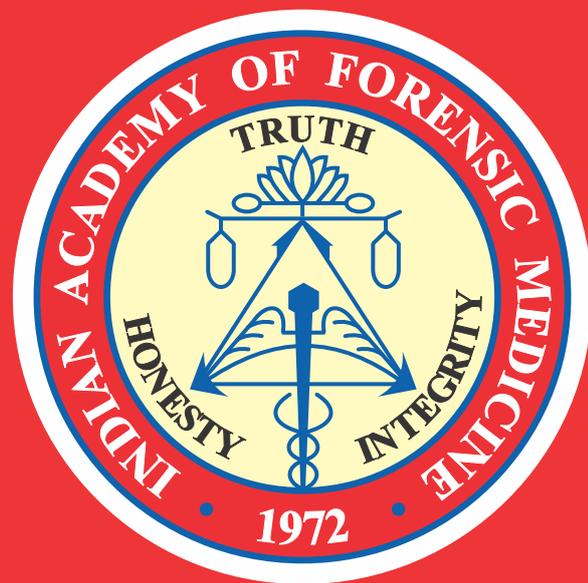


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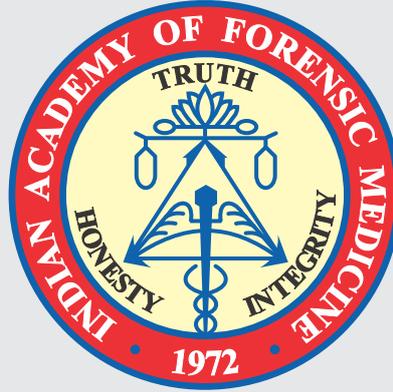
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## Selecting a journal for one's scholarly work – What is in the name?

**Tanuj Kanchan**

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At a time when I was planning to pen down an editorial for the current issue of our journal, and was thinking of a topic of common interest and utility, I received an e-mail from one of the younger contributors of our journal requesting for withdrawal of his submission as his research was accepted in an international journal. Not going into the intricacies of how he could submit his work simultaneously in two journals, what caught my attention was his proud announcement about the work being published in an 'international' journal. Out of curiosity, I searched for the journal he referred to, and found that the said open access journal was in its 3<sup>rd</sup> year of inception, and not unexpectedly had misleading information about its scope, impact factor etc. The journal in fact, seemed an ideal candidate to be listed as a predatory journal. The need for increasing awareness regarding predatory journals has been emphasized to ensure that young researchers do not fall prey to predatory journals.<sup>1</sup> In this regard, we have already brought to the attention of our readers, the issues associated with an evil called predatory publishing.<sup>2</sup>

This is not an isolated case though; young and/ or inexperienced researchers are often fascinated by the name of the journal, and end up sending their work to journals without going into its requisite details. Journals with prefixes such as 'International Journal of .....', 'World Journal of .....', 'Global Journal of .....', or words like 'Advanced .....', 'Innovation .....', 'Applied .....', 'Research .....', etc. in its title frequently catch attention of the researchers. Most intriguing, among all, is the expression 'international journal' in the title as a prefix or in the information provided on the homepage of the journal, declaring a particular journal as an international journal, the use of 'An international journal' or 'An international edition' as a suffix etc. It is argued that the word 'international' somehow provides the researcher with a false sense of superiority, as it is essentially mistaken to be associated with larger readership, international audience, and better quality of the work.<sup>3</sup>

While there are many predatory journals that have highly appealing titles, it is not true to suggest that all the journals with title containing international or other impressive jargons are below par. And hence, the title/name of journal should not form a criterion for choosing a journal for one's scholarly work. It needs to be recalled that two of the highly ranked forensic journals; International Journal of Legal Medicine and Forensic Science International have international as prefix and suffix respectively. These journals are highly ranked for the quality of research it publishes, the readership, citations and impact that it has, and not for the mere presence of international in their title.

In the given scenario, the researchers often find it difficult to choose a suitable journal for their scholarly work. And in

absence of adequate knowledge about the journals, end up making erroneous choices, resulting in loss of their hard work. They are left with a very pertinent query on how to choose a journal for their scholarly work? While it is clear that undue emphasis should not be given to the title of the journal, the criterion for journal selection need to be elaborated. In general, the choice of journal should be based on its impact, specialty, contents etc. Two essential criterion to be considered while selecting a journal for one's scholarly work are; firstly, select a specialty journal for the research findings that are being published, and secondly choose a journal that is indexed/ abstracted in one of the well-known databases such as PubMed/ Science Citation Index (SCI)/ Scopus etc. The widely accepted indicator of the quality of a journal include Journal Impact Factor (JIF), Eigenfactor, Scientific Journal Rankings, h-index, and Altmetrics, etc. Preference should be given to the journals published by well-established national and international societies/ associations of the subject specialty to which the research belongs. Though not a rule, journal name may suggest the broad subject area or specialty it deals with, the association, society or the institution that runs it, and sometimes the country, or state/province of its origin. The information provided, however, should be thoroughly verified before submitting one's hard work to a particular journal.

Our work may be good enough to be recognized internationally, but it is likely to get its due only when published in high impact journals/ journals with wide readership in the native country and/ or globally. It should be borne in mind that the legitimate work published in predatory journals is neither trusted nor cited by other researchers. Let the quality, readership, impact etc. be the criteria for journal selection and not the 'name' the journal carries.

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## Post-mortem lividity and its determinants – A cross sectional study

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### Abstract

A human body shows numerous changes following death, like cooling of body, stiffness of muscles, staining of body tissues, putrefaction and many. These follow a particular timeline. These changes when observed and studied keenly, provides us with vital information to achieve the objectives of any autopsies. Considering that postmortem changes may vary in different regions globally with varying weather conditions, this study was aimed to study the post-mortem lividity and its determinants in the study region. The present study was a prospective cross sectional description study conducted in mortuary of a tertiary care teaching hospital for a period of 6 months. A total of 74 cases were observed during the study period. It was learnt that the post-mortem staining starts appearing as small patches by 2 hours and coalesce to big patches by 9-12 hours. In maximum number of cases (95.94%) lividity appreciated at posterior surface and depended areas of body. The post-mortem staining occurs slowly among death due to hemorrhage and shock. The staining was fixed by 9-18 hours. Earliest time of fixation of post-mortem staining in our study was by 4 hours and while late fixation observed beyond 21 hours following death. The post-mortem staining starts appearing as small patches by 2 hours and then coalesces to big patches by 9-12 hours. The staining gets fixed by 9-18 hours. It was concluded that compared to other methods, the post mortem staining assessment can be used as the most conventional, easy and quicker method for estimating the time since death.

### Keywords

Post-mortem staining; Time since death; Post-mortem staining fixation; Post-mortem lividity

### Introduction

Postmortem hypostasis is one among the early changes of 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 of body after death etc. Post-mortem lividity is the bluish-purple or purplish-red (due to deoxy hemoglobin) discoloration, which appears under the skin in the most superficial layers of the dermis (rete mucosum) 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 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 6 hours.<sup>2</sup> After complete formation of the post-mortem staining if the body is left undisturbed for another 5 – 6 hours the staining gets fixed i.e., the area of staining remains in the same site even if the position of the body is changed.<sup>2</sup> The color of the staining is also influenced by the cause of death. The purplish-blue color

in hypostasis can be explained by following reasons: (i) In recently dead or dying tissue, oxygen dissociation between capillaries and surrounding tissues takes place until equilibrium is reached (ii) The venular blood owing to blue color.<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

Before starting the study, a study design was formed and submitted to the “Institutional Ethics Committee” and Ethical Committee clearance letter was obtained.

The present study was a prospective cross sectional description study conducted in mortuary of a tertiary care teaching hospital for a period of 6 months (July 2017 To December 2017). All the autopsies conducted during the study period with known time since death and proper history were included. The unknown bodies, where proper history was not available were excluded. In our study the post-mortem lividity of size 2-3 cm were considered as small patches and 8-10 cm size were considered as big patches for bringing objectivity to the observations.

The necessary details pertaining to the cases were collected from police enquiry report, witness statement and relative statement, findings of post-mortem examination report, hospital case sheet extracts, histo-pathological examination report, toxicological (chemical) analysis report, crime scene photographs and entered in preformed performa. The data

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collected were entered in Epi Info software for analysis. Descriptive statistics with proportion, mean and percentage are used to describe the data.

**Results**

A total of 74 cases were included in this study, of these 53 were males (74.62%) and 21 were females (28.38%). More than half of the cases (56.75%) were among the age group 21 – 50 years. (Table 1)

**Table 1:** Age and Sex distribution

Age (years)	1-10	11-20	21-30	31-40	41-50	51-60	61+	Total
Male	0	9	13	11	7	5	8	53
Female	2	4	3	6	2	0	4	21
Total	2	13	16	17	9	5	12	74

**Table 2:** Cause of death distribution

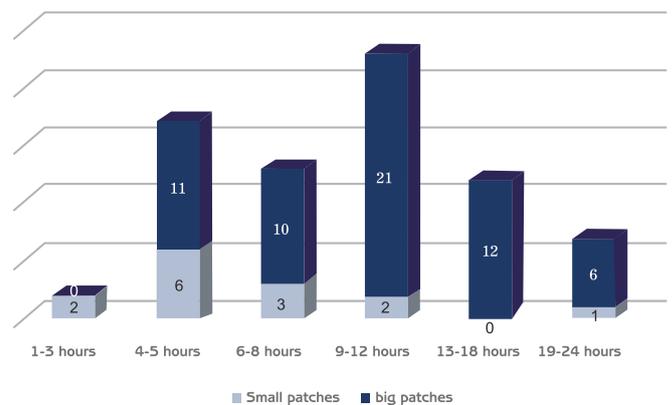
Cause of death	Frequency	Percentage
Poisoning	22	28.38
Hemorrhage and shock	18	22.97
Head injury	15	20.27
Septicemia	07	09.46
Snake bite	04	05.41
Natural death	04	05.41
Hanging	03	04.05
Drowning	01	01.35
<b>TOTAL</b>	<b>74</b>	<b>100.00%</b>

Keeping in consideration, the handling of bodies during day time alters the formation and fixation of post-mortem staining, the cases were grouped according to the time of death. More number of deaths occurred (59.47%) between 08:00 AM to 08:00 PM i.e., during the day time. 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 poisoning (28.38%) followed by hemorrhage and shock (22.97%) and injury to head (20.27%). (Table 2)

There were 18 cases died of hemorrhage and shock including road traffic accidents and railway injuries, of these in 72.22% of cases the homogenous development of post mortem staining area could not be appreciated even after 9 hours following death. In most number of cases (95.94%) the lividity appreciated at posterior surface and depended areas of body. Among 3 cases of death due to hanging, the typical glove and stocking distribution of staining area observed in 2 cases while in 1 case the staining area was the posterior surface of body. In all 74 cases the color of post-mortem staining was purple, and the post mortem staining was well appreciated in persons with fair complexion. It was appreciated that the development of lividity does not occur in the pressure areas of body like, resting surface of body on table / ground and along tight-fitting clothed area.

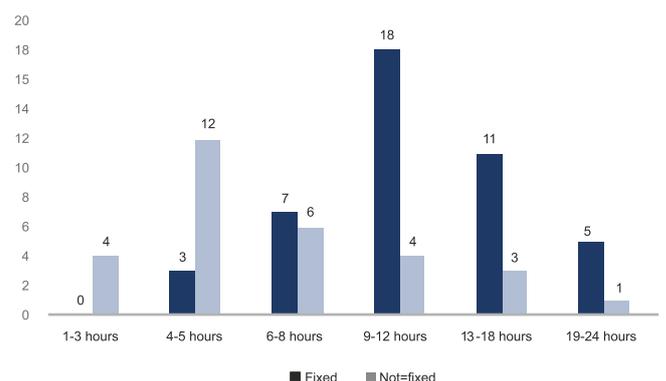
In 67.53% of cases the exact time of death was available as they

were documented in hospital case sheets. In 32% of cases 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 2 hours following death and late development as small patches was observed to be 11 hours following death in a case of railway accident. The earliest time the post mortem staining developed homogenously as big patches was by 4 hours following death and late development was observed to be 21 hours following death. Most number of cases (42.85%) showing small patches were by 4-5 hours following death. Maximum cases showing big patches (35%) were by 9-12 hours following death (Figure 1).



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

The earliest time the post mortem staining got fixed was by 4 hours following death and in a case of drowning the staining was not fixed even after 21 hours following death. In 26.66% of cases the staining was not fixed even after 9 hours following death. In 22.22% of cases the staining was fixed before 8 hours following death (Figure 2).



**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 2 hours following death and the staining developed as big patches by 4 hours, while

maximum cases showing big patches were by 9-12 hours (35%) following death and it was found to be statistically significant ( $p = 0.04$ ). In a similar study by Gradwohl<sup>5</sup> it was learnt that the staining appears as small patches in 0.5 hours and is well appreciated as big patches by 6-10 hours. Vander<sup>6</sup> in his study on postmortem staining documented earliest formation of small patches by 1 hour and big patches by 8-12 hours.

Earliest time of fixation of post-mortem staining in our study was by 4 hours and while late fixation observed beyond 21 hours following death. In 26.66% of cases the staining was not fixed even after 9 hours following death. In 22.22% of cases the staining was fixed before 8 hours of death. In maximum cases (65.90%) the staining got fixed by 9-18 hours and it was found to be statistically significant ( $p = 0.04$ ). It was found to be consistent with a similar study by Raymane et al.<sup>4</sup>

In our study there were 18 cases died of hemorrhage and shock including road traffic accidents and railway injuries, of these 72.22% of cases, the homogenous development of staining area could not be appreciated even after 9 hours following death. It is said that in cases of death due to hemorrhage and shock the appearance of post-mortem staining is delayed or is not appreciated well.<sup>7</sup> Our study findings were consistent with the above observations.

There are many other conventional methods for estimating time since death like assessment of stiffness of muscle (rigor mortis), cooling of body (algor mortis) and putrefaction changes etc., but the postmortem lividity analysis stands out to be best as it does not need any special instrument to measure and analyze, compared to the need of thermometer and complex mathematical formula for assessing algor mortis,<sup>8</sup> the rigor mortis depends on many influencing factors like manner of death, temperature of body at the time of death, age of the deceased etc.,<sup>9</sup> and assessment of time since death by observing putrefaction changes depends up on the temperature of surrounding environment, any disease of the body prior to death, presence or absence of animal and entomological activities etc.,<sup>10</sup> while other newer methods like studying the chemical changes in body, synovial fluid, vitreous humor, morphological and histopathological changes of organs and cells of body requires specialized instruments and expertise, also they are time consuming and are costlier. Hence the study of post mortem lividity can be considered as the most conventional method in estimating time since death.

## Conclusions

The post-mortem staining starts appearing as small patches by 2 hours and then coalesces to big patches by 9-12 hours. The post-mortem staining occurs slowly among death due to hemorrhage and shock. The staining gets fixed by 9-18 hours. Compared to other methods, the post mortem staining assessment can be used as the most conventional, easy and quicker for estimating the time since death

**Ethical clearance:** A prior approval was obtained from the Institutional ethics committee.

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## Spectrum of adrenal changes – A postmortem study

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### Abstract

Adrenal glands are not only important in life but also in death. The importance of examination of adrenals during medicolegal autopsies has been seized by many forensic experts. Adrenal lesions can be present in various forms. Gross and histological examination can diagnose adrenal lesions with great accuracy and may be associated with death. The present study is conducted to analyze gross and microscopic morphology of adrenals in postmortem cases and their correlation if any with the cause of death.

### Keywords

Adrenal glands; Histopathology; Autopsy

### Introduction

Adrenal glands are not only important in life but also in death. The functions of these tiny glands sitting over kidneys are well known to physiologists. The fact that their functions are vital for life as first described by Thomas Addison is well known<sup>1,2</sup> but its importance in postmortem cases are least studied. It is a well-known fact that adrenal insufficiency can remain clinically silent until abrupt adrenal decompensation takes place and the patient dies suddenly. Adrenocortical insufficiency can be due to many causes including autoimmune gland destruction, infection, and haemorrhage.<sup>2</sup> Blunt abdominal trauma is frequently associated with adrenal hemorrhages. Adrenal hemorrhages in severely traumatized patients can lead to potentially fatal adrenal shock.<sup>3</sup> Adrenal lesions can also be seen in septicemia, burns, trauma and natural cause and other non-traumatic conditions.<sup>4</sup> The examination of adrenals is important since it may provide a cause of death particularly in cases where no apparent findings are found at autopsy. Rather, it should be investigated as part of routine postmortem procedures. The present study was carried out to know the histomorphological spectrum of the changes in adrenals in different medicolegal postmortem cases and their correlation with the cause of death, if any.

### Materials and Methods

The present study was carried out in the department of forensic medicine and toxicology of a Government Medical College and tertiary care hospital with cooperation from the department of pathology after obtaining due permission from the institutional ethical committee. The study was an observational cross-section study during the period from February 2016 to October

2017. A total of 200 cases (123 males and 77 females, in age group of 1 year to 74 years) brought for postmortem which was fresh non-decomposed within 24 hours of death were only included in this study. All other information regarding age, sex, history, date and time of incidence and death, and cause of death were recorded from the accompanying police papers and autopsy record before starting the dissection.

In this study, Letulle (en masse) and Virchow's (individual organ) method<sup>5</sup> were equally utilized for dissection to obtain the adrenals intact. On gross examination, laterality, colour, nodularity, atrophy, hypertrophy was noted along with haemorrhage, congestion, tumour and any other gross pathological lesion. Appropriate sections were taken for microscopic examination after making vertical slices at 0.5 cm apart to check for lesions on cut section. 10% formalin was used in order to fix the tissue. Even if no lesions were identified on gross, standard routine histology was done including a section from each adrenal gland. Paraffin blocks were prepared separately for right and left adrenal gland. Sections were then taken at 4-5 microns and slides were prepared separately for right and left gland. Slides were stained using only Haematoxylin and Eosin stain (H and E stain) and all microscopic features were noted by using a light microscope. The data was analyzed using SSPS 20.0 version.

### Results

Adrenal gland examination was done in 200 cases out of the total medicolegal autopsies carried out during the study period. It includes 123 males and 77 males in the age group of 1 year to 74 years of different cases brought for medicolegal postmortem within 24 hours of death.

Table 1 shows the distribution of cases included for adrenal gland examination in relation to cause of death. Most numbers of cases included in the present study belonged to mechanical injury (36.00%) followed by death from natural causes (17.50%), poisoning (17.00%) and asphyxial deaths (16.00%), septicaemia (10%) and burns/electrocution (3.50%).

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**Table 1:** Distribution of autopsied cases in relation to cause of death

Cause of death	N	%
Natural death	35	17.50
Mechanical Injury	72	36.00
Asphyxial deaths	32	16.00
Burns / Electrocutation	7	3.50
Poisoning	34	17.00
Septicaemia	20	10.00
Total	200	100.00

Table 2 shows the distribution of gross and microscopic adrenal lesions as compared to normal in relation to gender. Adrenal changes were present in 32.25% cases on gross and 80% on microscopy. The adrenal lesion was noted in 82.93 % cases in males and 75.32% in females on microscopy. Whereas, it was found in 33.74% males and 29.88% females on gross examination. Thus, the lesion was found to be slightly more in males as compared to females

**Table 2:** Distribution of cases for changes in the adrenal gland among males and females

Adrenal Gland		Male ( n=246 )		Female ( n=154 )		Total ( n=400 )	
Gross	Lesions present	83	33.74 %	46	29.88 %	129	32.25 %
	Normal	163	66.26 %	108	70.12 %	271	67.75 %
Microscopy	Lesions present	204	82.93 %	116	75.32 %	320	80.00 %
	Normal	42	17.07 %	38	24.68 %	80	20.00 %

Table 3 shows the distribution of gross and microscopic adrenal lesion as compared to normal in relation to side. Adrenal changes were present in 32.25% cases on gross and 80% on microscopy. Both these changes were present bilaterally and there was no difference between the involvement of right and left gland.

**Table 3:** Distribution of cases for changes in the adrenal gland on the right and left side

Adrenal Gland		Right ( n=200 )		Left ( n=200 )		Total ( n=400 )	
Gross	Lesions present	64	32.00%	65	32.50%	129	32.25%
	Normal	136	68.00%	135	67.50%	271	67.75%
Microscopy	Lesions present	160	80.00%	160	80.00%	320	80.00%
	Normal	40	20.00%	40	20.00%	80	20.00%

Table 4 shows distribution of various gross and microscopic changes that were observed in adrenal gland in relation to gender. Congested glands (19.50%) were the most common gross finding seen in both males (20.32%) and females (18.18%) followed by enlargement (18.25%) in both males (19.91%) and females (15.58%). Congestion (52.20%) was the commonest microscopic finding present in both males (56.10%) and females (46.75%) followed by haemorrhage (25.50%) in both males (26.02%) and females (24.68%). These

microscopic findings were followed by nodule formation (9.75%), inflammation (7.50%), necrosis (6.25%), lipid depletion (5.25%), and others (4.25%) comprising of neoplastic conditions, atrophy, hypertrophy, myelolipoma, tuberculosis, sickle cell disease etc. It was also observed that higher incidence of gross and microscopic changes occurred mainly in males except lipid depletion which was more in females than males.

**Table 4:** Gross and microscopic findings in the adrenal gland among males and females

Observation in the Adrenal		Male		Female		Total	
		n=246	%	n=154	%	n=400	%
Gross examination	Normal	163	66.26	108	70.12	271	67.75
	Enlarged	49	19.91	24	15.58	73	18.25
	Congested	50	20.32	28	18.18	78	19.50
	Haemorrhage	4	1.62	0	0	4	1.00
	Granuloma	1	0.40	0	0	1	0.25
Microscopic examination	Normal	42	17.07	38	24.68	80	20.00
	Congestion	138	56.10	72	46.75	210	52.50
	Haemorrhage	64	26.02	38	24.68	102	25.50
	Inflammation	20	8.13	10	6.49	30	7.50
	Necrosis	16	6.50	9	5.84	25	6.25
	Nodule Formation	28	11.38	11	7.14	39	9.75
	Lipid Depletion	11	4.47	10	6.49	21	5.25
	Others	14	5.69	3	1.95	17	4.25

Table 5 shows the distribution of gross and microscopic changes that were observed in adrenal glands in relation to period of survival. It was observed that gross adrenal lesion was commonly seen during survival period of 7-15 days (8.75%) followed by 1-3 days (7.75%) and 4-6 days (7.25%). However, microscopic adrenal lesion was commonest during survival period of < 1 hour (28.75%) which consist of spot deaths and brought dead including cases of hanging followed by 1-24 hours (25%), 2-3 days (21%), 4-6 days (15.75%), 7-15 days (13.75%) and >15 days (6.75%). The survival period of <1 hour includes those cases who were brought dead as well as spot death cases. Thus, microscopic adrenal changes were more common in sudden death within 24 hours (53.75%) in contrast to gross changes which were commonly seen in survival period of more than 7 days.

**Table 5:** Findings in the adrenal gland in relation to the survival period (N=400)

Survival	Gross examination				Microscopic examination			
	Normal		Lesions present		Normal		Lesions present	
< 1 hour	94	23.50	22	5.50	30	7.50	115	28.75
1-24 hours	73	18.25	19	4.75	19	4.75	100	25.00
1-3 days	40	10.00	31	7.75	14	3.50	84	21.00
4-6 days	31	7.75	29	7.25	8	2.00	63	15.75
7-15 days	23	5.75	35	8.75	6	1.50	55	13.75
>15 days	10	2.50	20	5.00	3	0.75	27	6.75

Table 6 shows the distribution of gross/ microscopic adrenal lesions in relation to cause of death. In general, adrenal lesions were more commonly found in cases of death due to mechanical injuries and natural death. However, in respect to different

causes of death, adrenal changes in gross were more commonly seen in septicemia (47.5%) where the death was delayed in contrast to asphyxial death (21.88%) or spot burns/electrocution death (0%) where the death either occurs on spot or immediately. But the microscopic adrenal changes were seen in range of 80-84% in all-cause of death studied in the present study except burns/ electrocution death (57.14%) where the death occurs immediately.

**Table 6:** Frequency distribution of adrenal lesions in different causes of death (n=400)

Cause of death	Total	Gross	%	Microscopic	%
Natural death	70	26	37.14	56	80
Mechanical Injury	144	52	36.11	116	80.55
Asphyxial deaths	64	14	21.88	54	84.38
Burns/Electrocution	14	0	0	8	57.14
Poisoning	68	18	26.47	56	82.35
Septicaemia	40	19	47.50	32	80

## Discussion

Adrenal glands are the least studied as far as post-mortem studies are concerned. The study of gross and microscopic changes observed in adrenal glands is undertaken to observe the adrenal lesions in death in all cases brought for post-mortem examination. Out of the 200 cases in the age group of 1 year to 74 years, the adrenal lesions were slightly predominant in males as compared to females. This is in consistence with that of Dongre et al<sup>6</sup>, Nayak et al<sup>7</sup>, Knight<sup>8</sup>, Cheng et al<sup>9</sup>. However, Xarli et al<sup>10</sup> and Yadav et al<sup>4</sup> found female preponderance in the adrenal lesion.

On gross examination, 32.25% showed pathological adrenal lesions in the form of congestion (19.50%), enlargement (18.25%), haemorrhage (1.00%) and granuloma (0.25%). There was no pathological lesion on gross examination in 67.75% cases. While 80% cases showed pathological changes and 20% showed no pathological changes in adrenal glands on microscopic examination. The microscopic pathological lesions were in the form of congestion (52.50%), haemorrhage (25.50%), inflammation (7.50%), nodule formation (9.75%), necrosis (6.25%), lipid depletion (5.25%) and other categories (4.25%). Yadav et al<sup>4</sup> and Namiki et al<sup>11</sup> observed adrenal lesion in 15.2% and 18.70% cases respectively in their postmortem study. Dongre et al<sup>6</sup> observed that adrenal lesions were found in 86.11% cases in the deaths due to stress-related conditions with congestion in 37.04% and haemorrhage in 18.52% cases. Sevitt<sup>12</sup>, Nayak et al<sup>7</sup> and Hall et al<sup>13</sup> also observed adrenal haemorrhage in 26%, 19.5% and 12.8% respectively. Kumar et al<sup>14</sup> who found adrenal haemorrhage in 27.5% cases of burn victims. Russell<sup>15</sup> found an incidence of only 15.2% cases in cases of haemorrhage in cases of shock.

The incidence of various gross and microscopic pathological changes was slightly more in male as compared to female which are in accordance with that of Nayak et al<sup>7</sup> and Knight<sup>8</sup> except that of nodule formation which is more in female in the present study. However, there was no difference in the involvement of

the right and left side of gland. Kumar et al<sup>14</sup>, Nayak et al<sup>7</sup> and Ahmed et al<sup>17</sup> also found equal involvement of both the sides in their study of adrenal glands. Knight<sup>8</sup>, Xarli et al<sup>10</sup>, Namiki et al<sup>11</sup> and Vella et al<sup>18</sup> in their study on adrenal haemorrhage found that the adrenal lesions are observed bilaterally.

In relation to the survival period, the microscopic adrenal lesion was more commonly observed in sudden death with 24 hours, whereas gross lesion was more frequently seen in delayed death more than 7 days of survival period. Dongre et al<sup>6</sup> in their study of stress-related conditions also observed adrenal lesions in deceased died within 24 hours of onset of symptoms. Porter et al<sup>19</sup> in his study on adrenal haemorrhages in cases of trauma observed that 48% died within 2 hours and 68% died within 6 hours. Greendyke<sup>20</sup> observed that 70% of patients had died within 24 hours in their cases of adrenal haemorrhage. Sevitt<sup>12</sup> observed that the survival period ranged between 24 hours to 8 days in cases of adrenal haemorrhage having trauma to chest and abdomen.

In general, both the gross and microscopic lesions were commonly seen in cases of death due to mechanical injuries followed by natural death in the present study. Knight<sup>8</sup> also observed that the majority of the cases showing haemorrhage belonged to road traffic accidents. Xarli et al<sup>10</sup> in their study of adrenal haemorrhage observed that 72.7% patients of haemorrhage had localized or systemic infection at some point of time and 2/3rd experienced cardiac failure. Nayak et al<sup>7</sup> in his study on adrenal haemorrhage observed that the incidence of adrenal haemorrhage was highest in deaths due to burns (27%) followed by hanging, poisoning and road traffic accidents. Uotila et al<sup>21</sup> observed that factors including trauma, conditions of shock, pain, severe haemorrhages, burns, asphyxia, infections and drugs tend to accelerate the secretion of adrenaline by adrenal glands. They observed that a period of 2 days appears to be critical; after this the capacity of the organism to adapt itself decreases rapidly.

The adrenal lesions on gross were more commonly found in cases of septicemia where the death was delayed in contrast to other condition where the death was immediate. However, different microscopic lesions were commonly found in all-cause of death except for burns/ electrocution death. Yadav et al<sup>4</sup> observed that adrenal haemorrhage was present in 100% cases of peritoneal haemorrhage and coronary artery disease on anticoagulants. It was absent in cases of electrocution, gunshot wound, acute infection, poisoning, hanging, assault and ageing. Dongre et al<sup>6</sup> in their study on stress-related changes leading to death observed that nodule formation in adrenal gland was more common with people having history of diabetes or hypertension; lipid depletion was found in prolonged stress as in cases of septicemia (42.86%) followed by cardiac disease (23.81%); necrosis was common in hypovolemic and cardiac shock (21.43%); atrophy was present in cardiac failure (2.78%), hypertrophy was present in a post-partum female and a male suffering from pancreatitis. Tormos et al<sup>22</sup> found that adrenal lesions like haemorrhage commonly occurred in sepsis.

## Conclusions

Examination of adrenal glands is an important part of medicolegal autopsies. Presence of gross and microscopic changes may give a clue about the cause of death. It must be emphasized here that histomorphological studies are more reliable indicator to detect or appreciate adrenal changes than gross examination alone.

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## Accuracy and practical applicability of hand print dimensions in estimation of stature of an individual in North Karnataka region

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### Abstract

Stature estimation from hand prints may support height estimation of suspects made by eye-witnesses which narrows down the pool of suspects. 2<sup>nd</sup> year MBBS students (Male-50, Female-50) of S Nijalingappa Medical College, Bagalkot aged between 20–29 years were included in the study by purposive sampling. Height was recorded using standard stadiometer in a Frankfurt plane. Recording of the handprints were taken in document scanner, edited using Photoshop software and measurements were taken using digital callipers to the nearest millimetre: Hand print length (HPL), Hand print breadth (HPB), Length of individual finger print; Thumb print length (TPL), Index finger print length (IFPL), Middle finger print length (MFPL), Ring finger print length (RFPL) and Little finger print length (LFPL) were measured. Over all in males the left hand print length measurements correlated most with stature and in females the right index finger print length measurements correlated most to stature estimation. According to cross-validated discriminant analysis the hand dimensions that predicted the sex of the individual more significantly and accurately were the left hand palm breadth and length and the right hand index finger length. The study concludes that one can estimate stature of an individual with reasonable accuracy using hand print dimensions.

### Keywords

Hand print; Stature; Identification; Karnataka

### Introduction

Identification is the determination of the individuality of a person.<sup>1</sup> Forensic anthropologists of today face challenges in this era of increased crimes, terrorism, accidents and mass disasters to establish the biological profile of an individual (sex, age, ethnicity and stature). A biological profile with other markers effectively narrows down the pool of suspects while positive identification can later be established using traditional markers such as DNA analysis.<sup>2</sup>

Stature is considered as one of the "Big Four" parameters required to assist with the identification of an individual when other lines of evidence are corroborative.<sup>3</sup> There is an established relationship between stature and various body parts like head dimensions,<sup>4</sup> lower limb,<sup>5</sup> upper limb bone,<sup>6</sup> hand and hand bone dimensions<sup>7</sup> and foot<sup>8</sup> and palm prints.<sup>2</sup>

Fingerprints, handprints and footprints are usually encountered at the crime scenes which aid in the identification of the criminal/perpetrator.<sup>9</sup> Prints are conclusive evidence.<sup>10</sup> Often, the only evidence that may be available at the scene of a crime is in the form of latent impressions from hands and feet.<sup>3</sup> Stature calculation from these prints may support height estimation of suspects made by eye-witnesses which narrows down the pool

of suspects.<sup>10</sup> A number of studies have been done to estimate stature from footprints and shoeprints but studies on handprints/palm prints are scanty; which may be attributed to their flimsy presence at the crime scene.<sup>9</sup> However, according to one study nearly 30% of the latent prints at crime scenes are from palms which highlights the need for further study of this aspect.<sup>11</sup>

Researchers in the past have developed many sets of regression equations to derive the stature from handprints. It is a well-known fact that stature can be influenced by various factors like age, sex, heredity, race, geographical region and nutrition. Generalizing mathematical algorithms derived from a particular population to estimate stature from handprints for other populations may lead to erroneous interpretations.<sup>12</sup>

Recently one study demonstrated that stature can also be accurately estimated from hand impressions in an Indian population; SEE 4.64–5.50 cm with an accuracy closely approaching that of established long bone standards.<sup>3</sup> Studies have been conducted in the past to estimate stature from hand length dimensions which includes measurements from bracelet crease to dactylion but the latent prints available at crime scene never showed the bracelet creases. So, if we estimate stature using regression formula derived from hand length measured from bracelet crease, the estimated stature estimated will be lesser than actual one.<sup>3</sup>

Many a times the only available data at the crime scene are latent prints.<sup>3</sup> In such cases, regression formulae derived from hand dimensions cannot be applied to hand impressions.<sup>3</sup> One needs to consider the fact that it's not always possible to get whole hand impressions, sometimes only palm prints are found, especially while lifting or pushing heavy objects and at other

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times only digital prints, so one needs to measure both palmprints and digital prints.<sup>3</sup>

The present study was undertaken at S. N. Medical College, Bagalkot, and Karnataka, India, as no similar study has been conducted in the study region.

## Material and Methods

MBBS students (Male-50, Female-50) of S Nijalingappa Medical College, Bagalkot aged between 20–29 years were included in the study keeping in mind the fact that the maximum height of a person is attained by this age and growth regression starts after 30 years.<sup>13</sup> Apparently healthy individuals with valid document of proof of age who voluntarily consented for the study were included. Ethical clearance was obtained from the institutional ethical committee for the conduction of this study. The aims and objectives of the intended study were explained to the subjects in their vernacular language and an informed consent was obtained. The details of the participants were entered in the proforma. The following parameters were recorded.

**Height:** All the readings were taken at the same time of the day to minimize the diurnal variation. The height of each subject was recorded by asking the subject to stand erect and barefoot on the base of the standard stadiometer in a Frankfurt plane. The subject was instructed to stand without support and with the arms by the side of the body. The horizontal plate was attached to the vertical wooden scale having a height of two meters and the reading was noted in centimetres from the base of the stadiometer to the vertex of the head.

**Handprints:** Subjects were asked to wash and dry their hands. A document scanner (EPSON-L210 printer, scanner, copier) was used to acquire images (400 dpi) of the hands, which were then converted to handprints.<sup>14</sup> Subjects were advised to place their hands in a standardized position to provide uniform scanning. The whole hand and forearm, including the elbow were rested in the same plane as that of the scanning surface with the fingers extended and adducted. Care was taken to see that there was no abduction or adduction at the wrist joint, i.e., forearm was directly in line with the middle finger.

To obtain the most accurate approximation of handprints, the scanned images were edited using the Photoshop software (SC3 edition); this involves image conversion to grey-scale and adjustments made to the brightness and contrast. The resultant images were then printed at 1:1 and measured using measuring tape.<sup>14</sup>

The measurements and technique of taking hand prints is shown in Figure 1 and 2 respectively.

**Palm print length (PPL)** - Distance from the baseline of the print (transverse line from the most inferior point of the medial border of the palm) to the proximal flexion crease of the middle finger.

**Palm print breadth (PPB)** – Distance from the most laterally projected part of the palm print at the 2nd metacarpal to the most

medially projected part of the palm print at the distal transverse crease.

Length of Thumb print (TPL), Index finger print (IFPL), Middle finger print (MFPL), Ring finger print (RFPL) Little finger print (LFPL) was measured as distance between the proximal flexion crease of the finger to the tip of respective finger print as shown in Figure 2.



Figure 1: Scanner and printer used for generating the hand prints

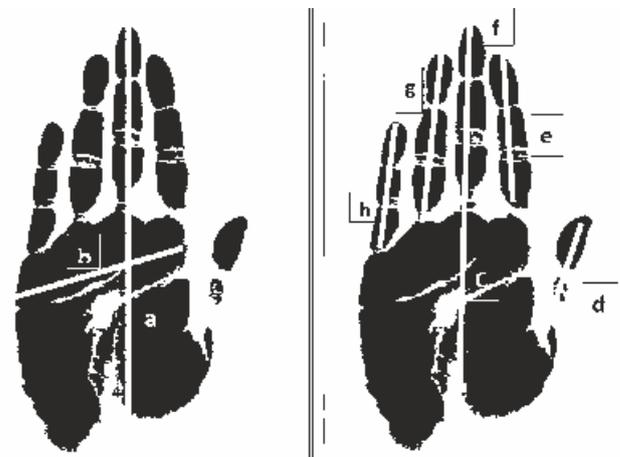


Figure 2: Hand print measurements: (a) Hand print length (HPL); (b) Palm print breadth (PPB); (c) Palm print length (PPL); (d) Thumb print length (TPL); (e) Index finger print length (IFPL); (f) Middle finger print length (MFPL); (g) Ring finger print length (RFPL); (h) Little finger print length (LFPL)

All the recordings were taken between 4pm to 8pm to avoid diurnal variations in stature and hand measurements. All the measurements were measured by three observers and the average value of the measurements was considered as the final value to eliminate inter observer variations.

**Statistical analysis:** The final readings were entered in master chart and subjected to statistical evaluation using SPSS software trial version 20.0 and the results were analyzed. The above study was approved by the Ethical Committee of the College. Linear regression equations were formed separately for each of the parameter and for either sex. Multiple regression formulas were derived for both sexes.

## Results

It was observed that the mean stature value was more for males as compared to females. The stature ranges from 155 to 185 cm in males and 145-172 cm in females (Table 1). It was observed from our study that, all the hand print dimensions had higher mean values in males as compared to females. Males had higher mean values for all measurements taken from the right hand, whereas, in females, except for hand print breadth, all the hand print dimensions had a higher mean value for the right hand. Descriptive statistics of various hand print dimensions in males and females are shown in Table 2.

**Table 1:** Descriptive statistics of stature

Stature (cms)	Minimum	Maximum	Mean±SD
Males	155	185	170.72 ± 7.282
Females	145	172	159.52 ± 6.701

SD- Standard deviation

**Table 2:** Descriptive statistics of various hand print dimensions in males and females

Variable	Sex	Mean	SD	SEE	t	P
Height	Male	170.72	7.282	1.030	8.003	.000
	Female	159.52	6.701	.948	8.003	.000
Right HPL	Male	18.164	1.016	.1437	8.028	.000
	Female	16.606	.921	.1303	1.452	.150
Left HPL	Male	18.148	.950	.134	8.728	.000
	Female	16.542	.888	.125	8.028	.000
Right HPB	Male	8.882	9.555	1.351	1.452	.150
	Female	6.918	.448	.0634	6.956	.000
Left HPB	Male	7.574	.484	.0685	6.956	.000
	Female	6.930	.439	.0622	1.450	.000
Right PPL	Male	12.255	14.417	2.059	8.484	.000
	Female	9.296	.609	.0862	8.728	.150
Left PPL	Male	10.290	.655	.0927	8.028	.150
	Female	9.276	.532	.0753	8.028	.000
Right TPL	Male	5.856	.4887	.0691	4.851	.000
	Female	5.366	.5208	.0736	4.851	.000
Left TPL	Male	5.748	.4477	.0633	5.822	.000
	Female	5.168	.5437	.0769	5.822	.000
Right IFPL	Male	7.084	.5144	.0727	4.958	.000
	Female	6.546	.5693	.0805	4.958	.000
Left IFPL	Male	7.038	.5294	.0748	5.660	.000
	Female	6.446	.5163	.0730	5.660	.000
Right MFPL	Male	8.000	.5656	.0800	5.624	.000
	Female	3.92	.5142	.0727	5.624	.000
Left MFPL	Male	7.894	.5430	.0767	5.141	.000
	Female	7.348	.5187	.0733	5.141	.000
Right RFPL	Male	7.364	.4885	.0690	6.129	.000
	Female	6.767	.4852	.0686	6.129	.000
Left RFPL	Male	7.340	.5642	.0798	6.018	.000
	Female	6.694	.5076	.0717	6.018	.000
Right LFPL	Male	5.924	.4514	.0678	5.690	.000
	Female	5.394	.4796	.0638	5.690	.000
Left LFPL	Male	5.814	.4819	.0681	6.129	.000
	Female	5.260	.4199	.0593	6.129	.000

HPL- Hand print length, HPB- Hand print breadth, PPL- Palm print length, TPL- Thumb print length, IFPL- Index finger print length, MFPL- Middle finger print length, RFPL- Ring finger print length, LFPL- Little finger print length, SD- Standard deviation, SEE- Standard Error of Estimate

Correlation of various hand print measurements with stature and regression equations derived for stature estimation from each measurement is shown in Table 3.

**Table 3:** Linear equations for stature estimation from hand print dimensions in males

Variable	Equations	SEE	R	R <sup>2</sup>
Right HPL	S=82.5+4.85 x Right HPL	5.4	0.67	0.45
Left HPL	S=74.1+5.32 x Left HPL	5.2	0.69	0.48
Right HPB	S=171.19-0.05 x Right HPB	7.3	0.06	0.005
Left HPB	S=130.8+5.26 x Left HPB	6.89	0.35	0.12
Right PPL	S=171.2-0.02 x Right PPL	7.31	0.05	0.003
Left PPL	S=103.8+6.49 x Left PPL	5.96	0.58	0.34
Right TPL	S=119.0+8.81 x Right TPL	5.93	0.59	0.35
Left TPL	S=125.9+7.7 x Left TPL	6.45	0.47	0.23
Right IFPL	S=105.1+9.2 x Right IFPL	5.56	0.65	0.42
Left IFPL	S=117.8+7.51 x Left IFPL	6.16	0.54	0.29
Right MFPL	S=112.4+7.28 x Right MFPL	6.06	0.56	0.32
Left MFPL	S=107.8+7.96 x Left MFPL	5.91	0.59	0.35
Right RFPL	S=102.0+9.32 x Right RFPL	5.73	0.62	0.39
Left RFPL	S=115.3+7.54 x Left RFPL	5.96	0.58	0.34
Right LFPL	S=114.3+9.52 x Right LFPL	5.73	0.62	0.39
Left LFPL	S=120.7+8.59 x Left LFPL	6.05	0.56	0.32

HPL- Hand print length, HPB- Hand print breadth, PPL- Palm print length, TPL- Thumb print length, IFPL- Index finger print length, MFPL- Middle finger print length, RFPL- Ring finger print length, LFPL- Little finger print length., SEE- Standard Error of Estimate

In males, the left hand print length measurement had a higher correlation (R=0.69) with stature as compared to the right hand print length (R=0.67). Correlation coefficient for hand print breadth and stature was higher for the left hand (R=0.35) than for the right (R=0.06). Among the finger print measurements, right index finger had the highest correlation coefficient (R=0.65) with stature followed by right ring finger print length (R=0.62). The left thumb print length had the least correlation coefficient (R=0.47) with stature. It is evident that the correlation coefficient for the left hand is greater than the right hand for all hand print dimensions except for the middle and ring finger print dimensions.

Correlation of various hand print measurements with stature and regression equations derived for stature estimation from each measurement is shown in Table 4. Among females, the right hand print length measurements had a slightly higher correlation coefficient (R=0.67) when compared to the left hand print length (R=0.66), and for the hand print breadth measurements, right hand print breadth had a higher correlation coefficient (R=0.48) when compared to the left hand print breadth (R=0.42). Among the finger print measurements, the right index finger print length had the highest correlation coefficient (R=0.69) with stature followed by the right ring finger print length (R=0.65). The left little finger print length had the least correlation coefficient (R=0.40) with stature.

Over all in males, the left hand print length measurements correlated most with stature and in case of females the right index finger print length correlated well with stature.

When Multiple regression formulae were derived for both the right and left hands it was observed that for males, left hand

measurements (SEE=5.181) and for females, right hand measurements (SEE=4.439) were more accurate for estimating stature (Table 5).

**Table 4:** Linear equations for stature estimation from hand print dimensions in females

Variable	Equations	SEE	R	R <sup>2</sup>
Right HPL	S=77.6+4.92 x Right HPL	4.97	0.67	0.46
Left HPL	S=76.5+5.01 x Left HPL	5.05	0.66	0.44
Right HPB	S=109.9+7.1 x Right HPB	5.9	0.48	0.23
Left HPB	S=114.2+6.5 x Left HPB	6.1	0.42	0.18
Right PPL	S=110.7+5.2 x Right PPL	5.9	0.47	0.22
Left PPL	S=101.8+6.2 x Left PPL	5.8	0.49	0.24
Right TPL	S=124.4+6.5 x Right TPL	5.8	0.50	0.25
Left TPL	S=125.0+6.6 x Left TPL	5.6	0.54	0.29
Right IFPL	S=105.9+8.1 x Right IFPL	4.8	0.69	0.48
Left IFPL	S=110.5+7.6 x Left IFPL	5.4	0.58	0.34
Right MFPL	S=101.7+7.8 x Right MFPL	5.4	0.59	0.35
Left MFPL	S=103.6+7.6 x Left MFPL	5.4	0.58	0.34
Right RFPL	S=98.4+9.0 x Right RFPL	5.1	0.65	0.42
Left RFPL	S=110.0+7.38 x Left RFPL	5.6	0.55	0.31
Right LFPL	S=117.2+7.83 x Right LFPL	5.7	0.52	0.27
Left LFPL	S=125.6+6.4 x Left LFPL	6.1	0.40	0.16

HPL- Hand print length, HPB- Hand print breadth, PPL- Palm print length, TPL- Thumb print length, IFPL- Index finger print length, MFPL- Middle finger print length, RFPL- Ring finger print length, LFPL- Little finger print length, SEE- Standard Error of Estimate

**Table 5:** Multiple regression formulae for both sexes

<b>Male right hand:</b>			
Height= 82.7 + 2.5 (HPL) - 0.12 (PPB) - 0.04 (PPL) + 4.4 (TPL) + 4.4 (IFPL) - 2.4 (MFPL) - 0.2 (RFPL) + 1.2 (LFPL)			
R=0.758	R <sup>2</sup> =0.574	Adjusted R <sup>2</sup> =0.489	SEE=5.181
<b>Male left hand:</b>			
Height= 76.03 + 1.2 (HPL) - 0.19 (PPB) + 3.9 (PPL) - 0.27 (TPL) - 1.9 (IFPL) + 6.1 (MFPL) - 0.11 (RFPL) + 0.07 (LFPL)			
R=0.708	R <sup>2</sup> =0.501	Adjusted R <sup>2</sup> =0.404	SEE=5.621
<b>Female right hand:</b>			
Height= 68.13 - 0.046 (HPL) + 4.1 (PPB) + 1.9 (PPL) + 0.81 (TPL) + 6.1 (IFPL) - 2.4 (MFPL) + 4.2 (RFPL) - 1.7 (LFPL)			
R=0.796	R <sup>2</sup> =0.633	Adjusted R <sup>2</sup> =0.561	SEE=4.439
<b>Female left hand:</b>			
Height= 68.85 + 5.2 (HPL) + 3.01 (PPB) - 1.94 (PPL) + 1.6 (TPL) + 2.6 (IFPL) - 3.6 (MFPL) + 0.64 (RFPL) - 0.27 (LFPL)			
R=0.717	R <sup>2</sup> =0.514	Adjusted R <sup>2</sup> =0.419	SEE=5.108

HPL- Hand print length, PPL- Palm print length, PPB- Palm print breadth, TPL- Thumb print length, IFPL- Index finger print length, MFPL- Middle finger print length, RFPL- Ring finger print length, LFPL- Little finger print length, SEE- Standard Error of Estimate

## Discussion

The present study is aimed at estimation of stature from hand print dimensions by formulating linear and multiple regression equations. In our study, it was observed that males have a taller stature as compared to females. Males are constitutionally taller owing to the fact that puberty is delayed by 2-3 years in them as compared to females giving them some additional time for growth.<sup>15</sup> This explains why regression formulae for one sex cannot be applied to the other.

The study observed that the mean right hand print length was

more when compared to left (p< 0.001), probably due to a greater usage of right hand in the majority of population. In the study conducted by Vijeta, Kapoor AK<sup>16</sup> dimensions were greater for the right hand in males and the left hand in females. But in a study done by Ishak et al<sup>17</sup> the mean values of hand print lengths for both the right and left hands were same while in Shende S et al<sup>18</sup> mean of left hand print length was greater than mean of right hand print length for both the sexes. In our study, it was observed that in males the mean value of right hand print breadth was greater when compared to the left, while in females the mean value of left hand print breadth was greater when compared to the right (p < 0.001). Among males, the study by Vijeta, Kapoor AK<sup>16</sup> correlated well with our study and mean values of both the right and left hand print breadth were the same as seen in the studies by Ishak et al<sup>17</sup> and Shende et al<sup>18</sup>. Among females, the mean of left hand print breadth was greater than the right hand print breadth, which was similarly observed by Shende et al<sup>18</sup>.

In our study, the linear equations derived for stature estimation from hand print length and SEE obtained therein for both hands were similar to the results obtained by Kapoor<sup>16</sup> and Shende et al<sup>18</sup> that observed that left hand print length was more accurate in estimating stature. Regarding hand print breadth for stature estimation in both sexes, observations of our study were in concurrence with other studies, except for the one carried out on North Indian students by Shende et al.<sup>18</sup>

Among males in our study the most significantly correlating finger print length with stature, was the right index fingerprint length (R=0.65 and SEE= 5.56), followed by the right ring fingerprint length. The least accurate for stature estimation was the left thumb print length (R =0.47 and SEE= 6.45). It is evident that the right index finger print length and the left ring finger print length have the same SEE= 5.82, and therefore, these finger print lengths are more accurate for estimation of stature by linear regression. This is followed by the left middle finger print length with an SEE= 5.85. The least to correlate was right thumb print length. When we compare our study to that of Ishak NI<sup>18</sup> it is seen that in both the studies the right index finger print length is the most accurate for estimating stature in males.

Among females, the most significantly correlating finger print length for stature estimation was right index finger print length (R=0.69 and SEE= 4.8), followed by the right ring finger print length. The least accurate for stature estimation was the left little finger print length, (R = 0.40 and SEE= 6.1).

In the study done by Ishak NI<sup>17</sup> it is seen that the left index finger print length and the right middle finger print length have a same SEE value of 6.17 and both finger print lengths are significantly accurate for estimating stature using linear equations. This is followed by the left middle finger print length and the left ring finger print length with a same SEE value of 6.22. The least correlating value for estimating stature from finger print length is the right thumb print length. When we compare our study with that of Ishak NI<sup>17</sup> the results do not match. In our study Right IFPL had the highest correlation, whereas in Ishak NI<sup>17</sup> it was that of Left IFPL and Right MFPL.

## Conclusion

Males have greater mean value for stature as compared to females. In males left hand print length and hand print breadth correlates strongly with stature as compared to those of the right hand. In case of females' right hand print length and right hand print breadth strongly correlate with stature as compared to measurements of the left hand. For both genders finger print lengths of the right hand are better predictors of stature when compared to those of the left hand. Values of SEE were lowest for the finger print dimensions of females when compared to males, therefore female finger print dimensions are better stature predictors.

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## Study of fingerprints in relation to gender and blood group among medical students in Kerala region

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### Abstract

Finger prints are considered as one of the best tools for identification. Due to the immense potential of fingerprints as an effective method for identification, the present work has attempted to analyse their correlation with gender and with the blood group of an individual. The objective of this study was to ascertain the distribution of finger print patterns in individuals with different ABO and Rh blood groups, along with an evaluation of the relationship between finger prints patterns and ABO blood groups in both males and females. This prospective study was carried out among medical students. A total of 200 students (100 male & 100 female) participated in the study. Majority of the subjects participating in the study belonged to the blood group O; followed by blood group B, A and AB respectively. Males were seen to have a higher incidence of whorls and whereas females had a higher incidence of loops. Loops are predominant in blood group A, B, AB and O in both Rh positive and Rh negative individuals with the exception of O negative where whorls are more common. We can conclude that there is an association between the distribution pattern of fingerprints, blood groups and gender and thus, prediction of gender and blood group of a person based on his fingerprint pattern is possible.

### Keywords

Fingerprints; Gender; Blood Groups; Identification; Dermatoglyphics

### Introduction

Identification is the determination of the individuality of a person based on certain physical characteristics. The various identification parameters that can be used are fingerprints, handwriting, lip prints, DNA fingerprinting, etc. A fingerprint is an impression of the friction ridges of the finger. The study of this epidermal ridge pattern on fingers, palm, and soles is known as "Dermatoglyphics." Dermatoglyphics have been analysed since ancient times, but it was finally the identification of an individual from fingerprints that brought a revolution in the field of crime investigation. Harold Cummins first coined the word in 1926.<sup>1</sup>

Finger prints appear for the first time between the 12<sup>th</sup> to 16<sup>th</sup> week of intrauterine life and their formation is completed by the 24<sup>th</sup> week of intrauterine life.<sup>2,3</sup> Fingerprint patterns are genotypically determined and remain unchanged throughout life.<sup>4</sup> The fact that the skin of the palm and soles have ridges that are unique to each individual has been used for personal identification.<sup>5</sup> Galton classified different fingerprint patterns on the basis of their primary pattern as -loops, whorls and arches.<sup>6</sup> Hahne in his study asserted that the blood group O is associated more with loops and less with whorls when compared to blood group A.<sup>7</sup> Herch found a high frequency of loops in blood group A.<sup>8</sup> Recently in India, Gowda and Rao in their study found a high frequency of loops, moderate and low

frequency of whorls and arches respectively, in individuals of A, B and O blood group. They also found a significantly greater number of loops in Rh-Positive individuals and whorls in Rh-negative subjects.<sup>9</sup>

Fingerprints present at the scene of crime can be used to identify suspects, which will help the law enforcement authorities in arresting/excluding the accused and also processing the investigation in right direction. Fingerprints aren't just for identification anymore. Studies determined that fingerprint patterns may hold clues to revealing potential health threats, including certain diseases and cancers.

Due to the immense potential of fingerprints as an effective method for identification, an attempt has been made in the present study to analyse their correlation with gender and with the blood group of an individual. This correlation between fingerprint patterns and these parameters can be used to aid in estimating sex as well as determining the blood group and vice versa, thus, enhancing the authenticity of fingerprints in detection of crime and criminals.

### Materials and Methods

The objective of this study was to ascertain the distribution pattern of finger prints in individuals with different ABO and Rh blood groups along with an evaluation of the relationship finger print patterns share with ABO blood groups in both males and female.

This prospective study was carried out over a period of two months among medical students. A total of 200 students (100 male & 100 female) belonging to the age group 18- 25 voluntarily participated in the study. The study was initiated after approval from the Institutional Ethics Committee. Students with permanent scars on their fingers or thumbs, with any hand deformities due to injuries, birth defects or disease,

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those having worn out fingerprints, extra, webbed or bandaged fingers, were excluded from the study. Data collected was subjected to statistical analysis using frequency distribution and Chi-square test with the help of Statistical Package of Social Sciences (SPSS) version 20.0

Each subject was asked to wash his/her hands thoroughly with soap and water and dry them using a towel. He/She was then asked to press his/her fingertip on the stamp pad and then on to the paper to transfer the fingerprint impression. The same method was repeated for all the fingers of both hands. In this way, the plain fingerprints of all the ten digits were taken separately on respective blocks on the same sheet of paper. Care was taken to avoid sliding of fingers to prevent smudging of the print. After the fingerprints were acquired, details such as name, sex and age was noted. The details of their blood group were noted from their college identity cards. Each subject was assigned a serial number. The fingerprint patterns were studied with the help of a magnifying lens and were classified as: Loops, Whorls and Arches based on the appearance of ridge lines as explained by Henry's classification system. This system assigns each finger a number according to the order in which is it located on the hand, beginning with the right thumb as number one and with the left little finger as number 10.

The distribution of dermatoglyphic fingertip patterns on both hands of individuals and its relationship with gender and different ABO and Rh blood groups was evaluated and analysed statistically.

### Results

A total of 200 subjects participated in the study out of which 100 were males and 100 were females. Majority of the subjects, 68(34%), in the study belonged to the blood group O; followed by blood group B, A and AB which were 64 (32%), 58(29%) and 10(5%) respectively. While blood groups A and B were found to be the most common (equally pre-dominant) among males, blood group O was the most commonly seen blood group in females. (Table 1).

**Table 1:** Distribution of subjects according to sex and blood groups

Sex	A	B	AB	O	Total
Male	34(17%)	34(17%)	4(2%)	28(14%)	100
Female	24(12%)	30(15%)	6(3%)	40(20%)	100
Total	58(29%)	64(32%)	10(5%)	68(34%)	200
P-Value	0.213				

Chi-square test was applied to study the association between blood groups and gender. There is no significant correlation or association between the blood group and gender of an individual [P value > 0.05]. Maximum 192 (96%) subjects in the study were Rh positive, of which 66(33%) belonged to the blood group O, 61(30.5%) belonged to the blood group B, 55 (27.5%) subjects had the A blood group while only 10(5%) had AB blood group. Among Rh negative individuals, 3(1.5%) belonged to blood group A, 3(1.5%) to blood group B and 2(1.5%) belonged

to blood group O. None of the subjects showed AB negative blood group (Table 2).

Fingerprint pattern analysis showed that, loops were the most common pattern in the study 1248(62.4%), followed by whorls 601(30.05%) and arches (7.5%) (Table 3).

**Table 2:** Distribution of subjects according to Rh factor

Blood group	Rh positive	Rh negative
A	55(27.5%)	3(1.5%)
B	61(30.5%)	3(1.5%)
AB	10(5%)	--
O	66(33%)	2(1%)
Total	192(96%)	8(4%)

**Table 3:** General distribution of finger print patterns in all fingers of both hands

Pattern	Number	Percentage
Loops	1248	62.4
Whorls	601	30.05
Arches	151	7.55
Total	2000	100

Frequency of loops was highest in both the Rh-positive and Rh-negative subjects of ABO blood groups except for O negative blood group where whorls predominate. Incidence of loops varied between 40% (in O negatives) to 86% (in A negatives). Amongst the subjects of different blood groups, blood group A showed the highest incidence of loops (Rh +ve 62.18% and Rh -ve 86.6. %). Whorls showed moderate frequency ranging between 6.6% (in A negatives) to 60% (in O negatives). Arches were the least common, ranging from 2% (in AB positives) to 10% (in O positives) as shown in Table 4.

**Table 4:** Distribution of fingerprint patterns among A, B, O and Rh blood groups

Pattern	A +ve	A -ve	B +ve	B -ve	AB +ve	AB -ve	O +ve	O -ve
Loops	342 (62.18%)	26 (86.60%)	392 (64.26%)	21 (70.00%)	67 (67.00%)	--	377 (57.12%)	8 (40.00%)
Whorls	177 (32.18%)	02 (6.60%)	181 (29.67%)	7 (23.33%)	31 (31%)	--	231 (35.00%)	12 (60.00%)
Arches	31 (5.63%)	02 (6.60%)	37 (6.06%)	2 (6.66%)	2 (2%)	--	52 (7.87%)	--
Total	550	30	610	30	100	--	660	20
P-Value	0.026							

There is a significant association between fingerprint patterns and ABO blood group (P < 0.05). Frequency of loops was found to be higher in females (53.20%) as compared to males (46.79%) whereas whorls were more common in males (57.73%) as compared to females (42.27%). 43.04% of arches were present in males and 56.95% in females (Table 5). There is a strong association between fingerprint patterns and gender (P < 0.05).

**Table 5:** Distribution fingerprint patterns among males and females

Type	Male	Female
Loops	584(46.79%)	664(53.20%)
Whorls	347(57.73%)	254(42.27%)
Arches	65(43.04%)	86(56.95%)
P - Value	<0.001	

## Discussion

The present study shows that there is an association between distribution of fingerprint patterns, blood group and gender. Majority of the subjects in the study belonged to the blood group O; followed by blood groups B, A and AB. On the other hand the study conducted by Fayrouz INE revealed O as most common blood group followed by A, B and AB for the Libyan population.<sup>10</sup> These findings do not coincide with the study conducted by Mehta, which revealed B as the predominant blood group and AB as the least common within the Indian population.<sup>11</sup> Majority of the subjects (96%) were Rh positive while only 4 % were Rh negative. The general distribution of the primary fingerprint pattern was of the same order in individuals with A, B, AB and O blood groups i.e. a high frequency of loops, a moderate frequency of incidence for whorls and a low frequency of arches. This is in accordance with the study conducted by Bharadwaja et al.<sup>12</sup> and Gowda MST<sup>9</sup>. Similar findings were seen in Rh-positive and Rh-negative individuals except for the O negative blood group where, whorls predominated. Bharadwaja et al conducted a study during 2000-2001 on 300 medical students with different ABO blood groups in Rajasthan which revealed that individuals with blood group A show a higher incidence of loops, while those with AB blood group have more whorls.<sup>12</sup> The finger print pattern observed in our study was similar to the study conducted on Indian population by Kanchan<sup>13</sup> and Nithin<sup>14</sup>. The studies conducted in Southern Nigeria, India, Libya, Kenya and Tanzania revealed similar ridge patterns.<sup>10,11,15,16</sup> The findings do not coincide with the study conducted in New Zealand which revealed a higher incidence of whorls (55.6%) than loops (43.6%) in males and a significantly higher frequency of whorls (65.6%) as compared to loops (33.7%) in females.<sup>17</sup>

In the present study it was found that blood group A had a higher frequency of loops. Blood group AB was not found to be associated with a predominance of whorls as was seen in the other study<sup>12</sup>. Present study also revealed that whorls were more common in blood group O (consistent with the study conducted by Sharma et al<sup>18</sup>), and arches in blood group A. While blood groups A and B were found to be the most common (equally predominant) among males, blood group O was most commonly seen in females. The present study also reveals that frequency of loops is relatively higher in females than males, while whorls were relatively commoner in males than females. Arches were found to be relatively more frequent in females.

Studies have shown that, various diseases can be predicted with the help of blood group of the individual. Blood group O is seen to be associated more with skin cancer and Hodgkin's disease as

compared to other blood groups, whereas blood group A is associated with ovarian, endometrial and stomach carcinoma.<sup>19,21</sup> Rh positive individuals are more frequently associated with colon cancer.<sup>22</sup>

## Conclusion

Each fingerprint is unique and hence it can be effectively used as an evidence and also for identification in the court of law. Loops are the most commonly occurring finger-print pattern while Arches are the least common. O positive blood group is the most common and A negative is rare. Loops are predominant in blood groups A, B, AB and O in both Rh positive and Rh negative individuals except for O negative blood group wherein whorls are more common. Loops and arches have the highest incidence in blood group A while whorls are more common for blood group O. Males have a higher incidence of whorls and females have a higher incidence of loops. The association between the whorl pattern of fingerprints and breast cancer might be potentially used for screening of breast cancer in under developed and developing countries, wherein access to mammograms may not be possible. These additional factors can be validated and the accuracy of prediction may be increased by encouraging and conducting this study on larger population groups.

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## Study of oxidative stress and antioxidant status in male and female poisoning cases - A case control study

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### Abstract

Pesticide poisoning is the major health problem in the developing countries. For a person who is frustrated or stressed, and one who wants to get rid of his problems, poison may seem to be the best answer. The stress and strain contribute to the imbalance between antioxidant and oxidant status, which lead to various other disorders. A pilot study was conducted on patients admitted with organophosphorus poisoning to our trauma and emergency care unit from January 2010 to March 2010. The various aspects of treatment, complications, drug options and uncommon problems were evaluated. The levels of Vitamin C, E, Malondialdehyde and activity of superoxide dismutase were measured in the participants of the study. Female subjects with organophosphorus poisoning had significantly decreased levels of vitamin C, E and SOD and increased levels of MDA, when compared to male subjects with organophosphorus poisoning and healthy controls.

### Keywords

Oxidative stress; Organophosphorus poisoning; Pesticides

### Introduction

Poisoning is a significant health hazard<sup>1</sup> and paucity of medical attention towards it has caused an increased mortality in the developing world (10-20%) as compared to 0.5-1% in the developed countries.<sup>2</sup> As per World Health Organization (WHO), 3 million acute poisoning cases with 2,20,000 deaths have been reported annually. Every year, in India, more than 50,000 deaths had been reported from toxic exposure.<sup>2</sup> However, the scenario might be graver than this as most of the poisoning cases go unreported.

In countries like India, where the agriculture is still the main source of livelihood, commercialization of horticulture farming, farm expansions, and trends of monoculture farming facilitate the proliferation of pests, which sequentially raises the requirement for pesticides. These pesticides keep the crops safe and help to meet the demands of the global market. However, the frequency of incidences of poisoning due to insecticides and pesticides have also been reportedly increasing as compared to others. This may be due to, the easy accessibility, feasibility, effectiveness and the unrestricted sale of these chemicals in the market, making them an easy tool for poisoning.<sup>3</sup> In preceding years, ample amounts of pesticide, particularly organophosphorus compounds had been introduced into the Indian agricultural market. Owing to its effectiveness against a wide range of insects and pets, this compound flourished in the markets.<sup>4</sup> However, along with this, an increasing number of

organophosphorus poisoning cases have also been reported.

Increased incidences of poisoning may be associated with changes in the socio demographic profile<sup>5</sup>. These socio demographic and economic changes along with modern way of life have resulted in increased expectations and distress. Sometimes failure to accomplish these expectations makes the person stressed & depressed. Stress and poisoning are the contributing factors for disturbing the equilibrium between the antioxidant and the oxidant status. Poisoning increases the formation of free radicals with respect to available antioxidants and interrupts this balance. Free radical / Reactive oxygen species (ROS) like superoxide anion (O<sub>2</sub><sup>-</sup>), hydroperoxyl radical (HOO<sup>·</sup>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), hydroxyl radical (OH<sup>·</sup>), lipid peroxide radical (ROO<sup>·</sup>), singlet oxygen (O<sup>1</sup>), nitric oxide (NO<sup>·</sup>), peroxy nitrite (ONOO<sup>-</sup>) are highly reactive and unstable molecules. ROS not only serves as key signal molecules in physiological processes but have a role to play in pathological processes as well<sup>6</sup>. The body defends itself against these free radicals by antioxidant vitamins like Vit A, C, E and certain antioxidant enzymes like superoxide dismutase, glutathione peroxidase, glutathione reductase and catalase. Increasing number of ROS overpowers the body defense system, and brings about Oxidative stress, a disturbance in the equilibrium between oxidants and antioxidants. Oxidative stress is known to be the cause of various health issues.

Exposure to organophosphorus pesticide has been associated with an increased risk of oxidative stress, but evidence for gender differences in this association is limited. Therefore, the aim of this study was to evaluate the gender differences in oxidative stress caused by organophosphorus pesticide poisoning, by elucidating parameters such as lipid peroxidation by-product malonaldehyde (MDA), antioxidant vitamin C, E, and antioxidant enzyme superoxide dismutase

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## Materials and Methods

The study was carried out from January 2010 to March 2010. During the period of the study a total of 65 cases of poisoning were registered with the Poison Detection Center, Forensic Medicine & Toxicology, J.N. Medical College, and KLE's Dr. Prabhakar Kore Hospital & MRC, Belgaum, Karnataka, India. Out of these 65 poisoning cases, 50 cases were reported positive for Organophosphorus poisoning. Out of 50 positive organophosphorus poisoning cases, 25 males and 25 females agreed to participate in this study.

The present pilot study was carried out in the Department of Biochemistry and the Poison Detection Center (Forensic Medicine and Toxicology) at Jawaharlal Nehru Medical College Belgaum, Karnataka. Data was collected from all the poisoning cases admitted during this period to the Trauma and Emergency Care Unit in KLES Dr. Prabhakar Kore Hospital and MRC, Belgaum, Karnataka. Information was recorded on a proforma on the type of poison consumed, age and sex from records for each case and analyzed.

The study was approved by the Institutional ethical committee (IEC). All participants gave written consent and this protocol was also approved by the ethical and research committee of Jawaharlal Nehru Medical College, Belgaum. Venous blood samples were collected from the clinically screened and diagnosed poisoning subjects. The samples were collected in two different vials, a plain vial (for serum separation) and a lithium heparin (for plasma separation) vial respectively. Both the vials were left at room temperature for 30 min. The Heparin vial was centrifuged for 15 min at 3,000 rpm to separate plasma. Separated plasma was used for the estimation of antioxidant status such as Vitamin C by 2,6- di chlorophenol indophenol reagent method<sup>7</sup> and Vitamin E by Emmerie Engel reagent method<sup>8</sup>. The whole blood was used for estimating the activity of Superoxide dismutase enzyme by Epinephrine reagent method<sup>9</sup>. Evaluation of Oxidative stress marker malondialdehyde (MDA) was done by Thio barbiturate method<sup>10</sup>.

This study includes 50 healthy (25 male and 25 female) volunteer subjects as controls and 50 organophosphorus poisoned subjects (25 male and 25 female) as cases. Patients were identified as a case of poisoning on basis of the history given by the patient or their associates and by observing clinical features like miosis, increased salivation, increased respiratory secretions, muscle cramps and abdominal discomfort. Cases of Animal bite, Plant poisoning, Drug and food poisoning were excluded from this study.

Statistical analysis: All values are presented as means and SD. Statistical significance was analyzed using the student t test. The level of significance was set at  $P < 0.05$ .

## Results

During this study period, a total of 65 poisoning cases were brought to the Trauma and Emergency Care Unit of KLES Dr.

Prabhakar Kore Hospital and MRC, Belgaum, Karnataka. 50 cases that were positive for organophosphorus poisoning were included in this study. Apparently healthy subjects were taken from the community as Control group.

50 healthy controls; Group I (25 male), Group II (25 female) and 50 poisoning patients Group III (25 male), Group IV (25 female) were investigated for oxidative stress via the antioxidant markers like Vitamin C, E enzyme like superoxide dismutase and lipid peroxidation marker MDA assays. Controls were matched in regard to sex and age (Table 1).

**Table 1:** Status of vitamins antioxidants and antioxidant enzyme activity in controls and poisoning cases

Markers	Controls Mean $\pm$ SD	Controls Range	Cases Mean $\pm$ SD	Cases Range	t-value
Ascorbic Acid	1.08 $\pm$ 0.233	0.7-1.43	0.43 $\pm$ 0.12	0.22-0.62	17.7*
$\alpha$ Tocopherol	0.91 $\pm$ 0.11	0.72-1.17	0.58 $\pm$ 0.14	0.34-0.85	13.3*
SOD	1071.4 $\pm$ 235.76	658.51-1568.62	477.39 $\pm$ 93.96	343.2-622.47	16.9*
MDA	9.31 $\pm$ 0.49	8-10.02	11.93 $\pm$ 0.68	10.5-13.2	22.1*

\*p-value <0.0001

Comparison of patients with controls was repeated in a gender-specific manner (Table 2). In accordance with our hypothesis, we found that poisoning patients significantly demonstrate higher levels of OS as compared to controls. Further analysis of the data revealed sex-specific differences in OS, with male and female controls. Male poisoning cases demonstrate significantly higher concentrations of MDA and decreased levels of antioxidants as compared to male and female controls. Although the healthy female controls demonstrate decreased levels of OS, a significantly higher degree of OS was found in female OP poisoning patients. A significant difference has been observed between male OP poisoning cases and male controls.

**Table 2:** Statistical comparison of antioxidant vitamins and enzyme status among same sex in poisoning cases with their controls

Markers	Control-Males (Group II)	Cases-Females (Group III)	Control-Males (Group II)	Cases-Females (Group IV)	t-value
Ascorbic Acid	0.8684 $\pm$ 0.10	0.3248 $\pm$ 0.067	1.2928 $\pm$ 0.08	0.5292 $\pm$ 0.05	39.045*
$\alpha$ Tocopherol	0.81 $\pm$ 0.04	0.425 $\pm$ 0.06	1.0052 $\pm$ 0.07	0.702 $\pm$ 0.07	15.2228*
SOD	873.08 $\pm$ 103.05	391.40 $\pm$ 36.57	1241.72 $\pm$ 144.66	563.39 $\pm$ 35.78	23.6990*
MDA	9.755 $\pm$ 0.25	12.68 $\pm$ 0.42	8.9 $\pm$ 0.23	11.3964 $\pm$ 0.39	28.0269*

\*p-value <0.0001

## Discussion

Acute organophosphate (OP) poisoning is a major health problem in agricultural countries. It claims approximately 1000,000 life per annum which is gigantic numeral compared to other causes of death such as road accidents, snake bites, burns and assaults<sup>11,12</sup>. Mortality due to poisoning is increasing every year. Organophosphates and Carbamates are most commonly used pesticides worldwide and more so in developing countries.

The organophosphate compounds on entering the human body

inhibits cholinesterase (ChE) enzymatic activity, thus bringing about a reduction in the cholinergic signs and symptoms. Fatalities of OP poisoning require immediate hospital emergency treatment to prevent a critical outcome.

From September 2008 till present we have observed that majority of poisoning cases which were admitted in the tertiary care hospital and referred to Poison Detection Center, were positive for organophosphorus compound. Increasing number of organophosphorus poisoning cases may be due to its wide range of effectiveness against insects and pests. This quality makes it the preferred choice of pesticide among the farmers and may be the reason for its usage as a common poisoning tool.

The normal vitamin C levels vary from 0.4 to 1.5 mg/dl. The levels of vitamin C in the age and sex matched apparently healthy controls were between 0.70-1.43 mg/dl. Range of Vitamin C for poisoning cases was from 0.22 to 0.62 mg/dl, which is significantly lower in comparison to control subjects. In 25 males (Group III) out of 50 poisoning cases, range of Vitamin C levels was between 0.22 to 0.50 mg/dl. In the remaining 25 female poisoning cases (Group IV) Vitamin C levels ranged between 0.43-0.63 mg/dl.

The mean value of Vitamin C significantly decreased in OP poisoning cases group III ( $p < 0.001$ ), group IV ( $p < 0.001$ ) and as compared to control Group I and Group II ( $p < 0.001$ ). Group III Male OP Poisoning cases showed maximum depreciation of Vitamin C levels as compared to group I, II and IV.

Generally, it is believed that Ascorbic acid is the first line of defense for oxidants and acts by donating a single electron chased by a proton to yield a chemically reduced, non-radical product and ascorbyl radical. Glutathione-dependent enzymatic systems further reduce ascorbyl radical and dehydroascorbic acid, effectively maintaining bioavailability of vitamin C in the body pool<sup>13,14</sup>. It also aids in the regeneration of vitamin E, and thus is also important in maintaining the vitamin E levels in the body.

Generally, it is considered that the  $\alpha$ -tocopherol is the most important lipid-soluble antioxidant, and by reacting with lipid radicals produced in the lipid peroxidation by ROS chain reaction, it also protects membranes from oxidation<sup>15,16</sup>. During LDL lipid peroxidation, lipid radicals get generated. These lipid radicals react with tocopherol and produces oxidized  $\alpha$ -tocopheroxyl radicals that can be recycled back to the active reduced form through reduction by other antioxidants, such as ascorbate, retinol or ubiquinol<sup>33</sup>. By removing the free radical intermediates, it also disrupts the propagation reaction from continuing<sup>17</sup>.

It is evident from the results of our study that patients with OP poisoning had lower level of serum  $\alpha$ -Tocopherol compared to normal reference levels whereas, amongst control groups, range of aforementioned marker were between 0.71 to 1.25 mg/dl. The normal vitamin E levels vary from 0.5 to 1.8 mg/dl. The levels of vitamin E in the age and sex matched apparently healthy controls were between 0.72-1.17 mg/dl. Range of Vitamin E in OP poisoning cases was 0.34 to 0.85 mg/dl. In Group III of OP poisoning cases, range of Vitamin E levels was

between 0.34 to 0.53 mg/dl. In remaining 25 female OP poisoning cases (Group IV) Vitamin E levels ranged between 0.61-0.85 mg/dl. Vitamin E is a well-known lipid chain breaking antioxidant. It reacts with lipid peroxy radicals and during the process itself gets converted into inactive tocopherol. Conversion of inactive tocopherol to active tocopherol requires vitamin C. Due to increased oxidative stress, Vitamin C is exhausted and not able to participate in this regeneration, resulting in the enhanced consumption of existing Vitamin E (active tocopherol) in order to compete with oxidative stress. This further brings about more deficiency of Vitamin E.

The activity of SOD significantly ( $p < 0.001$ ) decreased in OP poisoning cases as compared to control. The reference range of SOD as derived from age and sex matched apparently healthy controls were 658.51-1568.62 IU/gm of Hb which is significantly lower in comparison to control subjects. In 25 males (Group III) out of 50 OP poisoning subjects, SOD levels between 343.20 and 460.21 IU/gm of Hb were detected. Highest level of SOD in these male OP poisoning cases was less than the lowest level of SOD in control subjects signifying the extent of SOD depletion in OP poisoning subjects. In the remaining Group IV, SOD levels ranged between 498.20 to 622.47 IU/gm of Hb, which is also lower than the lowest level of SOD in control subjects. The mean activity of SOD significantly decreased in OP poisoning cases, both males and females. In group IV (Female OP poisoning cases) the SOD activity significantly reduced when compared to group II (control female) and a more significant reduction in the activity of SOD had been observed in group III when compared to Group I (male control). It can be inferred through these findings that not only the mean activities of SOD are significantly lesser in OP poisoning cases when compared to control groups in this study, but the activities of SOD are also related to gender. Male OP Poisoning cases have severely decreased activity compare to female OP poisoning cases. There is enhanced production of superoxide anions by organophosphorus compounds which may consume the SOD resulting in decreased activity of the same.

The reference range of MDA as derived from age and sex matched apparently healthy controls was 8.00 – 10.02 mg/dl. In 25 males (Group III) out of 50 OP poisoning cases, MDA levels ranged between 12.0 to 13.2 mg/dl. (Significantly more than reference values). Levels of MDA in these 25 male cases increased more than the highest level of MDA in control subjects signifying the extent of ROS damage in OP poisoning cases. In remaining 25 females (Group IV) OP poisoning patient's MDA levels ranged between 10.5 to 11.84 mg/dl, which is more than the highest level of MDA in control subjects.

These findings demonstrate an increased MDA level as compared to control. We are aware that MDA is an end product of lipid peroxidation and therefore increased MDA signifies increased lipid peroxidation by free radicals. This may be due to decreased antioxidant levels in body to defense against free radicals. the surrogate markers for evaluating the risk factors.

In this study, it is evident from these findings that male cases of

organophosphorus poisoning had lower levels of serum Vitamin C, E and SOD levels and increased MDA level compared to female cases of organophosphorus poisoning, normal reference level and control subjects respectively. It is evident that accidental/self-poisoning in stressful conditions may initiate or intensify the effects of poison which consequently create an imbalance in the antioxidant and oxidant equilibrium. Disturbance in this balance causes the reactive oxygen species (ROS) to overtake the antioxidant defense system of body and initiate a chain reaction of their own. Re-establishment of disturbed antioxidant-oxidant equilibrium is achieved by certain enzymes such as catalase, glutathione reductase, glutathione peroxidase, superoxide dismutase as well as by some vitamins like ascorbic acid, tocopherol, and retinols etc. together known as antioxidants.

The pathophysiology of OP pesticide poisoning in human body has to be investigated. It has been observed that toxicity of Pesticides occurs due to generation of Free radicals which alters the of oxidant --antioxidant equilibrium via 2 ways:<sup>18</sup>

1. Increasing the Nitric oxide synthase (NOS) activity results in an increased formation of Nitric Oxide (NO) free radicals from inflammatory cells. NO radicals further combine with superoxide radicals and form highly reactive peroxynitrite radicals, subsequently increasing oxidative stress.
2. Cytochrome c oxidase (Cox), the terminal enzyme complex of the mitochondrial respiratory chain, is dependent upon the polyunsaturated phospholipid cardiolipin. Presence of polyunsaturated phospholipid, makes it highly susceptible for lipid peroxidation resulting in mitochondrial dysfunction i.e. incomplete reduction of O<sub>2</sub> and increased formation of ROS.<sup>18</sup>

In the present study, significantly low levels/activity of Vitamin C, Vitamin E and Superoxide dismutase (SOD) and an increased level of oxidative stress by-product MDA is amongst organophosphorus poisoning (OP) subjects have been observed as compared to the control population. The decreased levels of antioxidants and increased level of MDA indicates increased oxidative stress in OP poisoning subjects.

The next question is whether oxidant status and antioxidant enzyme activities during poisoning are regulated in a sex-dependent manner. We have observed higher MDA levels i.e. increased lipid peroxidation in male poisoning cases as compared to female poisoning cases. This may be associated with higher antioxidant capacity of CAT and Gpx activity in females as compared to males. These findings have been supported by experimental study based on mice model, which indicates that brains of female mice are more efficiently protected from oxidative stress than brains of male mice<sup>19</sup>. The explanations for the variation of oxidative stress among male and female might be associated with- (a) Sexual dimorphism of the nervous system due to steroid hormones (b) Diverse activation of the HPA axis, (c) effect of gonadal steroids. Over and above the main difference between male and female

antioxidant/oxidant status is due to estrogen. It has been recognized that estrogen, due to the existence of a phenolic hydroxyl group, acts as an antioxidant<sup>20</sup>. Because estrogen acts as an antioxidant in females is why females have a stronger ROS defense system as compared to males.

## Conclusions

OP compounds are nowadays used as an important tool to protect farms and household gardens from pests. Ease of accessibility to these compounds may be the reason for an increased number of accidental and suicidal poisoning cases, all over world. Diagnosis of OP poisoning depends mainly on the history, characteristic clinical presentation and is supplemented by decreased levels of serum and erythrocyte cholinesterase levels.

In the present study, we observed that lipid peroxidation is raised, representing high oxidative stress in organophosphorus poisoning. Reduced levels of Vitamin C, Vitamin E and a decreased activity of SOD in organophosphorus poisoning cases indicates that oxidants/Free radicals have overpowered the antioxidant defense system of the body.

In the present study, we observed an increased oxidative stress in male poisoning subjects when compared to female poisoning subjects. This may be because the males are described to be most ambitious, productive and responsible. Hence, this populace is more susceptible to various emotional conflicts which occur in the journey of life. Such incidents accentuate the significance of community based programs. The Government and society should arrange for focused social supportive programs to improve family harmony and help lessen the cases of poisoning. We concluded that further research is required into examining other strategies and regimens.

## Limitation of Study

The number of patients in this study is very small. Nevertheless, it may be taken as an initial step to conduct more studies on oxidative stress due to organophosphorus poisoning among males and female.

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## An autopsy based cross sectional study of corrosive acid poisoning cases brought to Victoria Hospital, Bengaluru

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### Abstract

The study was conducted for a period of 1 year, from January 2017 to December 2017 to analyse the deaths due to corrosive acid. During this period of study, a total of 3173 autopsies were conducted among which 266 (8.38%) cases of deaths due to poisoning were studied in the Department of Forensic Medicine, Victoria Hospital, Bangalore Medical College and Research institute, Bangalore. Among 266 cases of poisoning death, 12 (4.6%) deaths were due to corrosive acid consumption. Majority of the victim of the study group were male 8 (66.7%). Most of the victim was in the age group of 30-40 years 8 (66.7%). Among the deceased 9 (75%) were married. Forensic Laboratory findings showed the most common substance of corrosive acid being hydrochloric acid 6(50%) followed by sulphuric acid 3(25%). During the autopsy of these cases, stomach perforation was found in 5(41.7%) cases. Most of the victims were brought dead to hospital 9(75%) and the common cause of death being shock 10 (83.3%) followed by peritonitis in treated patients. The most common manner of death was suicidal in 10 (83.3%) cases.

### Keywords

Acid; Poisoning; Corrosives; Stomach; Perforation; Fatal; Autopsy

### Introduction

A corrosive is a substance which burns everything which it comes to contact with and poisoning due to it can do lot of damages to the human body. Corrosive ingestion is a grave public health problem across the globe.<sup>1</sup> It is more common in the developing countries, but still seen in developed countries. Even in the United States about 5,000 to 15,000 corrosive ingestions are reported per year.<sup>2</sup> The exposure to it can happen via dermal, ocular, respiratory and gastrointestinal route. Following exposure to an acid, hydrogen (H<sup>+</sup>) ions desiccate epithelial cells, producing an eschar and resulting in what is histologically referred to as coagulation necrosis.<sup>3</sup> Ingestion of acid causes more damage to the stomach than the oesophagus because the squamous epithelium of the latter is more resistant to acids.<sup>4</sup>

Morbidity and mortality from exposure to caustics is a worldwide problem. One study from India describing outcomes in patients following acid ingestions found that acute complications occurred in 39.1% of cases with death resulting in 12.2%.<sup>5</sup> Acids are uncommon household toilet cleaner still found in some houses but it is easily available in the market. 3, 4, 6 It is most commonly used by criminals with intention to disfigure someone's face.<sup>6</sup>

### Materials and Methods

The present study was autopsy based prospective cross-sectional study that was conducted in the Department of Forensic Medicine & Toxicology, Victoria Hospital, Bangalore Medical College and Research Institute from Jan to Dec 2017 a period of 1 year. Ethical clearance was taken from the ethics committee of Bangalore Medical College, Bengaluru.

The study population comprised of all fatal cases with alleged history of corrosive acid poisoning brought to mortuary of Victoria Hospital for a period of one year. The study was done by careful and detailed autopsy methodology after excluding the non-corrosive acid poisoning, 12 cases of corrosive acid poisoning was identified and included all of them in the study. The viscera collected during autopsy was sent to forensic science laboratory for analysis.

Detailed information regarding the circumstances was sought from the police, victim's relatives and friends, visits to the scene of occurrence or deduced by the photographs of the scene of occurrence. Cases related to treated patients, medical and treatment history was collected from the hospital. Data was analysed as descriptive statistics and presented in the form of tables.

### Results

In 2017, total of 3173 medico-legal autopsy were conducted, out of these 8.38% cases are of poisoning. Among these poisoning cases, the study group of corrosive acid poisoning was 4.6% and non-corrosive acid poisoning was 95.5%.

The study group was dominantly consisting of male group 66.7% followed by female 23.3%. Most the deceased were in the age group of 30 to 40yrs 66.7% followed by age group of 20

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to 30yrs 25%. Majority of the study group were married 75%, Most of the cases were brought dead to the hospital 75% and only 25% were treated. The treated cases were declared dead within 6 to 48hrs of medical treatment. The most common cause of death was due to shock and hemorrhage 83.3% followed by chemical peritonitis in 16.7% cases.

The most common type of manner of death was found to be suicidal in 83.3% and accidental in 16.7% cases, one belonging to pediatric age group less than 10yrs of age.

Hydrochloric acid was the most common corrosive substance consumed found in 50% of case, followed by Sulphuric acid in 25% cases and least found to be Nitric acid in 8.3% cases.

Perforation of stomach was seen in 41.7% cases, of which 80% cases were due Hydrochloric acid and 20% due to Sulphuric acid.

## Discussion

Corrosive ingestion is associated with the potentially catastrophic presentation. It causes significant morbidity, mortality and prolonged hospital stay, resulting in huge economic burden to poorly resourced health system of developing countries.<sup>7</sup> During our study period a total of 3173 medico legal autopsy were conducted, out of which 8.38% cases are of poisoning. Among these poisoning cases, the study group contributed for corrosive acid poisoning was 4.6% (Table-1). The corrosive acid poisoning contributed very less portion, because people could have known by reading in newspaper, articles or in media commercials which elaborately shows the effect of acid on humans. The result of this study was observed similarly in studies conducted by Thomas et al and Al-Binali et al which observe very less incidence of corrosive acid poisoning compared to other poisons.<sup>8,9</sup>

**Table 1:** Distribution study group based on number of cases

Poisoning	Number	Total (%)
Non corrosive	254	95.4%
Corrosive acid	12	04.6%
Total	266	100%

This study group was dominantly contributed by male preponderance of 8(66.7%) followed by female 4(23.3%). This result coincides with the findings in the study conducted by Parvathi et al,<sup>10</sup> where the sex distribution was majority contributed by male 56.5%. Different studies show different demographic pattern of corrosive acid poisoning. The current study discovered that 66.7% cases of corrosive acid poisoning belonged to the population of 30-40 years age group, 25% in the age group of 20 to 30 years and less than 8.3% in pediatric age group. This was in contrast to study conducted in America, where the incidence of corrosives was around 50-80% in children.<sup>11</sup> Another study reports suggests that the incidence of corrosive poisoning in children of India and Nigeria is 15 and 25 % respectively.<sup>12</sup>

The study data suggested that the incidence of corrosive acid poisoning is more common in married people than unmarried people. The reason for high mortality rate in married people may be due to lot of commitments, financial burden and familial constringent. The data co-insides with the research by Parvathi et al, where the data gives highest rate of fatality rate in married people compared to unmarried people.<sup>10</sup> On the other hand Unmarried people on the other hand are more carefree and "happy go lucky" which explains the lower number of fatal cases.<sup>10,13,14</sup>

During this study, we observed that 9(75%) cases of study that was brought to our mortuary was not treated i.e. they were brought dead and remaining 3(25%) cases sought medical attention, among these cases which sought medical attention 1 case was declared dead within 6 hrs and remaining case by 48hrs. The cause of death was found to be shock and hemorrhage in 10(83.3%) of case and reactionary chemical peritonitis in 2(16.7%) of cases (table-2). The mortality and morbidity of acute corrosive gastric injuries are high and dependent on the severity of initial damage caused by the corrosive agent with a significant portion of patients succumbing to their injuries either before reaching tertiary care or soon thereafter.<sup>15</sup> Our study corresponds to the study conducted by Araz C et al states that mortality rates are generally reported to be 10-20% but they can be as high as 78% if the intake is purposely for suicide.<sup>16</sup>

**Table 2:** Distribution of study group based on Cause of Death

Manner	Male	Female	Total (%)
Suicidal	07	03	10 (83.3%)
Accidental	01	01	02 (16.7%)
Total	08	04	100%

In this study, the manner of death was found to be suicidal in 10(83.3%) of cases followed by accidental 2(16.7%) (Table-3), this higher percentage of suicidal tendency is due easily availability of corrosive acids in the form of household products.<sup>17</sup> Recent medical literature reveals that corrosive ingestion is seen in every age group. Ingestion may be either deliberately with suicidal intent or accidental. In developing countries, the incidence of corrosive ingestion is significantly higher and in most cases remains unreported.<sup>2,18</sup>

**Table 3:** Distribution of study group based on Manner of Death

Cause of Death	Male	Female	Total (%)
Shock & Hemorrhage	07	03	10 (83.3%)
Chemical Peritonitis	01	01	02 (16.7%)
Total	08	04	100%

This current study data with the help of forensic laboratory analysis revealed that the most common encountered corrosive acid was Hydrochloric acid in 6(50%) of cases followed by Sulphuric acid 3(25%), carboic acid 2(16.7%) and Nitric acid 1(8.3%) (Table-4). The hydrochloric being most commonly

abused corrosive because it easily available and cheap household product present in the commercial market.<sup>18</sup> It is often used in countries like India and Taiwan as opposed to the USA where its abuse is less than 5%.<sup>19</sup> The result correlates with study conducted by chibishev et al which states that Hydrochloric acid is the most common type of corrosive acid encountered by them.<sup>14</sup>

**Table 4:** Types of corrosive acid encountered

Corrosive Acid	Male	Female	Total (%)
Hydrochloric Acid	04	02	06 (50%)
Sulphuric Acid	02	01	03 (25%)
Carbolic Acid	01	01	02 (16.7%)
Nitric Acid	01	00	01 (8.3%)
Total	08	04	12 (100%)

The study data revealed that in 5(41.7%) of cases the stomach wall was perforated, among these the most common corrosive acid found to cause the perforation was Hydrochloric acid in 80% of cases, followed by sulphuric acid in 20% cases. The extent and severity of injury depends on the strength of the acid, duration of contact, and condition of the stomach, i.e., full or empty.<sup>20</sup> when you consider incidence of occurrence to particular corrosive acid 66.7% of hydrochloric acid consumption cases had caused gastric perforation and 33.3 % of sulphuric acid consumption cases had caused gastric perforation (Table-5). This result was in contrast to previous study done by Mills SW et al, where the perforation was more common in sulphuric acid than compared to Hydrochloric acid.<sup>6,17,21,22</sup>

**Table 5:** Incidence of stomach wall perforation in corrosive acid ingestion

Corrosive acid	Total cases	Incidence of perforation
Hydrochloric acid	06	04 (80%)
Sulphuric acid	03	01 (20%)
Total	09	05 (100%)



**Figure 1:** A-Non perforated stomach wall in Sulphuric acid Poisoning;  
B- Perforated stomach wall in Hydrochloric acid poisoning

## Conclusions

The study highlights fatal cases of corrosive acid poisonings cases brought Victoria Hospital, BMC& RI Bengaluru from Jan to Dec 2017. During this period deaths due corrosive acids were only 12 (4.6%) cases, with this small sample size in the given period acts one of the limitation to draw a firm conclusion. Longer duration of study on corrosive poisoning is needed as the cases of corrosive poisoning very less compared to any other form of poisoning. But in our study we found gastric perforation is more common in hydrochloric acid than to sulphuric acid. In India the data based on the current study is very minimal so there is need on study on this current topic. An early decision of treatment plan is helpful in corrosive poisoning, need of 24x7 poison information centers and suicidal helpline will be useful and handy.

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ORIGINAL ARTICLE

## Profile of fatal road traffic accidents in Pune region, Maharashtra: A cross-sectional autopsy study

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### Abstract

Road traffic accidents are unpremeditated events resulting in recognizable damage. In India, road traffic injuries will be the third leading cause of death by 2020. The present study reflects the data received from victims of road traffic accidents brought to mortuary of the Department of Forensic Medicine and Toxicology, BJGMC, Pune from May 2018 to September 2018. The overall prevalence of road traffic accident cases was 32.20 %, where the majority were from the age group 21-30 years. Male victims outnumbered female victims and thoracic injuries were highest (31.95 %) amongst all other causes of death. The most common internal organs to get injured were lungs. Data also reflects the highest occurrence of a road traffic accident between 06 pm to 12 mid-noon.

### Keywords

Road traffic accident; Mortuary; Thoracic injuries; Internal organs

### Introduction

“An injury is a bodily lesion at the organic level, resulting from acute exposure to energy (mechanical, thermal, electrical, chemical, or radiant) in amounts that exceed the threshold of physiologic tolerance<sup>1</sup>. According to the 2013 global survey of traffic collisions by the UN World Health Organization<sup>2</sup>, India suffered a road fatality rate of 16.6 per 100,000 people. The National Crime Records Bureau (NCRB) 2016 report states that out of 496,762 traffic collisions in 2015, road collisions accounted for 464,674 collisions which caused 148,707 traffic-related deaths in India<sup>3</sup>. In 2014 survey Maharashtra accounted for 11.1% of total fatal road accidents in India.<sup>4</sup>

### Material and Methods

All cases with an alleged history of road traffic accidents, which were brought dead and were directed for autopsy at the Department of Forensic Medicine and Toxicology, BJGMC, Pune during May 2018 to September 2018, after obtaining the consent, constituted the material for study. All other cases where victims had a history of hospital admission, history of surgical interventions following the accident, skeletonized body, decomposed bodies were excluded from the study.

Information regarding demographical aspect of the victims such as age, sex, type of vehicle, time of incidence etc. was collected from inquest and police official accompanying the deceased. The findings of the autopsy recorded in the postmortem examination report filled by the autopsy surgeon were also recorded into standard proforma. Later information gathered was analysed using Microsoft excel software.

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### Results

During the study period, total 826 brought dead cases were referred for postmortem examination, of which 32.20 % cases were victims of road traffic accidents. Victims were from age 01 year to 78 years. The majority of the cases (36.9%) were from the age group 21-30 years whereas the least number of victims were from age group of 71-80 years (1.5%). Males constituted as majorly affected sex and ratio of Male victims (n=173): Female victims (n=93) was 1.86:1 (Table 1).

Table 1: Age and Sex wise distribution of the victims

Age (years)	Male		Female		Total	
	N	%	N	%	N	%
0 - 10	04	1.50	05	1.87	09	3.38
11 - 20	16	6.01	12	4.50	28	10.51
21 - 30	58	21.81	38	14.28	96	36.09
31 - 40	44	16.54	22	8.27	66	24.81
41 - 50	32	12.03	03	1.12	35	13.16
51 - 60	12	4.50	09	3.38	21	07.89
61 - 70	04	1.50	03	1.12	07	02.63
71 - 80	03	1.12	01	0.38	04	1.50
Total	173	65.03	93	34.96	266	100

Trucks were commonest offenders responsible in 36.09% fatalities followed by cars (25.18%cases) (Table 2).

Table 2: Offending vehicle

Vehicle	N	%
Truck	96	36.09%
Car	67	25.18%
Bus	48	18.05%
Two-wheeler	55	20.67%

Multiple body parts were significantly involved, however thoracic injuries outnumbered others (31.95 %) (Table 3). Counting together, abrasions were the commonest surface injuries followed by lacerations. Internal examination showed that lung was most common internal organ to get injured (187 cases) followed by liver (91 cases). Concerning time of

**Table 3:** Anatomical region involved

Anatomical area	N	%
Head only	35	13.16%
Thoracic only	85	31.95%
Abdominal only	30	11.28%
Head and Thorax	33	12.40%
Head and abdomen	17	06.40%
Thorax and abdomen	31	11.65%
Head, Thorax & Abdomen	35	13.16%
Total	266	100%

**Table 4:** Distribution of external injuries

Regions	Abrasions		Contusions		Lacerations		Crush	
	N	%	N	%	N	%	N	%
Head	76	28.57	12	4.51	39	14.66	3	1.12
Thorax	68	25.56	74	27.81	51	19.17	10	3.75
Abdomen	49	18.42	27	10.15	22	8.27	7	2.63
Others	105	39.47	141	53.00	154	57.89	23	8.64

**Table 5:** Injuries to internal organ

Organs	Lacerations		Contusions		Crush	
	N	%	N	%	N	%
Brain	14	5.26	54	20.30	06	2.25
Liver	47	17.66	37	13.09	7	2.63
Kidney	23	8.64	32	12.03	15	5.63
Heart	20	7.51	33	12.40	39	14.66
Lungs	93	34.96	56	21.06	38	14.28
Spleen	21	7.89	0	0	10	3.75
Esophagus	05	1.87	0	0	12	4.51
Stomach	0	0	0	0	6	2.25
Airways	3	0.11	3	0.11	6	2.25
Diaphragm	1	0.37	0	0	1	0.37
Intestine	6	2.25	23	8.64	1	0.37
Mesentery	0	0	30	1.13	1	0.37
Aorta	3	0	13	4.88	1	0.37
Pancreas	0	0	0	0	2	0.75

**Table 6:** Distribution of cases according to time of Incidence

Time of accident	N	%
6am -12md	39	14.66 %
12md - 6pm	36	13.53 %
6pm -12mn	113	42.48 %
12mn - 6am	68	25.56 %
Not known	10	3.75 %

incidence, maximum number of cases occurred between 6 pm-12 midnight i.e. 113 cases (42.48%), followed by those between 12 am – 6 am i.e. 68 cases (25.56%) and least during 6 am- 12 mid-day i.e. 39 cases (14.66%). Among all cases, Shock and hemorrhage due to thoracic injuries were the most common cause of death (31.95%) followed by injuries to head, thorax and abdomen (13.16%).

## Discussion

During the study period, 32.20% cases of road traffic accidents were brought for postmortem examination which is quite close to the observation by Shrivastav et al<sup>5</sup> (29.8%). The most common age group involved in this study was 21-30 years (36.9%) followed by 31-40 years (24.81%). This finding is consistent with the findings of previous studies.<sup>6-14</sup> However, Sinha et al<sup>15</sup> reported 30-44 years as the most commonly affected age group. The reason for the above finding can be attributed to the fact that young adults are the ones who earn for the family and hence most of the outdoor works are carried by them, exposing them to higher risk. The males constituted the majority of accidents and the ratio of Male: Female was 1.86:1, which conforms to other studies.<sup>16-21</sup> We deduce the reason for male predominance as most of the outside works are usually carried out by males. Moreover, females stay in door due to the social structure of Indian society.

The most common offending vehicle for the accidents was truck (36.09%), similar to the results obtained in the study conducted by Ravi et al<sup>12</sup>. The present study showed that the maximum number of cases was reported between 6 pm-12am (42.48%). Our observations are in accordance with those made in a study conducted by Norman et al<sup>22</sup> and Katageri et al.<sup>23</sup>

In our study, the maximum number of victims had thoracic injuries that correlate with the observation by Saukko et al<sup>9</sup>, Benerjee et al<sup>24</sup>, and Hossack et al<sup>25</sup>. However, it contradicts the observation by Schmitz et al<sup>26</sup> and Singh D<sup>27</sup> (head injury), Banerjee et al<sup>24</sup> (thoraco-abdominal), Suri et al<sup>28</sup> and Aslam et al<sup>29</sup> (lower limb injuries). Among the internal visceral injuries, lungs were the most common organ involved followed by the liver. The reason for injury to the lungs and liver can be due to impact with the rib cage and the shearing forces by moving vehicle or due to direct impact. Our observation is in agreement with the study by Shetty et al<sup>30</sup>.

Abrasions were a common surface injury in road traffic

accidents followed by lacerations, which is consistent with observations made by Aggarwal et al<sup>31</sup> and Yogesh.<sup>32</sup> The commonest cause of death in our study was shock and hemorrhage due to thoracic injuries. This observation is consistent with study of Singh et al.<sup>33</sup> However, study by Kumar et al<sup>13</sup> observed head injury as the most common cause of death.

## Conclusions

The present study concludes that young adult males are prone for road traffic accidents, especially during late evening hours. The present research provides information about high risk groups in road traffic mishaps, and thus, will help traffic agencies to impart guidelines accordingly.

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## A population based cross sectional study of perception towards snakes and management of snakebites

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### Abstract

Considering few of the oldest myths and primitive medical writings, snakebite must have been one of its first kinds of poisoning known to mankind. India is known for its mythological concepts and traditional methods of treatment in regards to snakes and snakebites. Aim of this study was to evaluate awareness of the urban and rural population towards snakes and snakebite management. The present study was a cross sectional study conducted on urban and rural population in Gujarat state. Total 240 adult participants, 120 from urban areas and 120 from rural areas, were included in the study. Data was collected by personal interview of an individual with predefined data collection sheet which was comprised of three parts i.e. demographic information of participants, identification of snakes in terms of venomocity and pre-defined questionnaire. Prevalence of belief in regards to mythological significance of snakes is higher in rural in comparison to urban population. As far as identification of nature of snakes is concerned study found below average knowledge with marginally higher in rural areas. Both the population considers medical measures as an ultimate management for snakebites. However, perception in relation to first aid measures, identifying nature of snakes, do's and don'ts with a snake as well as with a case of snake bite need a serious attention especially towards usage of traditional methods.

### Keywords

Snake; Snakebite; Population; Perception; Traditional Methods.

### Introduction

As far as mythology is concerned; India remains the country where the snakes are worshiped as God in one or the other way. In terms of zoology, India possesses around 250 types of snake species out of which 52 species are known to be venomous. Considering all the facts and different aspects, this reptile stands as one of the venerable species of animal on earth.

Snakebite must have been one of the first kinds of poisoning known to mankind for it appears in some of the oldest myths and earliest medical writings.<sup>1</sup> A study estimated that globally, at least 421,000 envenomings and 20,000 deaths occur each year due to snakebite. The figures may be as high as 1,841,000 envenomings and 94,000 deaths. The highest burden exists in South Asia, Southeast Asia, and sub-Saharan Africa.<sup>2</sup> The actual global incidence of envenomations and severity of them remain mostly misunderstood, except for a few countries where these accidents are rare or reported correctly.<sup>3</sup> Envenoming is a disease of the poor and the negative association between deaths due to snakebite and government expenses on health corroborates that the burden of mortality is highest in those countries least able to deal with the substantial financial cost of snakebite.<sup>4</sup>

The majority of snakebites and consequent mortality is recognized to only 5 species in India, which includes King Cobra (*Ophiophagus hannah*), Common Cobra (*Naja naja*), Russel's Viper (*Vipera russellii*), Common Krait (*Bungarus caeruleus*), and Saw Scaled Viper (*Echis carinata*) and in Gujarat-Saurashtra region there are four species of venomous snakes found excluding king Cobra.<sup>5</sup>

Traditional methods of treatment for snakebites remain an area of choice for the researchers especially in India. Traditional methods include making local incisions or punctures at the bite site, sucking the venom out of the wound, electric shock, tying tight tourniquets around the limb, application of chemicals, herbs etc. Delay or denial in the administration of antivenom due to this contributes a good portion in total mortality statistics from snakebites. According to WHO guidelines for snake bite management, most of the traditional, popular, available and affordable first-aid methods have proved to be useless or even frankly dangerous.<sup>6</sup>

Aim of this study was to evaluate awareness of the urban and rural population towards snakes and snakebite management. Objectives of the study were based on assessing knowledge, attitude and perception towards snakes, medical management of snakebites as well as traditional methods of snakebite treatment.

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### Material and Methods

The present study was a cross sectional study conducted on urban and rural population in Gujarat state. The study had been approved by local ethical committee. Total 240 participants were included in the study out of which 120 participants

belonged to urban and 120 belonged to rural areas. Convenience sampling technique among the non-probability sampling methods was adopted in selecting participants. All those who were aged 18 years and above, and were willing to take part in the interview based survey were included in the study. Consent for the participation in the study was taken from each individual. Data was collected by personal interview of an individual in his/her vernacular language with predefined data collection sheet. Data collection sheet was comprised of three parts i.e. demographic information of participants, identification of snakes in terms of venomity and predefined questionnaire. The questionnaire was prepared in a way to assess knowledge and attitude of these two types of population towards snakes and management of snakebites. They were validated by means of face validation as well as content validation. Photographs of different snakes, commonly found in Gujarat (4 poisonous and 4 non-poisonous i.e. Common Cobra, Russell's Viper, Saw Scaled Viper Common Krait, Rat snake, Python, Wolf snake, Sand snake) were shown to individuals and their responses were collected on identification of snakes based on their venomous nature. The questions were put in front of each participant and answers were noted. Collected data was compiled in Microsoft office Excel 2007 and presented in tabulated way.

## Results

As shown in Table 1, Maximum numbers of participants were Hindu male and belonged to age group of 18 to 55 years. Maximum numbers of participants from urban population were "graduate" while from rural population they were educated up to higher secondary school.

**Table 1:** Demographic profile of the study participants

Demographic Profile		Urban	Rural
Age groups	18 -35	65	42
	36 -55	48	58
	56 -75	5	18
	76 and above	2	2
Sex	Male	80	70
	Female	40	50
Religion	Hindu	117	106
	Muslim	3	14
Education	Illiterate	3	20
	Primary school	1	18
	Secondary school	2	35
	Higher secondary school	18	41
	Graduate	96	6
Total		120	120

As shown in Table 2, slightly higher percentage of population found from rural areas in comparison to urban who had correctly identified nature of snakes. More than half of the participants identified each snake as poisonous snake.

**Table 2:** Responses in regards to venomity of snakes

Picture of snake shown	Identification by urban group as		Identification by rural group as	
	Poisonous	Non-poisonous	Poisonous	Non-poisonous
Common Cobra	66%	34%	70%	30%
Common Krait	67%	33%	66%	34%
Rat Snake	66%	34%	59%	41%
Russell's Viper	71%	29%	68%	32%
Python	68%	32%	67%	33%
Saw Scaled Viper	67%	33%	56%	44%
Wolf Snake	66%	34%	57%	43%
Sand Snake	63%	27%	48%	52%

As depicted in Table 3, maximum number of people (84%) from urban area didn't believe in mythological aspects of snakes, while maximum (71%) believed in rural area. Maximum number of people (96% in urban and 78% in rural) knew that

**Table 3:** Responses to questions in rural (n=120) and urban (n=120) population

Question	Response	Urban	Rural
1- Do you believe in mythological aspects of snakes i.e. 'nagmani' 'ichhadhari'naag etc.?	Yes	19	85
	No	101	35
2- Are all snakes poisonous?	Yes	05	26
	No	115	94
3- What should be done if one finds a snake?	Immediately kill	25	34
	Try to catch	11	44
	Call an expert	84	42
4-What should be done at bite site?	Incision and drainage of blood	74	50
	Sucking the wound	12	48
	Herbal treatment	24	19
	None of the above	10	03
5- What can be done to prevent spread of poison as a first aid measure?	Applying tight tourniquet to stop blood supply	106	91
	Splinting and bandaging	14	29
6- What is the appropriate approach after suffering from snakebite?	Shift to the nearest hospital	120	114
	Approach local quack	00	06
7- Who can treat snakebite?	Doctor	117	97
	Madari	00	07
	Tantrik	03	16

"all snakes are not poisonous". Most of the people from urban region (70%) had an opinion to call an expert or snake catcher instead of attempting to kill it or catch it one own self, while opinions from rural region were divided almost equally among the options. Majority (61% in urban and 40% in rural) believed that Incision and drainage of bite site would be the best measure. Maximum number of people (88% in urban and 76% in rural) believed that application of tight tourniquet above bite site would be the better option to prevent spread of poison. Almost all had knowledge regarding hospitalization of the snakebite

victim. Most of them (98% in urban and 80% in rural) had an opinion that a doctor can treat snake bite cases. However, some people from rural areas considered “madari” and “tantric” for the same. The observations of the present study were compared with the previous studies<sup>7,8</sup> (Table 4).

**Table 4:** Comparison of the observations of the present study with the previous ones regarding the management of snakebite and mythological significance of snakes

Opinions	Pathak et al. <sup>7</sup>	Chidananda et al. <sup>8</sup>	Present study
Tie a tourniquet	76%	93%	75%
Home based/herbal remedies	9.5%	30%	16%
Spitting out the blood	14%	NA	40%
Incising the bite site	NA	37%	42%
Immobilization-splinting-bandaging	NA	67%	24%
Considering other than doctor	9%	67%	18%
Hospitalization	100%	73%	95%
Mythological significance of snakes	81%	70%	71%

## Discussion

As far as identification of nature of snakes is concerned, both the urban and the rural communities had similar knowledge with a slightly higher percentage among the rural areas. More than half have identified each of the snake as poisonous snake which is contrary to their opinions in relation to venomity of snakes. This reflects, though they possessed theoretical knowledge that not all snakes are poisonous but have lack of practical approach in identifying the nature of snakes.

A myth behind concept of “Nagmani” or “Ichhadhari nag” is still popular among rural communities in comparison to urban. Some Rural people believe that a snake should be killed or catch immediately upon located instead of calling an expert/ snake catcher. This attitude may reflect the unavailability of such an expert in local areas in comparison with the attitude of urban population.

According to the WHO guidelines, nothing should be done at bite site except for splinting and bandaging the bitten limb. Traditional measures popular among the population i.e. incision and drainage of bite site, sucking of the blood as well as application of herbal formulas causes no gain but pain and are contraindicated. Sometimes, tightly applied tourniquet hamper blood supply of the area and causes more harm than benefit. Attitude towards ultimate medical management of snake bite was found appropriate among both the population.

One cannot exclude the role of Indian cinemas in spreading the misconceptions in relation to local treatments of snakebites. Cases were also reported where traditional methods by local healers were tried first before seeking medical treatment. Sometimes bites by nonpoisonous snakes or “dry bites” by poisonous snakes make the attempts of local healers successful and propaganda continues. It is high time for the government to

impart proper knowledge via public lectures of experts and medical personnel to increase awareness of the people towards snakes and management of snakebites.

## Conclusion

Prevalence of belief in regards to mythological significance of snakes is higher in rural in comparison to urban population. However, as far as identification of nature of snakes is concerned study found below average knowledge. Convenience sampling technique was used to select participants and therefore possibility of sampling error as well as volunteer bias cannot be excluded. Hence, though results may reflect the generalized trend, a stringent statement about the knowledge and attitude of specified population cannot be made.

Overall, steps need to be taken by the authorities to impart proper practical knowledge to cop up with the responses of killing or catching the snake to prevent brutality towards snake as well as to restrict self-harm. Both rural and urban population consider medical measures as an ultimate treatment for snakebites. However, certain areas in relation to first aid measures, identifying nature of snakes, do's and don'ts with a snake and a case of snake bite need a serious attention especially with the perception towards usage of traditional methods.

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## Knowledge about medicolegal aspect of documentation amongst residents and faculty - A cross-sectional study

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### Abstract

Medical documents are routinely used for the orders related to the indoor and outdoor patients, which includes the findings of the patient, details about patient history, treatment which should be in legibly written, this study was conducted at the AVBRH Sawangi (Meghe), Wardha. An approval was taken from the institutional ethical committee, prior to the study. Informed consent was obtained from all 300 participants. This study was aimed to assess and compare the knowledge of medical professionals about medicolegal documentations. The participating medical personnel were knowledgeable about the basic issues but lacked knowledge about the finer facts. No difference was observed in knowledge and awareness amongst the faculties of various designations. Mean knowledge score of residents and faculties was significant with values 32.97 and 38.62 respectively. Local, state bodies and medical associations should increase the participation in conducting seminars, CMEs for the doctors to increase awareness of ethical issues and medico-legal problems in medical documentation.

### Keywords

Medical records; Medical professionals; Medico legal issues; Ethics

### Introduction

Medical documents are the routine orders of indoor and outdoor patients which include various details and findings related to admitted patient such as history of illness, treatment and vitals related to patient. Medical documentation is important for treating doctors, for taking opinion from previous treatment, in hospitalized patient, hospital staff for daily instruction and for various legal purposes. Indian society is experiencing a growing awareness regarding patient's rights. In India, the Consumer Protection Act (CPA) came into existence in 1986, which was enacted for better protection of the interests of consumers. The provisions of consumer protection act now cover deficiency of service by medical professionals in such cases to provide redresses to the patients.<sup>1</sup>

Hospital medical records are the property of the hospital or the doctor. It is confidential information and could not be released without doctor's permission. Any information from the patient's medical records should be released on written request from the patient e.g. to employer or to insurance company. Police authorities and court can summon medical records under the due process of law. The Mumbai High Court has recently ruled that a doctor must provide copies of the patient's Medical Records to the patients on request and this should be remembered by all the doctors.<sup>2</sup>

Medical documents are orders, which the treating doctor has to

refer during hospitalisation of patient until the patient gets discharged, these documents then kept in medical record department for further follow up and medico legal purposes if required. To consult the operative events and treat the patient accordingly. To plan for the next operation. To know any anaesthesia problems met with. To plan for the operation of the next eye. Even after the treatment part is completed for the follow up of the patient as and when the patient comes for the treatment. Even more relevant when the patient is examined by another doctor.<sup>3</sup>

The medical records are, of the most important of all the documents a patient is having; despite of computerization where the data is stored in the computers itself the need of the hard copy cannot be ignored. According to the medical ethics if a patient is to be referred to other consultant, the original one (consultant) should write down the original history, medication, findings. Help doctor in reaching to a conclusive diagnosis and further to treat the patient accordingly. Law requires proper maintenance of case sheets. These are the single most important document that can be used in medico legal cases.<sup>4</sup>

The present study aimed to assess awareness and knowledge about documentation and its medicolegal aspects amongst residents and faculties. The study attempts to assess the knowledge about types of documents and its medicolegal importance, and to assess the knowledge about process of documentation.

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### Materials and Methods

This cross-sectional study was conducted at the AVBRH Sawangi (Meghe), Wardha. Permission and approval was taken from the institutional ethical committee & informed consent was taken from all the participants included in the study. Pilot

study was conducted amongst experts to know the effectiveness of the questionnaire and degree of repetition. An unorganized questionnaire validated by using a pretested was used to evaluate the knowledge of medicolegal aspect of documentation amongst residents. The duration of study was 6 months. Sample size was calculated as 300. The participants were selected amongst faculties (N=150) and residents (N=150) in AVBRH Hospital. The questionnaire used in the study is shown in **Table 1**. The responses were evaluated on a 5-point Likert Scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree), and taken as the knowledge score.

**Table 1:** Questionnaire used in the study

1.	Patients are entitled to a copy of their medical record?
2.	We can charge patients, lawyers, other physicians and insurance companies for copies of the medical record?
3.	If a patient has not paid the doctor for services rendered, we can refuse to send a copy of the patient's medical record to another physician? to an insurance company? or to the patient?
4.	We can send copies of medical records by fax?
5.	In case of emergency medical management can be done without consent?
6.	We need the patient's permission to permit other physicians who practice in our hospital to see the patient's medical records?
7.	Should we document in the patient's record incidents in which the patient was abusive to the physicians or staff?
8.	Informed written consent is must for surgical procedure
9.	Doctor have to enter his or her full signature after every progress note in the chart
10.	Should we keep duplicates of hospital reports in the patient's record chart?

**Results**

Mean knowledge score of residents and faculties were 32.97 and 38.62 respectively and the differences were statistically significant (Table 2).

**Table 2:** Comparison of knowledge score of residents and faculties (Z-test)

Participants	N	Mean	SD	SEM	Z-Value	p-Value
Residents	150	32.97	1.84	0.15	25.58	<0.001
Faculties	150	38.62	1.97	0.16		

SD – Standard Deviation; SEM – Standard Error of Mean

Table 3 shows question wise comparison of knowledge score amongst residents and faculties. The differences in knowledge scores were statistically significant, with faculty members doing better than the residents for most of the questions, except for question 3 (p=0.091) and question 10 (p=0.63), where the differences were insignificant.

**Table 3:** Question wise comparison of knowledge score of residents and faculties

Question	Subjects	Mean	SD	SEM	Z-Value	p-Value
Q1	Residents	3.10	0.67	0.05	18.80	<0.001
	Faculties	4.44	0.56	0.04		

Q2	Residents	3.10	0.67	0.05	19.49	<0.001
	Faculties	1.66	0.59	0.04		
Q3	Residents	2.46	0.56	0.04	0.10	0.91
	Faculties	2.47	0.56	0.04		
Q4	Residents	3.36	0.75	0.06	5.07	<0.001
	Faculties	3.78	0.65	0.05		
Q5	Residents	2.48	0.55	0.04	23.87	<0.001
	Faculties	4.10	0.62	0.05		
Q6	Residents	2.48	0.55	0.04	23.64	<0.001
	Faculties	4.10	0.63	0.05		
Q7	Residents	3.60	0.61	0.05	7.08	<0.001
	Faculties	4.10	0.62	0.05		
Q8	Residents	3.60	0.61	0.04	17.56	<0.001
	Faculties	4.70	0.45	0.03		
Q9	Residents	4.14	0.83	0.06	6.42	<0.001
	Faculties	4.65	0.47	0.03		
Q10	Residents	4.62	0.48	0.03	0.48	0.63
	Faculties	4.65	0.47	0.03		

SD – Standard Deviation; SEM – Standard Error of Mean

**Discussion**

Medicine is a noble profession but there is also growing insecurity in both within the medical profession and in the community regarding increasing trends of complaints and lawsuits against doctors. Negligence in the medical world has assumed great importance in relation to the medical malpractices suits in various countries in Asia, Europe, USA and more so in India. In the area of patient-doctor relationship two important models dominate viz. one is based on paternalism and other is founded on the doctrine of informed consent. According to Dworkin's standard definition of paternalism means "interference with a person's liberty of action justified by reasons referring exclusively to the welfare, good, happiness, needs, interests or values of person coerced."<sup>5</sup>

In the present study, most of the participants Knowledgeable about the medico legal issues. They think that knowledge of medicolegal documentation is extremely important and only few of them, their main source of knowledge on healthcare ethics was during training study conducted by Dash.<sup>6</sup> Mostly respondents were aware about the knowledge of record keeping of the patients and results were higher than the study done by Makhani et al.<sup>7</sup>

Written records, including medical history, chart notes, radiographs, and photographs must be meticulous, and it is necessary for the documents to be signed and dated. Under Article 51 A(h) of the Constitution of India, there is a moral obligation on the doctor, and a legal duty, to maintain and preserve medical, medico-legal, and legal documents in the best interests of social and professional justice.<sup>8</sup> Almost every participant in study have knowledge of informed consent and

this is in accordance with the study carried by Heywood R. in 2007 who found that 98% of medical students found IC to be important and necessary for a surgical intervention.<sup>9</sup> Consent requires that patient fully understand the information given, but if the patient is debilitated due to a serious illness/mental condition, a suitable surrogate should make decisions.<sup>10</sup>

This data showed that detail knowledge regarding aims and objectives of consumer protection act and its application is limited. Similarly, limited awareness was seen among the study by Jasuma et al.<sup>11</sup> The findings also showed difference between two specialties medical professionals regarding the consumer protection act. It was also found that general surgeons were more aware than gynaecologists. Data has showed that senior doctors have better level of knowledge than juniors. Similar results were found by Sing et al among health care professionals in Udaipur and Jasuma et al.<sup>11</sup> This might be due to the reason that with increase in exposure, awareness also increases. Similarly, it was also found that male doctors showed good knowledge regarding medico legal aspects. These results were in agreement with the study conducted by Singh et al.<sup>12</sup> It may be attributed to the fact that comparatively males devote more time to routine practice. Due to the limited knowledge by the health professionals, there is an increased risk of malpractice, especially from complex case situations. In addition, the expanding patient population is becoming more knowledgeable and aware of their rights, consequently taking action by contacting the consumer forum to lodge their complaints.<sup>13</sup>

### Conclusions

The study concludes that the participating medical personnel were knowledgeable about the basic issues but lacked knowledge about the finer facts. No differences were observed in knowledge and awareness among faculties irrespective of working experience. Though study findings are limited to a single hospital, its findings may be vital in increasing the awareness of newer ethical and medico-legal issues in medical documentation and modification, if any. To improve the competency of health care provider for better medicolegal documentation, emphasis should be put on conducting regular CMEs, seminars and workshops so as to upkeep the knowledge and awareness about medicolegal documentation amongst the healthcare practitioners.

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## Age estimation from third molar teeth in an urban population of North India

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### Abstract

Identification of age reliably is one of the challenging arena and has multitude significance in civil and criminal issues. Among the many available ways dentition is most commonly used but most of the dentition is complete by early teens except for third molar. Clinically as well as radiologically third molar eruption can be used for estimation between middle teens and adults, third molar age estimation takes a significant role. In this study 280 students between 14-28 years of age from various academic institutions of Rohtak, Haryana were subjected to clinical and radiological examination to estimate dental age by stages of eruption clinically and Orthopantomogram of third molar. Females were found to have higher number of unerupted third molar in comparison to males. Higher number of subjects had unerupted tooth in age less than 18 years. The mean age for partially erupted teeth for males and females lies in the range of 17.83 – 18.40 years and 16.9-18 years respectively and for completely erupted teeth was 21.07-21.87 years and 21.03 - 21.64 years for males and females respectively. Earliest mean age for eruption of third molar for males was 14 years while for females was 14.88 years. The study concluded earlier eruption of third molar in male to female and there was statistically significant positive linear relationship seen among the four quadrants and dental age.

### Keywords

Third molar; Age; OPG; Haryana

### Introduction

In this changing era, accurate age estimation takes significance due to its medico legal importance specially when identifying an unknown, or in age estimation for juveniles. Since long skeletal maturity and dentition are the two most common methods used for this. Forensic specialist has been sought after and plays an important role in these services. Dentition overall has durability and high resilience to external influences like putrefaction, fire, explosion and can be of great help in identification during disasters. Where skeletal maturity is identified through epiphysis diaphysis fusion of long bones, fusion of sutures and attainment of secondary sexual characters, most of which are already in place by middle teens and early twenties, appearance of third molar takes importance as some authors have concluded it to be the only valid biological variable in oral cavity for age estimation in early twenties.<sup>1</sup> Eruption and stage of teeth can be identified clinically as well as radiographically. Demirjian in his work identified stages of eruption by orthopantomogram (OPG) making dental age estimation scientifically uniform.<sup>2</sup> Darji et al had concluded with a strong positive correlation between various stages of

third molar and chronological age.<sup>3,4</sup> Third molar eruption has been estimated to vary from 9–23 years of age radiographically.<sup>5</sup> There is variation in timing of development, calcification and eruption of third molar which can be possibly hypothesised to cultural effects to ethnicity and environmental influences.<sup>6</sup>

The present study is an attempt to determine the age clinically as well as radiologically by studying various stages of eruption and development of third molar in age group 14-28 years in an urban population of Haryana. The main objective of this study was to estimate the age of eruption of third molar in the concerned sample, to evaluate the various stages of eruption clinically and by orthopantomogram, and to assess its statistical significance with age.

### Material and Methods

A total of 280 subjects (140 males and 140 females) studying in various schools, colleges and other academic institutions in Rohtak city of Haryana were recruited voluntarily after explaining the purpose of the study. Each group was further divided into 14 groups with twenty subjects in each group. A written informed consent was obtained from the subject/guardian. Institutional ethical committee clearance was obtained before commencing the study. Information regarding age, gender, physical parameters was collected and volunteers were subjected to clinically through mirror and probe and radiographically orthopantomograms done in a tertiary care teaching hospital of Rohtak, Haryana. Subjects with valid age proof in form of birth certificate or any other valid document, good oral hygiene, with all intact teeth were included in the study. Individuals with any congenital anomalies of teeth,

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malnutrition or any other disease affecting the skeletal growth and general development of individual, and with impacted or extracted third molar tooth were excluded.

Radiologically, Demirjian eight stage development (A-H) was used for assessment of third molar eruption which is described as:

- Stage A: Cusp tips are mineralized but have not yet coalesced
- Stage B: Mineralized cusps are united so the mature coronal morphology is well – defined
- Stage C: The crown is about 1/2 formed, the pulp chamber is evident and dentinal deposition is occurring.
- Stage D: Crown formation is complete to the dentinoenamel junction. The pulp chamber has trapezoidal form.
- Stage E: Formation of the inter radicular bifurcation has begun. Root length is less than crown length.
- Stage F: Root length is at least as great as crown length. Roots have funnel-shaped endings.
- Stage G: Root walls are parallel, but apices remain open.
- Stage H: Apical ends of the roots are completely closed and the periodontal membrane has a uniform width around the root.

The data was analyzed using SPSS version 21.0. Mean and 95% confidence intervals was determined using the descriptive statistics. Unpaired students t-test was done to compare the mean age in males and females for each quadrant. Simple linear regression and multiple linear regression tests for dental age estimation were used.

## Results

### Based on clinical staging

Total number of non-erupted third molar teeth were more in females (326) as compared to males (258) and more common in age less than 18 years (Table 1). There were higher number of total unerupted as well as erupted teeth in maxillary arch (292 and 248 respectively) as compared to mandibular (Table 2). Right lower quadrant had higher percentage of non-erupted (53.6%) and

partially erupted teeth (5.7%) but completely erupted teeth were more in the right upper quadrant and left lower quadrant (45 %) in comparison to other quadrant (Figure 1).

The mean age for partially erupted teeth in the four quadrants for males lies in the range of 17.83-18.40 years and for females it is 16.9-18.0 years. Mean age for completely erupted teeth in the four quadrants ranges from 21.07-21.87 years for males and from 21.03-21.64 years for females. Statistically there is no significant difference in mean age of males and females for each quadrant in partially erupted and completely erupted stages.

**Table 1:** Age and sex distribution of third molar teeth according to its clinical stage

Age	MALE			FEMALE		
	NE	PE	CE	NE	PE	CE
14.1-15	40	0	0	40	0	0
15.1-16	40	0	0	32	4	4
16.1-17	30	6	4	40	0	0
17.1-18	28	4	8	34	6	0
18.1-19	16	20	4	32	0	8
19.1-20	4	0	36	30	0	10
20.1-21	18	0	22	18	0	22
21.1-22	10	0	30	28	0	12
22.1-23	8	0	32	8	0	32
23.1-24	8	0	32	16	0	24
24.1-25	14	0	26	12	0	28
25.1-26	14	0	26	12	0	28
26.1-27	14	0	26	12	0	28
27.1-28	14	0	26	12	0	28
Total	258	30	272	326	10	224

NE - Not Erupted; PE - Partially Erupted; CE - Completely Erupted

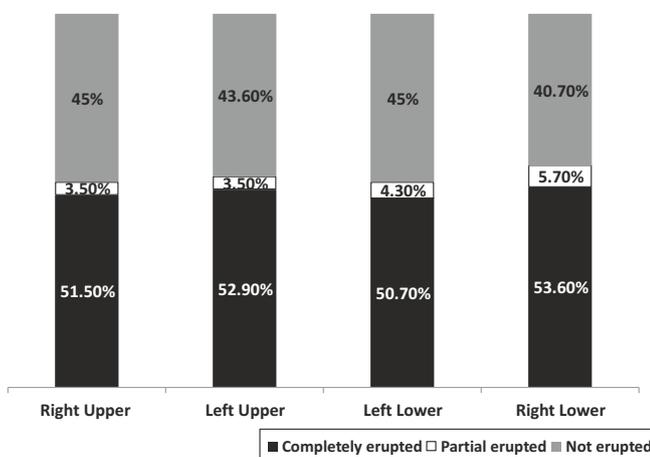
**Table 2:** Arch wise distribution of total number of third molar teeth

	NE	PE	CE
Maxillary	292	20	248
Mandibular	192	28	240

NE – Not Erupted; PE – Partially Erupted; CE – Completely Erupted.

**Table 3:** Sex distribution of third molar teeth according to Demirjian's staging

Stages	Right upper		Left upper		Left Lower		Right Lower	
	Male	Female	Male	Female	Male	Female	Male	Female
C	9	2	0	0	1	2	2	2
D	17	17	18	18	18	17	18	16
E	5	21	8	19	18	12	17	20
F	15	18	23	13	11	27	13	24
G	17	36	16	36	28	32	26	36
H	52	25	47	21	51	23	49	21
Absent	25	21	28	33	13	27	15	21
Total	140	140	140	140	140	140	140	140



**Fig 1:** Frequency distribution of third molar eruption for each quadrant

**Table 4:** Mean age for different stage of third molar development in males

Males	Right upper quadrant	Left upper quadrant	Left lower quadrant	Right lower quadrant
C	14.22 (14.15-14.29)			
D	14.65 (14.29-15.01)	14.72 (14.35-15.10)	14.72 (14.39-15.050)	14.83 (14.48-15.18)
E	15.80 (15.25-16.36)	16.13 (14.99-17.26)	20.17 (17.65-22.69)	20.41 (17.78-23.04)
F	22.00 (19.78-24.22)	23.48 (22.01-24.95)	23.09 (20.23-25.95)	22.77 (20.38-25.16)
G	19.41 (18.42-20.41)	19.38 (18.42-20.33)	18.86 (18.32-19.39)	18.69 (18.17-19.21)
H	23.23 (22.51-23.96)	22.43 (21.60 -23.25)	23.18 (22.39-23.96)	23.18 (22.37-24.00)

**Table 5:** Mean age for different stage of third molar development in females

Females	Right upper quadrant	Left upper quadrant	Left lower quadrant	Right lower quadrant
C	14.14 (14.08-14.17)			
D	14.88 (14.41-15.36)	14.78 (14.38-15.18)	16.69 (15.54-17.63)	16.69 (15.59-17.78)
E	21.76 (20.10-23.42)	21.95 (20.12-23.78)	16.58 (14.80-18.370)	17.55 (16.05-19.05)
F	21.61 (19.56-23.67)	18.77 (17.04-20.50)	21.04 (19.53-22.54)	23.04 (21.35-24.74)
G	22.56 (21.51- 23.60)	22.50 (21.45-23.55)	22.94 (21.83-24.05)	22.58 (21.51-23.61)
H	22.52 (21.36- 23.68)	22.43 (21.03-23.83)	22.48 (21.21-23.75)	22.81 (21.51-24.11)

### Based on radiological study

The percentage of third molar teeth eruption was more on right side and in lower arch (mandibular). No significant difference was found to exist in maxillary and right mandibular arch for the absent third molars in the males and females. The percentage of third molar teeth eruption is more in lower arch (mandibular) in both males and females. However, for left lower arch (mandibular) significant difference was found between males and female (p value-0.017). The earliest mean age for eruption of third molar for males is 14 years and can range up to 24 years as per Demirjian staging (Table 4). The earliest mean age for third molar eruption for females is 15.67 years and can range up to 23 years as per Demirjian staging (Table 5).

Based on univariate and multiple regression analysis, it was observed that for all four quadrants chronological age has a positive linear relationship with dental stage. The right maxillary molar has a stronger relation than other quadrants and explained a 26.0% variation in the chronological age (Table 6). The intercept showed when teeth formation was absent. The

**Table 6:** Univariate regression analysis

	Intercept	Regression coefficient	F ratios	R-square	P value
Maxillary right	16.115	0.947	97.818	0.260	<0.01
Maxillary left	17.652	0.777	43.184	0.134	<0.01
Mandibular left	16.817	0.770	50.515	0.154	<0.01
Mandibular right	16.154	0.772	65.729	0.191	<0.01

**Table 7:** Multivariate regression analysis

	Intercept	Regression coefficient	F ratios	R-square	P value
Maxillary right	15.212	0.739	27.904	0.289	<0.01
Maxillary left		0.051			
Mandibular left		-0.271			
Mandibular right		0.529			

mean of subjects in each quadrant and regression coefficients (slope) explained how much change in chronological age would occur if the subject moved from one stage to subsequent stage, in other words if subject moves from D to E then its age increases approximately 0.947 year for the 18 quadrant. Stepwise multiple regression analysis considers all the four quadrants at a time. It was found that only the 18 quadrant was statistically significant while the others were found to be statistically insignificant (Table 7).

### Discussion

In this study, mean age for completely erupted teeth ranges from 21.07-21.87 years for males and from 21.03 - 21.64 years in females. No statistical differences were noted in mean age of third molar eruption among genders. This was slightly less age prediction as compared to that reported in a study done in Chennai by Priyadarshini et al. where mean age was calculated to be 22.41 years in males and 23.81 years in females.<sup>7</sup> In the same study, statistical significant difference was reported between genders postulating maxillary sequence eruption to be earlier in males as compared to females.

The radiological finding of our study indicates that our population reaches stage H by 23 years in males in all arches and 22 years in females in maxillary and mandibular third molars. In comparison to a study from Chennai<sup>7</sup> where stage H was attained at a mean age of 22.88 years in males and 23.35 years in females for maxillary third molars and a mean age of 22 years in males and 22.53 years in females for mandibular third molars. In a study by Orhan et al. stage H reached at a mean age of 20.1 years.<sup>8</sup> Our study observed that stage H had a minimum chronological age of 18 years differentiating a major from a minor but this finding cannot be generalized as there are other studies like Knell et al<sup>9</sup> and Sisman et al<sup>10</sup> where H stage was reportedly being seen in teenage population also. In the present

study a positive linear relationship of chronological age with the dental stage was determined using regression analysis, strongest correlation being noted for the right maxilla. This is similar to the study by Naik et al<sup>4</sup> and Khosronejad et al,<sup>11</sup> who reported that third molar development can be positively affected by the chronological age. Also it was concluded that Demirjian's method can be applied with high accuracy for age estimation.

The variations with other studies can be explained by the differences in the selected age range of the study populations, population differences in the body build, head form, and dentition due to genetic and environmental interactions, the nutritional status which might be poorer in some countries and usually better in Western countries affecting the development pace and calcification timings. Furthermore, methodological limitations might be the case as classifications might be difficult at some points because of defining numerous stages that are hard to distinguish from each other. The method proposed by Demirjian avoids any numeric identification which might make it superior compared to other proposed approaches. Also, high reproducibility and capable of correct age estimation in various ethnicities was reported with this method. Still, age determination based on third molars remains a challenge: third molars are highly variable in characteristics such as development, eruption pattern, shape and contour, size, and relative positions and have an unusual 10-year period of development. An appreciation of this genotype–phenotype relationship as a source of physical variation in humans is important in the recognition and establishment of correct standards for any given population.

## Conclusions

Eruption of the third molar tooth is earlier in males as compared to females. Development of third molar might complete after the age 23. Indian individuals with third molars at H stage of development are extremely likely to be above the minor/major threshold of 18 years old. A positive linear relationship was also among the four quadrants and dental age. Third molar development in either maxilla or mandible is almost perfectly correlated with the chronological age of India and can be used for estimation.

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**Conflict of interest:** None to declare

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## 'Arrow line incision' – A new approach for neck dissection

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### Abstract

Police inquest is an integral part of medicolegal autopsy process in India. Autopsy surgeon usually makes dissection plan based on the information about the circumstances of unnatural or suspicious death in police inquest. Conventionally 'Y' or Modified 'Y' autopsy incision is practiced for examination of neck structures in cases of suspected neck compression. Unknown cases without any history of neck compression autopsies are done with usual midline straight incision or 'I' incision but once the autopsy is started with 'I' incision, no type of 'Y' incision is possible subsequently. I have developed a new incision called 'Arrow line incision' which can be practiced for neck exposure even after usual 'I' incision. This new dissection technique, 'Arrow line incision' can be practiced in all cases as routine autopsy incision for internal examination with or without history of neck compression.

### Keywords

'Arrow line Incision'; Neck compression; 'I' incision; 'Y' incision

### Introduction

Hanging is the commonest type of compression of neck and the next common method of neck compressions is strangulation by ligature and manual strangulation or throttling. Police or law Court is more interested to know the manner of death. Medicolegally hanging is almost always suicidal in manner, may rarely be homicidal and very rarely can be accidental. Strangulation by ligature is commonly homicidal, accidental is possible and very rarely it could be suicidal<sup>1</sup>, but throttling or manual strangulation in particular is always homicidal. In almost all cases of hanging some kind of information relating to death from hanging is usually available in the inquest report and ligature material of hanging is also almost always available. Moreover, in hanging, some kind of injury can usually be detected externally on the neck corroborating the information furnished by police or relatives. In some cases of neck compression particularly in suspected homicidal neck constriction, no indication whatsoever is generally available in the inquest, be it strangulation by ligature or throttling. Unlike hanging, ligature marks on neck in strangulations are most of the time either not very distinct or characteristic and ligature material most of the time is missing. Ligature mark on the neck is not obvious and even absent in many cases of constriction of neck particularly when constriction was by soft ligature material or compression was for short period and also when ligature was over cloth, hair or any intervening material. In manual strangulation cases most of the time minimum or no external injury on the neck can be found particularly when the victim is a dark complexioned one. In situations when females,

children or old debilitated persons are suddenly found dead in their room or on the bed, no history is usually available from the inquest. Rather a confusing story or even completely misleading information may sometimes be mentioned in the inquest. When some kind of history from inquest or hints from external examination relating to death by neck compression is available, normally autopsy surgeon adopts the conventional 'Y' or modified 'Y' incision for neck examination. But in absence of relevant history or any external injury on neck, those cases are rarely taken as a case of homicide by strangulation and so it is difficult for the autopsy surgeon to have any idea about the possible cause and manner of death. In such situation, autopsy surgeon ordinarily proceeds with general consideration of sudden death from disease condition or poisoning and adopts the usual common and conventional method of dissection- 'Midline Straight Incision' or 'I' incision.

### Conventional Incisions for Internal Examination

Skin incisions are primarily of three types:

- a) *'I' type incision or 'Standard Midline Incision'*: It is a midline incision from chin to pubis in straight line deviating to one side at umbilicus. 'I' type Incision is most preferred in forensic practice.<sup>2</sup>
- b) *'Y' Incision*: Incision is put from behind each ear to a point above the manubrium and continue downwards in a 'Y' shape.<sup>2</sup> This is also known as 'V' incision.
- c) *Modified 'Y' Incision*: There are several modifications of 'Y' incision, that include:
  - i) From uppermost point at manubrial notch two incision lines extended to mid clavicle along sub-clavicular line then extended upwards to either mastoid.
  - ii) From xiphisternum to either side of acromion process then extended upwards by the side of neck to mastoid. Vertical limb from xiphisternum downwards on midline to symphysis pubis skirting umbilicus (in Male). In Female upward limbs from

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Xiphisternum to bilateral acromion process skirting the breasts then from acromion extending upwards to the mastoid process on either side by the sides of neck.<sup>3</sup>

The variants of 'Y' incision are preferred when neck injury or pathology is suspected. In strangulation, hanging and in any condition where the larynx might be damaged, the 'Y' incision is to be preferred.<sup>2</sup>

However, conventional incision plans have some shortcomings and so autopsy surgeons usually attempt some modification or variation in incision plan to achieve proper exposure and better cosmetic closure<sup>4</sup>.

### Shortcomings of 'Y' or modified 'Y' Incisions

With 'Y' incision exposure of neck structure is inadequate, whole front of neck is not properly exposed and for exposure of lateral side and root of neck another wide skin flaps require to be dissected out. It is little difficult to do dissection without causing skin perforation of triangular thin skin flap holding at narrow pointed tip. After closure suture line passes obliquely across neck on both sides of neck which are clearly sighted from above or sides even in normal sleeping position. In any type of modified 'Y' incision skin flaps are wider and more amount of dissection is necessary and that requires a good deal of dissection skill to avoid puncture in skin flap. After restoration suture lines are also visible from any side of neck moreover whole process is time consuming.

### Need for a new incision type

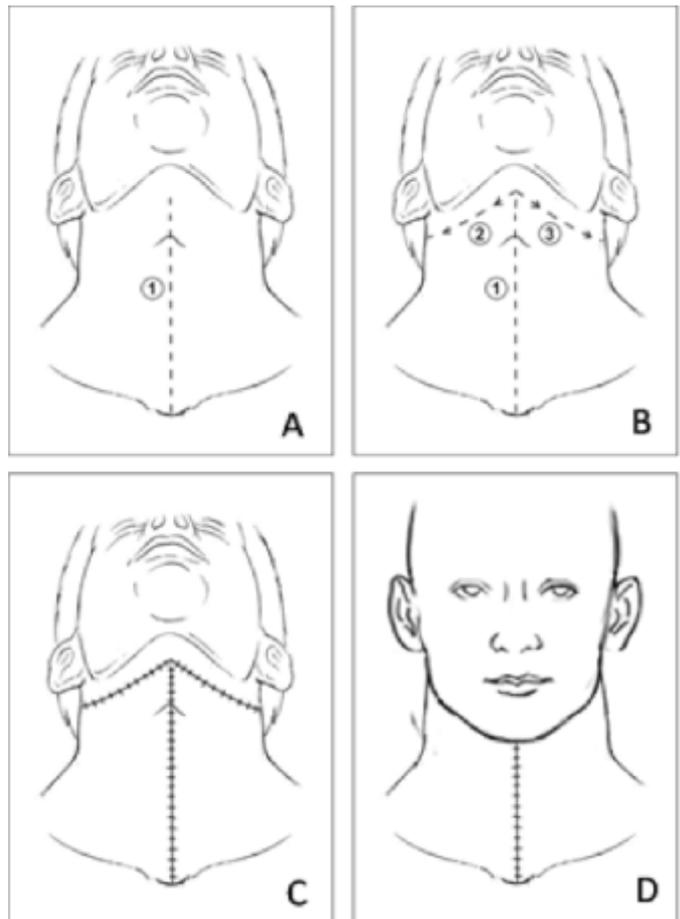
Most importantly for all 'Y' type incisions, prior planning is required before starting internal examination considering it to be a case of compression of neck. In all cases when no neck compression is suspected, autopsy is done by making most common and convenient usual straight line incision or 'I' type Incision. Sometimes after dissection no internal findings suggestive of any disease or injury or poisoning could be detected excepting evidences of congestion and or little bluish red discoloration of tissues. Occasionally, evidence of ecchymosis or bruise may suddenly be encountered in the neck near midline incision. In such situation exploration of neck structures becomes essential to rule out any foul play of neck compression but then no type of 'Y' incision can be done as already midline 'I' type incision has been given.

In that particular situation for proper neck exposure, the authors have developed a new incision plan that can be adopted for neck structure exposure even after 'I' incision (Fig. 1A). Myself with my post graduate students have been practicing this incision for over 2 years as a routine incision plan for internal examination more specifically neck dissection in all cases of suspected neck compression. We have named this incision as 'Arrow Line Incision' for its appearance after bilateral extension line of incisions (Fig. 1B).

### Procedure for making 'Arrow line incision'

**Step-1:** Midline straight incision starting from 1cm below Symphysis Menti down to Symphysis Pubis skirting the umbilicus on one side (Fig. 1A, 2B).

**Step-2:** Two linear incisions are made from highest point of midline straight incision extending to either side of the tip of Mastoid process along the line 1cm below and almost parallel to lower border of mandible (1 cm = 1 finger breadth approximately). The incision line appears like arrow line



**Figure 1:** A; Incision line starting 1cm below Symphysis Menti, B- Two incision lines (marked 2, 3) from top point of midline incision 1cm below and parallel to lower border of mandible to mastoid on either side, C- Sutured arrow line incision, D- View of sutured line on flexion of neck

diagram (Fig. 1B). Sequential procedure for this incision is shown in Figure 2 A to F.

In this method, examination of body cavities is done first with midline straight incision and then neck dissection is done with bilateral submandibular incision line. On making the bilateral submandibular incision, dissection is done by holding the skin margin with tooth forceps or gauge piece at upper medial side at chin. Dissection of skin flap is done above downwards and laterally. After complete dissection, skin flaps are opened sideways which appears like opening the pages of a book. Wide exposure with clear view of whole of the neck and front of chest can easily be appreciated (Fig. 2C). These skin flaps are not very



**Figure 2:** A; Author making an arrow line incision, B to E- Steps to show arrow line incision on the dead body during autopsy, F- Application of 'Arrow line Incision' in a case without any history of neck compression as mentioned in case report.

wide and both side upper and medial borders are almost straight line and therefore dissection can be done with ease and rapidity. Moreover, if required, extension dissection can easily be done round the sides of neck to back side. Closure of skin is most conveniently done by single continuous line from pubis to chin to either mastoid (Fig.2D). Alternatively, skin closure also can be done from the arrow head junction to either mastoid closing the scalp dissection line and then from arrow head to pubis. Skin closure should be done neatly with close short bites. On flexion of neck to normal sleeping position stitch line perfectly comes in the natural flexion crease under the lower jaw which is not visible from top or sides giving it a good cosmetic appearance (Fig. 1D, 2E). In this method first incision line is almost same as conventional 'T' incision line, only modification is that incision

upper point should be little below the point of chin preferably on midpoint between chin and adam's apple. In case the incision is done from the chin lateral extension incision on both sides can easily be done subsequently as planned in 'Arrow line incision' without any significant difficulties in terms of exposure of neck structure or skin closure. In the neck while giving midline incision, it should be shallow, just subcutaneous tissue depth to avoid cutting of any superficial engorged vessels in the neck. Normally midline incision in the neck is bloodless but if any blood oozing occurs from any cut vessels that should immediately be washed off so that spilled blood does not cause staining of neck structures. Cranial cavity is opened after examination of thoracic and abdominal cavity. Finally, lateral limbs of 'arrow line incision' are given for neck dissection. With

very simple dissection wide, adequate and proper exposure of neck can be achieved and neck structures can be examined in almost a bloodless field.

## Discussion

External findings with typical disposition of ligature mark on the neck reasonably establish the cause of death. In almost all cases of hanging, internal findings are generally indistinct and nonspecific. Conversely internal findings in neck are generally more evident and characteristic to prove a case of strangulation and external findings in many cases are minimum, indistinct or even absent and therefore, thorough and meticulous internal examination of neck is of paramount importance in all cases of narrated or suspected strangulations. Wider view of neck for clear observation of internal can most satisfactorily be achieved by dissection with this new method, 'Arrow line incision'.

Following case report is an example of successful application of arrow line incision -

One dead body of a 66 years old elderly thin built female subject was brought for post-mortem examination. Inquest stated that on return from father's house daughter in law found her lying unconscious on the floor in the room. No suspicion of foul play was mentioned by police or relative. Therefore, taking that a case of sudden death of an elderly lady autopsy was done. External examination showed no injury or signs of neck compression anywhere. Internal examination was started with regular 'I' incision but no findings were suggestive of cause of sudden death. Upon little exposure of soft tissue at the tip of 'I', small extravasation of blood in the subcutaneous tissue was noted, raising suspicion of neck compression but no option of 'Y' incision was available then as already 'I' Incision was applied. We used the 'Arrow line incision' for neck dissection by giving incision on either side of chin from highest point of 'I'

incision. On dissection of the neck we found little circular shaped bruises of variable size on either side of larynx at sub mandible line (Fig. 2F) suggestive of manual strangulation.

## Conclusion

The 'Arrow Line Incision' is far more practical, time-saving and easier over other regularly practiced methods for neck dissection with 'Y' or modified 'Y' incision. My plan of 'Arrow line Incision' is superior to any other neck dissection incision plan in terms of convenience, exposure, and cosmetic appearance. This Incision can be done any time even after conventional 'I' Incision, simply as extension incision. Arrow line incision can most effectively be practiced in all cases as routine autopsy incision for internal examination, with or without history of neck compression.

**Declaration:** Authors declare that this is a study on medico-legal autopsy cases, and no private party or living patients are involved.

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REVIEW ARTICLE

## Three-dimensional scanning – A futuristic technology in forensic anthropology

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### Abstract

Imaging innovations assume a necessary part irrespective of the considerable evolution in the discipline of forensic anthropology. Thus, enables the anthropologist to record the site and anthropological remains in outstanding point of interest. With advancement in innovations, virtual human studies are increasing pervasively replacing conventional radiographs that have been utilized to archive specimens. The forensic anthropologists have incorporated computed tomography (CT) and three-dimensional (3D) surface scans as advanced imaging methods for their case analyses and research to obtain process and dissect 3D information. Among these methods, three dimensional scanners have picked up a conspicuous place for an assortment of reasons that make them valuable to anthropologists. These propelled imaging innovations give a way to report anthropological specimens, their injury patterns, and thus provides a platform to create virtual models for record purpose. Imaging specialists have also tried creating techniques for evaluating and utilizing various parameters from the virtual models like surface mapping and advanced methods of geomorphometric analysis. It stretches out our capacity to evaluate phenotypic variety, its non-damaging nature adds to specimen preservation, and it can turn into a basic piece of virtual human studies, along these lines accomplishing more than simply "beginning to expose what's 3D scanning is all about. The present paper provides an insight on the new scanning technology and discusses the possible future application of these techniques in forensic analysis.

### Keywords

Forensic anthropology; Virtual anthropology; Forensic Science; Identification; Three Dimensional Scanning.

### Introduction

Forensic photography is considered as most common parameter for visual recognition and documentation purpose.<sup>1</sup> It has a pivotal role in preservation of the evidence, but due to its limitations to record only two dimensions (x and y); it can't record inside complexity and injuries in depth.<sup>2</sup> As the three dimensional (3D) structures or injury patterns are brought down to two-dimensional (2D) level, the unique characteristics such as its geometry and dimensions are lost.<sup>2,4</sup> These distortions are affected by many factors such as noise,<sup>5-7</sup> camera position, point of procurement and light conditions thereby decreasing the precision.<sup>8</sup> In this manner, the 2D archives of forensic wound are legitimately inadequate and not an ideal mode for interpretation of injuries and later presentation at any forensic department and court respectively. These loop holes led to an alternative method for recording forensic injuries using 3D scanning technology.<sup>4</sup>

Therefore, the present paper gives an overview of ebb and flow applications in anthropology and participates in a more definite discussion of some vital specialized perspectives, with the purpose to help experts in related disciplines to evaluate the capability of surface scanning for their particular research objectives. Regardless of their potential advantage, not every

single forensic anthropologist utilizes these technologies. One approach to mitigate the confinements includes interdisciplinary joint efforts amongst analysts and experts, especially with scientific pathologists. Through such coordinated efforts, advanced imaging can be an important device to help distinguish the dead, give understanding with respect to conditions encompassing their demise and for case documentation.

### Types of scanners

Generally, the 3D surface scanners are of two types: Non-contact and Contact scanners.<sup>3,4</sup> The non-contact 3D surface scanning method is a process of recording and representing dimension of object in 3D coordinates (x,y,z) without contacting the object.<sup>9</sup> Active scanning and passive scanning are two forms of non-contact scanning procedures.<sup>3,4,10</sup>

The passive techniques depend on capturing a series of photographs from various points on the object's surface and further locating correspondences between them through photogrammetric software<sup>11</sup> i.e. they are photographs based estimation methods. Whereas, in the active scanning technique, the scanners emit some kind of light and detect its reflection from the object, thus, the surface object is reproduced by estimating the sort of light to the object's surface.<sup>7</sup> It's an intense technique to archive forensic injuries,<sup>4,12</sup> on the grounds that 3D technology results provide a more elevated amount of exactness and resolution.<sup>8</sup> However, 3D active scanning is an old innovation that has been used in various industries, like medical, automobile for documenting auto collision,<sup>9</sup> forensic sciences in facial mapping and identification, documenting the

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heritage<sup>13</sup> and archaeological applications.<sup>8-11,14</sup> Since 1998 in Germany, the active scanning was acquainted to forensic pathology and later since 2003 in Switzerland ATOS - a multinational French company have applied light 3D scanners in the respective research and development departments.<sup>8,9</sup> In any case to produce high resolution results ATOS scanners include more conditions.<sup>15</sup> The active 3D surface scanning innovation has constrained its use within forensic medicine because of the market cost and the control of the casualty required. In this way, it isn't totally incorporated into the routine forensic work all over, despite the fact that the prospective technology shall have an awesome noteworthiness in coming times.<sup>12,15</sup> Though optional method such as photogrammetry do exist, but it is not unrivalled in recording forensic injuries since it can't get a similar level of exactness and point's thickness when contrasted with the active 3D scanners.<sup>8,11,12</sup>

### Why to use a surface scanner

Out of the numerous techniques, computed tomography (CT) has been widely accepted for digitizing bone specimens by medical fraternity that can accurately record the dimensions of the subject however, scanning parameters, scanner reconstruction algorithms and parameters, as well as, ruler positioning and landmark selection are few of the parameters that can result in error.<sup>16,17</sup>

The volume-scanners used for medical imaging provides inner anatomy yet no surface finish; moreover it requires extensive post-processing and expert radiologist. Whereas, the 3D surface scanners uses light as a source of illumination and provide non-invasive measurements with rapid generation of dense point clouds and polygon meshes (low post-processing). It also provides detailed surface contour and texture, high level of mobility, high to very high resolution and affordability.<sup>4,9,18</sup>

Thinking about the two technologies as choices, they ought to be viewed as correlative methods for archiving and measuring samples. Their strengths and weaknesses are clearly complementary. Instances wherein external morphology and morphometrics is the core objective, CT scanning is ineffective method for accomplishing it<sup>17-19</sup> For example on account of a hominin fossil or any skeletal bone, this requires finding a neighborhood imaging centre for CT scanning, transporting the human remains to that imaging centre and back and tedious post-handling of each piece.<sup>4,8,20,21</sup> In the event that aDNA (Ancient DNA) extraction is foreseen not far off, exposing it to ionizing radiation might be viewed as taking an obscure risk.<sup>20-22</sup> But, wherein living subjects or preservation of aDNA is involved, the volume-scanning technologies based on terahertz radiation<sup>21,22</sup> or infrared images<sup>23</sup> can be used as an alternative to x-rays.<sup>18</sup>

### Performance of 3D scanners

The anthropologist should consider certain specificities about 3D scanner when exposing anthropological tissues such as bones or teeth and their utilization in 3D data.<sup>17</sup> Measurement,

resolution, volume, portability, acquisition accuracy/precision, speed, and cost are some parameters that are most important for the end-user.<sup>18</sup> Size of the object is determined by measurement of volume, or field of view (FOV), that can be procured in a solitary pass. The scanning can be performed either by operating the scanner on the object or vice versa, but a significant multiplication of acquisitions can occur, resulting in decreased efficiency.<sup>14</sup> The surface scanner resolution is usually a component of pixel size of the camera, a charge-coupled device (CCD).<sup>12-15</sup> Both the parameters are inversely associated to one another that is smaller the FOV, higher the resolution for a given CCD.<sup>13-15</sup> The typical pixel size ranges for medium to small objects differ somewhere in the range of 500 and 20 microns, though much better and worst variation do exist. These resolutions are probably sufficient for most of the anthropometric applications. Exactness and accuracy of optical estimation frameworks are more subtle execution parameters, and an absence of universally perceived standards has added to some vulnerability in this area.<sup>24</sup>

### Use of 3D scanners in forensic anthropology

Basically, 3D surface scans can be utilized in an indistinguishable way from CT scans to make 3D replication of anthropological specimens for record purposes and illustration.<sup>16</sup> The anthropologist can allude various 3D rendered virtual model like skull, os coxae, femur, and some other areas of interest.<sup>17</sup> Since the surface scanners additionally captures the surface and tinge of the surface, taphonomic changes, for example, sun blanching and recoloring caused due to soil would also be saved. The resolution for scanning is sufficiently remarkable to precisely capture various patterns (particularly those showing plastic distortion or division at the fracture margins) and injuries.<sup>2,4</sup> Capturing proof of sharp power injury utilizing such digital scanners at times is challenging except if such deformities are two or three millimeters wide. Smaller sharp injuries and shallow cuts may have the capacity to be caught utilizing higher end scanners, however will rely upon the resolution and settings.<sup>4</sup> More research is required for 3D scanners in recording and analyzes of defects of trauma.<sup>2-5</sup>

Similar to volumetric scan data, any surface scanned model could be 3D printed, giving substantial reproduction that can be utilized for representation in court or for teaching purpose.<sup>17</sup> Plotting important landmarks and calculation from such digital models can aid in examinations of bullet directions and blood scatter.<sup>25</sup> Digital surface scanners can make a 360 degree remaking of a crime scene that can be utilized for informative purposes in the court.<sup>16</sup> One of the recent study entitled "Landscape Study on 3D Crime Scene Scanning Devices" published by The National Institute of Justice compared various 3D scene scanning devices<sup>25</sup> Such impediments might be best to distinguish the nearest territorial access of 3D scanners and team up for examining scene if required.<sup>26</sup>

Currently at this point, 3D surface scans have not contributed much directly for forensic anthropological case analyses. Regardless of the fact that anatomical landmarks and skeletal

measurements can be calculated accurately from the scanned data,<sup>16,17</sup> it is pointless in recording data digitally when the real specimen is accessible.<sup>26,27</sup> However, it is true for traditional age, sex, and ancestry estimation techniques.<sup>16,17</sup> Notwithstanding, as said beforehand, 3D virtual models give a chance to utilize new factors, for example, surface regions, volumes, traces, surface alleviation, and semi historic points (i.e., milestones set along bends or surfaces keeping in mind the end goal to catch shape) in skeletal variety investigations.<sup>26-28</sup> Since surface scan outputs are available easily than CT scans, a significant number of the unique strategies are presently created from such scan data.<sup>28,29</sup> However, Virtual bones generated from 'clinical' CT scans are larger in size than the dry skeletal element.<sup>27-29</sup> The bone measurement by virtual method was as accurate and reliable as the conventional method and is highly recommended in countries with limited skeletal collection.<sup>30,31</sup> With advancement in technology, restorative procedures can be performed digitally providing increased reliability and quality control than manual restoration.<sup>32</sup>

Violent conflict due to personal or group dispute is common throughout human history. Historical documents aids in registering recent events while the only way of assessing evidence for such behaviour in prehistory is through skeletal analysis.<sup>33</sup> The development in virtual anthropology generates advanced tools and permits energizing bits of knowledge into human variety. The greatest analytical potential of surface scans does not lie in for all intents and purposes recreating what can be effectively, more quickly and less expensively achieved, however for evaluation of morphological dimensions.<sup>32,33</sup> Though, virtual anthropology has facilitated the development of an efficacious alternate approach to biological profiling, the forensic experts must remain cognizant of relationship between resolution and slice thickness, where the level of discernible anatomical detail decreases with increasing slice thickness.<sup>32-34</sup>

With advancement in 3D technology, new researches are being conducted worldwide to generate 'Forensic Anthropology Data Banks' of different populations which help in the process of identification of human remains.<sup>35-40</sup> However, despite of various advantages, 3D technology cannot replace the real bones as this new arena is partly operator-dependent<sup>41</sup> and during manual segmentation small bone spurs or important structures may be accidentally deleted.<sup>31,34</sup> Moreover, inappropriate adjustment of rendering parameters such as opacity and brightness can also obscure subtle findings and certain features can be greatly felt by palpation than with viewing alone.<sup>35</sup> The virtual forensic anthropology allows for new possibilities of treatment of human remains where non-invasive techniques are available for use.<sup>40-43</sup>

## Conclusion

The 3D surface scanning technology can be a boon to forensic fraternity and the use of laser scanning, can have access to many opportunities in presentation of case reports, for teaching and research. With increase in 3D surface scanners, the collection, review, and analysis of evidence shall become better and

likelihood of solving the crime. Non-experts can also be taken into a 3D world that's more readily understandable than simple pictures and verbal scene description. It is obvious that surface scanning will have an increasingly important role to play in forensic medicine and anthropology with increasing resolutions, availability of better softwares, and with decline in costs.

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CASE REPORT

## Complex Suicide – A case report

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### Abstract

There are a great number of complex suicides in the literature. It will be useful to the scientific community to expand the list of methods employed by suicidal individuals which are encountered by Forensic experts worldwide. Frequently seen combinations are the ingestion of a toxic substance in combination with hanging, use of a gun with hanging, drowning and injuries from knives or jumping from heights. We present a case of a complex suicide of a young woman by using ingestion of kerosene associated with hanging. Forensic autopsy findings and circumstantial evidence were in favor of suicide without the intervention of another person. This case illustrates an example of complex suicide which is an uncommon way of suicide in this part of the country

### Keywords

Kerosene Ingestion; Hanging; Complex Suicide

### Introduction

Suicide is an act of intentionally causing one's own death. Suicides may be divided into simple and complex types.<sup>1</sup> In complex suicides, two or more methods are applied either simultaneously or one after the other.<sup>2</sup> Frequently seen combinations are the ingestion of a toxic substance in combination with hanging, use of a gun with hanging, drowning and injuries from knives or jumping from heights.<sup>3,4</sup> A 15-year-old individual in India had a cumulative risk of about 1.3% of dying before the age of 80 years by suicide; men had a higher risk (1.7%) than did women (1.0%), with an especially high risks in south India (3.5% in men and 1.8% in women). About half of suicide deaths were due to poisoning (mainly ingestions of pesticides).<sup>5</sup> The use of multiple, sometimes extraordinary methods, might lead to suspicion of homicide justifying the necessity for forensic investigations.<sup>6</sup>

### Case report

An 18-year old girl was found hanging inside her room with a suicide note beside her following a quarrel with her mother the previous night. She was immediately evacuated to a local hospital but was declared brought dead by the doctor. Her body was brought for autopsy in our centre. On examination, she was 4 ft 10 inches in stature, weighed 41 kgs and of average physique. Rigor mortis was developing; post mortem staining was present on the back, but not yet fixed; face was congested and there were dry stains of saliva extending from the right angle of the mouth to the chin. The saliva stains were also present on the front of her blouse. A ligature mark (14 cm x 1.2 cm) was observed on the front of the

neck in its mid part, obliquely placed and non-continuous on the left side with parchmentation. Another ligature mark (22 cm x 1 cm) was observed on the neck between the larynx and chin, which was non continuous on the left occipital area with parchmentation. Red abrasions and petechiae were present along the margins (Fig 1). Internally, the subcutaneous tissue beneath the ligature mark was pale and glistening. The lungs



Fig. 1: Ligature marks and saliva stains



Fig. 2: Presence of kerosene in the stomach

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were congested and oedematous and all other organs were congested. The stomach and small intestines contained about 150 ml of bluish fluid with kerosene smell (Fig 2). The cause of death was opined as asphyxia produced by hanging.

## Discussion

Reported suicide methods in order of frequency (differs from country to country) are: - Injuries by firearms (most common), intoxication with household products and insecticides, cutting of blood vessels, fall from a height, hanging, drowning and less commonly, self-immolation.<sup>4,7,8</sup> In complex suicides, two or more methods are employed either simultaneously or one after the other.<sup>2,3</sup> According to statistics, complex suicide represents 1.5 to 5% of all suicides.<sup>2</sup> The frequently seen combinations are: ingestion of a toxic substance in combination with hanging, use of a gun with hanging, drowning and injuries from knives or jumping from heights, etc.<sup>3,4</sup> Usually a distinction is made between planned and unplanned complex suicides.<sup>8</sup> In the first group, two or more methods are applied simultaneously in order to make sure that death will occur even if one method fails. In unplanned complex suicides, the method used is changed when the first method failed or was too slow or proved to be painful,<sup>2</sup> and an acute stressful event has been found to be an important predisposing factor. The present case may fall in this category. Generally, there is a gradation in the use of the different methods. In fact, the victim prefers to start with the least lethal and the less painful method before choosing a more serious approach to have less chance to escape death.<sup>9</sup>

Absence of ligature mark or double ligature mark or partial hanging with feet touching the ground may give a scope for false allegations as to the cause of death.<sup>10</sup> Interestingly, two ligature marks were also in the observed in this complex suicide case; however, this can be explained by the upward slipping of the ligature during suspension. The use of more than one method of suicide makes the distinction from homicide difficult. This case report illustrates an uncommon way of suicide in this part of the country and has unnecessarily brought about the lingering suspicion of homicide. Kerosene, a volatile liquid, often gets aspirated into the respiratory tract leading to bronchospasm and difficulty in breathing. Hence, the girl might have resorted to hanging as she could not bear the suffering. Further, the complete lack of other fatal injuries, signs of struggle, and the

circumstantial evidence of the hanging occurring inside her own room with history of a family quarrel and a suicide note guided the opinion in favour of suicide though of a complex nature.

Suicide is a delicate medico legal situation. This case report illustrates an example of complex suicide, which is an uncommon way of suicide in this part of the country. When more than one method of suicide is used, homicide may be suspected. Autopsy findings along with crime scene investigation and police investigations can determine the exact nature of the death and deliver justice. Scene investigation and autopsy is emphasized as part of the whole postmortem investigation of death in cases of unusual suicide using multiple methods of self-destruction.

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## CASE REPORT

# Suicidal shotgun wound on chest – An unusual entity

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### Abstract

Injuries from firearms are on rise causing problem that severely affects the criminal justice and health-care systems of the country. Legal ownership of guns, male gender, and youth has been identified as risk factors for firearm injuries. Gunshot suicides committed with legally owned firearms, are occasionally encountered; rather people tend to use easier and cheaper methods like hanging or poisoning. The wounds in the suicidal cases due to firearms are generally in head region. We report a case in which the deceased a middle aged male individual who committed suicide using a licensed shotgun weapon, and had a wound over his chest.

### Keywords

Suicide; Shotgun; Firearm; Chest Region; Weapon

### Introduction

Firearm weapons are generally procured for a sense of providing self-protection. There is a strong correlation between the acquisition of a firearm and its use in suicides, murders, assaults, and unintentional deaths. In India, a previous study showed male suicide being higher as compared to females due to poisoning, followed by hanging. However, suicides by firearm are not very common.<sup>1</sup>

Among the firearm, hand guns are frequently kept loaded, are easy to handle thus more frequently being used for suicide. The site of the wound is usually in head region both in the handguns and long weapons. The handgun's short barrel length may also be important; as it is difficult to aim a shotgun at oneself and pull the trigger.<sup>2</sup> This case is being reported because of the unusual manner of sustaining a firearm wound at a less commonly involved site and from a weapon unlikely to be used for suicide.

### Case report

A 51-year-old male had come home on parole from jail the previous evening. The whole of the family was sleeping on terrace. At midnight the victim who had this licensed smooth bore weapon, allegedly shot himself in the chest region and collapsed on the Charpai. On examination of scene of crime, he was lying in the pool of blood, with the clothes smudged with blood (Fig 1A) and alleged weapon lying on ground (Fig 1B).

On examination, body was wearing black colored short with strips which was smudged with blood at places, more so on the right half region. The deceased was thin built and moderately nourished, of 167 cm height. Rigor mortis was well developed

all over the body and post-mortem lividity was seen over the back and dependant areas except pressure areas. An entry wound of firearm measuring 1.8cm x 1.7cm with muzzle impression (Fig 2A) measuring 5.2cm x 2cm on left chest region, 134cm from left heel, 1cm left to midline, 10cm above and medial to left nipple. Entry wound had seared edges (Fig 2B) and visible black soot in the inner tissue. The wound was directed posteriorly, laterally and downwards to emerge as exit wound of size 2cm x 1.6cm on the left upper back region located 132cm from left heel, 4.5cm left to midline, and 25cm below occiput with liquid blood flowing out (Fig 2C). Along the track of the wound, it was fracturing the 2nd and 3rd ribs on left side, rupturing the upper lobe of left lung, to reach till exit wound. The track of the wound was going downwards, backwards and laterally.

### Discussion

Shotguns may have either a single barrel or double barrel. Double barrel shotguns may be “over and under” or “side by side” in configuration. In a double barreled shotgun, the unused

Figure 1: A; Victim lying in a pool of blood on the bed, B; Close up of the alleged weapon lying beside the bed



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barrel often leaves a characteristic patterned abrasion.<sup>3</sup> Shotgun contact wounds to the chest are different from the entry wounds over head, as splitting of skin is minimum and the gases disperse in the surrounding soft tissues and visceral cavities and produce less destruction. The wounds will have the diameter equal to the bore of weapon. Soot will be more prominent in the interior of wound or the track. In hard-contact wounds, no soot surrounds the entrance site, but the edges of the wound will be seared and blackened by the hot gases,<sup>4</sup> as shown in figure 2B of our case. In

**Figure 2:** A; Entry wound with muzzle impression, B; Close up of the entry wound with seared edges, C; Exit wound on the back of chest



the case of double barreled weapons, the sudden and catastrophic expansion of soft tissues will frequently create a faithful reproduction of the muzzle of the gun in the form of a circular laceration and abrasion.<sup>5</sup> The entry wound present in our case typically shows all the described features in Figure 2A.

The exit wounds are uncommon in injury over the trunk due to

less energy, small size of pellet and low muzzle velocity of the weapon. Commonly a bruise is present along the attempted exit wounds.<sup>6</sup> However, the present case had a typical exit wound which could be caused due to the high velocity of the weapon. Di Maio<sup>5</sup> explained the trajectory of the bullet or pellets in self-inflicting wounds to the chest and abdomen from rifles and shotguns. The individual, while committing suicide, braces the butt of the gun against the ground and leans over the weapon. The muzzle end is held against chest or abdomen with help of left hand and pull the trigger with the right hand (as in this case there was extensive dried blood stains on the right hand) rotating the upper body counter- clockwise.

So due to above phenomenon the bullet follows a right to left part. As the victim is hunched over the gun, the trajectory of the bullet is downwards and not upwards. The final trajectory will be downwards, and right to left in a right handed person,<sup>7</sup> which is consistent with the track of the wound in our case.

## Conclusion

Increased use of firearm weapons in the society has lead to false sense of safety, and the possession of the weapon also puts the individual at a risk of injuring himself or the others. The case report presents an unusual case of shotgun injury at not so common site used for suicidal purpose.

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## CASE REPORT

# Fatal colon rupture by compressed air of high-pressure pump

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### Abstract

Compressed air is the air which is kept at pressure higher than atmospheric pressure. It is mainly used in industries and garages and its injudicious use can be dangerous. Sudden trans-anal insufflation of high amounts of compressed air may cause rupture of rectum, intestines along with damage to other internal organs. It may be used as a means of torture or causing homicide. Limited literature on the subject mostly reports fatal outcome. We report a rare case of accidental prank that went terribly wrong and led to the death of a young man. The case report also discusses the mechanisms which may have led to death.

### Keywords

Colon rupture; Compressed air, Barotrauma

### Introduction

Compressed air is the air that is kept under pressure that is higher than atmospheric pressure. Many industries make use of high-pressure air and gas systems that can be harmful when handled inappropriately since it stores high amount of energy at high pressure. Barotrauma is an injury caused by pressure effect. Colon barotraumas are colon injuries, including mucosal traumas and colon perforation with elevated intraluminal pressure, is mainly caused by compressed air<sup>1-2</sup>. The most common cause of colon barotrauma is air insufflation during colonoscopy procedure, however, colon perforation by misuse of compressed air has been reported as one of the causes of non-iatrogenic colon barotraumas<sup>3</sup>. Injuries from barotrauma resulting from placement of high-pressure air in the digestive tract are not particularly common. They have been described as "rare, unique and traumatic intra-abdominal injury"<sup>4</sup>.

Forceful or playful insufflation of high-pressure air jet through the anal orifice can cause fatal injuries to the intestines leading to colonic and/or rectal perforation and development of tension pneumoperitoneum due to delivering of a large amount of pressurized air. It was suggested that it takes only 1 or 2 secs to deliver enough compressed air to cause major damage<sup>4</sup>. We came across one such rare incident of fun that went terribly wrong; causing colon barotrauma with perforation due to trans-anal insufflation of compressed air from an air pump.

### Case Report

A 21 years old male was brought to the emergency room by his co-worker for abdominal pain and distention of abdomen along

with difficulty in breathing. He was a garage worker and was the victim of a practical joke by his colleagues who playfully insufflated the compressed air through the anal route (6.0 kg/cm<sup>2</sup> pressured, less than 1s duration) with an air pipe for fun. The high-pressure air pipe was used for cleaning the cars as well as for inflating the tyres. Immediately, the patient experienced distention of abdomen and pain for which he was brought to the hospital. At admission, on general examination, patient was dyspnoeic and had tachypnoea (24/min) with tachycardia (92/min). His blood pressure was recorded as 84/48 mmHg. The findings of abdominal examination were consistent with that of perforation (distended abdomen, abdominal tenderness along

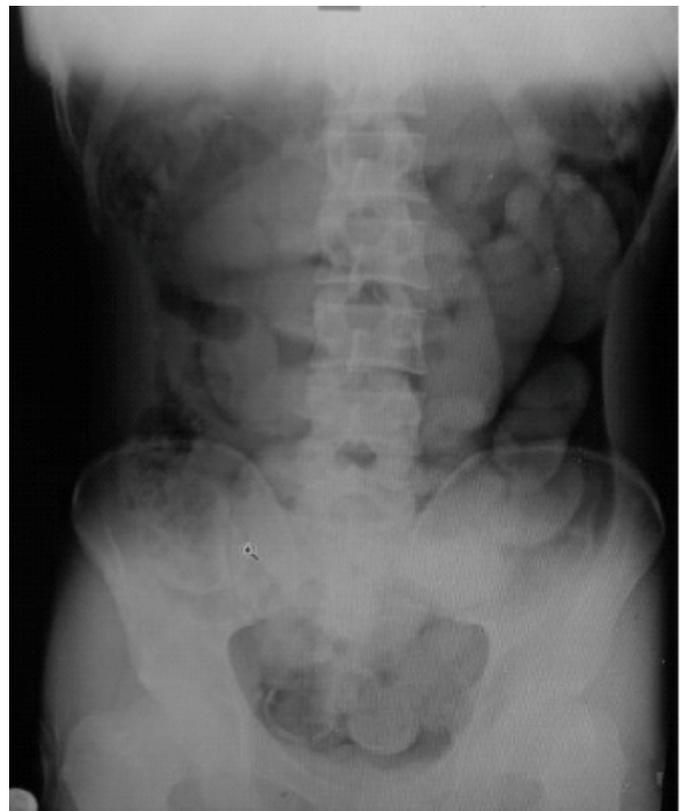


Fig 1: X-ray showing air under diaphragm indicative of bowel perforation

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Fig 2: Resected bowel segment with perforation of transverse colon



Fig 3: Gangrene of the caecum along with inflammation of the peritoneum

with guarding and rigidity). Liver dullness was masked with absent bowel sounds.

On rectal examination, fissure was seen at 7 'o'clock and digital rectal examination revealed scanty rectal bleeding. X-ray of the abdomen revealed air under the diaphragm (Fig.1). Computed Tomography revealed bowel perforation. Patient was taken for emergency exploratory laparotomy. On exploration, gush of air was observed along with 2L of hemoperitoneum. A perforation was seen in mid part of transverse colon along with multiple serosal tears in sigmoid, upper rectum, transverse and descending rectum. Gangrene of caecum was also observed. The involved segment was resected, perforation resected, and ileostomy and colostomy done. (Fig.2) However, condition worsened, and patients succumbed to his injuries on 2 days later and body was brought for post-mortem examination.

On external examination of deceased, a mucosal tear was present over anal region and mucosa was reddish and inflamed. External examination of abdomen showed laparotomy suture wound over midline of abdomen, vertical, from xiphisternum to suprapubic region. The colostomy wound was present in left lumbar region, along with two drainage wounds over the right and left iliac fossa respectively. On internal examination, pleural cavity contained 100 cc blood-tinged fluid. On opening peritoneum, blood-tinged fluid was present with foul smell. Peritoneum was inflamed. The intestines were inflamed. Multiple surgical stitches with pus pockets were present over the transverse colon. Caecum was blackish in colour indicating of gangrene. (Fig.3) The intestines were densely adherent to each other and overlying peritoneum. The rest of the organs were congested. Thus, the cause of death based on hospital records and postmortem examination was given as perforation peritonitis.

## Discussion

Most of the cases of iatrogenic colonic barotrauma occur during a colonoscopy procedure. Transanal barotrauma due to compressed air leading to colonic injury have been reported periodically. Stone reported the first case of pneumatic rupture of the colon in 1904<sup>5</sup>. According to the Law of Laplace, the wall tension is directly proportional to the intramural pressure and the diameter of the colon. The caecum has the largest diameter and is the most easily affected in colonoscopy procedures<sup>6</sup>. The findings range from "cat scratch colon" which is usually seen in a mild type of iatrogenic colon barotrauma to colonic perforation which is a severe finding<sup>7</sup>.

Misuse of compressed air is one of the common causes of non-iatrogenic colon barotrauma. Study of literature of injuries reveal that the cases were usually because of practical joke taking place at the workplace, hence because of a single incident of improper use that had disastrous effect on the affected person. Similar studies were also reported by Indian authors. It was observed that even when the air hose was distant from the body, fatal colonic injuries were present as clothing as a barrier is often lost<sup>4</sup>. The closer the nozzle, the greater are the chances of

colonic perforation.

Unlike air insufflation during colonoscopy, misuse of compressed air may lead to rectosigmoid perforation at the anti-mesenteric border of sigmoid colon<sup>8</sup>. It does not follow the Law of Laplace. The rectosigmoid junction is the site due to easily increasing of the intramural pressure and its bilateral fixation with limited mobility<sup>3</sup>. The order of resistant strength to intramural pressure were rectum, sigmoid colon, ileum, oesophagus, jejunum, transverse colon, caecum and stomach. Death was rare and those stemming from the ascending or transverse colon are less frequent<sup>9</sup>. The first involvement of the transverse colon was in 1914 and that of the ascending colon was 1912.<sup>11,12</sup> The rupture in our case was present on the transverse colon. However, gangrene of caecum was also seen.

Andrew using compressed air to distend the intestine of dogs and oxen, observed that normal intestines required a pressure of 0.49-0.88 kg/cm<sup>2</sup>.<sup>12</sup> Burt showed that the average pressure needed to cause full-thickness tear was 0.29kg/cm<sup>2</sup>. The rupture usually occurs in longitudinal direction along the muscles fibres with full thickness perforation and stripping of serosa and muscularis.<sup>13</sup> The pressure applied in our case was 6kg/cm<sup>2</sup> which was almost 30 times greater than the pressure required to affect the intestinal wall. The severity is also dependent on the duration of dispensation and it takes only 1-2 s to cause major damage.

The overall mortality of pneumatic rupture of the bowel was observed to be at 65%. Surgery reduced the mortality to 42%. The pathophysiology of death as hypothesized by Althoff can be attributed to acute air embolism, acute fat embolism, acute respiratory insufficiency, acute heart failure and peritoneal shock. Recovery may be seen if the tear is not complete<sup>14</sup>.

In our case, in the framework of pulmonary oedema and congestion and in the presence of negative biochemical blood analysis and microbiology report, which did not indicate fat or air embolism, the presence of an acute heart with overloading. Systolic overload of the heart occurred due to direct action of the compression of the colon on the abdominal aorta contributing to pulmonary hypertension, to accelerating functional impairment of breathing due to pneumoperitoneum and compression of the expansive loops on the diaphragm<sup>4</sup>.

All compressed air gas containers are constructed so that they are safe for the purpose that they are intended for. However, their misuse, mishandling and abuse can lead to serious accidents. Their licensing, design, transportation, usage and filling are governed by The Gas Cylinders Rules-2004, The Static and Mobile Pressure Vessels Rules and the Bureau of Indian Standards<sup>15</sup>. The present case appears to be a case of culpable homicide; however, the culpability of the offence will be decided in the court of law after complete trial.

Barotrauma causing colonic injuries due to misuse of

compressed air, calls for urgent policy reforms with respect to handling and usage of compressed air in the industrial as well as domestic set up. Strict workplace safety guidelines should be implemented, to discourage the workers indulging in so-called "practical joke" with compressed air. Mishaps due to inappropriate usage of compressed air can be prevented only when compressed air is handled properly and safely.

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## CASE REPORT

# Unintentional carbon monoxide poisoning to the occupant of motor car by exhaust gases emitted by stranded traffic vehicles and the motor car itself

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### Abstract

Incompletely burnt organic material is the major source of carbon monoxide in the environment. The hazardous nature of Carbon monoxide (CO) is mainly due to it being odourless, colourless, non-irritating, and tasteless and its omnipresent nature. It is also termed as a “silent killer” as it lacks the sensory warning properties. In the present case, a 30-year-old male was found dead in his car which was stuck in a pool of water along with many other vehicles stranded in a narrow lane following heavy rains. Autopsy features of CO poisoning were evident on examination. Chemical analysis report was positive for carboxyhemoglobin and alcohol. Fatal concentrations of CO gas are known to occur inside the automobile cabins due to defective exhaust systems. Alcohol impairs the reaction time and sensibility towards the signs of CO toxicity thereby reducing chances of survival. Awareness regarding dangers of CO poisoning, regular maintenance of vehicle and use of CO detectors are some of the key measures to avoid such fatalities. This case highlights the dangerous nature of carbon monoxide and fatal outcome of its exposure in an atmosphere with heavy concentration of exhaust gases and an enclosed space like a car in addition to the incapacitating effect of alcohol.

### Keywords

Carbon-monoxide; Alcohol; Poisoning; Carboxyhemoglobin; Catalytic convertors; Motor vehicles

### Introduction

Carbon monoxide emitting from automotive exhaust has been a grave concern for the public health. Most of the cases of carbon monoxide (CO) poisoning have occurred in non-moving vehicles. In United States, they are labelled as “Accidental poisoning by motor vehicle exhaust.” Similar to other cases of poisoning in adults, much less information is available regarding such deaths as most of them are brought dead to the hospital.<sup>1</sup>

Incompletely burnt organic material is a major source of carbon monoxide in the environment. Common exposures include smoke from fires and barbecues, wood or coal heaters that burn with inadequate oxygen, incomplete burning of butane or methane used in lighting and heaters, exhaust gases from motor vehicles and cigarette smoke.<sup>2,3</sup> The hazardous nature of Carbon monoxide (CO) is mainly due to it being odourless, colourless, non-irritating, and tasteless and its omnipresent nature. It is also termed as a “silent killer” as it lacks the sensory warning properties. Many accidental and few suicidal deaths due to CO poisoning are often reported throughout the world.<sup>4</sup>

A wide range of fatal CO concentration is known to occur in postmortem samples, depending on the rapidity of poisoning and physical state of the victim. Death is less likely in healthy adults under 60 years at saturation level below 50-60 percent.

Less than life threatening CO concentration (50-60%) may be found in post-mortem samples if CO in the inspired air was so high that death occurred before gas exchange in the lungs was able to progress sufficiently to enter all available monoxide into the red cells. Where death is delayed due to slow absorption autopsy samples may show up to 80 per cent saturation. Chronic heart diseases, senility, infancy, pregnancy, severe anaemia and presence of alcohol are some of the known factors where death can occur at relatively low concentration.<sup>5,6</sup>

### Case report

A 30-year-old male was found unconscious in his petrol driven car stranded in the middle of the road and was declared dead on arrival at the hospital in the morning hours. He had left home on previous evening to meet his friend as alleged by his relatives. The place where the deceased was found was waterlogged up to 2-3 feet due to incessant rains in Mumbai. As it was a small lane, many vehicles amassed in some time and were left stranded. The deceased was found dead by the police authorities in his car with the ignition key and air-conditioner button in 'ON' mode. The engine of the car however, was off. Windows of the car were rolled up, and the water was filled up to the level of clutch and brake in the car. Seats and the car dashboard were smeared with mud. Three cigarette butts were found on the car floor near the deceased foot. The car was an old model (2008) and its production had stopped in the year 2014 in India.

On external examination, the clothes were intact and dry. The deceased was well nourished; with well-marked & generalized rigor. Pink colored fixed postmortem lividity was appreciated on the face, neck, back and buttocks (Fig.1 A & B). Light pink hue was noted on the nail beds (Fig. 1C). No injuries were noted on the body. On internal examination, the blood appeared cherry

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**Fig 1:** A- Pink postmortem lividity on face and neck; B- Pink postmortem lividity on the back and buttocks; C- Nail beds show pinkish discoloration; D- Pink red discoloration of blood; E- Pink discoloration of thoracic muscles and intestines

pink in color (Fig. 1D). Brain was intact, congested and edematous. Thoracic muscles appeared pinkish red (Fig. 1E), lungs were congested & edematous, and coronaries were patent. Stomach contained about 500 cc of partially digested food without any peculiar odor and mucosa was pale. Serosal surface of intestines appeared light pink in color (Fig. 1E). Other visceral organs were congested.

Blood was preserved for carboxyhemoglobin and alcohol detection in separate plastic test tubes without any preservative. Viscera were preserved for chemical analysis. Pieces of organs were preserved for histopathological examination. Toxicological analysis report of blood was positive for carboxyhemoglobin but its quantification was not done. Blood alcohol level was found to be 79mg/100ml and viscera were tested positive for ethyl alcohol (72mg & 50 mg per 100 gms). Histopathology reports showed congestion in lungs with some inflammatory infiltrate while brain showed cerebral congestion and oedema. Histopathological findings in other visceral organs were unremarkable. The cause of death was opined as "Asphyxiation due to carbon monoxide poisoning"

## Discussion

Carbon monoxide has more than 200 times affinity for haemoglobin as compared to oxygen and it reacts with it to form carboxyhemoglobin, reducing the total oxygen carrying capacity of the blood. Also, CO shifts the dissociation curve of any remaining oxyhaemoglobin to the left, thereby reducing even further the liberation of oxygen. Consequently, tissue anoxia is much greater than simply the effects of the loss of oxygen carrying capacity.<sup>5</sup> It was formerly thought that all the

toxic properties of CO lay in this hypoxic action, but more recently it has been shown to interfere with other ferroproteins such as myoglobin and various enzymes including members of the cytochrome family.<sup>6</sup>

In the present case, the car of deceased was stuck in pool of water on road due to heavy rains. The water level was said to be up to waist height, so the exhaust must have been submerged in water. Windows of the car were found rolled up, so the car was as good as an enclosed chamber. The entry of CO in the cabin would have occurred as the engine was kept on to run the air conditioner. This can be affirmed from the fact that the position of the ignition key and the air conditioner button was in 'ON' position. Also it must be kept in mind that engine would stall in some time after the entry of water into the tailpipe. In the air conditioner of car there are two systems of air control. One in which the air inside is only cooled and re-circulated, while the other system sucks the air from outside environment and then circulates cool air inside the car. Now, if the external environment is already heavily polluted by exhaust gases of other vehicles, the air conditioning will suck up the surrounding polluted air into the cabin.

The most important feature for autopsy diagnosis of CO poisoning is cherry pink colour of postmortem lividity, blood and muscles which is usually evident if the saturation of the blood exceeds about 30 per cent. Below this, familiarity and good lighting are needed and below 20 per cent, no colouration is visible. Also as the pink discoloration requires some time to develop, it may be absent if the death is rapid.<sup>5</sup> In the present case, though the CO saturation is not mentioned in the chemical analysis report, from the appearance of pink discoloration, it can be stated that the CO levels must be exceeding 30 percent

saturation. Also it can be inferred that the death was not sudden as it takes some time for the sufficient CO levels to accumulate for appearance of pink coloration.

Blood and viscera were positive for alcohol in the present case, so it is obvious that the deceased was desensitized to a certain extent towards signs and symptoms of CO intoxication. The evidence of a synergistic effect of alcohol and carbon monoxide is documented, leading to death at lower COHb saturation levels in presence of alcohol.<sup>7</sup> Also, under the influence of alcohol; the deceased driver did not try to remove himself from the car, though it was getting flooded by the surrounding rain water. Similarly, the engines of the other vehicles, that were in the vicinity must have been running for some time before they were left stranded, adding to the concentration of exhaust gases.

CO emissions from the vehicle exhaust have reduced drastically over the years due to improved engineering and installation of catalytic converters. Installation of catalytic converters was made mandatory after 1975 which led to large drops in CO emissions. The exhaust system makes use of catalytic converter which helps to convert gas to less toxic pollutants by catalyzing a redox reaction (oxidation or reduction). The catalytic converter is used in internal combustion automobile engines fuelled by petrol or diesel to reduce the emission of carbon monoxide into the atmospheric air. Such was the effect of catalytic converters and tightly regulated emission norms that the total CO emissions from highway vehicles decreased 85% from 163,421 to 24,796 tons per year from year 1970 to 2013 in the USA.<sup>8,9</sup>

The car in the present case was an old model, manufactured in 2008. The amount of travel and subsequent wear and tear to the mechanics of the car may decrease the capacity to conform for the current emission standards and also increase the chances of CO entry into the car cabin from exhaust pipes. So it can be assumed that the CO emission from the exhaust of such an old car must be on a higher side. The fact that the deceased was confined in a small closed space, and had consumed alcohol compounded the issue and resulted in the fatal outcome.

The reported case highlights the dangerous nature of carbon

monoxide and fatal outcome of its exposure in an atmosphere with heavy concentration of exhaust gases and an enclosed space like a car. Alcohol intake with cigarette smoking further complicates the situation as the deceased becomes less reactive to signs and symptoms of CO poisoning. Though CO emissions have greatly reduced from automobile exhausts over the years due to advanced technologies, effective implementation of legislation, strict monitoring of automobile manufacturers, mandatory service checkups of vehicles and increase in general awareness among masses will go a long way in alleviating deaths due to CO poisoning.

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## CASE REPORT

# Concealment of identity by adopting transgender attire

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### Abstract

Identification is the individuality of a person and knowing the gender forms an important parameter for it. The practice of transvestism makes concealment of identity very easy. In an interesting Case report from North Bengal Medical College & Hospital, three transgenders were arrested by GRP for carrying illegal arms and ammunition. They were taken to North Bengal Medical College & Hospital for medical examination where we found all of them concealed their gender by adopting female attire. After general physical examination, radiological examination and karyotyping from buccal mucosa, it was concluded that all the three persons were genetically as well as phenotypically male.

### Keywords

Concealment of identity; Transgender; Transvestism; "Y" Chromosome; Testicular Volume

### Introduction

Identification is the establishment of identity of a person.<sup>1</sup> In biological terms, sex may be determined by number of factors present at birth, which include- type of sex chromosomes, type of gonads—ovaries or testicles, sex hormones, internal reproductive system (such as the uterus in females) and the external genitalia.<sup>2</sup> Gender refers to the socially constructed roles, behaviours, activities, and attributes that a particular society considers appropriate for boys or girls. These influence the behaviour of people, interaction, and feelings about themselves. Gender identity refers to a person's internal sense of being male, female, or something else. Gender is expressed, by the way, a person communicates to others through behaviour, clothing, hairstyles, voice, or body characteristics.<sup>3</sup> Gender identity and sexual orientation are not the same. Sexual orientation refers to an individual's enduring physical, romantic, and/or emotional attraction to another person, whereas gender identity refers to one's internal sense of being male, female, or something else.<sup>3</sup> Transgender is an umbrella term for persons whose gender identity, gender expression, or behaviour does not follow the biological sex. Transgender people may be straight, lesbian, gay, bisexual, or asexual, just as non-transgender people. Society show sympathy and prejudice to intersex. At times the time criminals take undue advantages of these sympathies either by using them for the criminal act (as a mules) or by adopting gesture of intersex.

We report some interesting observations of a case where three persons; allegedly "hijras" were arrested with illegal ammunition in a train and brought to North Bengal Medical

College Darjeeling for medical examination and gender determination so that they can be sent to either female or male jail accordingly.

### Case report

The New Jalpaiguri police had arrested three persons with allegation of illegal ammunition in train. Police brought them to Department of Forensic Medicine NBMC&H, Siliguri for their medical examination and gender determination. Medical examination was conducted after receiving requisition from the concerned police. It included particular of case, general physical examination, sexual examination, investigations and writing the final report.

Table 1: Observations on physical examination

Features	Case 1	Case 2	Case 3
Complexion	Fair	Wheatish	Wheatish
Age (years)	38	37	39
Sex	Transgender	Transgender	Transgender
Religion	Muslim	Muslim	Muslim
Height (cm)	176	158	158
Weight (kg)	78 kg	60	58
Dental examination	32 permanent teeth	32 permanent teeth	32 permanent teeth
Habitus	Male	Male	Male
Scalp hair	Red, 12 inches long	Black, 16 inches long	Black, 16 inches long
Beard and moustache	Clean shaven	Clean shaven	Clean shaven
Axillary hair	Black, adult type	Black, adult type	Black, adult type
Pubic hair	Curly black; Tanner V	Curly black; Tanner V	Curly black; Tanner V
Penis	Adult, Circumcised	Adult, Circumcised	Adult, Circumcised
Scrotum	Rugosed, contain two testicles	Rugosed, contain two testicles	Rugosed, contain two testicles
Breast	Absent	Absent	Absent
Uterus	Not palpable	Not palpable	Not palpable

On the first look all three persons appeared as transgender. Based on body habitus, two persons appeared like a male and the third one as a female. All of them were wearing a sari, female

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undergarments and sacred thread around waist line (suggestive of male as per local cultural milieu). After removal of cloths, it was surprised that they had male habitus with well-developed male external genitalia. Observations on physical examination are summarized in Table 1 and shown in Figures 1 and 2. All the three cases were advised for USG whole abdomen and scrotum for presence of uterus, prostate, testis, and the findings are shown in Table 2. Buccal smear karyotyping done for presence of 'Y' chromosome was positive in all the 3 cases.

**Table 2:** Table 2: USG findings

USG	Case 1	Case 2	Case 3
Uterus	Absent	Absent	Absent
Prostrate	Normal size (13.4 ml)	Normal size (13 ml)	Normal size (13.6 ml)
Scrotum	Normal size Right:13.6 ml Left:13 ml	Normal size Right:14.1 ml Left:13.8 ml	Normal size Right:12.9 ml Left:13.8 ml

On the basis of complete general physical examination, ultrasonography and buccal mucosa karyotyping, it was opined that all the three subjects were genetically and phenotypically male. Further investigation by law enforcing agencies to determine the exact reason for concealing their identity, and adopting female attire is not known to us.



**Figure 2:** Case 3 on examination



**Figure 1:** External appearance and examination of Case 1 and 2

### Discussion

Though sexuality is an important part of people's lives, Indian Census has never recognized third gender before 2011. In 2011, data of transgender were collected with details related to their employment, literacy and caste. In India, total population of transgender is around 4.88 Lakh as per 2011 census.<sup>4</sup> Even the National Crime Record Bureau recognize, criminal or victim only as male or female. They too do not have any specific data of transgender criminals.<sup>5</sup> National Crime Record Bureau of India introduced new proforma on 13th August 2018 in which they included many categories like crime against woman/ children/ media person/ those belonging to north eastern state, crime by saints/ Khap panchayat etc. Interestingly the proforma of crime committed by transgender was removed.<sup>6</sup> They do not conform to conventional notions of male or female gender but combine or move between the two.<sup>7</sup>

Everyone has a right to personal development, and this could be secured only when there exists a right against exploitation which creates a free environment for an individual. Transgenders are the worst victims of exploitation, due to their degraded economic status so, they indulge into prostitution, beggary and other immoral activities and are usually seen as taboo by the society. The Indian constitution provides every

person an equal status before the law and an equal protection of laws within the territory of India.<sup>8</sup> Therefore, it can be observed that the role of judiciary has been very significant in the protection of the transgender rights in India. In the view of this, in April 2014, the Hon'ble Supreme Court of India declared transgender to be the 'third gender' in Indian law.<sup>9</sup> Government of India is also thinking for the strengthening of transgender community so, they have made a bill the transgender persons (protection of rights) Bill, 2019 which is focused on providing protection of rights of transgender persons and their welfare. They also focused on the empowerment of transgender community socially, educationally and economically.<sup>6</sup> For the development of any country contribution from each and every individual is essential. Transgender population in India constitutes 4 per 10000 (0.04%) population, contribution of whom can't be ignored.<sup>4</sup> To get maximum contribution through transgender we should take them to the main stream of society. This can be done with giving them their proper recognition, respect, education, jobs.

There are other aspects of transgender in society besides being uneducated, underdeveloped, they are many a times involved in illegal and criminal activities like extortion of money in railways, as mules for transportation of drugs, and weapons etc. Many a times, males/ females involving in criminal activities use attire of opposite sex as a disguise to present as transgender and misguide the investigation, as depicted in the reported cases. It is hence, essential that such cases be investigated in detail to determine the true identification of an individual.

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CASE REPORT

## Disseminated invasive *Aspergillosis* in a case of fatal antemortem flame burns

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### Abstract

In the burn patients who survive, the most important factor limiting survival is infections. Today, the survival of a seriously burned patient is better due to advancements in burn care therapy. However, they still face increased risk of infectious complications, notably fungal infections. Broad-spectrum antibiotic therapy, large wound surface and impaired immune system contribute to the growth of opportunistic fungal species. As per available data, though burn wound are mostly contaminated by *Candida*, the fungal isolate commonly involved in invasion and dissemination across the body is *Aspergillus*. We report a case of Disseminated Invasive *Aspergillosis* of lung, heart and kidneys in a case of fatal antemortem flame burns in a 36 years old female. This case clearly shows awareness of possible dissemination of *Aspergillus* spp. is necessary in patients who have a burn injury, even if the patient has no risk factors as it is typically associated with a poor prognosis.

### Keywords

Flame burns; Fungal infection; Invasive *Aspergillosis*; Autopsy; Histopathology

### Introduction

For disseminated invasive fungal infections the burn patients are among the highest risk groups.<sup>1</sup> Burn wounds provide an ideal portal of entry and dissemination to various organs for fungi due to substantial immune dysfunction.<sup>2</sup> As a result, in past decade fungal infections have emerged as a potential cause of burn wound infection.<sup>3</sup> In burn patients, the incidence of fungal infection is reported to be 6.3% to 15%, although there are significant differences between individual burn centres ranging from 0.7% up to 24.1%.<sup>4</sup> In the ICU setting the burn patients are predisposed to the fungal infections due to their prolonged exposure to the ventilators, catheters, central and peripheral lines.<sup>5</sup>

Clinical warning signs for fungal infections are unspecific and do not differ from infections of bacterial origin. Due to burn-wound-related permanent inflammation and consequent physiological reactions, common definitions of sepsis are not applicable to burn patients.<sup>6</sup> Current diagnostic approaches for an early detection of mycosis are limited and often unreliable.<sup>7</sup> As per available data, though burn wound are mostly contaminated by *Candida*, the fungal isolate commonly involved in invasion and dissemination across the body is *Aspergillus*.<sup>8</sup> 68% of invasive burn wound infections were caused by *Aspergillus* in a study at Brooke Army Burn Center.

We report a case of Disseminated Invasive *Aspergillosis* in a 36 years old female who sustained flame burns with detailed review of literature.

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### Case History

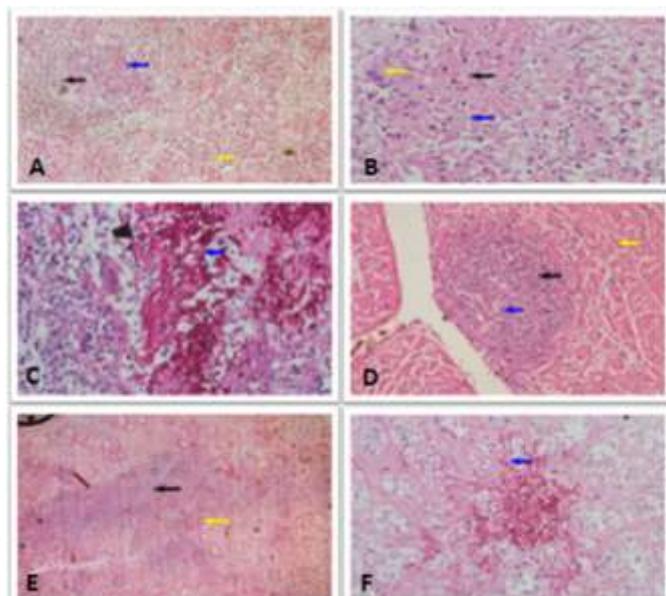
A 36-year-old female married since 11 years, sustained antemortem flame burn injury involving 55% body surface area while boiling milk over a stove in the kitchen with inhalational injury. Escharotomy and tracheostomy (Fig 1-A) were done on day of admission followed by escharectomy of third degree burns on post burn day fifth day. By post burn thirty fifth day there were features of multiorgan dysfunction requiring renal replacement therapy and ventilator support. Her condition gradually deteriorated, she developed respiratory distress and succumbed to her illness. There was no history of any other co morbidities like diabetes, fungal infection or immunodeficiency prior to this incident.



**Figure 1;** A & B: Multiple healing superficial to deep burns over face and chest. Neck shows tracheostomy opening in center with purulent burn wounds around, C & D: Tracheal lumen is congested with multiple blackish granular deposits along the wall

On external examination, the superficial to deep burns with sloughing were seen over the face, neck, chest, and abdomen above umbilicus, both upper limbs and both lower limbs sparing genitals covering total 55% body surface area (Fig 1-B). The burnt area was yellowish in colour along with hyperemia. The singeing of hairs of eyebrow and scalp was present. Few areas showed grey coloured slough and purulent spots over the body.

On internal examination, brain was oedematous and pale. The tracheal and bronchial mucosa congested with multiple blackish granular deposits along the wall (Fig 1-C & 1-D). The pleural cavity comprises of straw coloured fluid measuring about 50ml. Grossly both the lungs were heavy, oedematous weighing about 900 grams (right lung) and 780 grams (left lung) respectively. Heart weight was 260 grams. On dissection, coronaries were patent and ventricle thickness was within normal limits. In peritoneal cavity about 400ml of straw coloured fluid was found. Grossly both kidneys were pale in appearance weighing about 202 grams (right kidney) and 180grams (left kidney) respectively. On dissection, both the kidneys had poor cortico-medullary differentiation with small haemorrhagic and necrotic foci. State of shock and low haemoglobin were considered as reasons for the pale viscera in this case. We sent Heart, Lungs and Kidneys to the Pathology department of our college for histopathological examination which were preserved under 10% Formalin till analysis.



**Figure 2: Histopathological examination of lung (A-C), heart (D) and kidneys (E, F):**  
 A (Hematoxylin and Eosin stain, 100x): Section from lung shows collapsed alveoli (black arrow), alveoli with hyaline membranes (yellow arrow), interstitial and intra-alveolar edema, neutrophil aggregation and a multiple necrotizing granulomas (blue arrow).  
 B (Hematoxylin and Eosin stain, 400x): Closer view of a granuloma showing areas of necrosis alveoli (black arrow) surrounded by histiocytes (yellow arrow), with a few giant cells along with cross sections of refractile fungal hyphae in the lung (blue arrow).  
 C (Periodic acid-Schiff stain, 400x): Numerous fungal hyphae (blue arrow) are seen in lung which are thin, septate, with parallel walls and showing acute angle branching, morphologically consistent with *Aspergillus* spp.  
 D (Hematoxylin and Eosin stain, 400x): Section from heart showed granulomas (black arrow) composed of histiocytes with a few giant cells along with cross sections of refractile fungal hyphae (blue arrow). Normal cardiac muscles are seen around the granuloma (yellow arrow).  
 E (Hematoxylin and Eosin stain, 40x): Section from kidney showed granulomas composed of histiocytes and lymphocytes with areas of necrosis (black arrow). Glomeruli (yellow arrow) and tubules were essentially normal.  
 F (Periodic acid-Schiff stain, 400x): Numerous fungal hyphae (blue arrow) are seen in kidneys which are thin, septate, with parallel walls and showing acute angle branching, morphologically consistent with *Aspergillus* spp.

**Histopathological Examination:** Section from lung on staining from Hematoxylin and Eosin stain show collapsed alveoli with hyaline membranes, interstitial and intra-alveolar edema, neutrophil aggregation and a multiple necrotizing granulomas (Fig 2-A). Closer view of a granuloma showed areas of necrosed alveoli surrounded by histiocytes, with a few giant cells along with cross sections of refractile fungal hyphae (Fig 2-B). PAS stain revealed numerous fungal hyphae which were thin, septate, with parallel walls and showing acute angle branching, morphologically consistent with *Aspergillus* spp (Fig 2-C). Section from heart showed granulomas composed of histiocytes with a few giant cells along with cross sections of refractile fungal hyphae. Normal cardiac muscles are seen around the granuloma (Fig 2-D). Section from kidney showed granulomas composed of histiocytes and lymphocytes with areas of necrosis. Glomeruli and tubules were essentially normal (Fig 2-E). PAS stain revealed numerous fungal hyphae which were thin, septate, with parallel walls and showing acute angle branching (Fig 2-F).

On the basis of histopathological examination and autopsy findings the cause of death was given as multi organ failure consequent to disseminated aspergillosis in antemortem flame burns.

## Discussion

In the past *Aspergillus* was not considered a potent pathogen and cases of disseminated invasive *Aspergillosis* in immunocompetent host were extremely rare.<sup>9</sup> Over the past decade, *Aspergillus* became the most common pathogenic mould worldwide due to indiscriminate use of iv antibiotics and increase in the number of immunosuppressed patients. *Aspergillus fumigatus* is the most prevalent fungal pathogen responsible for fatal invasive *Aspergillosis*. Due to low index of suspicion histology is rarely done for such cases and unfortunately diagnosis becomes available only at autopsy.<sup>10</sup> For early detection of *Aspergillus* current diagnostic approaches are very limited and often unreliable.<sup>11</sup> The histological diagnosis of burn wounds after biopsy is a reliable method to confirm fungal colonization and infection. However, due to its invasive character, this method is usually avoided and not routinely performed.<sup>12</sup> These diagnostic limitations may sometimes prevent an early and appropriate antimycotic therapy.<sup>13</sup>

Patients presenting with burn injury, prolonged antibiotics, venous access (central and peripheral), dialysis, tracheostomy, and catheterization mechanical ventilation predispose to secondary fungal infection.<sup>14</sup> Prolonged antibiotic use impaired the natural defence mechanism leading to invasion and dissemination to other organs like Heart and Kidneys which is very rare in Immunocompetent patients. Any catheters inserted into the body of a burn patient, e.g., tracheal tubes, central or peripheral venous catheters, gastric tubes, rectal tubes, and urinary catheters, are possible mediators of fungal colonization or infection. Therefore, their necessity and duration should be re-evaluated frequently.<sup>1,5</sup>

## Conclusion

Opportunist and invasive fungal infections can be life threatening in burn patients when it is disseminated across the organs as seen in this case. The reported case suggests that awareness of possible dissemination of *Aspergillus* spp. is necessary in patients who have a burn injury, even if the patient has no risk factors as disseminated invasive Aspergillosis is typically associated with a poor prognosis. A high index of suspicion and early diagnosis for highly suspicious cases will go a long way in treating such cases. This case also underlines the importance of autopsy and histopathological analysis in a fatal flame burn case.

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## CASE REPORT

# Fatal bull horn injury – A case report

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### Abstract

From time immemorial, India has been an agrarian country and the cows and bulls have been the backbone of our agriculture. A large number of farmers in India depend on animal husbandry for their livelihood. The bull is a domestic animal and commonly reared for farming purposes. Bull horn injuries are commonly found in rural areas. Accidental farmer deaths add burden to farmer's suicides which is a troublesome problem in India now a day. Fatal bull horn injuries are not commonly reported in literature. Hence we are presenting a case report of a farmer who became victim of fatal bull horn injury.

### Keywords

Bull horn injury; Farmer death; Manner of death; Abdominal trauma

### Introduction

From time immemorial, India has been an agrarian country and the cows and bulls have been the backbone of our farming activities. Though machine technology viz. tractors, harvesters, pumping sets, coppers, etc. have been introduced in farming activities in most parts of India, still in some parts, conventional farming/ ploughing is done with the help of bulls. The bull is a domestic animal and commonly reared for farming purposes. A bull can get aggressive especially to the new handlers. The aggressive behavior however, may be displayed for no apparent reason.<sup>1</sup> Accidental farmer deaths add burden to farmer's suicides which is a troublesome problem in India now a day.<sup>2</sup>

Though bull horn injuries are commonly reported in rural areas,<sup>3</sup> fatal bull horn injuries are uncommon.<sup>4</sup> The present case reports a fatal bull horn injury sustained by a farmer.

### Case report

The deceased was brought dead to the casualty of our hospital with history of bull horn injury. The body was sent for medico-legal post-mortem examination. On external examination we found that clothes were stained with blood and the kurta (traditional shirt) showed tear on left lateral lower side (Fig. 1A). The deceased was averagely built. The body was cold, rigor mortis was developed all over the body, post-mortem lividity was faint purple and was not fixed.

An obliquely placed spindle shaped stab wound measuring 8cm was present over the lateral aspect of left iliac region (Fig. 1B). The inner end was lower than upper outer end, with maximum

width and gaping of 1.5cm. Both the ends were blunt, margins were irregular and showed element of abraded contusion, infiltrated with blood, upper margin was undermined. Protrusion of intestinal coils and fat were present through the wound (Fig. 1C). Centre of the wound was 15.5cm left from anterior midline, 10cm above Left anterior superior iliac spine and 22cm below left nipple.



Fig. 1: A - Tear on the kurta worn by the victim, B- Entry wound, C-Exit wound

On dissection; the track of the stab wound was through skin, subcutaneous tissues, and muscles, lacerating spleen, mesentery and pyloric end of stomach, (Fig. 2A to C) right dome of diaphragm, right 8th and 9th intercostal muscles with fracture of right 9th rib, subcutaneous tissues, and skin leading to formation of exit wound of size 4x1cm in between mid-clavicular and anterior-axillary line, protrusion of fat through the wound present (Fig. 1 C). Centre of exit wound was located 10.5cm right from anterior midline, 10cm below right nipple and 19cm above right anterior superior iliac spine. 2000 cc blood with clots was present within peritoneal cavity. Direction of wound track was upwards, forward and from left to right. All the internal organs were pale. Cause of death was ascertained as haemorrhagic shock due to stab injury.

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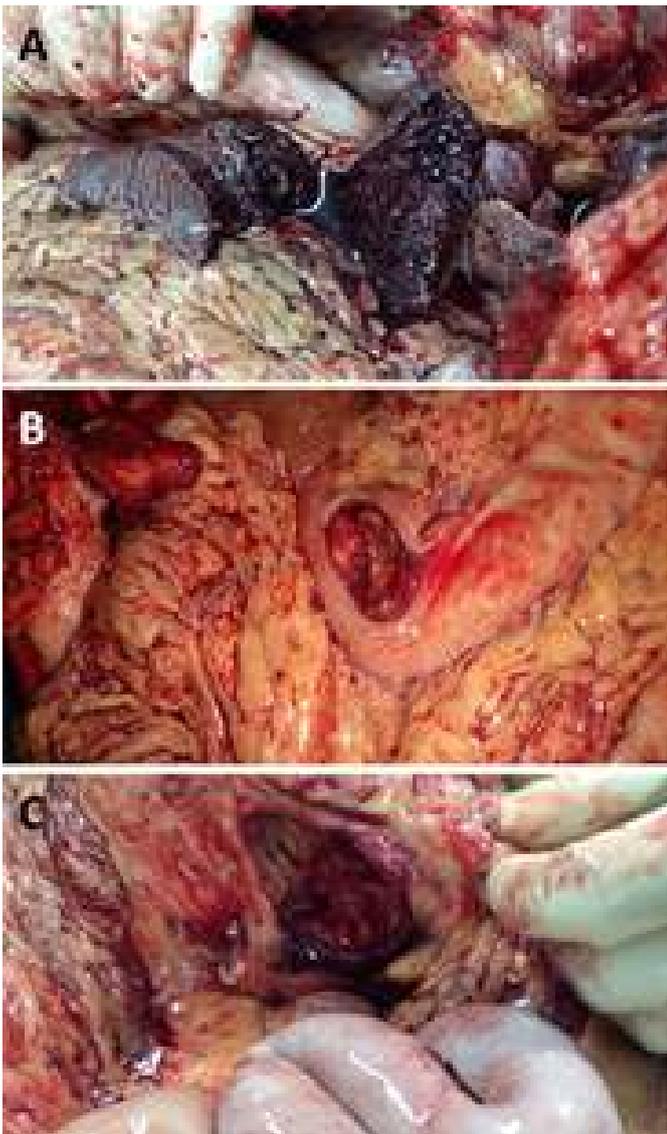
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**Fig. 2:** A- Ruptured spleen, B- Perforation of stomach, C- Mesenteric lacerations

After post-mortem examination we visited the spot where the alleged incidence has occurred. We found dried blood stains at the spot and over right horn of the bull. After careful observation of the concerned bull horn, the stab injury noted over the body was likely to be possible by it. We also examined the statements of the eyewitnesses with the help of accompanying police.

## Discussion

The most common site of injury in bull horn cases is the abdomen and perineal region.<sup>4,5-7</sup> The less common sites are chest and extremities.<sup>8</sup> Domestic animals per se can cause serious injuries by their various appendages, especially horns, and such injury may prove fatal. Bull horn injuries are defined as lesions resulting from collision with bull horns. These are classified in four grades as: Grade I- contusions only, Grade II- lacerations or bony injury, Grade III- visceral and/or serious cavity injury and Grade IV- death.<sup>5</sup>

The mechanism of injury allows understanding the complex wound patterns seen due to interaction of multiple distinct forces and the fact that the horn of the attacking animal usually follows a semicircular path, sideways or upwards.<sup>9,10</sup> The horns of bull are long and generally curved with tapering ends that produces various patterns of stab injuries depending upon the force and relative position of victim and bull. There is an additional force because of the effect of the bull's strong neck muscles when it raises its horn. This force causes upward tears at right angles to the ground. Bull horn wounds are often contaminated with multiple foreign bodies such as cloth fragments, mud, etc.<sup>11</sup>

The patterns of injuries vary depending upon the height of the victim, the height of the bull and relative position of the animal at the time of attack. In the abdomen, the horn first tears the skin, the subcutaneous tissues and later muscles and further if the violence is more, the peritoneum is punctured. The head of bull is at the same level as victim's abdomen, this part of body is most exposed to the attack. Although the surface area of abdomen is same as that of the chest, the abdomen suffers more than any other site. The reason appears to be lack of bony shield over the abdomen permitting the horn hook to engage and penetrate. The frequency of injuries over the abdomen in other studies being 3.7%<sup>7</sup>, 64%<sup>11</sup> and 11.3%<sup>12</sup>. These injuries can be in the form of perforations of abdominal wall, and internally hemorrhages and perforations involving mesentery and bowels. Visceral injuries involving spleen and more frequently liver being situated on right region of body are commonly encountered.<sup>8</sup>

Reconstruction of crime incidence carries immense importance in death investigation. If we try to reconstruct the incidence in this case keeping all above things in mind, then possibly deceased might be in standing position in front of the bull, as bulls right horn is involved in producing an injury bull might have been moving head upwards and towards left side. Hence the wound of entry is present over left lateral aspect of body.

Cases similar to the reported case, especially when unwitnessed, may raise a suspicion of homicide. Based on the preliminary police investigation, eye witnesses' account, autopsy findings, visit to the scene of incident, and circumstantial evidences we arrived at a conclusion that the deceased died due to accidentally sustained stab injury caused by pointed elongated object with rough surface, consistent with the history of bull horn injury.

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## LETTER TO THE EDITOR

### Checklist in medicolegal autopsy

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Dear Editor,

Checklist is defined a list of things to be checked or done.<sup>1</sup> It serves as an aid with an aim to reduce instances of failure by compensating for potential limits of human memory and attention, thus ensuring consistency and completeness in carrying out a scheduled job. First known use of checklist dates back to 18531 in aviation for Boeing Corporation's gleaming Aluminium-alloy Model 299, due to which US Army gained a decisive air advantage in the Second World War which enabled its devastating bombing campaign across Nazi Germany.<sup>2</sup> Even though there is abundant evidence regarding the benefits of checklists, medicine field has still remained hesitant/ slow in broadly adopting them into practice with a general feeling that relying on a checklist insults medical practitioner's intelligence or have a doubt whether a document with check boxes will ever prevent a medical mistake.<sup>3</sup> In midst of all, we forget that perhaps the most widely used checklist is the WHO Surgical Safety Checklist<sup>4</sup> whose positive outcomes are known to all.

Being inspired from WHO Surgical Safety Checklist, to avoid missing out on important tasks, the authors have prepared a checklist for medicolegal autopsy (Fig 1). It started with a crude

list that underwent several modifications, based on experiences, until it reached the present version. The checklist has been copyrighted with the Registrar of Copyrights, Government of India. In India, where most of the medicolegal autopsies are conducted by Medical Officers, who are not trained for the job, such checklist can help complete the desired tasks in a given case. The autopsy checklist, so developed, still can be improvised with regular use depending upon the requirements. One must not forget that any checklist is not prepared as a replacement for common sense. Cultivating a habit of using checklist during autopsy may go a long way in improving the outcomes of such an important medicolegal examination. No matter how good a checklist is prepared, if there is 'no habit' of using it, it is worthless.

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# CHECKLIST for MEDICOLEGAL AUTOPSY [v 1.0]

Authors: Swapnil S Agarwal, Krishnadutt H Chavali, Lavlesh Kumar©

Before starting autopsy	
Y	NA
<b>Perused requisite documents</b>	
<input type="checkbox"/>	Requisition letter
<input type="checkbox"/>	Inquest panchnama
<input type="checkbox"/>	Dead body challan
<input type="checkbox"/>	Hospital records
<input type="checkbox"/>	Earlier autopsy report [in case of re-postmortem examination]
<input type="checkbox"/>	Any specific request by investigating officer
<input type="checkbox"/>	Verified jurisdiction [with availability of requisite authorization from appropriate authority]
<input type="checkbox"/>	Checked for need for Board/ Panel of doctors of concerned specialty
<input type="checkbox"/>	Confirmed identity of the dead body to be examined
<input type="checkbox"/>	Checked availability of requisite forms, instruments and containers
<b>Do not proceed to next column until all above points have been verified</b>	

In the autopsy room	
Y	NA
<input type="checkbox"/>	Noted weight and length of the body
<input type="checkbox"/>	Listed all clothing, belongings, devices etc.
<input type="checkbox"/>	Examined all clothing, belongings, devices etc.
<input type="checkbox"/>	Noted marks/ features of identification [in case of unidentified body/ on specific request]
<input type="checkbox"/>	Completed external examination
<input type="checkbox"/>	Temperature
<input type="checkbox"/>	Hypostatis
<input type="checkbox"/>	Rigor mortis
<input type="checkbox"/>	Decomposition
<input type="checkbox"/>	Marks/ evidence of injuries
<input type="checkbox"/>	Marks/ evidence of disease
<input type="checkbox"/>	Back
<input type="checkbox"/>	All orifices
<input type="checkbox"/>	Completed internal examination
<input type="checkbox"/>	Head and its contents
<input type="checkbox"/>	Chest and its organs
<input type="checkbox"/>	Abdomen and its organs
<input type="checkbox"/>	Limbs [where indicated]
<input type="checkbox"/>	Spine [where indicated]
<input type="checkbox"/>	Weighted each organ
<input type="checkbox"/>	Collected required samples in respective containers [where further investigations deemed necessary]
<input type="checkbox"/>	Containers labeled [including time of collection of samples; highlighting infectious state etc.] and sealed
<input type="checkbox"/>	Taken scaled photographs of important findings [where requested/ indicated]

Before handing over the dead body	
Y	NA
<input type="checkbox"/>	Reviewed postmortem requests and addressed specific requests, if any
<input type="checkbox"/>	Finalized and documented
<input type="checkbox"/>	Cause of death
<input type="checkbox"/>	Time since death
<input type="checkbox"/>	Manner of death [where requested]
<input type="checkbox"/>	Nature of injuries [antemortem/ postmortem]
<input type="checkbox"/>	Age of injuries, at death
<input type="checkbox"/>	Other opinion [s] as requested by investigating officer
<input type="checkbox"/>	Handed over dead body with belongings to investigating officer under acknowledgement
<input type="checkbox"/>	Handed over collected samples and requisite documents to investigating officer under acknowledgement

Y- Yes, NA- Not applicable

\* This sheet is intended to serve as check list for activities before, during and after conducting a medicolegal autopsy so as not to miss out on any required aspect of postmortem examination. It can be freely used with acknowledgement to the authors of this checklist. Copyright of the checklist rests with the above mentioned authors.

## CHECKLIST for MEDICOLEGAL AUTOPSY [v 1.0]

Authors: Swapnil S Agarwal, Krishnadutt H Chavali, Lavlesh Kumar©

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Use of this checklist is not mandated by current Indian law. The purpose of the checklist is to do a medicolegal autopsy that is satisfactory and complete.

The checklist is intended to be completed after the examination to confirm that any important aspect of examination is not left out.

Autopsy surgeon should also consider the educational value of autopsies. This means that he/ she shall:

- Not regard each case as routine.
- Prepare to vary the dissection according to the needs [history, clinical or an initial finding after inspecting the body or after making incision may indicate that a particular examination should be performed; to be considered and acted accordingly].
- Preserve specimens of interest or of uncommon conditions with appropriate preservative for subsequent use at conferences or as mounted specimens for classroom use [within ambit of prevalent laws].
- Encourage visits of students, residents or other physicians, who may be interested, to the autopsy room to ask and discuss the findings.

# CME on “Role of Forensic Medicine in implementation of new curriculum and AETCOM module”

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## 2nd EC Meeting of the Governing Council of IAFM (2019-2022)

held on

June 22nd, 2019

at Government Allopathic Medical College, Banda, UP



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