.6)	
Belt	2		0		2 (1%)	
Total	134		55		189	

## Discussion

Commonly ligature material in cases of hanging are not brought with dead bodies to the mortuary. Either it was brought separately or sent for the examination in FSL if required by the investigating officer, but in current study ligature material of all cases were obtained from police. In some cases, people who saw first the victim attempt to rescue the victim by removing the ligature from around the neck and in few cases, they knew it already too late to revive the victim and call police in first place and, in this scenario, police took photographs and make spot panchnama regarding manner of death and bodies brought to mortuary with ligature around neck. Generally, ligature material is not examined, and its features are not submitted for methodical analysis. But the type of ligature material and position of the knot plays an important role in the mechanism of death and autopsy findings in hanging<sup>2</sup>.

In present study majority of hanging victims were male (70.89%) and rest were female (29.11%) with male female ratio of 1: 0.4. Kanchan<sup>3</sup> and Momin<sup>4</sup> observed similar incidence to be 2 times in males. A higher incidence of hanging in males was also reported by Sauraze-Penaranda<sup>5</sup> (77%), Sharma<sup>6</sup> (66.3%).

Similarly, National Crime Record Bureau, India (2019)<sup>1</sup> reported male victims (70.2%) more than the female victims in cases of death by hanging. According to it, the number of male victims was more than that of females for all means of suicides, except those committed by 'self-immolation'.

In our study, the ages of the victims ranged from 14 to 83 years, with an average age of 33 years. Out of 189 cases of hanging, the highest number of cases were noted in the age group of 21-40 years (59.2%), followed by ≥41 Years (23.8%) and 0 to 20 years (16.9%). These findings were consistent with studies around the world by Ahmad and Hossain<sup>7</sup>. Also, similar findings were reported from various parts of India by Joshi and Bharadwaj<sup>8</sup>, Vijayakumari<sup>9</sup>, Jayaprakash and Sreekumari<sup>10</sup>, Saisudheer and Nagraja<sup>11</sup>, Momin et al<sup>4</sup>. According to National Crime Record Bureau, India (2019)<sup>1</sup>, the most common age group committing suicide by hanging is 18 to 30 years.

Regarding the type of hanging, based on suspension, in the present study 55.03% cases were complete hanging and 44.97% were partial type. Similarly, complete hanging was found in majority of cases by Suarez-Penaranda et al<sup>5</sup>, Sharma et al<sup>6</sup>, Charoonnate et al<sup>12</sup>, Saisudheer and Nagraja<sup>11</sup>, Suresh Chand et al<sup>13</sup>.

In present study typical hanging was present in 32.8% cases and atypical hanging was present in 67.2% cases. Similarly higher incidence of atypical hanging were reported by Sharma et al<sup>6</sup> (88%), Suresh Chand et al<sup>13</sup> (88.4%), Navneet and Shalender<sup>14</sup> (88%), Khalkho and Pathak<sup>2</sup> (54.6%). Sharjia S. et al<sup>15</sup> also reported atypical hanging is more common with 37% cases in comparison with 9% cases of typical hanging.

We found that soft, ligature material (75.66%) was more commonly employed for hanging than the hard pliable materials (24.34%). Similar findings are reported by Naik<sup>16</sup> (257 cases of hanging), where he observed that soft ligature like scarf, napkin, sari, bed sheet, etc. were used in 127 (49.52%) cases and hard ligature like jute rope, plastic or nylon rope, electric wire etc. were used in 105 (39.69%) cases. Jayaprakash and Sreekumari<sup>21</sup> reported that soft material was used by 47% of deceased.

In our study, the most commonly used ligature materials for the purpose of hanging were dupatta (58.73%), rope (23.28%) and sari (13.22%). Soft materials specially dupatta and sari were the commonest ligature used for hanging, possibly due to their easy availability, accessibility as they are essential parts of traditional Indian female dressing.

We couldn't find any study describing association between ligature material used in age group and type of hanging. In our study we found soft ligature material dupatta was most used by both sexes in all age group.

## Conclusion

This study has analysed the characteristics of ligature material used in all type of hanging and age groups. A thorough examination of the ligature material and investigation in type of hanging is very important to determine an opinion in cause of death. Any hideous discrepancies in this regard may create doubt of foul play or suspicious death. We analysed

that in suicidal hanging soft ligature material dupatta was most used in Vadodara city. Most common hanging type is complete and atypical. Most of the victims are from 21 to 40 years of age group.

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## Progressive Pulmonary Tuberculosis – Progress Beyond the Walls

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### Abstract

Tuberculosis is caused by Mycobacterium tuberculosis. If the treatment is inadequate or if host defenses are impaired, the apical lesion in primary tuberculosis expands into adjacent lung tissues and may spread via airways, lymphatic channels, or the vascular system. It may also circulate back to the lung and cause miliary pulmonary disease. Systemic miliary tuberculosis occurs when bacteria disseminate through the systemic arterial system to involve any organ. In the present study, we discuss five such cases of systemic miliary tuberculosis wherein the deceased succumbed to the illness.

**Key words:** Tuberculosis; Miliary; series; histopathology; autopsy

### Introduction

According to WHO estimates, around 2.7 million people developed TB in India and over 400,000 people died due to TB in the year 2017.<sup>1</sup> Tuberculosis is caused by Mycobacterium tuberculosis. Primary tuberculosis is the form of disease that develops in a previously unexposed person. The inhaled bacilli get implanted in the distal airspaces of the lower part of the upper lobe or the upper part of the lower lobe, known as the Ghon's focus.<sup>2</sup> In most people, the primary infection is contained, but in others, primary tuberculosis is progressive. The diagnosis

of progressive primary tuberculosis in adults can be difficult. Progressive primary tuberculosis more often resembles acute bacterial pneumonia, with lower and middle lobe consolidation, hilaradenopathy, and pleural effusion; cavitation is rare, especially in people with severe immunosuppression. Lymphohematogenous dissemination may result in the development of tuberculous meningitis and miliary tuberculosis.

### Case one

A 60-year-old unidentified male was found dead in a public sports playground by the police during

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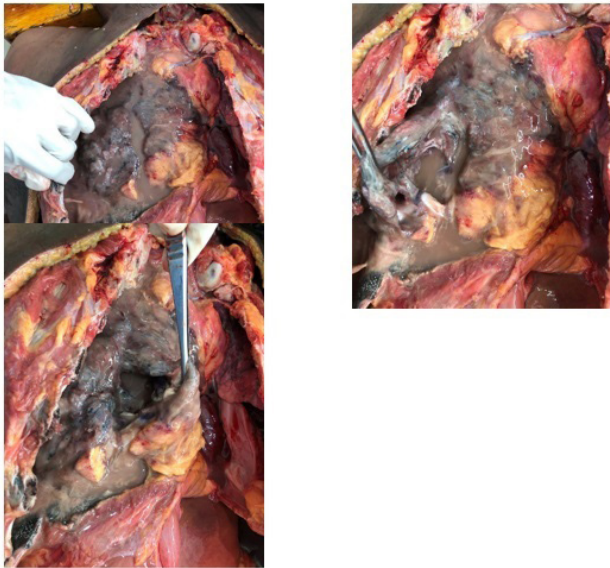
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the early morning hours. There was no history of any illness available.

On examination, the deceased was an emaciated male weighing 35kg, with no external injuries present over the body. On internal examination, the upper lobes of both lungs were adherent to the chest wall, and the entire upper lobes of both lungs showed multiple cavities with active caseous materials.



**Fig.1,2,3:Caseous necrosis of lung with cavities**

**Case two**

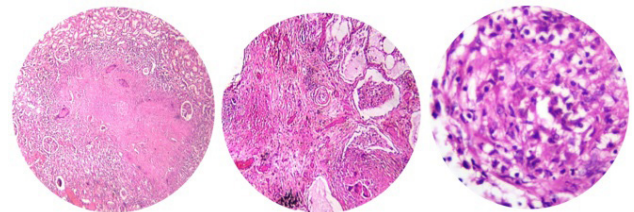
A 32 -year -old male brought dead to casualty after he collapsed in front of his neighbor’s house. His family gave a history of the deceased having fever and cough for the past one week. There is no history of any other significant illnesses in the past. On external examination, the deceased was a poorly nourished male weighing 50kg. Internally, there were multiple white granulomas seen on the parietal pleura, diaphragm, lungs, kidneys, mesentery, and the intestines.



**Fig.4: White granulomas on mesentery and intestines** **Fig.5: Cut section shows millet-seeds appearance**



**Fig.6: White granulomas on kidney**



**Fig.7,8,9: Histology of kidney (left), lung (middle) and mesenteric lymph node (right) showing granulomas**

**Case three**

A50-year-old unidentified male was found unconscious at a bus stand shed by a passerby in the morning hours. He was brought to the casualty of a nearby clinic where he was declared as ‘brought dead’. There was no medical history available.

On external examination, the deceased was an emaciated male weighing 42kg with no injuries. Internally, it was seen that both lungs were adherent to chest wall, diaphragm, and pericardium. The entire upper lobe and middle lobe of right lung showed active caseous material.



**Fig.10: Caseous necrosis of lung**

**Case four**

A 44-year-old lady collapsed in her house and was rushed to the hospital; however, she was dead on arrival. The history obtained from her family informs that she had persistent cough for the last 2 years and that she was on herbal medications for the same. There was no history of any other significant illnesses in the past.

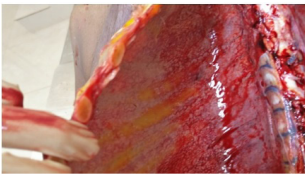
Externally, the deceased was a poorly nourished female weighing 50kg with no injuries. Internally, multiple white granulomas were seen on the intestines, mesentery, lungs, pericardium, spleen, diaphragm, liver, gall bladder, stomach, pancreas, uterus, and pleural cavities.



**Fig.11: White granulomas on mesentery and intestines**



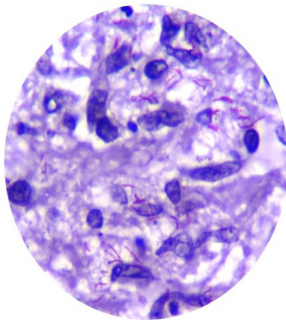
**Fig.12: White granulomas on pericardium**



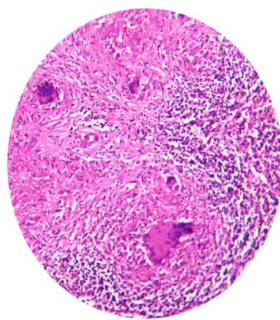
**Fig.13: Granulomas on parietal pleura**



**Fig.14: Granulomas on liver and gallbladder**



**Fig.15: Acid fast bacilli staining showing bacilli**

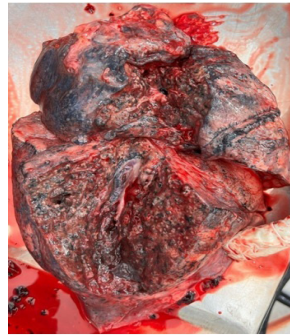


**Fig. 16: Histology of spleen showing granuloma**

**Case five**

A 65-year-old unidentified male was found dead in front of a garment shop by the police during early morning hours. There was no history of any previous illness available.

External examination showed an emaciated male weighing 38kg, with no injuries. On internal examination, the pleura on both sides was adherent to the chest wall and one lung showed multiple cavities with caseous material and other lung showed small whitish lesions involving all lobes.



**Fig.17: Cut section of lung shows Millet-seed appearance**



**Fig.18: Lung: Caseous necrosis with cavities appearance**

**Discussion**

Pulmonary tuberculosis progressing into disseminated pulmonary tuberculosis commonly manifests in the elderly and immunosuppressed. The apical lesion in primary tuberculosis expands into the adjacent lung tissue, this lesion is characterised by caseous material surrounded by macrophages and lymphocytes. Eventually, the lesion erodes into the bronchi and vessels, evacuating the caseous center, creating a ragged, irregular cavity that is poorly walled off by fibrous tissue. Unchecked bacterial growth may lead to hematogenous spread of bacilli to produce disseminated tuberculosis. Disseminated disease with lesions resembling millet seeds is termed miliary tuberculosis.<sup>3</sup>

With adequate treatment the process may be arrested. If the treatment is inadequate or if host defenses are impaired, the infection may spread via airways, lymphatic channels, or the vascular system.<sup>2</sup> Miliary pulmonary disease occurs when organisms draining through lymphatics enter the venous blood

and circulate back to the lung. Individual lesions are either microscopic or small, visible (2-mm) foci of yellow-white consolidation scattered through the lung parenchyma (Millet seed appearance). Miliary lesions may expand and coalesce, resulting in consolidation of large regions or even whole lobes of the lung. Over time and with progressive pulmonary tuberculosis, the pleural cavity is invariably involved, and serous pleural effusions, tuberculous empyema, or obliterative fibrous pleuritis may develop.<sup>2</sup>

Disseminated tuberculosis is defined as tuberculous infection involving the blood stream, bone marrow, liver, or 2 or more non-contiguous sites, or miliary tuberculosis.<sup>4</sup> Of all cases of disseminated tuberculosis found at autopsy, 33%–80% were missed antemortem.<sup>5</sup> Systemic miliary tuberculosis occurs when bacteria disseminate through the systemic arterial system; most prominently in the liver, bone marrow, spleen, adrenals, and meninges but could involve any organ.

Miliary tuberculosis has typically been considered a childhood disease. However, during the last three decades, it is increasingly being recognized in adults as well. Several reasons are thought to be responsible for this changing epidemiological trend. These include: human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), causes of immunosuppression, such as use of biologicals and immunosuppressive drugs for treatment, increasing occurrence of organ transplantation, malnutrition. Among immunocompetent adults, miliary tuberculosis accounts for less than 2 per cent of all cases of TB and up to 20 per cent of all extrapulmonary tuberculosis (EPTB) cases in various clinical studies.<sup>7-10</sup> In late HIV infection, EPTB accounts for more than 50 per cent of all cases of TB.<sup>11</sup>

A lesser encountered manifestation of this disease in the form of sudden death also finds a mention in literature and case reports.<sup>12,13</sup>

### Conclusion

In the present study, all the cases that we have reported presented with scarce previous medical history, most of them were malnourished individuals,

who may have also been immunocompromised. White granulomas may resemble metastatic lesions and must be differentiated by means of Acid-Fast Bacilli staining and histopathological examination. As disseminated miliary tuberculosis can be a cause of sudden death and poor response to unrelated treatments, it bears keeping in mind for all forensic surgeons as a direct and indirect cause for death. As HIV/AIDS is an important cause of immunosuppression, forensic surgeons should take precautions to avoid getting infected. There is a possibility of the deceased in our cases being defaulters of Anti-TB therapy which not only puts themselves at risk but the community at large via the appearance of drug resistant forms, and so the Government must take necessary strategies to prevent spread and mortality of the disease.

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**Ethical clearance:** Obtained from the Institutional Review Board (IRB No:10/2017).

**Conflict of interests:** Nil

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# Comparative Study of Sex Estimation by Mesiodistal width of Mandibular Canine and Mesiodistal width of Maxillary Canine in North Indian Population

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## Abstract

**Introduction:** Various methods of identification such as anthropometry, stature estimation, dactylography, sex estimation, age estimation, DNA analysis, differentiation by blood groups and odontology are used in forensic medicine to create biological profile of an unknown individual. Estimation of sex is the first step towards identification of person. Determination of sex from skeletal remains is an essential task in medicolegal examination. Teeth are highly indestructible and reveal minimal turnover of natural substance hence teeth can be used for sex estimation. Mesiodistal parameter of mandibular and maxillary canine gave evidence of sex estimation due to sexual dimorphism.

**Aim:** The aim of our study was to evaluate the sex estimation by mesiodistal width of mandibular canine and mesiodistal width of maxillary canine in north Indian population.

**Materials and Methods:** The sample comprised of dental impression from 120 individuals (60 males and 60 females), all young adults between 20 and 35 years of age. Impressions of the teeth were made using irreversible hydrocolloid (alginate) material and casts poured in dental stone. Mesiodistal (MD) dimensions of mandibular and maxillary canine of both right and left side is measure by caliper.

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**Results:** Mean mandibular canine width of both right and left side were higher in male than female and were statistically significant whereas, mean maxillary canine width of both right and left side were slightly higher in male than female but were not statistically significant in young north Indian population. Left mandibular canine width (6%) was more sexually dimorphic than right mandibular canine width (5.1%). Whereas negligible sexual dimorphism shown by maxillary canine.

**Conclusion:** The study confirmed that among maxillary and mandibular canine, mandibular canine can be used for sex estimation and shows significant sexual dimorphism.

**Keywords:** Maxillary canine, Mandibular canine, Sexual dimorphism, Sex estimation, Mesiodistal width.

## Introduction

Forensic derives utmost importance when there is requirement of the identification of an individual either from partial or complete remains<sup>1</sup>. Personal identification requires in courts of law for not only criminal identification but also for identification of other living individuals, dead person and body remains<sup>2</sup>. Various methods of identification such as anthropometry, stature estimation, dactylography, sex estimation, age estimation, DNA analysis, differentiation by blood groups and odontology are used in forensic medicine to create biological profile of an unknown individual<sup>3,4,5</sup>. Estimation of sex is the first step towards identification of person<sup>6</sup>. Determination of sex from skeletal remains is an essential task in medicolegal examination specially in damaged, mutilated or decomposed bodies<sup>7</sup>. Among various methods of sex estimation like osteometry, odontometry, DNA analysis and cheiloscropy, only analysis of DNA gives definitive proof of sex determination, but such methods are expensive, exhaustive, relatively prolonged involving difficult DNA extraction technique and requires trained staff<sup>8</sup>. Teeth are highly indestructible and reveal minimal turnover of natural substance hence teeth can be used for sex estimation in decomposed, mutilated bodies or from fragmentary skeletal remains<sup>9,10</sup>. Sexual dimorphism means difference in size and appearance in teeth among male and female that can be used for sex determination<sup>11</sup>. Mesiodistal parameter of mandibular and maxillary canine gave evidence of sex estimation due to sexual dimorphism<sup>12</sup>. The aim of our study was to evaluate the sex estimation by mesiodistal width of mandibular canine and mesiodistal width of maxillary canine in north Indian population.

## Material and Methods

### Material required

1. Alginate
2. Dental stone
3. Maxillary Impression Trays
4. Mandibular Impression Trays
5. Rubber Bowl
6. Spatula

The alginate dental impression forms an imprint (i.e., a 'negative' mould) of those teeth and gums, which can then be used to make a cast or 'positive' model of the patient's dentition.

### Sample size

#### Sample selection:

sample size was calculated by formula

$$N = Z_{\alpha}^2 p(1-p) / E^2$$

Where  $Z_{\alpha}$  is critical value of z-score at  $\alpha$  level of significance (at  $\alpha = 5\%$ ,  $Z_{\alpha} = 1.96$ ),  $p$  is proportion and  $E$  is permissible error. 5.738 % of sexual dimorphism observed by canine width (6.80% by right mandibular canine width and 7.72% by left mandibular canine width parameter. Average of sexual dimorphism by mandibular canine = 7.26 %. 4.58 % of sexual dimorphism observed by right maxillary canine width and 3.85 % by left maxillary canine mesiodistal width). Average of sexual dimorphism by maxillary canine = 4.215. So overall average is 5.738<sup>12</sup>. So,  $p = 5.738\%$ , i.e., .05738,  $1-p = .9427$ ,  $E = 4.1\%$  i.e., .041. So,  $n = (1.96)^2 \times 0.05738 \times 0.9427 / (.041)^2 = 123.6 \approx 120$ .

Study was conducted on 120 volunteer subject (60 male and 60 female) of both the sex having age

group between 20 to 35 years at Integral Institute of Medical Sciences & Research, Integral University, Lucknow. Institutional ethical clearance was taken for this study with reference number IEC/IIMSR/2023/13. Informed consent was taken from all participants.

#### Inclusion Criteria:

1. Age between 20 to 35 years.
2. Fully erupted with complete set of teeth.
3. No history of orthodontic treatment or any type of prosthesis
4. Non-carious, non-hypoplastic, non-traumatic, non attrited and periodontally healthy teeth.

#### Exclusion Criteria:

1. Age below 20 years and above 35 years.
2. Misaligned, spacing teeth, diastema or crowded teeth
3. Carious teeth, restored teeth, fractured teeth, hypoplastic teeth, teeth with prosthesis, attrited teeth, mobile teeth.

#### Methodology and toothmeasurements

Impressions of the teeth were taken using irreversible hydrocolloid (alginate) material and poured by dental stone (Figure 1). Mesiodistal (MD) dimensions of mandibular canine and maxillary canine of both right and left side, were measured on the casts using a digital caliper calibrated to 0.01 mm. The MD dimension was defined as the greatest distance between contact points on the approximate surfaces of the tooth crown and was measured with the caliper beaks placed occlusally and aligned with the long axis of the tooth (Figure 2&3). If any teeth were rotated or misaligned, measurements were taken between points on the approximate surfaces of the crown where it was considered that contact with adjacent teeth would normally occur. Sexual dimorphism calculated by following formula<sup>13</sup>.

Sexual Dimorphism in percentage (%) =  $[(Xm/Xf)-1] \times 100$ , where  $Xm$  is the mean value for males and  $Xf$  is the mean value for females.



Figure 1- Image of dental cast



Figure 2: Measuring mesiodistal dimension of mandibular canine teeth by the digital caliper



Figure 3: Measurement of mesiodistal dimension of maxillary canine teeth by the digital caliper

#### Results

Data obtained were quantified and analysed statistically using SPSS (Statistical Package for the Social Sciences). All description were shown in table 1 to 4. Data were summarized as Mean and standard deviation (SD). Groups (in Gender Male vs female)



were compared by unpaired or independent Student's t test. In our study mean of right and left mesiodistal mandibular canine width (Table 1, chart 1) was higher in male (for right mesiodistal mandibular canine width  $6.042167 \pm .518561$  and for left mesiodistal mandibular canine width  $6.084 \pm .604484$ ) than female (for right mesiodistal mandibular canine width  $5.74367 \pm .45661$  and for left mesiodistal canine width  $5.73783 \pm .60016$ ) and was statistically highly significant ((p

value = .0011 for right side and p value .002083 for left side). Whereas as mean of right mesiodistal maxillary canine width (Table 2, chart 2) was slightly higher in male ( $6.66533 \pm .69064$ ) than female ( $6.56667 \pm .58321$ ) and was statistically not significant whereas mean of left mesiodistal maxillary width was almost equal in male and female and was statistically not significant (for male it was  $6.678 \pm .75049$  whereas for female it was  $6.62933 \pm .72876$  with p value .71922).

Table 1. Measurement of mean and standard deviation of mandibular canine width among male and female

Sex	Right mesiodistal mandibular canine width (in mm)			Left mesiodistal mandibular canine width (in mm)		
	Mean	Standard deviation	p value	Mean	Standard deviation	p value
Male	6.04217	.51856	0.0011	6.084	.604484	.002083
Female	5.74367	.45661		5.73783	.60016	

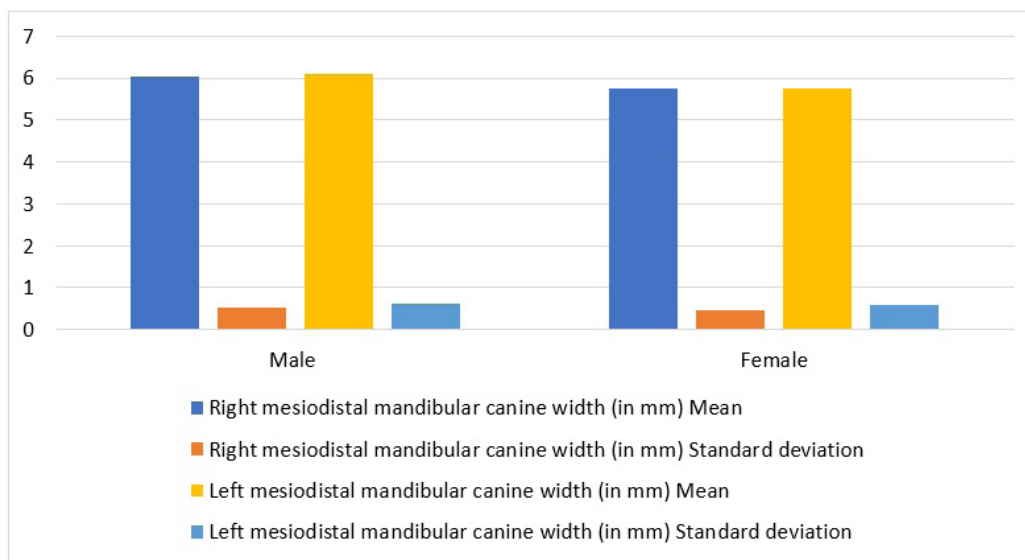


Chart 1. Measurement of mean and standard deviation of mandibular canine width among male and female

Table 2. Measurement of mean and standard deviation of maxillary canine width among male and female

Sex	Right mesiodistal maxillary canine width (in mm)			Left mesiodistal maxillary canine width (in mm)		
	Mean	Standard deviation	p value	Mean	Standard deviation	p value
Male	6.66533	.69064	.3996	6.678	.75049	.71922
Female	6.56667	.58321		6.62933	.72876	

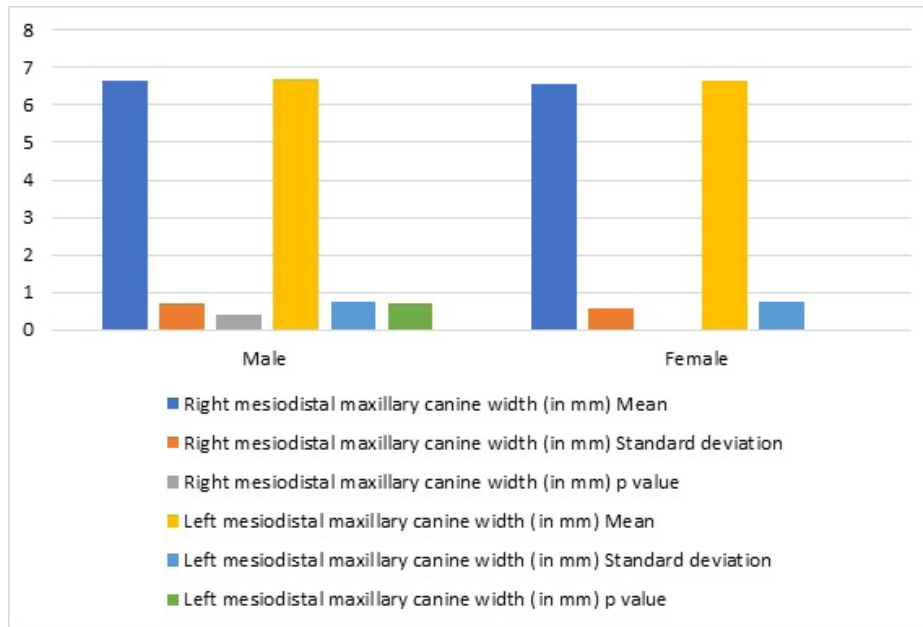


Chart 2. Measurement of mean and standard deviation of maxillary canine width among male and female

Table 3. Calculation of % Sexual dimorphism from right and left mandibular canine

Right mandibular canine	5.1 %
Left mandibular canine	6.0 %

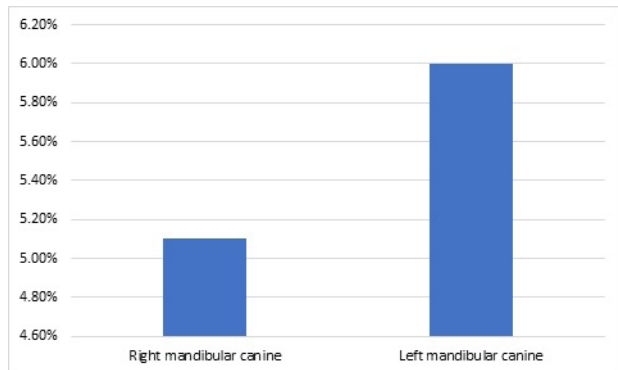


Chart 3. % Sexual dimorphism shown by right and left mandibular canine

Table 4. Calculation of % Sexual dimorphism from right and left maxillary canine

Right maxillary canine	1.5 %
Left maxillary canine	0.73 %

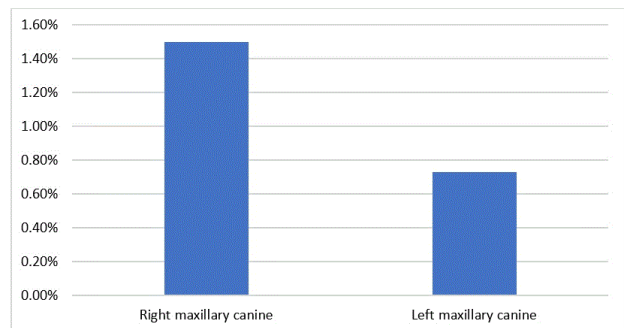


Chart 4. % Sexual dimorphism shown by right and left maxillary canine

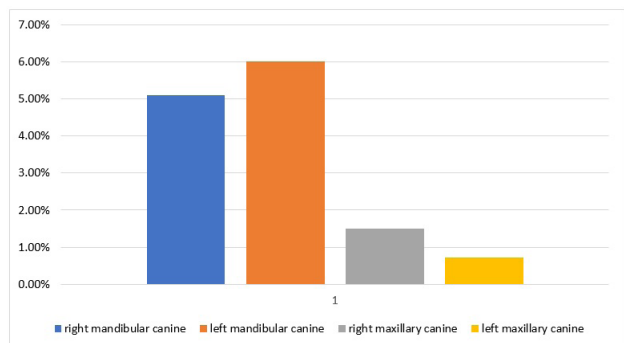


Chart 5. Comparative % sexual dimorphism shown by right and left mandibular and maxillary canine

Significant sexual dimorphism shows by right and left mesiodistal mandibular canine width (Table 3, chart 3). Left mesiodistal mandibular canine (6%) higher sexual dimorphism than right mesiodistal

mandibular canine width (5.1%). Negligible sexual dimorphism shown by maxillary canine (Table 4, chart 4). Comparative sexual dimorphism by mandibular and maxillary canine was shown in chart 5.

### Discussion

Sex determination from mutilated or damaged or from skeleton remains is most important steps in forensic medicolegal examination of identification. Identification of missing person become simplified and easy because missing person of that sex will be considered<sup>14</sup>. Canine play as key teeth for identification of a person since it is decay resistance, least affected by dental caries or oral disease, comparatively better to withstand severe trauma and last tooth to be extracted with respect to age<sup>15</sup>. Sexual dimorphism is difference in the physical appearance between male and female that is vital in dental identification<sup>16</sup>. Identification of an individual by means of teeth and gender determination is consider as top priority because tooth is very decisive in identification when other evidence is lacking<sup>12</sup>. Present study revealed comparative analysis of the mesiodistal dimension of maxillary and mandibular canine in sex estimation among male and female subjects in north Indian population. Our study revealed that mean value for right and left mesiodistal mandibular and mesiodistal maxillary canine width were less for female than male which was similar to the study of Gustafsson and Lindenfors<sup>17</sup>, studies of Frayer and Wolpoff<sup>18</sup> and study done by Syed MA et al<sup>19</sup> and in many other studies<sup>20,21</sup>. In their study, Otuga et al<sup>12</sup> found that mean of left mesiodistal maxillary canine width is higher in female than male. Though mean value of right and left maxillary mesiodistal canine width was slightly higher in male ( $6.66533 \pm .69064$  for right and  $6.678 \pm .75049$  for left) than female ( $6.56667 \pm .58321$  for right and  $6.62933 \pm .72876$  for left) but difference in male and female was not significant (p value was .3996 and .71922 for right and left side respectively) in our study which was similar to the study of Mohammed et al<sup>11</sup> on Saudi Arabian population who found that the mean value of mesiodistal width of maxillary canines was  $7.54 \pm 0.68$  mm (right) and  $7.54 \pm 0.67$  mm (left) in males, while in females mean value was  $6.8 \pm 0.925$  mm (right) and  $6.83 \pm 0.934$  mm (left), but the differences in males and females were not statistically significant. So, it is clear

out from our study and study of Mohammed et al<sup>11</sup> that mesiodistal width of maxillary canine was not suitable for sex estimation.

In our study left mesiodistal mandibular canine (6%) showed higher sexual dimorphism than right mesiodistal mandibular canine width (5.1%) which is similar to study done by Kaushal et al<sup>9</sup> on 60 north Indian subject who found left mandibular canine (9.796% in cast and 8.891% intraoral) to be more dimorphic than right mandibular canine (7.954% in cast and 7.594% intraoral), study of Nair et al<sup>22</sup> who found higher sexual dimorphism by left mandibular canine than right mandibular canine (6.2%) and observation of Kapila et al<sup>23</sup> in their study where greater sexual dimorphism (9.7%) was exhibited in the left mandibular canine than in the right mandibular canine (7.4%). Reason for such finding may be due the fact sexual dimorphism for tooth is population dependent and vary accordingly in different ethnic group<sup>13</sup>. Similar results also observed by Knak Priya et al<sup>24</sup>. Maneel et al<sup>25</sup> observed higher sexual dimorphism in right mandibular canine (10.11%) than left mandibular canine (4.44%) which was contradictory to our study. Negligible sexual dimorphism shown by maxillary canine in our study (for right maxillary mesiodistal canine teeth sexual dimorphism was 1.5% while for left maxillary mesiodistal canine it was 0.73%) which is contrary to study of Otuga et al<sup>12</sup> who found sexual dimorphism for right maxillary canine was 4.58 and for left maxillary canine was 3.85% and study of Yuvenva et al<sup>26</sup> who observed sexual dimorphism for right maxillary canine was 8.85% and for left maxillary canine it was 6.85.

### Conclusion

The right and left mandibular mesiodistal canine width dimension have comparatively higher mean in male than female and are statistically significant whereas right and left mesiodistal maxillary canine width is slightly higher in male than female but are not statistically significant. Hence among maxillary and mandibular canine, mandibular canine can be used for sex estimation and shows significant sexual dimorphism whereas, maxillary canine is not suitable for sex estimation.

**Conflict of interest:** Nil

**Source of Funding:** Nil

**Ethical Clearence:** Taken from Institutional Ethical Committee with reference number IEC/ IIMSR/2023/13.

**Consent:** Informed consent taken from all the volunteer subjects.

**Abbreviations:** MD: Mesiodistal, SD: Standard deviation, mm: millimetres.

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# Estimating Time Since Death From Post Mortem Lividity: An Autopsy Study Conducted in Government Medical College and Ssg Hospital of Central Gujarat State of India

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## Abstract

**Background:** Evaluation and estimation of time since death is a fundamental part of medico-legal investigations. Post mortem lividity or post-mortem staining is a bluish or reddish-purple discoloration due to capillo-venous distension with blood, at the under surface of the skin on the dependant parts of the body, as a result of settling of blood in those areas following pulling by gravity, after circulation of the blood in motion ceases.

A study was conducted in the department of forensic medicine, Government Medical College and SSG hospital, Vadodara to evaluate time since death by method of studying post mortem lividity.

This was prospective and observational study conducted on 256 dead bodies brought for post mortem examination from November 2021 to August 2022.

It was observed that the Post mortem Lividity starts appearing as a patchy form by 1-7 hours and well develops by 7-13 hours. Post mortem Lividity gets fixed by 8-18 hours following death.

It was concluded that compared to other methods, the post mortem lividity assessment can be used as the most conventional, easy and quicker method for estimating time since death.

**Keywords:** Post mortem changes, Death, Livor Mortis, Time Perception.

## Introduction

Postmortem hypostasis is one of the early changes in the body following death. It is considered

to be one of the surest signs of death. Apart from being a sign of death, it also carries other information along like, time since death, cause of death, position

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of body after death, etc. Post-mortem lividity is the bluish-purple or purplish-red discoloration (due to deoxyhemoglobin), which appears under the most superficial layers of the dermal part of the skin of the dependent parts of the body after death, due to capillo-venous distension. It is caused by the stoppage of circulation, the stagnation of blood in blood vessels, and its tendency to sink by the force of gravity<sup>1</sup>. When the body is left undisturbed without change of its position, the staining starts appearing in small patches at the dependent parts of the body, by the end of the first hour after death. Gradually the small patches increase in size and coalesce with each other to form uniform large areas by 5 to 26 hours. If the body is left undisturbed for an additional five to six hours after the post-mortem staining has fully formed, the staining gets fixed, meaning that the stained area stays in the same location even if the body is repositioned<sup>2</sup>. The cause of death has an impact on the staining's hue as well. The cause of death has an impact on the staining's hue as well. The purplish-blue color in hypostasis can be explained by the following reasons: (i) Oxygen dissociation between capillaries and surrounding tissues occurs in recently dead or dying tissue until equilibrium is attained (ii) The venular blood because of its blue tint<sup>3</sup>.

Considering that appearance of postmortem changes may vary in different regions globally with varying weather conditions and is dependent on varying conditions as described above, this study was aimed to study the post-mortem lividity and its determinants in the study region.

## Materials and Methods

**Ethical permission:** Medical College & SSG Hospital, Baroda IECBHR/137-2021 Dated 02/11/2021.

### Study design:

A study was conducted in the mortuary of Department of Forensic Medicine, Government Medical College, and SSG Hospital, Vadodara.

This was a prospective and observational study conducted on 256 dead bodies brought for post-mortem examination from November 2021 to August 2022.

### Inclusion Criteria:

1. Those cases were selected where the time of death was exactly known.
2. Brought dead cases where the exact time of death is known.

### Exclusion Criteria:

1. Decomposed cases.
2. The unidentified bodies, where proper history was not available.

### Sample size calculation

Based on the estimated load of the cases in our department is about 25-30 cases per month, so expected sample size over the study period has been around 250-300 cases.

### Data Collection:

A deep freezer kept the 256 medico legal cases that were gathered for the study at a temperature of 0 to 8 degrees Celsius. The test for determining if postmortem lividity was fixed involved pressing the deceased person's livid area with the thumb for 30 seconds. If blanching was observed, it was deemed that postmortem lividity was not fixed at the time of postmortem examination. The cases were divided into four groups based on the postmortem interval: 0-6, 6-12, >12-18, and >18-25.

### Data Analysis:

Data analysis has been done with the help of a computer and statistical software. All data from the proforma has been compiled in a master chart, and analyzed by calculating Mean, Standard Deviation range, and percentage. The data was also tabulated, and appropriate inferences were drawn from the data.

## Result

All the cases were classified into different age groups with a range of 10 years. The youngest victim was 9 years old while the oldest was 80 years old. The mean age was 39.89. The mean age for male victims was 40.94 years and for females was 35.68 years. ONLY 3 cases were reported from the age group 0 to 10 years.

It is concluded that 205 (80.08 %) were males and 51 (19.92 %) were females. The ratio of male to female cases was 4:1 (Table 1).

The maximum no. of cases belonged to the age group 21-30 years (n= 66, 25.78 %) followed by the age group 31-40 years (n= 47, 18.36 %) whereas the Minimum no. of cases belonged to age group 0-10 years (n=3, 1.17 %) followed by age group 70-80 years (n=9, 3.52 %)(Table 1).

The cases were categorized by age group in view of the fact that handling bodies during the day changes the way post-mortem staining forms and becomes fixed. The cause of death also determines the occurrence, area of distribution, color, and fixation of post-mortem staining hence the cases were categorized according to the cause of death. Maximum death occurred due to Road traffic accidents (n=119, 46.48%), followed by sudden death (n=50, 19.53%) and hanging (n=35, 13.67%) respectively. (Table 2)

There were 49 cases out of a total of 256 cases that died due to hemorrhage and shock including road traffic accidents and railway injuries, in these 19.14% of cases the homogenous development of post mortem staining area could not be appreciated even after 6 hours following death.

In most cases (97.65%, 250 out of 256 cases) the lividity appreciated at the posterior surface and dependent areas of the body. Among 6 cases of death due to hanging, the typical glove and stocking distribution of staining.

In all 256 cases, the color of post-mortem staining was purple, and the post mortem staining was well appreciated in persons with fair complexion. It was recognized that the development of lividity does not

happen in the body's pressure points, such as the areas where the body rests on a table or the ground, or along areas where clothing is too tight.

In all cases, the exact time of death was available as they were documented in hospital case sheets and also the time since death was considered based on history and inquest report. The earliest time the post mortem staining started to develop as small patches was by 1 hour following death and late development as small patches was observed to be 12 hours following death in a case of road traffic accident. The earliest time the post mortem staining developed homogeneously as big patches was 3.5 hours following death and late development was observed to be 23 hours following death. (Figure 1& 2)

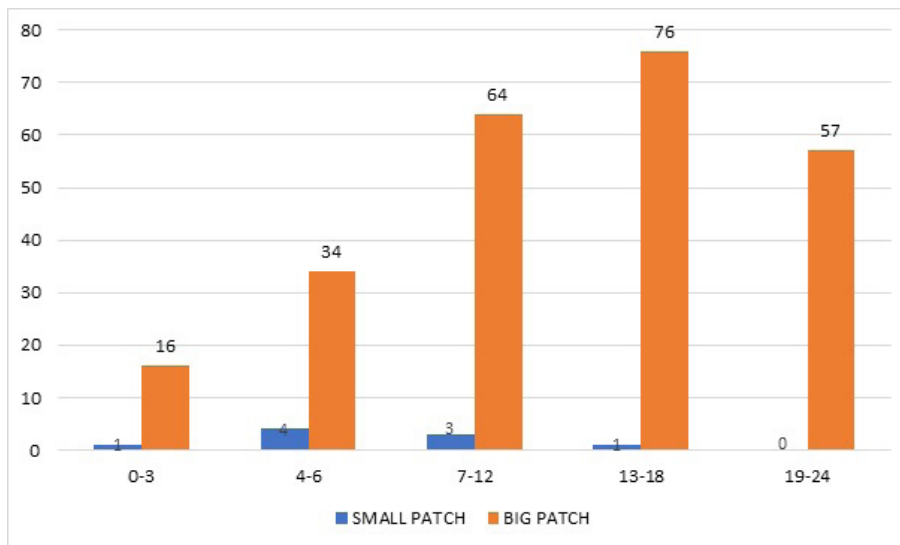
In the majority of cases, well-developed Post-mortem Lividity was seen in 86.33 % followed by diffuse form in 10.16%, Uniform in 2.73%, and patchy in 0.78%. the cases examined between 0-6 hours after death, post mortem lividity was developed but not fixed in the majority of the cases [n= 40 (93.02 %)]. In the examined cases between 6 -18 hours after death post mortem lividity was developed well and fixed in [n=198 (92.96 %)] cases. Post-mortem lividity starts to develop early in 55 minutes as a patchy form in most dependent areas while well development of PML was observed in 7 hours 15 minutes. The average time of development of the lividity is 4 hours 19 minutes  $\pm$  4 hours 13 minutes SD. In the present study, PML starts to be fixed at 3 hours and 5 minutes, and later on, it is fixed so on. The average time of fixation of the lividity is 13 hours 17 min  $\pm$  5 hours 29 minutes SD.

**Table 1: DISTRIBUTION OF CASES ACCORDING TO AGE AND GENDER**

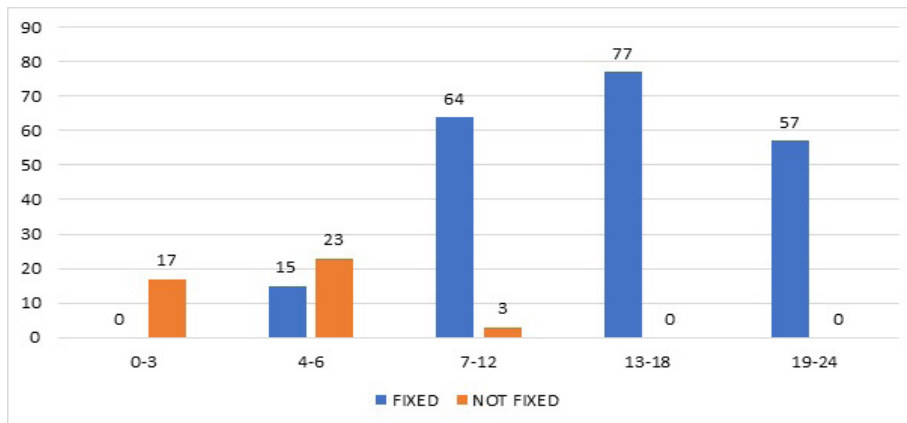
AGE GROUP	MALE	FEMALE	TOTAL	PERCENTAGE
0-10	2	1	3	1.17%
11-20	20	8	28	10.94%
21-30	48	18	66	25.78%
31-40	40	7	47	18.36%
41-50	29	5	34	13.28%
51-60	37	4	41	16.02%
61-70	22	6	28	10.94%
71-80	7	2	9	3.52%
TOTAL	205 (80.08%)	51 (19.92%)	256	100%

**Table 2: DISTRIBUTION OF CASES ACCORDING TO CAUSE OF DEATH**

CASES	NO. OF CASES	PERCENTAGE
ROAD TRAFFIC ACCIDENT	119	46.48%
SUDDEN DEATH	50	19.53%
HANGING	35	13.67%
POISONING	19	7.42%
FALL FROM HEIGHT	16	6.25%
HOMICIDE	8	3.13%
DROWNING	5	1.95%
ELECTROCUTION	3	1.17%
RAILWAY ACCIDENTS	1	0.39%
TOTAL	256	100%



**Figure 1: Time Since death and area of development of staining**



**Figure 2: Time since death and fixation of staining area**

**Discussion**

The post-mortem staining appears as small mottled patches of 1-2 cm. These small patches

gradually coalesce together to form homogenous big patches. The same was concluded in a similar study by Raymane et al.<sup>4</sup> In our study, the earliest



documentation of post-mortem staining was within 1 hour following death and the staining developed as big patches by 3.5 hours, while maximum cases showing big patches were by 12-18 hours (30%) following death and it was found to be statistically significant. In a similar study by Gradwohl et al<sup>5</sup>, it was learned that the staining appears as small patches in 0.5 hours and is well appreciated as big patches in 6-10 hours. Vander at et<sup>6</sup> in his study on postmortem staining documented the earliest formation of small patches by 1 hour and big patches by 8-12 hours. From a study done by Sharanagouda M Arikeri et al<sup>7</sup>, it was learned that the post-mortem staining starts appearing as small patches by 2 hours and coalesce into big patches by 9-12 hours. In a maximum number of cases (95.94%) lividity is appreciated at the posterior surface and dependent areas of the body.

The study done by Shailendra G. Dhawane et al<sup>8</sup> showed male-female ratio was 3:1 and most of the study population belongs to the 21-50 years of age group (67.64%) and concluded that PM lividity developed within 7 hrs was not fixed & PM lividity developed after 7 hrs was fixed, while in this study, we found 4:1 male to female ratio and 57.42% study population belong to 21-50 years of age group and concluded that PM lividity developed within 6 hrs was not fixed & PM lividity developed after 6 hrs was fixed.

### Conclusion

Post mortem Lividity starts appearing as a patchy form by 1-7 hours and well develops by 7-13 hours. Post mortem Lividity gets fixed by 8-18 hours following death. Post mortem Lividity prolongs in case of shock and hemorrhage i.e., Road Traffic

Accident, Fall from height, homicide. As compared to poisoning, hanging, and sudden death.

**Conflict of interest:** None to declare

**Source of Funding:** None to declare

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# Evaluating the Usefulness of Glasgow Coma Scale (GCS) in Diagnosing Traumatic Brain Injury: The Role in the Old Age Patients

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## Abstract

**Background:** Several previous studies have questioned on the applicability of Glasgow Coma Scale (GCS) for patients with old age having Traumatic Brain Injury (TBI).

**Aims and Objectives:** To evaluate the usefulness of GCS in diagnosing TBI in relation to elderly people.

**Materials and Method:** A prospective study was performed involving 558 patients with brain injury out of that 126 had TBI. The GCS was assessed and compared with patients after dividing them into different age groups. Logistic regression was performed after adjusting for addition classical factors influencing the GCS like sex, Abbreviated Injury Scores (AIS) and mode of injury.

**Results:** We found a continuously increasing trend for GCS score with age of the patients having TBI. The similar trend was noted at all the level of severity. Logistic regression has shown a significant trend after adjusting for patients' sex and mode of injury. However, level and height of the fall are the determining factors. GCS score increases significantly after the age of 44.

**Conclusion:** Greater weightage should be given to the age of the patients and the level and mode of injury to patients with TBI during the screening procedure.

**Keywords:** head injury, brain, age of patients, fall, road traffic accidents

## Introduction

Traumatic brain injury (TBI) has become an important challenge faced by the physicians working

in the emergency department due to high trauma-related mortality and disability. Though in emergency department (TRAUMA WARD) TBI can be detected using imaging techniques, overload in the TRAUMA

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WARD can make it difficult to diagnose it on time. This can be achieved by performing initial triage by the staff receiving the patients.<sup>(1)</sup>

Glasgow Coma Scale (GCS) is one of such tools for triage used in the TBI.<sup>(2)</sup> It was first published in the year 1974 which was designed to assess the severity of the brain injury. It was based on the three main aspects of the behaviour including motor responsiveness, verbal performance, and eye-opening.<sup>(3)</sup>

This scale score ranges from 3 to 15 and a patient with normal level of consciousness will have a total score of 15.<sup>(4)</sup> GCS was previously called as Abbreviated Injury Score (AIS) as a defining parameter for TBI, it is still being followed as basic triage tool for determining its presence.<sup>(5)</sup>

Several recent studies have questioned the ability of the GCS to reflect the situation in some of the patients, mainly in the elders. Hence in present study we tried to study the usefulness of GCS in diagnosing traumatic brain injury.

### Materials and Methods

We performed a prospective study including 558 patients having age more than 20 years in a tertiary care hospital from 1.1.2023 to 31.12.2023.

All the patients having head injury admitted to trauma ward were included. Out of 558 patients with head injury 126 had TBI defined as AIS diagnosis of internal brain injury. GCS was recorded for all the patients with TBI.

We exclude those injuries which were due to poisoning, drowning, and suffocation. We also excluded those patients who were discharged from the hospital after treatment in the Trauma ward, and those patients with head injury who were declared dead before arriving at the Trauma ward. We included only those patients whose relatives gave written informed consent for using their data in the study. This data was kept anonymous without revealing patient's identity anywhere.

Variables recorded in this study were demographic details of the patients which include age and genders, reasons for head injury were also recorded. GCS was assessed in TRAUMA WARD. We

also evaluated AIS for those with AIS score between 3-5. In present study we also excluded AIS 6.

Patients having GCS score of 15 was considered as normal score. Further, we divided patients into different age group viz. 20-44 years, 45-64 years, 65-74 years and more than 75 years to compare the GCS role I different age groups.

All the data analysis was performed using IBM SPSS ver. 20 software. Cross tabulation and frequency distribution were performed to prepare the tables. Chi square test was used to find out the association between the categorical variables. Multivariate logistic regression analysis was performed to examine the probability of possessing a GCS lower than 15, as a function of age, when AIS, gender, and injury mechanism were taken into account, due to these variables being associated with both GCS and age, and therefore being able to confound the association between them. For all analyses performed, a value of  $p < 0.01$  was considered statistically significant.

### Results

A total 558 patients having brain injury were screened and out of that 126 were found to have TBI. The reported incidence of TBI in our study was 22.58%.

We observed male preponderance in present study [72 (57.14%)]. Majority of the patients with TBI were old having age more than 65 years [88 (69.84%)].

While assessing the severity of the injury, it was found that more than half of the patients had AIS 4 [69 (54.76%)]. Whereas 12 (16.67%) had severe TBI with AIS 5.

Most common mode of injury was fall due to different reasons like sports [52 (41.57%)] and fall from the buildings [34 (26.98%)] followed by road traffic accidents accounting for 40 (31.74%) patients.

**Table 1: Showing grouping of GCS score among study cohort**

GCS score	No of TBI patients	Percentage
3-8	15	11.90
9-12	4	3.17
13-14	8	6.34
15	99	78.57

**Table 2: Logistic regression for predicting the odds of having a GCS lower than 15 (GCS 3-14).\***

Variables		Adjusted odds ratio	95%CI
Age	20-44	1.9	1.8-2.4
	45-64	1.3	1.1-1.6
	65-74	1.2	0.9-1.3
	>75	1	
AIS	5	11.4	9.4-11.9
	4	2.1	1.8-2.4
	3	1	
Mode of injury	Falls (sports)	1.4	1.1-1.8
	Falls (building)	1.6	1.2-2.4
	RTA	2.5	2.1-2.8
	Falls (from own height)	1	
Gender	Male	1.4	1.2-1.6
	Female	1	

\*C = 0.73. GCS: Glasgow Coma Scale; AIS: Abbreviated Injury Score; RTA: road traffic accident; CI: confidence intervals.

## Discussion

Taking the clue from the previous studies which have doubted the applicability of GCS score in patients with old age with TBI. However, still the association between the age and the GCS is unclear. (6, 7, 8)

Previous researchers have tried to analyse the reasons for this disparity between GCS among the elderly people by looking at the clinical, demographic or social parameters of elderly patients. Few explanations for these differences may be due to difference in the prevalence of mode of injury among the victims. Other reasons explained by the previous authors were alcohol consumption before the injury, elderly women, higher chances for brain injury to elderly people and chances of delay in seeking the treatment among the elderly due to their anatomical peculiarities. (6, 7, 8)

In present study, we found that a continuous effect of age on the GCS score among the patient's with TBI. This highlight uniqueness of elderly patients insufficient making higher chances of brain

injuries. It was also found that GCS score among the TBI patients increases with increasing the age regardless of anatomic injury severity. This is even observed after adjusting for other factors which are significantly associated with GCS such as gender, AIS and mode of injury.

In present study it was found that GCS increases monotonously with increasing age at every AIS level. This trend was mainly observed after the age of 44. Proportion of normal GCS score increased with increasing the severity of the injury assessed by the AIS. This finding is in line with previous studies. Salottolo et al and Kehoe et al in a similar study observed greater age difference in GCS presentation among more severely injured patients. (6, 7)

In present study we found a lower GCS score among male population. The similar findings were reported by previous study done by Kehoe et al in 2015 where author also reported lower GCS among the male population. This highlight the protective effect of female gender in cases of isolated TBI. (7)

When stratified with mode of injury, the age-dependent trends were not as monotonous. For RTA victims having age more than 44 years, the risk of TBI is more as compared to those with age 64 years. Similar findings were reported by previous studies by Kehoe et al (7) and Rau et al. (8)

Patients those who have fall from their own height and hospitalized, patients had similar GCS score who were younger than 65 years of age. However, in later age, the GCs score was observed to grow. In our study proportion of ground level fall (such as sports) is large, this could explain the dichotomic division of the age groups in the previous studies. (9) For those patients who have fall from the building or from the elevation the increase in the GCS scores with age was not found to be significant. This may be due to the large heterogenicity of these groups as hight of the fall depends of the height of the building or elevation. (10)

Based on the findings of the present study we recommend screening procedures for patients with TBI should involve giving a greater weight to the age of adult patients, beyond the level of the basic distinction between "elderly" and "non-elderly", as this factor strongly influences the reliability of triage tools.

## Conclusion

Based on the present study findings we conclude that age has a continuous influence on the reliability of GCS among the patients with TBI. The GCS score was found to be higher among the patients with greater age at all the level of severity. However, the trend also depends on the level and different mode of injury.

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**Conflict of interest** - None

**Permissions** - Obtained from Institutional Ethics Committee, GMERS Medical College, Junagadh on 12.12.2022

## Abbreviations

1. GCS - Glasgow Coma Scale
2. TBI - Traumatic Brain Injury
3. RTA - Road Traffic Accident
4. AIS - Abbreviated Injury Score

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# An Epidemiological Profile of Medico-legal Autopsies at a Tertiary Care Center

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## Abstract

**Background:** An essential and necessary component of any investigation into a sudden, suspicious death is the medico-legal autopsy. It's critical to understand the profile of medico-legal autopsy cases in order to ascertain the mortality rate from non-natural causes in a given area and addressing the demographic requirements in accordance with the region's unique mortality statistics.

**Material & Method:** The present study was a retrospective study of autopsies performed at a tertiary care centre in southern Haryana, from January 2018 to December 2023. During this period a total of 886 medico legal autopsies were conducted. Relevant information and subjective data like age, gender, marital status & manner of death have been collected from medico legal autopsy register from January 2018 to December 2023.

**Results:** It was observed that out of 886 cases male outnumbered females in ratio 2.06:1. Majority of the victims belonged to the age group 21-30 years. Majority of the deaths occurred due to poisoning (n=264, 29.79%), followed by road traffic accidents 26.74%.

**Conclusion:** Majority of cases were in the 3rd decade of life, males outnumbered females. Poisoning and road traffic accidents were the leading cause of death. Public attention, awareness, preventive and remedial strategies should be undertaken to reduce similar incidents.

**Key words:** Medico-legal Autopsies; Poisoning; Road traffic accidents

## Introduction

Medico legal autopsies are an important and

necessary component of any inquiry into a sudden, suspicious death. In addition it helps to address

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demographic needs based on region-specific mortality statistics, the profile of medico legal autopsy cases is crucial for understanding the death statistics in a given area from unnatural causes. It's also essential to research the actual crime rate in the area and avoid future avoidable casualties.<sup>1</sup>

Medical-legal autopsies are conducted upon request from the appropriate authorities in cases involving unexpected, mysterious, unexplained, violent, or criminal deaths. The results of these examinations are used in court for the legal purpose to assist the course of justice.<sup>2</sup> Postmortem examinations are performed to identify bodies when the identities of the deceased are unknown, as well as to determine the cause and time of death, whether the death was natural or not, and if it was not natural, whether it was accidental, homicidal, or suicidal. When it comes to newborns, the issues of viability and live birth are crucial and should be determined.<sup>3</sup>

Deaths due to unnatural causes include road traffic accidents, poisoning, drowning, physical assault, hanging, strangulation, firearm injuries, snakebite, fall from height, traumatic asphyxia, burns, accidental fire, lightning, electrocution, railway accidents, mines disaster, natural disaster, deaths during pregnancy and alcohol intoxication.<sup>4</sup>

The epidemiological profile of medico-legal autopsies is important for understanding the non-natural causes of death in an area and for assisting with demographic needs based on local mortality rates. The present study is an attempt to analyze the epidemiological profile of death so that efforts can be made for reducing their incidence.

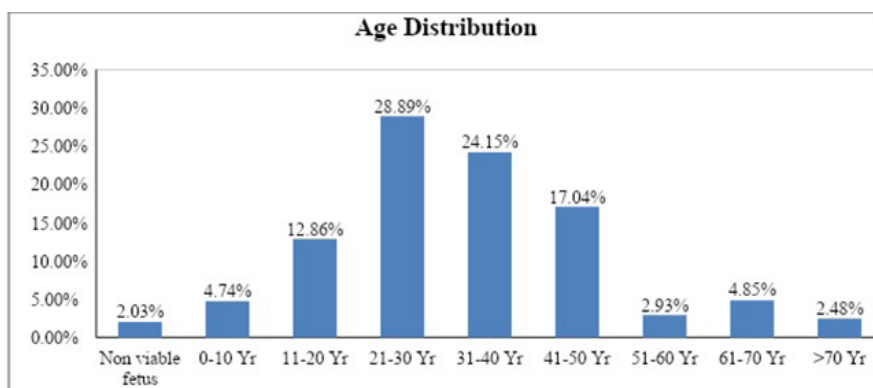
## Materials and Methods

The present study was a retrospective study of autopsies performed in the Department of Forensic Medicine of a tertiary care centre in southern Haryana, from January 2018 to December 2023. During this period a total of 886 medico legal autopsies were conducted in the Department of Forensic Medicine. Relevant information and subjective data like age, gender, marital status & manner of death was collected from medico legal autopsy register while detailed information regarding the circumstances of the death was collected from inquest papers maintaining at most confidentiality. Data was collected and tabulated using a pre-designed format and the information thus collected, was statistically analyzed.

## Observations and Results

A total of 886 medico-legal autopsies were conducted, from January 2018 to December 2023. In our study, it was observed that out of 886 cases, 597 were male (67.38%) and 289 were female (32.61%), the males outnumbered females in ratio 2.06:1.

It was observed in the study that the age group of 21-30 years old accounted for maximum number of medico-legal autopsy cases (28.89%), followed by the age groups of 31-40 years old (24.15%), 41-50 years old (17.04%) and least cases (2.03%) were non-viable fetus. The age wise distribution of medico legal autopsies is depicted in Figure 1.



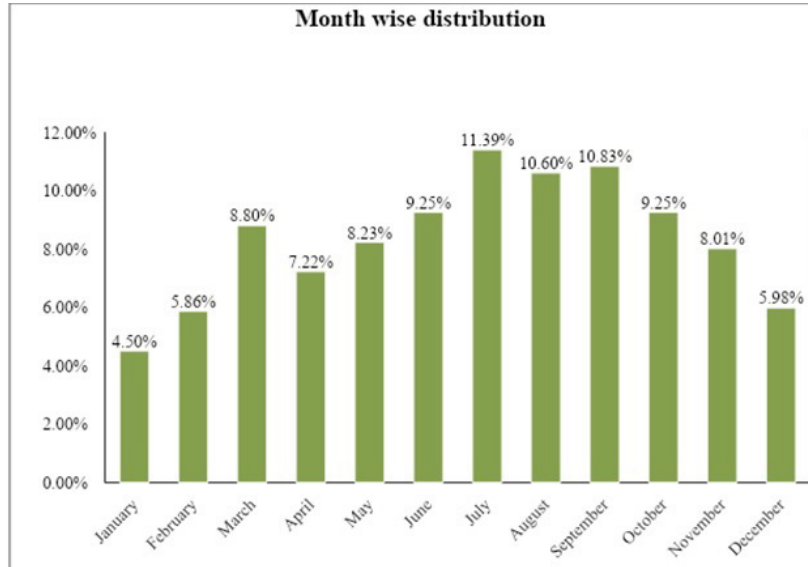
**Figure 1: Bar diagram demonstrating the age distribution (%) of medico legal autopsies (n=886).**

It was observed that 52.82% were Muslims being majority in number, followed by 34.42% Hindu, 09.70% were unknown cases in which religion could not be determined as they were unidentified bodies and 03.04% belonged to other religion.

Additionally, it was also observed that 459 cases (51.80%) were married and 341 (38.48%) were unmarried. Majority of the cases had rural background 72.57% and 17.72% cases belonged to urban areas, while 09.70% cases were unknown.

It was observed that maximum numbers of autopsies 101 (11.39%) were conducted in the month of July, followed by 10.83% in September and least

autopsies were conducted in January. The month wise distribution of medico legal autopsies is depicted in Figure 2.



**Figure 2: Bar diagram demonstrating the month wise distribution (%) of medico legal autopsies (n=886).**

It was observed that out of the total 886 medico legal autopsies the maximum autopsies, with respect to distribution of cases based on its type, poisoning cases being the most prevalent with 264 cases (29.79%) forms the major chunk of the cases followed by road traffic accidents with 237 (26.74%)

cases and drowning with 106 (11.96%) cases. When compared to other case types, these three make up the majority. The least common types were cases of burn, electrocution, railway accidents and blast injuries. Distribution of medico legal autopsy cases based on its type is depicted in Table 1.

**Table 1: Showing distribution of medico legal autopsy cases based on its type (n=886).**

Type of case	Number of cases	Percentage
Poisoning	264	29.79
RTA	237	26.74
Drowning	106	11.96
Disease / Natural	63	07.11
Assault	59	06.65
Hanging	48	05.41
Stillborn / Dead born	18	02.03
Firearm	16	01.80
Snakebite	14	01.58
Not determined	13	01.46
Strangulation	12	01.35
Fall from height	11	01.24
Traumatic asphyxia	09	01.01
Burn	05	00.56
Electrocution	05	00.56
Railway	04	00.45
Blast Injury	02	00.22
Total	886	100



## Discussion

Autopsy is a part of the evidence-gathering process in cases of unnatural, suspicious, and unexpected deaths. In sudden death investigations, autopsy examination explores the cause of death and resolves the suspicion of foul play in such unexpected deaths.<sup>5</sup>

In our study a total of 886 medico legal autopsies were conducted, from January 2018 to December 2023 and it was observed that out of 886 cases 597 were males (67.38%) and 289 were females (32.61%) and males outnumbered females in ratio 2.06:1. The reason for this is due to the fact that men are more likely to be involved in accidents, violence and stressful situations because they earn a living while women take care of home. These findings are in general agreement with the studies conducted by Junaidi et al,<sup>4</sup> Mugadlimath et al<sup>6</sup> and Kumar et al.<sup>1</sup>

In our study the age group of 21-30 years old accounted for the maximum number of autopsy cases (n=256, 28.89%), followed by that of 31-40 years old (n=214,24.15%). These results are consistent with those of Kumar et al<sup>1</sup> and Gannur et al.<sup>7</sup>

In the present study 52.82% were Muslims, followed by Hindus (34.42%), and the remaining 12.75% were others and unknown. The Muslim majority in this region is the reason for the high death toll among Muslims. The findings of our study are contrary to those of Junaidi et al<sup>4</sup> and Kumar et al<sup>1</sup>, where the majority population was Hindu.

In our study, of all medico-legal autopsies 72.57% were from rural areas, and only 17.72% were from urban areas. Our centre serves a more rural population, which is justified by this difference. The findings of our study were in line with those of study done by Junaidi et al<sup>4</sup> and Sahu et al.<sup>8</sup>

Our study's findings, based on the month wise distribution of cases indicated that there were more cases from July to September than from April to June, in contrast to the findings of studies conducted by Patel et al,<sup>9</sup> Junaidi et al<sup>4</sup> and Awadesh et al.<sup>10</sup>

In our study, deaths due to poisoning cases (n=264, 29.79%) are highest, followed by road traffic accidents 26.74%. Similar findings are observed in a study done by Gannur et al.<sup>7</sup> However, the findings

of our study are contrary to those of Agrawal et al<sup>11</sup> and Kartikeyan et al<sup>12</sup>, where the majority of deaths occurred due to trauma. This region is an agricultural area, making pesticides easily accessible for ingestion either intentionally or unintentionally, which contributes to poisoning being the leading cause of death in our study.

## Conclusion

From the present study it was concluded that the majority of cases were in the 3rd decade of life, males outnumbered females, rural residents were more in number, Muslims being in majority formed bulk of cases, poisoning, road traffic accidents and drowning were observed as leading causes of death. Maximum numbers of cases were seen in the period between July to September. Early government policies are necessary to address the various socioeconomic factors contributing to the high incidence of suicidal poisoning. The relevant authorities should impose stringent regulations to regulate the sale of agrochemicals and other pesticides. The general public should be educated about road safety measures, and strict enforcement of traffic laws, with special attention paid to drunken drivers, the use of cell phones, reckless and careless driving, are some of the measures that should be taken to reduce the mortality rate, particularly that results from road traffic accidents.

**Conflict of interest:** None

**Ethical approval:** Prior permission was not taken from the IEC as it was a record-based study without involving any live subjects or experimentation.

**Data Retention Statement**

The present study was a record based retrospective study. As per ethical guidelines, the identity of the deceased has not been disclosed. Data for the study was collected in a coded format maintaining at most confidentiality.

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# An Assessment of Death Profile of Unknown Dead Bodies, Brought for Autopsy to the Department of Forensic Medicine and Toxicology in Government Medical College of Garhwal Region, Uttarakhand: A Retrospective Study

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## Abstract

**Background:** an unknown dead body always becomes a challenge to the Investigating officer and forensic expert. However, the problem of determining the identity gets aggravated and taxes for the experts, when the dead body is recovered in decomposed/ skeletonized and mutilated form.

**Materials and Methods:** A standard proforma was designed to collect the information to ensure consistency for the whole sample. All dead bodies that were brought as unidentified were included however identified dead bodies were excluded from the study.

**Results:** A total of 407 post-mortem examinations were conducted at the mortuary of the department during under study and amongst them, 56 cases (13.75%) were found unidentified. Of these unidentified cases, 69.64% (39 cases) were in decomposed and 30.35% (17 cases) were in fresh state. Unidentified cases comprised 80.35% males (45 cases) and 19.64% females (11 cases).

**Conclusion:** Unidentified dead bodies were only 13.75% of the total dead bodies coming to the autopsy in the mortuary of the Department of Forensic Medicine and Toxicology, VCSGGIMS & R, Srikot, Srinagar, Pauri Garhwal, UTTARAKHAND during the study period of 5 years.

**Keywords:** Drowning, Medico-legal Autopsy, Unidentified bodies, artefact .

## Introduction

Identification means establishing the

individuality of a person<sup>2</sup>. It is important for both civil and criminal cases. Identification is carried out in both living and dead persons<sup>2</sup>. Establishing the

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identity of an unknown dead body always becomes a challenge to the Investigating officer and forensic expert. However, when a deceased person is found in a decomposing, skeletonized, or disfigured state, the identification process becomes more challenging and time-consuming for the specialists.<sup>3</sup> This mutilation may be due to the criminal intention to destroy all traces of identity or by animals as a post-mortem artifact. Mass disasters like earthquakes, bomb explosions, railway accidents, air crashes, tsunamis, etc. are other common instances where dead bodies are found in decomposed/ mutilated states<sup>1, 4</sup>. In such cases establishing the identity and cause of death becomes a Herculin task. A study also carried out by Hirsch showed that without any underlying cause, death would not have occurred<sup>5</sup>. There are 5 legally defined manners of death namely natural deaths, suicidal deaths, homicidal deaths, accidental deaths, and undetermined deaths. The purpose of the study is to obtain a profile of unidentified dead bodies concerning their age, sex, percentage of dead bodies that remain unidentified, cause and manner of death and to identify the place from where maximum numbers of dead bodies are brought for autopsy. Information on the accuracy of cause and manner of death on medico-legal autopsy of unknown/unclaimed dead bodies and to raise the awareness of the law enforcement authorities that they have to be careful in making decisions in issuing judgment.

### Material and Methods

This is a record-based study including post-mortem reports of unknown/unclaimed dead bodies brought to the Department of Forensic Medicine & Toxicology in VCSGGIMS & R, Srikot, Srinagar, Pauri Garhwal, UTTARAKHAND. We examined all available files of inquest papers, and autopsy reports from 1st January 2018 to 31st December 2022.

A standard proforma was designed to collect the information to ensure consistency for the whole sample. All dead bodies that were brought as unidentified were included however identified dead bodies were excluded from the study. Permission was taken from the Department to use the data for publication.

### Results

A total 407 post-mortem examinations were conducted at the mortuary of the department during under study and amongst them 56 cases (13.75%) were found unidentified. Of these unidentified cases 69.64% (39 cases) were in decomposed and 30.35% (17 cases) were in fresh state. Unidentified cases comprised 80.35% males (45 cases) and 19.64% females (11 cases). (Table 1)

**Table 1: Sex-wise distribution of cases.**

S.No.	Year	Male	Female	Total
1	2018	8 (72.72%)	3 (27.27%)	11
2	2019	9 (90%)	1 (10%)	10
3	2020	8 (61.53%)	5 (38.46%)	13
4	2021	11 (91.66%)	1 (8.33%)	12
5	2022	9 (90%)	1 (10%)	10
	Total	45 (80.35%)	11 (19.64%)	56

The maximum number of cases belonged to the age group of 31-40 years (35.71%), followed by the age group of 21-30 years (19.64%). The least number of cases were in the age group of 11-20 years. (Table 2)

**Table 2: Age wise distribution of cases.**

S.No.	Age group	No. of cases
1	0-10 years	7 (12.5%)
2	11-20 years	0
3	21-30 years	11 (19.64%)
4	31-40 years	20 (35.71%)
5	41-50 years	8 (14.28%)
6	51-60 years	4 (7.14%)
7	61-70 years	4 (7.14%)
8	71-80 years	2 (3.57%)
	Total	56

Overall maximum number of cases were encountered in the month of September (16.04% cases), followed by July (14.28% cases), and the least number of cases encountered in January (1.78% cases). However, there was no such pattern in year-wise distribution, the maximum number of cases brought on September 2018 and July 2022 (Table 3)

**Table 3: Month-wise distribution**

S.No.	Month	2018	2019	2020	2021	2022	Total
1	January	1					1 (1.78%)
2	February	1		1	1		3 (5.35%)
3	March			1	3	3	7 (12.5%)
4	April		1	1	1		3 (5.35%)
5	May	1		1	2		4 (7.14%)
6	June		1	3		1	5 (8.92%)
7	July		2	1	1	4	8 (14.28%)
8	August		1	1	1		3 (5.35%)
9	September	4	2	1	1	1	9 (16.07%)
10	October	2		2	1		5 (8.92%)
11	November	1	1		1		3 (5.35%)
12	December	1	2	1		1	5 (8.92%)

The maximum number of unidentified cases that were brought for autopsy was recovered from River (71.42%), followed by Hospital deaths (14.28%). (Table 4).

**Table 4: Area-wise distribution of cases from where dead bodies were recovered**

S.No.	Dead body recovered from	No. of cases
1	RIVER	40 (71.42%)
2	ROAD SIDE	5 (8.92%)
3	HOSPITAL	8 (14.28%)
4	GARBAGE	2 (3.57%)
5	BURRIED	1 (1.78%)

Opinion regarding the cause of death was given at the time of autopsy in 51.78% of cases while in the remaining 48.21% of cases, additional investigation was required. Viscera has been preserved in 57.14% of cases and sent for chemical analysis, and histopathology in 5.35% of cases.

**Table 5: Cause of death-wise distribution of cases**

S.No.	Cause of death	Number of cases
1	Natural Disease	6 (10.71%)
2	Drowning	12 (21.42%)
3	Strangulation	1 (1.78%)
4	Head injury	8 (14.28%)
5	Polytrauma	2 (3.57%)
6	Opinion reserved	27 (48.21%)

**Table 6: Showing the manner of death**

S.No.	Manner of death	Number of cases
1	NATURAL	6 (10.71%)
2	ACCIDENTAL	18 (32.14%)
3	SUICIDAL	0
4	HOMICIDAL	1 (1.78%)
5	UNKNOWN	31 (55.35%)

The majority of the opinions regarding the cause of death in these cases was given as 'drowning' (21.42%) followed by head injury (14.28%), death due to nature disease (10.71%), poly-trauma (5.57%), and least number of strangulation (1.78%) (Table 5). Regarding manner of death in these cases is presented in Table number 6.

To determine the individuality of the dead body, the investigating officer completed his formalities regarding photographs and publication of notices in newspapers in all the cases. Preservation of sternum/tooth/scalp hairs for DNA analysis in 71.42% of cases.

## Discussion

Uttarakhand state also called as the "Dev Bhumi" or the "Land of Gods" and is in northern part of India. This state receives large number of pilgrim's during the March to October since it is a very important for Hindu pilgrimage Char Dhaam Yatra as well as Sikh pilgrimage. Srinagar is a tehsil in Pauri Garhwal district which is a gate way for all

religious sites. Many Himalayan rivers drain into the Alaknanda River which passes through Srinagar. Being a hill state and home to many beautiful hill stations, it also attracts large number of tourists. Its situation make it prone to many natural disasters like cloudburst, floods, earth quack etc. As on 17<sup>th</sup> June 2013, Mandakini & Alaknanda valley of Garhwal received a heavy downpour and the cloudburst resulted in flash flood which was further intensified by the outburst of Besoka Lake, thus caused a huge devastation <sup>6,7</sup>. Determination of death profile of unknown dead bodies becomes a huge task for the autopsy doctor at that time. In our study total of 407 dead bodies was brought to the department for autopsy during the period 1st January 2021 to 31st December 2022 and among them 13.75% were identified as unidentified. However, studies conducted in New Delhi (16%) and Kolkata (24.5%) showed more number of unidentified deaths<sup>8,9</sup>. Since both cities are metropolitan and therefore the residing population is larger. Significantly only 3% of unidentified deaths <sup>10</sup> and a study conducted at Ahmedabad showed 7.43% unidentified deaths <sup>11</sup>. Among these unidentified bodies decomposition had started in 69.64% of cases and in 30.35% of cases dead bodies were in a fresh state. Males were predominant accounting for 80.35%, outnumbered females were 19.64% and these findings were consistent with similar findings observed in a study in Maharashtra <sup>12</sup>. As far as age is concerned, in the present study age group of 31-40 years was most affected and accounted for 35.71% of the total unidentified dead bodies. The study conducted at New Delhi (31-50 years), Chandigarh (21-50 years), Kolkata (31-45 years), Villupuram, Tamilnadu (51-70 years) and Ahmedabad (31.73%) showed somewhat similar findings (8,10,11). In the present study, the maximum number of deaths was observed in September (16.07%) followed by July (14.28%) months of the rainy season because many natural disasters happen during this period. The study conducted at Chandigarh exhibited more deaths in the winter season <sup>10</sup>. About 71.42% of cases were recovered from river followed by 14.28% of cases of hospital deaths. In 48.21% of cases as far as possible an attempt is made to give a definite opinion, when this is not possible "opinion reserved" is mentioned in the report as regards the cause of death, and Viscera was sent for chemical

analysis in 57.14% cases and histopathology in 5.35% of cases. Drowning accounts for 21.42 % of total unidentified deaths as the cause of death in the present study, followed by head injury in 14.28% of total cases. The study conducted at Ahmedabad had 20.19% coronary artery disease as a cause of death <sup>11</sup>. However, Kumar et al and Gitanjali noted 47.1% and 26.93% of deaths due to trauma respectively<sup>10, 13</sup>. As regards to facilitate the process of identification of the victim Sternum/ Tooth/ Scalp hairs were preserved for DNA analysis again at the request of the police officials.

### Conclusion

Unidentified dead bodies were only 13.75% of the total dead bodies coming to the autopsy in the mortuary of the Department of Forensic Medicine and Toxicology, VCSGIMS & R, Srikot, Srinagar, Pauri Garhwal, UTTARAKHAND during the study period of 5 years. The highest number of cases belong to the middle age group (31-40 years), the maximum number of deaths reported in the rainy season of the year. The cause was given as 'Opinion reserved' (48.21%) followed by Drowning (21.42%). Unidentified death cases pose challenges to the Investigating officer as well as the autopsy surgeon. As regards identification by the police personnel's request to preserve pieces of bone/ tooth/hairs etc. for DNA profiling. It is desired that the police personnel should take appropriate photos of the deceased, and clothing and upload them with the description of the deceased. Dental records and whole radiography may be useful for establishing the identity, which may reveal any old fracture or implant.

There is an urgent need to form a separate portal for unidentified death registration at the National level and their site should be easily visible and user-friendly. With the little effect on both sites by the doctors and investigating officers in many cases surprisingly, a large amount of information can be obtained even in the presence of the highly decomposed body.

Such information becomes a great advantage for the doctors and investigating officers to establish the identity and form an opinion about the cause and manner of death in unidentified cases.

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**Ethical Clearance:** Obtained from Institutional Ethical Committee. Certificate number- MC/IEC/2022-23/81 dated: 8th July 2023.

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## Near hanging with Multiple Tentative Cuts: A Case Series

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### Abstract

Suicide is one of the major global health issues specially in countries having low to medium socioeconomic condition. Hanging is method of choice for adults to commit suicide. Near hanging defined as person who survive a hanging injury for enough time to reach hospital. Tentative cut or self-inflicted injury is an intentional and direct injury to own's body part. It is also known as self-harm, self-wounding, moderate self-mutilation and parasuicide. Various factors responsible for high mortality in near hanging are low systolic blood pressure (<90), injury severity score (ISS) >15, Glasgow coma scale (GCS) <8, hypoxic brain injury on CT scan. Immediate arrival to hospital and aggressive management of near hanging and its complication can improve the final outcome.

**Keywords:** Near-hanging, Self-harm, Suicidal, Tentative cuts

### Introduction

Suicide is one of the major global health issues specially in countries having low to medium socioeconomic condition. Suicide is at 4<sup>th</sup> spot for cause of death among age group 15-29 years. 77% of worldwide suicide occur in countries having low to medium socioeconomic condition. Pesticide ingestion, hanging and firearm are leading methods of suicide in the whole world<sup>1</sup>. Various methods of suicide in India are pesticides ingestion, firearm, hanging, jumping from bridge, jumping in front of

train<sup>2</sup>. Hanging is method of choice in India for adults to commit suicide<sup>3</sup>. Hanging has higher success rate in comparison to other methods of suicide<sup>4,5</sup>. Hanging is defined as form of asphyxia caused by suspension of body by a ligature which constrict the neck and the constricting force being the body weight<sup>6</sup>. Near hanging defined as person who survive a hanging injury for enough time to reach hospital<sup>3</sup>. Cause of morbidity and mortality in hanging is due to venous compression, cerebral hypoxia, injury to laryngeal apparatus, laryngeal oedema resulting into

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respiratory obstruction, vagal inhibition and many other pulmonary complications such as aspiration pneumonia, pulmonary oedema, acute respiratory distress syndrome, status epilepticus, subarachnoid haemorrhage, hyperthermia etc<sup>7</sup>. Various factors responsible for high mortality in near hanging are low systolic blood pressure (<90), injury severity score (ISS) >15, Glassgow coma scale (GCS) <8, hypoxic brain injury on CT scan<sup>7,8</sup>.

Tentative cuts or self-inflicted injury is an intentional and direct injury to own's body part without intention of suicide<sup>9</sup>. It is also known as self-harm<sup>10</sup>, self-wounding<sup>11</sup>, moderate self-mutilation<sup>12</sup> and parasuicide<sup>13</sup>. This stereotypic behaviour not only seen in psychiatric populations but also common in nonclinical populations<sup>14</sup>. Skin cutting is most common self-inflicted injury. Other forms of self-inflicted injuries are burning, hitting body part, scratching and hindering the wound healing process<sup>9,15</sup>.

### Case Description:

#### Case 1.

A 19 years old female was admitted in female medicine ward at Gandhi Memorial and associated Hospital, King George's Medical University (KGMU) as a case of suspected hanging. A reference came to department of forensic medicine and toxicology, KGMU for examination, evaluation and giving expert opinion.

#### Examination of case no. 1

Examined the patient on bedside in medicine female ward, at Gandhi Memorial & associated Hospital, King George's Medical University (KGMU). Patient was conscious and well oriented to time, place and person. GCS was 14/15, BP was 149/97 mm Hg, pulse rate 101 and SPO<sub>2</sub> was 96%.

**Examination of local injuries:** On examination following injuries noted-

1. A reddish-brown ligature mark of dimension 8 cm×3 to 3.5 cm was present in front of neck, above thyroid cartilage. Ligature mark was 6cm below chin. From right ear lobule ligature mark was 10 cm vertically downward on right side and from left ear lobule ligature was 8.5cm vertically downward on left side.

There was interruption of 26 cm on back of neck. Ligature mark was moving obliquely upward from right front side of neck to left front side of neck. (Image no. 1)

2. 2 linear old abrasions of size 4 cm parallel to each other present on ventral aspect of left wrist.(Image no. 2)

**Blood investigations:** Blood investigation- total leucocyte count (TLC) was raised (15900 cells/mm<sup>3</sup>), neutrophil 82%, lymphocyte 14%, serum Na<sup>+</sup> was high (155.3mmol/l). Rest of the blood parameter was within normal range.

**Diagnosis and Opinion:** 1. Nature, pattern and characteristic of ligature mark (Injury No.1) is suggestive of hanging. 2. Injury no. 2 is suggestive of tentative cuts.

**Advise:** Patient was advised for psychiatric evaluation.

#### Case 2.

A 32 years old male was admitted in medicine male ward at Gandhi Memorial and associated Hospital, King George's Medical University (KGMU) as a case of suspected hanging. A reference came to department of forensic medicine and toxicology, KGMU for examination, evaluation and giving expert opinion.

#### Examination of case no. 2

Examined the patient 32-year-old male on bedside in medicine male ward at Gandhi Memorial & associated Hospital, King George's Medical University (KGMU). Patient was conscious but not well oriented to time, place and person. GCS was E<sub>3</sub>V<sub>1</sub>M<sub>4</sub>, BP was 104/60 mm Hg, pulse rate 84 and SPO<sub>2</sub> was 86%.

**Examination of local injuries:** On examination following injuries noted-

1. A reddish-brown ligature mark of dimension 24 cm×2 cm was present in front of neck, above thyroid cartilage. Ligature mark was 6 cm below chin. From right ear lobule ligature mark was 6 cm vertically downward on right side and from left ear lobule ligature was 5 cm vertically downward on left side. There was interruption of 13 cm on back of neck. Ligature mark was directed obliquely

upward from right front side of neck to left front side of neck. (Image no. 3 & 4)

- Multiple linear old abrasions of size 2 cm to 4 cm parallel to each other were present on ventral aspect of left wrist.

**Blood investigations:** Blood investigation- total leucocyte count (TLC) was raised (18200 cells/mm<sup>3</sup>), neutrophil 88%, lymphocyte 10%. serum electrolyte and other blood parameters were within normal range.

**Diagnosis and Opinion:** 1. Nature, pattern and characteristic of ligature mark (Injury No.1) is suggestive of hanging. 2. Injury no. 2 is suggestive of tentative cuts.

**Advise:** Patient was advised for psychiatric evaluation.

### Case 3.

A 22-year-old male was admitted in medicine male ward at Gandhi Memorial and associated Hospital, King George's Medical University (KGMU) as a case of suspected hanging. A reference came to department of forensic medicine and toxicology, KGMU for examination, evaluation and giving expert opinion.

### Examination of case no. 3

Examined the patient 22-year-old female on bedside. Patient was conscious and well oriented to time, place and person. GCS was E<sub>4</sub>V5M5, BP was 118/94 mm Hg, pulse rate 84 and SPO<sub>2</sub> was 91%.

**Examination of local injuries:** On examination following injuries noted-

- A reddish-brown ligature mark of dimension 24 cm×1.5 cm was present in front of neck, above thyroid cartilage. Ligature mark was 7 cm below chin. From right ear lobule ligature mark was 5 cm vertically downward on right side and from left ear lobule ligature was 5 cm vertically downward on left side. There was interruption of 8 cm on back of neck. Ligature mark was directed obliquely upward from left front side of neck to right front side of neck. (Image no. 5)
- Multiple linear old abrasions of size 3 cm to 5 cm parallel to each other were present on ventral aspect of left wrist. (Image no. 6)

**Blood investigations:** Blood investigation- total leucocyte count (TLC) was raised (15100 cells/mm<sup>3</sup>), neutrophil 86%, lymphocyte 12%. Serum sodium was raised (151) other serum electrolyte and blood parameters were within normal range.

**Diagnosis and Opinion:** 1. Nature, pattern, and characteristic of ligature mark (Injury No.1) is suggestive of hanging. 2. Injury no. 2 is suggestive of tentative cuts.

**Advise:** Patient was advised for psychiatric evaluation.



Image no. 1. Showing ligature mark at neck



Image no. 2. Showing tentative cuts at left wrist.



Image no.3. Showing hanging ligature mark at front of neck



**Image no.4. Showing hanging ligature mark at right lateral side of neck**



**Image no.5. Showing hanging ligature mark at front of neck**



**Image no. 6. Showing tentative cuts at left wrist.**

### Discussion

India has highest number of deaths by suicide in the world and most common method of suicide in India is hanging followed by pesticides ingestion<sup>16</sup>. Venous congestion, cerebral hypoxia, laryngeal oedema airway obstruction, laryngeal, laryngeal rupture, vasovagal attack due to stimulation of carotid sinus, fracture of hyoid bone and laryngeal apparatus, pulmonary complication like pulmonary oedema, acute respiratory distress syndrome (ARDS), bronchopneumonia and aspiration pneumonia

are the important reasons behind morbidity and mortality of near hanging<sup>17,18</sup>. Judicial hanging and non-judicial hanging are two major types of hanging. In judicial hanging body drops from height greater than individual height and death is caused by transection of spinal cord. In non-judicial hanging body drop from height less than individual height i.e., insignificant height. Depending on outcome, the non-judicial hanging may fatal or non-fatal. The term near hanging is used for non-fatal nonjudicial hanging<sup>19</sup>. All the discuss cases in the present study were of near hanging.

Characteristic features of non-judicial hanging are ligature mark around the neck and petechial haemorrhage around subconjunctival region due to venous engorgement<sup>20,21</sup>. Petechial haemorrhage and laryngeal fracture are uncommon in near hanging and were not seen in any of the case in our study. Injury of cervical spine is uncommon in near hanging since there was no significant drop from height<sup>22</sup>. Cervical injury was not present in any of the victim in our study. To rule out cervical and laryngeal injuries we advised for plain radiograph of neck and CT scan of head and neck. Overall survival rates of near hanging are about 70 to 100 percent<sup>3</sup>. There are various important predictor of high mortality in near hanging and one of them is Glasgow coma scale (GCS)<sup>7,8</sup>. GCS scores is highly controversial and most inconsistent. Jawaaid, *et al* in their study found that GCS was <8 (defined as poor GCS) in 56 patients out of 101. Almost all the 56 patients required endotracheal intubation. Out of 56 patient 42 completely recovered and 10 had poor neurological outcome<sup>23</sup>. Similarly, Ali *et al*. in their case series found that a GCS score of  $\leq 8$  on arrival of patient was not to have significant association with clinical outcome<sup>24</sup>. A GCS score of 3 at time admission was found to be associated with poor clinical outcome independently in three case series<sup>25,26,27</sup>. In our case series all the three patients had GCS  $\geq 8$  and had good outcome. Other important predictors for outcome are systolic blood pressure (<90), injury severity score (ISS) >15, hypoxic brain injury on CT scan and presentation after 4 hours<sup>7,8,24</sup>. Due to lack of guideline for management of the patient of near-hanging, the approach for management was based on Advanced Trauma Life Support (ATLS) guideline<sup>28</sup> require cervical spine immobilization, airways securing by endotracheal

intubation, fluid and electrolyte balance, glycaemic control and maintain normal arterial carbon dioxide pressure to maintain normal intracranial tension<sup>17,18</sup>. CT head and neck recommended if there is persistent neurological deficit within 24 hours of admission. In our case series we recommended CT scan of head and neck in all the three cases. All the patients of near hanging with or without neurological deficit or respiratory distress must be taken seriously and managed aggressively since the recovery is usually complete.

Tentative cuts are intentional and direct injury to own's body part without intention of suicide and this stereotypic behaviour not only seen in psychiatric populations but also common in nonclinical populations<sup>9,14</sup>. These intentional injuries are indicators of risk of suicide in near future. In our case series all the three patients had tentative over wrist and hence we advised them for psychiatric evaluation.

### Conclusions

Immediate arrival to hospital and immediate management of near hanging patients with standard protocol can definitely improve the outcome. Further management of common complication such as respiratory distress, pulmonary oedema, seizure, and other neurological deficit can improved the final outcome of near hanging patients. Intentional injuries are indicators of risk of suicide in near future hence such patient advised for psychiatric evaluation to reduce the risk of another future self-harm.

**Conflict of interest:** Nil

**Source of Funding:** Nil

### Data Retention Statement

- All data collected for the study were anonymized.
- Particulars of the patients were available only to the authors of this study.
- Patient's confidentiality was maintained during collecting the data.

**Consent:** Informed consent from the family was taken to published the photograph of the patient.

**Abbreviations:** GCS: Glassgow coma scale, CT: Computed tomography, KGMU: King George's Medical University.

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# Profile of Cases of Death Due to Coronary Artery Disease: An Autopsy Based Descriptive Study

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## Abstract

**Background:** Most common cause of sudden cardiac death is coronary artery disease, which contributes to 75 to 90%. The present study is undertaken to describe the profile of autopsy cases of coronary artery disease.

**Methods:** Descriptive cross-sectional study was conducted in all cases of sudden and unexpected death brought for autopsy a tertiary level centre in southern Kerala during a period of one year. Gross and microscopical examination of heart and coronary arteries were studied and in cases with coronary artery disease, associated factors like previous history of illness, personal habits, family history of illness, body mass index, abdominal circumference, horizontal earlobe crease were described in detail. Categorical variables were represented as frequency and percentage, continuous variables as mean and standard deviation and association was tested using Chi square test.

**Conclusions:** Statistically significant association ( $p$  value = 0.001) was observed between the horizontal earlobe crease and occlusive coronary artery disease. No significant association was obtained between the obesity parameters like body mass index, waist to hip ratio and occlusive coronary artery disease. Majority of the cases with significant occlusion was observed in the left anterior descending artery. The most common site of thrombus was in the proximal third of left anterior descending artery.

**Key words:** Sudden cardiac death, coronary artery disease, coronary thrombosis, coronary atherosclerosis, horizontal earlobe crease.

## Introduction

Sudden cardiac death is unexpected natural death of a person due to cardiac cause, within 24 hours of

onset of symptoms without any prior fatal disease<sup>1</sup>. Cardiac disorders constitute the most common causes of sudden and unexpected deaths. Among the sudden cardiac deaths, the most common cause

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is coronary artery disease (CAD) and it contributes 75 to 90% of sudden cardiac deaths in the world <sup>2,3,4</sup>

**Objectives:**

1. To analyze the profile of autopsy cases of death due to coronary artery disease
2. To find out the proportion of coronary artery disease among autopsy cases of sudden cardiac deaths

**Materials and Methods**

Descriptive cross-sectional study was conducted in all cases of sudden and unexpected death brought for autopsy a tertiary level centre in southern Kerala during a period of one year. The study was conducted after getting Institutional Ethics Committee and institutional research committee approval. Cases selected after obtaining the informed consent from the accompanying near relative. Personal details of the deceased like occupation, income, previous history of the illness (CAD, Hypertension, Diabetic Mellitus), personal habits (smoking and alcoholism), family history of CAD were collected from the police and the available near relative. During autopsy examination height, weight, waist circumference (midway between the lower rib margin and the iliac crest), hip circumference (at the level of widest circumference over the greater trochanters), abdominal subcutaneous fat thickness (midway

between the umbilicus and pubic symphysis) were taken. Gross details of aorta and heart including examination of coronary arteries were recorded and bits from relevant areas subjected to microscopic examination and findings noted.

Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meter. Base on BMI subjects were classified into four categories: < 20-lean, 20 to 24.9 (normal), 25 to 29.9 (overweight) and > 30kg/m<sup>2</sup> (obese). Waist hip ratio was calculated by dividing waist circumference with hip circumference. Data was collected using intake proforma, entered in Microsoft Excel spread sheet and analyzed using SPSS software version 16.0. Categorical variables were represented as frequency and percentage, continuous variables as mean and standard deviation and association was tested using Chi square test.

**Results and Discussion**

During the study period total 120 cases of sudden cardiac death were autopsied. Among that 92(76.7 %) cases were coronary artery disease, which included cases of Occlusive coronary artery disease and Coronary artery thrombosis.

The demographic characteristics of the cases are as follows,

**Table. 1 Age and Sex Distribution of the study population**

Age group (in years)	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
20-30	4	4.8	0	0	4	4.3
30-40	6	7.1	2	25	8	8.7
40-50	27	32.2	2	25	27	29.3
50-60	25	29.8	2	25	29	31.6
60-70	19	22.6	2	25	21	22.8
70-80	3	3.5	0	0	3	3.3
Total	84	100	8	100	92	100

**$\chi^2 = 34.360$        $df = 6$        $p = .001$**

A significant (*p value = 0.001*) relation was present between the age of the persons and sudden death due to occlusive coronary artery disease. The peak age of incidence was found to be 41 to 50 years, followed by 51 to 60 years. Higher occurrence of atherosclerosis was noted in 4<sup>th</sup> decade in a study conducted in

Trivandrum medical college (Sasikala K; Occlusive coronary artery disease - a histomorphological study of 100 medico-legal cases , Unpublished thesis.1996)

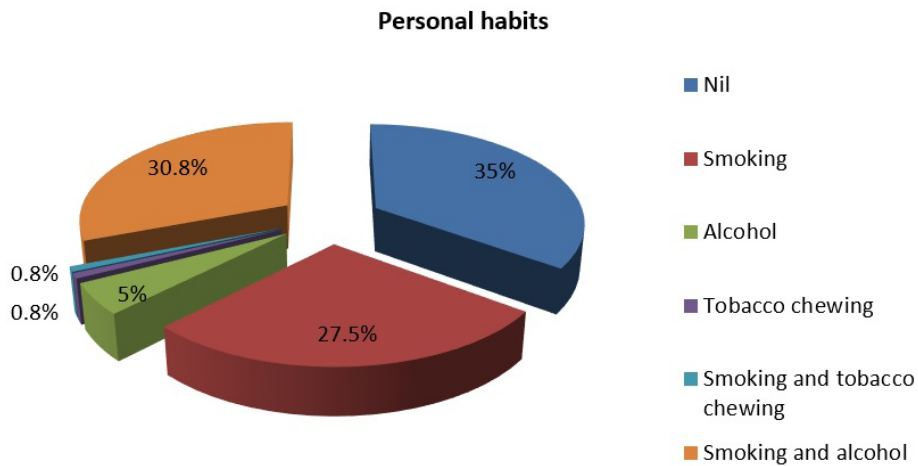
Males predominated in the study population (91%) which tallies with the observations of the

previous studies<sup>3,4</sup>. This huge preponderance is due to the higher incidence of coronary atherosclerosis in males, which forms the major part of the sudden death due to cardiac causes. Use of alcohol and

cigarette smoking may be the predisposing factors. Premenopausal females are well protected from the risk of atherosclerosis due to the presence of oestrogen.

**Table 2. Baseline characteristics of study population (N= 92)**

	Characteristics	Frequency	Percentage
Personal details	Dietary habits - Non veg	91	97.8
	Hypertension	22	23.9
	Diabetes mellitus	1	1.1
	Smoking	28	30.4
	Alcoholism	7	7.6
	Past H/o Heart disease	6	6.5
	Horizontal ear lobe crease	61	66.3
	Family history	Hyperlipidaemia	4
Diabetes mellitus		7	7.6
Hypertension		14	15.2



**Figure 1 Personal Habits**

A highly significant association ( $p\ value=0.008$ ) was found between smoking and coronary artery disease of the study sample.

Family history of hypertension was present in 15% cases. No significant family history was obtained in 75.8% of cases. Family history of the diseases like hypertension, diabetes and hyperlipidaemia have a contributory role in the development of coronary atherosclerosis. In the present series, relevant family history was obtained only in 24.2% of cases. This may be due to the inadequacy of the history obtained from the relatives available at autopsy.

Statistically significant association ( $p\ value = 0.001$ ) was observed between the horizontal earlobe

crease and occlusive coronary artery disease. This agrees with the findings of Moraes et al<sup>5</sup> and Toyosak et al<sup>6</sup> which may be considered as a prediction for the presence of coronary artery disease.

**General physical details**

**Table 3. Body mass index (N= 92)**

Body mass index	Number	Percentage
Under weight	6	6.5
Normal	31	33.6
Overweight or obese	55	59.8
Total	92	100



As per waist to hip ratio, 63% of the victims of coronary artery disease were normal and the rest were obese. The mean value for the waist circumference in

victims with occlusive coronary artery disease was 88.2cm with standard deviation of 11.8cm.

**Table 4. Waist to hip ratio and occlusive coronary artery disease (N=92)**

Waist to hip ratio	Occlusive coronary artery disease	
	Number	Percentage
Normal	58	63.0
Obese	34	37.0
Total	92	100

**Table 5. Abdominal fat thickness and extent of coronary artery occlusion (N=92)**

Thickness of abdominal fat	Percentage of Coronary artery occlusion								Total	
	<25		25-50		50-75		>75			
	No.	%	No.	%	No.	%	No.	%	No.	%
<2cm	9	50	7	50	8	57.1	24	32.4	48	40.0
2-4cm	8	44.4	6	42.9	4	28.6	44	59.5	62	51.7
>4cm	1	5.6	1	7.1	2	14.3	6	8.1	10	8.3
TOTAL	18	100	14	100	14	100	74	100	120	100

The mean of the abdominal fat thickness of the persons died of coronary artery disease was 2.8cm and the standard deviation is 1.1cm. In 59.5% of the cases of occlusive coronary artery disease with severe stenosis (more than 75% narrowing of the lumen) of coronary arteries, had abdominal fat thickness between 2 to 4 cm. This finding is in accordance with the observations by Korteleinen<sup>7</sup> that abdominal subcutaneous fat thickness had a significantly negative association with severity of coronary atherosclerosis.

In the present study, the presence of occlusive coronary artery disease is almost similar in overweight or obese cases and in normal people. This finding is contradictory to Framingham heart study<sup>8-10</sup>, which may be due to the presence of increased proportion of manual labourers (39.5%) in the present study.

### Findings in the Heart

In the present study, the mean weight of heart in males and females were 298.2gm and 282.5gm respectively. Mean thickness of the left ventricle was 2cm and the standard deviation 0.3cm. Prolonged undiagnosed hypertension could be the reason for increased left ventricular thickness.

Among 92 cases, 90.2% showed microscopic

changes of ischaemia in the myocardium. In the remaining cases, positive findings are occlusion of the coronary arteries by subintimal haemorrhage and thrombus.

In 14.1% of cases calcification of atheromatous plaque of the intima of any of the coronary arteries seen and showed ischaemic changes.

### Atheromatous plaques around coronary ostia

In 55.8% of cases, crowding of atheromatous plaques were present around both coronary ostia. In 19.2% of cases, it was present only around right coronary ostia and in 7.5% of cases, only around the left coronary ostia.

### Atheromatous thickening of the coronary arteries

In the right coronary artery, more than 75% narrowing of the lumen was present in 30% of cases. Left main trunk showed more than 75% narrowing in 6 cases (5%). More than 75% narrowing of the left anterior descending artery was present in 54.2% of cases. In the left circumflex artery, significant narrowing was present only in 5% of cases.

**Table 6. Atheromatous thickening of the Coronary arteries**

Artery	Less than / = 25%		26-50%		51-75%		More than 75%	
	No	%	No	%	No	%	No	%
Right coronary artery	32	34.7	24	26	9	9.7	27	29.3
left main coronary artery	30	33	36	39	20	22	6	6
left anterior descending artery	16	17.4	14	15.2	7	7.6	55	59.8
left circumflex artery	64	70	21	23	4	4	3	3

### Thrombus in the coronary arteries

In the present study, out of the 92 cases, 16.7% of cases showed occlusion of coronary arteries by a thrombus. Most common site of thrombus was in the upper third of left anterior descending artery in 50% of cases. Next common site is the right coronary artery (35%), in its upper half, in 20% of cases and in the lower half, in 15%.

### Gross changes in the myocardium

Myocardium was pale in 62.5% and granular in 53.3% of the cases. Among the 92 cases, gross fibrosis of the myocardium was present in 38.7% and haemorrhage in 27.5% of cases. Aneurysm of left

ventricle was present in 7 cases and mural thrombus in 5 cases.

### Microscopic ischaemic changes in the myocardium

Out of the 85 cases with microscopic ischaemic changes in the myocardium, 82.3% of the cases showed more than 75% narrowing of the lumen of any one of the coronary arteries. The microscopic changes in the myocardium in cases where the cause of death was occlusive coronary artery disease were, waviness of fibres (31.5%), hypereosinophilia of fibres (22.9%), inflammatory cell infiltration (75%), congestion (77.2%), interstitial oedema (47.3%), necrosis of myocardial fibres (48.9%), and haemorrhage (44.6%).

**Table 7. Percentage of occlusion of coronary artery and presence of any of the microscopic ischaemic change in myocardium**

Percentage of coronary occlusion	Cases with any of the microscopic ischaemic change in myocardium	
	Total	Percentage
<25	1	1.2
25-50	5	5.9
50-75	9	10.6
>75	70	82.3
Total	85	100

Apart from CAD, there were cases of Coronary Artery thrombosis and cardiac tamponade due to rupture of left ventricle. Both cases were males, aged 48 years. The left anterior descending artery was completely blocked by a fresh thrombus in one case and more than 75% narrowing of the right and the left coronary arteries were present in the other case. Grossly left ventricle showed extensive fibrosis in one case. In both cases, tear was in the left ventricle near the apex. Microscopically, myocardial necrosis, inflammatory cell infiltration with neutrophils and haemorrhages were seen in both cases.

### Conclusions

- A highly significant association ( $p$  value = 0.008) was found between smoking and coronary artery disease of the study sample.
- Statistically significant association ( $p$  value = 0.001) was observed between the horizontal earlobe crease and occlusive coronary artery disease. Horizontal earlobe crease can be considered as a prediction for the presence of coronary artery disease.

- In 59.5% of the cases with severe stenosis (more than 75% narrowing of the lumen) of coronary arteries had abdominal fat thickness between 2 to 4 cm.
- No significant association was obtained between the obesity parameters like body mass index and waist to hip ratio, and occlusive coronary artery disease.
- Mean thickness of the left ventricle in deaths due to occlusive coronary artery disease was 2cm and the standard deviation was 0.3cm.
- Majority of the cases with significant occlusion (>75%) was observed in the left anterior descending artery (54.2%), followed by right coronary artery (30%), left main coronary artery (5%) and left circumflex artery (5%).
- The most common site of thrombus was in the proximal third of left anterior descending artery (50%) followed by, right coronary artery (35%), in its upper half in 20% of cases and 15% in the lower half.
- In 90.2% of cases, any one microscopic change of coronary ischemia was seen in the myocardium.
- Left ventricle of the heart showed rupture following ischaemic changes of the myocardium in two cases.

#### Policy implications and limitations of the study

Further elaborative studies are required in the field of sudden cardiac death to take necessary actions to prevent or modify the associated factors. Proper history is not available in many of the cases because of the absence of near relative who has knowledge regarding the health condition of the person died.

**Ethical clearance:** Taken from Human Ethics committee, Govt. Medical College, Thiruvananthapuram (Reference no. IEC 04/04/2009 Dated 05/08/2009)

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