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From Editor's Desk

Dear All,

I thank you all for showing continuous faith in JIAFM which gives us immense satisfaction to work for the journal, the association and subject at large. The articles are pouring in, and we are visualizing the positive change in the quality of the work submitted to this prestigious journal. Slowly but solidly the citation of our articles are also improving at least in our own journal. With your continuous support, we are trying to resolve the grievances put forth to us during various interactions with IAFM members, in the EC and GBM meetings.

Myself and **Dr. Siddhartha Das** have tried to work for the upliftment and maintenance of the quality publications of the JIAFM. I had solicited great cooperation from **Dr. Mandar Sane; Dr. Narendra Patel; Dr. Richa Nigam; Dr. Vishal Baveja; Dr Vaibhav Agarwal** and **Mr. Chain Singh Lodhi** in bringing our journal to this shape in time.

As promised in our first interaction with the GBM, we are always trying to bring new dimensions to this journal in order to fetch the best place for our journal in the international arena. After having a separate submission and payment portal for JIAFM in its new website, along with open access to each article in JATS (XML) format, slowly but surely our journal is going to reach to maximum viewers. Our efforts to enhance visibility have yielded positive results with a notable increase in the reach and impact of published articles. Hopefully the strategic dissemination of quality content has contributed to improved citation rates, fostering a positive trajectory in our journals' impact factor.

While trying further to keep pace with international demands we are moving ahead to bring our journal into the platform of SAGE publication Pvt Ltd. Sage Publishing is an American independent academic publishing company founded in 1965 in New York City by Sara Miller McCune and now based in the Newbury Park neighbourhood of Thousand Oaks, California. Sage is a global academic publisher of journals, books and library resources with a growing range of technologies to enable discovery, access, and engagement. Sage publishes a rapidly growing list of Open Access journals. All articles will be rigorously peer-reviewed retaining the quality hallmarks of the academic publishing process. With the hope that this proposal which was graciously accepted and promoted by our GBM 2024 at Nagpur conference, would be the turnaround transition step when our journal will stand into the international space of recognition more impactfully and certairly will satisfy our upcoming young researchers and academicians of Forensic Medicine. This transition ensures a more streamlined and efficient review process contributing to the overall enhancement of publishing practices.

For **improving the number of citations from JIAFM and somehow increase the impact factor,** we are regularly requesting the authors to cite the articles of JIAFM in the references of their article for which they are getting an upper hand in publication and many authors are doing it. It is the first time that our **JIAFM bank account is audited twice in april 2023 and December 2023 and we have submitted IT return** well on time, thus enhancing in the transparency.

I give my sincere thanks to all the **authors** who showed enough patience in the queue while waiting for their turn to undergo a lengthy review process before publication. I am very much indebted to our **reviewers** who are continuously helping me in the review process. I thank you all once again for the cooperation given in 2022, 2023 and request all for your continued support in the year 2024.

Best wishes!

Sincerely

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EDITORIAL

Contemporary Forensic Medicine

Prof. Arneet Arora

Autopsies have been classified as either medicolegal or clinical. The two kinds of autopsies have different objectives and processes. Clinical autopsies have an academic, a scientific perspective and are done for the better understanding of a disease or a condition by either the family of the deceased or by the clinician or both. It needs the consent from next-of-kin of the deceased. Clinical autopsies in addition to gross examination of organs, diligently pursue all possible and required investigations to reach a diagnosis expressed as the cause of death in that particular case. Clinical autopsies are thus done in medical colleges and institutes where the required facilities and trained persons are available. Medicolegal autopsies in contrast are a requirement of the State to investigate unnatural deaths and deaths in suspicious circumstances. Consent is not required for conducting medicolegal autopsies. Cause of death, duration of death and manner of death are mentioned in opinion of medicolegal autopsies. Medicolegal autopsies are performed all over the country in large numbers by doctors of varied skill levels and training. The infrastructure and facilities available for conducting autopsies vary from place to place. This introduces non uniformity in quality of medicolegal autopsies all over the country. Some tertiary care institutions and medical colleges provide resources and infrastructure to develop practices of 'quality autopsy'. There exists a variability in standards of autopsy as practiced in the country.

Interestingly it is a very happening time for Forensic Medicine in the country. Virtual autopsy is being developed and practiced at AIIMS Delhi and NEIGRIHMS Shillong. Few centers in the country are vying to develop this modern advanced technique for conducting a non-invasive autopsy. The X-ray examination has now been accepted as an integral part of Forensic Medicine practice. Using a mobile digital X-ray (MDR) machine for pre-autopsy radiological examination has distinct advantages. The MDR machines in Forensic departments have addressed the long pending requirement of examination of injuries, age estimation, finding points for identification and detecting pathologies which may otherwise be missed at autopsy. Forensic Histopathology, Toxicology and Clinical Forensic Medicine are all growing as parts of contemporary Forensic Medicine in India. Biochemical tests which did not seem feasible post-mortem, are now not just possible but provide a very quick and reliable assessment of some of the significant parameters, by using the 'point of care tests (POCT)' which are used clinically.

Amidst this much required and exciting, one area of growth which is low resource demanding, very significant and has wide application is Post Mortem Microbiology. It has the potential to indicate cause of deaths due to infectious diseases, show presence of underlying or neglected infections, indicate duration of death when gut microbiome with genome sequencing methods is used, indicate prevalence of antimicrobial resistance in the community and help become better prepared to detect and handle bioterrorism. The method and skill of collecting samples in accordance with the protocol, holds the key for microbiological analysis. Transferring the sample for microbiological analysis, into culture media has become simple. Reliability of post mortem microbiology as representing status of ante-mortem infection at the time of death has been accepted. The microbiology reporting at level of medical colleges uses matrix-assisted laser desorption ionization time-of-flight mass spectrometry, the MALDI-TOF (MS) equipment which is an internationally accepted standard method. The analysis and interpretation of microbiology report is done in context with the history of the case, autopsy findings and histopathological observations. Combining all these ancillary investigations enriches the autopsy outcome becoming truly close to a 'complete diagnostic autopsy (CDA)'. Collaborating with Microbiology department for analyzing the samples collected at autopsy in much the same way as they analyze ante mortem samples can make the addition of PMM to autopsy work simple and be a less-demanding addition in financial terms. Analysis and interpretation of the Microbiology report with reference to the context of the case is a skill.

The investigations which were done only in clinical autopsies until recently are being done in medicolegal autopsies too, albeit in only a few limited centers in the country at present.

New fellowships and courses in these sub-specialties of Forensic Medicine are emerging. This is a positive trend which involves organizing the content of the sub-specialty as a transferable skill with updated knowledge. Fellowships in Forensic Histopathology and in Post Mortem Microbiology and DM courses in Toxicology, Forensic Radiology and Forensic Pathology are some such new courses.

We can in addition to good dissection skills at medicolegal autopsy, add investigations which are possible and feasible at our centers. This will enable to have lesser number of autopsies where cause of death is undetermined and where cause of death is inferred, to provide more substantiated opinion with objective evidence.

Dr Arneet Arora

I am working as Professor and Head, Forensic Medicine and Toxicology at AIIMS Bhopal. I did my M.D. in Forensic Medicine from Gandhi Medical College Bhopal in1996 and DNB (Forensic Medicine) National Board of Examinations in 2002. Over the years I continue to love and value the skill of conducting autopsies. I am currently interested in Post Mortem Microbiology (PMM). It is inevitable that this sub-specialty will grow. This movement towards complete diagnostic autopsy is my journey, a very promising and exciting journey where I hope that there are soon, lot of us if not all of us.

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ORIGINAL ARTICLE

An Autopsy based Demographic Profile of Homicidal Deaths in Central India, Indore

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Abstract:

Homicide is a serious crime committed against humans and its detection and solution is important to the entire society. The present study was taken up to know the incidence of homicides in the city of Indore and to determine the demographic trends in committing homicides. This was an autopsy based prospective study done on alleged homicide cases in Forensic Medicine Department M.G.M. Medical College, Indore from 26 January 2021 to 25 January 2022 (1 year). Data was collected from 57 male homicide cases. Males outnumbered females with a ratio of 4.38:1. Most of the victims belonged to age group 21 to 30 years, unmarried (50.88%), belonged to nuclear family (68.42%), residing in urban area (68.42%). Mostly sufferers were employed (50.88%) cases and self-employed (28.81%) cases. Maximum of the victims (36.84%) were brought dead followed by spot dead (35.89%).

Keywords: Male Homicide; Demographic trends; Demographic profile; Brought dead.

Introduction:

Homicide accounts for one of the most serious crimes and is as old as the human civilization and reported as early as in the Bible. Homicide in general means killing of one human being as a result of conduct of the other.[1] The word homicide has originated from two Greek words "homos" which means human beings and "cidos" which means destruction.[2] The increasing population, urbanization, poverty, unemployment, frustration, illiteracy, prevalent economic, social and political environment, insurgency terrorism, drug addiction, easy availability of weapon, and the widening gap between the rich and the poor are the causes of homicidal death. In our society, it is also clear that most of the crimes are the result of economic crisis.[3-4]

In India rate of homicides varies from as low as 0.4% to as high as 5.1%.[5] According to the data of National Crime Records Bureau 2020 which presented by Indian ministry of Home Affairs it was reported that murder cases in India have shown marginal increase of 1.0 % over 2019 (28,915 cases) where a total number of 29,193 cases registered in 2020. In Madhya Pradesh total of 2101 cases of murder were reported in 2020 which showed a massive increase from 1795 as were reported in year 2019. It was found that disputes was the most common motive with the highest number of cases (10404) during the year 2020, followed by personal vendetta or enmity (4034 cases) and gain (1876 cases). Also in Madhya Pradesh 'disputes' (819 cases) was found as a leading motive of murder followed by personal vendetta or enmity (425 cases). Love affairs and illicit relationship (298 cases) was found as the third leading motive of homicide in central India region.

In a metropolitan city, Indore (M.P.) total of 69 cases of homicide have been reported in the year 2020, where similar trends were observed where disputes (30 cases) were found as a leading motive of murder followed by personal vendetta or enmity (15 cases) and love affairs and illicit relationship (09 cases) was found as the third leading motive of homicide. According to age, victims mostly belong to the adult age group (2004 cases) where a higher number of victims were adult males aged between 30 to 45 years (545 cases) in the year 2020.[5]

In the future generation, young offenders are becoming increasingly violent and so homicidal deaths are becoming a threat to modern society in the world. Young and adult generation is mostly involved in the homicidal deaths.[6] All the civilized societies in the world try to control such terrifying incidences leading to un-natural deaths.[7] The goal of a peaceful society cannot be materialized without analyzing the data regarding cause, age, sex involved, weapon used and other demographic studies. Therefore, to analyze various epidemiological and demographical factors associated with homicidal deaths and to establish the incidence and patterns of various forms of homicidal deaths is the aim of the present study.

Materials and methods:

This study was carried out over a period of one year starting from 26 January 2021 to 25 January 2022 in the Department of Forensic Medicine and Toxicology, M.G.M. Medical College & M.Y. Hospital, Indore, Madhya Pradesh. Being the tertiary health care centre, cadavers are received from the Indore city and outskirts areas of Hatod, Khudel and also neighbouring districts of Ujjain, Dewas, Khargone, comprising population of 32.76 lakhs in Indore metropolitan.[8] Out of the 2379 medico-legal autopsies conducted during the above mentioned period, a total of

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Table 1. Distribution of study population according to age group (N=57).

Age group	No. of cases	Percentage
0-10	00	00%
11-20	06	10.55%
21-30	29	50.87%
31-40	13	22.80%
41-50	04	7.02%
>50	05	8.76%
Total	57	100%

Table 2. Distribution of study population according to marital status.

Marital Status	No. of cases	Percentage
Married	25	43.87%
Single	29	50.87%
Not known	03	5.26%
Total	57	100%

Table 3. Distribution of study population according to type of family.

Type of family	No. of cases	Percentage
Joint	15	26.32%
Nuclear	39	68.42%
Not known	03	5.26%
Total	57	100%

70 established homicidal cases were taken as study material. Cases with alleged history of accident or suicid at time of autopsy, cases which have been turned out to be natural, suicidal or accidental as per further police/magistrate investigation without autopsy findings indicative of homicidal death and unknown, unclaimed skeletonised body with no autopsy findings indicative of homicidal death were excluded from the study.

The history and sociological aspects of deceased were obtained from the inquest papers, hospital records, other scientific investigation reports available with police, accompanying persons/relatives and police as per the semi structured predesigned proforma by means of a questionnaire. Each homicidal case was examined and evaluated at autopsy, both externally and internally and post-mortem findings were noted carefully. Emphasis was also given on presence of any mechanical injury causing death, pattern of injuries, signs of struggle or defence wounds and evidences supporting homicide.

Results:

Out of all 2379 medico-legal autopsies, where 70 cases (2.94%) of homicides were studied with 57 males and 13 females. Males outnumbered females with a ratio of almost 4.38:1. All the male victims were taken into consideration in the study group. The age group of the victims 21 to 30 years was most commonly involved 29 (50.87%) followed by age group 31-40 years 13 (22.81%) (Table 1). Victims in most of the cases 29 (50.8%) were unmarried and belonged to nuclear family in 39 (68.42%) cases (Table 3 & 4). There was a predominance seen in the males in urban area 39 (68.42%) cases (Table 4). Maximum of the male victims 21 (36.84%) were brought dead followed by spot dead 20 (35.89%) (Table 5). Mostly sufferers were employed 29 (50.88%) cases and self-employed 13 (28.81%) cases (Table 6).

Discussion:

Most often homicides are unplanned hence not adequately witnessed. It becomes difficult to cover all the aspects yet to explore the truth which mostly relies on linking the act of crime. This is a challengeable task for the investigating agencies to explore the mystery. In the case of homicide, autopsy will be incomplete without thorough investigation, sociological analysis and correlating with the scientific interpretation of autopsy findings. It becomes the responsibility of forensic medicine specialist to recognise the medico legal injuries in their right perspective and help the investigating authorities for the aid in justice to reach conclusion.

Out of all medico-legal autopsies, (2.94%) homicidal cases were reported. Males outnumbered females with a ratio of almost 4.38:1. All the male victims were taken into consideration in this study. In our study, age group of the victims 21 to 30 years was most commonly involved 29 (50.87%) followed by age group 31-40 years 13 (22.80%) (Table 1). Similar results were seen in study done by Sumangala,[9] Jainik,[10] Gupta,[11] Aggrawal,[12] Patowry,[13] Batra,[14] Ghangale[15] and Mittal[16] except in the study conducted by Rekhi,[17] Finland[18] where the most common age group was 31 to 40 years. Same results have also been seen in studies done in other countries like Pakistan,[19,20] Malaysia,[21,22] Sri Lanka,[23] Nigeria,[24] Turkey,[25] South Africa,[26] Ireland.[27] This preponderance of adult age group 21-40 yrs. being more commonly victim of homicide may attribute to the fact that this age group bears the trust of responsibilities of various kinds including family, social, economic and status etc. and because of those responsibilities they have to quite often interact with other person and in this process, they are bound to clash with other person upon their interest different from that of others.

In our study most of the 29 (50.88%) cases were unmarried (Table 2) and belonged to nuclear family in 39 (68.42%) cases (Table 3). Similar findings were seen in study done by Rathod[28] where mostly male victim were unmarried. In study done by Mohanty,[29] Sashikanth Z,[30] Vinay,[31] Kumar R,[32] Mada,[33] Vijaykumari[34] and Gambhir[35] mostly homicide victims were married. This could be due to changing trends of late marriages in urban cities.

There was a predominance seen in the males in urban area 39 (68.42%) cases (Table 4). Similar findings have been observed in study done by Sumangala et al.,[9] Karim et al.[36] and Metwally et al.,[37] whereas my findings were inconsistent with the study done by Kumar R[32]

Maximum of the male victims 21 (36.84%) were brought dead followed by spot dead 20 (35.09%) (Table 5). Total 41 (71.93%) victims died on spot and rest while in transit to hospital pointing towards the lethality of the weapon and motive of assailant to take

Table 4. Distribution of study population according to type of residence.

Residence	No. of cases	Percentage
Rural	15	26.31%
Urban	39	68.42%
Not known	03	5.26%
Total	57	100%

Table 5. Distribution of study population according to survival.

Hospitalization	No. of cases	Percentage
Spot dead	20	35.08%
Brought dead	21	36.84%
Hospitalized	16	28.08%
Total	57	100%

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Table 6. Distribution of study population according to occupation.

Occupation	No. of cases	Percentage
Unemployed	2	3.51%
Student	9	15.79%
Self-employed	13	22.80%
Employed	29	50.88%
Not known	4	7.02%
Total	57	100%

away the life of person. Similar results were observed in the study done by Jainik.[10]

Mostly sufferers were employed 29 (50.88%) cases followed by self-employed 13 (28.81%) cases (Table 6). Similar results could not be found in previous research studies. Although study done by Jainik[10] showed labourers (20%) as the most sufferers. It may be said that employed and self-employed persons are more vulnerable to homicides as they are engaged in the monetary exchange, financial disputes or civil disputes with the acquaintances.

Conclusions:

Homicidal trends differ from country to country, region to region and from time to time. The social and cultural values along with demographic variables affect crime. Here in our study we observed that most sufferers were socially active employed and self-employed young males of urban population. We must keep up to date knowledge of prevailing trends of homicide to prevent law makers preventing homicidal cases. So that certain fruitful steps can be taken to decrease the rates of homicide, like uplifting the social life of people, providing better job opportunities, socioeconomic improvement can aid in strengthening the judiciary system and reduction in crime rates. A wide range of further investigation still needs to be done to measure the effects of surroundings, types of weapon used, inherent characteristics of victim & offender, and psychiatric illness can be carried out on the victims to point out some more predisposing factors whichcan be used to prevent homicide to a large extent. Therefore, a continuous assessment on socio-economical, cultural and multidirectional before and after effects needs to be researched to prevent the loss of innocent lives. And thus, social norms help to create a sense of safety and order, which contributes to decreasing crime rates in a country.

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ORIGINAL ARTICLE

Awareness of Undergraduate Medical Students Regarding Child Sexual Abuse in Society - A Cross-Section Study

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Abstract:

Child sexual abuse is a heinous crime of growing age children that may victimize both sexes of the child. Here, we tried to know the concerns, opinions, and understanding related to the child sexual abuse of young undergraduate students of AIIMS Patna. These students belonged to different communities, religions, and different states of India. Information was sent by mode using the google forms and was collected automatically online. linkert-type questions were given to gather the information; collected data was analyzed and reported. 81.6 % of students disagreed that only girls are sexually abused and the rest, 18.4% of respondents were not sure about the given statement. 6.0% of respondents agreed that only girls are victims of sexual abuse. There, 225 (45.0 %) of students opined that child sexual abuse boys are not homosexual, but the rest 226 (45.20) % of students, did not confirm the opinion. 100 (20%) students were neutral in opinion, whereas 49 (9.80%) students opined with disagreement with the statement means indirectly, child sexually abused boys were homosexual. Children from reputed families are not the victim of sexual abuse. 325 (65.0 %) of students disagree with the statement, 40 (8.0) % of students opine that reputed family children are not sexually abused, 27% of students were not in the stage of any opinion or either neutral or they do not know about the statement. 202 (40.4 %) of students opined that sexually abused children should not be sent to foster care, but 29 (5.8 %) of students disagreed with this opinion and suggested that they should be sent to foster care. 168 (53.60 %) participants had no conclusive opinion and 23.4 % had a neutral opinion. Opinion of the participants regarding few children being victims of sexual abuse: 137 (27.4%) agree with that statement, a significant number of participants disagreed with this statement and opined that 223 (44.6%) disagreed with the treatment, indirectly opined that a substantial number of children were the victim of child sexual abuse. The remaining 28 % of participants did not give a final opinion.

Keywords: Child sexual abuse (CSA); Indecent assault, Prostitution; Social taboos.

Introduction:

Child sexual abuse (CSA) is a global problem with grave life-long effects on victims. The World Health Organization (WHO) defines CSA as "the involvement of a child in sexual activity that he or she does not fully comprehend and is unable to give informed consent to, or for which the child is not developmentally prepared, or else that violate the laws or social taboos of society."[1] The term CSA includes activities like sexual harassment, indecent exposure and sexual exploitation, child prostitution, kissing with sexual intent, penetration, and sexual intercourse.[2] Child sexual abuse awareness in the targeted population should be introduced since they start talking and can communicate information to the parents and others. Very young children are unaware of the action happening with kids that come under nasty action or crime. They think abusive action comes with an ordinary course of affection and love with elders. Hence, this study intended to increase the awareness of adult medical students about child sexual abuse, as mentioned information in the material and method.

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Materials and methods:

A questionnaire was prepared and sent to the students via email or whatsapp. This questionnaire information was sent to the students through Google Forms. Pattern of all question was Likert type (Are only girls the victims of sexual abuse?/Abused boys are usually not homosexual/Reputed families childs are not the victims of sexual abuse/children who report being the victims of sexual abuse are not necessarily placed in foster care), Opinion taken in the form of disagree, neutral, agree or do not know, and information collected automatically in the google form. Participants were students at All India Institute of Medical Science Patna. Participants belong to different states of India Ethical clearance taken from the AIIMS Patna Ethical committee. The consent of participants was obtained using an online google form, and collected data was compiled and analyzed.

Question addressed: Awareness of undergraduate students regarding 1. Are only girls the victims of sexual abuse? 2. Abused boys are usually not homosexual 3. Reputed families children are not the victims of sexual abuse 4. Children who report being the victims of sexual abuse are not necessarily placed in foster care.

Observation: We gave Likert-type questions via online mode;

these Likert-type questions help to determine how strongly the respondent agreed with a particular statement.

These questions help to assess how the respondent feels about a particular issue.

Here, we observed that 81.6 % of students disagree that only girls are sexually abused; the rest, 18.4%, are not sure about the given statement. 6.0% of respondents agree that only girls are the victims of sexual abuse.

Opinions regarding sexually abused boys are usually not homosexual. 225 (45.0 %) of students opined that child sexual abuse boys are not homosexual, but the rest, 226 (45.20 %) students did not have a confirmed opinion. 100 (20%) students were neutral in their opinion, whereas 49 (9.80%) students opined that disagreement with the statement means indirectly, sexually abused boys were homosexual.

Children from reputed families are not the victim of sexual abuse, regarding this statement there were 325 (65.0 %) of participants disagreed with the statement, 40 (8.0 %) of students opined that reputed family children are not sexually abused, 27% of students were not in the stage of any opinion or neutral, or they do not know about the statement.

202 (40.4%) of students opined that sexually abused children should not be sent to foster care, but 29 (5.8 %) of students disagreed with this opinion of not sending to foster care, and indirect opinions suggested that they should be in foster care. 168 (53.60%) participants had no conclusive opinion, and 23.4 % had a neutral opinion. Opinion of the participants regarding few children being a victim of sexual abuse, 137 (27.4%) agree with that statement, a significant number of participants disagreed with this statement, and 223 (44.6%) disagreed with the statement. A significant number of children were the victims of child sexual abuse. The remaining 28 % of participants did not give a final opinion.

Table 1: Are Only girls the victims of sexual abuse?

SN	Opinion	No. (%)
1.	Disagree	408 (81.6)
2.	Neutral	46 (9.2)
3.	Agree	30 (6.0)
4.	I do not know	16 (3.2)
	Total	500 (100)

Table 2: Opinions regarding sexually abused boys are usually not homosexual.

SN	Opinion	No. (%)
1.	Disagree	49 (9.80)
2.	Neutral	100 (20.00)
3.	Agree	225 (45.00)
4.	I do not know	126 (25.20)
	Total	500 (100)

Table 3: Opinion regarding children from reputed families are not the victims of sexual abuse.

SN	Opinion	No. (%)
1.	Disagree	325 (65.00)
2.	Neutral	79 (15.80)
3.	Agree	40 (8.00)
4.	I do not know	56 (11.20)
	Total	500 (100)

Table 4: Opinion regarding Children who report being the victims of sexual abuse are not necessarily placed in foster care following these revelations.

SN	Opinion	No. (%)
1.	Disagree	29 (5.8)
2.	Neutral	117 (23.4)
3.	Agree	202 (40.4)
4.	I do not know	151 (30.2)
	Total	500 (100)

Table 5: Opinion regarding only a few children are victims of sexual abuse.

SN	Opinion	No. (%)
1.	Disagree	223 (44.6)
2.	Neutral	89 (17.8)
3.	Agree	137 (27.4)
4.	I do not know	51 (10.2)
	Total	500 (100)

Discussion:

Study done for the assessment of opinion regarding child sexual abuse in undergraduate graduate students at All India Institute of Medical Science, Patna. In the study, participation of the male sex was 312 (62.2%), and 186 (27.1%) were female participants. Reported there 82.0% of all juvenile victims were female, and 90% of adult rape victims were found female.[3] Between 11% and 26% of adolescent girls and young women in Sub-Saharan African countries that completed a Violence Against Children and Youth Survey (VACS) experienced sexual violence in one year.[4]

Females aged range 15-20 years were seen four times more vulnerable to CSA than the general population to be victims of rape, attempted rape, or other manner of sexual assault.[5] Women age range 18-24 years who were college students were three times more likely to experience sexual assault. Females of the same age range who were not admitted to college/school were four times more likely to be vulnerable to abuse or assault.[6] About 3% of American men have experienced an attempted or completed rape in their lifetime. One out of every ten rape victims are male.[7]

According to the report of this study, the male sex is more at risk for sexual abuse/assault. Childhood sexual abuse at 3-8 times the rate of heterosexuals.[8] Lower socioeconomic status families' children are more vulnerable to child sexual abuse.[9] Children in residential care have more risk of child sexual abuse than children growing up in foster families.[10]

Conclusion:

- 81.6 % of students disagree that only girls are sexually abused; the rest, 18.4% of respondents, were not sure about the given statement.
- Opinions about sexually abused boys are usually not homosexual 225 (45.0%), but the rest 226 (45.20%) participants were not in confirmed opinion. Where 49 (9.80%) students opined that disagreement with the statement means indirectly, child sexually abused boys were homosexual.
- Regarding the statement that children from reputed families are not victims of sexual abuse, about 325 (65.0%) of students. 40 (8.0%) of students opine that reputed family children are not sexually abused.

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- 202 (40.4%) of students opined that CSA victims should not be sent to foster care, but 29 (5.8%) disagreed with this opinion of foster care.
- The opinion of the participants about a few children being victims of sexual abuse: 137 (27.4%) agree with that statement, and a substantial number of participants who disagreed with this statement contributed 223 (44.6%) participants.

Conflict of interest: Declare no conflict of interest.

Funding agency: Non-funded project.

Ethical approval was taken from the institute ethical committee.

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ORIGINAL ARTICLE

Stature from Tibia Irrespective of Sex: A Cross-Sectional Study

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Abstract:

Mutilated human remains are recovered many times and may be the only evidence of crime. Establishing the identity of the victim is of primary importance and stature assumes a prominent feature in the identification parameters. In view of this, we have taken up the present study to on Indigenous Manipuri Meitei subjects, both males and females, in the age group of 21-25 years. This is a cross-sectional study comparing the standing height of the participants with the percutaneous tibial length. The degree of correlation has been analysed and a regression formula has been estableshed irrespective of sex, i.e., which can be used on any specimen, whether male or female. A total of 75 males and 75 females were studied in Department of Forensic Medicine and Toxicology, of a tertiary health care centre in north east India. Subjects with any obvious congenital or acquired deformity of spine or extremities was not included in the study. A regression equation is established based on the tibial length of the individual, irrespective of sex has been derived as, Y= 81.90 +.85 X3 + 4.11. The equation so developed is tested by F-test and found to be very highly significant (P=<.001). In other words, the developed equation is treated as best fit to the present data and henceforth it may be used to detect the stature of person too for any given value of his/her tibial length.

Keywords: Stature; Tibia; Correlation; Meitei; Regression equation; Irrespective of sex.

Introduction:

Situations where identification is a challenge, usually arise in cases of natural disasters, rail and aircraft accidents, wars and terrorist bombings. Many times, only parts of human body, such as limbs are available for identification. "Stature is defined as natural height in an upright position".[1] Estimation of stature, therefore, plays an important role in medico-legal cases in the identification of unknown bodies, parts of bodies or even skeletal remains.[2-4] There exists a strong relationship between stature and dimensions of different body parts, particularly bone lengths, which forms the basis for stature estimation.[5] Out of various body parts, long bones play an important role for stature estimation in forensic investigations.[6] The lengths of long bones of lower limb provide better estimate of stature as compared to the bones of upper limb.[7] The tibia is ideal in this application as it resists erosion and keeps its anatomical shape for long even after burial.[8] Tibia accounts for 22% of the total body length. The present work has been carried out on indigenous Meitei subjects of Manipur. The data collected has been analyzed in the Department of Forensic Medicine and Toxicology, Regional Institute of Medical Sciences (RIMS), Imphal where all the subjects have been studied based on the findings of the lengths of tibia to generate a regression formula for estimation of stature.

Aims & Objectives: To establish a regression formula for determination of stature of indigenous Meiteis from tibial height.

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Materials and methods:

This is a cross-sectional study on indigenous Manipuri Meitei between the age group of 21-25 years. The calculated sample size is 72, considering a dropout rate of 5% a total of 75 males and 75 females were studied in Department of Forensic Medicine and Toxicology, of a tertiary health care centre in north east India. Subjects with any obvious congenital or acquired deformity of spine or extremities were not included in the study.

Standing Height (Stature) of the subject was measured in a standing position on a standard stadiometer with both feet in close contact with each other with the trunk straight along the vertical board, and the head adjusted in Frankfurt-horizontal plane (eye-ear plane). The measurement was taken in centimeters by bringing the horizontal sliding bar to the vertex. For measuring the per-cutaneous right tibial height. The study subject was asked to sit with knee placed in the semi flexed position and the foot partly inverted to relax the soft tissues and facilitate bony landmarks prominent. Then two points were marked by skin marking pencil. Upper point- The medial most point on the upper border of medial condyle of the tibia and Lower point- Tip of medial malleolus of the tibia. Distance between two points was measured with the help of Spreading Caliper to determine tibial height. All the measurements were taken by the investigator with the same instrument to avoid any technical and/or inter-observer error and to maintain reproducibility. The measurements were taken three times and their mean value was considered for estimation of height.

Statistical Analysis: Data entry was done using Windows based statistical package for social sciences [SPSS] version 21.0 (Armonk NY: IBM Corp). Statistical analysis was performed

Table 1. Demographic profile of the subjects.

Demographic profile	No. of case	Minimum	Maximum	Mean±SD
Age (yrs)	150	21.0	24.0	22.26±1.01
Tibial length (cm)	150	25.0	43.0	37.09±3.03
Stature (cm)	150	148.0	179.0	164.14±7.88

Table 2. Correlation coefficient between each demographic profile & stature of the subjects .

Between	Stature & Tibial length	Stature & Age
Correlation coefficient (r)	85**; P<0.001	.08; P=.323

***: Correlation is significant at the 0.01 level (2-tailed);*
ρ: Spearman's rank correlation coefficient

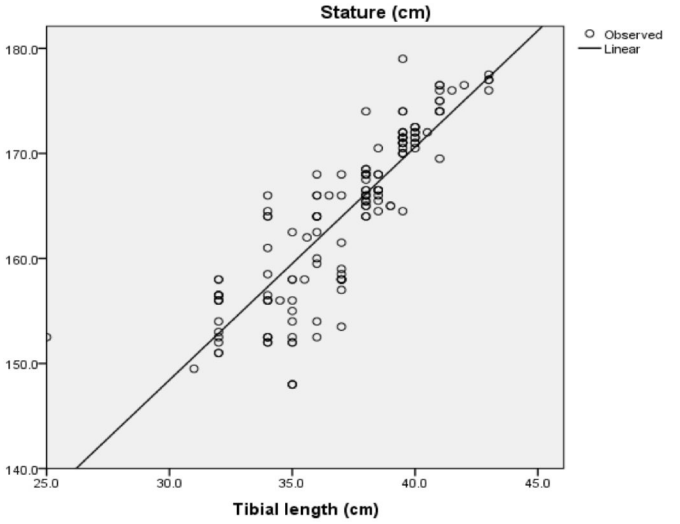

Figure 1. Showing average relationship between stature of an individual and tibial length through fitted regression line.

with the appropriate statistical test including chi- square test for categorical data and student 't' test for numerical data.

Descriptive statistics like mean used for socio demographic variable like age, sex, education etc. A P–value of 0.05 or less was considered significant. The data obtained was compared with the other similar studies.

Ethical issue: Coding was used for collection of cases and no cases in the study were identified from the data. Written informed consents were or consent was obtained from the participants regarding collection of data, and the approval from the Research Ethics Board (REB), Regional Institute of Medical Sciences (RIMS), Imphal was sought. The findings are recorded in proforma and the results are analyzed. The data obtained were kept in the department of Forensic Medicine, RIMS, Imphal. Access to the data will be restricted to the investigator and the guides, and members of REB (Research Ethics Board) when they demand.

Results and observations:

The following sections are discussed under the heading of "Results & Observations" viz.,

I. Patients' profile,

II. Correlation analysis,

III. Simple linear regression analysis.

I. Patients' profile: The present sample consists of 50% each for male and female, and all of them are in the age range of 21-25 years. The demographic parameters considered in the present study are age (yr), tibial length (cm) and stature (cm) of the subjects. Table-1 deals with descriptive information of the demographic profiles whilst table-2: Correlation coefficient between each demographic profile & stature of the subjects.

Table 3. Simple linear regression equation of stature on tibial length (PCTL).

Regression Statistics	Person irrespective of sex
Independent variable (X = PCTL)	X3= PCTL for person
Intercept (β0)	81.90
Regression coefficient (β1)	.85
Correlation coefficient (r)	.85**
Coefficient of determination (R2)	.72
Std. error of estimate (SEE)	4.11
P-value	<.001
Regression equation (Y= β0+ β1 X + ε)	Y= 81.90 +.85 X3 + 4.11
F-value	398.920
P-value	<.001

***: Correlation is significant at the 0.01 level (2-tailed);*

It is observed from the table-1 that, irrespective of sex, average age of the subjects considered in the present study is found to be 22.26 years with a standard deviation of 1.01 years. The youngest and oldest ages of them are 21 years and 24 years respectively. Mean and standard deviation (SD) of tibial length (cm) / per-cutaneous length of tibia (cm) are 37.09 cm and 3.03 cm with minimum and maximum values of 25 cm and 43 cm respectively. The average stature is noticed as 164.14 cm with SD of 7.88 cm. The shortest stature in the sample is found to be 148.0 cm as against the tallest of 179.0 cm.

II. Correlation analysis: As stature, tibial length and age are quantitative data and therefore their correlation is measured by Karl Pearson' coefficient of correlation (r). Table-2 highlights that there is direct/ positive correlation between their tibial length and stature. There is no significant positive correlation between stature and age as evident by insignificant P=0.323 even at 5% probability level. This insignificant correlation might have happened as age is restricted within 21-25years (where all the subjects are closed to growth) in the present study.

III. Simple linear regression analysis: In order to establish average relationship between stature and tibial length, in terms of their original unit of measurement i.e., cm, a simple linear regression equation of stature on tibial length (PCTL) is developed taking stature as dependent variable while tibial length, independent variable. The proposed equation is given by

$$Y= \beta_0+ \beta_1 X + \varepsilon;$$

where Y is dependent variable/ predicted value; X, independent variable; β0, Y-intercept; β1, regression coefficient/ slope of the regression line; ε; Standard error of estimate (SEE)/ residual.

In the table-3, relevant regression statistics are depicted along with developed regression equation based on the present data for a person (irrespective of sex).

A regression equation is established based on the tibial length of the individual, irrespective of sex.

$$Y= 81.90 +.85 X_3 + 4.11$$

The general difference of 81.90 cm. between stature of person

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and his/ her tibial length as depicted by β_0=81.90, and β_1=.85 demonstrates further that there is an increment of 0.85 cm in stature of the person when one cm enhances in their tibial length. And residual "ε" is found to be 4.11cm. Here, R^2 is also found to be 0.72 which is highly significant (P=<.001) and it highlights that the variation of stature of person can be explained by 72% of his/ her tibial length through the developed equation. The equation so developed is tested by F-test and found a very highly significant (P=<.001). In other words, the developed equation is treated as best fit to the present data and henceforth it may be used to detect the stature of person too for any given value of his/her tibial length.

In Fig-1, average relationship between stature of an individual and tibial length is shown through fitted regression line.

Discussion:

In the present study, correlation between percutaneous tibial length and stature is established irrespective of sex by framing regression equation among living indigenous Meitei population in the state of Manipur. Until now no studies have been done so far on this topic.

In the present study, in order to establish average relationship between stature and tibial length, in terms of their original unit of measurement i.e. cm, a simple linear regression equation of stature on percutaneous tibial length (PCTL) is developed taking stature as dependent variable while tibial length as independent variable. Similar study has also been conducted by Ghosh T and Konar S.[9]

In the present study the sample consists of 50% each of indigenous Meitei male and female; and all of them are in the age range of 21-25 years. The demographic parameters considered in the present study are age (yr), tibial length (cm) and stature (cm) of the subjects. Males out numbered females in terms of average height with mean height of 170.09 cm with a standard deviation of 4.37 cm and mean percutaneous tibial length of 39.24 cm with a standard deviation of 1.75 cm which is similar to the study conducted by Sume BW,[10] Moitra S,[11] Sangeetha V and Khan TA[12] & Martula et al.[13] which concluded that height of an individual can be calculated from percutaneous tibial length.

The present study findings are also similar to the findings of Anitha MR et al.,[14] Banerjee M et al.,[15] Sheikhazadi A et al.,[16] Trivedi A et al.[17] & Sah RP & Shrestha I[18] where they also conducted a study on group of population of certain age group on both male and female sex .

In our study, a regression equation is established based on a person's tibial length, irrespective of sex.

$$Y = 81.90 + .85X + 4.11$$

Where X is the tibial length irrespective of sex.

As stature, tibial length, and age are quantitative data and therefore their correlation is measured by Karl Pearson' coefficient of correlation ®. The present study highlights that there is direct/positive correlation between tibial length and stature which is similar to the studies conducted by Mohanty NK et al.,[19] Yayim Y[20] & Steele D.[21]

Since there is a need to derive separate regression equation for estimation of stature using the per-cutaneous tibial height for the specific castes, tribes and regions,[22,23] a regression equation has been derived for estimation of stature from percutaneous tibial length among the indigenous Meitei population of Manipur. The results of the present study validate and support the hypothesis that, there exists a strong relationship between stature and the percutaneous length of tibia. The present study also clearly demonstrates that the derived regression equation can be used for the estimation of stature from percutaneous length of tibia in indigenous Meiteis of Manipur, irrespective of sex.

Conclusion:

Stature is an important tool in identification and in analyzing the health and nutrition, stress, social and economic conditions, climate, changes in body proportions over time and between populations and genetic variations.[13,18,19] Tibia being subcutaneous is accessible for measurement in living subjects. Studies have also reported significant differences in the proportion of limb dimensions due to hereditary, environmental, ethnic and dietary factors which influence the stature of the person. Many authors have also established that the regression equation provide greater reliability in estimating stature. In the present study, correlation between percutaneous tibial length and stature is established by framing regression equation among living indigenous Meitei population in the state of Manipur. In our study, a regression equation is established based on person's tibial length, irrespective of sex, which has not been done before in this region.

Ethical clearance: Taken

Conflict of interest: Nil

Source of funding: Nil

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ORIGINAL ARTICLE

Retrospective Analysis of Pattern of Poisoning Cases Admitted in Tertiary Care Hospital

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Abstract:

Road traffic accidents, poisoning and animal bites are important part of medico legal cases coming to a health care centre. This paper presents the poisoning cases brought to Kamineni hospital L.B Nagar, Hyderabad during the span of 2 years (2020 & 2021). The cases were analysed for various epidemiological parameters. The large numbers of people involved are between 21-30 years. Most cases are of agricultural poisons, followed by drug overdose. Most of the cases are seen in the month of February and May.

Keywords: Poisoning; Drug overdose; Kamineni hospital; Hyderabad.

Introduction:

Poison is a substance (solid, liquid, gas) which if introduced in the living body, or brought into contact with any part thereof, will produce ill health or death, by its constitutional or local effects or both. The definition of poison is vague and unsatisfactory for a substance which is less harmful if consumed in small quantities and can be poisonous if consumed in large quantities. According to WHO health statistics 2020,[1] poisoning mortality rate is highest in India among the south East Asian countries. The causes of poisoning are mainly civilian, accidental and deliberate. The problem is getting worse with time as newer drugs and chemicals are being in vast numbers.

India after agricultural revolution has become a growing economy in agricultural sector. We started using pesticides abundantly and irresponsibly, mainly due to their easy availability. In most of the rural areas there is no proper usage of protective gear and pesticides are kept in the vicinity of reach. In India the second most common method of suicide is by poisoning after hanging according to NCRB report.[2] This is mainly because of easy availability of poisons like pesticides and insecticides in rural areas. Drug overdose in urban areas is mainly due to sale of drugs without proper prescription.

The study aims to analyse the pattern of poisoning cases brought to Kamineni hospital, part of Kamineni academy of Medical sciences and research centre L.B Nagar Hyderabad. It also focuses on different aspects of poisoning along with the demographic pattern, socio economic relation, education and other related parameters.

Materials and methods:

Study design: Record based retrospective study.

Study participants: All patients diagnosed with inhalational, ingestion, drug overdose poisoning admitted in Kamineni hospital from 1st January 2020 to 31st December 2021.

Inclusion criteria: Patients exposed to drug overdose, inhalational and ingestion poisoning.

Exclusion criteria: Patients diagnosed with poisoning, drug overdose who are brought dead. Patients with diagnosed poisoning and drug over dose discharged from casualty.

Sample size: A total number of patients admitted with poisoning and drug over dose from 1st January 2020 to 31st December 2021.

Observation and results:

In the present study it is observed that females are more prone to poisoning and drug overdose, but the margin is low compared to male sex. Around 76 people are males and 51 are females. The age group which is more susceptible for poisoning is younger generation followed by middle age if we consider average life expectancy in India from recent census as 70 years. The people who are in age group 21-30 are highest and the number decreases at extremes of age as being after 60 years and less than 20 years.

More than 50 percent of study population who are affected by poisoning and drug overdose are married. Majority of the cases are suicidal in nature and can be attributed to financial and other socioeconomic reasons. In this study maximum cases which are reported are seen between evening 4pm to 12am i.e. 58 cases, followed by morning 8am to 4pm i.e. 42 cases, least number of cases after mid night 12am to 8am i.e. 27 cases. Among the total 127 cases a vast majority of cases are due to agro chemicals accounting to 57 cases followed by drug overdose i.e. 41 cases, house hold disinfectants' stands at 3rd with 10 cases. Over 97% of the cases are due to ingestion, very small number of cases, i.e. 3 are by inhalation, one by Organophosphorus inhalation, one is by methanol and another by cyanide inhalation.

More number of cases are seen in months of February and least no of cases are seen in August. This doesn't coincide with any harvest season. In our study most of the people who are affected by poisoning and drug overdose are married, this along with the age at which they have done can be attributed mainly to socioeconomic factors. Only a few cases are accounted for

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accidental poisoning i.e 10. In most of the cases, the manner is suicidal in nature i.e 117. Most of the people discharged within 5 days i.e 103 cases, very small number of cases have stayed beyond 10 days. The mortality rate is less than 10 percent (9.7).

Discussion:

In the present study a total of 127 cases have been analysed, most of the cases involved in poisoning are female, young population and married. The study by Amaranth Misra[3] poisoning trends in Nepal shows similar increase in female cases in poisoning, whereas study by V Saxena et al.[4] in Uttarakhand showed males outnumbered females.

Most of the population involved in poisoning are young adults of age group 21-30 years. Similar cases have been observed by

Table.1 Age and sex wise distribution.

S.No.	Age	Sex		Total	Percentage
		Male	Female		
1	up to 10	2	0	2	1.57
2	11-20	6	10	16	12.5
3	21-30	18	37	55	43.3
4	31-40	10	11	21	16.5
5	41-50	9	8	17	13.3
6	51-60	3	6	9	7.0
7	61-70	1	3	4	3.14
8	71-80	2	1	3	2.3

Table.2 Distribution of cases in a year.

S.No.	Month in the year	No of cases
1	January	11
2	February	18
3	March	7
4	April	11
5	May	15
6	June	11
7	July	11
8	August	5
9	September	8
10	October	6
11	November	11
12	December	13

Table 3. Distribution of outcome of cases.

S.no	Outcome	No of cases	Percentage
1	Discharged	103	81.1
2	Lama	12	9.4
3	Dead	12	9.4

Barakha Gupta et al.[5] in study of poisoning cases in Uttar Pradesh. In 92% of the cases studied, the manner is suicidal in nature which is similar to the study conducted by Prakash M Mohiteet al.[6] Accidental poisoning can be seen in lower age group, similar pattern was been seen by Suparna Chatterjee et al.[7] in West Bengal.

The study conducted by Saxena A et al.[8] in trends of poisoning in north west Uttar Pradesh shows most of the cases involved are Organophosphorus poising, similar results are found in our study. Most cases are due to drug overdose, this can be attributed to change in recent trends of ease of access to a lot of medicines at home and in most of the cases of drug over dose Benzodiazepines are the main contributing factors. Similar trend can be seen in

Table 4. Distribution of outcome of cases.

S.No.	No of days in hospital	No of cases	Percentage
1	Less than 1 day	9	7.0
2	1-5 days	102	80.3
3	6-10 days	13	10.2
4	10-15 days	3	2.3

Table 5. Time of arrival at hospital.

Sno	Arrival time to hospital	2020	2021	Total
1	00-01	2	4	6
2	01-02	0	6	6
3	02-03	2	1	3
4	03-04	1	0	1
5	04-05	0	2	2
6	05-06	2	3	5
7	06-07	0	2	2
8	07-08	2	0	2
9	08-09	1	2	3
10	09-10	1	0	1
11	10-11	1	4	5
12	11-12	3	4	7
13	12-13	5	3	8
14	13-14	5	2	7
15	14-15	5	2	7
16	15-16	1	3	4
17	16-17	2	6	8
18	17-18	0	4	4
19	18-19	4	2	6
20	19-20	6	5	11
21	20-21	4	2	6
22	21-22	2	4	6
23	22-23	4	5	9
24	23-00	3	5	8

study conducted by Leena Anthony et al.[9] in pattern of poisoning and drug overdose in tertiary care hospital. The study conducted by Jesslin J et al.[10] in South India shows drug overdose as second most common cause of poisoning, similar results are seen in our study.

In our study most of the cases are seen in night, similar trend can be seen by Deepak Pokhrel et al.[11] retrospective cases of poisoning cases in Kathmandu university as many cases are suicidal, or an attempt for suicide and then many cases are in married, this can be attributed to socio economic factors.

The route of entry is almost always oral, this can also be attributed as most cases are suicidal in nature and only 3 cases are of inhalational poisoning, similar findings can be seen in Barakha Gupta et al.[5] study in western Uttar Pradesh. The study conducted by Subhash Chandra Joshi et al.[12] in Uttarakhand shows survival rate as 85% of all admitted cases, similar outcame can be seen in our study, over 81% is the survival rate.

In our study most cases are seen in Winter season. Similar findings can be seen in study conducted by Sudhir Ninave et al.[13] in Central India. Most of the poisoning cases are due to agrochemicals, which can be attributed to availability of pesticides and insecticides in houses.

Conclusion:

Due to better availability of medical care there is increased number of cases being treated and discharged. Proper education to use agro chemicals, first aid measures and preventive measures, along with strict rules to decrease the sale of over the

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Table 6. Table showing type of poison.

S.No		No of cases	Percentage
	Agro chemicals	57	44.8
1	Rat poison	3	2.3
2	Op poisoning	18	14.1
3	Herbicide	24	18.8
4	Insecticides	4	3.14
5	Mosquito repellent (all out)	5	3.9
6	Fungicide	1	0.7
7	Plant growth promoter	1	0.7
8	Anti tick	1	0.7
	Drugs	41	32.2
9	Benzodizepams	11	8.6
10	Thyroxine	3	2.3
11	Nsaids	4	3.14
12	Unknown drugs	7	5.5
13	Multiple known drugs	9	7.0
14	Antidepressants	4	3.14
15	Anti epileptics	3	2.3
	House hold disinfectants	10	7.18
16	Sanitizer	5	3.9
17	Chlorine	1	0.7
18	Harpic	1	0.7
19	Dettol	1	0.7
20	Phenol	1	0.7
21	Lyzol	1	0.7
	Hydro carbons	6	4.7
22	Turpentine	1	0.7
23	Nail polish	2	1.5
24	Pvc pipe solvent	1	0.7
25	Godrej	1	0.7
26	Methanol	1	0.7
27	Mercury	1	0.7
28	Cyanide	2	1.5
29	Food	3	2.3
30	Corrosives	6	4.7
31	Cuso4	1	0.7

counter drugs. Proper financial education will help in overcoming many socioeconomic factors in young and middle age population. Government has to do much more work on suicide prevention programmes and also encourage Non-Governmental Organisations in creating and spreading awareness.

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Conflict of interest: None to declare.

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ORIGINAL ARTICLE

Effectiveness of a Teaching Module using Simulated Patient, Photographs and Case Scenario in Wound Certificate Preparation by under-graduate Students

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Abstract:

Many mistakes inadvertently made during preparation of wound certificate by doctors could ultimately lead to a miscarriage of justice. As a primary first contact doctor, every Indian Medical Graduate needs to be conversant in the scientific principles of preparation of wound certificate to meet legal requirements. Wound certificates are one of the most compelling medicolegal documents that have for reaching implications in legal trails of homicides, assault and civil injury cases. It is necessary to strengthen the teaching of wound certificate preparation. This study was conducted with an objective to find out the effectiveness of a designated teaching module when compared with conventional method of lecture class. An interventional study done at Department of Forensic Medicine, in a Medical College with whole batch of Phase II MBBS students. A designed teaching module with simulated patient, photographs and case scenario was prepared to teach wound certificate. Students were divided into 6 major groups and each group again sub-classified into two; the study group was taught using teaching module and the control group using conventional teaching learning methods. Performance of students was assessed after the teaching schedule and statistically compared using unpaired 't' test. Students taught using teaching module performed better compared to students in a conventional method of teaching where the difference was found to be statistically significant.

Keywords: Unnatural deaths; Poisoning; Hanging, Head injury; Multiple injuries; Burns.

Introduction:

In a judgment by honorable High court of Kerala, India (B. Surendran v. E.X. Thomas: M.A.C.A No. 568 of 2008, against the Award Dated 12.04.2007 in O.P (MV) No. 985/1996 of II Addl. Motor Accidents Claims Tribunal), it was stated that "the Tribunal dismissed the claim petition of the appellant only on the basis of the statement in Ext.A8 wound certificate".[1] The above judgment of High Court of Kerala, India substantiates the importance of a scientifically precise wound certification for the proper administration of justice in a court of law.

Wound certificate is a medicolegal document giving details of the condition of the patient, solicited for legal purposes. In Indian scenario, examination and documentation of injuries is one of the most important and fundamental medicolegal work done by any primary care doctor.[2] Medical Officer who issues the certificate may be called upon to testify the same before the court.[3] Sometimes sufficient care is not shown for preparation of wound certificate. If wound certificate is not prepared properly, Medical Officers may invite adverse remarks from different quarters for obviously unintentional omissions in recording wound certificate. That would lead to miscarriage of justice.[4] A similar situation has been highlighted in the above judgment. Forensic medicine is being taught mostly through didactic lectures with a few demonstrations. Conventional method of teaching of wound certificate is followed with theory classes. These are insufficient in generating appropriate skills among doctors.[5] This conventional mode of teaching might have lead to the lack of interest and lacunae in writing wound certificate properly. This compelled educational researchers to look forward for more skill based teaching and training programmes for this subject. Teaching modules of knowledge and skills would be helpful to train our students.

The present study has been conducted with an objective to determine the effectiveness of the teaching module, with simulated patient, photographs and case scenarios to teach wound certificate preparation by undergraduates over the conventional method of teaching. Using multiple choice questions (MCQ) examination and an Objective Structured Practical Examination (OSPE) of preparation of wound certificate.

Material and methods:

Study design: Interventional comparative study.

Study setting: Department of Forensic Medicine.

Study Period: 5 months after Institutional Ethics Committee approval.

Study Population: Undergraduate Phase II Medical Students.

Sampling Method: Random allocation into groups.

Sample size: Whole batch of students (125 students) .

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Table 1. Comparison of mean marks obtained for MCQ examination by students of both categories in each group.

Group	Category	n	Mean	sd	t	p
I	Study	11	5.91	0.94	3.406	0.003
	Control	11	4.55	0.93		
II	Study	11	7.27	1.68	2.575	0.18
	Control	11	5.27	1.95		
III	Study	11	8.64	1.36	4.17	<0.001
	Control	11	5.09	1.77		
IV	Study	10	6.4	1.34	1.25	0.238
	Control	10	5.5	1.84		
V	Study	9	6.33	1.00	5.196	<0.001
	Control	9	3.33	1.41		
VI	Study	9	6.1	1.27	4.782	<0.001
	Control	8	3.0	1.41		

Inclusion Criteria: All Phase II medical students of 2018 admission batch were included in the study

Exclusion Criteria: Those students who refuse to give consent

Intervention: Teaching module for wound certificate preparation; including simulated patient, photographs and discussion based on case scenarios.

Study tools: Teaching module, Feedback questionnaire, Intake Proforma.

Data Collection: Study was started only after getting Institutional Ethics Committee approval. In discussion with Head of the Department, other faculties in the department, designed teaching module with case scenario, photographs and a single simulated patient was prepared. Its content and construct assessed by peer review process. Whole batch of Phase II Medical students formed study population. Whole batch consisted of 125 students. The study procedure was explained to them. Informed written consent was obtained from them. None of the students refused to give consent. Students were divided into six major groups according to the roll numbers in the attendance register. Major group consisted of 22 number of students in first three groups and 20 numbers in the next two and 19 in the last group. Among the 125 students 4 could not attend the class due to personal reasons. Each of the six groups were again be sub divided into two groups of equal number of students randomly by envelop method. One group was study group and the other was control group. The control group was taught in the conventional way of mini lecture class for preparation of wound certificate for 30 minutes. The routine class for wound certificate preparation is for 30 minutes in small groups. The study group was taught with the designed teaching module. After the class outcome of intervention was assessed by an objective type question paper consisting of 10 Multiple Choice Questions (MCQ) and an Objective Structured Practical Examination (OSPE) of preparation of wound certificate. Question paper and OSPE code sheet were prepared by the investigator and were validated by faculty and head of the department of Forensic Medicine. Mean marks obtained for each of the tests was calculated and compared. In order to avoid bias of the efficiency of teaching faculty with regard to students' performance different faculties have taken the classes using designed module and the conventional class. A feedback perception questionnaire was prepared to assess the satisfaction of the students. This questionnaire was also peer reviewed.

Table 2. Comparison of Mean marks obtained for OSPE by students of both categories in each group.

Group	Category	n	Mean	sd	t	p
I	Study	11	6.59	0.63	6.032	<0.001
	Control	11	4.18	1.17		
II	Study	11	6.68	0.98	7.4	<0.001
	Control	11	3.95	0.72		
III	Study	11	6.41	1.02	3.23	0.004
	Control	11	5.09	0.89		
IV	Study	10	6.95	0.44	3.992	<0.001
	Control	10	5.70	0.89		
V	Study	9	7.28	0.83	3.782	0.002
	Control	9	5.00	1.6		
VI	Study	9	6.44	1.04	2.941	<0.001
	Control	8	4.8	1.15		

Feedback from students in study group was assessed based on their response to the perception questionnaire.

After the data collection students in the control groups were given class with the prepared module to avoid ethical issues.

Statistical Analysis: Data collected were entered in the prepared intake proforma. Analysis was done using Software Statistical Package for Social Sciences (SPSS) version 25.0. Normality of the data was analyzed by Shapiro Wilks test. The data showed normal distribution; so parametric tests were applied. Continuous variables were expressed as mean, standard deviation (sd), minimum, maximum, median and inter quartile range (IQR). Categorical variables were expressed as proportion. Comparison of quantitative variables were analyzed by unpaired t test. Mean score of marks were compared and significance is assessed using unpaired 't' test. The 'p' value less than 0.05 was considered as statistically significant. Mean score was calculated for each group and for whole batch separately. Also mean score for MCQ tests and OSPE were calculated separately. More than 25% of difference of mean score was considered as significant and effective difference.

Results:

Among the 125 students of 2018 batch, 121 attended the study. They were in six groups. The group wise score of marks obtained in MCQ examination and OSPE are given in table 1 and 2. The difference in marks obtained for MCQ examination in group II and IV are not statistically significant; $p > 0.05$. Considering all groups together the mean mark difference is statistically significant. The marks obtained for MCQ and OSPE are high in the study group and the difference was statistically significant ($p<0.001$). Most of the students agree that the teaching module is effective.

Discussion:

The wound Certificate is an important medicolegal document which may help to prove or disprove a case in a court of law. It is the legal duty of a doctor to issue an injury report in the correct proforma with scientifically valid terminologies and proper description of injury. Accident cum wound certificate register is a confidential document and should be in the safe custody of the medical officer. All injuries, however insignificant they may appear, should be recorded. Proper, adequate, and complete documentation is very necessary. In the eyes of law, only those

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Table 3. Comparison of mean marks obtained for MCQ examination by students in both categories

Category	n	Mean	sd	Minimum	Maximum	IQR*
Study	61	6.8	1.57	4	10	6-8
Control	60	4.7	1.85	0	9	4-6
t : 6.822			p: <0.001			

*Inter Quartile Range

Table 4. Comparison of mean marks obtained for OSPE by students in both categories.

Category	n	Mean	sd	Minimum	Maximum	IQR*
Study	61	6.7	0.87	4.5	9	6-7.3
Control	60	4.8	1.20	1.5	7	4-5.9
t: 10.154			p: <0.001			

*Inter Quartile Range

injuries that have been duly recorded in the medicolegal certificate would be legitimately deemed to have been present on an individual's body and considered in the judicial process, whatever not been recorded by the doctor would be considered non-existent. Even old injuries should be recorded. A proper examination and documentation may reveal the nature of the wounding object, the direction of force, the approximate age, character and manner of the wound.[6]

A study was conducted by Karmarkar in a tertiary care hospital with regard to documentation of injuries by resident doctors and other medical staff revealed that there are still some lacunae in documenting injuries. Based on the study it was suggested that teaching of proper wound certificate preparation should be further strengthened at the undergraduate level.[7] At present conventional method of teaching of wound certificate is followed with theory classes. This conventional mode of teaching might have lead to the lack of interest and lacunae in writing wound certificate properly.

In a study which assessed the effectiveness of modular approach in teaching at university level it has been concluded that modular teaching is more effective in teaching learning process as compared to ordinary teaching methods. The goal of using modules would be to empower medical instructors in transforming teaching – learning ecosystem. It is recommended that the modular approach should be widely used at various levels of education into active, student-centered learning environments.[8]

A teaching module has clear objective, uniform educational contents, clear ways of assessment and evaluation. These modules focus on active learning and are student centric so that they gain maximum understanding and knowledge of the subject.[9] Modular teaching has been applied in various subjects with great success.[10] Modular teaching is found to be more effective in teaching learning process as compared to ordinary teaching methods. Various studies showed the effectiveness of various teaching modules at university level.[8] Studies also showed its effectiveness in various other departments in medical curriculum. Chavda P et al. in his study found that modular teaching fares better than didactic method and hence recommended to be used more frequently in community medicine clinical posting.[11]

The concept of modular teaching in Forensic Medicine is rare. Based on the concept of modular teaching, very few studies were

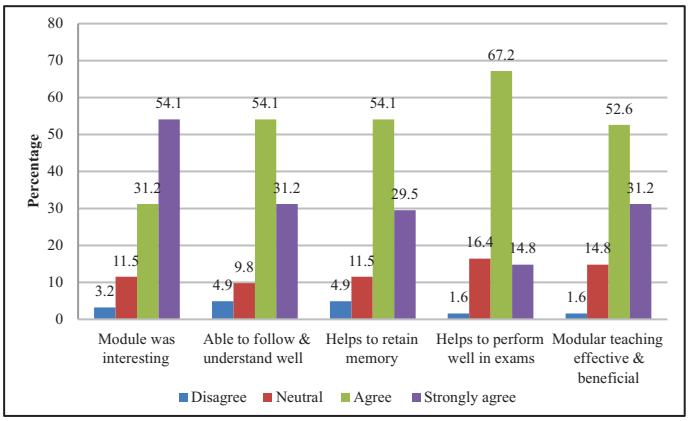

Figure 1. Perception of students in the study group regarding the teaching with teaching module (n=61).

done in Forensic Medicine, especially in India. According to Karthikeyan modular teaching provides knowledge with ample stress on basics through a wide variety of learning activities.[12] Murthy OP has conducted a study on modular teaching for Medico-legal work and modular teaching in Forensic Medicine and Toxicology.[9] One such study conducted by Kumaran S, using additional teaching module for issuing wound certificate by 2nd year MBBS students was found to be effective. He assessed the effectiveness of an additional modular teaching over conventional method.[13] But comparison of such new modality with conventional method were not performed. In the present study a new teaching module which included active teaching modalities simulated patient, photographs and case scenarios was prepared for better understanding of wound certificate preparation. Here we have compared the modular teaching with conventional lecture method in teaching wound certificate preparation. Both these showed positive results with modular teaching. Other studies also showed that the additional teaching module along with the existing conventional teaching is more efficacious as compared to either conventional teaching or modular teaching.[14] In the present study, students in the group of modular teaching could score better marks and the difference was found to be statistically significant. In two groups even though there is difference in marks obtained for MCQ examination; but that difference does not show any statistical significance ($p>0.05$). It could be due to smaller sample size in individual groups.

Regarding the student feedback about the teaching module, 30 to 67% of students think that this teaching module helps them to understand the topic properly, to retain the memory and to perform well in exam. Majority (84%) of students attended the class with teaching module believe that the teaching module is beneficial to them. Faculties also shared that the module is good and easy for teachers to handle classes and easy for the students to remember things well.

Conclusion:

Teaching module used for teaching wound certificate preparation produced better performance of undergraduate students in the examinations. Students also felt that teaching using the module is effective and help them to perform well in exams. Similar

reports modules are more helpful for self study at the learner's pace and during their free time. Modules can be prepared for teaching topics of self study in Forensic Medicine. The modular teaching helps to retain the memory for longer periods and will help them to perform well as an Indian Medical Graduate.

Limitations of the study: Only recent memory was assessed in this study because of shorter duration of study period. Long term retention of knowledge was not assessed. Retention of memory could have been assessed by a second OSPE and MCQ examination a few months later. Further a study has to be done in an elaborated way including many modules and multiple examinations to be conducted.

Implications of the study: Based on the results in this study we are planning to change the method of teaching in our department. There is obvious difference in the marks scored by two groups of students. So, teaching module is a better method to teach some areas of our subject. Modules can be prepared for teaching topics of self study in Forensic Medicine. So that students can study those topics during their free time.

Ethical issues: None.

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Conflict of Interest: None to declare.

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ORIGINAL ARTICLE

Prevalence of HIV Cases Among the Tuberculosis Deaths at Autopsy

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Abstract:

Mortuary/Autopsy room is a relatively high risk workplace. Infections such as Tuberculosis (TB) and HIV pose a risk to the autopsy workers. These infections pose a greater risk since many times they are not even diagnosed until the autopsy is done in the mortuary itself. In this study, we intend to analyse the prevalence of HIV in TB infected bodies and also the risks in a mortuary and find ways to tackle the hazards of contracting infections in a mortuary. This is a retrospective case-based study where we consider 63 autopsy cases with TB during 2010-2015 conducted at District Wenlock Hospital, Mangalore, India and analysed them. A statistical software SPSS was used for data analysis. The study has established that there is a clear correlation between positive HIV and positive TB cases at the autopsy. Most of these cases were found to be during the rainy season and co-related to the occupation of manual labourers. Since these infections pose a hazard to autopsy workers, there is a requirement to strengthen their safety.

Keywords: Tuberculosis; Autopsy; Safety; HIV; Infection; Occupational hazards; Sustainable development goals; Autopsy workers; Mortuary.

Introduction:

Mortuary/Autopsy room is a relatively high-risk workplace. The mortuary staff performs autopsy on various cases with a very wide spectrum of causes of death which also includes several serious and easily transmittable infectious diseases. This is inevitable since infectious disease are widely prevalent and attributed to most deaths in the developing countries. Consequentially, mortuary workers suffer several occupational hazards, some as serious as contraction of HIV or TB infections.

These infections pose a greater risk since many times they are not even diagnosed until the autopsy is done in the mortuary itself. On several occasions, unidentified cases are sent for autopsy with no prior history or background regarding the patient. Without history, determining the presence of infection or cause of death is difficult and yet autopsy procedure has to be performed on these cases. Situations like these can prove hazardous for the staff in case the body has infectious disease which can be transmitted to them during the autopsy procedure.

Infectious diseases such as HIV finds itself in the major mortality causing diseases list today and in fact in 2016,[1] 1 million people died because of this disease.[2] Opportunistic infections account for most of the deaths in patients with AIDS. Tuberculosis (TB) is the leading cause in one of these opportunistic infections.[3] Post-mortem examinations provide important information and is more reliable in ascertaining the cause of death in medicolegal cases infected with HIV. The possibility of transmission of HIV to autopsy workers, therefore, is always of concern if proper precautions are not taken. The safety of the autopsy workers should be paramount and hence contraction of these diseases should not be taken lightly and all efforts must be put to minimize the transmission of such infections in a mortuary workplace.

Our study is a retrospective study which identifies prevalence of such undetected HIV cases in post-mortem studies of TB infected bodies and various factors which can be correlated to them. This study will provide a direction regarding various precautions to be taken by autopsy workers. The study assesses the safety of the mortuary staff and the risks that are posed to them in a mortuary. The study also discusses several suggestions which can be used to reduce the transmission of such infectious in a mortuary such as use of proper gear at the workplace, right procedures and proper infrastructure for the same.

Materials and Methodology:

An autopsy based retrospective study was undertaken using post mortem reports. Post mortem reports of deaths due to TB related deaths referred to Wenlock District Government Hospital, Mangalore, India for medicolegal autopsy between January 1, 2010 to December 31, 2015, were considered. Of the total 5229 autopsy cases, 63 cases of TB related deaths were reported. The parameters considered in our study includes patients age, sex,

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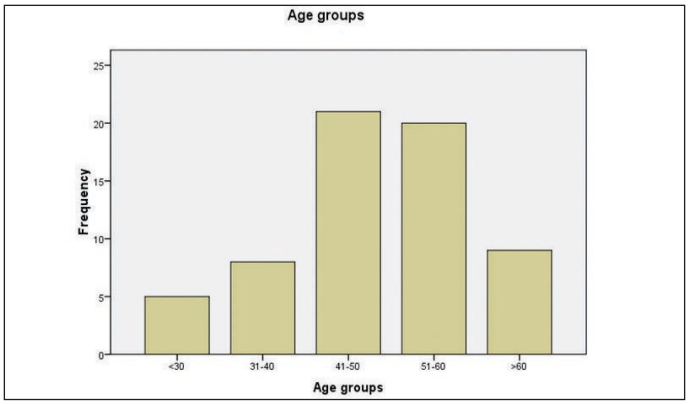

Figure 1. Age distribution among the TB cases.

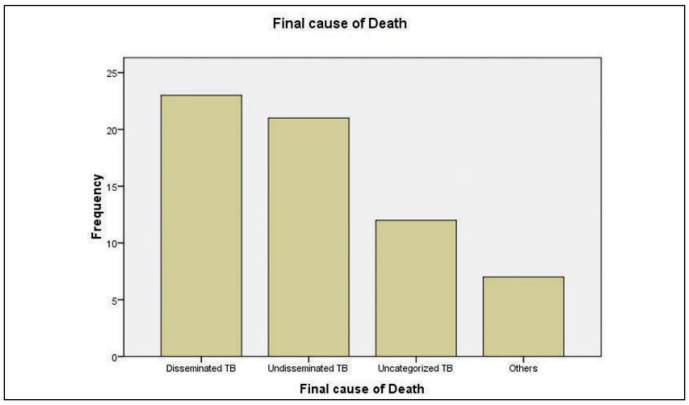

Figure 2. Distribution of cause of death among the victims.

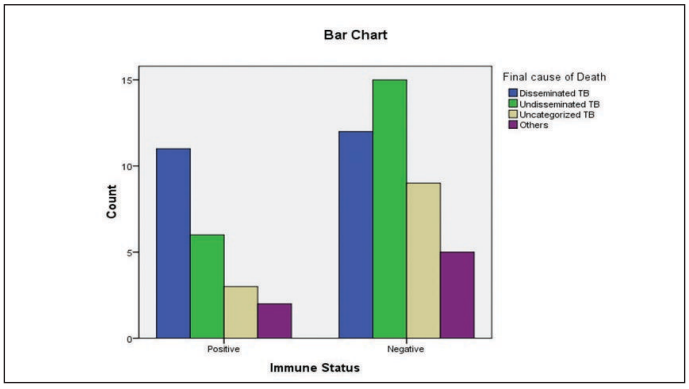

Figure 3. Immune status of the victims with their final cause of death.

HIV status, TB status, occupation, season/month of death, co-infections if any, if the body was unidentified or identified at the time of the autopsy, cause of death and if the same was confirmed or not at the end of the autopsy. HIV infections were identified by clinical correlation and as per therapeutic assessment. After obtaining the clearance from Institutional Ethics committee (IEC KMC MLR 02-2020/84) and Department of Forensic Science, KMC Mangalore, India, (Autopsy) Medico legal reports were studied to collect the data. This information retrieved from autopsy reports were extracted and maintained confidential. The data were entered in Excel sheet and our results were extracted using descriptive statistics. A statistical software "SPSS version 25.0" was used for analysis, obtain tables and draw relevant figures.

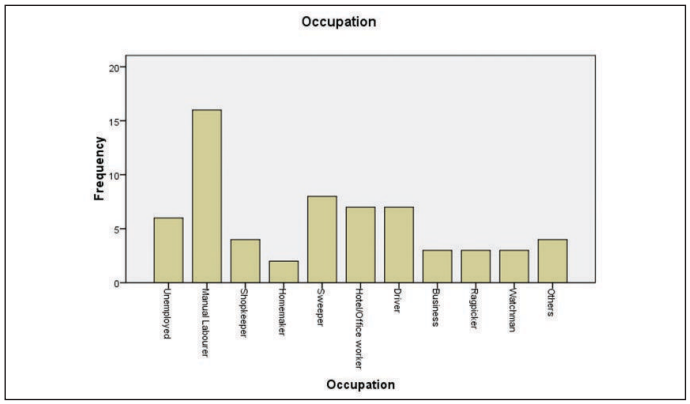

Figure 4. Distribution of occupation among the cases.

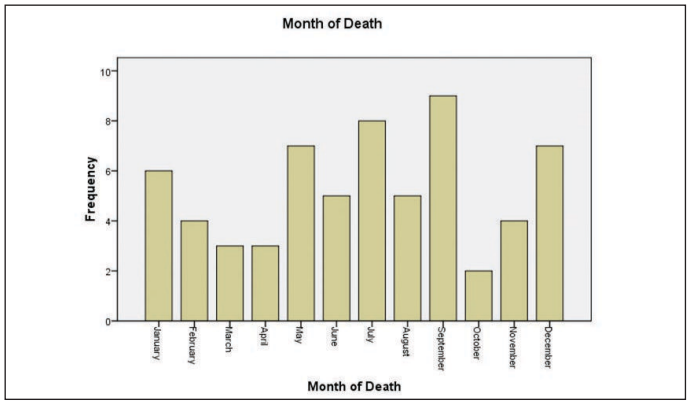

Figure 5. Distribution of the month of death of the cases.

Results:

The total of 5229 autopsies were conducted over six years among which 522 were sudden death cases accounts to 9.98 %. Respiratory causes of these deaths accounted for 365 cases. Further 63 cases (17.2%) out of the respiratory causes of death were TB related. 59 patients were men while 4 cases comprised of women. The mean age of the among our cases was found to be 49.1. The majority of cases (39) were within the age group 41-60 (Figure 1). A similar trend of age distribution was found among the HIV positive cases as well with the age group of 41–60-year-olds accounting for majority of these cases. Among the 63 patients we considered, the mortality in 56 cases was due to TB. TB with HIV positive cases were 22. In 20 of these 22 cases, TB was attributed to the deaths in patients.

The study showed that among the final cause of death of the cases, disseminated TB was encountered in 23 cases while in 21 cases TB was not disseminated. In 12 cases the categorization of TB could not be made due to lack of specified information in the database considered (Figure 2).

The results showed a similar trend in HIV positive cases. Out of the 22 cases, disseminated TB was encountered in 11 of the cases and pulmonary TB, which was not disseminated in 6 cases. In 3 of these 22 cases, the categorization of TB could not be made due to lack of specified information in the database considered (Figure 3).

The results also studied the types of occupations and their

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distribution among the HIV positive cases. 9 out of 22 HIV positive patients were manual laborers by profession. Manual labourers mostly being daily wage workers such as construction workers, factory workers, coolies etc. This was followed by sweepers accounting for 5 of the 22 HIV positive cases. Sweepers include janitors and all kinds of cleaning staff. The rest of the occupation types among HIV positive cases followed a fair uniform distribution with each occupation accounting for 0-2 cases. A similar trend was observed in the entire sample size of our study with manual laborers accounting for most of the cases followed by sweepers (Figure 4).

Out of the total 63 cases, 30 patients were identified at the time of autopsy while 33 were unidentified. However, in HIV positive cases a significant trend was observed.14 of the 22 HIV positive cases were unidentified when brought for autopsy.

Out of the total 63 TB positive cases, 8 patients were also found to be infected with pneumonia which was the only other co-infection that arose in this study.

Most of the TB cases occurred in the rainy season of the city of Mangalore, India (May to September). A total of 34 causalities happened in this season (Figure 5).

Discussion:

In our study, we targeted a single opportunistic infection, i.e. TB and its correlation with HIV positive and non-immuno-compromised patients and modelled our safety procedures in correspondence to the results derived from the data. We considered 63 cases of TB related mortality and in 56 of them, after the final autopsy procedure tuberculosis was assigned as the final and main cause of the demise. TB is a well-known and commonly encountered opportunistic infection in HIV positive patients. In our study, among the HIV positive cases, TB remains the leading cause of death which is in cohort with other similar studies done worldwide.[4]

Among the 'TB related death' cases in the present study, pulmonary TB and disseminated TB were almost equally prevalent. However, disseminated TB was observed to be more frequent among the HIV positive cases, resulting in 10 out of 22 fatalities in this category. This is in conformity with other studies conducted elsewhere.[5] This is evident from the fact that HIV positive patients will suffer from higher grades of TB due to low immunity levels and dissemination of TB is more obvious and logical in these patients.

As we analysed our data, it was found that manual labourers and sweepers accounted for more than one third of the total cases where TB was prime cause of the demise. However, correlation of any sort between occupation and cause of death being TB is hard to make as manual labourers and sweepers were the most common occupations of the cases considered in our study. More than half of these TB related fatalities occurred in the rainy season (May - September) of the city of Mangalore which are also the coldest months of the year here. Studies have shown that Tuberculosis infection is more likely in people with low levels of Vit D, and associated with reduced exposure to the sunlight, cooler weather, staying in at home and having other seasonal infections.[6,7] Although not statistically documented in our study, all these factors are the most prevalent in the rainy season of the city and hence the co-relation.

The present study showed that a high percentage of patients that were HIV positive were also unidentified at the time of the autopsy, which makes sense as unidentified cases normally come from the economically weaker strata of the society and are more likely to have infectious diseases prevalent among them. It is also very common for these infections to be undiagnosed and under diagnosed in the poorer sections of our society. In our findings, most of the TB cases have been documented amongst the 41–60-year-olds. This can be attributed to the fact that this is the most active and mobile working-class group of people. This makes them susceptible to these infections. This finding is in the direct correlation with other studies done.[8]

Suggestions: Active infections have implications on health professionals working inside the workplace like mortuaries. The mortuary room architecture and ventilation also play a major role in prevention of infectious diseases and safety of workers. Recommendation to use protective gadgets and standardized instrument usage care as per effective public health guidelines. Preventive strategies comprise of estimation of contracting the infection, timely diagnosis with gross and microscopic findings, lab investigations, using of techniques and technology to reduce generation of air droplets and protect against the infection during post-mortem examination.

Anyone that may come in the immediate vicinity of a mortuary or products originating from there should be encouraged seek tuberculosis vaccine. Proper protective gear (i.e., a headcap, eye glasses, face mask, surgical shirt and trousers, water-resistant shoes, a full body gown, a water-resistant apron and at least one pair of gloves) should be always worn at all times when performing an autopsy. The instruments should be used carefully and scrupulously to reduce the chances of any cuts or needle stick injuries during autopsy.

Necessary measures should be taken to nullify aerosol formation during an autopsy as TB is an airborne infection. Proper air circulation systems should be installed in the mortuary area. Aerosol formation can be minimized by minimizing the use of saw and opening of the intestines submerged in water. While washing or handling organs, special attention should be given to prevent aerosol formation. Use of equipment utilised in the process of post-mortem should be minimised and provided a dedicated station so as to keep them in clear view. Instruments (especially sharps) should be carefully handled by the staff. It should also be ensured that safe sharp practices be always followed. In cases where the patient has been diagnosed of HIV, chances that the patient has TB should be considered as a strong probability rather than a possibility. Effective training of staff and periodic screenings are a must to ensure necessary standards. Awareness of associated hazards are also important for reducing the risk of exposure among these health professionals specially at their workplace.

Consent for publication- Institutional ethical clearance (IEC KMC MLR 02-2020/84) was taken.

Conflict of Interest: None.

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ORIGINAL ARTICLE

Autopsy Based Prospective Study About Pattern of Head Injuries in Deceased of Road Traffic Accidents at Central India (Indore) Region

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Abstract:

Head injury is one of the most dreaded injuries which has more than one modalities and a spectrum of consequences, death being the most dreaded closely followed by disability. Head injuries may be accidental, homicidal or suicidal in nature. Among the aforementioned manners of death, accidental deaths have constituted as the most common manner of death. Road traffic injuries are the leading cause of death globally and the principal case of death in the age group of 15-49 years.[1] Two-wheelers were the most commonly involved vehicles in Road traffic accidents. Majority of the two wheeler users were not using helmets. Scalp injuries in the form of contusions were the most common. Linear type of fracture was the most common among the victims of RTA. Subdural haemorrhage along with subarachnoid haemorrhage was the most common type of intracranial haemorrhage observed among the victims.

Keywords: Road traffic accidents; Two-wheelers; Hospitalisation; Fracture.

Introduction:

Head injury is one of the most dreaded injuries which has more than one modalities and a spectrum of consequences, death being the most dreaded closely followed by disability. Head injuries may be Accidental, Homicidal or suicidal in nature. Among the aforementioned manners of death, Accidental deaths have constituted as the most common manner of death.

Vehicular accidents can be defined as 'An event that occurs on a way or street open to public traffic; resulting in one or more persons being injured or killed, where at least one moving vehicle is involved. They involve high human suffering and socioeconomic costs in terms of premature deaths, injuries, loss of productivity, and so on.[2]

Owing to the constantly improving yet still poor state of the infrastructure, casual attitude towards road safety and the challenges faced in implementing road traffic rules have ensured that the number of road traffic accidents and the number of fatalities caused as a result of these road traffic accidents have been rising year after year. The rise in population along with the rise in vehicles of all shapes and sizes on the roads have further contributed to the road traffic accidents. The pattern of injuries inflicted to the head is very diverse.

The head being the most vulnerable part of the body, is involved frequently in road traffic accidents (RTA). Head injury is the single most important cause of mortality in road traffic accidents. It has been defined as, “a morbid state, resulting from gross or subtle structural changes in the scalp, skull and/or the contents of the skull produced by mechanical forces”.[3]

A total of 3, 66,138 road accidents have been reported by States and Union Territories (UTs) during the calendar year 2020, which claimed 1,31,714 lives and caused 3, 48,279 injuries.[4] While in comparison to 2019 there is a remarkable fall in the number of road accident cases that happened in 2020, but this fall can be majorly attributed to the nationwide lockdown that was imposed in India which restricted the movement of people exempting only the emergency services.

In short, head injury is a major health and socioeconomic problem that affects all populations, regardless of age, sex, income, or geographic region.[5]

A total of 4,37,396 road accident cases were reported during 2019. Road accident cases in the country have decreased from 4,45,514 in 2018 to 4,37,396 in 2019. The fatalities in road accidents have increased by 1.3% (from 1,52,780 in 2018 to 1,54,732 in 2019).[4]

The main intention behind conducting this study is to analyse and understand the pattern of head injuries in vehicular accidents and to establish their co-relation with factors such as type of vehicle used, usage of helmet and the anatomical sites of the head involved.

Materials and Methodology:

The study was carried out in the mortuary of Department of Forensic Medicine and Toxicology, M.G.M Medical college, Indore after getting approval from the institutional Ethics Committee. Data for one year starting from February 2021 was compiled and presented here. A structured proforma was designed to enter the data. The collected data was analysed and the statistical method used are descriptive statistics which comprise percentages, ratios and proportions.

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Table 1. Distribution of head injuries due to RTA Based on type of vehicle involved (N-125).

Total no. of Road Traffic Accidents (%)	Two-wheeler (%)	Three wheeler (%)	Four Wheeler (%)	Pedestrian (%)
125 (100)	98 (78.4)	2 (1.6)	0 (0)	25 (20)

Table 2. Distribution of head injuries based on rider or pillion wearing helmet in case of two wheeler (n-98).

Wearing Helmet (%)	Not wearing helmet (%)
16 (16.33)	82 (83.67)

Table 3. Distribution of head injuries based due to rta on the basis of distribution of type of scalp injuries in the victim (n-125).

Type of scalp injury	Number of cases	Percentage
Abrasion	5	4
Contusion	103	82.4
Laceration	6	4.8
Contused abrasion	3	2.4
Contused laceration	7	5.6
Absent	1	0.8
Total	125	100

Table 4. Distribution of head injuries due to rta based on distribution of region of scalp injuries in the victim (n-150).

Region of scalp injury	Number of cases	Percentage
Frontal	21	16.8
Parietal	4	3.2
Temporal	10	8
Occipital	3	2.4
Multiple	86	68.8
Absent	1	0.8
Total	125	100

Observation and Results:

A total of 125 cases of fatal RTAs brought to the mortuary were carefully observed. The type of vehicle most commonly involved was two-wheeler 98 (78.4%) (Table-1). Usage of helmet among two-wheeler users was seen in only 16 (16.33%) cases (Table-2). The most commonly observed scalp injury was contusion seen in 103 (82.4%) (Table-3). The most commonly involved area of scalp individually was Frontal 21 (16.8%) and multiple areas of the scalp were involved in 86 (68.8%) (Table-4). Most common type of skull fracture seen in the victims was Linear 45 (36%) (Table-5). The most commonly fractured individual bone of the skull was Temporal in 20 (24%) cases (Table-6). The most common type of intracranial haemorrhage observed in the victims was combination of subdural and subarachnoid haemorrhage 91 (72.5%) (Table-7). Multiple regions of the brain were found to have intracranial haemorrhages in maximum cases 89 (71.2%) (Table-8).

Discussion:

In our study, out of all the cases of head injuries that were studied, the maximum cases were those of road traffic accidents constituting 83.33% of cases. Road traffic injuries are the leading cause of death globally and the principal cause of death in the age group of 15 to 49 years.[1]

In this study, maximum number of road traffic accidents were found to be due to the victim using a two-wheeler. The next most common victims of road traffic accidents in our study were found to be pedestrians. Two wheelers are inherently unsafe in nature since the rider and pillion are exposed to the elements of nature. The poor state of road infrastructure which comprises not just the state of roads but also the lack of road signs, poor lighting, construction/renovation activity, improper parking etc. make the two wheeler users more prone to accidents. This finding was found consistent with that of Pathak A et al.,[6] Ravikumar R,[7] Barman et al.,[8] Uddin MJ,[9] Radha PK et al.[10]

In a study conducted by Bhatt SB et al.,[11] Gupta A et al.,[12] Nandeibam et al.,[13] Tambuzzi S et al.,[14] pedestrians were most commonly involved in deaths as a result of head injury. In our study, pedestrians have been found to be the second most common victims of fatal road traffic accidents. This finding is inconsistent with the findings of our study as this can be attributed to the several factors like number and density of population, vehicles, adherence to traffic laws etc.

Helmets are of paramount importance and play a significant role in preventing injuries but the lack of awareness and compliance among users means that not all 2 wheeler users put a helmet on.

Also, while riders are usually the ones who are seen using helmet, it is the pillion riders who more often than not never use helmet making them more prone to head injuries. Two-wheeler users often try to accommodate more than one pillions. Hence, the higher number of occupants often leads to imbalance and the lack of helmet makes the occupants more prone to head injuries.

Pathak A et al.,[6] Thube HR et al.[27] and Bhat MA et al.[21] conducted a study in which it was found that 87.17%, 84% and 91.09% victims respectively on two wheelers had not used helmet. This finding is consistent with the findings of the current study.

In studies conducted by other authors, Bhoi S et al.[15] and Ravikumar R,[7] Yadukul S et al.[16] it has been found that 50 %, 64.17%, 50.90% cases respectively, the riders were found to be wearing helmets. This finding is inconsistent with our study because in our study maximum victims were found to have not wearing the helmet at the time of the incident.

This can be attributed to the higher awareness and/or better adherence among two wheeler users of the author's study and possibly better execution of road safety rules in a city like Bangalore. Ravikumar[7] found that none of the pillions were wearing helmets. This finding is consistent with our study.

The most widely found type of scalp injury was contusion. This finding was found to be consistent with other researches done by Pate RS et al.,[17] Sundaragiri et al.,[18] Chourasiya S et al.[19] Singha

Table 5. Distribution of head injuries due to rta based on distribution of skull fracture in the victim (n-125).

Type of skull fracture	Number of cases	Percentage
Fissure/linear	45	36.0
Depressed	10	8.0
Comminuted	13	10.4
Diastatic/sutural	4	3.2
Ring fracture	0	0
Pond fracture	0	0
Hinge	0	0
Basal	4	3.2
Multiple	15	12.0
Absent	34	27.2
Total	125	100

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Table 6. Distribution of head injuries due to rta based on distribution of region of skull fracture in the victim (n-125).

Region of skull injury	Number of cases	Percentage
Frontal	12	9.6
Parietal	5	4
Temporal	30	24
Occipital	4	3.2
Multiple	36	28.8
Absent	38	30.4
Total	125	100

Table 7. Distribution of head injuries due to rta on the basis of type of intracranial haemorrhages (n-125).

Type of Hemorrhages	Number of Cases	Percentage
EDH	0	0
SAH	8	6.4
SDH	20	16
ICH	0	0
SDH + SAH	91	72.8
EDH + SDH	1	0.8
EDH + SDH + SAH	2	1.6
SDH + SAH + ICH	0	0
Absent	3	2.4
Total	125	

Table 8. Distribution of head injuries on the basis of distribution of region of intracranial haemorrhages (n-125).

Regions	No. of cases	Percentage (%)
Frontal	0	0
Parietal	1	0.8
Temporal	2	1.6
Occipital	2	1.6
Multiple	118	94.4
Absent	2	1.6
Total	125	100.0

YN,[20] Bhat MA et al.,[21] Malik Y et al.,[22] Gupta A et. al.[12]

Individually, frontal region of the scalp has been found to be most commonly involved followed by the temporal region in our study which is consistent with the findings of Wankhede MN.[23] In a study conducted by Bhat MA et al.,[21] combination of scalp regions were studied for contusions and they found frontal, parietal and temporal region to be involved in maximum cases. Multiple regions of the scalp were found to be involved in maximum number of victims in our study. This finding is consistent with the findings of Bhat MA et al.[12] who also found combination of areas to be involved.

The most commonly found individual fracture of skull in our study is fissure/linear which is consistent with the findings of Patil MA et al.,[24] Pathak A et al.,[6] Rupani R et al.,[25] Singha YN et al.,[20] Ahmad M et al.,[26] Thube HR et al.,[27] Pate RS et al.,[17] Sundaragiri et al.[18] The second most common individual fracture found in our study was comminuted followed closely by depressed fracture of the skull.

The temporal bone of the skull was found to be the most commonly involved. This finding of our study is consistent with Ahmad M et al.,[26] Gupta A et al.,[29] Bhat et al.,[21] Kulkarni PR et al.,[30] Waghmode AH et al.,[31] Gupta A et al.,[12] Bhat MA et al.[21]

Sahu G et al.,[32] Singha YN[20] found parietal bone to be the most commonly fractured followed by temporal bone, this is not consistent with our findings. The higher involvement of temporal bone in skull vault fractures can be attributed to the squamous part of the temporal bone being relatively thin and hence more prone to getting fractured as compared to others.

In our study SDH with SAH combined were most common haemorrhages. This finding is consistent with that of Patil AM et al.,[24] Pathak A et al.,[6] Singha YN et al.,[20] Sundaragiri S et al.,[18] Chourasiya S et al.,[19] Giri SK et al.,[33] Bhat M A et al.,[21] Das PP et al.[34] Individually, SDH was the most common intracranial haemorrhage observed which is consistent with the findings of Pathatk A et al.,[5] Sahu G et al.,[32] Ravikumar R,[7] Singha YN et al.,[20] Ahmad M et al.,[6] Waghmode AH et al.,[31] Das PP et al.[34] In our study we found that more than one regions of the head were found to be involved in maximum cases when it came to intracranial haemorrhages.

Conclusion:

It was found that among road traffic accidents, majority of the cases occurred where a 2 wheeler was involved. Among the two-wheeler users, there was a very small proportion that used helmet. The usage of helmets has a crucial role to play in the prevention of head injuries. The extent of head injury was found to be variable in the victims. Considering the magnitude of problem caused by RTA, a strict implementation of the various safety measures like usage of helmet, usage of mobile phones, following traffic rules should be done so as to reduce the number of Road Traffic Accidents.

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ORIGINAL ARTICLE

Estimation of Stature from Upper Limb Measurements by Regression Analysis in North -West Indian Population

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Abstract:

The estimation of a deceased stature, which is a part of the identification process, is crucial in cases where mutilated or dismembered bodies presented for postmortem examination. Nevertheless, stature differs by race and is determined by genetics, environment, climatic conditions, and geographic location. Therefore, the study was intended to estimate stature from upper limb parameters in the north-west Indian population, to see if there is a significant correlation between stature and various upper limb parameters, and to create regression equations for estimating stature from various upper limb parameters. Inclusion in the study group was restricted to subjects who were willing to participate and who provided written informed consent. Students with evident physical deformities were not included in the study. Using Pearson's correlation test, correlations between various parameters of the upper limb and height were determined. Gender-specific linear regression equations for estimating stature were developed by using upper limb measurements. Stepwise regression analysis was used to generate equations for multiple regressions based on a variety of parameter combinations. Using a paired T-test, there was no statistically significant difference observed between known and estimated stature for both the right and left sides in a mixed-gender and in both males and females ($p>0.05$). From the parameters, the upper limb length and hand length had shown strong positive correlations with stature in the north-west Indian population.

Keywords: Identification; Stature; Upper limb; Arm length; Hand length; Forearm length; Hand breadth.

Introduction:

The aim of conducting a post-mortem examination or autopsy is not merely dissecting the body to find out the cause of death, but also to determine the identity of the deceased in cases of decomposed, mutilated, fragmented and skeletonised bodies. Identification appears to be a critical consideration in forensic medicine as it helps in connecting the criminal to the crime. Along with sex, age, and race, stature is also considered one of the important parameters for identification.[1-3] It is common to find the fragments or peripheral parts of the body such as fingers, hands, feet, etc. in deaths from natural disasters like earthquakes, cyclones, floods, tsunamis, and man-made disasters like bomb blasts, terror attacks, mass accidents, wars, plane crashes, railway accidents etc. Stature estimation which is an integral part of identification is of paramount importance in such scenarios. Different parts of the body can be used for the estimation of stature.[4-9] Numerous studies have been conducted in different regions in the past to estimate the stature from various upper limb segments of the body. However, stature varies with race and is determined by a person's genetics, environment, climatic conditions and geographical location.[10] Therefore, the study was intended to estimate stature from upper limb parameters in the north-west Indian population, to see if there is a significant correlation between stature and various upper limb parameters, and to create regression equations for estimating stature from various upper limb parameters.

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Materials and Methods:

The cross-sectional study was conducted in a tertiary care centre of Southern Haryana. The study subjects comprise of medical students of more than 18 years of age who belongs to North-west region of India. The approval was obtained from Institutional Ethical Committee before the commencement of study. Only those students who voluntarily gave their informed consent were enrolled in the study. Those who had evident physical abnormalities were excluded. The following measurements were obtained and recorded in the proforma:

Stature: After making sure the individuals weren't wearing any kind of footwear or headwear, the stature was measured on stadiometer. Subjects were asked to stand tall on a stadiometer, with their feet axis parallel or slightly divergent, their heads balanced on their necks in the Frankfurt Horizontal Plane, and their hands hanging by their sides. The stadiometer's movable horizontal head piece was brought into touch with the subject's scalp to measure their height in centimetres.[11,12]

Upper Limb Length: Participants were instructed to stand tall with their weight spread evenly on their feet, their shoulders relaxed with arms at their sides. The distance from the acromion process to the tip of the longest finger was measured using a measuring tape and recorded in centimetres to the nearest decimal place.[12,13]

Arm Length: Participants were made to stand with the arm straight at the side of the body and the forearm bent to 90 degrees

Table 1. Descriptive statistics of age, stature and various upper limb dimensions.

Para-meter	Males (n=116)				Females (n=88)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Age	21.30	1.60	18	28	20.82	1.98	18	27
Stature	174.27	5.90	162	189	161.43	5.73	148	175
ULR	78.24	3.88	70.10	92	71.20	3.76	63	82.30
ULL	78.22	3.93	70.30	92	71.23	3.83	63	82.30
ALR	36.67	2.75	26.30	45.50	33.29	2.45	27	42
ALL	36.71	2.83	26.50	47	33.33	2.50	27	41
FLR	28.95	2.81	22.80	47	26.27	2.49	23	42.10
FLL	28.84	2.90	22.50	48	26.14	2.61	22	42
HLR	18.84	0.92	16.20	22	17.44	1.16	14	20
HLL	18.87	0.96	16.20	22	17.49	1.15	13.50	20.20
HBR	8.36	0.57	6.30	10	7.48	0.53	6.50	8.70
HBL	8.30	0.58l	6.30	10	7.43	0.56	6.40	8.70

ULR: Upper limb right; ULL: Upper limb left; ALR: Arm length right; ALL: Arm length left; FLR: Forearm length right; FLL: Forearm length left; HLR: Hand length right; HLL: Hand length left; HBR: Hand breadth right; HBL: hand breadth left.

Table 2. Pearson's correlation analysis between upper limb parameters and stature.

Parameter	Males		Females		Combined	
	R	p-value	R	p-value	R	p-value
ULR	0.635**	0.000	0.673**	0.000	0.822**	0.000
ULL	0.605**	0.000	0.658**	0.000	0.807**	0.000
ALR	0.382**	0.000	0.525**	0.000	0.647**	0.000
ALL	0.394**	0.000	0.537**	0.000	0.648**	0.000
FLR	0.489**	0.000	0.218*	0.042	0.559**	0.000
FLL	0.473**	0.000	0.222*	0.038	0.547**	0.000
HLR	0.512**	0.000	0.542**	0.000	0.707**	0.000
HLL	0.510**	0.000	0.495**	0.000	0.687**	0.000
HBR	0.318**	0.001	0.232*	0.030	0.606**	0.000
HBL	0.275**	0.003	0.229*	0.032	0.582**	0.000

* p-value <0.05; ** p-value <0.01

at the elbow joint. The distance from the acromion process to the olecranon process was measured using a measuring tape and recorded in centimetres to the nearest decimal place.[14,15]

Forearm length: With forearm flexed at 90 degrees at the elbow joint, the distance between the radial styloid process and olecranon was measured with a measuring tape and recorded in centimetres to the nearest decimal place.[13]

Hand Length: The hand length was measured by using Vernier callipers. The participants were instructed to place their hand on a hard horizontal surface in supine position with their fingers fully extended and adducted. In this position, the hand length was measured from the mid-point of the distal transverse crease of the wrist to the tip of longest finger.[16] Hand Breadth: The hand breadth was also measured by using Vernier callipers. With the hands placed supine on a flat hard horizontal surface with all the fingers extended and adducted, the hand breadth was measured as a distance between the radial side of the second metacarpophalangeal joint and the ulnar side of the fifth metacarpophalangeal joint.[17]

All measurements were recorded in centimetres to the nearest two decimal places on both right and left side of the body. The measurements were performed every day at the same time between 2:00 and 3:00 PM to minimise the inconsistencies caused by diurnal fluctuation. Also, the measurements were done by the same observer each day to eliminate any intra-observer

Table 3: Linear regression equations for stature (cm) estimation in male, female & combined.

Parameter	Equation	R	R2	SEE
Males				
ULR	98.578+0.967 ULR	0.63	0.40	4.57
ULL	103.263+0.928 ULL	0.60	0.36	4.72
ALR	144.207+0.820 ALR	0.38	0.14	5.47
ALL	144.123+0.821 ALL	0.39	0.15	5.45
FLR	144.558+1.026 FLR	0.48	0.23	5.17
FLL	146.467+0.964 FLL	0.47	0.22	5.22
HLR	112.223+3.292 HLR	0.51	0.26	5.09
HLL	114.824+3.150 HLL	0.51	0.26	5.09
HBR	146.990+3.262 HBR	0.31	0.10	5.62
HBL	151.279+2.769 HBL	0.27	0.07	5.70
Females				
ULR	88.455+1.025 ULLR	0.67	0.45	4.26
ULL	91.396+0.983 ULLL	0.65	0.43	4.33
ALR	120.489+1.230 ALR	0.52	0.27	4.90
ALL	120.393+1.231 ALL	0.53	0.28	4.86
FLR	148.273+0.501 FLR	0.21	0.04	5.62
FLL	148.723+0.486 FLL	0.22	0.04	5.61
HLR	114.623+2.684 HLR	0.54	0.29	4.84
HLL	118.503+2.454 HLL	0.49	0.24	5.00
HBR	142.773+2.493 HBR	0.23	0.05	5.60
HBL	144.165+2.323 HBL	0.22	0.05	5.60
Combined				
ULLR	65.645+1.371 ULLR	0.82	0.67	4.91
ULLL	68.099+1.338 ULLL	0.80	0.65	5.10
ALR	105.526+1.795 ALR	0.64	0.41	6.59
ALL	106.467+1.766 ALL	0.64	0.42	6.58
FLR	123.782+1.617 FLR	0.55	.031	7.17
FLL	126.278+1.534 FLL	0.54	0.30	7.23
HLR	79.073+4.916 HLR	0.70	0.50	6.11
HLL	81.972+4.747 HLL	0.68	0.47	6.28
HBR	109.670+7.398 HBR	0.60	0.36	6.87
HBL	113.451+6.973 HBL	0.58	0.33	7.03

error in an approach that may have occurred. Before proceeding with the data collection, a pilot study was conducted to assess the reliability and reproducibility of the numerous upper limb measures in question. The measurements of the upper limbs that were going to be employed in the study were obtained by the same observer on 10 different subjects over the course of two separate days. Both times, the measurements that were taken were essentially the same.

Statistical Evaluation: IBM SPSS Statistics Version 20.0 for Windows (Armonk, NY: IBM Corp) was utilised for statistical analysis of the data. A p-value 0.05 was considered as statistically significant. The Pearson's correlation test was applied in order to assess whether or not there was a relationship between the parameters of the upper limb and stature. Gender-specific linear regression models for the estimate of stature were established. Coefficient of correlation (R), coefficient of determination (R2), and standard error of estimation (SEE) were determined. Using stepwise regression analysis, the equations for multiple regressions were generated based on various parameter combinations. The paired t-test was employed to compare the known and estimated stature.

Result:

A total of 204 students participated in the study, which comprises of 116 males and 88 females. The mean age for males in this study

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Table 4. Multiple regression equations for stature (cm) estimation in male, females & combined.

Equation	R	R2	SEE
Males			
82.786+0.654 ULR-0.045 ALR+0.546 FLR+1.083 HLR+ 0.687 HBR	0.70	0.49	4.27
89.061+0.473 ALR+0.668 FLR+1.891 HLR+1.540 HBR	0.66	0.43	4.50
98.943+0.747 FLR+2.260 HLR+1.329 HBR	0.62	0.39	4.65
106.024+2.936 HLR+1.543 HBR	0.53	0.28	5.04
86.383+0.575 ULL-0.010 ALL+0.525 FLL+1.227 HLL+ 0.605 HBL	0.68	0.46	4.39
93.855+0.446 ALL+0.618 FLL+1.846 HLL+1.372 HBL	0.64	0.41	4.58
102.112+0.690 FLL+2.247 HLL+1.185 HBL	0.61	0.37	4.71
108.543+2.903 HLL+1.318HBL	0.52	0.27	5.06
Females			
81.288+0.665 ULR+0.460 ALR+0.006 FLR+1.180 HLR- 0.440 HBR	0.71	0.51	4.09
96.164+0.880 ALR+0.075 FLR+1.993 HLR-0.099 HBR	0.64	0.42	4.46
112.240+0.186 FLR+2.607 HLR-0.153 HBR	0.54	0.29	4.88
114.464+2.677 HLR+0.039 HBR	0.54	0.29	4.87
81.588+0.617 ULL+0.553 ALL-0.006 FLL+1.063 HLL- 0.129 HBL	0.71	0.50	4.15
95.259+0975 ALL+0.039 FLL+1.773 HLL+0.224 HBL	0.64	0.41	4.49
114.256+0.211 FLL+2.287 HLL+0.224 HBL	0.50	0.25	5.03
116.862+2.376 HLL+0.405 HBL	0.49	0.24	5.03
Combined			
54.768+0.820 ULR+0.227 ALR+0.387 FLR+1.254 HLR+ 1.332 HBR	0.85	0.72	4.56
60.662+0.885 ALR+0.538 FLR+2.306 HLR+2.490 HBR	0.81	0.66	5.01
68.899+0.726 FLR+3.159 HLR+2.762 HBR	0.77	0.59	5.50
73.030+3.730 HLR+3.468 HBR	0.74	0.55	5.80
56.369+0.770 ULL+0.275 ALL+0.380 FLL+1.258 HLL+ 1.420 HBL	0.84	0.70	4.71
62.821+0.909 ALL+0.499 FLL+2.186 HLL+2.538 HBL	0.80	0.65	5.12
71.289+0.709 FLL+3.027 HLL+2.838 HBL	0.76	0.57	5.65
75.034+3.634 HLL+3.441 HBL	0.72	0.52	5.95

was 21.30 years and 20.82 years for females. The descriptive statistics for age, stature, and various upper limb dimensions for both males and females is depicted in Table 1.

The Pearson's correlation in the combined group showed good correlations between upper limb parameters and stature, in which ULR exhibited the highest correlation (R=0.822) followed by ULL (0.807). All upper limb parameters showed a significant correlation with stature in both males and females. The Pearson's correlation between upper limb parameters and stature in males, females and a group consisting of both sexes is depicted in Table 2.

A summary of linear regressions in males, females and combined sexes is depicted in Table 3. By employing the linear regression equation, the stature can be approximated from the mutilated or fragmentary body remains by using the regression: y (stature) = b (constant) + a (regression coefficient of the independent parameter) x. The regression in a group consisting of both sexes showed that ULR and ULL have a coefficient of determination (R2) of 68% and 65% respectively. This means that approximately 68% of the variation was contributed by the parameters, while the remaining 32 % of the variation was due to random error (Table 3). The variance was subsequently reduced for rest of parameters. The regression-based on ULR and ULL in males, females and a group consisting of both sexes showed the lowest standard error of estimation (SEE) i.e., 4.57, 4.26, 4.91for ULR and 4.72, 4.33, 5.10 for ULL respectively, as compared to all other parameters (Table 3).

Table 5. Descriptive statistics of mean values of known stature and estimated stature in male, female & combined.

		N	Min	Max	Mean	SD
Known Stature	Male	116	162	189	174.27	5.90
	Female	88	148	175	161.43	5.73
	Combined Sex	204	148	189	168.73	8.63
Estimated Stature RT	Male	116	164.81	185.89	174.26	4.17
	Female	88	152.73	173.70	161.39	4.12
	Combined Sex	204	150.95	188.93	168.69	7.35
Estimated Stature LT	Male	116	163.93	185.66	174.31	4.05
	Female	88	154.35	172.43	161.45	4.07
	Combined Sex	204	152.10	189.42	168.74	7.26

Table 6. Paired T-test between known & estimated height.

		Mean	t	Sig
Estimated Stature RT	Male	0.003	0.009	0.993
	Female	0.037	0.089	0.929
	Combined Sex	0.041	0.130	0.896
Estimated Stature LT	Male	-0.045	-0.113	0.910
	Female	-0.020	-0.046	0.963
	Combined Sex	-0.008	-0.024	0.981

The regressions obtained by the multiple regression analysis for all five parameters by using various combinations for both left and right sides in males, females and a group consisting of both sexes have been depicted in Table 4. In the combined group, the multiple regressions showed lower SEE (4.56–5.95) than that in linear regressions (4.91–7.23) (Table 4). The regressions based on ULR, ALR, FLR, HLR and HBR showed the lowest SEE in both males and females (4.27 and 4.09 respectively) $p<0.01$ which was highly significant.

The mean difference between known stature and estimated stature was 0.01 cm on the right and -0.04 cm left side in males. The mean difference between known stature and estimated stature in both the sexes is depicted in Table 5.

There was no statistically significant difference between known stature and estimated stature by using paired t-test for both right and left side in a group consisting of both sexes, males and in females ($p>0.05$) (Table 6).

Discussion:

Estimation of stature is an important factor in the identification of comingled remains received during a forensic examination, which can be achieved by anatomical and mathematical examination. The body's physique is influenced by climatic, hereditary, nutritional and racial factors. Therefore, considering this, the study was undertaken to use various dimensions of upper limb from the living people in north-west population of India and correlate it with stature. In the present study, males surpassed females in stature as well as upper limb dimensions which are in concurrence with other studies.[8,9,18] The fact that males are taller than females explain this difference. The age of puberty being two years later in males as compared to females gives them additional time for growth.[8,18]

In the current study, strong positive correlation was observed between upper limb length on both right side (r=0.822) as well as left side (r=0.807) in combined group consisting of both sexes, while moderate degree of association observed between hand breadth and stature in males and females for both right and left

Table 7. Pearson's correlation comparison of various studies on different populations for arm length and forearm length.

Study	Population	Parameter											
		ALR			ALL			FLR			FLL		
		M	F	CS	M	F	CS	M	F	CS	M	F	CS
Present Study	North Indian	0.382	0.525	0.647	0.394	0.537	0.648	0.489	0.218	0.559	0.473	0.222	0.547
Uzun et al[13]	Turkish	0.497	0.575	0.717	0.534	0.574	0.724	0.486	0.549	0.753	0.473	o.538	0.734
Ahmed AA[1]	Sudanese	-	-	-	-	-	-	0.725	0.722	-	-	-	-
Akhlaghi et a[17]	Iranian	0.602	0.669	0.759	-	-	-	0.354	0.299	0.58	-	-	-
Howley et al[19]	Australian	-	-	-	-	-	-	0.748	0.78	0.886	0.74	0.778	0.887

Table 8. Pearson's correlation comparison of various studies on different populations for hand length and hand breadth.

Study	Population	Parameter											
		HLR			HLL			HBR			HBL		
		M	F	CS	M	F	CS	M	F	CS	M	F	CS
Present Study	North Indian	0.512	0.542	0.707	0.51	0.495	0.687	0.318	0.232	0.606	0.275	0.229	0.582
Krishan et al[18]	North Indian	0.599	0.686		0.609	0.677		0.514	0.503		0.537	0.403	
Uzun et al[13]	Turkish	0.339	0.309	0.501	0.35	0.307	0.505	0.248	0.26	0.48	0.312	0.317	0.318
Rastogi et al[8]	North Indian	0.659	0.717	-	0.664	0.694	-	0.504	0.46	-	0.44	0.473	-
Pal et al[2]	Bengalee	-	-	0.683	-	-	0.682	-	-	0.53	-	-	0.524
Ahmed AA[1]	Sudanese	0.602	0.615	-	-	-	-	0.353	0.431	-	-	-	-
Akhlaghi et al[7]	Iranian	0.696	0.724	0.816	-	-	-	0.31	0.509	0.736	-	-	-
Howley et al[19]	Australian	0.647	0.719	0.949	0.686	0.865	0.748	0.505	0.433	0.743	0.592	0.535	0.785

Table 9. Comparison of coefficient variance and standard error of estimate of various studies.

Study		Upper Limb parameter																	
		ULR			ULL			HLR			HLL			HBR			HBL		
		M	F	CS	M	F	CS	M	F	CS	M	F	CS	M	F	CS	M	F	CS
Present Study	R2	0.40	0.45	0.67	0.37	0.43	0.65	0.26	0.29	0.50	0.26	0.25	0.47	0.1	0.05	0.36	0.07	0.05	0.33
	SEE	4.58	4.26	4.91	4.72	4.34	5.10	5.1	4.84	6.11	5.1	5.01	6.28	5.62	5.61	6.87	5.70	5.61	7.03
Uzun et al[13]	R2	0.49	0.62	0.78	0.59	0.64	0.78	0.43	0.47	0.68	0.47	0.5	0.62	-	-	-	-	-	-
	SEE	4.39	3.58	3.90	3.72	3.54	3.97	4.9	4.25	4.70	4.96	4.12	4.81	-	-	-	-	-	-
Krishan et al[18]	R2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SEE	-	-	-		-	-	5.22	3.78	-	5.17	3.82	-	5.6	4.5	-	5.5	4.76	-
Rastogi et al[8]	R2	-	-	-	-	-	-	0.43	0.51	-	0.44	0.48	-	0.25	0.21	-	0.19	0.22	-
	SEE	-	-	-	-	-	-	5.01	4.24	-	4.97	4.38	-	5.74	5.4	-	5.97	5.36	-
Pal et al[2]	R2	-	-	-	-	-	-	-	-	0.47	-	-	0.46	-	-	0.28	-	-	0.27
	SEE	-	-	-	-	-	-	-	-	4.25	-	-	3.49	-	-	3.95	-	-	4.06

side. (Table 2). Our results for upper limb length are consistent with studies conducted by Uzun et al.[13] on Turkish population (r=0.861 for right side and r=0.868 for left side) and by Akhlagi et al.[7] on Iranian population (r=0.832 for right side). The comparative analysis of correlation of arm length and forearm length of various studies on different populations is depicted in Table 7. It was observed from the results of various studies that arm length and forearm length exhibit a moderately strong correlation with stature like in studies done by Uzun et al.[13] and Shakya et al.[11]

Similarly, the hand length and hand breadth depicted moderately strong positive correlation with the stature in the current study as well as in the other study results also. The comparative analysis of correlation of hand length and hand breadth of various studies on different populations is depicted in Table 8.

A small standard error of estimate (SEE) in regression analysis depicts greater accuracy. The regression based on upper limb right side in males, females and combined group showed the lowest standard error of estimation (SEE) i.e., 4.57, 4.26 and 5.91 respectively, as compared to all other parameters (Table 3). Table 9 compares the coefficient of determination (R2) and the standard error of estimate for upper limb length, hand length and hand breadth of various studies on different populations.

The mean difference between the estimated stature and known stature was in the current study was 0.01 for right side and 0.04 cm for left side. The mean difference between known stature and estimated stature was in females for the right side was 0.04 cm and 0.02 cm on left side. No statistically significant difference (p-value >0.05) was observed between the known stature and estimated stature by using paired T-test for both right and left side in any of the group (Table 6). Therefore, the derived right and left side equations can be employed for estimation of stature. No statistically significant difference was observed between the known stature and estimated stature based on the various upper limb measurements by paired t- test in other studies as well.

Study limitations: Population migration and colonization can impact the regional groups. These factors were not taken in to account while categorization of the study subjects. The sample size in the present study was not enormous. Therefore, further studies on a larger sample size that represents the particular population after taking in account the confounding factors like migration etc. could be undertaken.

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Conclusion:

The present study has established a definite correlation between stature and five parameters individually, namely upper limb length, arm length, forearm length, hand length and hand breadth. Out of the six parameters studied, the upper limb length showed the highest degree of correlation and hand breadth showed the lowest degree of correlation. The regression equations formulated in this study provided valid and reliable stature estimations with high correlation and accuracy levels and the same can be used for the forensic identification purposes.

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ORIGINAL ARTICLE

Variation in Resource Supply of Mortuary for Autopsy at Tertiary Care Center - A Nation-Wide Survey

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Abstract:

Mortuaries and medicolegal services are essential support services to the administration of healthcare. There is a lack of information and uniformity regarding various resource supplies especially day to day consumables for medico-legal services in India. For this reason, a study was undertaken to evaluate the current status of mortuaries and resource supplies for autopsy work as well as the elements that contribute to it. A cross sectional study was conducted in several Indian tertiary care facilities using both qualitative and quantitative methods of data analysis. 74 faculty members from 71 institutes, including 5 AIIMS and AFMC Pune, participated in this study using data from 61 districts across 19 states and the union territories. Information about these health care institutions was gathered using a Google form that included 18 carefully crafted questions with options to observe and interview the faculties who are directly related to autopsy work. Across all the health care facilities we looked and discovered a wide range in resource availability and reluctance on the part of the institute to provide various resources for postmortem services.

Polythene and cloth to wrap the body after the postmortem were arranged by relatives and NGOs in 34% and 46% of institutes, respectively; even in 14% of institutes, containers for the preservation of viscera have been arranged by relatives of the deceased. In 57% of institutes, doctors and 45% of institute mortuary workers are not receiving any postmortem allowance; in 30% of institutes, doctors received less than 500 rupees; and in 22% of institute mortuary workers received less than 50 rupees. In 39% of institutes, mortuary workers are outsourced by the institute on a temporary basis, and in 24% of institutes, departmental sweepers are employed as mortuary workers. Most mortuaries did not have adequate and trained human resources. Thus the present study attempts to highlight the variation of resource supply for medico-legal cases in autopsy block, mortuary workers, their recruitment method, and the lowest rank of investigating officer handling PM, highlights the value of uniform guideline for these services at institute, state or national level.

Keywords: Medico-legal; Resources; Mortuary; Healthcare.

Introduction:

A medico-legal case of injury or ailment where attending doctor after taking history and clinical examination of the patient thinks that some investigations by law enforcing agencies are essential so as to fix responsibility regarding the case. It is the responsibility of a registered medical practitioner to judge each and every case properly and when in doubt, it is better to inform the police. This saves the doctor from unnecessary and needless allegations later.[1] Medico-legal cases comprises of accidents, assaults, burns, poisoning, sudden deaths, operative deaths, suicide, homicide, any suspicious deaths and cases referred from police or court.[2] A mortuary is hospital service point where security and safety of human corpses awaiting identification or autopsy to fasten the justice delivery system. They are useful source for tracking records and information on dead person and other medico-legal issues as well as institution for research.[3]

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Despite the increased urge to improve medico-legal service delivery around the world, in India medico-legal services have not received much attention. Throughout India the tertiary care centers face challenges in maintaining mortuary and medico-legal facility.[4] Unfortunately medico-legal services are grossly neglected all over the country especially in northern states and continue to struggle maintaining mortuary which other medico-legal services.[4] There are no central government guideline or national SOP issued by any association or academy regarding the functioning of medico-legal services. Though some states have their own SOP although very few have been passed by concerned ministry or government to make it an official document. In the institutes, like AIIMS in various states, the availability of resources and medico-legal practices are much more coherent and uniform as compared to other institutes.

Data Collection:

Data was collected from responsible faculty members of various institutes who are involved in medico-legal services of that institute, using Google form through 18 specific questions related to resource supply in mortuary services. The questionnaire was validated through a small group assessment, before this study. Responses were recorded on Microsoft excel software and analyzed.

Materials and methods:

Institutes we studied are from Bhopal, Sagar, Jabalpur, Vidisha, Indore, Shahdol, Chindwara and Satna in Madhya Pradesh, Mumbai, Yavatmal, Aurangabad, Sangli, Nandurbar, Ahmednagar, and Pune in Maharasthra, Kota, Jodhpur, Ajmer, and Bikaner in Rajasthan, South Goa in Goa, Bathinda and Patiala in Punjab, Bahraich, Jalaun, Raibareli, Gorakhpur, Prayagraj and Noida in Uttar Pradesh, Mandya, Manglore, Dharwad and Dakshin Kannada in Karnatka, Nalhar (Nuh) and Karnal in Haryana, Rajkot, Vadodara and Surat in Gujrat, Sambalpur and Cuttack in Odisha, Bilaspur, Rajnandgaon, Raipur, and Jagdalpur in Chattishgarh, Hydrabad in Telangana, Agartala in Tripura, Delhi, Pondicherry, Malapuram and Thiruvant in Kerela, Parganas, Kolkata, Malda and Purba Bardhaman in West Bengal, Vellore and Chengalpattu in Tamilnadu, Kangra in Himachal Pradesh.

Total 74 participants from 65 institute (Including AIIMS and AFMC) of 18 states/union territories were included in this study. Evaluation was carried out by following specific questions-

1. Polythene to wrap the body of the deceased arranged by...!
2. Cloth to wrap the body of the deceased arranged by...!
3. Candle and lakh (chapadi) used to seal the articles arranged by...!
4. Container and bottle to preserve viscera/tissues for chemical analysis and histo-pathological examination arranged by...!
5. How much postmortem allowance per case paid to doctor?
6. How much postmortem allowance per case paid to sweeper/mortuary worker?
7. Postmortem report given in which format?
8. Which documents are mandatory before conducting postmortem?
9. FSL reports are provided to doctors...!
10. Whats the lowest rank of investigating officer in police inquest?
11. Whats the lowest rank of investigating officer in magistrate inquest?
12. Mortuary workers are appointed through...!
13. Histopathology of postmortem cases are done...!
14. In magistrate inquest how often the magistrate comes to the mortuary as an investigating officer?
15. Postmortem performed by...!
16. In any case of postmortem examination requiring, X-Ray it is done...!
17. Pathological autopsy including non-MLC foetal autopsy in the institute...!
18. In most of the cases unknown body preserved in the mortuary cold storage for how much time?

Limitations: Few responses were not complete and few were believed to be unauthentic which were not included in this study as authors cannot read the mind of responders and it is unrealistic for author to cross check each response with the respective

Table 1. Polythene to wrap the body of the deceased.

Arranged by	No of institutes	%
Hospital purchase	39	52.70%
Police	3	4.05%
Departmental fund	3	4.05%
Relative and NGO	25	33.78%
Other	4	5.40%

Table 2. Container and bottle to preserve viscera/tissues for chemical analysis and histo-pathological examination

Arranged by	No of institutes	%
Hospital purchase	46	62.16%
Police	12	16.21%
Departmental fund	5	6.75%
Relative and NGO	10	13.51%
Other	1	1.35%

Table 3. Postmortem allowance per case paid to doctor

In rupees	No of institutes	%
More than 1000	0	0%
Less than 1000	10	13.51%
Less than 500	22	29.72%
Not given	42	56.75%
Other	0	0%

Table 4. Format for postmortem report

Format	No of institutes	%
Computer typed	33	44.59%
Handwritten in english language	24	32.43%
Software like MedLEaPR	11	14.86%
Handwritten in hindi/any other local language	0	0%
Other	6	8.10%

Table 5. FSL reports

FSL reports provided to doctors	No of institutes	%
In every case	37	50%
In specific case	19	25.67%
Only after the request made by doctors	7	9.45%
Not provided to doctors even after the request	11	14.86%
Other	0	0%

Table 6. Lowest rank of investigating officer (IO) in police inquest

Investigating officer in police inquest	No of institutes	%
Constable	7	9.45%
Head constable	37	50%
ASI	22	29.72%
SI	8	10.81%
Other	0	0%

Table 7. Appointment of mortuary workers

Mortuary workers appointed through	No of institutes	%
Permanent recruitment by government	15	20.27%
Departmental sweeper used as amortuary workers	18	24.32%
Outsourced by institute (temporary)	29	39.18%
Through department funds	1	1.35%
Other	11	14.86%

Table 8. Histopathology in postmortem cases

Histopathology in postmortem cases are done by	No of institutes	%
Forensic Medicine departmentwith the help of Pathology department	9	12.16%
Department of Pathology ofown institute	55	74.32%
Other institute	5	6.75%
No clear cut guidelines regardinghisto-pathological examination	5	6.75%
Other	0	0%

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institute, hence authenticity of responder is the limitation of this study.

Result and Observations:

Following data were collected from the responses received - in 39 (53%) of institutes polythene to wrap body of the deceased (table-1) is provided by hospital purchase and 25 (34%) arrangements made by relatives or some NGO, 3 by police, 3 by departmental fund, and in 4 institutes, polythene was not used. Almost similar finding found for cloth to wrap the body: In 35 (47%) institutes, cloth to wrap body was provided by hospital purchase and in 34 (46 %) it's arranged by relatives or some NGO, in 4 (5.40%) arranged by police, and in 1 institute cloth is not used.

Candle and lakh (chapadi) used to seal the articles: It is provided by hospital purchase fund in 63 (85%) of institutes and in 7 (10 %) institutes arrangement made by departmental fund, in 3 (4.05%) institutes it is arranged by police, and 1 institute do not use lakh chapadi.

In 46 (62%) institutes containers and bottles (table-2) are provided by hospital purchase, in 12 (16%) institutes arranged by police, in 10 (14%) institutes it's arranged by relatives and NGO, in 5 (7%) institutes it's provided by departmental fund, and in 1 institute it's provided by police for viscera to carry to FSL and for histo-pathology it's provided by hospital purchase. In 42 (57%) institutes no postmortem allowance given to the doctors (table-3), in 22 (30%) institutes less than 500 rupees and in 10 (13%) institutes less than 1000 or 1000 rupees per PM postmortem allowance is given to the doctor.

Postmortem allowance given to the mortuary worker: Similarly in 40 (54%) institutes no postmortem allowance given to the mortuary worker, in 16 (22%) institutes less than 50 rupees, in 8 (11%) institutes less than 100 rupees, in 7 (9%) institutes less than 200 rupees, in one institute 300 rupees and exceptionally in one institute 500 rupees per PM is given to the mortuary worker. In one institute there is fix pay for mortuary workers. In 33 (45%) institutes PM report (table-4) is computer typed, 11 (15%) institutes online software (like MedLEaPR – Medico Legal Examination and Post-mortem Reports) is used for report writing, while 24 (32%) institutes still handwritten report in english is given and in 6 (8%) institutes they used both (typed or handwritten) method as per convenience.

Documents mandatory before conducting postmortem: In another observation it was found that all the documents like requisition form with copy of panchnama, merg intimation and hospital documents were required before conducting postmortem in 39 (52%) institutes, in 20 (27%) institutes requisition form along with panchnama is needed, in 8 (10.81%) institutes requisition form with copy of panchnama and merg intimation while in 7 (9%) institutes only requisition form was sufficient.

37 (50%) institutes get FSL report (table-5) in every case, whereas 11 (15%) institutes do not get the report even after request made by the doctor, 19 (26%) institutes get report in specific case, and 7 (9%) institutes receive report after request.

In 37 (50%) institutes head constable is the lowest rank of investigating officer (IO) in police inquest (table-6), in 22 (29.72%) institutes ASI is the lowest rank and in 7 (9%) institutes constable is the lowest rank. Lowest rank of investigating officer in magistrate inquest: In 22 (29.72%) institutes nayab tehshildar is the lowest rank of investigating officer in magistrate inquest, in 20 (27.02%) institutes tehsildar is the lowest rank and in 14 (18.91%) institutes SDM is the lowest rank of IO. Magistrate come to the mortuary as an investigating officer: One more observation related to magistrate was to assess whether they come to the mortuary as an investigating officer in magistrate inquest. In 48 (64.86%) institutes, magistrate comes to the mortuary as an investigating officer while in 20 (27.02%) institutes, he comes to the mortuary only in sensitive/high profile magistrate inquest cases. In 3 (4.06%) institutes they come to the hospital administrative building but never to mortuary, while in 3 (4.06%) institutes they never come to institute.

Table 9. Performance of postmortem

Postmortem performed by	No of institutes	%
Casualty medical officer/medical officer of the institute	3	4.05%
Only by the department of Forensic Medicine	57	77.02%
Both the above options	13	17.56%
Doctors outside the institute comes to perform postmortem in the department mortuary	1	1.35%
Others	0	0%

Table 10. Unknown body preserved in the cold storage of mortuary

Unknown body preserved in the cold storage	No of institutes	%
Only for 48 hours	1	1.35%
Only for 72 hours	33	44.59%
Only for 96 hours	6	8.10%
Indefinite as per request by the IO/authorities	30	40.54%
Others	4	5.40%

In 29 (39%) institutes mortuary workers (table-7) are outsourced by institute on temporary basis, in 18 (24%) institutes departmental sweepers are used as mortuary workers, in 15 (20%) institutes they are appointed by permanent recruitment method, and in 11 (15%) institutes mortuary workers are both on permanent and temporary basis. In 55 (75%) institutes histo-pathological examination of postmortem cases (table-8) are done in department of Pathology of own institute and only in 9 (12%) institutes Forensic Medicine department is actively involved in the work of histopathology.

X-ray in the body of gunshot cases: Out of all the institutes studied, in 51 (69%) institutes body is send to Radiology department for x-ray in gunshot cases, while only 8 (11%) institutes have own x-ray machine in FMT department, and in 7 (9%) institutes x-ray not done in these cases. In 57 (77%) institutes post-mortem is performed (table 9) exclusively by department of Forensic Medicine and in 13 (17%) institutes department of Forensic Medicine and casualty medical officers both are involved in postmortem work.

There are no specific uniform guidelines for 'how much time body could be stored in mortuary cold storage?' (table-10). In 33 (44.59%) institutes, unknown body is preserved in the cold storage for 72 hours and in about 30 (40.54%) institutes, it is stored indefinitely as per the request by IO/authorities, which makes mortuary the dumping and storage station for unidentified bodies. Some institute are allowed for 7 days and some institute don't have cold storage.

Discussion:

No previous similar study was found during review of literature. Looking to the pathetic condition, of medico-legal services in India, BPRD ministry of home affairs government of India has given a consolidated framework and basic guidelines for the mortuary work.[5] Grounded in the data obtained from this study, it is evident that a significant number of health institution have less focus on medico-legal services, and even few tertiary care center don't have basic requirements for mortuary services. More so they don't have any clear cut guidelines from the state or center regarding arrangements of these resources, manifested by lack of the necessary infrastructure, human resources, poor information management system and poor processes in managing human remains. These findings and gross variation in resource supply conform to the assertion that the mortuary and medico-legal services are much neglected part of health care delivery system.[3] Since death is a saddening and grieving experience to the relatives of the deceased, this may be worsened further when relatives have to face the reality of seeing their loved ones go through such poor condition of the mortuaries where there is no polythene and cloth for covering the body, body handled by in experienced sweeper, even relative have to manage containers etc. for viscera preservation in some cases. This may have led to a poor perception in society towards mortuary services, related to these institutes.

The study also revealed among others that in many institution postmortem and histopathology services are performed by other department even after presence of Forensic Medicine department in the institute, and those who are involved in these services don't get any extra allowance in many institutes. This challenge may not be unique to India but the same problem identified in many developing countries.[4] In addition, medical superintendent and dean of these institute may have little to do about this, as they have to follow the local or central government policies as far as human resource recruitment are concerned, where such an important human resource like mortuary helper or worker cannot be permanently recruited, and the institutes have to outsource these workers on temporary basis or daily consumables have to be purchased through contingency funds, where no sperate specific budget is allocated for such purchase.

Even police and home department doesn't take these services seriously. Various studies show that only head constable is the investigating officer in majority of medico legal cases, who is less trained and taught about criminology and forensic investigation. In addition to this, services which are integrated with each other like department of Pathology in medical colleges, Forensic Science labs under home department are also reluctant in taking up histo-pathological samples or toxicological samples, which may be due to already existing overload of cases further complicating the situation. Pediatricians, other clinicians or pathologists are not very keen to perform foetal or adult pathological autopsies to upgrade knowledge regarding unknown causes of death in various cases. In gunshot cases many institute don't have facility of x-ray of the deceased and in maximum institute body has to be send to the radiology department which causes inconvenience to patients, doctors and relatives.

Mortuary workers and doctors at many institute don't get extra allowance which is essential to keep mortuary worker satisfied with the job. Post-mortem report writing vary from institute to institute, state to state, where some doctors still prefer hand written report, others provide computer typed report and in very few states the report is written through established online software such as MedLEaPR (Medico Legal Examination and Post-mortem Reports) which is made mandatory through respective high court.

Conclusion:

This study has revealed that good facilities in the mortuaries are practically nonexistent in some tertiary care centers in India. The services provided by many institutes are not properly facilitated or adequately funded, and only few health care delivery centers like AIIMS and other central government institutes have comparatively good support from the management and government to impress quality assurance and resource development. As a result, medico-legal services are underutilized and Forensic Medicine experts are not given due importance as per their experience, knowledge and qualification specially in most of the private medical colleges all over the country where they are only involved in theory teaching of undergraduate MBBS students. Ministry of health, medical education, home department of state or union government and local administration in the region should pay attention to this very sensitive state of affairs and consider functionalizing the mortuaries and medico legal services in top priority. Here also comes the role of Forensic Medicine experts to sensitize masses and media regarding these lacunas especially on the special days like Forensic Medicine day or doctors day or insisting on WHO themes on this very pertinent deficiency in health care system.

Conflict of interest: The author has no conflict of interest to declare.

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ORIGINAL ARTICLE

Farmer Suicides and Alcohol Consumption: An Autopsy Based Medicolegal Study of Suicide Methods and Risk Factors

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Abstract:

The term "suicide" refers to the planned and intentional death of oneself. It is distinctly human, and homicide and suicide are the next three most common causes of unnatural deaths after accidents.[1] Farmer's suicide is mainly attributed to crushing financial pressures on farmers, farm product prices being too low, environmental problems, inadequate irrigation, increased use of chemical fertilizers, crop failure, etc. The current study was conducted at the Medical College in a rural region of central India, where most cases are brought from rural areas. The current study concluded that the majority of incidents affected young adults (20–40 years) who committed suicide by poisoning 72 cases (36.7%). In 16.32% (n=32) of the cases, the farmers had consumed alcohol at the time of the incident. Although 18.88% (n = 37) of the farmers' cases were addicted to alcohol.

Keywords: Farmer; Suicide; Autopsy; Alcohol; Addiction.

Introduction:

The term "suicide" refers to the planned and intentional death of oneself. It is distinctly a human affair. Only humans can decide to terminate themselves. The phenomenon of suicide is as old as mankind but still remains an unsolved puzzle. One of the oldest industries in the world, farming is often depicted as a joyful way of life. However, compared to other industries, the agriculture industry has one of the highest suicide rates. According to observations, homicide and suicide are the next three most common causes of unnatural deaths after accidents.[1] In the Vidarbha region of Maharashtra and rural Punjab, economic problems such as debt, crop failures, and severe financial loss or responsibility (such as marriage in the family) were substantially related to farmer suicides.[2,3]

Farmer suicides in Maharashtra state are attributed mainly to crushing financial pressures on farmers, farm product prices are too low, environmental problems, stress, and household obligations, governmental regulations, inadequate irrigation, increased agricultural costs, private money lenders, increased usage of chemical fertilizers, crop failure, etc. From the available figures, it appears that the issue of farmer suicide is very common in rural parts of central India.[4]

Taking into account the seriousness of farmer suicide and the stigma to society and country, a study was conducted to assess the different factors of farmer suicide deaths in rural areas of central India, where the farmer suicide rate is always high, which could help society reduce the suicide rate.

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Materials and methods:

The current study is being carried out at the Medical College in a rural region of central India, where most cases come from rural areas. The material for the present study comprises cases of alleged suicide among farmers subjected to a medicolegal autopsy in the rural area of Central India from August 2013 to July 2017 retrospectively and prospectively. After excluding all exclusion criteria, a total of 196 suicide cases were studied during the above-mentioned period. Suicidal cases in which the deceased was a farmer by occupation according to the inquest papers and information provided from the relatives of the deceased brought to the autopsy centre in the rural area of Central India, which belongs to the area under study, were included in the current study. Then these cases were cross-checked with the list of farmer suicides provided by the governing authority of the study region.[5] The study was carried out after ethical approval from IEC, MGIMS, Sevagram.

Observations and Results:

In the current study, all cases of farmer suicide that were taken to a mortuary and autopsied are being investigated, which were carefully chosen considering the study's objectives, inclusion, and exclusion criteria.

Poisoning was the most common way of committing suicide in both the young adult (20-40 years) age group, n=72(36.7%) and adult (41-44%), n = 47 (24%) followed by hanging, n = 26 (13.7%) in the young adult group, while drowning in the 9 (4.6%) cases in the adult group.

Table 1. Distribution of suicidal death according to age and method of committing suicide.

Method of committing suicide	Age in years											
	Child (0-12)	%	Adolescent (13-19)	%	Young adult (20-40)	%	Adult (41-64)	%	Older (65 or above)	%	Total (n)	%
Poisoning	0	0	3	1.53	72	36.7	47	24	5	2.55	127	64.8
Hanging	0	0	0	0	26	13.3	8	4.1	3	1.53	37	18.9
Drowning	0	0	1	0.51	10	5.10	9	4.6	4	2.04	24	12.2
Burning	0	0	0	0	2	1.02	5	2.5	1	0.51	8	4.1
Total	0	0	4	2	110	56.1	69	35.2	13	6.6	196	100

Table 2. Distribution of farmers' suicidal deaths with respect to time of committing suicide (n=196).

Period	Sex				Total (n)	%
	Male	%	Female	%		
Morning(6 am to 11:59 am)	36	18.37	5	2.55	41	20.92
Afternoon (12pm to 5:59 pm)	62	31.63	2	1.02	64	32.65
Evening (6pm to 11:59 pm)	77	39.29	9	4.59	86	43.88
Night (12am to 5:59 am)	5	2.55	0	0	5	2.55
Total	180	91.84	16	8.16	196	100

Table 3. Distribution of farmer suicidal death with respect to the place of suicide (n=196).

Place of suicide	Sex				Total (n)	%
	Male	%	Female	%		
At home	102	52.04	12	6.12	114	58.16
At farm	70	35.72	4	2.04	74	37.76
Other than home/farm	8	4.08	0	0	8	4.08
Total	180	91.84	16	8.16	196	100

The table number 02 shows that out of 196 cases, 86 (43.88%) cases of suicidal death occurred during the evening hours (from 6 pm to 11:59 pm) followed by 64 (32.65%) cases during the afternoon hours (from 12 pm to 5:59 pm).

According to the table given above, of the total of 196 cases, the maximum number of victims, 114 (75.67%), preferred their own homes as the place of suicide. 74 (37.26%) cases preferred their farms as the place of suicide. Only 8 (4.08%) cases preferred places other than home and farm as the place of suicide, and all were males. The table shows that of a total of 196 cases of farmer suicidal deaths, 32 (16.32%) cases had consumed alcohol at the time of suicide and all cases were men.

The table shows that out of a total of 196 cases, alcohol addiction was observed in 37 (18.88%) cases. No single case of alcohol addiction was found among women.

Discussion:

Method of committing suicide with respect to age: In the present study, the method used by young adults (20-40 years) to commit suicide is poisoning 72 (36.7%) followed by hanging 26 (13.3%), drowning 10 (5.10%) and burning 2 (1.02%), respectively. All these forms of suicide are most commonly seen in young adults (20-40years) of which poisoning contributed the most. In the adult age group (41-64 years), poisoning is the most common method of suicide in 47 (24%), followed by drowning in 9 (4.6%) cases.

Our study agrees with Behere PB et al.,[6] Murkey P et al.,[7] Saiyed MZ et al.,[8] and Singh KP et al.,[9] Vijaya Mahantesh SN et al.,[10] Sumanta Dutta et al.[11]

Table 4. Distribution of farmer suicidal death with respect to alcohol consumption at the time of suicide (n=196).

Alcohol at the time of suicide	Male	Female	Total (n)	%
Present	32	0	32	16.32
Absent	148	16	164	83.68
Total	180	16	196	100

Table 5. Distribution of farmer suicide with respect to alcohol addiction (n = 196).

Alcohol addiction	Male	Female	Total (n)	%
Present	37	0	37	18.88
Absent	143	16	159	81.12
Total	180	16	196	100

The primary factor that influences people's decision to use poisoning as their preferred form of suicide may be due to the fact that the main occupation is agriculture; insecticides and pesticides are not strictly regulated and are readily available. The second most popular way to end one's life is by hanging behind the poisoning, as there is an easy availability of ligature material. In this region, suicide from firearms is not seen, which may be due to factors such as less accessibility to weapons, their high cost, and strict law enforcement regarding the possession and usage of firearms.

With repeated use, harmful pests become resistant, leading to a growing need for more and more powerful pesticides. This further affects crop production. After facing the crisis due to crop production failure and mounting debt, farmers commit suicide. Ironically, insecticides/pesticides that are used have now turned out to be deadly to the farmer himself.

The maximum number of suicides in young adults (20-40 years) can be ascribed to various factors such as: prevalence of psychiatric risk factors in youth, especially substance abuse or depression, and unemployment. They are directed towards farming industries to fulfil their family needs, family liabilities, and if their expectations remain unfulfilled, then there can be an increased sense of hopelessness or depression.

Time of incidence: In the present study, maximum suicidal deaths (43.88%) occurred in the evening (6 pm to 11:59 pm) followed by the afternoon (12 pm to 5:59 pm) 32.65% of cases, morning (6 AM to 11:59 AM) 20.92% and night (12 AM to 5.59 AM) 2.55% of cases respectively. The current study is in accordance with Murkey P et al.[7] and R. Ponnudurai et al.[12] Our study is not in agreement with Tanna JA et al.,[13] Bardale et al.,[14] and Palimar DV et al.[15] The high incidence during the evening and night hours gives room for speculation on whether there is any association between suicidal behaviour and diurnal variation in depressive mood in the evening and night hours, as reported in many depressed patients.

Place of incidence: In the present study, the maximum suicide victims preferred suicide at their own home 114 (58.16%), while 74 (37.76%) committed suicide on the farm and 8 (4.08%) neither at home nor at the farm. The present study agrees with Manik Changoji Bhise et al.,[2] Tanna JA et al.,[13] Bardale et al.,[14] and Murkey Pankaj et al.[16]

A suicidal individual looks for a safe place to end his life. The safest place to commit suicide is still in a person's home because

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supplies like pesticides, ligature material, matchboxes, and kerosene are readily available there. As a result, homes are the place where most suicides are committed.

Alcohol consumption at the time of suicide: In the present study, 32 (16.32%) cases have consumed alcohol at the time of suicide. The present study is in accordance with R. Ponnudurai et al.,[12] Shankar Udaya B S et al.[17] and Auer Med.[18] The present study is not in agreement with Madadin et al.[19] who found alcohol in only 5.55% of cases.

Drinking alcohol encourages people to take risks. Consumption of alcohol can reduce the inhibitions necessary for an individual to act against an impulse of suicide thoughts, which they might never have done if not under the influence of alcohol.

History of alcohol addiction: In the present study, there was a history of alcohol addiction in 37 cases out of 196. Our study is in agreement with the study by Meel BL,[20] according to which alcoholics were at high risk of suicide, which accounts for 20% to 40% of all suicides. The present study is not in accordance with Tanna JA et al.,[13] who found that 5% had a significant history of substance abuse.

Alcohol can worsen existing mental health problems and accelerate their development. Alcohol can affect the ability to cope, handle and cope with regular pressures and important life events. Alcohol plays an important role in developing or worsening pre existing mental health problems such as anxiety, depression and a tendency to self-harm. Having alcohol addiction increases the likelihood that someone will attempt suicide, and this is especially true for men. Addiction following debt is the most important reason farmers commit suicide.[21]

Summary and Conclusion: Deaths are always painful for families and friends, but some are more tragic than others. Taking into account the seriousness of farmer suicide and also the stigma to society and the country, this study was carried out to evaluate various aspects of farmer suicide in rural areas of central India where the farmer suicide rate is invariably high, which can help society reduce the rate of suicide. The current study was carried out with the aim of analyzing and being aware of various suicide methods, causes or precipitating factors, sociodemographic characteristics, time and seasonal variation, and suggesting legal and preventive policy measures. Taking into account the importance of knowing the suicide scenario, the present study was carried out titled 'Medicolegal profile of farmer's suicide cases autopsied at Rural Medical College in Central India'. A retrospective and prospective study was conducted from August 2013 to July 2017. In the present study, a total of 196 suicidal cases were included, which were autopsied at our medical school and hospital.

In addition to this, we also included age, sex, marital status, education, type of family, religion, socioeconomic status, time and place of incidence, season, alcohol addiction, alcohol consumption at the time of suicide, the reason for committing suicide, the method used, and detailed findings of post-mortem examination findings of poisoning, hanging, drowning, and burn cases.

The observations obtained were plotted in the form of tables and illustrative graphs to better understand and analyze various parameters. The results were then analyzed and compared with the work of previous authors (as cited in a review of the literature).

From the present study, the following points are deduced.

1. In most of the incidents that affected young adults (20–40 years) suicide was committed by poisoning 72 (36.7%).
2. The most common method of committing suicide was poisoning in 127 (64.8%) cases followed by hanging in 37 (18.9%) cases drowning in 24 (12.2%) cases and burning in 8 (4.1%) cases. No single case of suicide due to a firearm was seen.
3. Maximum suicidal deaths of 86 (43.88%) cases occurred in the evening (6 pm to 11:59 pm) followed by the afternoon (12 PM to 5:59 PM) 64 (32.65%) cases, morning (6 AM to 11:59 PM) 41 (20.92%) cases, and night (12 AM to 5.59 PM) 5 (2.55%) cases respectively.
4. Home was the preferred suicide comprising 114 (58.16%) cases followed by farm as suicide in 74 (37.76%) cases.
5. 32 (16.32%) farmers had consumed alcohol at the time of suicide.
6. 37 (18.88%) of the cases of farmers addicted to alcohol had committed suicide.

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ORIGINAL ARTICLE

Analysis of Injury Patterns in Railway Track Death and their correlation with Manner of Death in the Bhopal Region- An Autopsy Based Study

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Abstract:

Cases of deaths due to railway injuries are important in respect to medico- legal investigation to find out the underlying cause and manner of death. This study was undertaken for assessment of load and to study the cases of railway fatalities for the pattern of injuries sustained, manner and cause of death with the evaluation of factors responsible for such events and to suggest recommendations for curbing such events. The primary goal of this study, which focused on 107 railway-related deaths at the Gandhi Medical College in Bhopal, was to identify the cause of death from the pattern of injuries. In our study we found 91.6% of the 107 victims were men, while 8.4% were women. Most victims (54.2%) were in the age range of 21 to 40. 90.7% of 107 incidents resulted in spot deaths. In case of the visceral injuries brain and liver are maximum affected organs. Externally abrasion and contusions are commonly seen in both type of cases, abrasion found in almost 100 percent cases. Laceration and crushed injuries are more commonly seen in accidental cases and decapitation seen only in suicidal cases. There were no homicide cases in this study; instead, 66.4% of the cases were accidental and 33.6 percent of the cases were suicide. Our study's analysis suggests that after detailed examination of spot and body position at the scene of crime, closely checking for injury pattern and their frequency in same type of cases, obtaining detailed history from police, relatives and eye witnesses we can opine a possible manner of death.

Keywords: Decapitation; Suicide; Amputation; Trauma; Accident; Railway.

Introduction:

Indian Railways (IR) is a statutory body under the jurisdiction of Ministry of Railways, Government of India that operates India's national railway system.[1] It manages the fourth-largest railway network in the world by size, with a route length of 67,956 km as of 31 March 2020. 45,881 km or 71% of all the broad-gauge routes are electrified with 25 kV 50 Hz AC electric traction as of April 2021.[2,3] With ever increasing mechanization vehicular accidents are steadily increasing in magnitude and frequency. Indian Railway is the largest railway system in the world under a single management.

Railway accidents occupied an important role in the medico legal disclosures on trauma and traumatic disorders.[4] In India most of the railway tracks run in the overly populated areas and being the cheapest mode of transportation, most trains travel thickly packed, especially in India, having a large railway network with unprotected railway crossings. All these factors increase the possibilities of accidents.[5] The railway also provides a convenient mode of suicides and many cases have been reported where a person was deliberately lying across the railway line or even place his head on the line in order to achieve self-destruction.[6] Railway related deaths account for approximately one percentage of all fatalities submitted to medico legal autopsies. The purpose of all railway track death investigations is to establish the cause of incidents. Regulatory authorities may fix the responsibility and safety authorities will want to see what can be done to prevent recurrence.[7]

In recent times there has been a spate of railway accidents in India, leading to loss of a significant number of human lives.[8] Although less frequent than automobile accidents, train accidents have a major impact on victim's lives.[9] Bhopal, being the capital of the state of Madhya Pradesh is an important junction as regards to train traffic; catering to the arrival and departure of about 200 local and superfast trains per day and more than 385 trains within a week.[10] Being a metropolitan city, Bhopal district is spread over an area of about 2772 km square[11] the railway track crosses through inner parts of city of Bhopal at various places, which range from lowly populated to highly populated regions including areas with congestion of road traffic too. Trains are a common means of committing suicides owing to easy availability and higher chances of mortality.

Apart from this, train accidents can also be used as a means of masking homicidal deaths to mimic the event as an accidental or suicidal railway death. Many of these fatalities do not raise any medico-legal questions as most of these events are witnessed, but in some cases the expertise of an autopsy surgeon is sought for a legal conclusion for the manner and nature of the injuries sustained. Cases of deaths due to railway injuries are important in respect to medico-legal investigation to find out the underlying cause and manner of death.

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Material and method:

This is a cross sectional descriptive study. In 4356 autopsies, 107 cases (2.45%) were railway related deaths, which form the cohort of the present study. All autopsies were performed during a 20 month period from January 2020 to August 2021 in the department of Forensic Medicine and Toxicology of Gandhi Medical College, Bhopal, which is a tertiary care teaching hospital in state of Madhya pradesh.

The data of each deceased will be collected on a proforma specially designed for this study which includes history given by police, previous medical records if so, autopsy findings and forensic science lab evidence which will be analyzed for correlation.

Limitations of study: Many a times the history given by relatives, police and eye witnesses are not completely reliable and do not correlate with the findings of the case/body which may be the cause of limitations in this study. Sometimes photographs of the case/body and location of the body distorted due to mishandling by untrained personnel.

Results:

During the period from January 2020 to August 2021 (20 months) a total of 107 cases were reported as railway track deaths which were studied. Railway deaths constituted 2.45% of the total autopsies conducted during the study period. The maximum incidence of cases were seen in the fourth decade of life closely followed by third decade of life (Table 1). Males predominated the study with the gender ratio of 10.9:1 showing that males are more prone than females in railway track deaths (Table 2). The railway fatalities were more of accidental in nature (66.4%), followed by suicidal (33.6%) and no homicidal cases were found

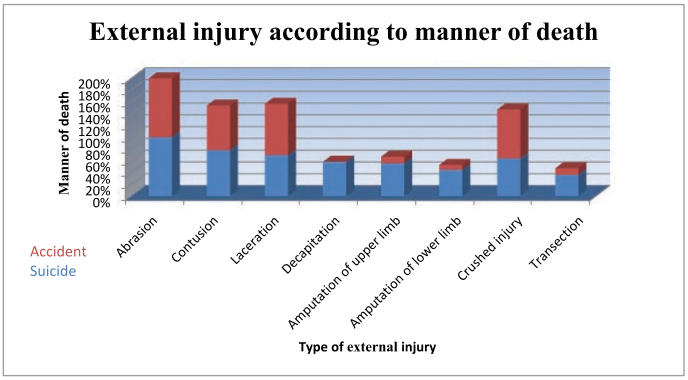

Figure 1. External injury according to manner of death.

during the study period (Table 3). The most difficult task in railway injury death autopsy cases is to established the identity of deceased, 77.5% cases were identified and 22.43% cases were unidentified until the time of postmortem. Accidents were more during the evening and night hours. Railway fatalities were more during the rainy season. January was the month with more number of mortality cases. It is very difficult to determine manner of death by just seeing the injury patterns.

After detailed examination of spot and body position at the scene of crime, closely checking for injury pattern and their frequency

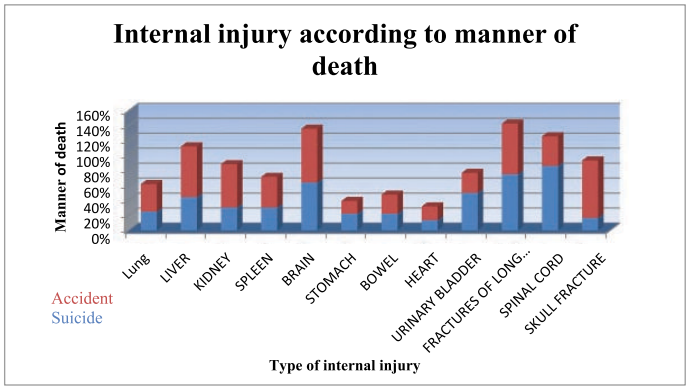

Figure 2. Internal injury according to manner of death.

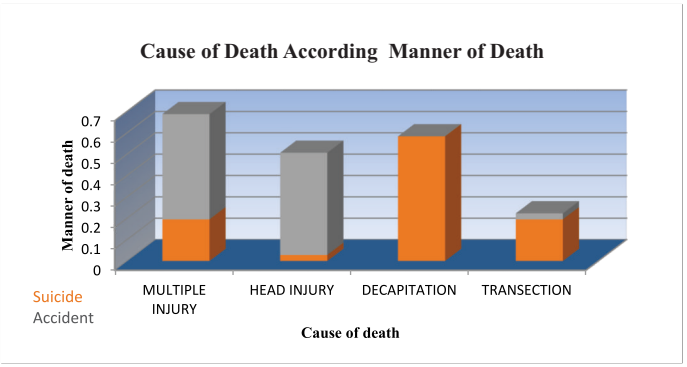

Figure 3. Cause of death according manner of death.

in same type of cases, obtaining detailed history from police, relatives and eye witnesses we can opine a possible manner of death. The accidental deaths by railway injuries occurred mostly while crossing the track or walking along the track. The suicidal deaths by railway injuries occurred mostly by lying on the track. From the analytical study of the railway fatality injuries it was revealed that fractures were most commonly seen.

Internal organs commonly involved are brain followed by liver, spinal cord, kidney, spleen, lungs etc. In accidental cases laceration and crushed injuries were the most common external injury whereas in suicidal cases decapitation, amputation of limbs and transection of body were the most common external injuries (Table 4) (Figure 1).

In accidental cases lungs, liver, spleen, kidney and skull fracture were the common internal organ injury whereas in suicidal cases spinal cord, stomach and bowel were the common internal organ injuries (Table 5) (Figure 2). Abrasion, contusion, fractures of long bones and brain injuries are found almost same in both accidental and suicidal type of cases. It is also found that injuries to the upper half of the body are more common when compared to that of lower half of the body. 90.7% cases were spot dead and which clearly shows the severity of railway injuries. Multiple injuries and head injury is most common cause of death in accidental cases. Decapitation and transection is most common cause of death in suicidal cases (Table 6) (Figure 3).

Discussion:

Out of the 4356 medico-legal autopsies conducted at the mortuary, 107 cases were of railway related deaths. The burden of railway track related deaths was 2.45% which is similar to other

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Table 1. Age wise distribution.

Age group	Frequency	Percent
11-20	7	6.5
21-30	28	26.2
31-40	30	28.0
41-50	18	16.8
51-60	11	10.3
61-70	8	7.5
70+	5	4.7
Total	107	100.0

Table 2. Sex wise distribution.

Sex	Frequency	Percent
Male	98	91.6
Female	9	8.4
Total	107	100.0

Table 3. Sex wise distribution.

Manner	Frequency	Percent
Suicide	36	33.6
Accident	71	66.4
Total	107	100.0

Table 4. External injury according to manner of death.

External Injury	Suicide (N=36)	Accidental (N=71)
Abrasion	36 (100%)	71 (100%)
Contusion	28 (77.77%)	54 (76.05%)
Laceration	25 (69.44%)	62 (87.32%)
Decapitation	21 (58.33%)	0 (0.0%)
Amputation of upper limb	20 (55.55%)	8 (11.26%)
Amputation of lower limb	16 (44.44%)	6 (8.45%)
Crushed injury	23 (63.88%)	59 (83.09%)
Transection	13 (36.11)	8 (11.26%)

studies Das G et al.[14] (1.96%) and Rohit Kumar et al.[15] (2.16%). And quite less as compared of other studies conducted in different parts of the country as 6.7% Kumar A,[16] 25.79% Sheikh MI et al.,[4] 5.99% Wasnik RN.[12] These differences in various parts of the country can be explained by the geographical variations in the population, availability of rail road facility, security and the awareness of general population of the region. Although the death toll in 2020 was lower than in the last four years, it remains important as passenger traffic was restricted following the announcement of the corona virus lockdown on March 25. Only freight trains were in operation during the closure period. Before the railroad began, a special Shramik train ran from May 1st, taking migrant workers home.

77.57% of railway fatalities autopsied during the study period were identified and remaining 22.43% dead bodies were unidentified until the time of postmortem examination. Which is similar to Rohit Kumar et al.[15] which is 18.25% unidentified bodies. Maximum numbers of victims were in 21-40 years of age group (54.2%). The peak occurring in age group of 31-40 years (28%). Similar results have been reported by other authors Wasnik RN[12] and Das G et al.[14] Males predominated the study population (91.6%) out numbering the females (8.4%) which is similar to other studies Puttaswamy,[17] Tyagi S et al.,[18] Wasnik RN[12] and Das G et al.[14] The sex ratio in this study was 10.9:1, which is quite similar to 10.4:1 Rohit Kumar et al.[15] and 8.62:1 Wasnik RN.[12] However, the results of this study are not similar to those of Kumar A[16] who reported a male: female ratio of 1:1.3. The reason for high incidence of railway fatalities in males reflects their high activity levels and participation in high-risk activities. It is due to greater male exposure to the railways. On the contrary, females

Table 5. Internal injury according to manner of death.

Internal injury	Suicide (N=36)	Accidental (N=71)
Lung	9 (25%)	26 (36.66%)
Liver	16 (44.44%)	48 (67.60%)
Kidney	11 (30.55%)	41 (57.74%)
Spleen	11 (30.55%)	29 (40.84%)
Brain	23 (63.88%)	51 (71.83%)
Stomach	8 (22.22%)	12 (16.90%)
Bowel	8 (22.22%)	18 (25.35%)
Heart	5 (13.55%)	13 (18.30%)
Urinary bladder	18 (50%)	19 (26.76%)
Fractures of long bone	27 (75%)	48 (67.60%)
Spinal cord	31 (86.11%)	28 (39.43%)
Skull fracture	6 (16.66%)	54 (76.65%)

Table 6. Cause of death according manner of death.

Cause of death	Manner of death		Total
	Sucide	Accident	
Multiple injury	7(19.44%)	35(49.29%)	42
Head injury	1(2.77%)	34(47.88%)	35
Decapitation	21(58.33%)	0(00%)	21
Transection	7(19.44%)	2(2.81%)	9
Total	36	71	107

are confined to various indoor activities principally and further precaution taken by members of the family to keep them safe.

The information furnished by police in the inquest report on the basis of history from eye witnesses, relatives and spot examination. Our study revealed that accidental railway fatality was the commonest manner (66.4%) followed by (33.6%) suicidal deaths which are similar to Rohit Kumar 2016 (67.4% accidental & 27.7% suicidal),[15] Wasnik RN (91% accidental & 8.68% suicidal deaths),[12] Kumar A (88% accidental & 10% suicidal)[16] and Tyagi S et al. (90% accidental & 2% suicidal).[18]

Decapitation (Figure 4) was the commonest (about 58.3%) followed by transection from the chest & trunk (Figure 5) observed in 19.4% cases in suicidal cases. Crush amputation of extremities (upper and lower limbs) were seen in 46.7% cases which is also shown in study of Panigrahi H et al.[20] Multiple fractures were seen commonly in most cases with fracture ribs seen as a common occurrence due to the effect of shearing and grinding force from rotating train wheels.

The study revealed that head was injured in most cases followed by upper limbs, chest, neck, lower limbs & trunk. Victims had also suffered other injuries from primary and secondary impacts which is similar to the study of R Raut ji.[13]

In the present study Brain was the most commonly affected internal organ (69.2%) followed by liver (59.8%), spinal cord (55.1%), kidney (48.6%), Spleen (37.4%) and least heart (16.8%). Our results are quite similar to those of Wasnik RN.[12] Abdominal injuries were sustained following primary and secondary impact resulting in grave injuries to abdominal viscera and transection at the abdominal level. These results are similar to the studies of Wasnik RN[12] and Sheikh MI et al.[4]

In this study suicidal death occurs most commonly by lying over the track (86.11%) and in few cases by walking on the track in front of the train (11.11%), whereas the most common circumstance of accidental railway related deaths was during the crossing the track (56.33%) which is similar to the study of

Figure 4. Decapitated body present in between rails.

Figure 5. Transected body present half on the track and half on side.

Figure 6. Showing decapitation and amputation of both legs in same case.

Figure 7. Showing multiple abrasion present over both lower limbs.

Figure 8. Showing multiple abrasion and graze abrasion.

Panigrahi H et al.[20] In this study, in case of accidental death externally laceration and crushed injuries are most common and internally lungs, liver, spleen, kidneys and skull fractures are most common which is similar to the study of Dr. Syed Zubair Ahmed Tirmizi et al. study.[19] In this study in case of suicidal death externally decapitation, amputation of limbs and transection is most common and internally stomach, bowel and spinal cord injuries are most common which is similar to the study of Panigrahi H et al.[20] (Figure 6).

Abrasion, contusion, fractures of long bone and brain injuries are found almost same in both type of cases. These results are closely similar to Dr. Syed Zubair Ahmed Tirmizi et al. study[19] (Figure 7 & 8). Most common cause of death in our study was multiple injuries (39.3%) which involved multiple fractures, traumatic amputations of limbs and crush injuries. Our results are in accordance with studies of Sheikh MI et al.[4] Wasnik RN[12] and Das G et al.[14] Our results are dissimilar to study of Tyagi S et al.[18] who reported head injury to be the commonest cause of death followed by shock and hemorrhage.

Miscellaneous factors which also contributed in accidental railway track death such as consuming alcohol while sitting on track, taking photographs (selfie) in front of an oncoming train, and living near track in slum area also proved to be fatal due to regular movements near the railway tracks.

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Conclusion:

The proper certification of death in general and of railway deaths in particular, is dependent not only on the skill of the autopsy surgeon, but also on his knowledge and grasp of the connected medico-legal issues. The following observations should be considered while determining the medico-legal cause of death.

1. Postmortem findings.

2. Immediate circumstances leading to death.

3. Explicit or implicit mental intent of the victim and

4. Psychological profile and pattern of the victim or causality.

The victim's implicit mental intent, as well as his psychological profile and pattern, may be essential in comprehending the cause of the fatality and its legal values. Autopsy findings and real accident reconstruction are the most important predictors of medico-legal cause of death. The presence of severe injuries, such as crush injuries to the head, traumatic decapitations, trunk crush injuries, and limb amputations, may indicate that the cause of death was traumatic. The pattern of injuries and situations reveals the traumatic character of dying.

The purpose of the railway deaths investigation is to ascertain the cause of death; it is not a court for determining legal liability.

As a result, the entire technique of the investigation differs from the type of investigation that may be undertaken in other sorts of incidents. In most circumstances, when a dead corpse is discovered along a railway track, the public might assume it was an accidental or suicidal death. The same is true when a dead person is discovered in a railway compartment, which can be assumed to be a natural death. In all of these cases, the investigating officer is more concerned with getting the dead body to the nearest mortuary and completing the formalities than with conducting a thorough inspection of the crime scene.

Typically, the study of the crime scene is limited to capturing one or two images, which is insufficient. This is how many crucial clues are lost in the first stage. The same is true when a medical officer gets a railway fatality for autopsy. The autopsy is performed with a preconceived notion of suicide or accident in mind, taking into account the pattern of injuries across the body. Suicidal deaths are defined as decapitation or traumatic amputations, whereas multiple trauma fatalities are defined as accidental.

When compared to other cases, the Medical Officer spends less attention without looking into history because the majority of these cases are reported as unknown bodies. As a result, partial autopsies and inappropriate analysis of injury patterns became a prevalent source of error in medico-legal evaluation. The damage should be inspected in further detail to determine whether it is ante mortem or post mortem from bleeding infiltration into tissues or essential organs.

In questionable circumstances, a thorough histo-pathological study is performed to resolve the issue. The determination and evaluation of casualties in railway fatalities may be complex, but careful investigation of the medico-legal casualty frequently proves to be of medico-legal relevance to many individuals and societal groups .

Compliance with ethical guidelines: This study was approved by Institutional Ethics Committee of Gandhi Medical College, Bhopal (MP) affilated to Madhya Pradesh Medical Science University, jabalpur (MP), india.

Registration No. (code) ECR/1055/Inst/MP/2018

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Conflict of Interest: - None

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ORIGINAL ARTICLE

Study of the Socio-Demographic Profile, Pattern of Substance Abuse and Criminal Behaviour in Patients with Opioid Use Disorder

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Abstract:

With the ongoing increase in supply, temptations, stressful lifestyle and easy availability, substance abuse is growing amongst different populations at an alarming rate. Its demand is increasing alarmingly in the younger generation due to various socio-economical reasons. Substance abuse has also been found to be associated with violent behaviour and infectious diseases. The aims of this study were to find out the socio-demographic profile, pattern of substance abuse and criminal behaviour associated with Opioid Use Disorder. 106 diagnosed patients of Opioid Use Disorder registered at the OST Centre, Department of Psychiatry, S.R.N. Hospital, associated with Moti Lal Nehru Medical College, Prayagraj were included. All patients were interviewed according to a semi-structured questionnaire prepared for the purpose of collection of information regarding patterns of opioid abuse and history of criminal behaviour, if any. Out of 106 cases, 48 were found with a history of criminal behaviour. Criminal behaviour was found mostly amongst the cases of unemployed and uneducated cases. Cannabis was found to be the most common substance used prior to initiation of opioid abuse. The 20-29 years age group was found to be the most vulnerable age group for initiation of opioid abuse and commission of crime. Accordingly, the 2nd and 3rd decade of life needs better familial and social support along with strict law enforcement related to the supply of illicit substances.

Keywords: Opioid addiction; Criminal behaviour; Criminality; Alcohol; Cannabis.

Introduction:

Consumption of different substances of abuse has been in existence all around the world since the dawn of civilization. Usually, adolescence is the critical phase of life when the first initiation of substance abuse takes place. Around 275 million people had used drugs worldwide during the last year, while over 36 million people suffered from drug use disorders. Between the years 2010-2019, the number of people using drugs has increased by 22 per cent and opioids continue to account for the largest burden of infectious disease attributed to intravenous drug use.[1] Violent behaviour is also linked with substance abuse and it can occur during various phases, such as acute intoxication, withdrawal, or substance-induced psychosis. Furthermore, violence may occur both in individuals who do and in those who do not suffer from a substance use disorder.[2]

Material and methods:

The present study was approved by the Institutional Ethics Committee (Ethics Committee Registration No. ECR/922/inst/UP/2017 issued under Rule 122DD/of the Drugs & Cosmetics Rule 1945), M.L.N. Medical College, Prayagraj. Written informed consent was obtained from adult research participants. The study was conducted in accordance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Humans. The study was a descriptive cross-sectional study. This study aimed to find out the socio-demographic profile and criminal behaviour in patients with Opioid Use Disorder. The study has been conducted by the Department of Forensic Medicine and Toxicology, M.L.N. Medical College, Prayagraj and carried out on the patients of Opioid Use Disorder registered at Opioid Substitution Therapy Centre, Department of Psychiatry, Swaroop Rani Nehru Hospital, Moti Lal Nehru Medical College, Prayagraj. The duration of the study was 12 months. All patients of Opioid Use Disorder who arrived at Opioid Substitution Therapy Centre for initiation or follow-up of pharmacotherapy were included. Those excluded were the patients not willing to be included in the study or those having other unrelated psychiatric disorders like Schizophrenia, Bipolar Affective Disorder, Obsessive Compulsive Disorder and Dementia.

Results:

Total 106 cases (102 males and 4 females) of Opioid Use Disorder were taken in this study, out of which, 48 cases had criminal history, comprising 45.28%. Out of these 48 cases, 35 (32.41%) cases had conviction or penalization by the court of law.

Table-I indicates the occupational status of the cases. It is observed that 55 (51.89%) cases were skilled workers followed by 29 (27.35%) unskilled workers, 20 (18.87%) unemployed cases and 2 (1.89%) professionals. Amongst all the cases, the greatest proportion of criminal behaviour is found associated with unemployed and unskilled workers (more than 50%). Skilled workers have lesser such history, while no criminal tendency is observed in the professionals.

Table II illustrates the educational status of the cases. The

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majority of the cases are illiterate i.e., 32 (30.19%) followed by those who received education up to primary level i.e., 31 (29.25%). It is followed by 21 (19.81%) cases with education up to high school, 12 (11.35%) cases with intermediate and at last 10 (9.43%) cases with graduate level education. The above table clearly reveals that education had a negative impact on criminal tendencies in the observed cases. The proportion of criminal association is found much higher in illiterate and primary level educated cases (more than 50%) in comparison with the cases that had higher educational levels.

Table III enlightens the relationship between different types of substance abused and criminal history. According to this table, out of 106 cases of Opioid Use Disorder, 48 cases have a history of criminal behaviour. Out of these 48 cases, those addicted to the combination of Cannabis and Opioid i.e. 26 (54.17%) have the highest incidence of the criminal act, followed by cases with

Table 1. Distribution of Cases on the basis of their Occupational Status (N=106).

Occupational Status	Male		Female		Total	
	No. of cases	With Criminal history	No. of cases	With Criminal history	No. of cases	With Criminal history
Professional	2 (1.89%)	0 (0%)	0 (0%)	0 (0%)	2 (1.89%)	0 (0%)
Skilled Worker	55 (51.89%)	21 (19.81%)	0 (0%)	0 (0%)	55 (51.89%)	21 (19.81%)
Unskilled Worker	29 (27.35%)	14 (13.21%)	0 (0%)	0 (0%)	29 (27.35%)	14 (13.21%)
Unemployed	16 (15.09%)	11 (10.38)	4 (3.77%)	2 (1.89%)	20 (18.87%)	13 (12.26%)
Total	102 (96.23%)	46 (43.39%)	4 (3.77%)	2 (1.89%)	106 (100%)	48 (45.28%)

Table 2. Distribution of cases on the basis of their educational status (N=106).

Educational Status	Male		Female		Total	
	No. of cases	With Criminal history	No. of cases	With Criminal history	No. of cases	With Criminal history
Graduate	9 (8.49%)	2 (1.89%)	1 (0.94%)	0 (0%)	10 (9.43%)	2 (1.89%)
Intermediate	12 (11.32%)	6 (5.66%)	0 (0%)	0 (0%)	12 (11.35%)	6 (5.66%)
High School	20 (18.87%)	9 (8.49%)	1 (0.94%)	0 (0%)	21 (19.81%)	9 (8.49%)
Primary	31 (29.25%)	17 (16.04%)	0 (0%)	0 (0%)	31 (29.25%)	17 (16.04%)
Illiterate	30 (28.30%)	12 (11.32%)	2 (1.89%)	2 (1.89%)	32 (30.19%)	14 (13.21%)
Total	102 (96.23%)	46 (43.39%)	4 (3.77%)	2 (1.89%)	106 (100%)	48 (45.28%)

isolated Opioid addiction i.e. 17 (35.42%). Alcohol and Opioid consumption are found in 2 (4.17%) cases with a criminal history. Alcohol, Cannabis and Opioid consumption are also found in 2 (4.17%) cases. Lastly, alcohol, cannabis, alprazolam and opioid consumption is found in only 1 (2.08%) individual. Cases who abused alcohol and opioid have committed crimes like bomb making (1) and theft (1). Cases who abused cannabis and opioid were charged by the law against crimes like theft (9), multiple crimes (7), attempt to murder (1), murder (1), bomb making (2), handling drugs (3), IPC 151 (2), IPC 355 (1). Cases that abused alcohol, cannabis and opioid were charged against crimes like handling drugs (1), theft (1). One case that abused alcohol, cannabis, alprazolam and opioid had committed multiple types of crime. Cases who abused only opioid were charged against crimes like attempt to murder (2), bomb making (2), criminal intimidation (1), handling drugs (3), IPC 151 (1), murder (1), theft (1), multiple crimes (6). Overall, it can be concluded from the data of this study, as theft (25%) has the highest incidence amongst all types of crimes committed, that it could be executed for the purpose of obtaining the substance of abuse.

Fig. 1 shows the history of other substances abused prior to Opioid use. The most common substance abused before Opioid addiction is found to be Cannabis in 58 cases, out of which, half of the cases (29 cases) have shown criminal history. Previous addiction to alcohol is found in 22 cases, having 6 cases with a criminal history. Similarly, 9 cases of tobacco addiction have shown criminal history in 5 while 3 cases of Alprazolam addiction have criminal history in only 1 case. Surprisingly, out of those 33 cases who started consuming opioid directly, without any prior substance use have criminal history in 15 cases.

Fig. 2 depicts the distribution amongst age groups of those cases who have criminal history (n=48) when they consumed Opioid for the very first time. According to this table, the majority have consumed Opioid for the very first time in their 3rd decade of life i.e. 27 (56.25%) cases. The second most common age group of beginning of Opioid consumption is found to be <19 years and 30-39 years, having 9 (18.75%) cases in each group. The least number of cases are from the >40 years age group with only 3 (6.25%) cases.

Fig. 3 depicts the age of the cases with criminal history when they committed the first crime. 3rd decade of life shows the most number of cases. The age group 20-25 years is found to be the most vulnerable age group for committing the crime with 16 (33.33%) cases. The second most common age group is 25-30 years with 11 (22.92%) cases. This indicates that, out of 48 cases, 27 have committed their first crime in their 3rd decade of life. It is also evident from the above table that with advancing age, criminal tendency reduced continuously as 10 (20.83%) cases are observed to commit the crime in 30-35 years of age while 3 (6.25%) in 35-40 years of age with only 2 (4.17%) after 40 years of age. A small number of cases have done the criminal act in their 15-20 years of age i.e. 6 (12.50%) cases.

Discussion:

In the present study, out of 106 cases, there are 102 male subjects and 4 female subjects of Opioid Use Disorder, 48 cases had criminal history constituting 45.28%. Distribution on the basis of their Occupational Status:- Amongst total 106 cases, 51.89% cases were skilled and 27.35% cases were unskilled workers. Similar to our results, studies conducted in relatively developed parts of India revealed that a larger proportion of Opioid abusers were unemployed or labourer as observed by Aggarwal et al., (2015)[3] (in Kota), Kumar N et al., (2013)[4] (in Mangalore). However, Bhat BA, Dar SA, Hussain A (2018)[5] (in Kashmir) and Mohanty R, Senjam G, Singh NH (2018)[6] (in Manipur) reported professional class as the major group involved. In this study, the greatest proportion of criminal behaviour was found associated

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Table 3. Relation between substance abuse and criminal behaviour (n=48).

Types of crime	Alcohol And Opioid		Cannabis And Opioid		Alcohol, Cannabis and Opioid		Alcohol, Cannabis, Alprazolam and Opioid		Only Opioid		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Attempt to murder	0	0%	1	2.08%	0	0%	0	0%	2	4.17%	3	6.25%
Bomb making	1	2.08%	2	4.17%	0	0%	0	0%	2	4.17%	5	10.42%
Criminal intimidation	0	0%	0	0%	0	0%	0	0%	1	2.08%	1	2.08%
Handling drugs	0	0%	3	6.25%	1	2.08%	0	0%	3	6.25%	7	14.58%
IPC 151	0	0%	2	4.17%	0	0%	0	0%	1	2.08%	3	6.25%
IPC 355	0	0%	1	2.08%	0	0%	0	0%	0	0%	1	2.08%
Murder	0	0%	1	2.08%	0	0%	0	0%	1	2.08%	2	4.17%
Theft	1	2.08%	9	18.75%	1	2.08%	0	0%	1	2.08%	12	25.00%
Multiples types of crime	0	0%	7	14.58%	0	0%	1	2.08%	6	12.50%	14	29.17%
Total	2	4.17%	26	54.17%	2	4.17%	1	2.08%	17	35.42%	48	100%

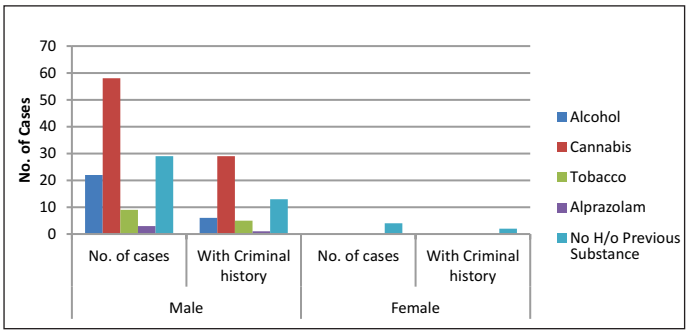

Figure 1. History of other substance abused prior to opioid use.

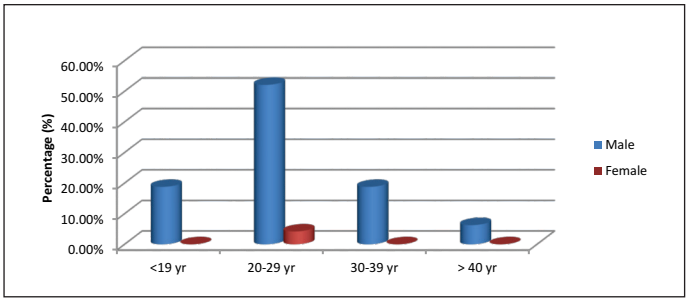

Figure 2. Age at first use of opioid in cases with criminal history (n=48).

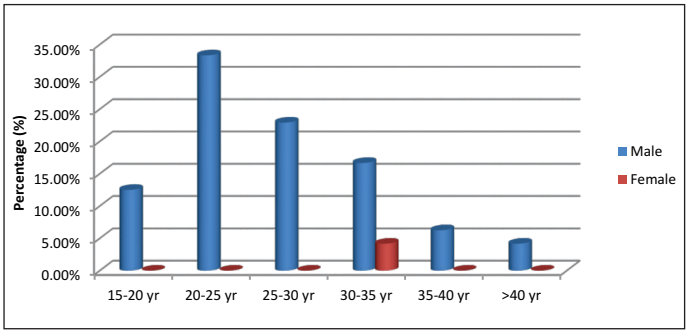

Figure 3. Age of the case at the commission of first crime (n=48).

with unemployed and unskilled workers. Skilled workers had the lesser tendency, while no criminal tendency was observed in the professionals.

Distribution on the basis of their Educational Status:- In this study, the majority of the cases were illiterate (30.19%) followed by those who received primary level education (29.25%). Our findings that lower education level is associated more with Opioid use has also been reported by Aggarwal et al., (2015)[3] (in Kota) in which the maximum number of cases of Opioid abuse received primary to middle-level education (60%). However, our results differ from Mohanty R, Senjam G, Singh NH (2018)[6] (in Manipur) in which maximum cases received higher secondary education (42.5%), Jumade PP, Kasbe AM, Giri PA (2016)[7] (in Mumbai) in which majority of cases received secondary education (53%) along with Kumar N et al., (2013)[4] (in Mangalore) who found out that majority of the cases were graduated (39.8%). The present study also reveals the fact that education had a negative impact on criminal tendencies amongst the observed cases. The proportion of criminal association was found much higher in illiterate and primary level educated cases in comparison with those cases who received higher level education.

Relation between Substance Abuse and Criminal Behaviour:- Out of 48 subjects with a criminal history, cases who abused alcohol and opioid committed crimes like bomb making (1) and theft (1). Cases who abused cannabis and opioid were charged by the law against crimes like theft (9), multiple crimes (7), attempt to murder (1), murder (1), bomb making (2), handling drugs (3), IPC 151 (2), IPC 355 (1). Cases that abused alcohol, cannabis and opioid were charged against crimes like handling drugs (1), theft (1). One case that abused alcohol, cannabis, alprazolam and opioid had committed multiple types of crime. Cases who abused only opioid were charged against crimes like attempt to murder (2), bomb making (2), criminal intimidation (1), handling drugs (3), IPC 151 (1), murder (1), theft (1), multiple crimes (6). Overall, it can be concluded from the data of this study, as theft had the highest incidence amongst all types of crimes committed, that it could have been executed for the purpose of obtaining the substance of abuse.

In most of the studies, it was found that substance abuse plays a significant role in the criminal behaviour of the cases, especially when the case is an abuser of multiple types of substances. A study conducted by Sharma S, Sharma G, Barkataki B (2016)[8] found that the most common crime associated with Opioid abusers were Snatching and Burglary, with Cannabis use it was found to be Murder or Attempt to murder, while amongst alcohol and inhalant users, Rape was the commonest crime. Other studies which found a positive relationship between substance abuse and criminal behaviour are Hammersley et al., (1989),[9] Lundholm, L.

(2013)[10] and Javier Fernández-Montalvo et al., (2013).[11]

Prior substance abused before initiating with Opioid:- Amongst total 106 cases, the most common substance abused prior to Opioid addiction was found to be cannabis in 58 cases, out of which, half of the cases had shown criminal behaviour. Criminal history was found in 6 out of 22 cases of alcohol addiction. Surprisingly, amongst those 33 cases who started consuming Opioid directly, 15 had a criminal history. Many studies found history of other substances like Cannabis, alcohol, tobacco, etc. getting consumed by the case before initiating with Opioid, such as Bhat BA, Dar SA, Hussain A (2018)[5], M.-F. Poirier et al., (2004)[12], S. E. Back et al., (2011).[13]

Age of patient at the initiation of Opioid consumption:- Amongst 48 cases with criminal history in this study, the majority had consumed opioid for the very first time in the 3rd decade of their life i.e. 56.25% cases. Second most common age group was found to be <19 years and 30-39 years, having 18.75% cases in each group. The least number of cases were from the >40 years age group. It is now established that age group of 20-29 years is the most vulnerable age group for opioid initiation followed by the age group <19 years in the majority of the studies. Mohanty R, Senjam G, Singh NH (2018)[6] had 50% cases who initiated opioid abuse between 20-29 years of age while Bhat BA, Dar SA, Hussain A (2018)[5] had 89.19% of cases who initiated before 19 years of age. In an article, 'Cannabis as a Gateway Drug for Opioid Use Disorder' written by Arthur Robin Williams,[14] it was summarized that several converging lines of inquiry have shown that adolescent and young adult (i.e. through age 24) brain development is key to executive functioning and behavioural control, that cannabis can change adolescent gene expression and alter these key periods of neuro development, that genes can predict the priming impact of cannabis on opioids and that there is likely individual variation in the risk of cannabis use in adolescence having a deleterious effect on adolescent brain maturation and downstream vulnerability to opioid exposure and addiction.

Age of the patient at the commission of first crime:- Out of 48 cases with criminal history, 27 had committed the first crime in their 3rd decade of life. It is also evident from the data that with advancing age, criminal tendency reduced continuously as 20.83% of cases were observed to commit crime at 30-35 years of age, 6.25% at 35-40 years of age and only 4.17% after 40 years of age. It was also observed that few cases had done the criminal act in their 15-20 years of age i.e. 12.50% of cases. In a study conducted by Gordon et al., (2004)[15] in the USA, it was reported that the mean age of the first crime of the 161 youth who had committed one or more crimes (other than drug use and possession) was 11.2 years (SD = 3.1). Few studies have also suggested that there is a correlation between early onset initiation of drugs and criminal behaviour, such as C. Gustavson et al., (2007),[16] Slade et al., (2008).[17]

Conclusion:

The present study was conducted on 106 patients of Opioid Use Disorder including 102 male and 4 female patients, out of which 48 had criminal history. The greatest proportion of criminal history was found associated with groups of unemployed or unskilled workers, uneducated or primary level educated subjects. The most common type of crime committed by the subjects was found to be theft. A combination of cannabis and opioid was found to be associated with the majority of the crimes attempt to murder, murder, theft, handling drugs, etc. The most common substance abused by the cases before initiating opioid abuse was found to be cannabis while a decent proportion of individuals began directly with opioid.

According to the findings of this study, it can be concluded that 3rd decade of life is the most vulnerable age group for getting involved in addiction of substance abuse and committing crime. Many factors can be said to be responsible for such vulnerability such as childhood trauma, history of substance abuse amongst family members, literacy level, employment status, social and cultural effects along with the willpower of the individual. It is a multi-factorial phenomenon and needs to be dealt with all together. The role of family members, educational institutes, Government organizations and Law enforcement bodies are important in moulding an individual to not get involved in these illicit Activities.

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ORIGINAL ARTICLE

Is Medicolegal Autopsy necessary in Diagnosed Natural Deaths?

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Abstract:

Medicolegal autopsies are performed in unnatural, sudden and suspicious deaths to find out mostly the cause, manner and mode of death. With the annual autopsy load of 3718 in the year 2022 at our centre, 524 cases consisted of diagnosed natural deaths where the cause of death was known to the physician yet they were sent for medicolegal autopsy as initially it was registered as a medicolegal case. Estimation of magnitude of natural deaths coming for medicolegal autopsy with an aim to find out whether the autopsy findings provided any extra merit over the diagnosed clinical findings including the cause of death that is, the relevance of medicolegal autopsy in natural deaths. It is a retrospective, descriptive and cross-sectional study which took 524 cases of diagnosed natural deaths coming for medicolegal autopsy at our centre in the year 2022 amongst which unidentified cases, unnatural death cases, cases which were brought dead to the hospital, sudden deaths, deaths with suspicion of foul play, cases where no clear history of the disease were available to us and cases where medical records of the deceased could not be arranged were excluded. Out of all such diagnosed natural death cases, majority of the cases (255 cases) (48.6%) died due to sepsis and the least common cause being diseased condition of the heart which constituted (56 cases) (10.6%) amongst such diagnosed natural deaths. On medicolegal autopsy, there were no extra appreciable findings which could justify the physician's decision of sending the deceased for medicolegal autopsy.

Keywords: Medicolegal; Autopsy; Natural; Unnatural; Deaths.

Background and justification:

Literally, autopsy signifies personal inspection.[1] Broadly, there are three major types of autopsies:

i. Academic or Anatomical autopsy- here the medical students gather information regarding the normal structures of external and internal human organs, ii. Pathological autopsy/clinical autopsy which is performed by pathologists or clinicians solely to find out the cause of death[1] including extent of a disease condition and sometimes to check the effectiveness of the provided treatment on the disease process,[2] iii. Medicolegal autopsy which is synonymously used with the term "post-mortem examination" where the autopsies are generally performed in sudden, suspicious and unnatural deaths. It is carried out after receiving a requisition and/or inquest from Police, Magistrate or following an order from Court of Law. Here all the body cavities are explored, all the organs are inspected to corroborate the findings with the evidences given by any eye witness if any and to provide substantial information to the law investigating agencies to aid in administration of justice.[1] The broad objectives of medicolegal autopsies are: i. Fixation of identity of an unknown deceased, ii. Cause of death, iii. Mode of death, iv. Nature of death, v. Manner of death, vi. Time passed since death, vii. Time passed since infliction of injuries, viii. Nature of the offending weapon causing the injuries, ix. To differentiate between dead born, still born and live born, x. Whether suspicion of any foul play could be ruled out even in cases of negative autopsies etc. In India, medicolegal autopsy is really a challenging situation to the government due to shortage of manpower including properly trained experts in this discipline and a huge number of cases demanding medicolegal autopsies.[1] While performing day to day medicolegal autopsies at our centre, we encountered that a significant number of already diagnosed natural death cases were regularly coming for medicolegal autopsies as those cases were booked as a medicolegal case.

Initially registering a case as a medicolegal/police case during the time of admission with a vague history of fall or with a history of being found in unconscious condition, does it mandate the medicolegal autopsy in cases of natural deaths where the patient was admitted in the hospital for a considerable duration of time and the cause of death was known to the physician and the cause of fall or unconsciousness was clearly established due to the natural disease process? It is highly unexpected for an autopsy surgeon to receive such cases for medicolegal autopsy where the broad indications for medicolegal autopsies are not met. The treating physician in such cases being acquainted with the entire history of the patient and the clinical records is expected to write the cause of death without a shadow of a doubt. With the annual autopsy load of 3718 in the year 2022 at our centre, 524 cases consisted of diagnosed natural deaths where the cause of death was already known to the treating physician yet they were sent for medicolegal autopsy mentioning cause of death to be determined by post mortem examination. This study is aimed to explore all those natural deaths to find out any relevance for medicolegal autopsy and whether the medicolegal autopsy is providing any extra merit over the clinical diagnosis.

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Aims and objectives:

Aim: Justification of medicolegal autopsy in diagnosed natural deaths to verify whether the autopsy findings provided any extra merit over the clinical findings in such cases.

Specific objectives: 1. To estimate the magnitude of diagnosed natural deaths sent for medicolegal autopsy.

2. To identify the cause of death amongst such diagnosed natural deaths.

Methodology:

A. Study design: Retrospective descriptive cross-sectional study.

B. Study period: January 2022 to December 2022.

C. Study area: Department of Forensic Medicine and Toxicology, NRSMCH, Kolkata.

D. Study population: Inclusion criteria: All the cases of diagnosed natural deaths coming for medicolegal autopsy at our centre which were initially registered as a medicolegal case with a history of fall or unconsciousness and were subsequently admitted, treated in the hospital for a few days and then later on were diagnosed to be a natural cause.

Exclusion criteria: i. All the cases of unnatural, sudden and suspicious deaths coming for medicolegal autopsy at our centre.

ii. All the cases registered as brought dead cases in the hospital.

iii. All the unidentified cases.

iv. All the cases of natural deaths where no clear history about the clinical condition was available to us from the medical records.

v. All the cases where medical records of the deceased could not be arranged.

E. Sample size and sampling procedure: All the 524 cases of diagnosed natural deaths amongst total number of 3718 autopsies in the year 2022 were considered for this study, based on inclusion and exclusion criteria.

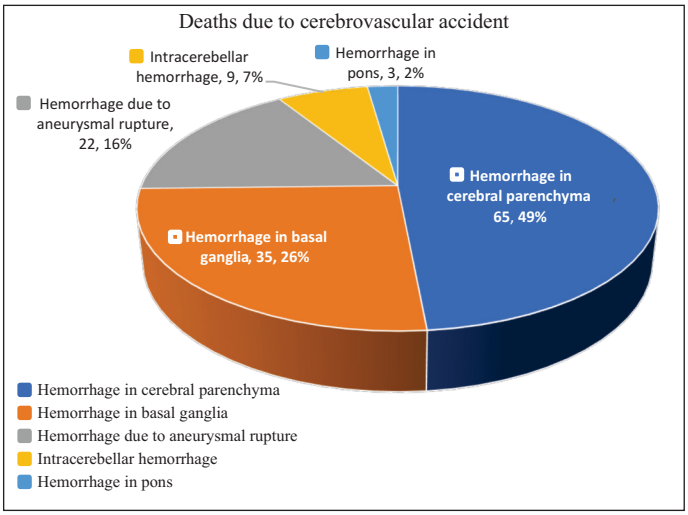
F. Data collection: Out of 3718 autopsies in the year 2022, 524 cases were found to be already diagnosed natural deaths which were initially registered as a medicolegal case where the information was collected from autopsy reports, medical records of the deceased and the police requisition/inquest and autopsy findings were compared with the clinical findings to find out the justification of medicolegal autopsies in those diagnosed natural death cases and whether the medicolegal autopsies in those cases were providing any extra merit over the clinical findings.

G. Data analysis: The collected data is stored in the computer, tabulated and statistically analysed.

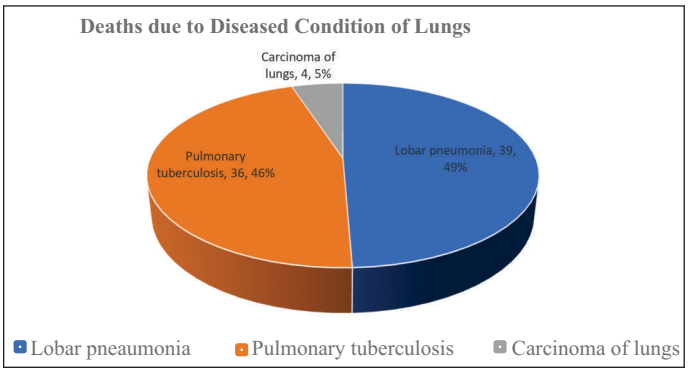
H. Human subject protection: Approval from the Institutional Ethics Committee of NRSMCH was taken.

Results:

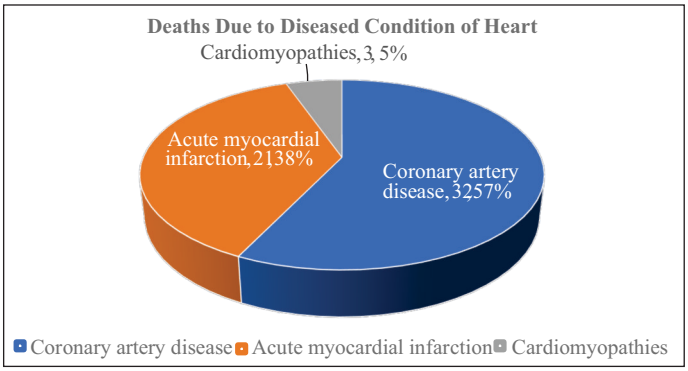
After the autopsy reports of the above given cases were compared with the clinical findings from the medical records of the deceased, to our surprise we noticed no difference in both the findings which completely justifies the fact that medicolegal autopsy is not required in cases of natural deaths where the physician has already diagnosed the cause after the patient was admitted and treated for a considerable duration of time under him/her.



Graph 1. Showing the proportion of various causes of deaths in deaths due to cerebrovascular accident.



Graph 2. Showing the proportion of various causes of deaths in deaths due to diseased condition of lungs.



Graph 3. Showing the proportion of various causes of deaths in deaths due to diseased condition of heart.

Discussion:

Medicolegal autopsies are performed after getting inquest from the police or magistrate. As per the law of our country which authorizes the investigating officer to hold an inquest in sudden, suspicious and unnatural death cases as per Section 174 of CrPC.

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Table 1. Showing the proportion of medicolegal autopsies performed on both natural and unnatural death cases out of the total number of medicolegal autopsies performed in the year 2022.

Serial Number	Autopsy	Number of Cases
1>	Total number of medicolegal autopsies	3718
2>	Total number of medicolegal autopsies in unnatural deaths	2937 (78.91%)
3>	Total number of medicolegal autopsies in natural deaths	781 (21.09%)

Table 2. Showing the proportion of medicolegal autopsies performed in the year 2022 in various types of diagnosed natural deaths.

Serial Number	Type of Diagnosed Natural Death Case	Number of Medicolegal Autopsies done in Diagnosed Natural Death Cases in 2022 (n=524)
1.	Sepsis	255 (48.6%)
2.	Cerebrovascular accident	134 (25.7%)
3.	Diseased condition of lungs	79 (15.1%)
4.	Diseased condition of heart	56 (10.6%)

The term "sudden death" here literally differs from the WHO definition of sudden death and indicates those deaths where death is not certified and considered as a medicolegal case. Unnatural deaths include cases of accidents, suicides, homicides including death following an attack of an animal, snakebite cases, on-table deaths etc. As per Merriam-Webster medical dictionary, "natural death is defined as death occurring in the course of nature and from natural causes (as age or disease) as opposed to accident or violence".[3] Natural causes are also defined in a way when a lesion is found at autopsy which is incompatible with life like ruptured aortic aneurysm or when a lesion found at autopsy which is known to cause death without any suspicion of foul play like advanced heart disease, lobar pneumonia, etc.[4] It is mandatory that all unnatural deaths and brought dead cases should be reported to the police and in all such cases inquest should be done but depending on the circumstances of death, it is the sole responsibility of the investigating police officer to decide whether medicolegal autopsy is at all required in those cases. The basic objective of inquest is to find out the commission of any offence by creating a record of crime if any, to reveal the truth behind the deaths.

In routine day to day autopsy practice at our centre, it is revealed that a mentionable number of diagnosed natural cases are sent for medicolegal autopsies as at the time of arrival at the hospital, the cases were booked as a medicolegal case either due to unconsciousness or with a vague history of fall.

In cases of deaths due to sepsis, an internal focus of infection in the body mainly served as the source of septicemia as was evident from the clinical history and the hospital records in most of the cases.

Out of the 134 deaths due to cerebrovascular accident, the majority of deaths were due to hemorrhage in the cerebral parenchyma (65 cases) followed by deaths due to hemorrhage in basal ganglia (35 cases), deaths due to hemorrhage resulting from aneurysmal rupture (22 cases) constituted the third most common cause and the least common cause was pontine hemorrhage (consisting of 3 cases).

Out of the 79 deaths due to the diseased condition of lungs, lobar pneumonia constituted the most common cause with a total of 39 cases followed by pulmonary tuberculosis which constituted 36 cases and the least common cause was carcinoma of the lung which had a total of 4 cases.

Out of the 56 deaths due to diseased condition of the heart, the most common cause was coronary artery disease which constituted a total of 32 cases, the second most common cause was acute myocardial infarction and its complications which constituted a total of 21 cases and the least common cause was cardiomyopathy which constituted 3 cases out of the total.

Now we would like to highlight a pertaining question "does registering the case as a medicolegal case at the time of admission mandate medicolegal autopsy when the entire history of the patient along with the clinical records were available to the physician and the cause of death was purely natural without any history of foul play?". To our surprise, even though the cause of death was known to the treating physicians, still they did not certify the cause of death in the MCCD (medical certification of cause of death) and noted that cause of death is to be determined after medicolegal autopsy.

In our study out of 3718 medicolegal autopsies performed at our Centre in the year 2022, 524 cases were of diagnosed natural deaths i.e., 14.09% of the total cases which is a significant measure of unwanted autopsies where the autopsy findings do not provide any extra information over the clinical findings. Therefore, such cases could clearly be avoided to prevent wastage of manpower and resources.

Now, naturally a question in our mind arises as to where lies the problem? If we analyze the entire scenario, then we find the actual issue to be multifaceted. The issues are hereby enlisted:

A. Issues in the Emergency: i. Huge case load creating a burden on the limited number of physicians, ii. Improper history taking of each and every case as the time allotted for each patient is shortened due to the huge case load, iii. Inadequate knowledge of the physicians as to which case should be registered as a medicolegal case which is a consequence of incomplete history taking.

B. Issues in the ward: i. Huge load of patients being admitted in the ward disproportionate to the number of treating physicians, ii. Inadequate history taking by the junior doctors, iii. Lack of supervision by senior doctors, iv. Improper knowledge of the doctors regarding MCCD (medical certification of cause of death) as to how to fill up the MCCD form in different cases including medicolegal cases where the pathophysiology behind the death is clearly known to the treating physicians which leads to non-certification of cause of death even in natural death cases. We would like to highlight that it is the responsibility of the hospital and the treating physician to deregister those cases as medicolegal case which were admitted with unconsciousness or a vague history of fall and later the cause of unconsciousness or the fall was clearly established due to disease condition like fall after a hypertensive intracerebral hemorrhage, fall on the ground or unconsciousness following any cardiac or cerebral cause and pathophysiology of death following a natural cause.

C. Issues on the part of police: i. Improper training of the police officers regarding preparation of inquests and fear of taking

responsibility to waive off medicolegal autopsies in those cases where the cause of death is already known and no foul play is established from investigational point of view. But it is an undeniable fact that as the treating physician who was in the best position to diagnose the disease condition and issue a MCCD (medical certification of cause of death) by exploring the pathophysiology of natural death, is not taking the responsibility to certify those deaths as natural deaths and deregistering those cases from the status of medicolegal case, it is quite obvious that the investigating officer cannot take the responsibility of waiving off the medicolegal autopsy when the treating physician has certified that the cause of death is to be determined by medicolegal autopsy in the MCCD (medical certification of cause of death).

All the above enlisted issues eventually lead to the following outcomes: i. Harassment on the part of the relatives of the deceased as a considerable number of formalities need to be completed for a medicolegal autopsy to be done and a medicolegal autopsy being done on the body of the deceased becomes a reason for grave mental agony on the part of the relatives, ii. The relatives of the deceased also face issues during claiming of insurance if any viscera at all is preserved during medicolegal autopsy, iii. Even after the medicolegal autopsy is completed, the relatives of the deceased have to wait for a considerable duration of time before the body is actually handed over to them, iv. An unnecessary burden is created on the limited number of autopsy surgeons and mortuary assistants as giving attention to such unwanted autopsies performed in diagnosed natural death cases reduces the autopsy surgeon's time which was to be allotted to cases of unnatural, sudden and suspicious deaths which mandate a meticulous and detailed autopsy.

A study conducted by Parmar, Pragnesh B et al., published in "Journal of Family Medicine and Primary Care" revealed cardiac cause of death was in 6.64 % of cases and 11.99 % were due to natural cause which were consistent with the respective inquests.[5]

A study titled "India and the problem of needless autopsies" published in "Egyptian Journal of Forensic Sciences", the authors expressed that where the cause of death was very obvious still autopsies are performed in the name of law ignoring the observations of the Supreme Court of India and they termed those autopsies as "needless autopsies" and also mentioned that unnecessary postmortem examination is a burden to India leading to waste of resources.[6] In a study done by RB Kotabagi, SC Charati et al. titled "Clinical autopsy v/s Medicolegal autopsy", the authors emphasized the need of clinical autopsies to reduce the burden of medicolegal autopsies where the cause of death were already established and to study the disease process in situ to enrich the medical knowledge. Their study was aimed to create awareness among the medical officers of their institute by highlighting the differences between medicolegal autopsy and clinical autopsy.[7]

In a study done by Parekh U, Kanchan T published in "Journal of Forensic and Legal Medicine", the authors concluded that in India under Section of 174 CrPC, innumerable cases which were sent for medicolegal autopsy should be considered as highly needless which included natural deaths as well as unnatural hospitalized deaths where the treating physician could certify the cause of death as the mechanism and pathophysiology of death was well understood. Though the cases were designated as medicolegal cases at the time of hospital admission but had well documented clinical case records and thus the cause of death was known to the treating physician and in all those cases, medicolegal autopsy was unnecessary.[8]

In a study done by Gupta S et al. titled "An approach to sudden natural deaths in medicolegal autopsies at Karamsad, Gujarat" published in the "Journal of Indian Academy of Forensic Medicine", the authors thoroughly reviewed 825 autopsy cases which were held from January 2007 to December 2009 over a span of 3 years. Out of 825 cases, 63 (7.64 %) died due to a sudden natural cause. 31-50 years was the most common age group as per the authors to which most of the cases belonged to. The most common cause of such deaths was cardiovascular disease which shared 58.73 % of the sudden natural deaths. Coronary artery disease was the most common cause of death amongst the cardiovascular causes.[9]

In a study done by Angam G et al. titled "A study of the pattern of sudden natural deaths: A JNIMS experience" published in the "Journal of Indian Academy of Forensic Medicine", as per the authors, majority of the natural deaths were due to cardiovascular diseases which contributed to 45 % of the total natural deaths with respiratory diseases being the second most common cause contributing to 28 % of the natural deaths. Gastrointestinal diseases contributed to 22 % of the natural deaths and neurological diseases were the least common cause of natural death contributing a mere 5% of the total natural death cases. The most common cause amongst the cardiovascular diseases contributing to natural death was ischemic heart disease.[10]

In a study done by Dayananda R et al. titled "Pattern of sudden natural deaths among autopsies conducted at Mysore Medical College" published in the "Journal of Indian Academy of Forensic Medicine", the authors studied 204 cases of sudden natural deaths out of which cardiovascular diseases contributed to 128 deaths being the most common cause of sudden natural deaths followed by respiratory diseases which contributed to 46 deaths, neurological diseases which contributed to 16 deaths, gastrointestinal diseases which contributed to 9 deaths, genitourinary diseases which contributed to 4 deaths. 119 deaths (41%) were due to coronary artery disease alone making it the most common cardiovascular cause of natural death.[11]

Conclusion and recommendations:

Taking into account the scenario as noted above and the issues faced both on the part of the doctor and the police with respect to such diagnosed natural death cases, the following recommendations can be taken into account :- i. If at all the treating physician is interested in knowing the etiology of the disease, then there should be a provision for pathological autopsy instead of medicolegal autopsy as clinical or pathological autopsy aims at studying the disease condition in detail rather than stressing on the mode and manner of death, ii. Physicians should take more responsibility on their shoulders for effective history taking and efficient management despite the huge load of patients as apt and efficient history taking can help the physicians

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to decide at the time of admission itself as to which cases are to be registered as a medicolegal case thereby reducing the number of unwanted medicolegal autopsies later on, iii. Proper supervision of the junior doctors by the senior doctors regarding the filling up of MCCD (medical certification of cause of death) and the training of the physicians in general as to which cases should be labelled as medicolegal which in turn would help the police to arrive at a decision regarding which cases are to be sent for medicolegal autopsy, iv. Physicians should not hesitate in having a proper communication with the police if they deem it necessary during the course of treatment that the case should be deregistered from the status of medicolegal case, v. Proper inquest should be done by the police to evaluate whether there is actually any foul play in question which will further dictate the necessity of any medicolegal autopsy.

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ORIGINAL ARTICLE

Determination of Sexual Dimorphism from Foramen Magnum in an Eastern Indian Population

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Abstract:

Human identification is an important arena of forensic investigation, it includes sex determination which becomes extremely difficult in fragmented skeletal remains. Skull dimensions are measured for the purpose of sexual dimorphism which vary in different populations. In this study, we attempted to analyse the measurements from adult human skulls and employ discriminant function to predict sex accurately. A manual vernier calliper was used to measure the antero-posterior (AP) diameter and transverse diameter of foramen magnum of 88 skulls (49 males, 39 females) from the collection housed at the department of Anatomy, RG KAR medical college and Calcutta medical college. The Wilk's lambda for the model is 0.795. The discriminant function equation is, Df= 3.342× (AP diameter of foramen magnum) +0.725× (Transverse diameter of foramen magnum) -13.641(constant). The cut-off point is 0.505. So above this value 0.505, the cases are male and below it, the cases are female. On comparing the measurements, we found that antero-posterior dimensions and transverse dimensions of foramen magnum were greater in males than females. Collectively, all the results indicate that dimensions of foramen magnum can be used as a moderate indicator for sex determination in regional populations.

Keywords: Forensic science; Forensic anthropology; Sex characteristics; Discriminant analysis; Foramen magnum.

Introduction:

Identification is the determination of individuality of a person (living or dead) based on certain physical characteristics.[1] In forensic investigation human identification is an essential trait. This identification process includes sex determination which becomes extremely difficult and complex in fragmented and mutilated skeletal remains obtained from the sites of bomb explosions, mass natural disasters, exhumations and warfares.[2] In Forensic context, the process of sex determination is directly associated with the quantity and quality of bone remains. The more number of bones available, the more will be the probability for accurate sex determination results.[3] According to Krogman, sex determination from skull can be done with 90% accuracy, from pelvis with 95% accuracy, from long bones with 80% accuracy, from pelvis and skull with 98% accuracy, from complete skeleton with 100% accuracy.[1] So, skull is one of the most useful bones for accurate determination of sex.[4] In the skull inferior to the sagittal suture on the cranial base in the posterior cranial fossa, foramen magnum is located which is largely occupied by the occipital bone and it is one of the primary centers of ossification during growth and development.[5] Murshed (2003) classified foramen magnum into eight different shapes: oval, egg, round, tetragonal, pentagonal, hexagonal, irregular A, irregular B.[6]

The aim of the present study is to estimate the sexual dimorphism among East Indian population from various parameters of dry skull bones.

Materials and methods:

The study was conducted at the department of Forensic Medicine and Toxicology, Calcutta National Medical College; department of Anatomy, RG KAR Medical College and department of Anatomy, Medical college, Kolkata. The study samples comprise of 88 skulls (49 males, 39 females) which were collected from the museums housed at the above mentioned departments.

Inclusion criteria: Dry adult human skulls irrespective of sex were included in present study.

Exclusion criteria: Skulls of children, skulls with fracture, congenital deformity and other damages or loss of bone tissue from any place were excluded from present study.

Skull bones from both sexes were kept separate as the sex determination was done beforehand by forensic experts. A vernier caliper (Mitutoyo) with a least count of 0.02 mm was used for measuring the following dimensions of foramen magnum:

- Antero-posterior diameter (APD) of foramen magnum: Distance from basion to opisthotonos in the midsagittal plane.

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- Transverse diameter (TD) of foramen magnum: Maximum distance between the lateral margins of foramen magnum perpendicular to midsagittal plane.
- Foramen magnum index (FMI): It is calculated by dividing transverse diameter by antero-posterior diameter and then multiplying that value by 100.
- Foramen magnum area (FMA): It is calculated by multiplying (π/4) with antero-posterior diameter and transverse diameter (Radinsky's formula).[7]

The data were analyzed using the SPSS (Statistical package of social sciences) software (version 29). Ethical clearance number of this study EC-CNMC/2022/32.

Table 1. Comparison of measurements in centimetre.

Sex	N=80	APD of foramen magnum	TD of foramen magnum
Males	Mean	3.56 cm	3.00 cm
	Number	49	49
	Maximum	4.07 cm	3.34 cm
	Minimum	3.05 cm	2.82 cm
	Standard deviation	0.275	0.219
Females	Mean	3.29 cm	2.84 cm
	Number	39	39
	Maximum	3.71 cm	3.24 cm
	Minimum	2.68 cm	2.62 cm
	Standard deviation	0.255	0.208

Table 2. Wilk's lambda.

Test of function (s)	Wilk's lambda	Chi-square	df	Sig.
1	0.795	19.513	2	.000

Table 3. Canonical discriminant function coefficients.

APD of foramen magnum	3.342
TD of foramen magnum	0.725
Constant	-13.641

Results:

88 skulls (n=88) were analysed for this study out of which 49 were males and 39 were females. In table 1 it has been shown that in males, mean antero-posterior diameter (APD) was 3.56 cm with a minimum value of 3.05 cm and maximum value of 4.07 cm. In males mean transverse diameter (TD) was 3.00 cm with a minimum value of 2.82 cm and maximum value of 3.34 cm. In females, mean antero-posterior diameter was 3.29 cm with a maximum value of 3.71 cm and minimum value of 2.68 cm. In females mean transverse diameter was 2.84 cm with a maximum value of 3.24 cm and minimum value of 2.62 cm. On comparing the results, we found that the antero-posterior diameter and transverse diameter of foramen magnum were greater in males than females.

Multivariate discriminant function was performed on all study variables [AP diameter, Transverse diameter of foramen magnum].The Wilk's lambda for the model is 0.795 and the p-value is 0.00 which signifies a moderate discriminating power of the model which is shown in the table 2.

Table 3 shows that the canonical discriminant function co-efficient of antero-posterior diameter of foramen magnum is 3.342 and of transverse diameter of foramen magnum is 0.725.

The discriminant function equation is: Df=3.342 ×(APD) + 0.725×(TD) -13.641(constant). Table 4 shows that the function at group centroids for males is 0.448 and for females is -0.563. The cut off point is {0.448- (-0.563)}/2=0.505. So above this value the cases are male. Below this value the cases are female.

Table 4. Function at group centroids.

Sex	Function
Male	0.448
Female	-0.563

Table 5. Classification results.

		Sex	Predicted group membership		Total
			Male	Female	
Original	Count	Male	35	14	49
		Female	9	30	39
	%	Male	71.4	28.6	100
		Female	23.1	76.1	100
Cross-validated	Count	Male	35	14	49
		Female	9	30	39
	%	Male	71.4	28.6	100
		Female	23.1	76.9	100
Original grouped cases that can be correctly classified			73.9%		
Cross validated cases that can be correctlyclassified			73.9%		

Table 6. Univariate discriminant function analysis.

Measurements	Constant	Co-efficient	Cut off value	Accuracy
APD of foramen magnum	-12.907	3.747	0.502	76.1 %
TD of foramen magnum	-13.641	4.659	0.371	65.9 %
Foramen magnum area (FMA)	-7.181	0.911	0.493	71.6 %

Discriminant function= (measurement x coefficient) + constant
If discriminant score> cut-off value = male
If discriminant score< cut-off value = female

Table 5 shows that in the present study 73.9% of original grouped cases can be correctly classified. Among the cross validated cases 73.9% can be correctly classified.

Univariate discriminant functional analysis was performed where the study samples were correctly classified according to their gender from antero-posterior diameter with 76.1% accuracy, from transverse diameter with 65.9% accuracy and from foramen magnum area with 71.6% accuracy which are shown in table 6.

Discussion:

The present study showed that the antero-posterior diameter (APD) and transverse diameter (TD) of foramen magnum are greater in males than females. This study involved the adult skull bones of eastern Indian population and values of variables obtained from this study varied with the studies conducted in recent times amongst the ethnic groups in other parts of the world. In a study conducted at Mangalore (2015), mean value of APD of males was 3.321 cm and in females was 3.099 cm, mean value of TD of males was 2.692 cm and in females was 2.545 cm, accuracy obtained from APD was 69.6% which was lower than the accuracy obtained in present study, accuracy obtained from TD was 66.4% which was slightly higher than the accuracy obtained in present study, accuracy from FMA was 70.3% which was slightly lower than accuracy of present study.[7] In a study conducted at Indore (2016), mean value of APD of males was 3.73 cm and of females was 3.395 cm, accuracy from APD here

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Figure 1

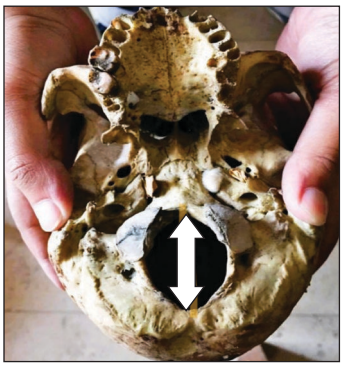

Figure 2

Figure 1. and 2. are showing the transverse diameter and antero-posterior diameter of foramen magnum marked in white arrow.

Figure 3a

Figure 3b

Figure 3a and 3b are showing the process of measuring the diameters of foramen magnum using vernier calipers.

was 53.9% which was much lower than the present study, mean value of TD of males was 3.71 cm and in females was 2.65 cm, accuracy obtained from TD was 65.4% which was slightly lower than the present study, accuracy from FMA was 72.1% which was greater than the accuracy obtained in present study.[9] A study conducted in Egypt [2020] showed that mean value of APD of males was 3.68 cm and of females was 3.57 cm and accuracy obtained from it was 59.5% which was much lower than the present study, mean value of TD of males was 3.15 cm and of females was 2.99 cm, accuracy obtained from TD was 64.7% which was lower than the present study, accuracy from FMA was 70.9% which was slightly lower than the present study.[10] A study was conducted in Turkey (2017) which showed that mean value of APD of males was 3.473 cm and of females was 3.299 cm and the accuracy of APD here was 69% which was lower than the accuracy obtained in the present study, mean value of TD of males was 3.047 cm and of females was 2.84 cm and the accuracy obtained from it was 66% which was similar to the present study, accuracy of FMA was 68% which was lower than the present study.[11] In the study conducted in Greece (2017), mean value of APD of males was 3.66 cm and of females 3.48 cm and the accuracy obtained was 63.6% which was much lower than the present study, mean value of TD of males was 3.24 cm and of females was 3.04 cm and the accuracy of TD was 65.6% which was similar to the present study, accuracy from FMA was 66.9% which was lower than the present study.[12] The study which was conducted in Iraq (2014) showed that the mean value of APD of males was 3.49 cm and of females was 3.29 cm and the accuracy of APD was 69.3% which was lower than the present study, mean value of TD of males was 2.95 cm and of females 2.73 cm and the accuracy of TD was 68.2% which was greater than the accuracy obtained in the present study, mean value of FMA was 69.3% which was lower than the present study.[3] In the study conducted in Nepal (2022), mean value of APD of males was 3.48 cm and of females was 3.22 cm and the accuracy of APD was 63.2% which was much lower than the accuracy obtained in present study, mean value of TD of males was 3.01 cm and of females was 2.78 cm and accuracy of TD was 67.3% which was greater than the present study.[13] The study conducted on Bengali population (2015) showed that mean APD of foramen magnum of males was 3.402 cm and of females 3.303 cm, mean TD of males was 2.81 cm and of females 2.746 cm, but this study didn't evaluate the accuracy of sex estimation of the dimensions of foramen magnum which has been evaluated in the present study.[14]

Conclusion:

The antero-posterior dimension and transverse dimension that have been used in the present study show significant sexual dimorphism in the studied eastern Indian population. These dimensions can be used to determine the sexual dimorphism in unknown human skulls on larger multicentric studies for use in forensic practice. However, data should only be used as a supporting finding in sex estimation in case of fragmented skull bases and not recommended as sole indicators for sexing complete skulls.

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ORIGINAL ARTICLE

Study of Cephalic Index and its correlation with Sex and Race in Central India

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Abstract:

The technique of expressing quantitatively the form of the human body, living or dead and also skeleton is anthropometry. In the world, all human beings belong to the same species, Homo sapiens. Any two individuals are not the same in all their measurable traits, even there are differences in the genetically identical twins in some respects. For estimating sex and race, cephalofacial measurements and indices are useful like the cephalic index or cranial index. 3-4 racial groups are organized by anthropologists based on skull categorization methods. India falls in this craniofacial measurements group's as considered by Thomas Huxley. Asian skulls are brachycephalic with wide faces having flat supranasal regions and facial flatness. Craniofacial type of Australoids fall between Negroids and Caucasoids. The study was conducted on 196 medical students (92 males and 104 females). Hardlika's method was used to measure the cephalic index. The mean cephalic index was 79.71 ± 4.55 in males and in females it was 83.14 ± 7.69. Irrespective of gender the mean cephalic index of overall study was found to be 81.53 ± 6.62. Based on cephalic index, 45.65% males were dolicocephalic, 31.52% mesocephalic, 15.22% brachycephalic and 7.61% hyperbrachycephalic. In females, 46.15% were dolicocephalic, 33.65% mesocephalic, 10.58% brachycephalic and 9.62% hyperbrachycephalic.

Keywords: Race; Anthropology; Cephalic index; Head length; Head breadth.

Introduction:

Homo sapiens is the species to which all the human beings in the world belong. Any two individuals are not the same in all their measurable traits, even there are differences in the genetically identical twins in some respects. Many factors which influence development of skeleton are responsible for producing differences in skeletal proportions between different geographical areas. Therefore, for quantitatively assessing such variations exhibited by such traits, some means are required. As anthropometry can indicate quantitatively the form of the human body, living or dead and skeleton, it constitutes that means and the anthropometric data is believed to be objective. [1]

Swedish professor of Anatomy Anders Retzius (1796–1860) defined the cephalic index and first he used it in physical anthropology in Europe for classifying the ancient human remains.[2] Anthropologically for finding racial and sexual differences also, cephalic index is very helpful.[3] Information about the cephalic index is helpful in living for comparing the skulls of different populations having various crucial differences in nutritional status, race, ethnicity, geography etc.[4] Cephalic index is one parameter amongst many used in the science of anthropology which is measurable and comparable to distinguish an individual, either into race or sex or even for identification.[5]

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By comparing the changes in cephalic indices of parents, off springs and siblings we can get a clue to genetic transmission of inherited characters. For designing various equipment of standard sizes like helmets, head phones, goggles etc. also anthropometric study of head is important.[6] Sexual dimorphism which is a key in individual identification is important for forensic anthropologists. For identification of unknown persons cephalic indices can be very important evidence. Such data can be useful in forensic anthropology, for comparative studies and during surgeries also. Due to variations in genetic factors, nutritional growth and habitat there are significant differences in these indices. In forensic science and medicolegal cases, differences in cephalic indices act as markers of ethnicity and sex.[7]

Material and method:

This was an observational and cross-sectional study conducted at dept. of Anatomy, JNMC, Wardha after obtaining approval from institutional ethics committee. The population selected were the medical students between age group 18-25 years regardless of their caste, religion, socio-economic status and dietary habits and were born and brought up in Central India. Informed consent was obtained. Subjects with significant growth disorders, deformities, bony anomalies, craniofacial malformations were excluded from the study.

The cephalic index was measured using Hardlika's method.[8] Students were seated in relaxed state, with back straight and looking forward. Spreading caliper was used for measuring head length and head breadth (Photo no.1). The head length or maximum antero-posterior diameter was measured by keeping one point of the two arms of spreading caliper at glabella and the

other point at inion (Photo no.2). Maximum transverse diameter or head breadth was measured as the distance between the two most lateral points on the side of the head (Photo no.3). Cephalic index was calculated by dividing maximum head breadth by maximum head length and then multiplying it by 100. Depending upon the value of cephalic index the head types were classified as:

Dolicocephalic- < 74.9

Mesocephalic- 75-79.9

Brachicephalic- 80-84.9

Hyperbrachicephalic- >85

Collected data was analyzed using SPSS version 28 software.

Observations and results:

The results of the study are presented in the tables below:

Table 1. Cephalic index in males (n=92).

	Minimum	Maximum	Mean
Head Length	16.40	19.80	18.30
Head Breadth	13	16.20	14.58
Cephalic Index	66.67	89.01	79.71

Mean head length in males was 18.30 cm, mean breadth 14.58 cm and a mean cephalic index was 79.71.

Table 2. Cephalic index in females(n=104).

	Minimum	Maximum	Mean
Head Length	13.60	19	16.90
Head Breadth	12.20	17	14
Cephalic Index	69.66	98	83.14

Mean head length in females was 16.90 cm, mean breadth 14 cm and a mean cephalic index was 83.14.

Table 3. Comparison of cephalic index in males and females.

Gender	N	Mean	Std. Deviation	Std. Error Mean	Range	p-value
Male	92	79.71	4.55	0.47	66.67-89.01	3.73
Female	104	83.14	7.69	0.75	69.66-98	P= 0.0001,
Total	196	81.53	6.62	0.47	66.67-98	S

The mean cephalic index of overall study was 81.53. In our study, the mean cephalic indices were 79.71 and 83.14 in males and females respectively. The minimum cephalic indices were 66.67 and 69.66 in males and females respectively. The maximum cephalic indices were 89.01 and 98 in males and females respectively. The difference in the cephalic index of males and females was significant.

Discussion:

Our study was an observational and cross-sectional study, conducted in dept. of Anatomy, JNMC, Wardha. In our study regardless of gender the mean cephalic index was 81.53 ± 6.62. Mean cephalic index for male subjects was 79.71 ± 4.55 and for females it was 83.14 ± 7.69 and the difference was found statistically significant. The dominant head type in central Indian males was dolicocephalic (45.65%) followed by mesocephalic (31.52%). 15.22% were brachycephalic and 7.61% were hyperbrachycephalic. The dominant head type in females was also dolicocephalic (46.15%) followed by mesocephalic (33.65%), 10.58% were brachycephalic and 9.62% were hyperbrachycephalic.

Table 4. Frequency and percentage of head phenotype (92- M, 104-F).

Head Shape	Range of cephalic index	Male	Female	Total
Dolicocephalic	<74.9	42(45.65%)	48(46.15%)	90(45.92%)
Mesocephalic	75-79.9	29(31.52%)	35(33.65%)	64(32.65%)
Brachycephalic	80-84.9	14(15.22%)	11(10.58%)	25(12.76%)
Hyperbrachycephalic	>85	7(7.61%)	10(9.62%)	17(8.67%)
Total		92(46.94%)	104(53.06%)	196(100%)

45.92 % subjects had dolichocephalic phenotype followed by mesocephalic in 32.65% subjects. 12.76% were brachychocephalic and 8.67% were hyperbrachycephalic.

Table 5. Comparison of cephalic index (mean) with other studies.

S. No.	Research workers	Population	Mean Cephalic index
1.	Bhargava & Kher, 1960	Bhils of central India	76.98
2.	Shah GV, Jadhav 2004	Gujarat population	80.81
3.	Anupama et al. 2009	Medical students of Punjab	85.53
4.	Jadav et al. (2011) Gujarat population 80.20	Jadav et al(2011) Gujarat population 80.20	80.20
5.	Anitha MR et al. (2011)	North Indian	79.7
6.	Yagain VK et al. (2012)	Indian students	80.85
7.	Babatunde OA (2014)	Nigerian Population	76.56
8.	Present Study	Central India	81.53

Anjankar et al. in their study in central India recorded the mean cephalic index as 81.21 ± 3.68 which correlates with our study but they mentioned mesocephalic as the dominant head type in their study followed by brachycephalic whereas we found dominant head type as dolicocephalic.[2] In our study mean head length in males was 18.30 cm ranging from 16.4 to 19.8 cm and mean head breadth was 14.58 cm with range of 13 cm to 16.2 cm. Mean head length in females was 16.90 cm with range of 13.6 cm to 19 cm and mean head breadth was 14 cm with range of 12.2 cm to 17 cm. In the study conducted by Shah GV et al., they recorded 18.26 cm as the mean head length in males and the range was from 16.5 cm to 20.1 cm. In females the mean head length was 16.5 cm with range from 14.1 cm to 18.9 cm. In males the mean head breadth was 14.56 cm ranging from 12.7 cm to 16.4 cm, whereas in females the mean head breadth was 14.1 cm ranging from 12.7 cm to 15.6 cm, which corresponds with our study but the mean cephalic indices noted in their study were 80.42 and 81.20 for males and females respectively which were slightly higher than our study.[3] Pandey N et al. reported dominant head type in Nepalese males as dolicocephalic followed by mesocephalic while in Nepalese females it was mesocephalic followed by dolicocephalic. In males they mentioned the mean cephalic index as 75.82 (range 74.43–80.69), while it was 78.36 in females (range 75.15-81.15) which is lesser than our study.[4] Anitha MR and Mahesh Kumar et al. in their studies on Cephalic Index in North Indian Population and Haryanvi population respectively, reported dolichocephalic as dominant head type in both males and females followed by mesocephalic and then brachycephalic, which correlates with our study.[5, 6] Twisha Shah et al. observed that in Gujarati males, mesocephalic was the dominant head type followed by dolicocephalic and the dominant head type in females was dolicocephalic followed by mesocephalic and they noted that the mean cephalic index of gujarati was 77.2.[7] Anupama Mahajan et al. in her study on Punjabi population reported the mean cephalic index of 81.34 and 85.75 for males and female respectively which corresponds with our observations.[9] Wirginia Likus et al. in his study noted that in girls

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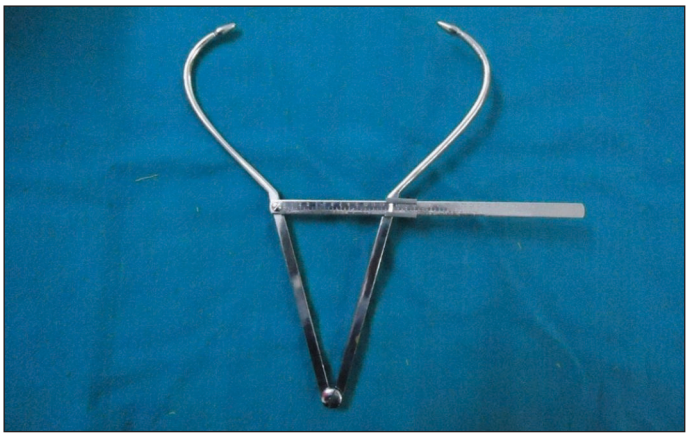

Figure 1. Spreading caliper.

Figure 2. Measuring the head length.

under 3 years of age, the average cephalic index was 80.54 ± 7.20, while it was 82.22 ± 6.87 in the boys of the same age group and the difference was not found to be significant. In both sexes the dominating head type was mesocephalic (34%). Hyperbrachycephalic type was found in 26% and dolichocephalic in 22% of the children while 18% were brachycephalic.[10]

Yagain VK et al. in their study in Karnataka reported mean head length of 18.76 cm in males and mean head breadth of 14.59 cm and in females mean head length of 17.67 cm and mean head breadth of 14.17 cm which is higher than our study. The mean cephalic index in males was recorded to be 77.92±5.2 and in females was 80.85±7.71, which is slightly less than our study. Dolicocephalic and brachycephalic were the dominant head shapes recorded each in 33%, followed by mesocephalic in 27% and hyperbrachycephalic in 6% males. Among females majority skull types were brachycephalic (33%), 29% each of dolicocephalic and hyperbrachycephalic and mesocephalic was least common (9%). In our study we found that dolichocephalic phenotype was dominant followed by mesocephalic and brachychocephalic.[11] Babatunde in his study on older children and adolescent population of Nigeria recorded the mean cephalic index as 76.56, 77.21 and 76.50 were the cephalic indices in males and females respectively. They found that 78.68% individuals were mesocephalic, 11.4%, 9.0% and 0.43% were dolichocephalic, brachycephalic and hyperbrachycephalic

Figure 3. Measuring the head breadth.

respectively. They observed that mesocephalic phenotype was predominant in school students. The head shape variations observed in different studies may be due to heredity factor and environmental factors have secondary effects. The presence of dominant head shape is also influenced by the kind of diet a person takes and also from one generation to the other.[12] Priti A. Nemade et al. noted mean cephalic index of Maharashtrian population as 78.25. Males had mean cephalic index of 77.96 and females had 78.53 which is lower than our study, also predominant skull shape was mesocephalic followed by brachycephalic.[13] Khanduri et al. in a study by Computed Tomography in a North Indian population showed mean cephalic index as 76.67±3.18, and dominant head shape was dolichocephalic in Northern India which correlates with our study.[14] Seema & Verma PT in their study on North Indian population recorded the mean cephalic index as 85.53. The mean cephalic index was 80.52 and 84.32 in males and females respectively which is higher than our study. There is evidence of continuous growth of brain more in lateral direction which is called as "brachycephalisation". This can be seen when we compare previous records with recent works on cephalic index. The head shape in tropical zones is dolichocephalic but in temperate zones it is mesocephalic or brachycephalic.[15] Isurani Ilayperuma in her study on Shrilankan medical students found mean cephalic index in males to be 78.04 and 79.32 in females which is lower than our study and the dominant type of cephalic phenotype was dolichocephalic in males and brachycephalic in females.[16] In a study by Ujwala Bhanarkar et al. on medical students of West Bengal, most of the subjects were found mesocephalic. Mean cephalic index in male was 78.45 % ± 2.44 and for female was 77.65 % ± 3.58 which is lower than our study and mean cephalic index irrespective of gender was found to be 80.5 % ± 3.67 which is also lower than our study.[17]

Conclusion:

In our study, mean cephalic index for males was 79.71 ± 4.55 and for females was 83.14 ± 7.69. Overall mean cephalic index in our study was found to be 81.53 ± 6.62. Based on cepcorresponds with our studyhalic index, 45.65% males were dolicocephalic, 31.52% mesocephalic, 15.22% brachycephalic and 7.61% hyperbrachycephalic. In females, 46.15% were dolicocephalic,

33.65% mesocephalic, 10.58% brachycephalic and 9.62% hyperbrachycephalic. So predominant head shape was dolicocephalic for both males and females. The observations in our study may be useful for similar extended cephalometric studies based on various geographical zones. It may also be useful for anthropologists and forensic science persons.

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ORIGINAL ARTICLE

Comprehensive Analysis of Fatal Road Accidents: Patterns and Characteristics of Injuries in a Forensic Medicine Setting

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Abstract:

An accident is an occurrence that takes place suddenly, unexpectedly and unintentionally, often arising from unforeseen circumstances. Road traffic injuries (RTA/RTI) resulting in death, especially Motor Vehicle Traffic Accidents (MVTA), have been recognized as a concealed epidemic with global impact, affecting every segment of society. This study has been conducted at a tertiary care hospital, aimed to identify different patterns and distributions of injuries, with the goal of devising preventive measures for the future.

Keywords: Fatal injury; pattern of injury; RTA.

Introduction:

An accident is an event that occurs suddenly, unexpectedly and inadvertently under unforeseen circumstances. Death resulting from road traffic injuries (RTA/RTI), specifically Motor Vehicle Traffic Accidents (MVTA), has been globally characterized as a hidden epidemic that affects all sectors of society. The definition of a road traffic accident (RTA) entails "an accident which took place on road between two or more objects, one of which must be any kind of a moving vehicle."[1-3]

William Haddon, the Head of the Road Safety Agency in the USA, has highlighted the complex nature of road accidents, emphasizing that they are linked to multiple issues that require individual attention, encompassing pre-event factors, post-event factors and those factors occurring during the event related to humans, vehicles and the environment, all of which interplay and influence the occurrence and outcome of traumatic events.

Furthermore, the process of globalization has contributed to an improvement in the socio-economic status of people all over the world. This, in turn, has led to significant changes in the lifestyle of individuals. However, along with these positive changes, there has also been an emergence of non-communicable diseases and accidents as prominent concerns within the healthcare delivery system. The broader impact of these changes has brought attention to the need for comprehensive strategies in managing road safety, encompassing preventive measures, post-accident care and addressing the overall health and well-being of individuals.[3,4]

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This study was conducted at a tertiary care hospital with the aim of thoroughly examining and understanding the causative factors, patterns and distribution of injuries resulting from road accidents. The primary objective was to gather comprehensive data that would enable the formulation of effective measures to prevent such incidents in the future.

Aims & Objectives:

- To identify patterns of injuries arising out of fatal road traffic accidents.
- To interpret different causes of death found in different patterns of injury.

Material and methods:

To accomplish the aims, the researchers meticulously analyzed a wide range of variables associated with fatal road accidents presenting to the Department of Forensic Medicine and Toxicology, in MKCG Medical College, at Brahmapur. These variables included descriptions of human injuries, such as site (head, upper limb, lower limb, abdomen, pelvis, etc.), type of injury (like abrasion, laceration, contusion, crush etc.) during a 2 year period from August 2019 to July 2021.

By examining these factors in detail, the researchers sought to identify commonalities and trends among accident cases. This involved analyzing the types and severity of injuries sustained by the individuals involved, as well as the locations on body where the injuries occurred.

Observation:

During the study period, a total of 2,664 autopsies were conducted, with 350 of them (13.1%) attributed to road traffic accident (RTA) deaths. Table 1 provides an overview of the injury distribution among these 350 RTA deaths. Out of the 1,449 sites examined, the lower limb was the most frequently involved, accounting for 270 cases (77.14%), followed by the head in 262

Table 1. Site of injuries in fatal road traffic accident.

Site of injury	Total Count (1449)	Percentage out of 350	% out of 1449
Head	262	74.85%	18%
Maxilo-facial	200	57.14%	14%
Neck	40	11.42%	3%
Chest	134	38.28%	9%
Abdomen	137	39.14%	9%
Pelvic	38	10.85%	3%
Perineum	21	6.00%	1%
Upper limb	249	71.14%	17%
Lower limb	270	77.14%	19%
Back	98	28.00%	7%

Table 2. Sites of fatal injuries in fatal mono-trauma road traffic accident.

Site of fatal injury	Total count (202)	Percentage	Female (26)	Male (176)
Head	158	78.21%	20	138
only abdominal injury	22	10.89%	3	19
only lower limb	13	6.43%	-	5
only chest injury	5	2.47%	3	10
only pelvic injury	3	1.48%	-	3
only spinal cord injury	1	1.53%	-	1

Table 3. Distribution of visceral injury in fatal road traffic accident.

Type of viscera	Total count (350)	Percentage (%)
Liver injury	99	28.28
Contusion/laceration of lungs	86	24.57
Contusion/laceration of brain	78	22.28
Spleen injury	36	10.28
Intestine loop injury	26	7.4
Contusion/laceration of heart	23	6.57
Contusion/laceration of Spinal Cord	21	6.00
Kidney injury	16	4.5
Bladder injury	2	0.57

Table 4. Pattern of injury on head in fatal road traffic accident.

Pattern of head injury	Total count 262	Percentage (%)
Abrasion of scalp	17	6.48
Contusion of scalp	253	96.56
Laceration of scalp	143	54.58
Intracranial hematoma	240	91.06
Brain laceration	78	29.77
Skull fracture	217	82.82
Crush injury	24	9.16

Table 5. Pattern of injury in chest (thorax) in fatal road traffic accident.

Pattern of chest injury		Total Count 134	Percentage (%)
Abrasion	Extenal injury	73	54.44
Grazed abrasion		23	17.16
Laceration		17	12.68
Crush injury		12	8.95
Contusion of chest wall	Internal injury	107	79.85
Rib fracture		95	70.89
Sternum fracture		42	31.34
Clavicle fracture		19	14.17
Contusion or laceration of lungs		86	64.17
Contusion or laceration of heart		23	17.16

cases (74.85%), the upper limb in 249 cases (71.14%) and the maxillofacial region in 200 cases (57.14%). Chest and abdomen injuries were observed in 38.28% and 39.14% of cases respectively. Neck injuries were present in only 40 cases (11.42%), pelvic injuries in 38 cases (10.85%) and injuries to the perineum were the least common, occurring in 21 cases (6%).

Among the 350 RTA deaths, 202 were attributed to fatal injury to a single system, with 176 males and 26 females. The head (including face) was the most frequently involved region, accounting for 78.21% of cases followed by the abdomen (10.89%), lower limb (6.43%), chest (2.47%) and spinal cord (1.53%) as shown in Table 2.

Table 3 reveals the most common organs involved in fatal road traffic accidents out of 350 cases. The liver (28.28%), lungs (24.57%) and brain (22.28%) were the top three involved organs. Spleen (10.28%), intestine (7.4%) and heart (6.57%) were also commonly affected. Spinal cord (6.00%), kidney (4.5%) and bladder (0.57%) were less frequently involved.

Among the 350 deaths, 262 individuals had head injuries, with contusion of the scalp observed in 253 cases (95.56%) and intracranial hematoma in 91.58% of those cases, as shown in Table 4. Skull fractures were present in 82.82% of the cases, while brain lacerations were found in 29.77% of cases. Interestingly, scalp abrasions were the least common, occurring in only 17 cases (6.48%). This highlights that internal injuries within the head are more prevalent than surface abrasions, with lacerations and contusions being common in the scalp region.

Table 5 shows that out of the total 350 deaths, chest injuries were observed in 134 cases. Internal injuries, including chest wall contusion and associated rib fractures, were present in 79.85% and 70.89% of cases, respectively. Fatal chest injuries involved lung contusion or laceration in 64.17% of cases and heart contusion or laceration in 17.16% of cases. External injuries primarily consisted of abrasions, present in 54.44% of cases, followed by grazed abrasions in 17.16% of cases.

Abdominal and pelvic injuries were present in 175 of 350 deaths, i.e., 50 %, as shown in Table 6. In internal injuries, damage to liver was most common (99 cases) i.e. 56.57%, following injury to spleen i.e., in 35 cases or 20.57 %. Following which the 35 cases of pelvic fracture i.e., 20.57 % and 26 cases of intestinal loop injury i.e., 14.85 % and 22 cases of injury to mesentery i.e., 22 cases or 12.57%. Injury to kidney was present in 16 cases i.e., 9.14%.

In external injuries, abrasion was most commonly evident, a simple abrasion being present in 49 cases i.e, 28.0 % followed by grazed abrasions in 26 cases or1 4.85%, injury to perineum was present in 18 cases i.e., 10.27%.

In Table 7, the analysis of 860 cases reveals the distribution of extremity injuries. The most common type of injury observed was abrasion, accounting for 31.51% of cases, followed by grazed abrasions (8.25%), contusions (3.48%) and lacerations (18.72%). Severe injuries included fracture dislocations, with the ankle joint being involved in 1.74% of cases, followed by the knee joint (2.55%), hip joint (2.44%), wrist joint (1.27%), elbow joint (0.81%) and shoulder joint (1.97%). Fractures were also observed in specific bones, including the hand (1.27%), forearm (3.13%), arm (3.13%), foot (1.80%), leg (7.44%) and thigh (7.20%). Additionally, 3.13% of cases involved crush injuries.

Discussion:

Distribution of injuries : Out of the total 350 deaths resulting from road traffic accidents (RTA), 1449 injury sites were observed on the deceased bodies, including both fatal and non-

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Table 6. Pattern of injury on abdomen & pelvis in fatal road traffic accident.

Pattern of abdominal and pelvic injury	Category	Total count (175)	Percentage (%)
Abrasion	External Injury	49	28.00
Grazed abrasion		26	14.85
Contusion		15	8.57
Laceration		25	14.28
Crush injury	Crush Injury	12	6.85
Intestine loop injury	Internal Injury	26	14.85
Mesentery injury		22	12.57
Kidney injury		16	9.14
Liver injury		99	56.57
Spleen injury		36	20.57
Pelvic fracture		35	20
Bladder injury		2	1.14
Perineum	Miscellaneous	18	10.27

fatal injuries. The lower limbs were involved in 270 cases (77.14%), making it the most frequently affected body part. The head was involved in 262 cases (74.85%), followed by the upper limbs in 249 cases (71.14%), and the maxillofacial region in 200 cases (57.14%). The chest and abdomen were affected in 38.28% and 39.14% of cases, respectively. The neck was involved in 40 cases (11.42%) and the pelvis in 38 cases (10.85%). The perineum was the least affected region, with only 21 cases (6%).

Distribution of injuries in fatal "mono-trauma": Among the 202 deaths caused by fatal injuries to a single body system, the head (including face) was the most frequently affected region, accounting for 78.21% of cases (158 cases). The abdomen was involved in 22 cases (10.89%), while the lower limbs were affected in 13 cases (6.43%). Chest injuries were observed in 5 cases (2.47%) and only 1 case (0.49%) involved the spinal cord. These findings are consistent with similar studies, where the head was most commonly affected (60%), followed by the abdomen (18%) and the chest (6%).[5] Another study reported the highest number of injuries in the head and face region (71.69%), with lower extremity injuries accounting for only 3.77% and chest injuries at 1.88%.[6]

Distribution of visceral injury: According to this study, the most commonly involved organ in fatal road traffic accidents out of 350 cases was the liver, accounting for 28.28% (99 cases). This was followed by the lungs at 24.57% (86 cases), the brain at 22.28% (78 cases), the spleen at 10.28% (36 cases), the intestine at 7.4% (26 cases), the heart at 6.57% (23 cases), the spinal cord at 6.00% (21 cases), the kidneys at 4.5% (16 cases), and the bladder at 0.57% (2 cases).

In a study conducted by Farooqui et al.(2013), it was found that the highest organ involvement was in the brain at 38.61%, followed by the lungs at 12.37%, the liver at 11.88%, the heart at 7.92%, and the spleen at 5.94%.[7] These findings differ from my study, which may be due to the fact that their study focused only on rural areas, whereas my study included both urban and rural areas.

Pattern of head injury: In this study, head injuries were identified in 262 out of a total of 350 deaths. Contusions of the scalp were present in 253 cases, accounting for 95.56% of the head injury

Table 7. Pattern of injury to extremities in fatal road traffic accident.

Pattern of extremities injury	Total count (860)	Percentage
Abrasion	271	31.51
Grazed abrasion	71	8.25
Contusion	30	3.48
Laceration	161	18.72
Fracture dislocation of ankle joint	15	1.74
Fracture dislocation of knee joint	22	2.55
Fracture dislocation of hip joint	21	2.44
Fracture dislocation of wrist joint	11	1.27
Fracture dislocation of elbow joint	7	0.81
Fracture dislocation of shoulder joint	17	1.97
Fracture of hand bone	11	1.27
Fracture of forearm bone	27	3.13
Fracture of arm bone	27	3.13
Fracture of foot bone	16	1.8
Fracture of leg bone	64	7.44
Fracture of thigh bone	62	7.20
Crush injury	27	3.13

cases. Intracranial hematomas were found in 240 cases (91.58%), while skull fractures were observed in 217 cases (82.82%). Lacerations in the brain were present in 78 cases (29.77%). The lowest incidence was recorded for scalp abrasions, which were found in only 17 cases (6.48%).

In a study by Kumar et al. (2008), the most common type of intracranial hemorrhage was subdural hemorrhage (89.11%), followed by subarachnoid hemorrhage (72.98%). Extradural hemorrhage was present in 20.25% of cases.[8] Additionally, skull fractures were found in 69.63% of head injury cases, which is similar to the findings of this study.

Pattern of chest injury: In this study, out of the total 350 deaths, 134 cases involved chest injuries. External injuries were predominantly abrasions (54.44%), followed by grazed abrasions (17.16%) and lacerations (12.68%). Fractures were most commonly observed in the ribs (70.89%), followed by the sternum (31.34%) and clavicle (14.17%). These findings align with a study by Patil et al. (2017), where similar proportions of abrasions (52.50%), lacerations (16.25%), rib fractures (64.71%), sternum fractures (21.85%) and clavicle fractures (9.24%) were reported.[9]

Regarding internal injuries, contusions or lacerations of the lungs (64.17%) and the heart (17.16%) were frequently observed. The study by Patil et al. (2017) also found lung injuries in 53.40% of cases and heart injuries in 30.10%, which aligns with the findings of this study.[9]

Pattern of abdominal injury: In this study, abdominal and pelvic injuries were identified in 175 out of a total of 350 deaths. Among the internal injuries, the most common organ affected was the liver (56.57%), followed by the spleen (20.57%), intestinal loops (14.85%), mesentery (12.57%) and kidneys (9.14%). In contrast, a study by Patil et al. (2007) reported different percentages for organ injuries, with the liver affected in 31.45% of cases, the spleen in 11.27%, intestinal loops in 5.15%, mesentery in 7.51%, and the kidney in 21.13%. The variation in findings could be attributed to the fact that in the study by Patil et al. (2007), the percentages were calculated based on the total number of injuries,

while in our study, the percentages were calculated based on the total number of deaths.[9] However, the order of organs involved, from most common to less common, is generally similar between the two studies.

Conclusion:

The study analyzed 350 deaths from road traffic accidents, with 202 deaths attributed to fatal injury to a single system. The head was the most frequently involved region, consistent with previous studies. The liver was the most commonly affected organ in abdominal and pelvic injuries, followed by the spleen, intestinal loops, mesentery and kidneys. Findings related to head and chest injuries align with previous studies, highlighting consistent patterns. Understanding these injury patterns can inform preventive measures and medical interventions to reduce the severity and fatality of road traffic accidents.

Conflict of interest : Nil.

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Ethical clearance: Yes.

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ORIGINAL ARTICLE

Evaluating the Level of Cognitive domain for Postgraduate Summative Assessment in Forensic Medicine

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Abstract:

Summative assessments hold significant sway over a student's learning journey. However, there is a noticeable scarcity of literature addressing the validity of postgraduate summative assessment question papers within the domain of Forensic Medicine & Toxicology. This study endeavours to fill this gap by scrutinizing 48 question papers sourced from 12 healthcare universities spanning India for the year 2023. The question paper was evaluated based on several criteria, which included employment of structured & unstructured questions, presence or absence of action verb, distribution of marks based on competencies & level of cognitive domain assessed. From the results of the study, the content validity of the postgraduate summative question papers in Forensic Medicine and Toxicology fell short of expectations. This underscores the imperative for a comprehensive evaluation of the clarity and effectiveness of the blueprints employed by universities. It is evident that faculty training is indispensable to inspire and catalyse a shift in mindset, ultimately leading to a course correction.

Keywords: Summative assessment; Action verbs; Content validity.

Introduction:

Forensic Medicine and Toxicology in India serves as a platform to equip undergraduates with the aptitude to apply their medical knowledge within the legal framework. It amalgamates the domains of Forensic Pathology, Medical Jurisprudence, and Toxicology, forming a comprehensive discipline. At its core, it aims to empower postgraduate students by enabling them to proficiently address medical-legal matters and effectively employ their medical expertise to facilitate justice.[1] This branch focuses on equipping individuals with the aptitude to navigate the intricacies of the nation's medicolegal system. To ensure the excellence of postgraduates in this specialty, it is essential to implement meticulous certification procedures by utilizing appropriate assessment techniques.[2] Since assessment drives learning, the assessment of competence; measuring the student's or physician's abilities- ought to offer a window into real-world performance, including their habitual actions when not under observation. Furthermore, this assessment should gauge their capability to navigate change, discover and innovate new knowledge, and enhance overall performance.[3]

Summative assessment for postgraduates in FMT across diverse Indian universities encompasses both written theory examinations and clinical evaluations. Ideally, postgraduate theory examinations should be designed to assess cognitive domains of a higher level, such as critical thinking, evaluation, and synthesis skills. It is crucial to assign appropriate importance to all components of the curriculum to ensure the validity of the examination paper.[2]

It's important to note that higher levels of skill attainment aren't inherently superior to lower levels, as one cannot master the higher levels without a solid foundation in the lower ones. Yet, as individuals progress to higher levels, the skills become increasingly relevant and applicable to the demands of daily life.[4] Forensic Medicine, characterized by its emphasis on practical application, calls for assessments that evaluate critical thinking and synthesis skills. Within this study, we conducted an analysis and comparison of postgraduate summative examination question papers in Forensic Medicine & Toxicology from 12 esteemed universities across India. The focus of our analysis encompassed content distribution, cognitive domain levels, and the structural construct of the questions.[1]

Methodology:

A retrospective cross-sectional record-based observational study was undertaken at Pramukhswami Medical College, following the acquisition of ethical approval from the Institutional Ethics Committee. The study involved the selection of 48 summative examination question papers from 12 distinguished medical universities across India. The criteria for selection were based on the accessibility of the respective university's question papers in the public domain. All the chosen question papers pertained to the Doctor of Medicine University Assessment for the year 2023. Question papers for the subject of Forensic Medicine & Toxicology were sourced from university websites and college

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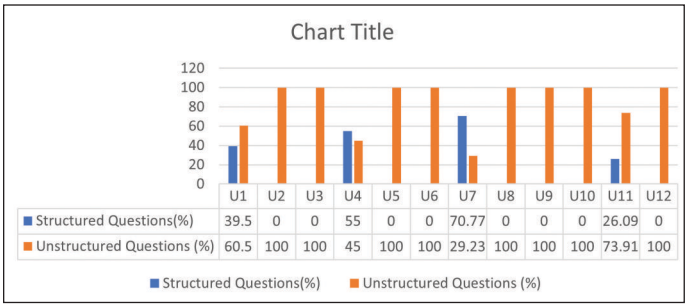


Chart 1. University wise distribution of structured & unstructured questions in question papers.

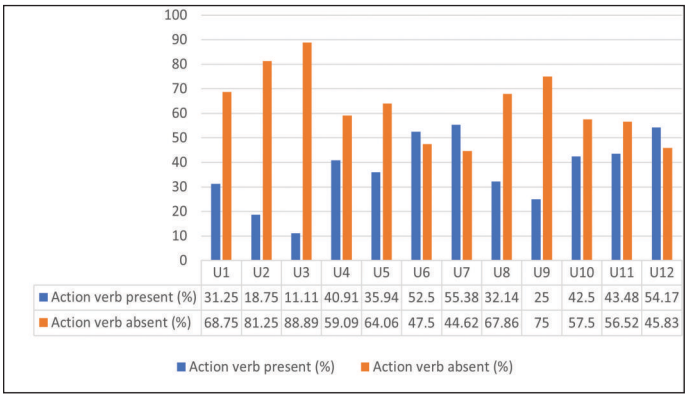


Chart 2. University wise distribution of action verb as per revised bloom's taxonomy in question papers.

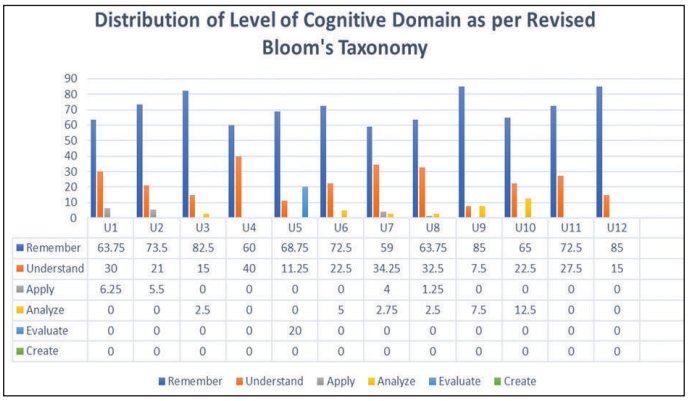
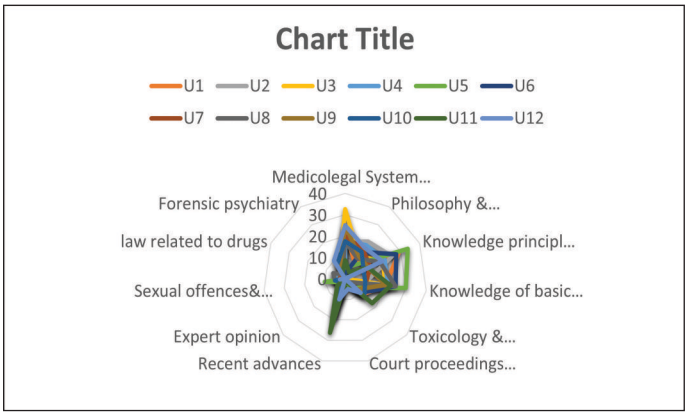


Chart 3. University wise comparison of percentage mark distribution based on the cognitive domain of learning.



Radar graph 1. Distribution of marks based on competencies.

records of affiliated institutions through a comprehensive web search. Throughout this process, the identities of the universities were maintained in an anonymous manner during result analysis. All data was collected from publicly available sources, eliminating the requirement for explicit consent. The confidentiality of the medical universities' identities was upheld during the assessment of the question papers.

As per the regulations outlined by the National Medical Commission (NMC), the summative postgraduate theory examination in Forensic Medicine & Toxicology comprises four theory papers, collectively amounting to a total of 400 marks. For the analysis, questions were categorized based on their structured and unstructured formats, as well as assessing the presence or absence of action verbs as per revised blooms taxonomy. Additionally, questions were classified according to the level of cognitive domains they corresponded to. The subjects within the domain of Forensic Medicine & Toxicology can be effectively categorized into distinct subheadings, as per the Guidelines for Competency Based Postgraduate Training Programme for MD Forensic Medicine by the Medical Council of India. These guidelines outline the essential competencies expected within the postgraduate curriculum for forensic medicine.

The gathered data was meticulously organized into an Excel Sheet, facilitating the documentation of percentage allocations of marks across diverse subtopics. This data was subsequently utilized to create visual representations through radar graphs and bar diagrams. These visualizations offered a means to effectively comprehend and compare the distribution of marks within various topics across each question paper. Throughout this analysis, particular emphasis was placed on assessing the weightage assigned to subtopics.

Ethical clearance was taken from Institutional Ethics Committee (IEC/BU/2023/Ex.78/314/2023)

Results:

This study involved the evaluation of 48 question papers from a diverse range of 12 medical universities spread across India. All the 12 universities marked U1-U12 respectively. Specifically, the assessment focused on the MD examination format. In this examination, each university administers four papers, with each paper carrying a total of 100 marks in the summative assessment in Forensic Medicine. Chart 1 provides a breakdown of the percentage distribution of structured and unstructured questions for each university during their respective final postgraduate summative examinations. Among the 12 universities, a total of 8 universities opted not to include structured questions in their MD assessments. Among the remaining 4 universities that incorporated structured questions, University 7 allocated the highest proportion with 70.77% structured questions, followed by university 4 with 55%. The two remaining universities, University 1, and University 11 allocated 39.5% and 26.09% of structured questions, respectively.

Chart 2 demonstrates a noteworthy trend across the universities, except for U6, U7, and U12. It was noted that a significant number of questions in these papers did not include action verbs that align with the revised Bloom's Taxonomy. The presence of

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Table 1. Various previous research articles.

Sr No.	Author's name and year	Place of study	Question paper considered	Universities considered	Conclusion
1.	Mehta SJ and Kikani KM, 2019[9]	Gujarat	March 2005-January 2015	Saurashtra University	The findings indicated that a significant majority of the questions (approximately 97%) were based on familiar topics from the syllabus, and they primarily assessed the foundational knowledge level (approximately 95%) within the cognitive domain. The conclusion drawn from this study underscores the critical need for a standardized blueprint to establish consistency in theory examinations
2.	Swart AJ et al., 2010[10]	Republic of South Africa (RSA)	2002-2006	Vaal University of Technology, South Africa	The findings revealed that in the final examination papers of the electronics academic field, a higher proportion of questions (approximately 52%) were oriented toward lower-order cognitive skills, while a slightly smaller proportion (approximately 48%) focused on higher-order cognitive skills
3.	Chauhan RP 2019[11]	Maharashtra	2001-2018	Maharashtra University of Health Sciences (MUHS)	A minority of paper setting in the field of community medicine at MUHS (approximately 39%) was found to be inadequate in terms of aligning with the syllabus representation
4.	Kar SS et al., 2016[12]	Puducherry	December 2008-May 2012	JIPMER, Puducherry	Majority (68.9%) questions tested the knowledge skills of the students.
5.	Choudhary R et al., 2012[13]	Rajasthan	2001-2006	Rajasthan University of Health Sciences	The conclusion drawn is that the absence of weightage for different subdivisions has made the process of question setting somewhat challenging.

action verbs was noted at percentages of 52.5%, 55.38%, and 54.17% in U6, U7, and U12, respectively. For the remaining universities, the proportion of questions in their MD assessments that included action verbs was consistently less than 50%.

The distribution of marks in each question paper was meticulously analysed and visualized through a bar diagram (Chart 3) for comprehensive representation. The analysis distinctly illustrates the distribution of marks among the 12 universities. Notably, 3 universities assigned over 80% of marks, while another 3 universities allocated marks within the range of 70-80% for remember domain. Additionally, 5 universities designated marks in the range of 60-70%, and a single university assigned 59% marks specifically for the remember domain. Specifically, four universities designated percentages of 6.25%, 5.5%, 4%, and 1.25% for the 'Apply' domain. Five universities, on the other hand, allocated marks for the 'Analyse' domain, with varying proportions of 2.5%, 2.75%, 2.5%, 7.5%, and 12.5%. Interestingly, out of the 12 institutions under examination, merely one university included marks allocation for the 'Evaluate' domain. A surprising observation emerges that no university allotted marks for the create domain.

In 2017, the Medical Council of India divided the competencies within Forensic Medicine and Toxicology for the purpose of curriculum development. Radar graph 1 provides a detailed analysis of postgraduate summative question papers, breaking down the distribution of marks among these competencies as a percentage. Clearly, a noticeable pattern emerges (Radar graph 1) in the distribution of marks across various competencies in nearly all universities. The emphasis on competencies such as medicolegal autopsy, basic sciences, and the medicolegal system of India is quite pronounced, with a significant allocation of marks. In contrast, competencies like toxicology, medical jurisprudence, expert opinion, sexual offences, and forensic psychiatry receive a notably lower share of marks.

Discussion:

Examinations exert a significant influence on students' reading habits. They communicate to students what is deemed important from the perspective of examiners. Moreover, these assessments can impact a student's self-esteem, career aspirations, and overall achievements in a substantial way.[5] According to research conducted by Bheeshma P, Shyamala S, and Sunethri P involving 205 undergraduate students, a comparison was made between the performance of structured essay questions and unstructured essay questions. The findings of the study indicated that a substantial portion of the students achieved higher scores when they were presented with structured essay questions in contrast to unstructured ones.[6] Current study also revealed that out of the 12 universities examined, a combined total of 8 universities made the choice to exclude structured questions from their MD assessments. Within the subset of the four universities that integrated structured questions, University 7 allocated the largest percentage, accounting for 70.77% of structured questions. Following closely, University 4 allotted 55% of structured questions. The remaining two universities, University 1, and University 11 allocated 39.5% and 26.09% of structured questions, respectively. As per CBME Curriculum 2019 issued by National Medical Council, it is essential to provide well-structured questions with clear problem statements and indicate the marking distribution for transparency in grading (Medical Council of India. Assessment Module for Undergraduate Medical Education Training Program, 2019: pp 1-29.). Study done by Zeller et al also suggested that Evaluations using unstructured questions often fall short of attaining satisfactory levels of reproducibility.[7]

Educators have long acknowledged that assessing learning outcomes can serve to enhance both learning and teaching (Halpern, 1988). Assessing specific types of acquired skills can offer instructors valuable insights into areas where students excel and areas where they may need improvement in relation to these skills. Prioritizing the use of action verbs allows instructors to clearly define the skill sets students are expected to develop because of completing the course. According to John Biggs' study, the choice of verb in the Intended Learning Outcomes (ILOs) plays a pivotal role in establishing alignment between the ILO itself, the teaching and learning activities, and the

assessment tasks. Different ILOs call for different levels of verbs. For instance, some ILOs may require low-level verbs like "describe," "enumerate," or "list." Others may involve middle-level verbs such as "explain," "analyze," "apply to familiar situations," or "solve standard problems." In contrast, advanced-level ILOs would necessitate the use of verbs like "hypothesize," "reflect," or "apply". These verbs help articulate the depth and complexity of the intended learning outcomes and guide the design of teaching, learning, and assessment activities accordingly. The utilization of action verbs facilitates the efficient evaluation of specific Intended Learning Outcomes (ILOs) through well-defined assessment tasks.[8] The current study has uncovered that among the 12 medical universities nationwide, a notable finding is that 9 of these universities did not incorporate action verbs in a substantial portion of their questions, exceeding 50%, based on the revised Bloom's Taxonomy.

Evaluations often guide students in focusing their learning efforts toward achieving the intended learning outcomes (ILOs). They serve as instruments for enhancing the transfer and retention of knowledge. Typically, learning outcomes that involve higher cognitive processes like comprehension, interpretation, and practical application are more likely to be retained for an extended period and are better suited for application in various contexts compared to outcomes centred solely on memorization.[9] According to a study conducted by Kautilya et al., theory question papers are designed to assess students' knowledge and cognitive abilities. However, confining these questions solely to recall-type queries have a detrimental impact on the overall quality of the question paper. Fields like Forensic Medicine demand the application of knowledge rather than mere recall. Consequently, it is imperative to incorporate questions that evaluate higher-order cognitive skills to ensure the validity of the assessment.[1] In a study conducted by Rajalakshmi M et al., the content analysis of theory examination question papers yielded some noteworthy findings. They discovered that questions evaluating higher cognitive domains were present in a limited proportion, specifically 15% in PU, 3.75% in TN, and 2.5% in KR Universities. Additionally, their analysis revealed that most essay questions (72.5% in PU, 92.5% in TNMU, and 90% in KUHS) predominantly assessed the Level-1 of Bloom's taxonomical domain in postgraduate Community Medicine examinations across all the examined Universities (PU, TNMU, KUHS). [(2)] In line with the results of the current study, previous research has similarly noted a prevalence of lower-order questions (Table 1) in comparison to higher-order ones. To create a fair and comprehensive postgraduate examination paper, it's essential to incorporate questions of varying difficulty levels and allocate marks according to a well-defined blueprint. This approach ensures that the assessment accommodates the diverse capabilities of students. Validity is a crucial attribute of effective assessments, and one of the primary threats to validity in medical education is the underrepresentation of constructs. According to the current study as well as previous studies, there is a consistent pattern of mark distribution towards the specific competencies in nearly all universities.[9-13]

Conclusion:

It is advisable to widely disseminate the design of question papers to all relevant parties at the commencement of the academic year. Therefore, it is recommended that national-level workshops be organized, bringing together competent and enthusiastic educators who can collectively establish a shared consensus on the design of Postgraduate Summative Assessment paper in Forensic Medicine & Toxicology. This collaborative effort will help maintain consistent standards across assessments. Furthermore, it is suggested that the implementation of blueprinting plays a crucial role in achieving a balanced distribution of weightage and questions across various topics. Integrating a blueprint into the assessment process is highly recommended, as it ensures fairness and consistency in evaluating different subject areas.

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ORIGINAL ARTICLE

Analysis of Skin Color Variation using CIELAB Index: An Empirical Study from Delhi, India

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Abstract:

Skin color is a conspicuous trait regulated by complex metabolic processes and its significant diversity among Indian populations is quite remarkable making it an ideal choice for dermatological investigation. To elucidate skin pigment variation with respect to age, we studied 714 healthy individuals (aged 20-70 years) using CIELAB system. Skin reflectance was measured from the volar surface of upper arm using DSM II ColorMeter (Cortex Technology, Hadsund, Denmark) among population of Delhi, India to provide CIELAB color space values, L* (light/dark), a* (red/green), and b* (yellow/blue) followed by statistical analysis to examine the correlation between age and gender on skin on constitutive skin pigmentation. The studied parameters were observed to vary widely {L* (Range: 24.98-51.62, M=38.66, SD=4.41), a* (Range: 4.61-17.16, M=10.18, SD=2.03), and b* (Range: 20.16-34.83, M=28.93, SD=2.30)} across all age groups. ANOVA results suggest a statistically significant effect of age on skin lightness {$F(4,709)=124.1332$, $p<0.001$}, redness {$F(4,709)=20.0594$, $p<0.001$} and yellowness {$F(4,709)=95.1434$, $p<0.001$}. Positive correlation was observed between age and both hue (ho) {$r(712)=0.9027$, $p<0.001$} and chroma (C) {$r(712)=0.9224$, $p<0.001$}. Significant effects of gender were noticed on skin lightness among all age groups, along with skin redness below the age of 40 years ($p<0.001$). Notable color differences ($\Delta E*ab$) were witnessed among males and females across all age groups in the studied population. The age group 21-30 years was found to have the highest $\Delta E*ab$ value (3.5987), followed by 51-60 years (2.98), 31-40 years (2.5579), 61-70 years (2.1837), and 41-50 years (1.6639). We would like to highlight that skin lightness, redness, and yellowness differs significantly with age. Females were observed to be lighter in color as compared to males across all age groups. The findings of the current study would provide better understanding of skin color variation among Indian population.

Keywords: Skin pigmentation; Skin color; CIELAB index; Chromophores; Melanin.

Introduction:

Skin color varies widely among individuals, making it one of the most remarkable indicators of phenotypic diversity. Variation in skin pigmentation across populations has emerged as a result of evolutionary changes with respect to altered intensities of UV radiation (UVR) across geographic locations.[1] Melanin is the key pigment responsible for imparting color to the skin which is synthesized by a multistage biochemical process known as melanogenesis.[2] It occurs in highly differentiated skin cells or melanocytes that produce specialized intracellular vesicles called melanosomes. Skin color is controlled by the number, size, distribution, localization, and degree of melanosome aggregation.[3] Chromophores like carotene, bilirubin, hemoglobin etc. also have significant impact on the regulation of skin color. Various intrinsic and extrinsic factors also affect the inter- and intra-variation in skin pigmentation among populations.[1,4] Pigmentary changes in skin can be majorly classified as constitutive and facultative.[5,6] Constitutive skin color can be defined as the baseline levels of melanin and associated chromophores in absence of external stimuli, whereas, facultative skin color can be referred to as an elevated level of pigmentation contributed by the effect of UVR exposure, hormones, and growth factors on melanogenesis. The assessment of human skin color is a key descriptive factor in various clinical and scientific studies, extending its importance to the field of forensic science. Accurate evaluation of skin color can provide valuable information in several forensic contexts, such as bruise examination, wound examination, and forensic DNA phenotyping.[7,8] Researchers have utilized color scales, reflectance spectrophotometers and tristimulus colorimeters for assessment of skin tone and associated metrics.[9] Reflectance spectrophotometry has replaced the widely used color scales as it provides more precise, quantifiable, and rapid measurements without any associated bias of visual perception of color by the naked eye. Spectrophotometers can be used to define spectral characteristics of skin color based on reflectance and absorption of visible light (400-700nm) by major skin chromophores, usually in terms of melanin or erythema indices. Though the concentration of main chromophores usually differs from the actual appearance of skin color, its clinical exploration has not garnered much attention among researchers.[9] DNA phenotyping study has garnered much attention recently by forensic scientists which may be considered as a valuable investigative tool. Skin color is one of the most prominent phenotypic features and is

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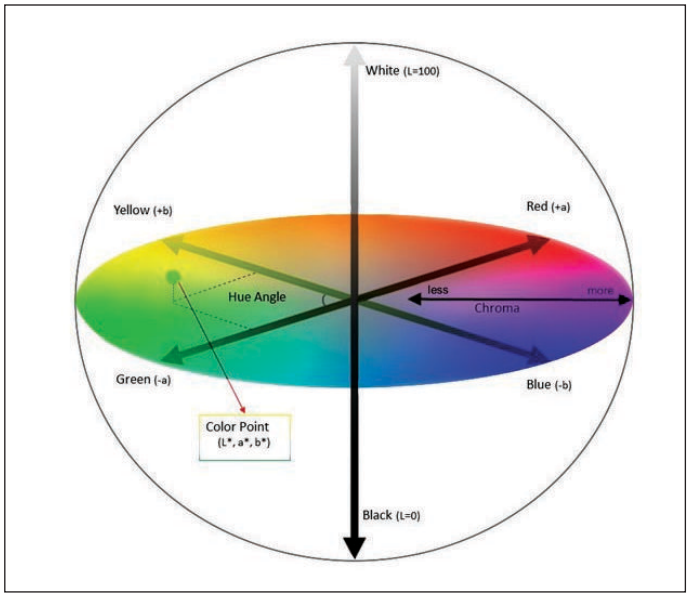

Figure 1. CIELAB color space diagram representing the color parameters L*, a*, b*, hue angle (ho) and chroma (C).

being extensively analyzed by geneticists to develop prediction tools.[10] Hence, it is imperative to understand the skin color variation among various populations.

The CIELAB or CIE*L*a*b** color space (Figure 1) is an internationally recognized system established by the Commission International d'Eclairage (CIE) for the evaluation of colored surfaces in terms of *L* a** and *b** indices. The measured *L** value has been recommended to correlate with change along a gray scale ranging from 0 (black) to 100 (white). The a* and *b** coordinates distinguish colors according to red vs. green and yellow vs. blue attributes, respectively. Skin pigmentation studies necessitate only the positive values for each coordinate. Therefore, in this study, *a** and *b** are used to describe the attributes of skin redness and yellowness. These coordinates can be used to define hue angle *(h^o)*, the psychometric correlate of visually perceived attributes of hue, corresponding to an angular position around a central point on a color space diagram that can be used to describe the relative amount of redness and yellowness. The color attribute of saturation also referred to as chroma *(C)*, is used to describe the intensity of color and can be measured by the distance from the *L** axis in the *a*b** plane. Along with absolute measurements for three attributes of perceived skin color, these chromatic parameters also enable the quantification of color differences *(ΔE)* between individuals or measured sites.

Figure 1. The present study has been carried out to assess the skin color variation among individuals residing in Delhi, India. Skin reflectance data were collected from healthy individuals (aged 20-70 years) using the CIE system to understand the differences in skin pigmentation with respect to age and its heterogeneity among males and females.

Material and methods:

Subjects: A total of 714 healthy unrelated volunteers (males=383, females=331), aged 20-70 years, belonging to Delhi, India were

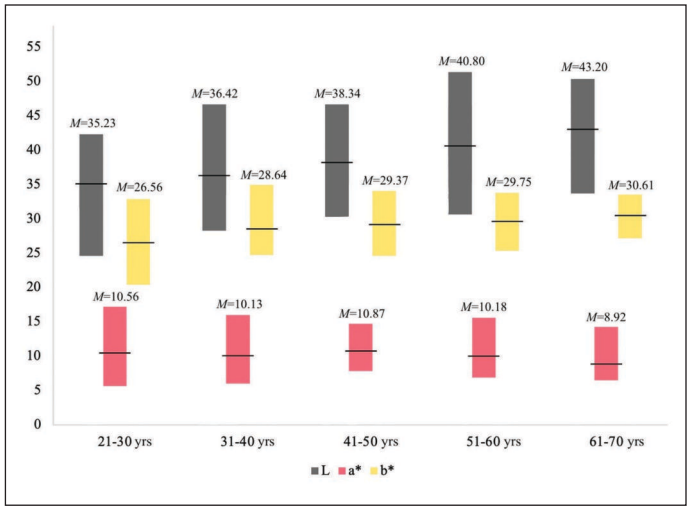

Figure 2. Distribution of CIELAB parameters (L*, a*, b*) of skin color among individuals aged 21-70 yrs, India. Bar length corresponds to the frequency distribution of the skin color parameters.

enrolled in this study via written consent. The subjects were further divided into five age groups: 21-30 years, 31-40 years, 41-50 years, 51-60 years, and 61-70 years. For all participants, at least three generations were reported to be born in Delhi. Volunteers with known pigmentation disorders, having tattoos at the assessment site or using topical medications/dietary supplements that may affect pigmentation were excluded from the study. The volunteers were advised not to be involved in any kind of vigorous physical activity at least 1hr prior to sample collection. Samples were collected during day time with optimum lighting conditions at room temperature (27°C-30°C) in air-conditioned rooms. The study protocol has been reviewed and approved by the Institutional Ethical Committee (Anth/2021-22/07/002).

Skin color measurements: Skin reflectance was measured in triplicates from the volar surface of non-dominant upper arm (least exposed to external factors affecting pigmentation like UVR) using DSM II ColorMeter (Cortex Technology, Hadsund, Denmark) after calibrating with a standard to provide numerical color values in CIELAB color space. Chromatic parameters included *L** (light/dark), *a** (redness), and *b** (yellowness). Furthermore, hue angle *(h^o)* and chroma *(C)* were calculated as *h^o*

Table 1: Distribution of skin reflectance data of Delhi population in terms of CIELAB parameters L*, a*, b*, hue angle (h^o), and chroma (C).

Subjects (Age group)	N (number of individuals)	Mean age ± SD (years)	Mean L* ± SD (Skin Lightness)	Mean a* ± SD (Skin redness)	Mean b* ± SD (Skin yellowness)	h^o (Hue angle)	C (Chroma)
21-30 years	148	26 ± 2.53	35.23 ± 3.30	10.56 ± 2.23	26.56 ± 2.61	68.27°	28.58
31-40 years	140	35.74 ± 2.98	36.42 ± 3.32	10.13 ± 1.92	28.64 ± 1.74	70.47°	30.37
41-50 years	162	44.24 ± 3.04	38.34 ± 3.07	10.87 ± 1.64	29.37 ± 1.79	69.67°	31.31
51-60 years	136	56.1 ± 2.70	40.80 ± 4.19	10.18 ± 1.77	29.75 ± 1.46	71.09°	31.44
61-70 years	128	64.12 ± 3.35	43.20 ± 3.00	8.92 ± 1.97	30.61 ± 1.38	73.74°	31.88

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Table 2. Skin color differences (ΔE*ab) with respect to CIELAB color parameters (L*, a*, b*, ho, and C) between male and female of studied population. Statistically significant p values (p<0.001) are highlighted in bold.

Subjects (Age group)	Gender	N (number of indivi-duals)	Mean age ± SD (years)	L* ± SD (Skin Lightness)	p value for L* differences (Statistical significance)	a* ± SD (Skin Redness)	p value for a* differences (Statistical significance)	b* ± SD (Skin Yellowness)	p value for b* differences (Statistical significance)	h^o (Hue angle)	C (Chroma)	ΔE*ab (Color differences between male and female)
21-30 years	Male	78	26.07 ± 2.54	36.30 ± 2.93	2.14 x 10^{-5}	11.86 ± 2.03	1.41 x 10-15	26.81 ± 2.69	0.2198	66.13°	29.31	3.5987
	Female	70	26.12 ± 2.43	34.04 ± 3.29		9.11 ± 1.69		26.28 ± 2.51		70.85°	27.81	
31-40 years	Male	74	35.09 ± 3.11	37.39 ± 3.39	1.85 x 10^{-4}	10.82 ± 1.96	2.86 x 10-6	28.41 ± 1.67	0.0952	69.10°	30.40	2.5579
	Female	66	34.53 ± 2.75	35.35 ± 2.89		9.36 ± 1.56		28.91 ± 1.79		72.01°	30.38	
41-50 years	Male	89	44.57 ± 3.13	39.06 ± 3.25	6.94 x 10^{-4}	11.04 ± 1.74	0.1387	29.23 ± 1.80	0.2702	69.25°	31.24	1.6639
	Female	73	44.41 ± 3.10	37.47 ± 2.61		10.66 ± 1.49		29.54 ± 1.78		70.14°	31.40	
51-60 years	Male	71	55.66 ± 2.73	42.18 ± 4..23	3.60 x 10^{-5}	10.53 ± 1.81	0.0175	29.87 ± 1.30	0.2948	70.53°	31.67	2.98
	Female	65	55.12 ± 3.04	39.30 ± 3.62		9.81 ± 1.65		29.61 ± 1.61		71.62°	31.19	
61-70 years	Male	71	64.04 ± 3.26	44.05 ± 2.59	3.55 x 10^{-4}	9.37 ± 1.67	0.0057	30.46 ± 1.34	0.1951	72.89°	31.86	2.1837
	Female	57	65.21 ± 3.14	42.13 ± 3.16		8.38 ± 2.19		30.78 ± 1.41		74.75°	31.90	

$= arctan\ (b/a)$, $C = [(a^*)^2 + (b^*)^2]^{½}$. Color differences (ΔE^*_{ab}) between males and females were computed as $\Delta E^*_{ab} = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$.

Statistical Analysis: Differences in skin lightness (L^*), redness (a^*) and yellowness (b^*) with respect to age among the studied population were computed using ANOVA. Pearson's correlation coefficient was computed to assess the causal relationship of hue and chroma with age. The effect of gender on chromatic parameters lightness L^*, h^o and C was evaluated using unpaired t-test. α-level of 0.5 was utilized and $p<0.001$ was considered significant.

Results:

The skin color distribution of 714 subjects from Delhi in terms of the CIELAB color parameters L^*, a^*, b^*, hue angle (h^o), and chroma (C) have been presented in Table 1. The L^* values ranged from 24.9847 to 51.6275 (M=38.6600, SD=4.4119). The mean L^* values were observed to increase with age, with the age group 21-30 years and 61-70 years being the lowest (M=35.23, SD=3.30) and highest (M=43.20, SD=3.00), respectively (Figure 2). The values on a^* axis ranged from 4.61 to 17.16 (M=10.1809, SD=2.0351). The 41-50 years age group exhibited the highest a* values (M=10.87, SD=1.64), while the lowest values were observed among individuals between 61-70 years (M=8.92, SD=1.97). The b^* values varied from 20.16 to 34.83 (M=28.9382, SD=2.3076). Significant increase can be observed in b^* values, similar to L^*, with the age groups of 21-30 years and 61-70 years showing the lowest (M=26.56, SD=2.61) and highest mean (M=43.20, SD=3.00), respectively. ANOVA results suggest a statistically significant effect of age on skin lightness $\{F_{(4,709)}=124.1332, p<0.001\}$, redness $\{F_{(4,709)}=20.0594, p<0.001\}$ and yellowness $\{F_{(4,709)}=95.1434, p<0.001\}$. Hue angle (h^o) and Chroma (C) was found to be lowest in the age group 21-30 years, which corresponds to more red and less saturated skin. Statistically significant positive correlation was observed between age and both h^o $\{r_{(712)}=0.9027, p<0.001\}$ and C $\{r_{(712)}=0.9224, p<0.001\}$.

Figure 2. Males (n=383) across all age groups were associated with numerically higher L^* and a^* values than females (n=331), while no such trend was observed with b^* values. To test the statistical significance of the hypothesis, an independent sample t-test assuming unequal variance was performed (Table 2). Significant effect of gender was observed on skin lightness. For all five age groups, males were found to be significantly darker as compared to females. Increased level of skin redness among males was found to be statistically significant below 40 years and is most evident in the age group of 21-30 years. A non-significant decline in a^* values can be seen among females of other age groups, indicating a very slight decrease in skin redness above 40 years. No statistically significant differences were observed in skin yellowness among males and females with respect to age. To study the pigmentary changes between male and female across all age groups, color differences (ΔE^*_{ab}) were evaluated. It was observed that the age group 21-30 years showed the highest ΔE^*_{ab} (3.5987) followed by 51-60 years (2.98), 31-40 years (2.5579), 61-70 years (2.1837), and 41-50 years (1.6639).

Discussion:

Both intrinsic and extrinsic factors play a crucial role in chronological ageing of skin.[11,12] Age-related pigmentary changes are primarily brought about by the cumulative effects of progressive loss of melanocyte naevi, elevated production of free radicals, decreased melanogenesis, melanocyte senescence, and exposure to UV radiation.[13,14] Changes in the concentration of a number of enzymes and antioxidants also play a significant role in the ageing process of the skin, leading to heterogeneous pigmentation.[15-17] Previous studies suggest an inverse relationship between age and proliferative activity of melanocytes leading to hypopigmentation of aged skin. Despite a decline in the number of active melanocytes, continuous UV exposure stimulates melanogenic activity, thereby increasing the number of DOPA positive melanocytes, resulting in hyperpigmentation.[18-20]

In the current study, skin lightness (L^*) was found to decrease with age, which may be explained by the long-term effects of UVR exposure and increased deposition of lipofuscin leading to irreversible persistent darkening of skin.[21,22] Our results also indicate an upward trend of skin yellowness (b^*) with advancing age. However, no such trend could be reported for skin redness (a^*) as the 41-50 years age group exhibited highest a^* values

while the age group 61-70 years showed the lowest values with a steep decline in skin redness. The results of the current study are supported by previous studies that indicated that Asian skin gets darker and more yellow with age, whereas Caucasian skin gets darker and redder with age.[23]

Significant color differences (ΔE^*_{ab}) were noted among males and females across all age groups in the studied population. Several research findings have indicated females to be lighter than males across populations, irrespective of geographic locations.[24-26] The observed patterns of sexual dimorphism have resulted from the sexual selection pressure for lighter than average skinned female sexual partners and natural selection to optimize the synthesis of cutaneous D3 vitamin high calcium requirements during pregnancy and lactation.[27] Although it is difficult to assess whether previous studies have controlled for potential confounding effects, the data based on analyses of unexposed skin areas could possibly rule out the argument that these variables account for the differences between males and females.[24,27] In India, research on the genetic basis of pigmentation in forensic DNA phenotyping is ongoing but in its nascent stage. Skin pigmentation details of individuals and skeletal remains can provide additional information to complement forensic anthropological or radiological studies which are routinely used for estimation of stature and age.[28-31] While these traditional methods offer crucial insights into the biological profile of the deceased, they may not be sufficient to generate individual's physical appearance. Analysis of genetic markers associated with skin pigmentation can provide a comprehensive understanding of the individual's phenotypic traits and ancestry leading to successful identification of individuals. Studies have been conducted to identify genetic markers that are associated with skin pigmentation in different population groups in India. However, the validity of predictions based on these markers is yet to be fully established and requires further research to improve accuracy.

Conclusion:

The study results strengthen the notion that skin color is diverse in nature and it darkens and becomes more yellow with advancing age. Females were found to bear lighter skin than males. However, significant association has been reported for skin lightness among all age groups along with skin redness among individuals below 40 years. Assessment of skin pigment variation along with underlying genetic make-up among populations would enhance our understanding towards a more accurate phenotyping prediction model. As skin pigmentation is a multifactorial trait which is influenced by both genetic and environmental factors, a large and diverse population size is needed to fully understand age related variation among male and female.

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ORIGINAL ARTICLE

Assessment of Medico-legal Knowledge among Internees of a Medical College, Kolkata: A Cross-sectional Study

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Abstract:

Medical professionals around the world are encountering medico-legal issues in their daily practices. This is particularly problematic as patients or consumers are becoming increasingly aware of their rights. The term "medico-legal" refers to the intersection of two professions: medicine and law. It encompasses the legal and ethical duties of physicians as well as the medico-legal assessment of patients to ensure the smooth functioning of society. The consequences of an uninformed doctor making a mistake can be severe. Therefore, it is imperative that medical professionals have a thorough understanding of their rights and responsibilities. Addressing the issue of inadequate knowledge of legal medicine and the legal aspects of medical practice is critical and should be dealt with promptly. This present study was done to evaluate the level of knowledge regarding medico-legal issues among the internees of Calcutta National Medical College, Kolkata and to make the future medical professionals aware regarding their medico-legal responsibilities. An institution based cross-sectional descriptive study was conducted among internees of Calcutta National Medical College. Internees who were absent on the days of data collection, unwilling to give consent were excluded from the study. Data were collected by using a pre-designed, pre-tested and semi-structured questionnaire. The study was conducted among 195 interns of Calcutta National Medical College, Kolkata. Among them 115 (59%) were male, 173 (88.7%) were below the age of 25 years, 16 (8.2%) belonged to middle to lower socio-economic class and 110 (56.4%) were residing in hostel. Only 60 (30.8%) students showed interest in doing internship in Forensic Medicine &Toxicology (FMT). About one-third of study subjects 55 (28.2%) had inadequate knowledge regarding medico-legal aspects. While assessing knowledge regarding medico-legal aspects overall mean score was 13.96 ± 2.67. The study revealed that upper socio-economic class (p=0.043), doing internship in FMT (p=0.041) were found to be statistically significant. Multi-nominal bivariate analysis showed that students who did internship in FMT department had better medico-legal knowledge than others.The objective of the current study was to assess the level of knowledge of medico-legal aspects among future medical professionals. The results indicated that completing a residency in the FMT department positively impacted their understanding of medico-legal issues. To address any knowledge gaps and increase awareness of legal aspects, it is recommended that the optional rotatory internship in FMT be made compulsory. This would ensure that all medical professionals have a comprehensive understanding of various legal aspects.

Keywords: Medico-legal; Interns; Knowledge; Forensic Medicine & Toxicology.

Introduction:

India has experienced significant advancements in both government and private healthcare sectors since the end of British colonial rule. With the general population becoming increasingly knowledgeable, there has been a rise in awareness levels regarding health and healthcare facilities, resulting in an increase in seeking judicial justice against malpractices in the healthcare industry. To protect consumer interests, the Indian government passed the Consumer Protection Act[1] in 1986, but there was uncertainty about whether medical services were included until the Supreme Court of India made a decision in 1995 (Indian Medical Association v VP Shantha)[2] to bring medical services within the ambit of the Act. The medical profession is also governed by a code of medical ethics and etiquette as laid down by the Medical Council of India.[3] Following the Supreme Court's decision, there was a significant increase in the number of litigations against doctors and hospitals. Medico-legal, which combines the basics of medicine and law, incorporates the legal aspects of medicine such as legal rights, privileges, duties and obligations of a medical practitioner.[4] This field has gained importance in recent years after the passage of the Consumer Protection Act. While forensic medicine and medical jurisprudence are part of the medical school curriculum in India, many interns and residents lack knowledge about medico-legal issues. The trainee period is a critical time for foresting ethical reasoning.[5,6] Good medical practice requires that medical graduates demonstrate knowledge and understanding of the law,[7] as professionalism relies heavily on the depth of knowledge and application of medical ethics in everyday healthcare practice.[8] The knowledge of medico-legal issues is essential for maintaining the patient-doctor relationship and preventing the commercialisation of the profession.[9,10] Lack of knowledge of legal medicine and legal aspects of the practice

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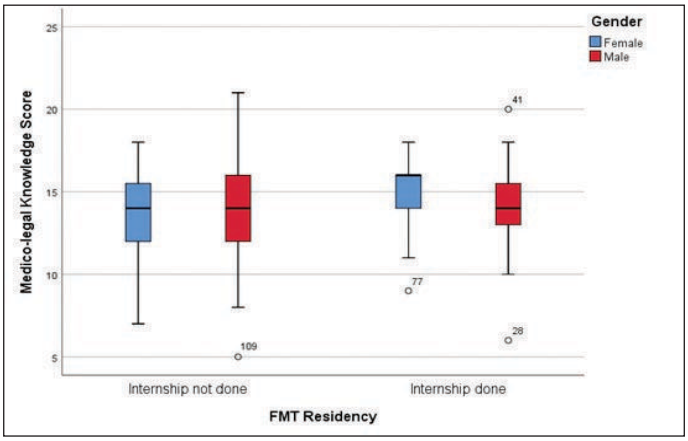
Table 1. Distribution of study subjects according to socio-demographic profile and knowledge regarding medico-legal aspects (n=195).

Variable		Number	Percentage
Gender	Male	115	59.0
	Female	80	41.0
Age Group (Years)	≤ 25	173	88.7
	≥ 26	22	11.3
Socio-economic Status	Upper	179	91.8
	Middle to Lower	16	8.2
Residence	Hostel	110	56.4
	Other than hostel	85	43.6
Internship in FMT	Yes	60	30.8
	No	135	69.2
Medico-legal Knowledge	Adequate (Score ≥ 50%)	140	71.8
	In-adequate (Score ≤ 50%)	55	28.2

Diagram 1. Box-plot showing gender-wise medico-legal knowledge score among the study subjects who did internship in FMT and who didn't (n=195)



of medicine is a significant issue that needs to be addressed promptly.[11]

Although, Forensic Medicine and Toxicology (FMT) are included in the medical curriculum, the subject has lost its importance over the years, leading to a lack of knowledge among future practitioners irrespective of their specialty. Therefore, this study aims to evaluate the level of knowledge regarding medico-legal issues among the internees of Calcutta National Medical College in Kolkata and raise awareness among future medical professionals regarding their medico-legal responsibilities.

Materials and methods:

An institution based cross-sectional descriptive study was conducted among internees of Calcutta National Medical College from February to March, 2023. Before starting data collection ethical approval was taken from institutional ethics committee (Ref. No: EC-CNMC/179, Dated: 28.01.2023). Internees who were absent on the days of data collection, unwilling to give consent were excluded from the study. Out of 236 Internees, data were collected from 195 by using a pre-designed, pre-tested and semi-structured questionnaire. It had two parts. First part was to gather information regarding socio-demographic profile. Second part was to assess medico-legal knowledge which was consisted of 26 questions. These questions were validated (Cronbach's alpha 0.693). Each correct response was scored as one and for wrong answers score zero was given. Henceforth the score range

Table 2. Distribution of study population according to internship in FMT department with different variables (n=195).

Variables		Internship in FMT Department		χ2	df	P
		Yes	No			
		Number (%)	Number (%)			
Gender	Male (n=115)	35 (30.4)	80 (69.6)	0.015	1	0.903
	Female (n=80)	25 (31.3)	55 (68.8)			
Socio-economic Status	Upper Class (n=179)	55 (30.7)	124 (69.3)	0.002	1	0.965
	Middle – Lower Class (n=16)	5 (31.3)	1 1 (68.7)			
Residence	Hostel (n=110)	37 (33.6)	73 (66.4)	0.974	1	0.324
	Others (n=85)	23 (27.1)	62 (72.9)			

Table 3. Distribution of study population according to knowledge with different variables (n=195).

Variables		Knowledge Score		χ2	df	P
		Score ≥13	Score ≤ 12			
		Number (%)	Number (%)			
Gender	Male (n=115)	82 (71.3)	33 (28.7)	0.033	1	0.855
	Female (n=173)	58 (72.5)	22 (27.5)			
Socio-economic Status	Upper (n=179)	132 (73.7)	47 (26.3)	4.089	1	0.043*
	Middle – Lower (n=16)	8 (50)	8 (50)			
Residence	Hostel (n=110)	75 (68.2)	35 (31.8)	1.627	1	0.202
	Others (n=85)	65 (76.5)	20 (23.5)			
Internship in FMT	Yes (n=60)	49 (81.7)	11 (18.3)	4.171	1	0.041*
	No (n=135)	91 (67.4)	44 (32.6)			

Table 4. Bivariate analysis of medico-legal knowledge with different predicted variables (n=195).

Variable	OR	AOR	df	p Value	95% CI for Exp (B)	
Gender (Female)	0.942	0.924	1	0.814	0.477	1.787
Socio-economic Status (Middle to Lower)	2.808	2.659	1	0.073	0.912	7.759
Residence (Other than hostel)	0.659	0.658	1	0.219	0.338	1.282
Internship in FMT (No)	2.154	2.265	1	0.035*	1.060	4.838

was 0-26. Minimum score of 50% i.e. 13 was considered as adequate knowledge regarding medico-legal aspects. Modified B. G. Prasad Socioeconomic Scale, 2022 was used to determine socio-economic status of the students. Data were collected on a pre-specified date in department of Community Medicine using the questionnaire within a stipulated time period.

Statistical analysis: Data entry and analysis were done in Statistical Package for Social Sciences (SPSS) version 16.0. Frequency distribution tables were used for descriptive statistics. Chi-square test and multi-nominal logistic regression were used to assess factors influencing medico-legal knowledge considering significance level at 5% assuming 95% confidence interval (CI).

Results:

The study was carried out on 195 interns from Calcutta National Medical College in Kolkata, with 115 (59%) being male and 173 (88.7%) being below the age of 25 years. The majority of interns, 110 (56.4%), resided in the hostel and only 60 (30.8%) expressed interest in doing an internship in Forensic Medicine & Toxicology (FMT) as an optional subject. Around one-third of the subjects, 55 (28.2%), had insufficient knowledge about medico-legal aspects (Table 1). However, female interns (31.3%), interns belonging to middle-lower socio-economic groups (31.3%), and

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those who lived in hostels (33.6%) showed more interest in doing residency in the FMT department as an optional subject, but statistical significance was not found in these findings (Table 2).The overall mean score for assessing knowledge regarding medico-legal aspects was 13.96 ± 2.67. Female interns had a higher mean score (14.03 ± 2.61) than male interns, and interns who did residency in FMT scored higher (14.25 ± 2.45) than those who didn't (13.83 ± 2.76) (Diagram 1).The study revealed that female interns (72.5%), those belonging to the upper socio-economic class (73.7%), interns residing outside the hostel (76.5%), and those who completed an internship in FMT (81.7%) had better knowledge than their counterparts. However, only the upper socio-economic class (p=0.043) and completing an internship in FMT (p=0.041) were found to be statistically significant (Table 3).Multi-nominal bivariate analysis showed that students who completed an internship in the FMT department had better medico-legal knowledge than others (AOR= 2.265, p-value = 0.035, 95% C.I. 1.06-4.838) (Table 4).

Discussion:

The rotatory internship period is vital & important transitional period from learning student to practical professional, as during this time student can acquire practical knowledge by hands on training, technical skills and try to reach their excellence by doing their responsibilities and duties. Legal issues are very much important & necessary in every type of professional practices in their own domain. So also for medical professionals face medico-legal issues which is increasing in nature in our country or other developing countries irrespective of region or places. The services of medical professionals are very sensitive, risky, emergency instant decision making & crucial and any wrong or inappropriate or inadequate decision may be disastrous to beneficiaries. But even in that midst of situation professional should have medico-legal part kept in mind. Medical professional should be well acquainted with Medical Laws & Ethics before performing or providing any medical services otherwise facing penalty either monetary, physical, loss of reputation or even their professional licences temporarily or permanently. The present study assessed medico-legal knowledge among 195 interns of Calcutta National Medical College, Kolkata. Study showed that 71.8% of interns having adequate knowledge regarding medico-legal aspects which was not corroborated with the study done by Mohite PM[12] who performed a similar study in 2000 showing high level of ignorance about medico legal issues. This lack of knowledge is not restricted to professionals from India only. Even developed nations like USA have issues related to lack of knowledge about medico legal aspect of medicine. A study done by Giri PA[4] in Rural Medical College (RMC), Maharastra showed the inadequate knowledge among the interns and residents. Significant disjunction between legal standards and doctors' awareness was shown in the study done by Darvall L.[13] Study done by Moreno-Hunt et al.[14] also observed significant lacunae in the knowledge of medico legal issues among obstetrics and gynaecology residents in USA. Among the study subjects 59.0% were male, 8.2% belong to middle-lower income group, 56.4% were residing in hostel. Only 30.8% interns did their residency in FMT. A study conducted in NEIGRIHMS, Shillongby Ropmay AD[15] found that only 3.7% of interns had poor knowledge but the current study found that nearly one-third (28.2%) had inadequate knowledge. From this study it was seen that interns who resided in hostel showed more interest in doing FMT residency but there was practically no difference among different genders and socio-economic status category in doing internship in FMT. This finding may be further evaluated by doing in-depth interview. This study also revealed that female interns and interns who did residency in FMT were more knowledgeable than others in medico-legal issues. The study revealed that female interns (72.5%), upper socio-economic class (73.7%), interns residing outside of hostel (76.5%) and those who had done internship in FMT (81.7%) had better knowledge than their counterpart. But only doing internship in FMT was found to be statistically significant.

Conclusion:

The purpose of the current study was to assess the level of knowledge of medico-legal aspects among the next generation of medical professionals. With the introduction of the Consumer Protection Act and the increasing awareness of people regarding their legal rights, this aspect has become a crucial part of the medical curriculum. The study findings revealed that undertaking residency in the FMT department had a positive impact on the medico-legal knowledge of the participants. Therefore, making the optional rotatory internship in FMT compulsory one could significantly enhance their understanding of various legal aspects. Furthermore, conducting regular re-orientation programmes, CMES and workshops for all medical professionals, organized by different medical associations, could help dispel any misconceptions, bridge knowledge gaps, and keep them updated on different legal issues related to medical practice.

Limitations: The study was conducted only among the intern batch of Calcutta National Medical College. Conducting a study involving all other medical professionals would reveal a larger scenario. Constructing a detailed questionnaire involving different angles of legal issues would definitely point out the lacunas among the healthcare givers.

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CASE SERIES

Body Packer Syndrome - Ethical Issues? A Case Series

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Abstract:

Transporting the foreign bodies, goods, outside or inside the body is called body packer or body pusher or body stuffers and also mules. Contraband substances and specially gold are smuggled in this process. If suspected by Custom Agency or the Police, they refer the case for medical examination and further medico-legal process of recovery of these substances from human body. The role of the doctors is very crucial as far as the life of mules, amount of material to be recovered, preservation of the evidence material including documents, radiological evidence, x-rays and the procedural methods followed, till handing over the recovered material to the concerned officer and keeping records. In the present study, we discussed various cases of body packers which smuggled cocaine and gold. NCCT scan of abdomen is more effective technique to identify body packers. The work experience of such cases in tertiary care hospital is presented here with the aim to share with medical professionals and medico-legal experts.

Keywords: Body packer syndrome; Illicit drug smuggling; Gold smuggling; Role of doctors.

Introduction:

Body packing refers to the concealment of prohibited substances in person's body.[1,2] "Body packers" usually ingest or insert wrapped packages of illicit drugs for the purpose of smuggling.[3,4] A swallower typically fills tiny balloon with small quantities of a drug. The balloon may be made with multilayered condoms, fingers of latex gloves, rubor balloons or more sophisticated hallow pellets.[5,6] These packets are usually tightly packed , tiny and tapered at machine-made forms as compared to genitally inserted packets which are smaller in size and relatively round in shape. Sometimes, Body Packer Syndrome causes death due to effect of rupture of heroin or cocaine packets in the gastrointestinal tract.[7-9] The drugs most often involved in body packing are heroin and cocaine.[10-11]

Case report 1: A 33 years old male was escorted by Airport Police to hospital due to suspicious behaviour at the airport after landing. He was suspected of body packing but without abdominal pain or vomiting. Plain abdominal X-ray was performed, the examination showed multiple, well-defined, oval shaped, radiopaque foreign bodies studded in colon. He was admitted under care of General Surgery as a case of drug carrier. NCCT abdomen was performed which showed multiple foreign bodies within colon and rectum. Patient was managed conservatively, total 35 capsules of cocaine were recovered from stool over period of 5 days, and capsules handed over to the Customs Officer and a follow-up NCCT abdomen revealed none of the previously seen hyperdense objects in scan. At the time of discharge, suspect was doing well, mobilised with no active complaints.

Case report 2: A 43 years old male was caught in the airport for suspicion of possession of contraband substance in the form of body packing, with no complaints. He was brought in ED and admitted under care of General Surgery; patient after being apprehended passed 65 capsules of cocaine through defecation. He had ingested unknown number of capsules in Brazil. The contraband substance had size of a thumb, white in colour. Packed, sealed and handed over to Customs Officer. Since patient had no more capsules on NCCT abdomen and was asymptomatic, patient was discharged.

Case report 3: A 51 years old male was caught in the airport for suspicion of possession of contraband substance in the form of body packing, with no any complaints. He was brought in ED and admitted under care of General Surgery; patient after being apprehended passed 74 capsules of cocaine. He had ingested unknown number of capsules in Brazil. The contraband substance were weighed and found to be 177 gms. Packed, sealed and handed over to Customs Officer. Since patient had no more capsules on NCCT abdomen and was asymptomatic, patient was discharged.

Case report 4: A 37 years male was caught in the airport for possession of contraband substance in the form of body packing. Patient after being apprehended passed 38 capsules of cocaine at airport. He had ingested about 140 capsules of cocaine in Brazil. For this reason, patient brought to ED and admitted under care of General Surgery, CT abdomen plain was performed which showed multiple 30-40 foreign bodies present within colon and rectum. Patient was managed conservatively, 39 more capsules

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were recovered over period of 7 days, and capsules handed over to the Customs Officer and a follow-up NCCT abdomen revealed none of the previously seen hyperdense objects in scan. At the time of discharge, suspect was doing well, mobilised with no active complaints.

Case report 5: A 24 years old female was caught in airport for possession of contraband substance in the form of body packer. Brought in ED and X-rays was performed, X-rays showed 2 metallic exhibits inside vagina. Patient was then referred to OBGY, and on per speculum examination two rectangular exhibits wrapped with gauze piece were found. All two metallic exhibits packed and sealed, handed over to custom officers.

Case report 6: A 30 years old male brought by intelligence officer of airport. Regarding suspicion of carrying certain contraband substance, which the patient initially denied but agreed for the same later on. He passed 41 capsules at airport, the same capsules were chemically analysed by Narcotic Department and was found to be contain "Methaqualone". The patient was brought to ED for further screening and admitted under care of General Surgery. Patient passed 11 capsules on day admission. NCCT abdomen was performed which showed multiple (approximatelly 20cc) hyerdense foreign bodies of density around 171HU in ascending colon, sigmoid colon and rectum. Patient paased 110 capsules more over a period of 5 days admission, and capsules were handed over to the Customs Officer and a follow-up NCCT abdomen revealed none of the previously seen hyperdense objects in scan. At the time of discharge, suspect was doing well, mobilised with no active complaints.

Discussion:

From many decades, body packing is one of the common means of transporting illegal drugs across high security ports worldwide by drug smugglers. It has been observed that body packers were mostly young men, however there are evidence of adolescent males and pregnant women being used for the same. Heroin, cocaine and cannabis are the most commonly used drugs by body packers. For packaging of these drugs, body packers use waterproof multilayered latex sheath of balloons or condoms. Recently body packers swallow the cocaine and heroin in the form of capsules. NCCT scan of abdomen is more sensitive and accurate than abdominal X-ray to determine a body packer.[12]

Our cases also suggested that the drug swallowed by the body packers was cocaine by performing preliminary investigation. Plain abdominal X-ray and NCCT scan of abdomen revealed multiple capsule-like structures inside the bowel, and the capsules were confirmed to be cocaine using an onsite immunoassay drug-screening test. The various capsules of sedative drug i.e. methaqualone swallowed by 30 years male. In a case of female body packer, she hid two metallic exhibits (probably gold) inside vagina. Some of the body packers were asymptomatic. But they were under suspicision hence brought to the hospital by custom officer.

Conclusion:

By studying these case reports, it is concluded that clinical examination aided by radiological investigations are the fundamentals in diagnosing a body packer. Body packers accepted that they smuggled heroin and cocaine for getting large amount of money. This method of illicit drug smuggling is very frequent across the world hence role of treating doctors and investigating officer is very important.

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CASE REPORT

Massive Bilateral Pulmonary Thromboembolism – A Bolt from the Blue Case Report

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Abstract:

Thrombosis originating from the deep veins of the lower limbs can result in recurrent emboli leading to acute on chronic pulmonary thromboembolism. The death in such situations would be sudden and unexpected due to acute right sided heart failure (cor pulmonale). There can be few preceding non-specific symptoms such as cough and/or dyspnoea, especially in non-hospitalised decedents. Many a time pulmonary thromboembolism is only detected in a medicolegal autopsy. The sudden and unexpected death in an apparently healthy individual paves the way for a police inquest procedures, and a medicolegal autopsy would be the only legal and logical alternative to find a closure. However, massive bilateral pulmonary thromboembolism occluding almost more than 80 percentage of the pulmonary artery vasculature is an extremely rare phenomenon in a medicolegal autopsy. This case report has been prepared to discuss on such a rare presentation, discovered during the medicolegal autopsy of an apparently healthy 46-year-old individual who collapsed on the sides of a road, and was brought dead to the hospital.

Keywords: Cor pulmonale; Pulmonary thromboembolism; Sudden death; Venous thrombosis.

Introduction:

Venous thrombosis within the veins of the lower limbs usually results in pulmonary thromboembolism (PTE). When PTE is of the massive grade, it may lead to fatal acute cor pulmonale (right sided heart failure). Among cardiovascular diseases, PTE is the third most common cause of death.[1] The mortality rate of PTE is higher than acute myocardial infarction.[2,3] A vast majority of PTEs occur very soon after presentation of their first symptom – usually within an hour.[4] The death would be sudden and unexpected as a result of acute right ventricular dysfunction, often causing the police officer in charge of the investigation to be puzzled. As in this case report, a medicolegal autopsy is the only recourse to find out the exact cause of death in such situations.

Case Report:

A 46year-old male, security officer by profession, while walking to his workplace from his residence, coughed out a few clots of blood, following which he slumped on to the sides of the road, and then fell unconscious. On arrival at hospital, he was declared dead, and that initiated a police inquest. As per the requisition form submitted by the investigating officer (IO), there was no prima facie evidence as to the cause and manner of death. The IO said that he was suffering from Diabetes Mellitus, and was once hospitalised for dyspnoea recently. Even though further details were sought, they were not made available. The autopsy was conducted at the Autopsy Block in AIMS, Kochi. The body of the decedent was that of moderate built and moderate nourishment. Dried blood stains were seen within the nostrils, and mouth contained a few clots of blood. There were no antemortem injuries on the body. Air passages were smeared with blood. Heart (220grams) was normal, except for left ventricular hypertrophy (2cms thick). On dissection of the heart, a 10cms long non-friable and firm antemortem thrombus was seen in situ, extending from the chamber of the right ventricle through the trunk of the pulmonary artery, into the right and left pulmonary arteries of the lungs (Figure 1). The thrombus continued for another distance of 8cms into each lung, completely occluding all the lobar arteries of both the lungs – the entire pulmonary artery vasculature (approximately more than 80 percentage) was thereby continuously occluded with antemortem thrombus (Figure 2). Stomach contained partially digested food materials (with no unusual smell) in a coffee brown coloured (consistent with altered blood) semi-solid medium; the mucosa of the stomach was normal. There were no other significant internal examination findings. The cause of death was opined[5] as being strongly consistent with acute right sided heart failure due to massive bilateral pulmonary thromboembolism; and the manner of death being a natural death.

Discussion:

Even though advanced age is a known risk factor for PTE, one meta-analysis has shown middle aged individuals to be presenting with a high frequency of the same, as seen in this case report.[6] Non-pathognomonic features such as dyspnoea and or chest pain are commonly associated with PTE as a pre-existing manifestation, one to few days before death. The occurrence rate of these features were seen to be higher in outpatients, rather than in-hospital patients, similar to the case in discussion.[6] Deaths in PTE have a strong association with right ventricular dysfunction.[7,8] Though right ventricular hypertrophy is seen in such deaths, it is not a mandatory finding – being absent in the case discussed here.[9] During autopsies of massive PTE (extending up to the distal parts of lobar/segmental arteries) the

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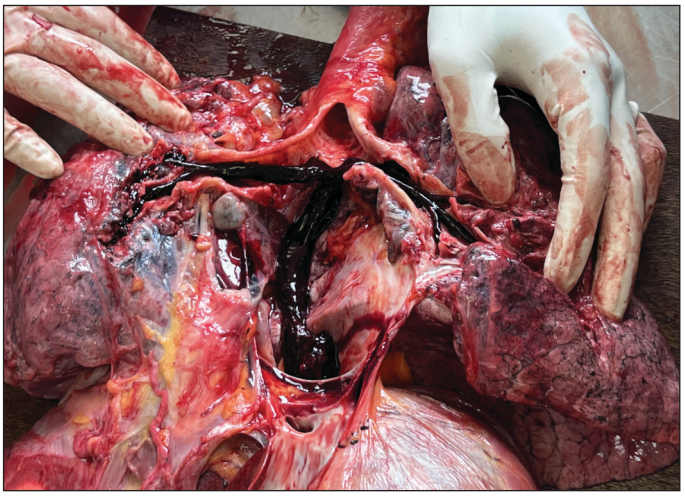

Figure 1. Massive bilateral pulmonary thromboembolism (heart has been removed to visualise and measure the complete extent of the antemortem thrombus.

pulmonary parenchyma usually appears pale due to infarction. But as seen in the present case, this is an infrequent finding. This could be due to dual perfusion of the lungs (pulmonary and bronchial arteries); or as a result of short duration from the onset of the symptoms up to death (sudden deaths).[10] Over 90% of the emobli seen in lethal PTE, originates from deep leg veins (crural veins), the soleal veins being the major culprits since these are highly susceptible to venous stagnation, caused by prolonged sitting.[11,12] The occupation of the decedent in this case report keeps up with this explanation. A very massive thromboemboli resulting in a single fatal attack is often referred to as an incidence of acute on chronic PTE, and this is a common feature relatively higher in outpatients. The mechanism being postulated as repeated thrombotic events which progressively worsens, climaxing in sudden unexpected death. Such patients can have a preceding cough and dyspnoea.[6] These literature excerpts are abreast with the findings in the current case report.

Histopathological examination in medicolegal autopsies (vs. pathological autopsies) has been found to be not affecting the legal status and or outcome of the 'cause of death' section (of the report) in courts. This is true in medicolegal autopsies of both natural and unnatural deaths.[13,14] Recently, the consensus is to avoid routine microscopic examination of tissues in medicolegal autopsies.[15] Such ancillary investigations are only warranted in obscure/negative autopsies. Hence no histopathological examination was undertaken in this medicolegal autopsy. Moreover, the cause of death is being obvious – the massive bilateral PTE is sufficient in the ordinary course of nature to cause severe stress on the right side of the heart, and this in turn is sufficient to cause acute right sided heart failure and cardiovascular collapse, culminating in instantaneous death.

To conclude, acute massive PTE is still one of the most common life-threatening disease, and in such sudden unexpected suspicious deaths an autopsy examination is the only way out to have a closure. The prosector must be extremely forbearing and cautious while performing dissections in such medicolegal autopsies.

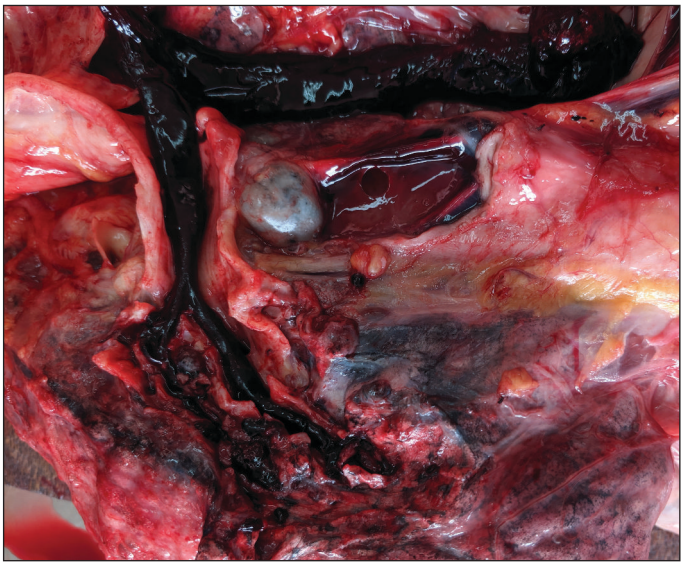

Figure 2. Closer photograph showing the extent of the thrombus into the distal portions of the lobar arteries (pulmonary vasculature).

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CASE REPORT

Dilemma of the General Surgeon in a Medico-Legal Autopsy of a Case of Traumatic Asphyxia: A Unique Case Report

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Abstract:

The ability to perform medicolegal autopsy does not necessarily give a registered medical practitioner the expertise over it which is a major setback in solving medicolegal cases. Manner of death is very much important to decide as like cause of death and time since death for the proper disposal of justice to the dead. Traumatic asphyxia is a type of mechanical asphyxia, where respiration is prevented by external pressure on the body, at the same time inhibiting respiratory movements and compromising venous return from the head. Here we present a case of traumatic asphyxia where a general surgeon who conducted the autopsy could not be convinced by the police investigation that tractor accident was the cause for which the deceased succumb to death without any external & internal injuries and meanwhile got confused with the findings in the body suspecting it to strangulation death which was finally resolved by the opinion of the subject expert.

Keywords: Registered medical practitioner; Medicolegal autopsy; Traumatic asphyxia; Inquest.

Introduction:

General surgeons are doctors specialized in surgical procedures of the living body for diagnosis and treatment. In comparison to them, autopsy surgeons are those who are specialized to examine dead bodies to elicit the cause and manner of suspicious unnatural death for the administration of justice.

The unnatural deaths could be homicidal, accidental, suicidal, and rarely undetermined in origin depending on the circumstances of the death.[1] The doctor holding a post-mortem examination should be familiar with the normal and pathological appearance of the viscera and should be able to interpret post-mortem findings by proper training and experience, otherwise miscarriage of justice is sometimes a possibility.[2] As per the rule for medico-legal autopsy, an authorized government medical officer is allowed to conduct a post-mortem examination in a morgue attached to the hospital, not in a private room.[3]

The registered medical practitioner(RMP) is allowed to conduct an autopsy irrespective of the specialization or no specialization of the subject of forensic medicine. It is observed that due to the lack of expertise of the RMP, some of the medico-legal cases remain unsolved or obscured. Here we present a case of traumatic asphyxia where a general surgeon who conducted the autopsy could not be convinced by the police investigation that tractor accident was the cause for which the deceased succumb to death without any external & internal vital injuries present.

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Case Report:

An average-built 21 years old male, tractor assistant by occupation, not being a known case of any medical illness in the past was brought dead in a tertiary health center with a history of minor tractor accident. While the tractor was reversing the deceased got compressed in between a concrete wall and the trolly of the tractor and collapsed. Inquest was conducted by the investigating officer on the dead body of the deceased in the presence of relatives and the tractor driver. They all agreed that the cause of death was a tractor accident. Autopsy was conducted in the mortuary of the nearby govt hospital by the duty doctor, who was a surgery specialist. On external examination (Figure-1), a linear abrasion of length 12 cm, lying obliquely on the back of the right chest over the right scapula, a linear abrasion on the front of the right knee joint of length 5cm, and an abraded contusion of size 1.5cm x 0.5 cm on the dorsum of the right big toe. “I "incision was given from chin to pubic symphysis for internal examination of the thoraco-abdominal cavity. On incision of the neck, a gush of dark frank blood came out, which brought the autopsy surgeon towards a bias regarding death due to strangulation (Figure-2). All the bones of the chest cage were intact. The anterior border of the left lung showed a line of hemorrhage without any other injuries (Figure -3). Both lungs were almost intact, congested, and oedematous. The internal examinations of the abdomen showed signs of congestion without any internal mechanical injuries. No characteristics smell of any poison or features of intoxication were observed from the stomach except semi-digested food particles of rice. Cranial cavity findings were unremarkable with features of deep congestion. The autopsy surgeon was unable to reach an opinion regarding the cause of death. Regarding the manner of death as mentioned in the inquest to be accident, was not convincing after performing the postmortem. Considering the congestive features, the autopsy surgeon suspects that the cause of death could be of

Figure 1. Shows the linear abrasion on the back.

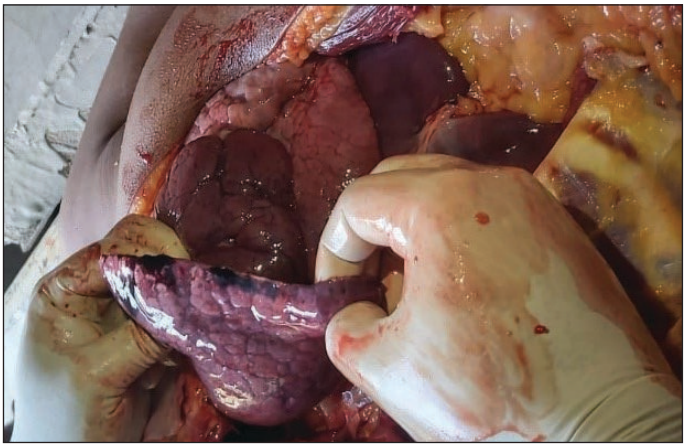

Figure 3. Exhibits marginal haemorrhage on the anterior border of left lung.

Figure 2. Illustrates the exploration of neck showing gush of blood.

Figure 4. Depicts line of demarcation on the chest.

compression the neck by some soft broad ligature material possible strangulation and the manner is homicidal. The culprit behind this case is the tractor driver as it was not witnessed by anyone. Before reporting the case, the autopsy surgeon came with the photographs taken by him to the author for discussion, where he was convinced by, seeing the marks of demarcation which lies in the upper chest (Figure -4) and the excessive bleeding on the neck due to severe congestion and edema of the head & neck above the line of demarcation. Now the manner and the cause of death were confirmed as suffocation resulting from traumatic asphyxia and consistent with the history of the police investigation.

Discussion:

Traumatic asphyxia is a rare condition presenting with cervicofacial cyanosis and edema, petechial and subconjunctival hemorrhage of the face, neck and upper chest that occurs usually due to a compressive force to the thoraco-abdominal region but has also been associated with asthma, paroxysmal coughing, protracted vomiting, and jugular venous occlusion.[4] It is first described in 1937 by Oliver d' Angers in his observation of cadavers who were trampled.[5] Later, Perthes added some other characteristic features in living like cyanosis, sub-conjunctival hemorrhage, contusion pneumonia, and hemoptysis to the initial description to form a complex of symptoms called Perthes like syndrome.[6] Traumatic asphyxia is also referred by other names traumatic cyanosis, compressive cyanosis, traumatic apnoea, and crush asphyxia.[6,7] It is characterized by the association of florid red or blue congestion of the face and neck (Masque ecchymotique) and a well-defined demarcating line between the discoloured upper portion of the body and the lower normal part.[7] Both the pathognomonic features were found in our case to solve the confusion of the autopsy surgeon. On average 2 to 5 minute compression period is sufficient to develop traumatic asphyxia.[8] These cases are usually seen as a result of motorcycle accidents, trample deaths, falls of walls and heavy machines/furniture on the thoraco abdominal wall as in our case of a tractor accident. Though this is common in traumatic cases but no definite direct trauma history could be obtained from the face and neck area of the deceased as also observed in our case. It is also rarely seen in deep-sea diving, epileptic seizures, difficult delivery, and asthmatic attack. Traumatic asphyxia cases are rarely seen in clinics. The prognosis of this syndrome depends on the nature and duration of the compressive force and the presence of other injuries. Supportive treatment such as oxygenation and elevation of the head to 30° is usually sufficient in the management of these patients.

Conclusions:

Forensic medicine experts are very less in numbers in comparison

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to the rise of medico-legal autopsies and cases in various parts of our country. A registered medical practitioner is allowed to conduct an autopsy because of the lack of our experts to meet the caseloads. The cases of accident, murder and suicide where suspicion arises, it is better to consult with the experts of that branches so that justice will be easily carried out.

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Conflict of interest: None

Acknowledgements: The authors express sincere thanks to the registered medical practitioner (General Surgeon) who conducted the autopsy.

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CASE REPORT

Blood and Desire: A Case of Preplanned Murder, following Torture by Spouse

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Abstract:

As one of the oldest civilizations of the world, India has experienced several seismic changes in culture, migration and invasion in which violence has played an integral part which has also brought changes in patterns of homicide and responses to it.[1] Attempts to camouflage the homicidal incidents is not an unknown phenomenon, which neither the science nor the law is always successful in unearthing and when the element of premeditation is involved, the crime becomes much more heinous.[2] Requisition for conducting post-mortem examination of a 42-year-old male was brought to Kolkata Police Morgue on 05/11/2022, being referred from a district hospital. External examination showed multiple injuries over the face, extremities and external genitalia with numerous nail scratch abrasions over the anterior aspect of the neck. Internally all visceral organs were congested.

Keywords: Murder; Manual strangulation; Genital injuries; Hyoid fracture.

Introduction:

Although the term homicide is sometimes commonly used synonymously with murder, there exists an ocean of difference between these two which can be bridged by three terms-unlawful, intentional and with a malice aforethought.[3] Therefore, a prosecutor must prove this "level of intent" before someone can be convicted of murder. The concept of culpability is intimately tied up with notions of agency, freedom and free will. All are commonly held to be necessary, but not sufficient to prove culpability which can be proved if the following elements are involved:

I. Negligence II. Recklessness

III. Knowingly IV. Purposefully

There are always some elements of a crime that constitute the backbone of every criminal case and corroborate that evidence of a crime. These elements are further categorized into two:[4]

I. General elements: -

● Mens rea ● Actus rea ● Concurrence ● Causation ● Harm

II. Specific elements (elements needed to prove a specific crime like the motive of the crime, circumstantial evidence, etc).

For every crime, whether the perpetrator(s) is/are known or unknown, the line of inquiry always follows an analytical approach to join missing links in cases where the investigation of the judiciary has met a dead-end. In the following report, we present this case, where the deceased was cold-bloodedly throttled to death. Even though it was not an off-the-record case of manual strangulation, the interest of the case lies in the very fact that it has shed light on every element of murder and the motive behind the crime.

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Case history:

On the 5th of November, 2022, the Kolkata Police Morgue received a requisition for conducting the medicolegal autopsy of a 42-year-old male. The case was referred from a district hospital due to the unavailability of forensic pathologist in that hospital. He was brought dead at one of the rural hospitals, where the emergency medical officer after declaring him "Brought dead", sent the deceased's body for a post-mortem examination.

2.1 Findings: Autopsy findings: The routine medicolegal autopsy was conducted at 4:00 pm on 05/11/2022.

2.1.1 External: The dead body of a well-built and well-nourished male subject weighing 95 kg and height 5' 10", Rigor Mortis present all over the body, face dusky, eyes closed, pupils dilated equally on either side and fixed, conjunctiva congested and corneas were hazy.

W/A- One grey-coloured vest with one greenish-black drawer was noted. Liquid blood is noted to be oozing out of the right nostril. There was bluish discolouration of fingertips, nail beds, the tip of the tongue and nose, and ear lobules.

Figure 1. External appearance.

Figure 2. Dusky face.

PM No. 637/KPM
Date: - 05/11/2022

Figure 3. Lacerated wound over Rt Upper Eyelid.

One lacerated wound measuring, 1" x 1" x muscle deep over right upper eyelid, 1.3" to the right of midline, 5" vertically above lower border of right half of mandible, with diffuse extravasation of blood within soft tissues.

Class IV human bite mark, involving an area of 1.5" x 1", with gaps of 0.3" each over the two lateral ends, over th right side of the face with one abrasio measuring 1" x 0.4" over the lower pa of the right side of the face, with diffus extravasation of blood in the soft tissue and muscles, excluding the right parotid gland

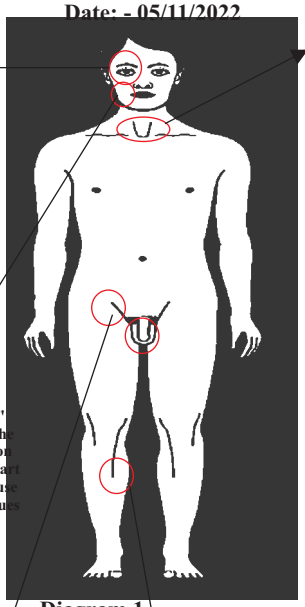

Diagram 1

10 (ten) number of abrasions, involving an area of 5" x 2", over right side of the neck placed obliquely from above downwards, one below the other, with evidence of overlapping at places

Figure 8. Numerous nail scratch abrasions, placed obliquely one below the other, from above downwards.

Figure 4. Human bite mark over Right cheek, revealing deep bruise on further dissection.

One bruise of size 1.2" x 0.5" over right inguinal region, 3" below right anterior superior iliac spine

Figure 5.
Bruise over Rt Inguinal region.

One Class IV human bite mark involving an area of 1.5" x 1" over the medial aspect of upper part of the right leg, 11.5" above the right medial malleolus with extravasation of blood in and around subcutaneous tissues

Figure 6. Human bite mark over medial aspect of Rt leg.

Diffuse extravasation of blood in all the layers of right scrotum with diffuse bruising and softening of right testis

Figure 7. Bruise over Rt scrotal layers and Rt testis.

Figure 9. Bruise around cornu of Hyoid without fracture.

Figure 10. Epicardial petechiae.

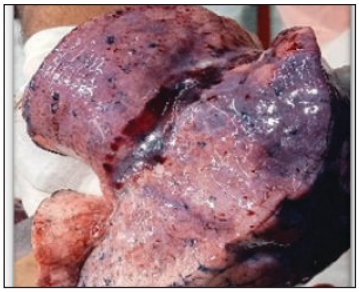

Figure 11. Subpleural and interlobar hemorrhages.

Figure 12. Diffuse submucosal hemorrhages in stomach.

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Injuries noted were as follows: -

- Extravasation of blood into the layers of superficial muscles of the front of the right half and left half of the neck measuring about 3" x 2.5" and about 3" x 2" longitudinally, respectively.
- All the injuries noted above showed signs of vital reaction.
- The abrasions were non-scabbed and bruises and extravasated blood were dark red.
- The margins of the lacerated wounds were irregular and showed extravasation of blood in and around.

2.1.2 Internal: ● Diffuse extravasation of blood in and around the right cornu of the hyoid bone.

- All the visceral organs were congested.
- Epicardial petechial hemorrhages were present. Both the lungs were oedematous with evidence of subpleural and interlobar petechial hemorrhages.
- Mucous membranes of larynx and trachea were congested with intact hyoid bone and thyroid cartilage.

2.1.3 Toxicological analysis: Routine viscera along with blood, urine, vitreous humor and bile were packed, labeled, signed, sealed and handed over to the police for onward transmission to Forensic Science Laboratory for toxicological analysis, which came out negative for any drug or pharmacological agent.

Discussion:

Death in this case, was antemortem because of manual strangulation. The only point of contention that arose was regarding the fact that whether the deceased succumbed to vasovagal syncope due to testicular squeezing or mechanical asphyxia or due to the combined effects of both, as genital trauma proved to be fatal in various literature.[5] This however, has very little to do with the background in which the events have occurred. Based on the post mortem findings and reconstruction of events, it was possible to throw some light on the circumstances and a clue about the perpetrator based on which the investigating officer nabbed the spouse of the deceased who confessed of having an extramarital affair about which her husband came to know of. One afternoon when he returned from work she feigned desire with the intent of murdering him in course of time. Taking advantage of the situation, she groped his testicles firmly and squeezed it hard. Furthermore, to confirm his death, She tried to throttle him and during that scuffle inflicted injuries upon him with brutality and cruelty.

Here, we try to prove the criminal intent as follows: -

- The act was unlawful and intentional, evidenced by the multitude of wounds.
- The question of whether it was malice aforethought or impulsiveness can be answered by: -

1. The verbal statement that was given by the assailant (as in this case).
2. Circumstantial evidence.
3. A review of previous literature on similar cases has shown that the modus operandi of the assailant almost always remains the same.

- In the court of law, to prove this level of intent, the convict's mens rea may be attributed to the level of committing the act “knowingly” and “purposefully”.
- The burden of crime can be substantiated from both the specific element (in this case the modus operandi of the assailant) along with the five general elements of murder described previously.
- The interest in the case was heightened more because a man of such well-built strength compared to his spouse could easily be subdued. This tends to contradict results of various studies which have shown that physical strength, level of aggressiveness and mental abilities tend to be higher in men compared to women.[6]
- Such a crime falls under the types where offender profiling becomes essential. Based on Cesare Lombroso's theory of criminology, where he classified criminals into three major categories (born criminals, insane and criminaloids), the assailant in this case may be classified under the criminaloid group.[7]

Conclusion:

Thus, conducting a post mortem examination meticulously coupled with the knowledge of the nature of injuries over a dead body, the manner of death can be deduced to a great extent. In cases of suspected homicide/murder, this knowledge helps in understanding an offender’s method of operation. The equation of profiling an offender can be formulated in such a way that intent of every crime, be it justifiable or non-justifiable, easily fits into. [8,9]

Overall, when we investigate such a case from forensic point of view, they may help forensic pathologists to reconstruct the scene of crime and delve a little deeper into the psychological aspect of the perpetrators.

Abbreviations: FSM: Forensic and State Medicine.

W/A: Wearing apparels.

Conflict of interest: None.

Source of funding: None.

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CASE REPORT

Death Due To 2, 4-DI-Ethyl Ester Poisoning –A Rarely Documented Compound in Clinical and Forensic Practice

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Abstract:

Poisoning with Herbicides, Pesticides and Rodenticides etc. is very common nowadays especially in the northern parts of India due to their easy availability from market. Such compounds are available in the houses of farmers, persons dealing in agriculture sectors. Most of the time the cases of poisoning which are brought to our hospitals or are brought for autopsy in the mortuaries are of Organo phosphates, Organo chloro compounds or Aluminum Phosphide poisoning. In this case, we will discuss about the poisoning with a rarely documented compound 2, 4 Di Ethyl Ester which is a compound of Phenoxy acetic group. 2,4 Dichlorophenoxyacetic acid (2,4-D) is a selective herbicide used to kill broad leafed plants. The signs and symptoms of this compound mimics with anti-cholinesterase compounds which might be the reason for under reporting of this compound as a potential cause of poisoning. The role of preserving blood sample during post-mortem to look for myoglobin and creatine phsphokinase levels may be of help in giving opinion regarding cause of death in case of negative FSL's reports.

Keywords: 2, 4 Di Ethyl Ester; Herbicide; Phenoxy acetic group.

Introduction:

There are many pesticides and herbicides available for farming purpose. A herbicide, also commonly known as weed killer is a substance used to kill unwanted plants.[1] 2, 4-Di Ethyl ester is an herbicide of Phenoxy acetic group widely used in Northern India against broad-leafed weeds in cereal crops, lawns and parks. Ingestion, skin contact and inhalation are three main routes of human exposure to 2, 4-D herbicides. Very few documented poisoning cases with this compound have been reported. Chances of misdiagnosis are high as initial symptoms may mimic as that of anti cholinesterase poisoning.[2,3] 2, 4-Di-Ethyl Ester (2, 4-D) is an herbicide with highly toxic effects. Complications occur due to difficulty in diagnosis. Management is only supportive with alkaline diuresis and treatment of complications as there is no specific antidote to this compound.[4,5]

This poison has severe pulmonary, renal, neurological, gastrointestinal and myotoxic effects leading to multiorgan dysfunction and rapid death. Muscle fibrillations, myotonia, myoglobinuria and muscular weakness are the myotoxic effects leading to acute kidney injury.[6]

Case Description:

A 36 yrs. old male found unconscious on roadside during morning hours in August, 2020. A bottle of HEERA 44 (half empty) was present besides the body. Patient was brought to the casualty of DRPGMC, Tanda by relatives with the history of consumption of about 150 ml of HEERA 44. Police was informed by the doctor posted in casualty and medico legal report was issued, gastric lavage and blood sample were preserved for chemical analysis.

As per hospital record, patient was admitted and treated symptomatically for 2, 4-Di-Ethyl Ester (HEERA 44) poisoning. Sodium bicarbonate 60 mg equivalent slow bolus intravenous stat was given after checking serum Potassium levels. The patient died next day and the body was handed over to police for further necessary action. Medico legal autopsy was conducted in the mortuary of Dr. Rajendra Prasad Govt. Medical College, Kangra at Tanda.

Post-mortem findings:

It was the dead body of a male, 162 cm in length, moderate built and moderately nourished. Rigor mortis was present over the upper part of the body. Post-mortem staining, purplish in colour was present over the back of neck, trunk and lower limbs except on the areas of contact flattening and was fixed. No injury was appreciable over the body externally except therapeutic puncture marks present over bilateral cubital regions.

Both lungs were intact and showed pulmonary oedema. Lower lobes of both the lungs were of liver like consistency. Stomach contained about 50 ml of brownish coloured fluid. Mucosa of stomach was congested and sub-mucosal haemorrhages were present. Abnormal smell was present from its contents. All other organs were congested. Urinary bladder was empty.

Samples sent:

Viscera and blood were preserved and sent for chemical analysis

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to Regional Forensic Science Laboratory, Dharamshala through investigating officer of police. Blood sample was also preserved in plain vial to check Creatinine Kinase, Myoglobin levels and was sent to diagnostic lab in DRPGMC, Tanda.

Reports: 1. No poison or ethyl alcohol was detected in the Chemical analysis report issued from RFSL, Dharamshala.

2. Creatinine Kinase in serum of deceased: 5359 U/L(Normal range is less than or equal to 171U/L).
3. Myoglobin :>30000ng/ml (Normal range is 28.0-72.0ng/ml).

Discussion:

As 2, 4 Di Ethyl ester has been available as a herbicide for many years but there are only few reported cases of occupational exposure and its used as a suicidal agent. This can be due to the inability to distinguish clinically from the Organophosphorus compounds as the initial symptoms mimics with these compounds. Secondly, as our chemical analysis centres i.e. FSL's are not well equipped so that the wide range of compounds available in the market and consumed by the public by mistake or with suicidal intent could be detected on chemical analysis.

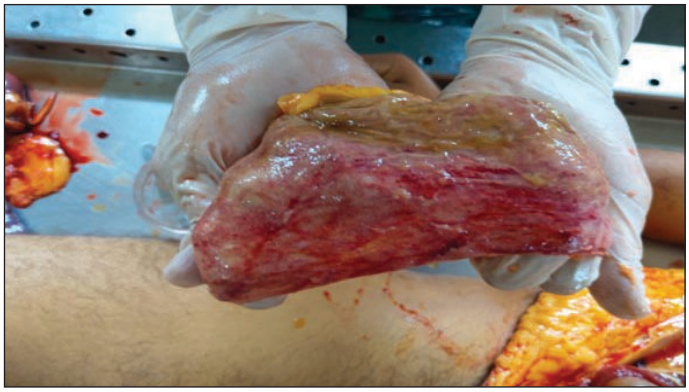

Figure.1 Shows congested mucosa of stomach along with sub-mucosal haemorrhages.

2,4-D is cardiotoxic, myotoxic, neurotoxic, hepatotoxic, nephrotoxic and also produces haematological disturbances. Since there is no specific antidote available, management is supportive in the form of maintaining hydration, supporting respiration, preventing aspiration. Since myoglobinuria produces nephrotoxicity, alkaline diuresis may be helpful in preventing renal damage. Urine alkalinisation with high-flow urine output may possibly increase the herbicide elimination and should be considered in all seriously poisoned patients. In addition haemodialysis can play a vital role in the management as myotoxic effect is the main feature of this compound.

No poison was detected in the viscera and blood of the deceased as per the chemical analysis report but the values of creatinine kinase and myoglobin were much higher than the normal serum value in the blood which was preserved and sent to diagnostic lab of DRPGMC Tanda. It shows that this compound is highly myotoxic.

Conclusions:

In cases of poisoning brought for treatment, where the diagnosis of organo phosphates and organo-chloro compounds is not clear to the clinician, the poisoning with 2, 4-dichlorophenoxyacetic acid compounds should also be kept in differential diagnosis. Alkaline diuresis may increase the elimination of such poisons and treatment for rhabdomyolysis may also be done in such cases. Even during post mortem examination, blood may be preserved to check Creatine kinase and Myoglobin levels in cases where the diagnosis of Organophosphates or Organo chloro compounds was not made by the clinician; as per treatment record. This poison may also be called as “Misdiagnostic poison.” Besides stringent laws and their implementation at the ground level to regulate the sale and possession of herbicides, pesticides etc. are also the need of the hour.

FSL's should be well equipped so that the wide range of compounds available in the market and consumed by the public by mistake or with suicidal intent could be detected on chemical analysis. The number of groups/compounds which are checked by scientists at FSL's in routine should also be increased. The casualty/emergency department of every Medical College or even District hospital should have a poison information centre where the facility of detection of poisons should also be made available.

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REVIEW ARTICLE

A New Model of Integrated Forensic Database in India- Road to Future

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Abstract :

There have been tremendous technological developments in the 20th century which has been called the age of science. Forensic science in India also developed in the 20th century and intensified in the 21st century. For timely solving crime cases through proper scientific investigations, a lot of facilities were created in India. But due to the increasing number of crime cases, efforts are being made, but still, it is not enough. There is a further need for improving Forensic Science in India. In countries like the Philippines and Switzerland, an integrated database of these systems has been formulated and implemented to deal with sexual offense cases and sample evidence like DNA and its dealings. This article highlights and discusses the integration of intelligence units of Police, Forensic Experts, and Forensic Medicine Doctors sharing a common database which is linked first in the state and then nationwide, an integrated DNA model which is needed to increase the success rate in sexual assault cases, problems, a roadmap for better future of forensics in India. A feasible model, keeping in mind the Indian scenario and administrative context, has been depicted in detail.

Keywords : Forensic science; Forensic database; Forensic medicine; Evidence; DNA isolation.

Introduction :

Over the last few decades Forensic Science, Forensic Medicine, and Toxicology have advanced significantly worldwide.[1] Police, Forensic Scientists and Forensic Medicine doctors are interconnected with each other professionally in dealing with criminal cases. Crimes are committed anytime at any place and in any form.[2] Proper analysis of evidence can make it easier to identify the guilty and innocent. Particularly in cases of brutal and organized crimes, forensic scientific evidence plays an important role.[3]

Presently in India, there are various Forensic Science Laboratories in the Government and private sectors. Central Forensic Science Laboratory (CFSL), State Forensic Science Laboratory (SFSL), and Regional Forensic Science Laboratory (RFSL) are the government laboratories whereas Sherlock Institute of Forensic Science (SIFS), Clue 4 Evidence are some of the private laboratories. Forensic evidence analysis affects the victim or accused's life significantly- from criminal trials or civil trials, conviction or acquittal, loss of job, career, health, and what not.[4-6] Disbursement of justice and forensic procedures mainly depend on the quality and quantity of the sample evidence and the performance and dealing of the first responding officer who visited the crime scene.[3] Crime scenes and possible evidences are often tampered and disturbed due to mishandling. Basically, the evidence should be collected by a trained forensic science expert with his best skill and knowledge. To maintain the proper quality of evidences one should follow 7S of Crime Scene Investigation i.e Securing the scene, Separating the witnesses, Scanning the scene, Seeing the scene, Sketching the scene, Searching for evidence, Securing and collecting evidences.[7] After that Packaging, Marking and Labelling should be done to maintain the proper chain of custody from the crime scene to the court of law.

To maintain the quality of testing an integrated system and intelligent databases are much more important thing. In our country it is not yet well utilized. The conviction rate in India is quite low (around 50% currently) in comparison to Canada (62%), Israel (93%), UK (80%) and US (90%). To improve the situation, an integration of forensic information and criminal intelligence database is very important.

Existing database integration systems worldwide: In most cases, the insufficient sample of DNA makes the situation challenging. The samples either degrade or are contaminated due to improper storage. So, while dealing with the medicolegal evidence, for maintaining a proper chain of custody a workflow of DNA model has also been formulated and started recently in the Philippines which maximizes the quality analysis of the collected sample evidence. DNA is a vital key that unlocks all the possible clues. The criminal justice system is improved to a significant extent in the Philippines by these developments. This workflow of the DNA model changes the overall system and identifies the actual perpetrator of the crime.[8]

Another integrated system has been implemented in Western

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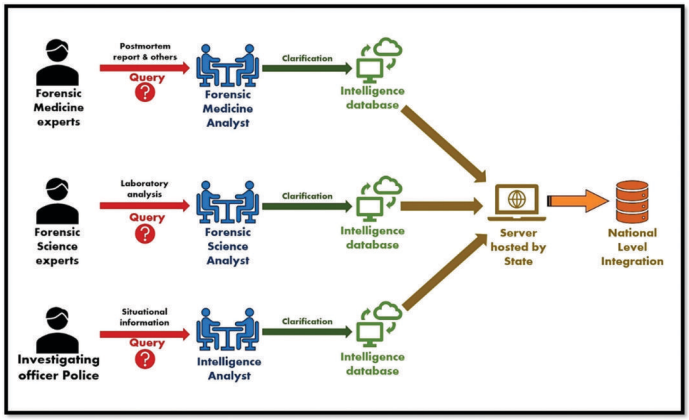

Figure 1. The proposed model interlinks Police, Forensic Experts & Forensic Doctors database automatically and feeds the shared intelligence database through a secured VPN connection. The sever is hosted by State Police, FSL Experts & Forensic Doctors and ultimately merges at national level.

Switzerland to deal with the high volume of crimes. The proposed model there interlinks Police, Forensic Experts' & Forensic Doctors' information databases automatically and feeds the shared intelligence database through a secured VPN connection. The server is hosted by State Police, FSL Experts & Forensic Doctors and ultimately merges at the national level. It has already started to build databases of each and every crime. The databases include possible opinions and explanations of the modus operandi, DNA, Shoe and Ear Marks, Images, Fingerprints, and other evidences. This integrated system is very much helpful for solving the crimes there. The same person who previously committed a crime is easily detected. It is linked to the crime scene, criminal, and modus operandi of the criminals.[9]

Problems in dealing criminal cases in India: There are several pitfalls and shortcomings, when we looked into the Indian Forensic scenario carefully.[10] Most of the officers of Police are not trained properly and due to lack of knowledge they contaminate the evidences. It is also the most alarming issues of Forensic Science. The main factors are lack of research and development, lack of experts, lack of instruments and chemicals, not maintain proper protocols.[11] There are very low number of employees working in laboratories and they are not much knowledgeable in forensic.

The adversarial legal system of India gives an equal chance to both prosecution and defense and clarifies it later. After performing the test of preserved evidence, the prosecution experts verify testimonials and give their expert opinion. The defense party can anytime challenge the expert opinion. The second expert's opinion can also face the same problem. The scientific data and evidence should not be hampered by the adversarial legal system.

The Proposed Model in India (Fig-1):[9] There are large number of pending cases in each Forensic Science Laboratories so we have to develop the system. To develop Forensic Science, a similar model [Fig-1] can be proposed and implemented in India. The Forensic Expert can explore only when the model implemented first in states, then in nationwide.[1] After developing and implementing the model, the rate of pending cases becomes less and within few years it becomes zero.

A proposed Integrated System of DNA Testing Model in India (Fig- 2):[8] DNA testing consists of a number of steps and it is time consuming process. So, an integrated system of DNA Model is prepared (Fig 2) to maintain the proper chain of custody without any contamination of the collected evidences. If this system is implemented in India, it would be helpful for the Forensic Experts to solve the cases in a systematic way.

Evidence Collection, Storage and Characterization:[8] The first responding officer of Police i.e. the Investigating Officer of the case (I.O.) and the Forensic Expert with his team should go and protect the crime scene. If the victim is still alive, send him to the hospital and if not send the body for post-mortem examination. After that searching should be done for possible evidences without any delay. The evidences are packed and sealed in paper packets or container and sent to Forensic Science Laboratory for analysis. If the accused person or perpetrator of the crime is identified and found, he along with the victim or deceased are examined by Forensic Medicine experts (Doctors) for possible evidences and then sent to the Forensic Science Laboratory accordingly.

In laboratory, the samples are to be carefully examined. If the materials are visible, presumptive tests are performed. If it is not visible in naked eye examination, alternative light sources are to be used for identification of the materials at first. Then presumptive tests are performed. In sexual assault cases the samples are basically vaginal, anal and urethral swabs and smears. The samples are stored at room temperature, but samples mixed with feces are stored at 4^0C. sometimes condom may be found from crime scene. If the external and internal swabs are available, Semenogelin (Sg) test is performed. If the samples are mixed with blood, Acid Phosphatase test is to be performed. If the test is positive, Semenogelin (Sg) test is performed and if negative then presence of other materials is tested.

DNA Extraction, Amplification and Fragment Analysis:[8] The samples are then sent for DNA analysis. There are three methods of DNA extraction: i) Organic method, ii) Inorganic method and iii) Kit method. After that quantitative Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) amplification is done which measures the amount of male DNA present in the sample. Specific primers are used during RT-PCR that attach a fluorescent tag to the copies STR. The size of Short Tandem Repeat (STR) at each genetic locus is determined using genetic analyser. The genetic analyser separates the copied DNA by Capillary Gel Electrophoresis (CE) and detect the fluorescent dye on each STR. The fragments can be detected while we put the raw data into a computer.

DNA Data and Evidence Interpretation:[8] Running the sample through CE generates electropherogram through which allelic peaks can be measured. The number of times a nucleotide sequence is repeated in each STR can be calculated from size of the STRs. A Forensic Scientist can use this information to determine if a body fluid sample comes from a particular person. The two DNA profiles from different samples are then compared and if found same, the chance that the samples came from

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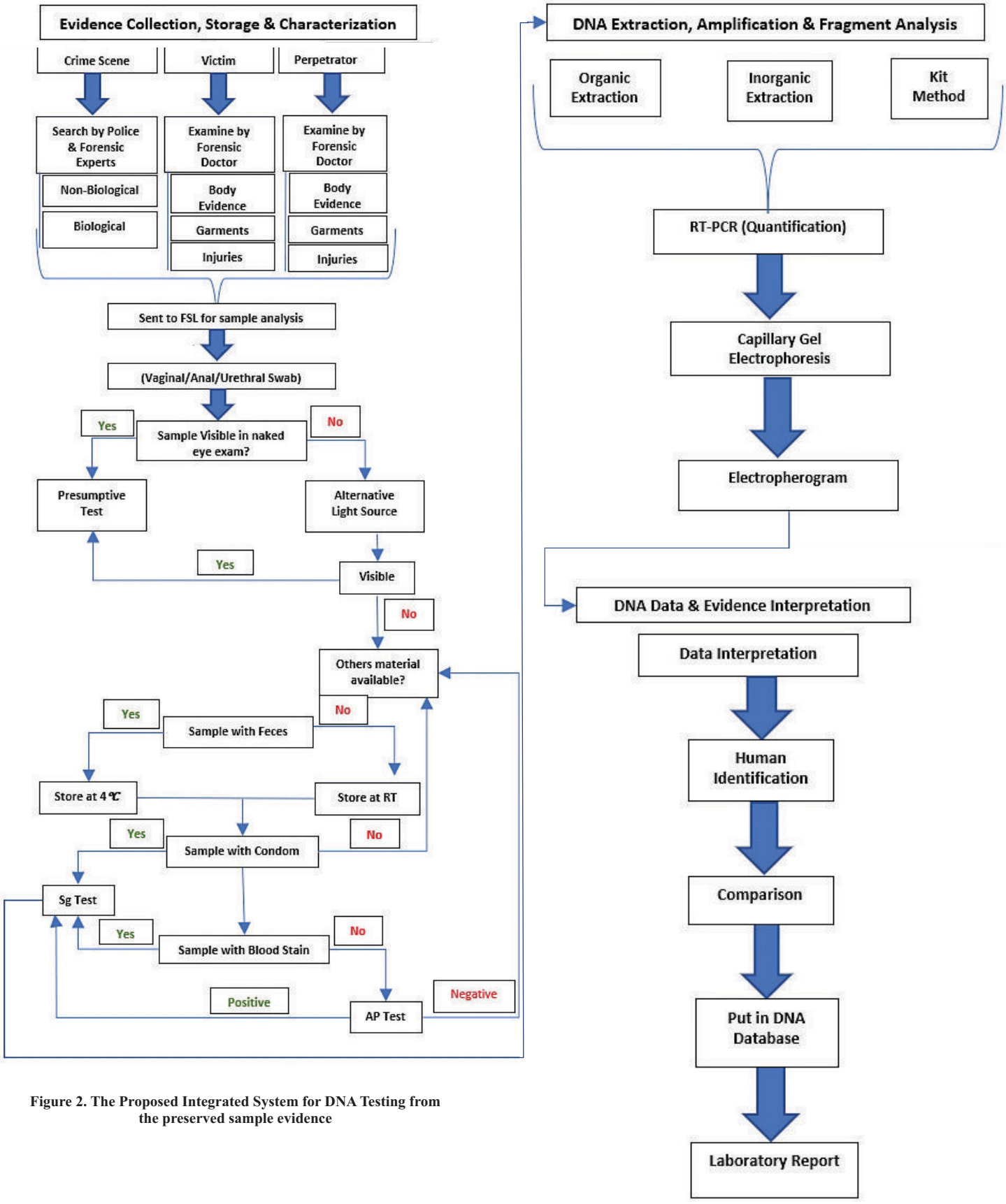

Figure 2. The Proposed Integrated System for DNA Testing from the preserved sample evidence

different persons is low. This provides strong evidence that the sample have a common source. After that put it into DNA database for future use. Lastly, a laboratory report on analysis of the sample materials must be prepared.

Roadmap for better future: [12-15]

1. The scene of crime is to be properly secured.
2. The crime case exhibits are to be collected without contamination, duly preserved, packed, labelled, signed, sealed & forwarded scientifically maintaining the chain of custody.
3. Physical evidences such as photographic and videographic recording from the scene of crime are compared with the databases for identifying the criminals.
4. Proper examination of the evidences should be done without any delay to facilitate the investigation process.
5. Assistance in the inquiry procedure of Ld. Courts and other commissions are to be readily sought.
6. Development of an online integrated platform for video conferencing can shorten the unnecessary delay.
7. For detail Forensic examination, individual database is to be prepared for fingerprints, footprints, firearms, DNA, tyre marks, biometrics, NDPS, wildlife exhibits, hair, currency notes, coins, passports, and other relevant documents.
8. Research and development of various technology in the modern branches of forensic science is need of the hour.
9. Development of Forensic Science education is to be updated and regularised.
10. Police, forensic science students and laboratory experts are to be trained professionally regarding dealing with sample evidences, maintaining the chain of custody and examination of the preserved samples.
11. Recruitment of more employees in forensic science laboratory for prompt and better service.
12. The forensic science laboratories in India need modern technology and ISO certified instruments for better testing of the samples.

Conclusion:

The integrated management of the database of forensic evidence utilized in criminal cases for identifying the pattern and series of crime is underestimated globally. It is the pillar of legal dealings which has a crucial impact on the disbursement of justice. This field's recent advances in forensics can be explored only after the implementation of integrated forensic database management systems across the state and the nation. Moreover, the integration of forensic case data can supplement information on the structure of criminality and give more insight into operational and strategic decisions. The State Government and Central Government must give immediate attention to this issue to improve the medicolegal investigation and conviction rate for which more allocation of funds to build up the system is necessary.

Conflict of interest: None declared.

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BRIEF RESEARCH

Dilemma of Antemortem and Post-mortem Fracture: A Brief Research

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Abstract:

The major duties of a medicolegal system in handling deaths falling under its jurisdiction are to determine the cause and manner of death, identify the deceased if unknown, determining the time of death and injury, collecting evidence from the body that can be used to prove or disprove an individual's guilt or innocence and to confirm or deny the account of how the death occurred, documenting injuries. However, the most important query that is to be solved during autopsy is to designate an injury as either post-mortem or antemortem. Five cases are discussed here to differentiate antemortem and post-mortem injury. There are various permutations and combinations that makes it difficult to designate an injury antemortem. Even when an injury is antemortem, one couldn't find the properties of it due to the dynamic process of sustaining an injury. Infiltration of blood in the fractured ends of bones is a process that needs time to appear and depends on the severity of injuries sustained over the body. If the process of sustaining the injuries is sudden and there is rupture of greater blood vessels, one cannot find any infiltration of blood in the bony trabeculae on autopsy.

Keywords: Autopsy; Antemortem; Post-mortem; Injuries; Fracture; Railway incidents.

Introduction:

Blood itself is an extremely important entity in the medicolegal practice, which alone or along with other trace evidences can play a clinching role to unfold different criminal problems. It is the task of the police to collect such evidence from the scene and of the autopsy surgeon to collect such evidence from the victim's body/clothing, etc., which may help the police in locating matching materials from the suspect(s) in order to provide objective evidence of their presence at the scene.[1] One of the important aspects of the visit to the scene of crime is searching for and interpretation of bloodstains. Relatively minor blood smearing may also provide significant evidence, such as a smear on the door handle. Heel prints or shoe prints on bloodstained area of the body, help in the identification of the assailant. The distribution and amount of blood at the scene of the crime may give valuable information about the manner of death, whether it was suicidal or homicidal, and whether the victim struggled or moved about after his injuries.[2] As per the Locard's principle of exchange, it could be certain by foreign blood stain over the dead body found in suspicious circumstances for example dried blood found over the lips and nostrils in cases of smothering when the struggling victim bites overt the hand of assailant. The substantiality of extravasation of blood in the soft tissues or bony structures to differentiates between antemortem and post mortem injury is already proven in literature. Many times, in cases of either decomposed dead bodies or the body with extensive disintegration brought from the railway track and multiple runover the body after a road side accident confusing the investigating authorities as well as the autopsy surgeons in ascertaining the cause of death as its difficult to differentiate between antemortem and post-mortem nature of injuries. However, meticulous and thorough examination with sceptical eye examination of these types of injuries on the basis of infiltration and extravasation of blood could make it possible to designate the antemortem and post-mortem nature of injury. In this case series the author will discuss about the dynamic role of blood infiltration in the fractured ends of bones via different autopsy cases of railway track incidents.

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Case 1:

A body of middle-aged male individual was received in the mortuary for autopsy after a railway accident to decide the cause and manner of death. On examination, the body was found into two pieces transected at the mid i.e. at pelvis. As per the history and police inquest papers, the body was of a male beggar who jumped in front of a running train with an intent of suicide. The incident was reported by the pilot of train by which this incident occurred. On autopsy, both the lower limbs were found detached from the torso and were inside a black coloured trouser which was found torn from its waistline (Figure 1 and 2). The frilled ends of the trouser showed some blackish greasy material suggestive of the grease from the railway engine. A crush injury was present over the distal end of upper half of the body with crushed intestinal loops and urinary bladder with a stump of proximal part of left femur bone of size 12 cm. On examination of the fractured end of left femur bone using a hand lens, there was no infiltration of blood into the bone marrow and cortex of fractured ends of bone. After such a disintegrating injury to the body by the train, there was extensive pooling of the blood from the body and no blood was remained in the body to infiltrate the fractured ends of bones. Multiple reddish abrasions were present over the posterior


Figure. 1


Figure. 2


Figure. 3

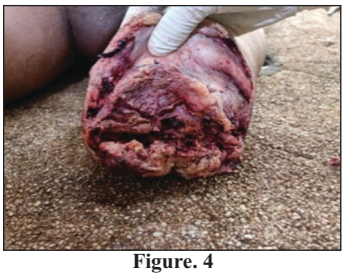
Figure. 4

aspect of the body which were antemortem in nature. Cumulatively, the injuries sustained over the bodies were antemortem in nature as the whole event was dictated by the eye witnesses.

Case 2:

The author received a mutilated dead body with a history of railway track accident a day before. As per history, the patient was a diagnosed case of major depressive disorder and was on anti-depressive treatment. On examination, the dead body of a male individual wrapped in a white sheet of cloth. It had crush injury over the abdomen and both lower limbs were found amputated below the level of knee joint (Figure 3 and 4). The fractured ends of bones showed no infiltration of blood in their bony trabeculae. The case was reported by the train pilot and the deceased came and jumped in front of train with a clear suicidal intent.

Case 3:

Received dead body of a male individual after an alleged incident of railway track injury. After the incident the deceased was taken to our facility and was declared dead. On examination, the left upper limb was found traumatically amputated from the left shoulder joint. The left lower limb was found traumatically amputated from the mid of thigh with a crush injury (Figure 5). The right lower limb was found traumatically amputated below the knee leaving behind a stump of upper one third of right leg and crush injury. The fractured ends of bones showed no infiltration of blood in their bony trabeculae.

Case 4:

We received a dead body of male individual after an accidental railway track injury. The deceased has crush injuries over both arms with both humerus bones fractured in multiple pieces (Figure 6 and 7). The body was autopsied and the fractured ends of long bones showed infiltration of blood in their bony trabeculae.

Case 5:

The dead body of a male individual after a railway track accident. The right lower limb was found amputated. The right femur bone


Figure. 5


Figure. 6


Figure. 7


Figure. 8


Figure. 9

Interpretation and analysis:

Case Number	Antemortem Injuries	Post-mortem Injuries	Major Blood Vessels Injury	Infiltration of blood
01	Yes	No	Yes	Absent
02	Yes	No	Yes	Absent
03	Yes	No	No	Absent
04	Yes	Yes	No	Present
05	Yes	Yes	No	Present

was found fractured through and through with infiltration of blood in their bony trabeculae (Figure 8 and 9).

Discussion:

An abrasion or graze is a superficial injury involving (generally) outer layers of skin without penetration of full thickness of the epidermis. They are caused when there is contact between a rough surface and the skin, often involving a tangential 'shearing' force.[3] Antemortem abrasions have a reddish-brown appearance and heal without scarring. Abrasions produced after death are yellow and translucent with a parchment-like appearance.[4] A contusion is an extravasation or collection of blood due to rupture of blood vessels caused by application of mechanical force of blunt nature without loss of continuity of tissue.[5] Contusions may be present not only in skin, but also in internal organs, such as the lungs, heart, brain, and muscles. One of the most commonly heard statements in regard to contusions is that they indicate that the injury was incurred prior to death, because one cannot form a contusion after death. This is not absolutely correct. Contusions can be produced post-mortem if a severe blow is delivered to a body within a few hours of death. The blow can rupture capillaries, forcing blood into the soft tissue and producing a

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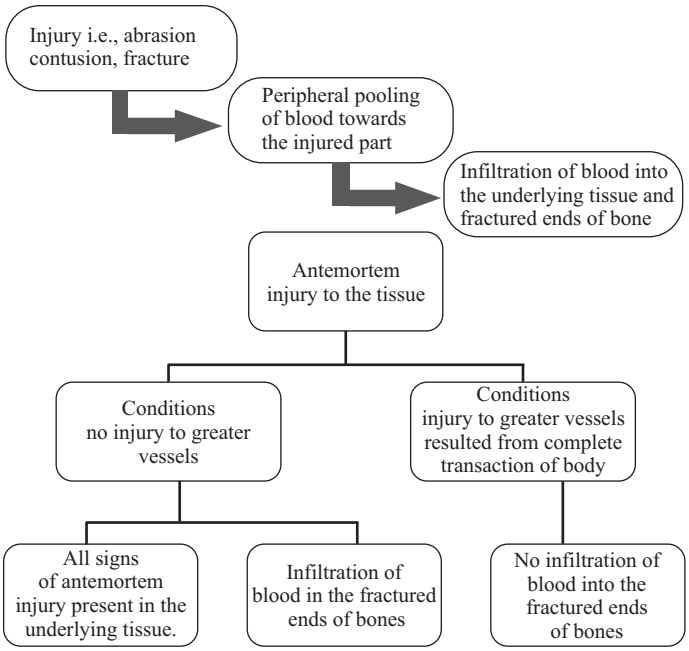
post-mortem contusion identical in appearance to an antemortem contusion. Postmortem contusions rarely occur and are most commonly seen in skin and soft tissues overlying bone or bony prominences such as in the head. Microscopic examination of a contusion to determine whether it is antemortem or postmortem is usually of no help, because, in most cases, the antemortem injuries are incurred immediately prior to death and there is insufficient time for tissue reaction.[4] When the tissues get crushed or stretched beyond the limits of their elasticity thus tearing off leading to the formation of lacerated wound. The lacerated wound is caused by a blunt trauma. Thus, it may be caused in falls, in accidents and in blows to chest, abdomen, head etc. by blunt object.[6] A fracture is a break in the continuity of a bone. On the basis of quantum of force causing fracture, fracture is classified into high-velocity injury fractures sustained as a result of severe trauma force, as in traffic accidents where there is severe soft tissue injury (periosteal and muscle injury) with extensive devascularisation of fracture ends and low-velocity injury fractures sustained as a result of mild trauma force, as in a fall where there is little associated soft tissue injury and hence these fractures often heal predictably.[7]

The most frequent query that arise after a transportation related death is how the injuries over the body came about. Homicidal traffic deaths are rare, though the author (BK) has been involved in one incident where racial hatred led to the running-down of youths of one ethnic group – and another where a man repeatedly crashed the near-side of his own car in an effort to kill his passenger. Attempts at deliberate self-destruction by the use of a motor vehicle are said to be not uncommon, though this is difficult to prove in most cases. Once again, the evidence is more likely to be based on circumstantial rather than medical evidence- a matter for the investigating authorities rather than the pathologist.[8]

Among the transportation injuries, railway track related deaths are the most difficult to classify as either antemortem and post-mortem because criminal act can easily camouflage behind the extensive disintegration of body by the heavy machinery. However, circumstantial evidences and detailed autopsy can clear the incertitude regarding the cause and manner of death.

Concept and theory:



Conclusion and summary:

Infiltration of blood in the fractured ends of bones is a process that needs time to appear and depends on the severity of injuries sustained over the body. If the process of sustaining the injuries is sudden and there is rupture of greater blood vessels, one cannot find any infiltration of blood in the bony trabeculae on autopsy as the blood drains out as soon as possible in a severed vessel. However, it is difficult to say with certainty in cases where the injuries sustained posthumously as long as perimortem period lasts. Therefore, it is the need of an hour that more research should be conducted in demarking an antemortem injury from the post-mortem one.

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Authors contribution: All the authors contributed significantly in this case series.

Conflict of interest: None.

Ethical clearance: In Indian legal system, consent of the relatives is not necessary for autopsy performed in medicolegal cases. As these are medicolegal autopsies, the particulars of the deceased are not revealed and kept confidential with the authors, so ethical clearance is not required in this present case series.

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