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Original Article

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A Case Report of Amitraz Poisoning

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Abstract

Amitraz is a pesticide commonly used in agriculture and veterinary practice to repel ectoparasites and insects. Poisoning with amitraz is rare especially for the purpose of self-harm. Although rarely fatal, it can result in significant symptoms. Management typically involves symptomatic treatment. We report a 34-year-old man who attempted suicide by ingesting amitraz presenting with unconsciousness. He had miosis, persistent bradycardia and extreme hypotension. Symptomatic treatment recovered him well with discharge from care with no complications and good health within 36 hours.

Keywords - bradycardia; hypotension; poisoning; vomiting; drowsiness.

Introduction

Amitraz (BTS27419**),** a pesticide known as a formamidine and a derivative of dimethylformamidine, is commonly utilized in agriculture and veterinary medicine to control insects[1, 2].Amitraz'salpha-2 adrenoceptor agonist action may play a role in manifesting the symptoms its of ingestion[3]. Incidents of human poisoning caused by amitraz are exceptionally rare and have limited documentation in the literature. The reported symptoms associated with ingestion include central nervous system depression, hypothermia, bradycardia, hypotension, hyperglycaemia, glycosuria, vomiting and respiratory failure[4].

Case presentation

A previously healthy 22-year-old male ingested 10 ml of 12.5% amitraz for deliberate self-harm. The patient was brought to the hospital 2 hours later exhibiting drowsiness. His blood pressure was 90/60 mmHg, and his pulse rate was 60/min. The respiratory rate was 12/min with an oxygen saturation of 92% on room air. The patient's Glasgow coma scale (GCS) was 9/15 (E-2, V-2, M-5) and his pupils were bilaterally reactive to light, measuring 2 mm. The rest of the systems examination were normal.

Arterial blood gas analysis indicated a type II respiratory failure, with a pCO2 of 60.1 mmHg(35mmHg-45mmHg) and a pO2 of 70 mmHg(75mmHg-100mmHg) pH-7.29(7.35-7.45), HCO3-28mEq/L(22mEq/L-24mEq/L) and lactate – 0.8. The patient was administered two doses of intravenous naloxone 0.4 mg within a 5-minute interval for suspicion of opioid poisoning. However, there was no improvement following initial management. Thirty minutes later, the patient's GCS decreased to 4/15 (E-1, V-1, M-2), and he became bradypnoeic, with a rate of 8/min. A repeat arterial blood gas revealed worsening type 2 respiratory failure, with a pCO2 of 70 mmHg (35mmHg-

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45mmHg) and a PaO2 of 65 mmHg(75mmHg-100mmHg),pH-7.19(7.35-7.45), HCO3- 29.5mEq/L (22mEq/L-24mEq/L)and lactate-1.0.The patient underwent elective intubation.

The patient received intensive care for 3 days, with continuous hemodynamic monitoring. On the fourth day he was safely extubated and stepped down to ward-based care. He was diagnosed of moderate level of depression and was initiated on oral fluoxetine 20mg mane. The patient did not have any residual medical complications and was euthymic on review 1 month after termination of care.

Table 1: Investigation results of the patient

White blood cell count	10.3 x 10^9	7.5x 10^9
neutrophils-	67.6%,	63.6%,
lymphocytes	22.4%	20.4%
Hemobglobin	13 g/dl	12.3 g/dl
platelets	342 x 10^9	339 x 10^9
Serum creatinine	88µmol/l (74-110)	77µmol/l (74-110)
Blood urea	3.1mmol/l (2.8-7.2)	3.0mmol/l (2.8-7.2)
Serum Na	135.2mmol/l (135-145)	138.3mmol/l (135-145)
Serum K	3.5 mmol/l (3.5-5.1)	4.1mmol/l (3.5-5.1)
Serum Calcium	2.2mmol/l (2.02-2.6)	
Aspartate aminotranseferase	23.2U/l (<50)	24.3U/l (<50)
Alanine aminotranseferase	22.3U/l (<50)	20U/l (<50)
Total Bilirubin	20 µmol/l(5-21)	19 µmol/l (5-21)
Direct Bilirubin	4.2 µmol/l(0-3.4)	4 µmol/l (0-3.4)
INR	1.01	
Creatinine phosphokinase	131(<171)	
Non-Contrast CT Brain	Normal	
Urine toxicology screen	Negative	

Discussion

Intoxication with amitraz in adults is usually suicidal and infrequently accidental. Only few reported human intoxications by this pesticide have been cited in literature, the existing information about it has been from animal studies or isolated case reports. Amitraz poisoning occurs via oral, dermal or inhalational routes. The toxic effects of amitraz are due to its α2-adrenergic agonist actions in the central nervous system and both α1 and α2 adrenergic receptorstimulation in the periphery. It also inhibits monoamine oxidase (MAO) enzyme activity and prostaglandin E2 synthesis. Some of these effects may be dose dependent. It has shown to have rapid toxic effects on both animals and human beings but rarely last beyond 48 hours[5, 6, 7, 8].

The primary clinical manifestation of amitraz poisoning involves a depressive effect on the central nervous system, resulting in decreased spontaneous activity. Other common symptoms include miosis, bradycardia, hypotension, hypothermia, hyperglycaemia and respiratory depression that can potentially lead to death. With prompt management, complete recovery from all signs and symptoms typically occurs within a span of 3-4 days. In cases where lower doses of amitraz are involved, individuals may exhibit heightened sensitivity and hyperactivity to external stimuli[5].

It is important to consider that symptoms and signs similar to its toxicity can also be observed in cases of organophosphate (OP) poisoning, as well as with the ingestion of substances such as clonidine, opioids, barbiturates, benzodiazepines, phenothiazines, and tricyclic antidepressants during an overdose. The onset of action in most reported cases of amitraz poisoning ranged from 30 to 180 minutes following ingestion. Our patient was discovered unconscious by a relative approximately one hour after ingesting the pesticide.

The primary symptoms observed in our patient were unconsciousness, respiratory depression, bradycardia, and hypotension. The central nervous system depression associated with amitraz poisoning is primarily attributed to its effect on α2-adrenergic receptors. The presence of respiratory depression alongside central nervous system depression may

indicate a direct inhibitory effect of amitraz on the respiratory centre. Additionally, the α1 and α2 agonistic actions of amitraz contribute to the development of bradycardia and hypotension, as reported in several case studies[5].

Since there is no specific antidote available for the treatment of amitraz poisoning, the medical management primarily focuses on symptomatic and supportive care[9]. This approach involves stabilizing the patient's haemodynamics, ensuring a clear airway, and implementing measures to minimize the absorption of the toxic substance. In the case of our patient, gastric lavage was performed upon presentation to the hospital. Dopamine, a medication with inotropic and chronotropic effects and in doses of 5-10 µg/kg/min, dopamine stimulates β1 adrenergic receptors and increases cardiac output by increasing cardiac contractility with variable effects on heart rate. Since only very few case reports on inotrope use in amitraz poisoning are available, convincing data to support any inotrope as the preferred first-line is lacking. To counteract the bradycardia and hypotension caused by amitraz, dopamine in doses of 5–10 µg/kg/min as used in our patient, can be the choice of inotrope.

Conclusion

Despite the severe clinical presentation involving central nervous system and cardiovascular depression, most reported cases of amitraz poisoning in humans have shown a favorable outcome, with recovery typically occurring within 12 to 48 hours. Patients were discharged without experiencing any organ dysfunction. The management of amitraz poisoning relies heavily on previous case reports and review articles, as there is currently no specific antidote or standardized treatment protocol available. Supportive and symptomatic care is the mainstay of management, with close monitoring of the nervous system, cardiovascular system, and respiratory system.

Conflict of interest: Nil

Source of funding: There is no source of funding

Ethical clearance: Since this is a case report no ethical clearance needed. Informed consent was taken from the patient

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Original Research Article

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Study of Sudden Natural Death: An Autopsy Based Cross Sectional Study in a Tertiary Care Medical College and Hospital of Assam

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Abstract

Sudden natural death accounts for significant portion of mortality. Autopsy is the only solution for finding the definite cause of sudden deaths. The aim of this study is to find out the causes of sudden natural death and to evaluate associated factors. Study comprise 64 cases of Sudden Death autopsies performed in Silchar Medical College during the period 1st May 2022 to 30th November 2022. The organs were retained for histopathological examination. Information gathered from available documents in departmental records. Inferences made after analyzing data. Out of 514 autopsies during the study period, 64 cases were sudden natural death. Male dominated over female victims. The maximum death occurred in the age group 40-50 years followed by 30-40 years. The cause of deaths in 39% were attributed to cardiac causes and the remaining were due to non-cardiac causes. Sudden unexpected death requires significant health concern as most death occurs in the age ranging from 30 to 50 years. Cardiac causes contribute the maximum and male population are mostly affected. This kind of death of adulthood affects the financial stability of whole family as well as the Society.

Keywords: Autopsy, Sudden Death, Adulthood, Natural Death, Histopathological examination

Introduction

Sudden natural deaths contribute a significant portion of deaths. Autopsy is the only solution for finding the definite cause of sudden death. The term "sudden" has no agreed universal definition. World Health Organization (WHO) defines sudden death as death which is not known to have been caused by any dangerous disease, trauma, poisoning or violent asphyxia and where death occurs all of sudden or within 24 hours of the onset of the terminal symptoms[6]. Natural death means that the death was caused entirely by the disease and the trauma or poison did not play any part in bringing it about.[5] **The aim** of this study is to find out the causes of sudden natural death and to evaluate the socio demographic and epidemiological factors associated with it.

Objectives

- To know about the socio-demographic profile of the deceased of sudden death cases

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- To know about the most predominant system of involvement (Cardiovascular, Respiratory, Central Nervous, Genito Urinary) from the available reports.

Methods and Materials

It is a Cross sectional study conducted among the Victims of sudden natural death cases brought to the Department of Forensic Medicine, Silchar Medical College for medico legal autopsy. A total of 64 Sudden Death cases from 1st May 2022 to 30th November 2022. The Inclusion Criteria consist of All cases of sudden natural death died within 24 hours of onset of terminal illness brought for autopsy and both sexes of all age groups were included. Unnatural deaths due to accidents, suicides and homicides; Putrefied or decomposed bodies, Poisoning cases and those cases of more than 24 hours of hospitalization were excluded from the study. The whole organ or the portion of organ showing gross pathological changes were retained for histopathological examination. Required information for the study was gathered from inquest reports, autopsy reports, histopathological examination reports and available documents in the departmental records. The collected information was statistically analysed using Microsoft excel version 2019.

Result

During the study period, 514 medico-legal autopsies were conducted and out of these 64 (12.45%) cases were of sudden death. Males dominated over females in the ratio of 6.14:1(86% Male and 14% Females). Among the study population 62% were Hindus and 25% were Muslims and 11% were Christians. Reason could be due to the fact that Hindus constitute the main population in southern part of Assam. Even though age ranged from 0 to 80 years; maximum number of deaths were in the age group 40 to 50 years (31.25%) (20 cases) followed by 30 to 40 years (20.3%) (13 cases). Area wise distribution of cases consists of 66% belong to rural area. Among total 64 cases, 50% of victims died on the way to hospital, 41% found dead at home and only 9% died during hospital stay. Among the causes of sudden death, 25 cases (39%) were due to cardiovascular causes (CVS) followed by respiratory causes (30%), gastrointestinal causes (25%), central nervous system (CNS)(6%). Maximum cases of sudden death due to cardiac causes (39%) were seen in 40-50 years of age group and coronary artery disease (CAD) (64%) was the leading cause with male dominance. Respiratory 12 cases due to chronic parenchymal lung disease. Gastrointestinal 15 cases due to chronic liver disease. Central nervous system cause is 4 cases of intracerebral hemorrhage.

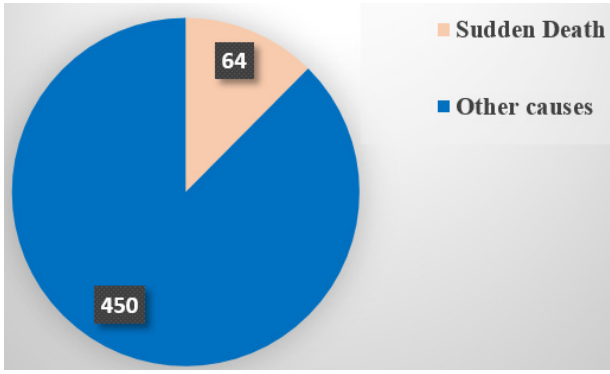


Fig 1: Incidence

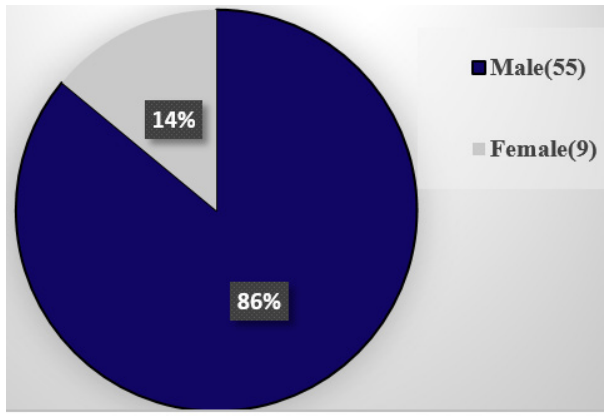


Fig 2: Sex wise incidence

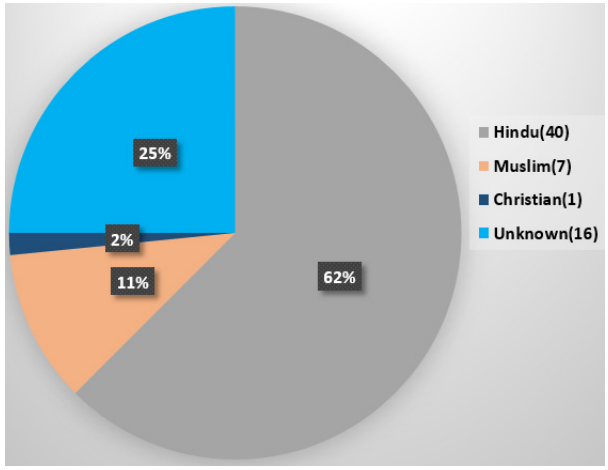


Fig 3: Religion

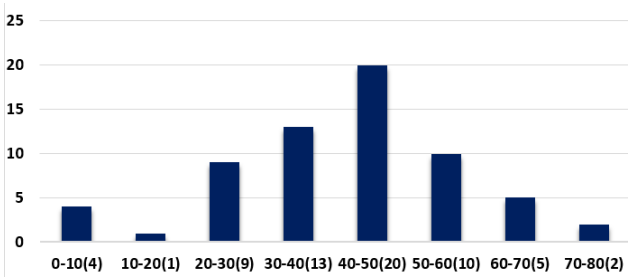


Fig 4: Age Distribution of victims

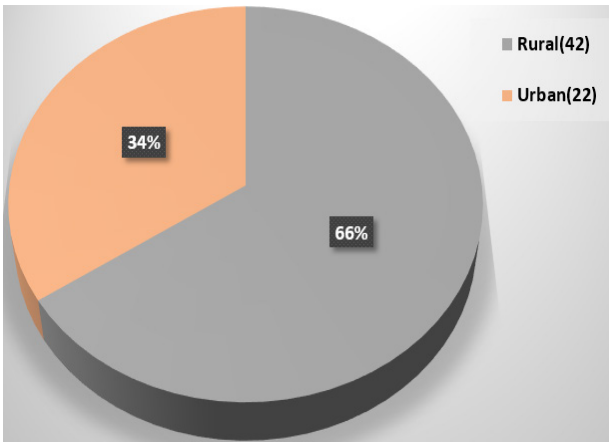


Fig 5: Area Distribution

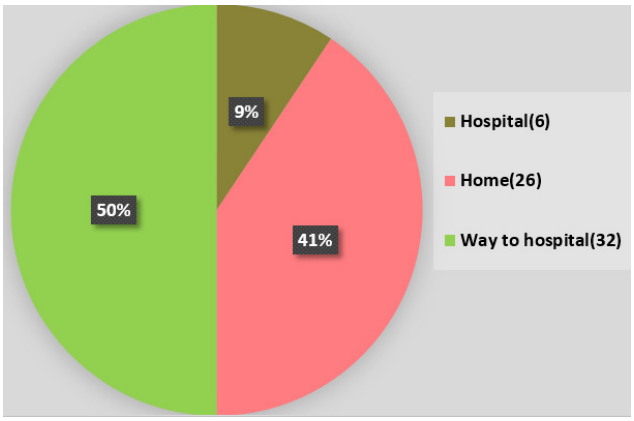


Fig 6: Place of occurrence

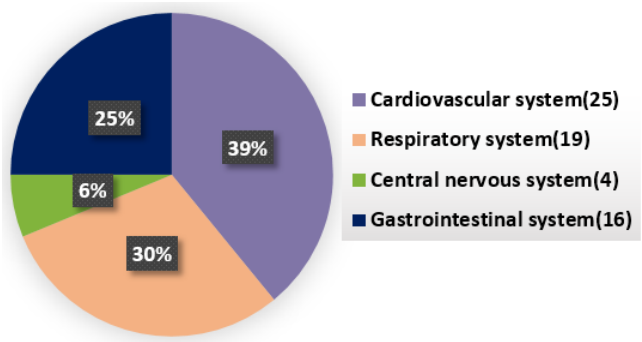
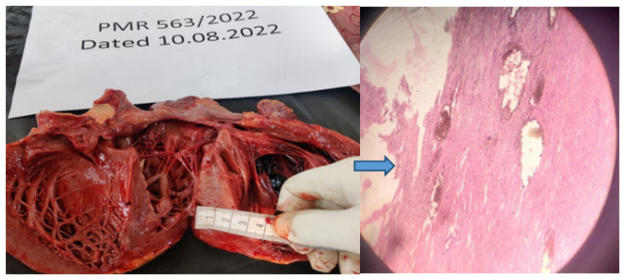
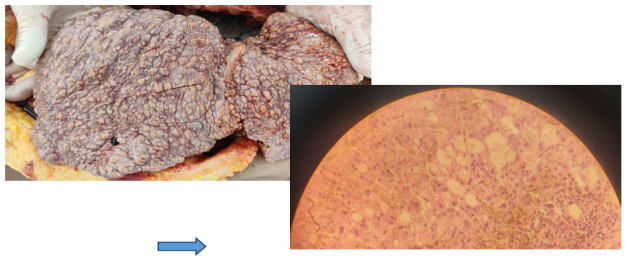


Fig 7: System Involved

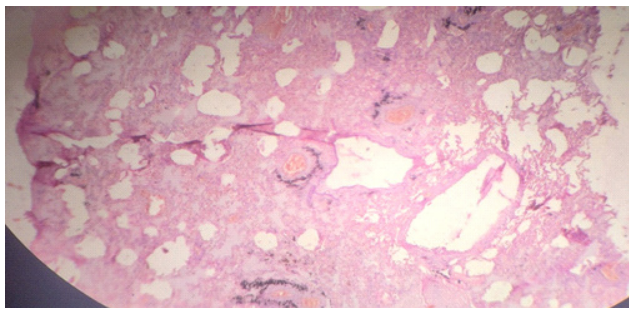
- Gross specimen of heart showing left ventricular hypertrophy. And the histopathology specimen showing thrombosis in capillaries.



- Specimen of chronic liver disease with histopathology showing normal hepatocytes are distended with large lipid vacuoles with peripherally displaced nuclei



- Histopathological section of lung tissue shows lung parenchyma with acute on chronic inflammatory cells infiltrate, stromal edema, congestion and foci of deposition of pigment material.



Discussion

- In the present study, the incidence of sudden natural death was 12.45% (64/514) which is consistent with studies by Zanjad and Nanadkar (8.92%) and Chaudhari (9%)
- Male: Female ratio is 6.14:1(86% Male and 14% Female) and that is consistent with Chaudhari (4.3:1) and Zanjad and Nanadkar (5.6:1)
- Age distribution: Most of the cases (31.25%) belonged to 40 to 50 years of age group followed by 30 to 40 years of age (20.3%). Findings matches with study of Chaudhari and Zanjad and Nanadkar.
- From all above these studies, it is seen that the maximum number of sudden deaths are seen in the middle age (30-50 years). This may be due to westernization of Indian society, sedentary lifestyle with increased smoking and alcohol consumption habit.
- Although there are numerous causes of sudden death, cardiovascular causes are the principal cause among sudden death in the present study.
- Out of 64 cases of sudden death, 25 (39%) were due to cardiovascular causes, of which 21 (84%) were male and 4 (16%) were female. Similar findings seen with study of Modi (61%); Dayananda(41%); Zanjad and Nanadkar (49.55%)
- Coronary artery disease was not only the principle cause among cardiovascular causes (64%) and is the important cause among sudden death amounting to 25% with male predominance. Consistent with previous studies
- 29.7% were due to respiratory causes. Most common are Chronic parenchymal lung disease 12 cases (63.1%) and pneumonia 5 cases (26.3%). The findings of deaths due to respiratory diseases are similar to all above studies
- The incidence of deaths due to liver pathology, comparatively higher as compared to all above studies
- Cerebrovascular causes accounts for 6 % cases which is higher as compared to Modi (2%) and Chaudhari (3%). Consistent with Zanjad and Nanadkar (8%) and Dayananda (7%)
- 91% of all cases occurred outside the hospital setting
- Victims were either not aware of their prevailing medical conditions or refused to seek appropriate medical intervention.

Conclusion

- In order to customize health care priorities and to plan for primary prevention strategies, predominant system involved has to be found out.
- Maximum cases of sudden natural death in the age group of 40 to 50 years of both sexes included in which males outnumbered females.
- This is a challenge to the health care professionals and increased awareness is needed among population at risk
- Coronary artery disease the cardiovascular disease is the most common cause and cause of death is confirmed by histopathological examination.
- Meticulous post-mortem examination always helps in avoiding unnecessary litigations in sudden death cases.
- Awareness of routine health check-up amongst the general public would help to reduce the incidence of such death.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: Taken from institutional ethics committee at Silchar Medical college, Silchar, Assam

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Original Research Article

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Assessment of Applicability of Gleurich and Pyle (GP) Method for Determination of Age of Children in 14-18 Years Age-Group at S.M.S. Medical College, Jaipur

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Abstract

Background, Aim and Objective: Age estimation is also one of the important factors to establish individual's identity and radiological investigations play a phenomenal role in estimation of age in conjunction with clinical examination. The aim of this study to assess the applicability of Greulich and Pyle (GP) method for determination of age in 14-18 years of age group healthy population of Jaipur region. And objective is to assess the skeletal age determined by GP method using hand radiography of study population.

Method: This study was carried out on total 80 subjects at the Department of Forensic Medicine in association with the Department of Radiology after obtaining due permission and approval from the RRB and IEC of SMS Medical College, Jaipur during the period from 1st July, 2020 to 31st August, 2021 of subjects between 14-18 years of age. All subjects recruited from each age sub-group category viz 14-15 years (Group A), 15-16 years (Group B), 16-17 years (Group C) and 17-18 years (Group D) including equal number of members from both sexes (10 males and 10 females of each age sub group category). After obtaining valid informed consent for age estimation all details, general physical & dental examination was done and recorded in proposed Pro forma. The skeletal age (bone age) was determined using Greulich and Pyle Atlas (2nd edition, 1959)15. X-ray image on computer was compared with images on GP Atlas according to sex and most matching image to assess the skeletal age. Images were separated in two groups according to their sex and examined by both observers at different occasions to determine skeletal age of subjects and result derived.

Result: Among all (n=80), of 81.2% Hindus (34 males and 31 females), 12.5% Muslims (4 males and 6 females) and 6.25% Jains (2 males and 3 females). Correlation of estimated skeletal age by GP method to the chronological age in both females and males showed a strong positive correlation. {r value=0.987 (females) & 0.974 (males)} and for both $p<0.001$ which indicates that the correlation of estimated skeletal age and chronological age was statistically significant.

Conclusion: Study reveals skeletal age lagged behind chronological age in all age subgroups in both boys and girls but the difference of CA and SA is less in girls as compared to boys. The G-P atlas method, although very old but used with caution can yield good results for assessment of bone age in Indian boys and girls, better for

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girls. Delay in skeletal maturation was observed in both males and females, but the females in the sample matured earlier then the males. Thus, G-P atlas method seems applicable on Indian children. However, studies on larger sample sizes considering other factors may yield better insight into its forensic application.

Key Words: Age Estimation, Greulich and Pyle (GP), Chronological Age(CA), Skeletal Age(SA)

Introduction

Forensic age estimation is a scientific process in forensic medicine which aims to determine in the most precise way possible, the chronological age of a person of an unknown or doubtful age involved in medical or legal proceedings such as unregistered children, asylum seekers, immigrants, marriage, sporting events and criminals[1]. Various methods have been constructed and tested to estimate the age of young individuals[2]. Among them are the physical examinations using anthropometric measurements[3,4], skeletal maturation[5], dental age estimation[6], a combination of dental development and anthropometric measurements[7] and a combination of skeletal and tooth eruption[8]. The essential components of age estimation are the history, physical and clinical examination, dental examination and radiological examinations ranging from plain X-rays to Computed Tomographic scans and ultrasonography films as per requirement of cases. Multiple methods are always used in combination for optimal accuracy.

Age estimation is also one of the important factors to establish individual's identity[9] and radiological investigations play a phenomenal role in estimation of age in conjunction with clinical examination. The aim of this study to assess the applicability of Greulich and Pyle (GP) method for determination of age in 14-18 years of age group healthy population of Jaipur region. And objective is to assess the skeletal age determined by GP method using hand radiography of study population.

Such age estimation examinations for legal/ governmental purpose may be requested for any age group, but, the adolescents/ young adults are most frequently encountered issues in Forensic practice for reasons that this age range includes considerable milestones of medico-legal importance like the legal age of attainment of Majority, legal age for employment, legal age for consent, etc. The scientific basis of forensic age assessment in adolescents and young adults is the predetermined temporal progression of defined developmental stages of various characteristics that are identical for all people, such as physical development, skeletal maturation, and dental development. For age assessment, reference studies are used in which these defined developmental stages have been correlated with both the sex and the known age of the examined persons from a reference population[10].

The forensic application on the reliability of Greulich and Pyle method has been sparsely valuated over the globe including India although the method is utilized for determination of age. Thus, this study was undertaken to assess the reliability of Greulich and Pyle (GP) method for determination of age of children between 14-18 years to look for the prospect of its application in forensic practice to increase the reliability and accuracy of age estimation for legal opinions.

Material and Method

This study was conducted at the Department of Forensic Medicine & Toxicology in association with the Department of Radiology after obtaining due permission and approval from the Research Review Board and Institutional Ethics Committee of SMS Medical College and Attached Hospitals, Jaipur during the period from 1st July, 2020 to 31st August, 2021, on total of n=80 subjects between 14-18 years of age.

After obtaining informed consent for age estimation examination and participation in the study, all personal details and general physical examination and dental examination was done and recorded in proposed Proforma. At the time of examination of subjects their name, age, sex details were also recorded. Then X-rays (wrist, Elbow and Pelvis) were taken. The skeletal age (bone age) was determined using Greulich and Pyle Atlas (2nd edition, 1959)[11]. X-ray image on computer was compared with images on GP Atlas according to sex and most matching image to assess the skeletal

age. Images were separated in two groups according to their sex and examined by both observers at different occasions to determine skeletal age without disclosure of the chronological age of subjects and result derived.

The data so collected from 80 subjects was then subjected to statistical analysis using Epi info version 7.2.1.0 statistical software. The chronological age (CA), skeletal age as per GP method (SA) and their difference (CA-SA) were noted. The mean value and standard deviation (SD) of chronological age (CA), skeletal age (SA) and their difference (CA-SA) was calculated for each age group. Correlation Coefficient (r value) was deduced for correlating the estimated skeletal age by G-P method and chronological age to determine the relation between the two. p-value was determined using chi square test to know the significance of the results in age group of the study. Level of significance was kept at 95% to determine statistical significance. ($p<0.05$ as statistically significant). Bland Altman analysis was done to determine the difference between estimated skeletal age by G-P method and chronological age of both male and female study subjects.

Observations and Discussion

The present study included subjects of 14-18 years with equal number of subjects recruited from each age sub group category as shown in table no 1 viz 14-15 years (Group A), 15-16 years (Group B), 16-17 years (Group C) and 17-18 years (Group D) including equal number of members from both sexes (10 males and 10 females of each age sub group category). **Patil ST, et al. (2012)**[12] and **Tiwari PK, et al (2020)**[13]studied 1 day-19 years and 0-19 years age groups whereas **Mohammed RB, et al (2015)**[14]studies 9-20 years age groups. However, there is a great difference in the sample size if the present study in comparison to other studies- 660 cases **{Mohammed RB, et al (2015)**[14]**}** & 375 cases **{Patil ST, et al (2012)**[12]**}**; but it is quite near to that of **Tiwari PK, et al (2020)**[13]who studied on 100 cases**.** The study subjects in the present study were sub grouped according to their chronological ages in to four age subgroups.

Table 1: Age & Gender wise distribution of study population

Group	Age Group (Years)	Minimum Age(years)	Maximum Age (years)	Male	Female	Total
A	14-15	14.23	14.72	10	10	20
B	15-16	15.13	15.70	10	10	20
C	16-17	16.27	16.72	10	10	20
D	17-18	17.11	17.68	10	10	20

Table 2: Gender wise comparison of mean weight (kg) of the study subjects of different age sub groups

Group	Group Age	Males Mean ± SD	Females Mean ± SD
A	14-15	38.18 ± 1.79	44.1 ± 1.8
B	15-16	44.25 ± 1.96	50.08 ± 1.65
C	16-17	44.68 ± 1.8	52.95 ± 1.57
D	17-18	50.22 ± 7.28	58.45 ± 4.4
P value		<0.001 (S)	<0.001 (S)

Correlation of the study subjects of different age sub groups to mean weight for both genders was statistically significant for both genders. ($P<0.001$).(as shown in Table no.2)

This study showed that skeletal ages were delayed than the chronological ages in adolescent boys and adolescent girls (14-18 years) and the females in the study sample matured earlier then the

males. **Sheikh AH, et al. (1998)**[15] determined skeletal age by Greulich-Pyle method in normal Pakistani children aged 8-18 years. On an average, the males were 1 year and the females were 0.5 years retarded from 8-15 years and from 8-13 years respectively. However, males after 15 years and females after 13 years (round about puberty and afterwards) were found advanced in their skeletal age indicating earlier maturity in Pakistani children as compared to western children. **Mora S, et al. (2001)**[16] assessed the value of the Greulich and Pyle method in determining the skeletal ages of healthy American children of European (EA) and African(AA) descent born after the year 1980 aged between 0 to 19 year. Mean difference between skeletal and chronological age in pre-pubertal children of African descent was 0.09 ±/- 0.66 year, while that in children of European descent was -0.17 ±/- 0.6 7 year; (t = 3.13; p = 0.0019). Variations in skeletal maturation in prepubertal children were greater than those reflected in the Greulich and Pyle atlas.

Conclusion

The study concludes, skeletal age lagged behind chronological age in all age subgroups in both boys and girls but the difference of CA and SA is less in girls as compared to boys. The G-P atlas method is quite well correlated to skeletal age assessments in Indian boys and girls with mean difference of 3.87 months for girls and 7.14 months for boys. The G-P atlas method, although very old but used with caution can yield good results for assessment of bone age in Indian boys and girls, better for girls. Delay in skeletal maturation was observed in both males and females, but the females in the sample matured earlier then the males. Thus, G-P atlas method seems applicable on Indian children.

Limitations of Study

Resource constraints (time, availability of scans, budget) limited the total sample to 80 individuals. W.W. Greulich (1957)[11] has stated that to derive age estimation standards a minimum of 1000 scans for each sex is required, evenly distributed by age group, although less can be used if the scans are from a longitudinal study.

Another potential limitation of this study is the lack of assessment of bilateral asymmetry. The radiographs used in this study were a mixture of left- and right-hand wrists, while the age estimation methods applied were designed for the left-hand wrist. There was a lack of radiographs of both hands obtained from the same individual at the same time for an assessment of asymmetry to be performed owing to the ethical barrier of higher exposure to harmful radiations to each particular individual belonging to the adolescent age groups.

Ethical Clearance: Taken from Institutional Ethical Committee of SMS Medical College, Jaipur

Conflict of Intrest: Nil

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Original Article

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Estimation of Time Since Death by Potassium ion Level in the Vitreous Fluids: A Postmoterm Study in a Tertiary Care Center, South India

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Abstract

Background: It is of great value to find time since death in the medicolegal investigations like serious crimes. Vitreous humor was more often used for the biochemical analysis as it is less contaminated or not affected by the putrefactive changes than other fluids of the body. It was stated by many researchers that potassium levels in the vitreous humour is more accurate in predicting time since death.

Aim: The aim of the study is to assess the time since death using potassium level in the vitreous humor

Methodology: This study includes 54 cases of victims brought to the tertiary care hospital based on inclusion and exclusion criteria. Cases with known time of death and with clear vitreous humor samples were included. Baseline characteristics like name, age, gender, exact time since death was collected. Vitreoushumor was collected through appropriate standardized technique. Sampling time was also noted. The collected data was entered in MS excel and analysis done in SPSS 23 software. P value <0.05 is considered to be significant.

Results: Majority of the study participants belongs to 57-67 years of age group (28%) followed by 27-37 years of age (22%).Male predominance was observed in our study 41(76%). There is a linear correlation found between the vitreous potassium concentration and the postmortem interval (R^2=0.907). The rate of the vitreous potassium increase was 0.36 meq/hr (Coefficient of regression =2.76 meq/l/hr)

Conclusion: There is a linear relationship found between vitreous potassium concentration and time since death. Thus potassium in the vitreous can be used for assessing the time since death.

Keywords: Postmorteminterval, vitreoushumor, time since death, medicolegal.

Introduction

The interval between the death and the time of postmortem examination is known as Time since death**.** Immediately after death or shortly many changes occur after death but each have their own time and rate1**.** Time since death plays a major role

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in the crime investigations**.** Time since death is determined with the help of Vitreous humor fluid as it is not affected by the degradation and contamination due to postmoterm[2].

Forensic pathology uses vitreous humor as it has postmortemstability. Many studies have been in process in studying the biochemical changes which occurs in the body fluids of the diseased persons like aqueous humor, vitreoushumor, cerebrospinal fluid and blood. It has been found that electrolyte changes occur in these fluids related to the postmortemtime. Of these vitreous humor is the most commonly used fluid in estimating the time since death. Though there are many contents in the vitreous humor, potassium is considered as the major determinant[3].

Potassium is actively transported from the ciliary body into the posterior chamber. Anterior chamber and lens also contributes potassium level[4]. The normal potassium level in the vitreous is 3.8 mmol. Soon after death the potassium is leaked from the retinal cells which is due to the non operating Na+K+ pump. This leads to the increase of potassium in the postmortem. This increase depends on the environmental condition[5]. Thus this study was done to assess the time since death using potassium level in the vitreous humor.

Methodology

Study setting:

Hospital based cross sectional study was conducted in the Department of Forensic Medicine, Government Medical College, Thrissur which is a tertiary care centre. The study was done for a period of one year, from August 2017 to July 2018.

Inclusion criteria:

- Cases with known time of death
- Cases with clear vitreous humor samples

Exclusion criteria:

- Visibly discolored sample was excluded from the study
- Bodies with damaged eye balls
- Cases where the exact time of death was not known

Sample Size:

Based on the inclusion and exclusion criteria the victims were recruited for our study. The final sample size attained during the study period is 54.

Data collection:

Personal particulars like Name, Age, Gender, exact time of death were collected. Survival period was calculated from the treatment findings and the autopsy findings. The sampling time was also collected.

Vitreoushumor collection:

After obtaining the consent, vitroushumour was collected from the posterior chamber of eye, slowly and gradually in such a way avoiding tearing of loose fragment of tissue. The puncture of 5-6 mm away from the limbus was made using a sterile 5 ml syringe and needle of size 22 gauge. From one eye of the diseased 1 ml of the vitreous was collected in the rubber stoppered vial. In order to maintain the shape of the eyeball normal saline was injected into that eye. Then the sample was sent for the biochemical analysis lab. Samples were centrifuged for 10 minutes at 4000 rpm. Then it was analyzed by MEDICA EASLYTE Na+/ K+ Automated analyzer concentration of potassium was recorded.

Statistical analysis:

After collecting the data, it was entered in MS excel Windows10.Statistical analysis was done in SPSS 23.Continuous data were expressed in terms of Mean±Standard deviation and. Categorical variable were expressed in terms of numbers(percentages).P value of <0.05 is considered as significant

Results

Table 1: Age and sex of the study participants

Variables	Number(N)	Percentages (%)
Age category		
< 27	8	15%
27 -37	12	22%
37-47	7	13%
47-57	5	9%
57-67	15	28%
>67	7	13%
Sex		
Male	41	76%
Female	13	24%

Majority of the study participants were in 57-67 years of age 15(28%) followed by 27-37 years of age 12(22%). Male preponderance were observed in the study 41(76%).

Table 2: Distribution of cases based on time since death

S. No	TSD (hrs)	No. of cases	% of cases
1	Within 8	6	11%
2	08 – 13	6	11%
3	13 – 18	14	26%
4	18 – 23	11	20%
5	23 – 28	10	19%
6	28 – 32	5	9%
7	Above 32	2	4%
Total		54	100%

It is concluded from table 2 that the majority number of cases were in 13-18 TSD was 14(26%) followed by 18-23 hours TSD 11(20%). Only 2(4%) of the cases were observed in >32 hrs.

Table 3: PMI (hrs.)

TSD(hr)	Frequency	Mean of PMI (hrs)	SD of PMI (hrs)	Range of PMI (hrs)
03 – 08	6	5.16	1.40	3.7
08 – 13	6	10.56	1.96	4.0
13 – 18	14	14.96	1.34	4.4
18 – 23	11	19.79	1.09	3.3
23 – 28	10	23.53	0.88	3.0
28 – 32	5	26.94	0.72	1.9
32 – 37	2	33.18	1.38	2.0

Table 4: Levels of Potassium (range and mean) depending upon the time since death (TSD)

TSD(hr)	Frequency	Mean of K+(mEq/L)	SD of K+(mEq/L)	Range of K+(mEq/L)
03 – 08	6	6.61	0.70	1.8
08 – 13	6	7.50	0.33	0.7
13 – 18	14	8.43	0.67	2.2
18 – 23	11	10.45	1.06	3.7
23 – 28	10	11.41	1.25	4.1
28 – 32	5	13.69	2.30	5.6
32 – 37	2	12.74	5.07	7.2

Out of the estimated concentration in the vitreous humor samples collected from 54 subjects the minimum value for vitreous potassium concentration was 5.89mEq/L and the maximum value was 16.32mEq/L (Mean ± SD, 9.74 ± 2.47).

Table 5: Comparison of potassium & PMI using student t-test

S.No	PMI (hrs)	No.of cases	Mean (K+)	SD (K+)	Range (K+)	t-value	P-value
1	Within 12	12	7.05166667	0.665668	1.93	-8.34	<0.05
2	12 to 24	34	9.84441176	1.540415	5.67	-6.54	<0.05
3	Above 24	8	13.30375	2.471411	7.17	-3.56	<0.05

Comparing 1&2, 1&3, 2&3 the p value were highly significant

From the above statistical analysis it is evident that there is highly significant increase in the potassium concentration with the increasing time since death.

Table 6: Correlation between postmortem interval and vitreous humor potassium for proposed formulae

Mean of PMI(hr)	Mean of K+(mEq/L)
5.16	6.61
10.56	7.50
14.96	8.43
19.79	10.45
23.53	11.41
26.94	13.69
33.18	12.74

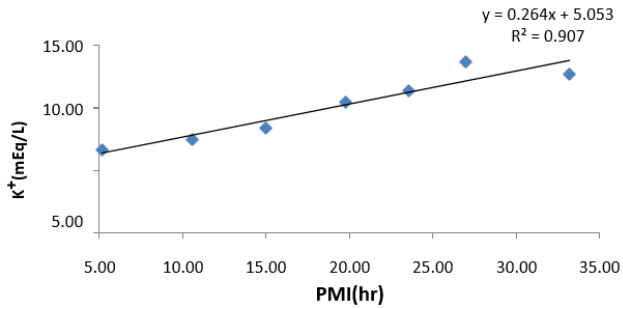

Fig 1: Scatter diagram showing correlation between Time Since Death and Vitreous potassium concentration

The linear regression correlation of vitreous potassium and PMI was found to be strongly correlated and highly significant.(R^2=0.907)

Table 7: Comparison of potassium concentration according to different age groups

Age groups	No. of cases	Mean K+(mEq/L)	SD K+(mEq/L)	Range K+(mEq/L)	P value
Within 27	8	10.21	2.95	9.33	>0.05
27 to 37	12	117.41	2.64	9.33	>0.05
37 to 47	7	65.35	2.20	5.31	>0.05
47 to 57	5	44.33	1.34	3.87	>0.05
57 to 67	15	158.10	2.28	7.90	>0.05
Above 67	7	58.86	1.70	5.33	>0.05

From the above statistical analysis, it is evident that there is no significant effect of age on the levels of Potassium up to 57 years of age. But above 57 years of age, there is significance.

Discussion

In our study out of the 54 cases were included 41(76%) were males followed by females 13(24%). Most of our study participants were 57-67 years 15(28%) followed by 27-37 years 12(22%). This was in contrast to the Dr Amit Srivastavaet al[6] study most of the study participants were in the age group of 20-40 years. Males preponderance was also seen in his study 127(63.5%). In our study majority of the study participants fall in range of <24 hours of study 37(69%). Similar results were also seen in the Dr Amit Srivastava et al study[6].

It was proposed by many studies that retinal cells and the vascular choroid are the source of the potassium influx in the vitreous humour[7,8,9,10]. Naumann et al[11] also in his study stated that due to the autolysis in the cell membrane the potassium has been influxed. Breakdown of the metabolic especially anaerobic active membrane transport stops and selective membrane permeability was lost and thus facilitating the diffusion of ions due to concentration gradient was the finding of the study done by Madea et al[12].

In our study we found that there is a linear relation of increase in the potassium ions level in vitreous with postmortem interval .The linear regression correlation of vitreous potassium and PMI was found to be strongly correlated and highly significant. (R^2=0.907).This finding was also seen in other studies done by Amit Srivastava et al[6], Dr. Priyanka vaitla et al[13], Ahi et al[14], Jashnani et al[15].

In our study age have an influence on the potassium levels in the vitreous humour. Similar result was also reported by Dr. Priyankavaitla et al[13]and Jashnani et al[15]

Limitation:

The main limitation of the study is its low sample size. Secondly we didn't measure the serum electrolytes concentration at time of death as it may interfere with our study results

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Conclusion

It is concluded in our study that a linear relationship was found between the vitreous potassium concentration and time since death. Our method used in our study is extremely simple as it requires only inexpensive apparatus for the collection of sample and processing. Thus vitreous potassium is a very useful indication for determining the time since death.

Recommendations:

It is recommended to do a study which sees correlation with electrolyte concentration of the serum at the time of death. And we have only little data published in the vitreous potassium and its relationship with the postmortem interval. More number of studies have to done to throw light in that grey area.

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Original Research Article

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Prospective Study on Estimation of Stature of Adult from Length of Clavicle in a Tertiary Care Hospital in Tamilnadu

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Abstract

Forensic anthropology can play an important role in the identification process. Besides determination of race, sex and age of the unknown individual, estimation of stature enhances the reliability of identification. It is easier to get those data when the whole body or the entire skeleton is available to the forensic anthropologist. However in cases of deliberate mutilation and disposal in parts, interference by wild animal and bomb blast by terrorist attack, recovery of the whole body or complete skeleton may not be possible. In those cases, in the forensic anthropologists have to give this opinion based upon the available supplied skeleton remains.

Although approximate stature of the individual can be estimated from most of the long bones using either multiplication factors or regression formulae, studies on estimation of stature from clavicle are limited. In the past, Terry, Oliver and Thieeme have tried to estimate the stature of the individual from clavicle. So the present study is planned to determine the stature from clavicle.

Keywords: Forensic anthropology, Clavicular length, stature estimation

Introduction

In medico-legal cases, establishing an individual's identity is necessary in both living and dead. Various features including bones, body parts, and marks over the body, things associated with the individual, behavioral pattern, etc are used for identification. Forensic anthropology mainly involves the study and analysis of human remains and assists in criminal investigative process. The four important parameters of forensic anthropology are sex, age, stature and race. Fair information about the individual's identity can be established using these parameters. Among these parameters, stature estimation is an important process of identification when the body parts are dismembered / mutilated or only bones are recovered. Stature estimation is also useful in mass disasters like earthquakes, tsunami, etc. where only bones or body parts of many people are found.

In early days, stature was estimated by rearticulating the skeleton and measuring it. The most common method to estimate stature is using long bones of the body. Karl Pearson, Trotter and Gleser

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derived regression formulae for estimation of stature using the lengths of different long bones like humerus, ulna, radius, tibia, fibula and the bicondylar length of femur and concluded that maximum length of femur and stature had a linear relationship[1].In 1967, study conducted by Genoves[2], in Mesoamerican population, proved that femur and tibia are the best predictors of stature. In 2003, Ozaslan et al[3] conducted study in Turkish population that derived stature from length of leg and in 2007, Petrovecki et al[4]in their study found that tibia is the best predictor in males and humerus is the best predictor in females. Athawale et al[5] conducted a study of Indian population to obtain regression formulae for estimation of stature using forearm bones. His study concluded that there was more significant linear relationship between forearm length and stature than individual forearm bones and stature.

Various studies have been conducted to correlate stature with foot length, foot bone length, metacarpal and metatarsal length. Steele and McKern[6] found that, utilizing specific segments of the humerus, femur, and tibia, they could estimate the corresponding long bone lengths and provide a reasonable estimate of living stature which was revised by Simmons et al[7]. Patil and Mody[8] determined that height could be estimated from the skull using separate regression formulae for males and females. Several studies on stature estimation using other bones like clavicle, sternum, scapula and various body parts were conducted.

Many studies have been conducted using clavicle in forensic context. The most common studies include determination of age and sex from clavicle and its radiographic estimation using various parameters like length of the clavicle, vertical diameter, sagittal diameter, mid-clavicular circumference, weight, etc. Natalie Renee Shirley[9] conducted a study of age and sex estimation from the human clavicle in American population. In 2015, Falys and Prangle[10] found that sternal end of the clavicle is more reliable factor for estimation of age. Makander et al[11] conducted a study on determination of sex and race from adult clavicle in South Indian population. In 2014, Marjan Mansorvar[12] conducted a study on bone age assessment using hand and clavicle x-ray images.

In 1952, Singh and Sohal[13] conducted a study to estimate stature from clavicle in Punjabi population. Balvir et al[14] estimated stature from the length of clavicle in Vidarbha region of Maharashtra and derived regression formula for estimating stature from clavicle. Rani et al[15] conducted a study on correlation of stature of adult with length of clavicle and derived regression formulae for both males and females separately.

There are only very few studies on estimation of stature from clavicle. This is because long bones proved to be reliable parameter for estimation of stature. But in forensic context, long bones may not be available in every case. So it is important to estimate stature from other bones like clavicle. The current study was undertaken with the aim to add to the current body of knowledge on stature estimation. The present study was conducted with the objective to find out correlation between length of right and left clavicle with stature of an individual and to estimate the stature of individual with maximum length of clavicle. Also the regression formula to estimate stature from adult clavicle for both sexes was derived in the study.

Materials and Methods

The present study was a cross sectional study carried out in Institute of Forensic Medicine, Madras Medical College, Chennai-3.The descriptive component was used to determine mean stature, length of right and left clavicle in both male and female subjects. The analytical component was used to find the correlation between the stature and length of clavicle and to formulate regression equation for stature from clavicular length in both males and females. All cases in the adult age group (>22 years) subjected for medico-legal autopsy from the month of April 2017 - March 2018 were included for the study. Cases with fracture and pathological deformity of clavicle, cases with skeletal deformity and cases not from Tamil Nadu were excluded from the study. The stature of the cadaver was measured initially after noting down the particulars of the deceased. The living stature is obtained from cadaveric stature by deducting 15 mm for males and 20 mm for females. The clavicle from both sides were removed from the body after dissecting sternoclavicular joint and acromioclavicular joint and all muscular attachments of clavicle. The remaining soft tissues attached to the clavicles were removed and clavicles were cleaned.

The length of the clavicle is measured using digital vernier caliper.

Results

In this study, 200 cases which were subjected to medico legal autopsy in mortuary attached to Institute of Forensic Medicine, Madras Medical College were taken as study sample. In the study, 79% of the cases were male and 21% were female. 46.5% of cases belonged to the age category 31 – 50 years while 27.5% and 26% of cases belonged to the age group 51 – 70 years and 23 – 30 years respectively.

The total number of cases was classified into 7 groups according to their stature. 2%, 1.5%, 8.5% and 9.5% of total sample size were in stature group 139.0 - 145.0 cm, 145.1 – 150.0 cm, 150.1 – 155.0 and 155.1 – 160.0 cm respectively. 25.5% & 14% of cases were in stature group 165.1 – 170.0 & 170.1 – 175.0 respectively. The stature group with highest number of cases was 160.1 – 165.0 with 78 cases which constituted 39% of total sample size.

The age group 23-30 consisted of 46 male cases which constituted 29.1% of total male cases and 6 female cases which constituted 14.3% of total female cases. The age group 31-50 consisted of 64 male cases which constituted 40.5% of total male cases and 29 female cases which constituted 69% of total female cases. The age group 51-70 consisted of 48 male cases which constituted 30.4% of total male cases and 7 female cases which constituted 16.7% of total female cases. The p value calculated for the above data was 0.004 which was statistically significant. The stature group 139.0 - 145.0 cm consisted of 2 male cases which constituted 1.3% of total male cases and 2 female cases which constituted 4.8% of total female cases. The stature group 145.1 – 150.0 cm consisted of nil male cases and 3 female cases which constituted 7.1% of total female cases. The stature group 150.1 – 155.0 consisted of 6 male cases which constituted 3.8% of total male cases and 11 female cases which constituted 26.2% of total female cases. The stature group 155.1 – 160.0 consisted of 11 male cases which constituted 7% of total male cases and 8 female cases which constituted 19% of total female cases. The stature group 160.1 – 165.0 consisted of 70 male cases which constituted 44.3% of total male cases and 8 female cases which constituted 19% of total female cases. The stature group 165.1 – 170.0 consisted of 43 male cases which constituted 27.2% of total male cases and 8 female cases which constituted 19% of total female cases. The stature group 170.1 – 175.0 consisted of 26 male cases which constituted 16.5% of total male cases and 2 female cases which constituted 4.8% of total female cases. The p value calculated for the above data was <0.001 which was statistically significant.

The mean stature of the total sample was 163.9 cm. The mean right clavicle length and the mean left clavicle length of total sample was 145.8 mm and 150.4 mm respectively. The mean stature of the total male population was 165.3 cm while that of female population was 158.6 cm. The mean right clavicle length of total male population was 147.4 mm and that of total female population was 139.9 mm. The mean left clavicle length of total male population was 152.4 mm and female population was 142.8 mm. It is noted that length of left clavicle is more than right clavicle in both male and female.

Table 1 shows independent sample test for stature in both male and female. The p value was calculated for this data and found to be <0.001 which proves that the data is statistically significant. The mean stature of 23 - 30 yrs group is 167.33 cm with minimum stature of 150 cm and maximum stature of 174 cm. The mean stature of 31- 50 yrs group is 164.01 cm with minimum stature of 152 cm and maximum stature of 175 cm. The mean stature of 51-70 yrs group is 160.49 cm with minimum stature of 139 cm and maximum stature of 170 cm. In total, the mean stature of total population is 163.90 cm with minimum stature of 139 cm and maximum stature of 175 cm as shown in table no.2.

Table 1: Distribution of Mean Stature in Male and Female

	SEX	N	Mean	Std. Deviation	Std. Error Mean	t value	P value
STATURE	Male	158	165.3101	5.46780	.43499	6.435**	<0.001
	Female	42	158.6190	7.66669	1.18300		

Table 2: Distribution of Stature among Different Age Groups

Age in years	N	Mean stature	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	f value
					Lower Bound	Upper Bound			
23-30	52	167.3269	4.67249	.64796	166.0261	168.6278	150.00	174.00	16.792**
31-50	93	164.0108	5.70373	.59145	162.8361	165.1854	152.00	175.00	
51-70	55	160.4909	7.73609	1.04313	158.3996	162.5823	139.00	170.00	
Total	200	163.9050	6.56976	.46455	162.9889	164.8211	139.00	175.00	

The correlation between stature and right clavicle length was calculated using Pearson's correlation formula and the correlation coefficient was found to be 0.586 and p value was <0.001. (Figure No.1) This proves that there is positive correlation between the stature and length of right clavicle, i.e., when length of right clavicle increases stature of the individual increases and vice versa. Similarly, the correlation between stature and left clavicle length was calculated using Pearson's correlation formula and the correlation coefficient was found to be 0.586 and p value was <0.001 (Figure No.2). This proves that there is positive correlation between the stature and length of left clavicle, i.e., when length of left clavicle increases stature of the individual increases and vice versa.

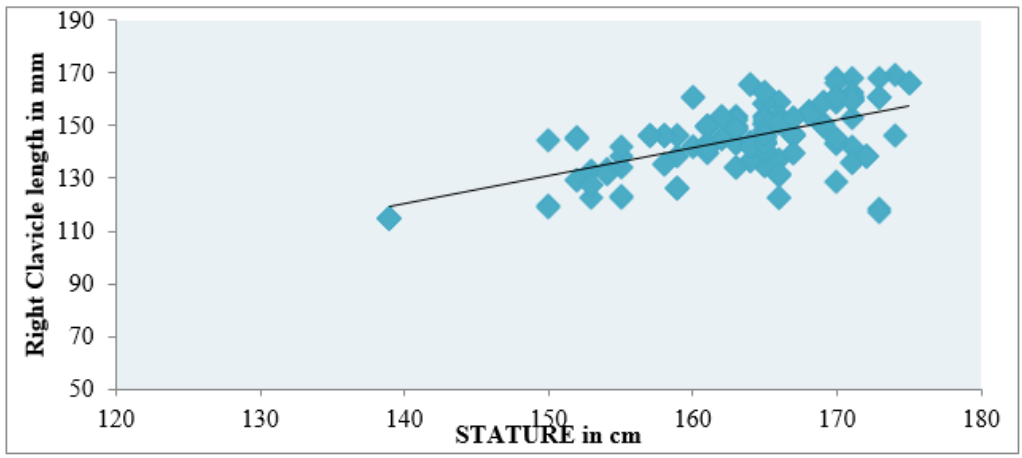

Figure 1: Correlation Between Stature and Length of Right Clavicle

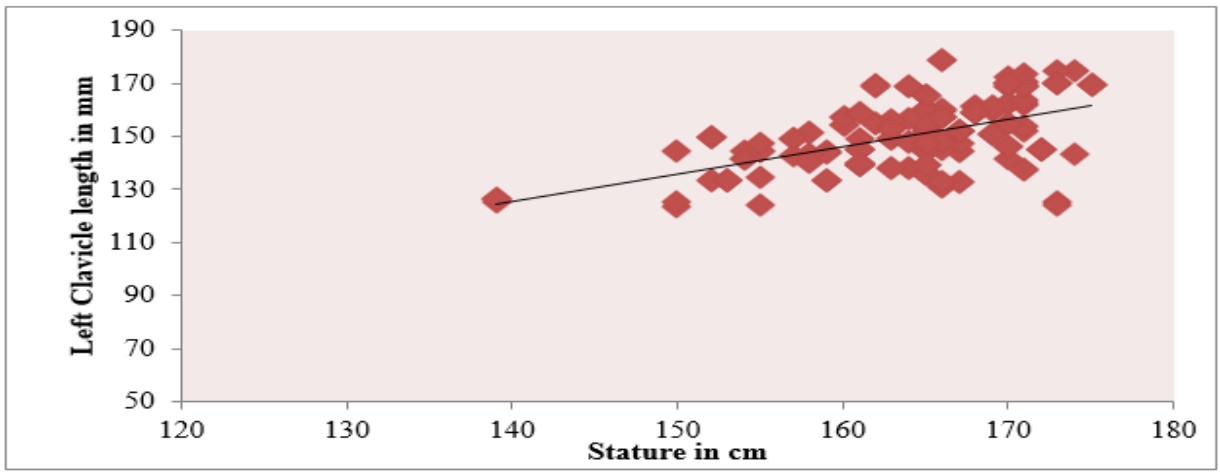

Figure 2: Correlation Between Stature and Length of Left Clavicle

The summary of regression analysis for stature prediction [Predictors (Constant): left clavicle length, right clavicle length] is shown in Table No.3 and ANOVA table for regression analysis calculated with predictors as left and right clavicle length and stature as dependent variable Table No.4.

Table 3: Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.590[a]	.348	.341	5.33225

Table 4: Anova Table for Regression Analysis (Stature as Dependent Variable)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2987.906	2	1493.953	52.543	.000[a]
	Residual	5601.289	197	28.433		
	Total	8589.195	199			

From the analysis it was found that length of right clavicle is a good predictor of stature with p value <0.05. On the other hand, the length of left clavicle is not a good predictor of stature since the p value is >0.05.

Table 5: Coefficients of Regression Analysis

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	115.506	4.772		24.205	.000
	Right clavicle length	.251	.068	.456	3.694	.000
	Left clavicle length	.078	.066	.146	1.186	.237

A regression formula for estimation of stature of an individual from maximum length of right clavicle irrespective of gender is formulated as Stature = 0.251(Right Clavicle Length) + 115.506

The correlation between stature and right clavicle length was calculated using Pearson's correlation formula and the correlation coefficient was found to be 0.498 and p value was <0.001 in males and 0.663 and p value was <0.001 in females. The correlation between stature and left clavicle length was calculated using Pearson's correlation formula and the correlation coefficient was found to be 0.450 and p value was <0.001 in males and 0.592 and p value was <0.001 in females. This proves that there is positive correlation between the stature and length of right and left clavicle in both sexes.

From the regression analysis done for stature estimation in both gender, it is clear that length of right clavicle is a good predictor of stature with p value <0.05. On the other hand, the length of left clavicle is not a good predictor of stature since the p value is >0.05. The regression formula for estimation of stature of an individual from maximum length of right clavicle for male population is formulated as Stature = 0.214 (Right Clavicle Length) + 128.66. The regression formula for estimation of stature of an individual from maximum length of right clavicle for females is formulated as Stature = 0.412(Right Clavicle Length) + 104.883.

Discussion

The mean stature in the present study was found to be 165.3 cm in males and 158.6 in females. According to Nataraja Moorthy et al[16], the mean stature of Tamil Nadu population was found to be 173.7 cm. In a study conducted by Angus Deaton et al[17], the mean stature of Tamil Nadu population was found to be 165.8 cm in males and 153.4 cm in females.

The mean length of right clavicle in males in the present study was 147.4 cm and that of left clavicle was 152.4 cm and the mean length of left clavicle in females in the present study was 139.9 cm and that of left clavicle was 142.8 cm. In a study done by Rani et al[15], the mean length of right clavicle in males was 149.7cm and that of left clavicle was 146.2cm and the mean length of left clavicle in females in the present study was 118.4cm and that of left clavicle was 115.6 cm.

In the present study, the mean length of right clavicles is less than left clavicles in both males and females which is similar to the study conducted by Sudha et al[18]in south Indian population, Makandar et al[11].

In the present study, the regression equation was determined to estimate the stature from maximum length of right clavicle in both males and female are as

For male: STATURE = 0.214 (RIGHT CLAVICLE LENGTH) + 128.662

For females: STATURE = 0.412 (RIGHT CLAVICLE LRNGTH) + 104.883

In a study conducted by Balvir et al[14], regression formulae were determined for both males and females from both right and left clavicles.

For males:

Right clavicle: STATURE = 1630.58-0.0772 (MAX LENGTH OF RIGHT CLAVICLE)

Left clavicle: STATURE = 1617.47 + 0.0157 (MAX LENGTH OF LEFT CLAVICLE)

For females:

Right clavicle: STATURE = 1707.2-1.31 (MAX LENGTH OF RIGHT CLAVICLE)

Left clavicle: STATURE = 1674.58 + 1.0385 (MAX LENGTH OF LEFT CLAVICLE)

Conclusion

In the present study conducted, it has been concluded that the mean stature is more in males than females. The mean length of right clavicle is less than the mean length of left clavicle in both males and females. The mean length of right and left clavicle is more in males than in females. There is a positive correlation between stature and length of both right and left clavicle in both males and females. Length of right clavicle proved to be a good predictor of stature. The multiplication factor for males and females showed considerable difference. This shows that sex identification prior to stature estimation will give more accurate results. Since the study included only subjects from Tamil Nadu, regression formulae obtained in this study can be used to estimate stature for Tamil Nadu population.

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Ethical Clearance: This research has received approval from the Institutional Ethics Committee, Madras Medical College, Chennai.

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Original Article

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Analysis of Signature Patterns: Consistency and Distinctiveness in Handwritten Signatures for Forensic Authentication

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Abstract

Handwritten signatures are unique behavioural attributes that serve as a distinct form of identification for individuals. This study focuses on the analysis of signature patterns using various parameters, including aspect ratio, angle of the first letter with respect to the baseline, and the ratio of the area of a circle to its radius within the signature. A dataset consisting of 1200 genuine and 1200 simulated (English) signature samples from 12 individuals were examined using an image analysis tool to record measurements for these parameters. The primary objectives were to investigate the consistency of signatures within the same person and to compare genuine signatures with simulated ones. This study contributes to the field of forensic investigations by offering insights into the authentication of signatures and the measurement of dissimilarities between signatures of the same and different individuals based on their patterns. The findings aid in identifying most influential parameter in distinguishing genuine signatures from counterfeits and enhance the evidential value of handwritten signature samples. Additionally, the simplified approach employed in this study allows for universal applicability across languages. Future research endeavours could expand the dataset and explore additional parameters to further improve the accuracy and reliability of signature verification methods in forensic analysis.

Keywords: document examination, forensic investigations, image analysis software, pattern recognition, signature examination, statistical representation

Introduction

Handwriting signatures are one of the most essential personal behavioural biometric traits, and they have a special place in the biometric cosmos. Meanwhile, the handwritten signature is frequently utilized to authenticate persons in a variety of civilian applications for improved security and privacy[1, 2]. Depending on the acquisition approach, signatures are categorised as offline or online. In the case of offline, signatures are scanned and saved as grayscale or binary images, whereas in the case of online, signatures are defined by sequential data (e.g., x-y positions, velocity, acceleration, pressure, and pen inclination)[3].

The design of online handwriting signature verification systems is more complex than the design

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of offline one, since many desirable attributes such as velocity, pressure, and so on are not available during acquisition[4]. The verification system is dependent on the attributes selected from the signature, and in general, offline signature verification systems have higher dependency as it is cheap and easy to perform in regular laboratory cases, whereas in online modes the specialized gear[5], such as a digitizing tablet or electronic pens with several sensors are required which is difficult to access due to its high cost and only trained people can perform the examinations [6, 7]. Hence, because of its ease of use and cost effectiveness, the offline signature is more extensively employed in everyday life. As a result, handwriting signature verification remains an open task, with the key being the development of novel record methods to gather full handwriting information such as position, velocity, acceleration, pressure, force, direction, and pen inclination when writing at a cheap cost.

Materials and Methods

A total of 1200 genuine and 1200 simulated signature samples were collected from individuals aged between 25 and 50. Each person provided 100 signature samples. The participants used a blue ballpoint pen of the brand Luxor Uniflo Pen to write their signatures. A uniform-static writing desk in the presence of even natural light was used during the collection of signature samples. This suggests that the sitting arrangement was consistent for all participants. Prior to collection of samples, it was ensured that participants understand the purpose of the study and voluntarily consent to provide their signatures for research purpose.

The signature samples were scanned using a document scanner application with version 1.6. This digital scanning process allowed for the conversion of physical signatures into electronic images. The Digimizer-image analysis software with version 5.7.5 was used as a measurement tool for analysis. This software provides features for precise manual measurements and analysis of the scanned signature images. It allows for defining the unit of measurement and can measure distances, lengths of line segments, perimeters, areas, angles, paths, etc.[8]. By utilizing the Digimizer software, the collected signature samples and the simulated genuine signature samples can be analyzed and compared in a systematic manner, taking advantage of the software's measurement capabilities. This work was carried out in the Department of Forensic Science, SHUATS, Prayagraj-211007, U.P., during December, 2022-April, 2023.

Firstly, all the signature samples were scanned through the scanner for its preservation. Further, all the signature samples were examined on Digimizer-image analysis software and measurements were recorded, based on few parameters which are categorized as follows:

(a) Aspect Ratio: The aspect ratio of a signature sample is the ratio of its width to its height. To calculate the aspect ratio, the width and height of each signature sample was measured using the Digimizer software. Then, the width was divided by the height to obtain the aspect ratio value. The aspect ratio provides information about the overall shape and elongation of the signature.

(b) Angle of First Letter: The angle of the first letter in a signature refers to the angle formed between the baseline of the signature nd the first letter. It was measured using the Digimizer software to determine the orientation of the first letter with respect to the baseline.

(c) Ratio of Area of Circle to its Radius: This parameter involves creating a circle that covers the entire signature sample. Firstly, the area of this circle was measured using the Digimizer software. Then, the radius of the circle was calculated. Finally, the area of the circle was divided by its radius to obtain the ratio. This ratio provides information about the compactness or dispersion of the signature within the enclosing circle.

By analyzing and recording these parameters for each signature sample using the Digimizer software, quantitative data was gathered that can be further analyzed and compared to identify patterns, similarities, or differences among the samples. Figure 1 shows how Digimizer software is used to collect the measurements of signature samples based on the chosen parameters in the study.

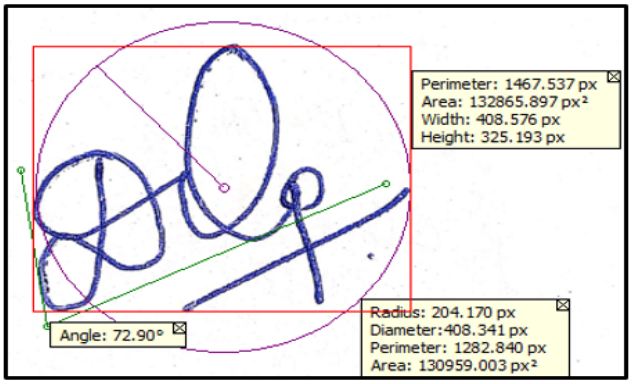


Figure 1: Measurement of Signature Samples based on chosen parameters (via Digimizer software).

Secondly, the probability distribution of the collected samples was analyzed to assess whether the data sets were derived from populations following a common distribution, specifically a normal distribution. In a normal distribution, the data is symmetrically distributed, forming a bell-shaped curve, with the majority of values clustering around the central region and gradually decreasing as they move away from the centre.

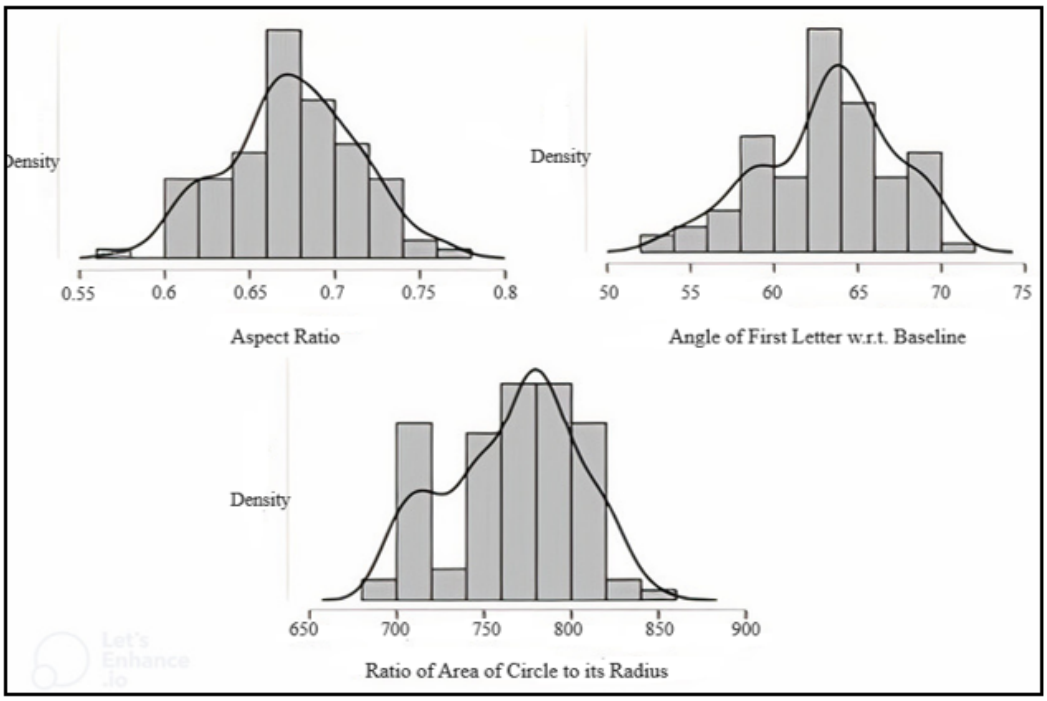


Figure 2: Probability Distribution of Signature Samples.

Figure 2 shows the histogram representation of collected signature samples from random population highlighting the density of various examined parameters like Aspect ratio of the signature, Angle of first letter with respect to baseline and Ratio of area of circle to its radius in the signature. These parameters show symmetrical distribution (bell-shaped curve), which infers more extreme efficacy which may contribute in better analysis and comparison in terms of accuracy and reliability in identification of handwritten signature samples in Forensic investigations.

Further, statistical hypothesis testing was employed to evaluate and estimate the differences and similarities between two sets of data obtained from signature samples. This testing involves formulating two distinct hypotheses: the null hypothesis and the alternative hypothesis, which do not overlap. The null hypothesis makes a statement about the population mean assuming no effect, while the alternative hypothesis presents a complementary proposition to the null hypothesis. The hypothesis considered in our study can be stated as follows: Null Hypothesis (H_0): There is no significant difference among the signature samples of the same person ($\mu_1 = \mu_2$).Alternate Hypothesis (H_1): There is a significant difference among the signature samples of different individuals ($\mu_1 \neq \mu_2$).

In this study, the Z-test was utilized to compare two means, specifically for conducting inter-group comparisons and comparing Genuine and Simulated Signature Samples. The Z-test is chosen for testing the significance of the difference between two means. It is similar to the T-test in that they both assess means of one or two groups. However, there is a crucial distinction between them. The Z-test necessitates knowledge of the population standard deviation, whereas the T-test employs an estimate of the standard deviation based on a sample. Additionally, the Z-test does not require information about degrees of freedom. In the present study, the sample size exceeds 30, making the Z-test preferable over the T-test[9]. To ensure reliable results, several assumptions should be met by the data: random sampling, continuous data, a normal distribution of samples, a large sample size, known population standard deviation, and independent variables. Fortunately, the data in the present study satisfies all these assumptions, which enhances the reliability of the results. Now, let's examine the formula adopted in this study, along with a brief description: Z-test formulas enable the calculation of the test statistic (Z). The study may involve either one-sample or two-sample analysis. Both formulas require the sample means ($\bar{x}$) and sample sizes (n) from the test sample.

One sample Z-test formula:

$$Z = \frac{\bar{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$$

Two sample Z-test formula:

$$Z = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Here,

$\bar{x}$ = Sample Mean

σ=Population Standard Deviation

n= Sample Size

μ_0=Hypothesized Standard Mean

$\overline{x_1}$ = Sample Mean

$\overline{x_2}$ = Sample Mean

σ_1 = Expected Standard Deviation

σ_2 = Expected Standard Deviation

n_1= Sample Size

n_2= Sample Size

In this study, a comparison between two means was conducted, thus necessitating the use of the two-sample Z-test formula. For Z-tests, critical values are determined by referencing the standard normal distribution, as degrees of freedom are not involved. To obtain the critical value for a Z-test, the significance level and whether it is a one-tailed or two-tailed test must be taken into account. In the present study, the critical value for the Z-test (denoted as Ze) was determined as 1.96, based on the table value. This critical value was utilized during the Z-test analysis performed in the study[10, 11].

Results and Discussion

In this study, the off-line handwritten signature pattern recognition was introduced where few global parameters, such as aspect ratio, angle of first letter with respect to baseline, ratio of area of circle to its radius in the signature were considered and studied which is similar to study recorded [12]. Firstly, it was investigated whether there is an inter-se consistency among the signature samples of the same person or not, which is elaborated below.

Table 1 shows the data of various parameters of signature samples with calculated Mean and Standard Deviation, and the Weighted Average of the Mean and Standard Deviation of the data is also calculated so as to facilitate Z-test in further process. Data-1 and Data-2 are the two sets of data collected from the same person to investigate the deviations in the signature sample of the same person (inter-se consistency).

Table 1: Calculated Mean, Standard Deviation and the Weighted Average of the Mean and Standard Deviation of the data (for inter-se comparison).

Sample No.	Parameters	Data-1		Data-2	
		Mean (in pixel)	Std. Deviation (in pixel)	Mean (in pixel)	Std. Deviation (in pixel)
Sample-1	1. Aspect Ratio	0.672	0.040	0.691	0.037
	2. Angle	66.455	0.658	66.761	0.033
	3. Ratio of area of circle to its radius	882.675	1.968	872.203	1.766
	WEIGHTED AVERAGE	1439.4134	67.9475	1433.4524	67.9965
Sample-2	1. Aspect Ratio	0.227	0.015	0.297	0.029
	2. Angle	75.724	0.839	66.455	0.648
	3. Ratio of area of circle to its radius	711.292	9.587	706.292	9.616
	WEIGHTED AVERAGE	1044.0414	107.8472	1055.4009	106.8451
Sample-3	1. Aspect Ratio	0.310	0.013	0.329	0.015
	2. Angle	70.434	1.840	65.445	1.658
	3. Ratio of area of circle to its radius	534.290	4.588	562.675	5.968
	WEIGHTED AVERAGE	1399.194	64.039	1394.8544	65.9357
Sample-4	1. Aspect Ratio	0.274	0.016	0.262	0.013
	2. Angle	70.244	1.140	73.414	1.215
	3. Ratio of area of circle to its radius	766.262	7.266	770.232	8.616
	WEIGHTED AVERAGE	1226.8363	64.0964	1223.31	67.1519
Sample-5	1. Aspect Ratio	0.680	0.042	0.697	0.049
	2. Angle	63.182	3.930	68.455	2.658
	3. Ratio of area of circle to its radius	790.262	4.534	786.292	6.616
	WEIGHTED AVERAGE	1038.4839	104.5843	1030.9815	102.3559
Sample-6	1. Aspect Ratio	0.277	0.015	0.281	0.013
	2. Angle	74.874	2.727	73.364	2.178
	3. Ratio of area of circle to its radius	768.162	1.200	772.892	1.037
	WEIGHTED AVERAGE	1213.6055	64.1172	1212.7949	67.3926
Sample-7	1. Aspect Ratio	0.226	0.021	0.229	0.015
	2. Angle	55.764	0.839	56.455	0.658
	3. Ratio of area of circle to its radius	49.968	0.607	51.088	0.619
	WEIGHTED AVERAGE	1393.4684	77.5346	1392.8248	73.8579
Sample-8	1. Aspect Ratio	0.231	0.018	0.225	0.016
	2. Angle	74.534	1.890	75.724	1.999
	3. Ratio of area of circle to its radius	814.928	4.558	811.292	6.428
	WEIGHTED AVERAGE	1052.1696	103.8103	1051.7159	103.7202
Sample-9	1. Aspect Ratio	0.689	0.044	0.697	0.049
	2. Angle	62.798	2.543	66.455	2.958
	3. Ratio of area of circle to its radius	767.562	5.083	770.292	6.616
	WEIGHTED AVERAGE	1031.1631	101.8627	1034.8767	102.3676
Sample-10	1. Aspect Ratio	0.327	0.014	0.322	0.013
	2. Angle	55.724	2.840	53.414	2.215
	3. Ratio of area of circle to its radius	678.566	6.863	676.299	5.623
	WEIGHTED AVERAGE	1212.5597	63.2782	1213.0508	67.1798

Continue.....

Sample-11	1. Aspect Ratio	0.235	0.020	0.225	0.016
	2. Angle	75.213	1.944	77.724	1.940
	3. Ratio of area of circle to its radius	512.552	3.928	513.292	3.588
	WEIGHTED AVERAGE	1041.3462	107.0406	1044.8503	107.7065
Sample-12	1. Aspect Ratio	0.679	0.042	0.690	0.046
	2. Angle	64.585	2.192	66.545	2.676
	3. Ratio of area of circle to its radius	769.051	5.516	778.244	7.710
	WEIGHTED AVERAGE	1030.8707	101.2303	1026.6346	101.5691

Table 2 shows the Z-static value for all the 12 signature samples studied for the inter-se deviations among the signature samples of the same person, which inferred that there is no significant difference, since the calculated value of Z_0 is smaller than the table value of Ze = 1.96. Therefore, the null hypothesis H_0 is accepted.

Table 2: Z-static and Z-critical value (obtained for inter-se comparison).

Sample No.	Z-static (Z_0) (Calculated value)	Z-critical (Z_e) (Table value)
1	0.4385	1.96
2	0.5465	1.96
3	0.319	1.96
4	0.2624	1.96
5	0.3625	1.96
6	0.0616	1.96
7	0.0428	1.96
8	0.0214	1.96
9	0.6394	1.96
10	0.0376	1.96
11	0.3125	1.96
12	0.2089	1.96

Secondly, it was investigated whether there is a significant difference between the genuine and the simulated samples or not, which is elaborated below. Table 3 shows the data of various parameters of signature samples with calculated Mean and Standard Deviation of both Genuine and Simulated Signature Samples, and the Weighted Average of the Mean and Standard Deviation of the data is also calculated so as to facilitate Z-test in further process. Data-1 and Data-2 are the two sets of data collected from two individuals to investigate the deviations in the genuine and simulated signature sample.

Table 3: Calculated Mean, Standard Deviation and the Weighted Average of the Mean and Standard Deviation of the data (for comparison between genuine and simulated samples).

Sample No.	Parameters	Data-1 (Genuine Samples)		Data-2 (Simulated Samples)	
		Mean (in pixel)	Std. Deviation (in pixel)	Mean (in pixel)	Std. Deviation (in pixel)
Sample-1	1. Aspect Ratio	0.672	0.040	0.621	0.737
	2. Angle	66.455	0.658	56.761	0.433
	3. Ratio of area of circle to its radius	882.675	1.968	872.203	1.766
	WEIGHTED AVERAGE	1439.4134	67.9475	1308.7538	69.4215
Sample-2	1. Aspect Ratio	0.227	0.015	0.297	0.029
	2. Angle	75.724	0.839	96.455	1.648
	3. Ratio of area of circle to its radius	711.292	9.587	766.292	5.016
	WEIGHTED AVERAGE	1044.0414	107.8472	1155.2713	208.0783
Sample-3	1. Aspect Ratio	0.310	0.013	0.429	0.115
	2. Angle	70.434	1.840	55.445	2.658
	3. Ratio of area of circle to its radius	534.290	4.588	662.675	8.968
	WEIGHTED AVERAGE	1399.194	64.039	1443.5632	69.3342

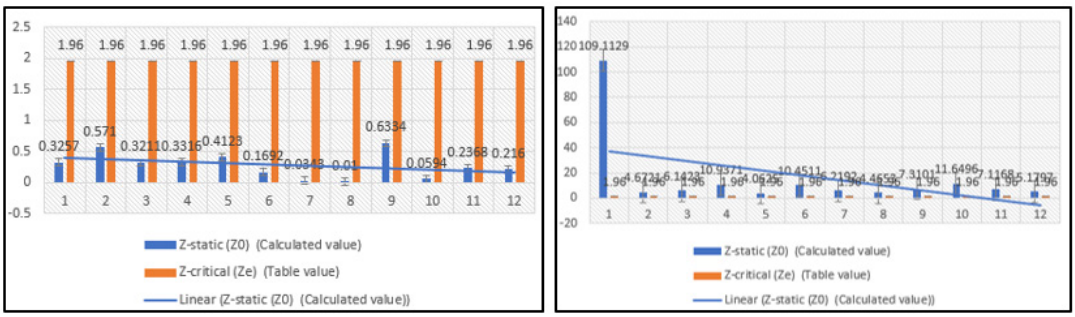
Continue.....

Sample-4	1. Aspect Ratio	0.274	0.016	0.362	0.213
	2. Angle	70.244	1.140	93.414	2.215
	3. Ratio of area of circle to its radius	766.262	7.266	750.232	8.616
	WEIGHTED AVERAGE	1226.8363	64.0964	1058.9394	110.3473
Sample-5	1. Aspect Ratio	0.680	0.042	0.727	0.249
	2. Angle	63.182	3.930	76.455	2.658
	3. Ratio of area of circle to its radius	790.262	4.534	826.292	9.616
	WEIGHTED AVERAGE	1038.4839	104.5843	1122.2713	214.6783
Sample-6	1. Aspect Ratio	0.277	0.015	0.321	0.023
	2. Angle	74.874	2.727	73.364	4.178
	3. Ratio of area of circle to its radius	768.162	1.200	805.892	6.037
	WEIGHTED AVERAGE	1213.6055	64.1172	1059.2943	114.4903
Sample-7	1. Aspect Ratio	0.226	0.021	0.324	0.615
	2. Angle	55.764	0.839	86.455	2.658
	3. Ratio of area of circle to its radius	49.968	0.607	66.049	0.049
	WEIGHTED AVERAGE	1393.4684	77.5346	1443.5632	69.3342
Sample-8	1. Aspect Ratio	0.231	0.018	0.425	0.106
	2. Angle	74.534	1.890	95.724	2.999
	3. Ratio of area of circle to its radius	814.928	4.558	703.299	9.522
	WEIGHTED AVERAGE	1052.1696	103.8103	964.8502	125.8147
Sample-9	1. Aspect Ratio	0.689	0.044	0.397	0.009
	2. Angle	62.798	2.543	56.455	1.658
	3. Ratio of area of circle to its radius	767.562	5.083	806.292	11.616
	WEIGHTED AVERAGE	1031.1631	101.8627	1236.2713	254.0783
Sample-10	1. Aspect Ratio	0.327	0.014	0.222	0.013
	2. Angle	55.724	2.840	63.414	6.255
	3. Ratio of area of circle to its radius	678.566	6.863	726.292	19.616
	WEIGHTED AVERAGE	1212.5597	63.2782	1025.9394	150.3473
Sample-11	1. Aspect Ratio	0.235	0.020	0.425	0.606
	2. Angle	75.213	1.944	97.724	2.940
	3. Ratio of area of circle to its radius	512.552	3.928	833.292	12.588
	WEIGHTED AVERAGE	1041.3462	107.0406	1169.6502	146.7988
Sample-12	1. Aspect Ratio	0.679	0.042	0.590	1.046
	2. Angle	64.585	2.192	46.545	2.676
	3. Ratio of area of circle to its radius	749.051	5.516	801.292	17.710
	WEIGHTED AVERAGE	1030.8707	101.2303	1141.9908	198.4952

Table4 shows the Z-static value for all the 12 signature samples studied for the difference between the signature samples of the two individuals, which inferred that there is significant difference, since the calculated value of Z_0 is greater than the table value of Ze = 1.96. Therefore, the null hypothesis H_0 is rejected. This finding can be supported by the study given by Srivastva and Sharma[13], in which it was concluded that out of all alphabets present in any signature, there are only 5% possibility of any letter to be not matching with letters of same person's handwriting. Hence, there are very less chances of maintaining the original range of any particular signature by any other individual.

Table 4: Z-static and Z-critical value (obtained for comparison between genuine and simulated samples).

Sample No.	Z-static (Z_0) (Calculated value)	Z-critical (Z_e) (Table value)
1	13.4375	1.96
2	4.7974	1.96
3	4.7669	1.96
4	11.986	1.96
5	3.6715	1.96
6	11.6454	1.96
7	4.9369	1.96
8	5.3085	1.96
9	7.1881	1.96
10	11.3994	1.96
11	7.7833	1.96
12	5.085	1.96



(a) **(b)**

Figure 3: (a) Inter-se comparison. (b) Comparison between the genuine and simulated signature samples.

Figure 3 (a) represents the study of inter-se comparison, which shows the difference between Z-static and Z-critical (Z_0 < Ze). Therefore, the null hypothesis H_0 is accepted. Figure 3 (b) represents the study of comparison between the genuine and simulated signature samples, which shows the difference between Z-static and Z-critical (Z_0 >Ze). Therefore, the null hypothesis H_0 is rejected.

Conclusion

Handwriting is a complex skill involving neurological, physiological, and sensory processes[14]. During childhood, individuals learn to write by imitating letter designs from copybooks. However, each person has a unique ability to reproduce these designs based on their perception and interpretation. With practice, handwriting becomes a mastered skill, allowing writers to focus more on content rather than the physical act of writing. As a result, individuals develop their own distinct characteristics and deviations from standardized forms. Handwriting becomes a habitual and subconscious pattern that remains consistent across multiple writing instances[15, 16]. This personalized nature of handwriting makes it a valuable and unique skill for each individual[17].

The present study aimed to examine the inter-se consistency among signature samples and difference between genuine and simulated signature samples using statistical measures. The study successfully achieved these objectives and concluded that there is no significant difference among the signature samples of the same person. However, significant differences exist between signature samples of different individuals, as it is unlikely to maintain

the exact range of a specific signature. By following the procedure outlined in the study, document experts can closely estimate the writer or signer of a set of signature samples, narrowing down the number of suspects and establishing connections to identify the primary suspect. Therefore, the study provides reliable and valuable insights for forensic investigations in cases involving suspected signature samples and document-related investigations.

Ethical Clearance, Source of Funding and Conflict of Interest:

Ethical Clearance: The study is related to signature examination hence clearance was taken from the student advisory committee only. Prior to collection of samples, we ensured that participants understand the purpose of the study and voluntarily consent to provide their signatures for research purpose.

Source of Funding: There has been no significant financial support for this work.

Conflict of Interest: There are no known conflicts of interest associated with this publication.

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A Case Report

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Canine Menace: A Case Report

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Abstract

A 13 years old male found dead with several bite marks in the body, with some 8 to 10 dogs around that area. The deceased body was brought to Mortuary, Osmania General Hospital at 03:30 PM on 19/05/2022 by the Investigation Officer and requested for postmortem examination under section 174 Criminal Procedure Code. On postmortem examination, there were multiple claw marks, avulsed lacerations, puncture wounds present all over the body, laceration of platysma and a retro-laryngeal hematoma with fracture of 6th cervical vertebrae were noted, all were suggestive of canine tooth injury. All the internal organs were pale and cause of death was given as massive haemorrhage consequent to animal bites over head, neck and trunk.

Keywords: Avulsed laceration, Claw marks, Multiple puncture wounds, Retropharyngeal hematoma, Massive hemorrhage.

Introduction

- Dogs usually bite when they are provoked / aggressive. The following are the common aggressions [1]

  Sexual aggression

  Maternal aggression

  Food aggression

  Fear aggression

  Territorial aggression

  Aggression due to rabies

- Rabies in dogs is due to LYSSA virus which affects a dog's central nervous system, spinal cord and brain. It initially settles in the muscle tissue and moves to the dog's nervous system, ultimately entering salivary glands. It will kill the animal host in nearly 100% cases. Virus cannot survive for longer than 24 hours outside the host. [2]

- Dogs are the most common carriers of Rabies. Other common carriers of rabies are fox, bats, skunks and racoons. Rabies spread through saliva coming out from another affected animal. Dogs are more prone to catching the infection if they have a scratch, laceration or an open wound. To humans it is transmitted by bite of the affected animal.[2]

- **10 signs of rabies in dogs:** [3]

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- **Restlessness**
- **Withdrawal**
- **Licking the bite**
- **Aggression**
- **Furiousness**
- **Dilated pupils**
- **Seizures**
- **Lack of fear**
- **Salivating**
- **Paralysis**

} **Final stage symptoms**

➢ The farther away from brain, the longer virus takes to spread through central nervous system.

➢ **Pathway for ascend in humans:**[4]

Virus enters tissue from saliva of the biting animal
↓
Virus replicates in muscle near bite
↓
Virus moves up to peripheral nervous system to central nervous system
↓
Virus ascends to spinal cord
↓
Virus reaches brain and causes fatal encephalitis
↓
Virus enters salivary glands and other organs of victim

➢ Symptoms in human: [4]

- Fever
- Depression
- Agitation
- Painful spasms followed by excessive saliva – Foaming at mouth after drinking water.
- Death within week without vaccine
- **Treatment: Hospitalisation, Immunoglobulin injections, anti-rabies vaccine.**

THE CASE:

➢ On 19th of may at around 3:30 pm, we received an inquest from station house officer of Kulsumpura police station of Hyderabad city police division. As per the police inquest, at around 12:30 pm on the same day. Two persons, in the bank of Moosi river, saw an unknown male aged around 10-15 years, found lying unconscious with several bite marks in the body, with some 8 to 10 dogs around that area. They both immediately informed it to the police. Later, father of the deceased confirmed that the deceased person is Master. xxxxxx, his 13-year-old son. According to his statement, his son used to play with his friends usually in that area and on that particular day as his friends were not there, he went for fishing in that river and later found dead. Case was filed under section 174 Criminal procedure code and the corpse was brought for autopsy to Osmania General Hospital and requisition for autopsy was submitted by the Investigation officer and autopsy was conducted on the same day.

CRIME SCENE:

Fig 1. Clues team tags in crime scene

Fig 2. Body found away from belongings

Fig 3. Position altered in the crime scene.

➢ **POST MOTEM EXAMINATION:**

❖ An average built male aged about 13 years with height of 142cm {Fig 4}. Body was dressed in Olive green colour floral designed shirt, soaked in blood, ragged and tattered, dark green colour pant torn at outer thigh, belt, leg and buttocks region {Fig 5}. Body was supine, eyes closed, mouth partly closed, wild dried green leaf twigs present all over the body. Dried blood stains present over face, neck, upper part of chest, both the upper limbs and both feet. Skin peeling was present at multiple areas. Penis was circumcised. Rigor mortis developed over upper limbs and Post-mortem Lividity could not be appreciated {Fig 6}.

Fig 4. Body of the deceased

Fig 5. Clothes

Fig 6. Post-mortem lividity not appreciated

❖ Multiple scalp deep avulsed laceration were present over temporoparietal region of both sides of the head. Multiple scalp deep lacerations were also noted all over the head {Fig 7,8}. The margins of all injuries were irregular in shape with evidence of skin tags. On reflection of skin over the scalp, contusion of size 7cm x 4cm was present 2cm in front of left parietal region {Fig 9}. Contusion of size 14cm x 10cm was present over the right parietal region extending up to left occipital region on the back.

Fig 7. Avulsed laceration

Fig 8. Avulsed laceration

Fig 9. Skull after reflection of scalp

❖ Claw marks overlapping each other, 1cm apart below the left ear lobule tip with 2 skin deep lacerations present over the left side of neck {Fig 10}. Multiple skin-deep puncture wounds were present over the right side of neck from midline extending up to 6cm below the right ear lobule {Fig 11}. Multiple skin-deep punctured wounds were present over the upper and mid part of neck.

Fig 10. Claw marks over left side of neck

Fig 11. Puncture wounds over right side of neck

❖ On reflection of skin internally, a contusion with underlying laceration of platysma and a retro-laryngeal hematoma with fracture of 6th cervical vertebrae were noted, all were suggestive of canine tooth injury {fig 12 to 14}


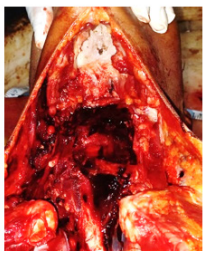
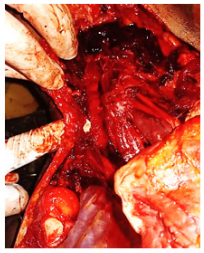

Fig 12. Retropharyngeal hematoma **Fig 13. Lacerated platysma** **Fig 14. Depicting a puncture wound**

- Chest: Multiple claw marks along with multiple muscle deep lacerations were noted {Fig 15,16}.


Fig 15. Claw marks in chest **Fig 16. Muscle deep lacerations over back of chest**

- Abdomen: Multiple claw marks with muscle deep lacerations were noted {Fig 17}.

Fig 17. Claw marks with lacerations in abdomen.

- Right Upper Limb: multiple skin deep puncture wounds and multiple skin deep lacerations were noted {Fig 18}.

Fig 18. Puncture wounds in right upper limb

- Left upper Limb: Multiple skin deep puncture wounds and Multiple muscle deep lacerations were noted.


Fig 19. Skin deep puncture wounds in left upper limb **Fig 20. Muscle deep lacerations in left upper limb**

- Back: Multiple claw marks and multiple skin deep puncture wounds were noted.

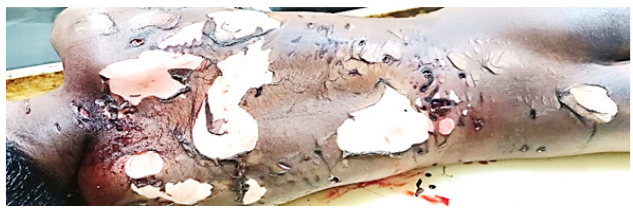

Fig 21. Skin deep puncture wounds over the back

- Lower limbs: Multiple Muscle deep bite marks were noted over front and back of both the lower limbs.


Fig 22. Muscle deep bite marks over front of lower limbs **Fig 23. Muscle deep bite marks over back of lower limbs**

- Internally all the organs appeared extremely pale.


Fig 24. Pale and oedematous brain **Fig 25. All the internal organs – pale.**

- No tissues were preserved for further examination and no specimen preserved for chemical analysis.
- **Cause of death** was opined as **'MASSIVE HAEMORRHAGE CONSEQUENT TO MULTIPLE ANIMAL BITES [CANINES] OVER HEAD, NECK AND TRUNK'.**

Discussion

(a) Telangana recorded 80281 cases of dog bites in 2022 and it has increased from 24000 in 2021.

(b) The report on dog bite cases was tabled in the Lok Sabha by Bharati Pravin Pawar, Minister of state, Ministry of Health and Family welfare. The report stated that Telangana stood 8th in terms of dog bite cases reported in 2022.

(c) India has witnessed a surge in the cases of rabies in the last decade.

(d) According to a report by the World Health Organization, approximately 35 million stray dogs live in India while 18 to 20 thousand rabies cases occur every year that accounts for 36 per cent of the world's deaths from rabies. (https://mediaindia.eu/ society/stray-dogs-a-major-problem-in-india/).

(e) The World Health Organization (WHO) target of ending human rabies deaths globally by 2030 will not be achieved unless India succeeds as it accounts for a large percentage rabies cases in the world.[5]

(f) The number of stray dogs in India is unfortunately on the rise due to lack of proper sterilization drives in the country. Activities such as animal control policies (including spaying and neutering), lack of animal welfare project implementations by civic bodies only add to the stray dog bites and attacks.

(g) Stray dog population is controlled by sterilisation of Stray dogs by implementing ABC-ARV Programme as per the Animal Birth Control (Dog) Rules-2001.[6]

(h) The tips of the ears of the sterilised stray dogs are cut in 'V' shape mark for identifying the stray dogs which have undergone sterilisation operation in ABC-ARV Programme. [6]

(i) Animal Birth Control Operation will reduce sexual aggression, maternal aggression and ARV programme will prevent the rabies disease in dogs. Territorial aggression, food aggression, fear aggression is natural to dogs which cannot be controlled, hence public should behave appropriately with the stray dogs. [6]

(j) In the ABC-ARV Programme, all the stray dogs are vaccinated against Rabies soon after the Animal Birth Control Operation and they are revaccinated every year. [6]

(k) Animal Laws in India to protect stray dogs: [8]

I. The Animal Birth Control (Dogs) Rules, 2001

II. Section 428 of the Indian Penal Code, 1860

III. Prevention of Cruelty to Animals (PCA) Act, 1960

IV. The Delhi High Court states that there are no laws that prohibit people from feeding stray animals. It is a crime to threaten, abuse or harass neighbours who feed animals. (Section 506)

V. Can file a complaint with the nearest local police station under Section 428, 429 IPC (Indian Penal Code) if the Resident Welfare Association is not cooperative.

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Original Article

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Comparative Evaluation of Odontometric Parameters for Determining Gender

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Abstract

Background and Aim: Sex estimate is a crucial component of human identification in a forensic setting. Due to the sexual dimorphism of human teeth, odontometrics—the measuring and analysis of tooth size standards—is most frequently utilized in age and sex determination. The aim of this study was to assess the degree of sexual dimorphism in mandibular canine using mandibular canine index using mesiodistal (MD) and buccolingual (BL) dimensions of the crown and inter canine distance measured.

Material and Methods: The study sample included 200 people (100 men and 100 women), ages 18 to 35, with an average age of 22 years. The distance between the mesial and distal contact points was used to calculate the mesiodistal dimension of the mandibular canine (CMD). Each subject's right mandibular canine index and left mandibular canine index were used to construct the canine index. The standard canine index (SCI) value was used as a cutoff point to differentiate males from females.

Results: Men's right and left mandibular canines mesio-distal crown widths were found to be significantly greater than those of their female counterparts. The current study demonstrates a very high significance of p value seen in the left mandibular canine and a significant difference in mesiodistal breadth between males and females of the right mandibular canine of p value. The total probability of sex determination for the right mandibular canine is 55% and for the left canine is 59.5% based on the conventional MCI calculations for the right mandibular canine (0.22) and for the left mandibular canine (0.21), suggesting that the left mandibular canine is more relevant for sex determination.

Conclusion: It has been proven beyond a reasonable doubt that mandibular canines exhibit significant sexual dimorphism when it comes to sex determination, and it is clear from the study that this breed is a more trustworthy source for sex determination.

Key Words: Canine, Crown, Sexual dimorphism, Standard Canine Index

Introduction

Every human being has three defining characteristics: age, sex, and race. Sex estimate is a crucial component of human identification in a forensic setting. Identifications are made easier when the sex is predicted since only absent people who

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fit the predicted sex need to be taken into account. Following that, sex-specific age estimation can be done.[1,2]

Due to the sexual dimorphism of human teeth, odontometrics—the measuring and analysis of tooth size standards—is most frequently utilized in age and sex determination. "Sexual dimorphism" is the term for differences in the shape, size, and appearance of teeth between men and women that can be used to determine gender.[3,4]

A person must be identified in order to receive a death certificate and for other personal, social, and legal reasons. Numerous factors, such as age, sex, dactylography, footprint, size, tattoos, scars, and more are used to identify identity. Determining a person's gender is the first stage in the forensic identification process.[5,6]

Gender discrimination has benefited from odontometry. Mesiodistal and buccolingual crown measurements, or linear measurements, are typically used for gender identification. However, linear odontometry would not be attainable in teeth with caries, attrition, or incomplete eruption. Alternative measurements, such as diagonal or cervical measurements, will thus be needed.[7,8]

Because they may be used to study anthropology, genetics, and odontology, teeth are a great forensic resource. Compared to other body parts, the measurements of the teeth and skull have a number of advantages since the anatomical landmarks are uniform, well-established, and simple to find. The aim of this study was to assess the degree of sexual dimorphism in mandibular canine using mandibular canine index using mesiodistal (MD) and buccolingual (BL) dimensions of the crown and inter canine distance measured.

Material and Methods

Present study was performed at the department of Forensic Medicine, Tertiary care Institute of India from January 2022 to January 2023. During this period, 1254 subjects in age range of 18-35 visiting outpatient department of Tertiary care Institute of Gujarat but only 200 subjects met the inclusion criteria applied for the study. The Institutional Ethical Committee gave their approval (GMERS/Narmada/1824) to the study protocol. After receiving the subjects' written agreement, the study was conducted. The entire maneuverwas described to the individuals, and they were informed of any unanticipated dangers that might arise throughout the course of the study. Alginate imprints of both arches were taken after receiving the subjects' written consent, and then castings were placed in dental stone.

Inclusion criteria: Since subjects between the ages of 18 and 35 have generally intact dentitions and experience less physiological and pathologic tooth wear at this time, this age group was chosen.

Exclusion criteria Individuals with fractured, missing, malformed or restored first molars were excluded.

Measurements

Using Type II dental stone right away to prevent any distortion, an impression of the maxillary arch was taken after receiving written agreement from the participants. The analysis was then conducted using the mandibular arch research models. To ensure easy reproducibility, all measurements were carried out by a single observer using digital callipers with a resolution of 0.01 mm on the casts.

The distance between the mesial and distal contact points was used to calculate the mesiodistal dimension of the mandibular canine (CMD). Both the left and right canine's MD width were measured, and the average value was used in the calculations.

Canine Index

Each subject's right mandibular canine index and left mandibular canine index were used to construct the canine index. The mandibular canine index (MnCI) formula was modified from that developed by Rao and colleagues to determine sex identification.

Canine Index CI = Mesiodistal crown width of canine / Intercanine distance

Standard Canine Index

The standard canine index (SCI) value was used as a cutoff point to differentiate males from females. Each canine tooth will therefore have its respective SCI. It is calculated using the following formula adapted from Rao and colleagues.

Standard CI = ([mean male CI SD] + [mean female CI + SD])/2.

If the subject's CI value is less than or equal to the standard CI, the individual is thought to be female. If the CI value was higher than the typical CI, the patient is assumed to be male. Using the formula provided by Garn et al. (1967), sex dimorphism in the right and left mandibular canines was estimated as follows:

Sexual dimorphism = (Xm _ Xf 1) _ 100 (Mean male canine width (Xm) and mean female canine width (Xf)). The obtained dimensions were subjected to statistical analysis to assess sex differences using an unpaired t-test. Statistical analysis was performed regarding MD, CI, LL, and Man ICW, and canine index for teeth 33 and 43, and standard CI and sexual dimorphism were also calculated. Percentage accuracy of reporting sex identity by this method was then checked as the actual sex of each subject was known by comparing means and median for teeth 33 and 43.

Results

Men's right and left mandibular canines' median mesio-distal crown widths were found to be greater than those of their female counterparts. ($p < 0.05$) This value was statistically significant. The mesio-distal crown width of the right and left mandibular canines also showed results with statistically significant values. ($p < 0.05$)

The current study demonstrates a very high significance of p value (0.0001) seen in the left mandibular canine and a significant difference in mesiodistal breadth between males and females of the right mandibular canine of p value (0.002). Using standardized criteria, the distance between the cusp points of the right and left mandibular canines was measured. The results showed that the mean intercanine distance for males were 24.30 and for females it was 22.01, with a p-value of 0.130 indicating non significant.

A uniform formula was used to determine the MCI. The mean MCI in men was found to be 0.22 mm on the right side and 0.22 mm on the left. The MCI was found to be 0.21 mm on the right side of females, compared to 0.20 mm on the left. Right canine MCI is very significant compared to left canine MCI, which is not significant.

The total probability of sex determination for the right mandibular canine is 55% and for the left canine is 59.5% based on the conventional MCI calculations for the right mandibular canine (0.22) and for the left mandibular canine (0.21), suggesting that the left mandibular canine is more relevant for sex determination. And for the right and left canines, respectively, males have a higher percentage accuracy of 59% and 66%, while females demonstrate 49% and 55%. The percentage of sexual dimorphism determined by the formula is 4.05 for the right canine and 7.30 for the left canine.

Overall, it was discovered that males with sexual dimorphism had considerably larger values for the right canine width, left canine width, right MCI, and left MCI. Additionally, the left mandibular canine has a wider profile than the right mandibular canine when it comes to reliability.

Table 1: Probability of sex determination (MCI – Right canine)

Gender	Number of cases studied	No. of cases with correct gender prediction by MCI
Females	100	49
Males	100	59
Total	200	55

Table 2: Probability of sex determination (MCI – Left canine)

Gender	Number of cases studied	No. of cases with correct gender prediction by MCI
Females	100	55
Males	100	65
Total	200	59.5

Table 3: Sexual dimorphism in Maxillary and Mandibular canine

Mandibular canine	Percentage
Right canine	4.05
Left canine	7.30

Discussion

No two people are the same and all are unique, and the human identification processes make use of this idea of uniqueness. Even though standard methods like DNA profiling, finger prints, anthropometric data, and dental records are available, there are times when it makes sense to use ancillary techniques like cheiloscopy, palatoscopy, and other odontometric measurements because they can produce results that are reasonably reliable when carried out consistently. In order to generate a biological profile from the skeletal and dental remains and to reconstruct the faces of unidentified people, gender discrimination is a crucial component of human identification techniques.[9]

Even with burned and decayed carcasses, forensic and anthropological investigations using teeth can determine a person's race, sex, and age. Studies on sexual dimorphism provide insight into both population and, by extension, individual evolution. In the study of Spitz W et al (2020)[10] an effort was made to identify a person's sex among the Iranian population using the mesio-distal breadth of canine teeth and the corresponding inter-canine lengths.

Although other studies evaluated indices using both study models and intraoral measures, we did not record any value clinically to minimise patient discomfort and to facilitate easy measurement replication. We have also come across research where the effectiveness of the right and left sides was compared, however we have taken the average of both sides and used it in the formulas. To establish dimorphism in our work, we only employed maxillary odontometric indices to replicate crime scenes or other situations where only a skull with a maxilla was available.[11,12]

They also noticed that men's values were greater than those of their female counterparts. Al-Rifaiy and Abdullah found that the average width of the mandibular and maxillary canines and the intercanine distance were both greater in men than in women in the Saudi population. They reported no statistical significance in the canine widths, but a significant difference between male and female in the intercanine distance (p 0.0001).

In contrast to the MD width of canine and CI values, Paramkusam et al. discovered that conventional mandibular CI was more accurate at estimating gender. They discovered that the accuracy rate while utilising the standard canine indices for the maxilla and mandible was >70%.[13,14]

In the current investigation, only linear measurements were used for the morphometric analysis, which was conducted by the authors using tooth casts. Such studies are advised because of their affordability, dependability, and simplicity. There would have been some bias in the dimensions and conclusions if there had been a lower sample size and only one examiner participated in the measurements. Therefore, it is impossible to generalise the study's conclusions. Every group has different tooth dimensions that are impacted by ethnic, environmental, and cultural factors. To the best of the authors' knowledge, this is the first study to apply morphometric analysis involving MD, CI, LL, and IC widths as well as CI. These results can serve as a guide for future research on canine measures.

Conclusion

It has been proven beyond a reasonable doubt that mandibular canines exhibit significant sexual dimorphism when it comes to sex determination, and it is clear from the study that this breed is a more trustworthy source for sex determination. In situations where other sophisticated factors for sex determination are not easily accessible, the standard canine index is quite helpful and would act as a rapid approach for sex determination. To reliably detect sex, SCI should be used in conjunction with other factors as it has limited utility alone.

Ethical approval was taken from the institutional ethical committee and written

Informed Consent was taken from all the participants.

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Original Research Article

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Estimation of Pattern of Skull Fractures in Homicidal Deaths: An Autopsy Based Cross Sectional Study Conducted in a Tertiary Care Hospital

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Abstract

The head is the most vital part of the body among various organs as the injury to the head will result in fatal outcomes compared to injuries sustained to other parts of the body. There has been an increased global incidence of head injuries in case of homicidal deaths. The present study aims to estimate the various patterns of the skull fractures in case of homicidal deaths and also the nature of injury causing such skull fractures in homicidal deaths. The present cross-sectional study revealed that out of 4036 autopsies, there were 74 cases of homicidal deaths with 67 male and 7 female cases. The skull fracture was noticed in 54 cases out of these 74 cases. The maximum number of homicidal deaths were found to be in the age group of 21 to 40 years. Among the different types of skull fractures, the isolated cut fracture contributed to 46.30% of cases followed by isolated fissured fractures and then by the combination of other types of skull fractures. The nature of injury causing skull fractures was blunt force in 51.8% of the cases then by sharp force injuries and then by the combination of these two. To bring down the incidence of homicidal deaths among the younger individuals, strict enforcements of law may be ensued on possession of blunt and sharp force weapons which are used for the brutal attacks.

Keywords: Homicidal deaths, Skull fractures, Blunt force.

Introduction

The head is the most vital part of the body among the various organs as the injury to the head will result in very fatal outcomes compared to injuries sustained to other parts of the body. This is the main reason for the place of infliction of the injury especially in case of homicidal deaths. There has been an increased global incidence of the head injuries in case of homicidal deaths. This has been a serious concern to our society.

According to world report on violence and health by World Health Organisation, in 2000, about an estimated 5,20,000 people were killed in acts of the various forms of interpersonal violence with a rate of 8.8 per 100000 population. But the actual statistics of the homicidal deaths was not clear as many cases were being concealed as accidental death or attributed to natural diseases. For every person who had been killed by interpersonal violence many of them were physically injured or psychologically damaged to certain extent(1).

The various patterns of the interpersonal violence vary among the different nations of the world. In the developing nations like India, the most common pattern of interpersonal violence resulting

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in homicidal death is by inflicting the head injury. The global incidence of fatal head injuries as the result of assault is greater than the number of non-fatal cases [2].

Homicide is the common endpoint of various different behavioural pathways among which causing injury to the skull and brain is more prevalent [3]. It may be the result of arguments between acquaintances, various drug addictions, domestic violence, terrorism and antisocial activities and robberies [4]. The assailants usually select a particular region of the body where maximum and fatal injuries can be inflicted even with minimal effort such as the head [2]. The ultimate outcome of such attacks depends on a number of factors such as the type of weapon used, site of the injury in the body, number of blows, etc. the presence or absence of the skull fractures, the type and site of the skull fracture if present and the associated presence or absence and type of the intracranial haemorrhages has an immense significance in the final outcome of such cases [5].

The previous study conducted by Suraj Sundara Raj et. al showed that around 85.6% of skull fractures in homicidal deaths are produced by blunt force injury, of which the linear fracture of the skull was the commonest pattern among the skull fractures accounting for about 52.6%. Frontal bone was the commonest bone involved in homicidal deaths (16.5%) [6].

The thickness of the cranial vault is not the same in all the areas. It varies in different locations and in different age groups and also depend on the health status of the individual. It is usually thinner over the frontal and the temporal regions and is greater in strength along the suture lines in adult individuals [7]. Greater the force of impact, more severe will be the damage caused and the outcome will be fatal. As head is the most vulnerable and vital part of the body, the head injury is the most effective method of causing a homicidal death [7]. The present study aims to estimate the various patterns of the skull fractures in case of homicidal deaths and also the nature of injury causing such skull fractures in homicidal deaths.

Materials and Methodology

The present study was conducted in the Department of Forensic Medicine and Toxicology, Government Stanley Medical College and Hospital, Chennai. It was a cross sectional study conducted during the period January 2019 – December 2020. All the cases of the homicidal deaths that were subjected to postmortem examination were studied. All the rest of the cases of natural deaths, accidental deaths and suicidal deaths were excluded from the study. The data was collected from the available postmortem records, clinical records, inquest reports and the weapon examination reports. The collected data were analysed and compared with the various national and international studies.

Results and Observations

The present study revealed that a total of 4036 autopsies were conducted in the Department of Forensic Medicine and Toxicology, Govt. Stanley Medical College and Hospital, Chennai during the study period. Among those 4036 cases, there were about 74 cases (1.83%) which were died as result of homicide. Among the 74 cases of homicide, the head injury alone caused death in about 47 cases (63.51%). The head injury along with other injuries contributed to death in about 7 cases (9.46%). The injuries other than head injuries such as the cut throat injury, stab injury to chest and abdomen, blunt force injuries to other parts of the body contributed to death in about 20 cases of homicidal deaths (27.03%). This clearly showed that head injury was the most common cause of death among all the homicidal deaths **(Table 1)**.

Out of 74 cases, 67 (90.54%) were male and 7 (9.46%) were female. Among the cases of homicidal deaths, the skull fracture was noticed in about 54 cases (72.97%). The fracture of the skull bone was not present in rest of the 20 cases (27.03%). The homicidal death cases were divided among the different age groups of population. It showed that there were 5 cases (6.76%) in the age group of less than 20 years, 46 cases (62.16%) were in the age group of 21 to 40 years, 19 cases (25.68%) were in the age group of 41 to 60 years and 4 cases (5.4%) in the age group of more than 60 years. This shows that the

maximum number of homicidal death cases were in the age group of 21 to 40 years **(Table 2)**. Among the cases of homicidal deaths in different age groups, the skull fracture was present in all cases aged less than 20 years (100%), 33 cases in age group of 21 to 40 years (71.74%), 15 cases in the age group of 41 to 60 years (78.95%) and 2 cases in the age group of more than 60 years (50%).

Among the 54 cases of homicidal deaths with skull fracture, the isolated frontal bone fracture in 1 case, isolated parietal bone fracture in 1 case, isolated temporal bone fracture in 5 cases, isolated occipital bone fracture in 1 case and combination of multiple bones of the skull in 46 cases were noticed **(Table 3).** The base of the skull fracture was noticed in 16 cases. Among the various types of skull fractures, the isolated fissured fracture was noticed in 12 cases (22.22%) **(Figure 1)**, isolated cut fracture was noticed in 25 cases (46.30%) **(Figure 2)**, isolated comminuted fracture was present in 5 cases (9.26%) **(Figure 3)**, isolated sutural diastasis was present in 1 case (1.85%) **(Figure 4)** and a combination of different types of fractures were present in 11 cases (20.37%) **(Table. 4)**. The nature of the injury causing the skull fractures was blunt force in 28 cases (51.85%), sharp force injury in 23 cases (42.59%) and the combination of both blunt force and sharp force injuries were noticed in 3 cases (5.56%) **(Table. 5)**.

Table 1: Cause of death in Homicidal Cases:

CAUSE OF DEATH	NO. OF CASES	PERCENTAGE
Head Injury alone	47	63.51%
Head Injury + Other Injuries	7	9.46%
Other Injuries alone	20	27.03%

Table 2: Age Distribution of Homicidal Deaths:

AGE GROUP	NO. OF CASES	PERCENTAGE
<20 years	5	6.76%
21 – 40 years	46	62.16%
41 – 60 years	19	25.68%
>60 years	4	5.4%

Table 3: Location of skull fractures:

LOCATION OF SKULL FRACTURE	NO. OF CASES	PERCENTAGE
Isolated frontal bone	1	1.85%
Isolated parietal bone	1	1.85%
Isolated temporal none	5	9.26%
Isolated occipital bone	1	1.85%
Multiple sites	46	85.18%

Table 4: Types of Skull Fractures:

TYPE OF SKULL FRACTURE	NO. OF CASES	PERCENTAGE
Fissured fracture	12	22.22%
Cut fracture	25	46.30%
Comminuted fracture	5	9.26%
Sutural diastasis	1	1.85%
Combination of fractures	11	20.37%

Table 5: Nature of Injury causing Skull Fractures:

NATURE OF INJURY	NO. OF CASES	PERCENTAGE
Blunt force	28	51.85%
Sharp force	23	42.59%
Blunt and Sharp force	3	5.56%

Figure 1: Fissured fracture of Skull

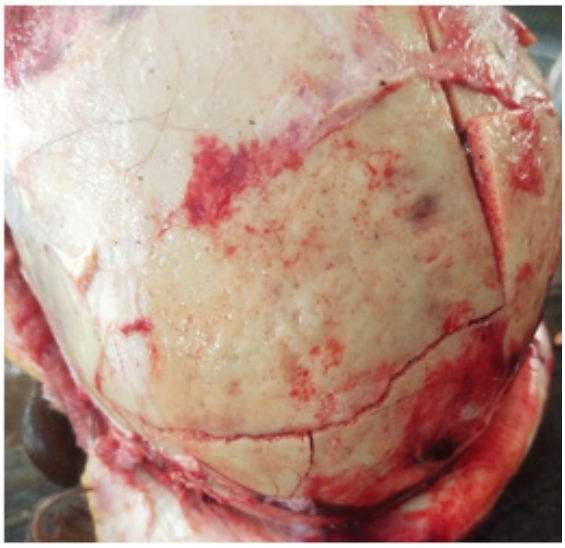

Figure 2: Cut fracture of Skull

Figure 3: Comminuted fracture of Skull

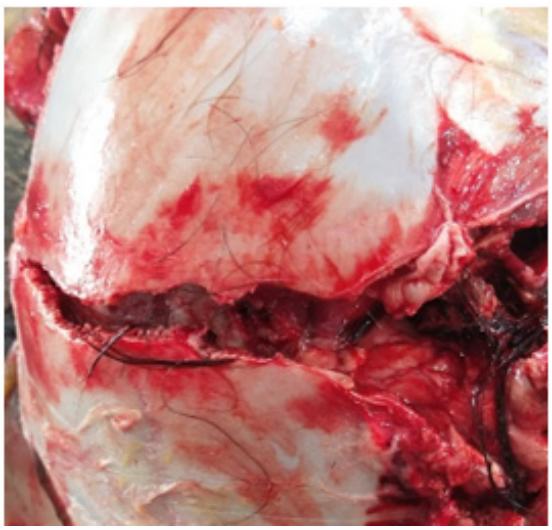

Figure 4: Diastasis of Coronal suture of Skull

Discussion

In the present study, the homicidal deaths contributed to about 1.83% of the cases. The studies conducted by Suraj Sundaragiri et al [6], Mohanty et al [8] and Mishra et al [9] also revealed similar findings such as 2.1%, 3.4% and 3.8% respectively. The head injury was the cause of death in about 63.51% of the cases of homicidal deaths. This is similar to the results observed in the study conducted by Malik et al [10]. The skull fracture was noticed in about 72.97% of the cases of homicidal deaths. This result is very much similar to the results of the studies conducted by Malik et al [10] and Punia et al [11] which revealed to be 71.3% and 75% respectively. The homicidal skull fractures amounted to 93.1% in the study conducted by Chattopadhyay et al [2] and 97.2% in the study conducted by Mishra et al [9]. The present study also revealed that the most common age group for homicidal head injuries was 21 to 40 years which amounted to 62.16% of the cases followed by 41 to 60 years with 25.68%. These results are very similar to the study conducted by Suraj Sundaragiri et al [6] reported that 21 to 30 years was the most common age group of homicidal deaths. Similar results were observed in various other studies conducted by the Indian authors [11-16]. Majority of the cases were male which is similar to the reports of other studies. This male preponderance is due several socioeconomic and other factors. Most of the homicidal deaths occurred in lonely places and after evening time which is similarly observed by Henderson et al [19]. Most of the skull fractures in homicidal deaths were caused by blunt force weapons followed by sharp force weapons and then by combination of both which is in concordance with the studies conducted by Chattopadhyay et al [2], Gupta et al [13] and Singh et al [20]. The most common type of homicidal skull fracture was found to be cut fracture followed by a combination of different types of fracture. To the contrast, linear or fissured fracture was the most common type as noticed by Suraj Sundaragiri et al [6]. As there were maximum number of cases with skull fracture noted over multiple sites, this shows that multiple blows and multiple assailants were involved in case of homicides.

Conclusion

The present study showed that younger individuals especially the male population were more vulnerable and the victims of fatal homicidal head injuries. Attacks by multiple offenders by

multiple strikes over the body was noticed in most of the cases. In majority of the cases, the injuries were very severe in nature involving all the structures of the head. The blunt force weapons like wooden log, stones, etc in majority of the cases caused isolated injuries but when combination of skull fractures included, the sharp force weapons like machete, sword, etc caused fractures in majority of the cases. The type of the skull fracture and its location and the number of cranial bones injured indirectly indicates the severity of force of the impact which leads to underlying brain damage and results in death of the individual. Culpable homicide is the worst form of all crimes. The concerned authorities should take firm steps to control this heinous crime. To bring down the incidence of homicidal deaths among the younger individuals, strict enforcements of law may be ensued on possession of blunt and sharp force weapons which are used for the brutal attacks.

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Research Article

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Comparative Soil Analysis from Different Crime Prone Areas of Kottayam and Kollam Districts of Kerala for Forensic Characterization

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Abstract

Soil is the loose surface material that covers land on which plants grow. It consists of a mixture of organic remains, clay, and rock particles, which gives it its uniqueness from place to place. Because of the uniqueness of soil, it has a high evidential value in the field of forensic science. In the present study, research has been conducted to check the range of variations in the soil collected from different crime-prone areas of Kottayam and Kollam districts of Kerala by physical, chemical, microscopic, and instrumental examination. In physical examination, soil colour, texture, consistency, and density were measured, and in chemical examination, pH and total soluble sulphate of the soil were measured. In instrumental examination, Heavy metal analysis was done by using Atomic Absorption Spectrometry (AAS), which helps to measure the amount of trace elements present in the soil. The study found that each soil has some significant variations that make it unique. In the field of forensic science, this can be highly helpful in determining the origin of soil by examining its colour, texture, structure, content, etc.

Keywords: Soil comparison, Physical, Chemical, Microscopical, Atomic Absorption Spectrometry (AAS)

Introduction

Soil is one of the most important resource of the nature. Soil can be found in all major environments on earth and it covers the surface of the planet. It is the fine earth which covers land surfaces as a result of the *insitu* weathering of rock material or accumulation of mineral matter transported by water, wind, ice.[8] Soil is formed as a result of weathering, which involves the breakdown of rocks and boulders into smaller pieces by erosive forces. It is a complex mix with a range of mineralogical, chemical, biological, and physical characteristics. Therefore, soil varies from place to place, has unique features, and so tells a lot about the geography of a region. In this way, soil acts as significant physical evidence that can yield vital information after being subjected to a chemical, physical, and biological analysis, making it relevant and trustworthy evidence in the field of forensic science.

Pedology is the scientific discipline of soil science, which examines all characteristics of soils, including their physical and chemical characteristics, the function of organisms in the production of soil and in relation to soil characteristics, the description and mapping of soil units, and the origin and formation of soils.

Chemical and physical changes lead to the formation of soil sediments, which cause differences

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in soil that vary from place to place. Because of the uniqueness of soil, it can be used to connect the crime scene, the victim, and the suspect and gather vital information about the type of ground surface there.

Soil is a common form of physical evidence, which are found at scene of crimes such as automobile accidents, hit and run cases, decoity, bulgury, theft, etc. Soil specimens can be obtained from shoes, shirts, pants, fingerring, watches, tool, tyres, etc., which can be easily collected, seperated and analysed. Soil is nearly invisible and suspects may be less aware of importance of soil in connecting crime scene, suspect and victim and it can be easily collected, seperated and analysed. In this way, soil serves as an ideal trace evidence which is highly individualistic with high probability of transfer and retension and can be easily collected, separatde and analysed.[2]

In accordance with the Locard exchange principle, when two things come into contact, physical components can be exchanged. This exchange could take the form of soil moving from one place to another.Soil can be used as an identification marker due to its unique features or characteristics.[10]

In forensic science, the examination of soil samples using various scientific techniques helps to resolve or support criminal investigations. A significant component of many forensic investigations is soil analysis. Comparing soils has relevance as evidence because of their extensive distribution, extremely variable composition, relative ease of transmission, permanence, and resistance to deterioration.

Comparative analysis of traces and micro-traces, which comprises a number of morphological and analytical tests, is particularly crucial in the field of forensics for figuring out the circumstances surrounding crimes. With the evolution of potent and effective technology, forensic examinations of soil has improved and it may now be carried out at the lowest scales of dimensions, with more sensitivity, and with vastly differentiating intervals. Moreover, it is feasible to find unexpected or previously inaccessible samples.

In the present study, by comparing the soil samples from different crime-prone areas of Kottayam and Kollam districts of Kerala and analysing their components or characteristics by classic and successful soil analysis methods from the point of view of forensic science. This experiment is carried out to investigate the soil samples from Kottayam and Kollam districts of Kerala. The reason this experiment was chosen was to see the difference in heavy metal concentration in each of the soil samples by AAS and study the differences found in each of the soil samples. This experiment allows us to compare the texture, size, colour, density, pH, and heavy concentration of soil samples from two districts in the same state (Kerala).

Materials and Methods

Kottayam is a city in the Indian state of Kerala. It is situated in the centre of Kerala and serves as the district of Kottayam's administrative centre. In the Kottayam district, alluvial and laterite soil types are most abundant. Another district, Kollam is located in the southern part of Kerala, 70 kilometres north of Thiruvananthapuram, the state's capital. The district experiences five main types of soil- Lateritic soils, Brown Hydromorphic soils, Greyish Onattukara soils, Riverine and Coastal Alluvium, and Forest Loam.

Materials required

Waterproof marking pen, Beakers(250ml, 500ml), Droppers, Measuring cylinder(10ml,500ml,1000ml), Glass rod, Burette, Conical flask, Density gradient column, Whatmann filter paper, Sieve, Munsell colour chart.

Distilled water**,** Hydrogen peroxide 30% (SRL Pvt. Ltd)**;** Buffer Solution of pH 7.0**;** Sodium hexametaphosphate, Extra pure, 65-70% (SRL Pvt. Ltd); Bromo form, Special Grade, 98% (Loba Cheme Pvt. Ltd); Bromobenzene Extra pure, 99% (Loba Cheme Pvt. Ltd); Phenolphthalein, 99% (Rankem); Sodium hydroxide, extra pure, 30% (SRL Pvt. Ltd);Ethyl alcohol 99.9%; Rhodizonate reagent 98.9% (Central Drug House Pvt. Ltd);Barium chloride 99% (SRL Pvt. Ltd); Silver nitrate, 99% (Loba Cheme Pvt. Ltd);Hydrochloric Acid extra pure 35% (Loba Cheme Pvt. Ltd) andNitric Acid 65% (Emsure) were used for sample preparation and analytical purposes.

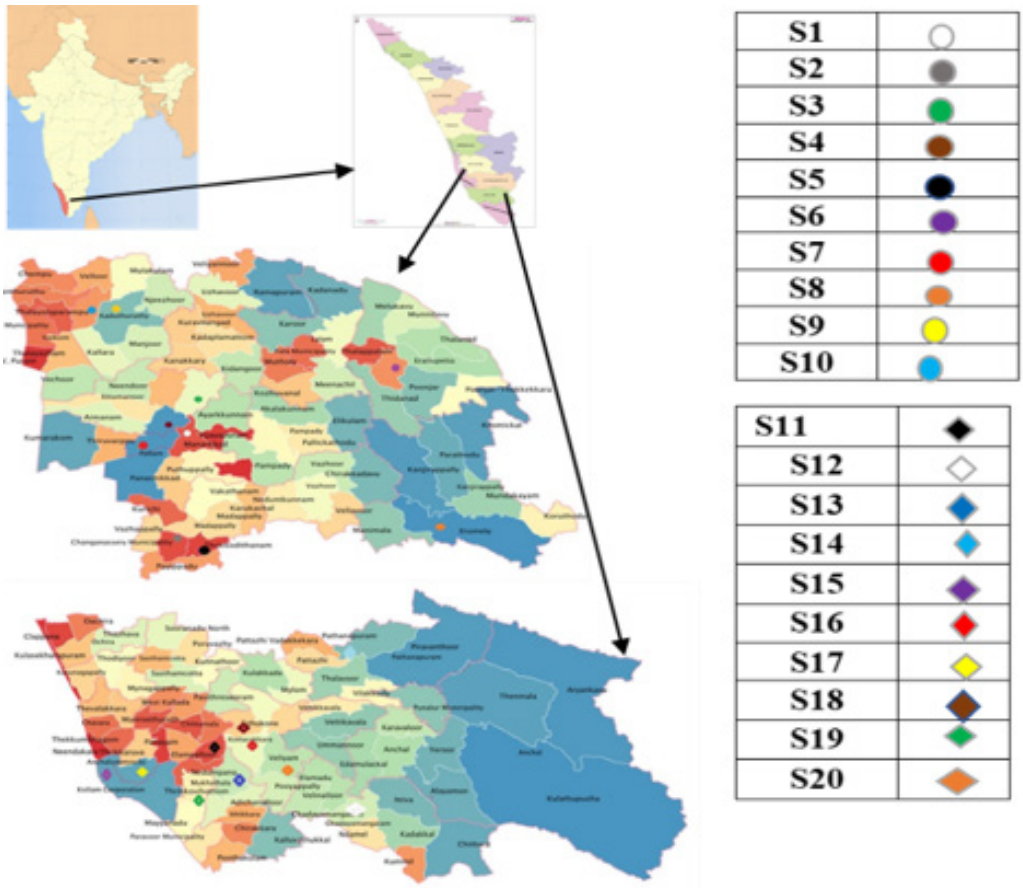
Atomic Absorption Spectrometer (Model no. AA240), Digital pH meter, Bouyoucos Hydrometer were used for analysis purpose.

Soil Sample collection

Total 20 samples were collected from 10 crime prone areas of each Kottayam and Kollam districts of Kerala. Collection was done with the help of spade and 5 samples (4 samples from the 4 corners and one from the centre) were collected from each selected site. Then quadrant method was followed for the collected samples. The samples were then packed in plastic zip-bags and were labelled accordingly.

Table 1: List of samples collected from both districts

KOTTAYAM		KOLLAM	
SAMPLE NO	**NAME OF AREA**	**SAMPLE NO**	**NAME OF AREA**
S1	Manarcadu	S11	Kundara
S2	Changanassery	S12	Chadayamangalam
S3	Ettumanoor	S13	Kilikollur
S4	Gandhinagar	S14	Pathanapuram
S5	Thrikodithanam	S15	Sakthikulamgara
S6	Erattupetta	S16	Kottarakara
S7	Kottayam west(kodimatha)	S17	Anchalummoodu
S8	Erumely	S18	Ezhukone
S9	Kaduthuruthy	S19	Kottiyam
S10	Thalayolaparambu	S20	Pooyapally



(Source: www.mapsofindia.com)(Source: www.ecostat.kerala.gov.in)

Fig 1: Geographical map of Study area

Sample Preparation

Each soil sample was air dried under shade to remove moisture. Then the samples were sieved using 2mm sieve to remove unwanted materials like roots, large stones, leaves, etc. Sieved samples were stored in plastic zip-bags and labelled accordingly.

Sample Analysis

Different methods were used for the analysis of the soil samples. In physical examination, soil colour determination was done by referring and comparing the colour of samples, both in dry and wet conditions, with the Munsell colour chart.[11] Soil texture represents the proportion of sand, slit and clay in the soil which was determined by Bouyoucos Hydrometer.[1] Wet soil samples were taken for measuring soil consistency through physically touching and feeling the soil grains; and the density gradient method was used for measuring the density of the soil.[7] In chemical examination, soil pH was determined with the help of Digital pH meter[9]and total soluble sulphate in soil was determined by titration method.[3]

In instrumental examination, Atomic Absorption Spectrometer (AAS) (Model no. AA240) was used for the heavy metal analysis of the soil samples. To digest the soil samples, 1g of soil was mixed with diacid (HCl: HNO3) in a 3:1 ratio by addition of 10 ml of the solution to each sample, and then the mixture was placed on a hot plate to digest until the digestion was complete or the soil was completely burned. After digestion, 100 ml of DDW was added to each beaker and the mixture was filtered using Whatmann No. 1 filter paper. After filteration, 5 ml of aliquot was poured 25 ml volumetric flask and diluted with double distilled water. An atomic absorption spectrophotometer was used to determine the concentrations of Mg, Cu, Fe, and Zn in the sample solution.[5]

All the data was compiled and entered in a Microsoft Excel worksheet, and the measurements were tabulated and statistical analysis was carried out using a t-test for two dependent means with a two-tailed hypothesis and a significance level of 0.05 to check for variation in the soil samples collected from districts of Kollam and Kottayam.

Results

The present study was carried out with an objective of comparative study of soil samples collected from each 10 crime prone areas of Kottayam and Kollam districts of Kerala by physical, chemical, microscopical and instrumental examination. There are five parameters that are statistically significant (density, pH, concentration of Mg, Cu and Zn) because their P value is less than 0.05. There are two parameters that are not statistically significant (Total soluble sulphate, concentration of Fe).

Table 1: Physical Examination of soil samples from Kottayam

KOTTAYAM						
Samples	Soil Colour		Soil Texture	Soil Consistency		Density
	Dry	Wet		Stickiness	Plasticity	
S_1	Yellowish Red	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_2	Yellowish Red	Dark Red	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_3	Reddish Brown	Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_4	Dark Brown	Dark Brown	Sandy Clay Loam	Non- Sticky	Non- plastic	1.778
S_5	Strong Brown	Strong Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_6	Brown	Dark Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_7	Dark Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_8	Brown	Dark Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_9	Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.334
S_{10}	Reddish Brown	Yellowish Red	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778

Table 2: Physical Examination of soil samples from Kollam

KOLLAM						
Samples	Soil Colour		Soil Texture	Soil Consistency		Density
	Dry	Wet		Stickiness	Plasticity	
S_{11}	Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.612
S_{12}	Dark Reddish Brown	Yellowish Red	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_{13}	Dark Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	1.778
S_{14}	Reddish Brown	Yellowish Red	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.473
S_{15}	Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Non- Sticky	Slightly Plastic	1.778
S_{16}	Yellowish Red	Yellowish Red	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.473
S_{17}	Dark Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Non- Sticky	Slightly Plastic	2.612
S_{18}	Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.612
S_{19}	Reddish Brown	Dark Reddish Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.612
S_{20}	Strong Brown	Strong Brown	Sandy Clay Loam	Slightly Stickiness	Slightly Plastic	2.473

Table 3: Assessment of Chemical Examination

KOTTAYAM			KOLLAM		
SAMPLES	pH	Total Soluble Suphate	SAMPLES	pH	Total Soluble Suphate
S_1	4.86	0.09168	S_1	5.68	0.09696
S_2	5.31	0.09888	S_2	5.98	0.09072
S_3	5.61	0.10896	S_3	6.35	0.1032
S_4	5.9	0.10416	S_4	6.21	0.08832
S_5	6.27	0.09168	S_5	6	0.09168
S_6	5.16	0.08928	S_6	6.05	0.10704
S_7	5.94	0.11088	S_7	5.6	0.09648
S_8	5.96	0.09456	S_8	6.24	0.10224
S_9	5.56	0.10176	S_9	5.85	0.09696
S_{10}	5.54	0.09984	S_{10}	5.82	0.09264

Table 4: Heavy metal concentration in soil samples of both districts

KOTTAYAM					KOLLAM				
Sample	Mg	Cu	Fe	Zn	Sample	Mg	Cu	Fe	Zn
S_1	101.76	3.9	36.14	3.84	S_{11}	102.69	2.8	64.6	48.2
S_2	79.8	1.93	29.04	7.66	S_{12}	65.98	1.2	39.57	4.79
S_3	94.89	3.23	20.91	9.28	S_{13}	43.03	4.26	180.25	38.53
S_4	103.86	6.7	128.6	12.61	S_{14}	53	2.83	113.41	10.3
S_5	81.96	1.07	47.15	3.2	S_{15}	9.66	3.08	205.75	28.52

Continue.....

S_6	98.79	5	23.46	2.14	S_{16}	43.61	2.54	34.78	50.6
S_7	96.21	6.83	222.25	30.29	S_{17}	55.78	3.04	28.17	29.59
S_8	80.48	7.45	166.5	46.61	S_{18}	18.23	3.32	168	31.92
S_9	166.23	11.5	56.97	6.07	S_{19}	57.18	4.73	27.66	12.17
S_{10}	152.28	4.55	127.55	10.47	S_{20}	79.74	3.76	28.14	48.65

Table 5: Result of differences between Kottayam and Kollam soil samples

Parameters	Mean	μ	S^2	S^2M	SM	t	P
Density	0.49	0	0.14	0.01	0.12	4.13	0.00254
Ph	0.37	0	0.18	0.02	0.13	2.72	0.02364
Total soluble sulphate	0	0	0	0	0	-0.774	0.45837
Concentration of Mg	-52.74	0	954.77	95.48	9.77	-5.4	0.00043
Concentration of Cu	-2.06	0	7.03	0.7	0.84	-2.46	0.03639
Concentration of Fe	3.18	0	11125.9	1112.59	33.36	0.1	0.92623
Concentration of Zn	17.11	0	512.23	51.22	7.16	2.39	0.04051

In the physical examination, soil colour, texture, consistency, and density were analysed, which are the most important distinguishable characteristics of soil during the preliminary examination of a forensic investigation. In Kottayam and Kollam district, soil colour in dry condition and dry condition varies from Yellowish Red, Reddish Brown and Brown. The presence of numerous organic matters and colouring compounds in soil gives soil it's colour. The wet soil is darker than the dry soil. Agricultural sub soil contains moisture and hence it appeared dark.[4] The texture of the soil collected from all the sites was found to be sandy clay loam in nature, in which the sand, silt and clay percentage of soil from Kottayam district varied from 68.177 - 71.16 sand, 4.82 -7.81 silt and 22.9 - 24.024 clay and the sand, silt and clay percentage of soil from Kollam district varied from 68.86 - 71.193 sand, 4.78 - 7.1 silt and 24 - 24.041 clay, respectively. Soil consistency depends on texture, organic matter content, and the amount of clay in the soil. In Kottayam, soil consistency (wet condition) was mostly found to be slightly sticky and slightly plastic, whereas in Kollam district, all the samples were found to be slightly sticky, non-sticky, and slightly plastic. The density gradient column is the most commonly used method for soil comparison. It was observed that the density of soil from Kottayam is 1.778 g/cm^3, except for sample S_9 (Kaduthuruthy), which has 2.334 g/cm^3. In Kollam, the density ranges from 1.778 g/cm^3 to 2.612 g/cm^3, with the highest density found in 4 places (S11, S17, S18, and S19) due to different size particles than in other samples.

The pH value of soil from Kottayam district ranged from 6.27 to 4.86, which is from slightly acidic to very strongly acidic, and that of Kollam ranged from 6.35 to 5.6, which is from slightly acidic to strongly acidic. All the soil samples were observed to be acidic, which might be due to heavy rainfall, which leads to continuous removal of basic cations by leaching and high use of chemical fertilisers.[12]In the soil samples from Kottayam, the concentration of soluble sulphate in S_7 (0.11088) from is higher because Kodimatha is an area where there is a large amount of pollution from industries and vehicles, and the lowest concentration is in S6 (0.08928) from Erumely, whereas in Kollam, the concentration of soluble sulphate in the sample from S_{16} (0.10704) is higher, while in S_{14} (0.0864) has the lowest concentration, which indicates that in the region of S_{16} there must be anthropogenic activities in the soil

In Kottayam district, the higher concentration of Mg in S9 (Kaduthuruthy) is maybe due to the high occurrence of parent material and presence of minerals in soil or due to amount the rainfall, while Cu in S9 (Kaduthuruthy) was observed to be high which may be due to the high use of fertilisers, organic matter. In S8 (Erumely) have higher concentration of Zn and S7(Kodimatha) have higher concentration of Fe possibly because of industrial waste, fertilisers, organic matter, whereas in Kollam the higher concentration of Mg in S11 (Kundra) maybe due to presence of minerals in soil, while Cu in S19 (Kottiyam) may be due to natural processes like weathering and human activities, Fe in S15 (Sakthikulangara) may be due to human activities like industrial processes, Zn in S16 (Kottarakara) were observed to be high maybe due to the high use of fertilisers, industrial waste may result to pollution.[6]The amount of trace elements present in soil samples from Kottayam was in the following order: Mg > Fe > Zn> Cu, while that of soil from Kollam was in the following order: Fe >Mg > Zn > Cu. In forensic science, testing soil for heavy metals gives each soil its own unique imprint.

In statistical analysis it is found that five parameter like density, pH, concentration of Mg, Cu and Zn because the p value is less than 0.05) are statistically significant and 2 parameter Total soluble sulphate, Concentration Fe are not statistically significant because p value is greater than 0.05. The results obtained from the above methods reveal that there were significant variations in some parameters like density, pH, concentration of Mg, Cu and Zn and soil samples from both the districts show differences in soil colour and consistency. This uniqueness in soil will help forensic investigators to determine the origin of soil samples found at a crime scene and potentially link the soil to a particular location.

Conclusion

The present study focused on identifying any distinguishable differences in the soils of Kollam and Kottayam districts of Kerala state which could be used in forensic investigations. From this study, it is concluded that soil samples from both districts have the same soil texture with different proportions of sand, silt, and clay, and the granular structure observed for all the soil samples and it showed variation in soil colour and consistency. The more differences in both soil samples were measured by seven parameters, of which five are statistically significant (density, pH, Concentration of Mg, Cu and Zn) as their p value is less than 0.05. So it can be concluded that we can compare the soil samples from both districts using five methods that show statistical significance along with soil colour and consistency. These characteristics of soil, which individualise the soil from one place to another, make soil an important form of forensic evidence. This can be very useful in the field of forensic science to identify the origin of soil samples found at a crime scene by analysing their colour, texture, structure, composition, etc.

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Original Research Article

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Knowledge and Attitude towards Post-mortem Examination amongst the Residents of Imphal West

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Abstract

A postmortem examination is still under an umbrella of misconceptions, myths, and emotions amongst the people as well as physicians. The knowledge and attitude of the general public towards medicolegal postmortem examination have not been investigated thoroughly. This cross-sectional study was conducted to assess the knowledge and attitude towards postmortem examination amongst the residents of Imphal West. A total of 450 participants were approached and analyzed. It was observed that 41% of the participants had adequate knowledge about the medicolegal postmortem examinations. Further, 11 % of the participants had negative attitude towards the postmortem procedure. Despite having an important role in the machinery of justice, the knowledge and attitude of the general public towards autopsy is still poor. From the findings of our study, it is evident that myths, misconceptions and lack of awareness still exist in the minds of people about postmortem examinations. There is a need for clarification about the essence of postmortem examination, which is an important tool in the administration of justice.

Keywords: Postmortem examination, knowledge, attitude

Introduction

Postmortem examination or autopsy is the examination of a human body after death. A medicolegal postmortem examination is duty of a medical person for assisting the law enforcers in the investigation of crimes. The postmortem procedure is largely stigmatized, and many people still view the practice as an unnecessary desecration of the body. It is still under an umbrella of misconceptions, myths, and emotions amongst the common people as well as physicians. In India, a medicolegal postmortem examination is conducted without the consent of the relatives, and the relatives tend to protest in certain circumstances[1]. Some section of the people of the Islamic faith also does not encourage postmortem examination as they believe that the body should be returned back to God in the best of condition.[2] The knowledge and attitude of the general public towards medicolegal postmortem examination have not been investigated thoroughly. This study was conducted

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to assess the knowledge and attitude towards postmortem examination amongst the residents of Imphal West.

Materials and Methods

This study was a cross-sectional study, conducted in the Department of Forensic Medicine and Toxicology of tertiary teaching hospital, which deals with medicolegal cases brought mainly from Imphal West of Manipur. The study was conducted from January 2021 to October 2022. The study population included residents of the Imphal West district of Manipur and also relatives or family members of the deceased persons brought for medicolegal autopsies at the RIMS mortuary, Imphal West. Persons above 18 years of age who were residing in Imphal West since birth and relatives or family members of the deceased person belonging to Imphal West were included in this study. Informed consent was taken from the participants prior start of the study. And the total sample size was around 450**.** After obtaining approval from the institutional ethics committee, data was collected. The participants were selected based on the geographical spread of the district and adequate sex representation. A structured questionnaire was used. The Statistical Package for the Social Sciences (SPSS) version 26.0 for windows (Armonk, NY: IBM Corp; 2020) was used for analysis. Knowledge Score was summarized using mean with SD and range. Chi-square tests for proportions and 't-test for the age, sex, community, educational qualification, occupation.A p-value of less than 0.05 was considered significant.

Results

A total of 450 participants were included in the study. The majority of the study participants were males (67%) and the remaining were females (33%). Most of the study population were Meiteis (68%), followed by Manipuri-Tribals (19%).The maximum number of participants were graduates (28.4%) and only 4.4% were illiterate. Figure 1showsthat 41% of the participants hadadequate knowledge about the medicolegal postmortem examination. Male participants had better knowledge than female participants. There was no statistically significant difference between the knowledge level and the sex of the participants. Table 1 shows that older participants ≥ 34 years had comparatively better knowledge than the younger participants ≤ 34 years, but was not statistically significant. Less educated and illiterate participants had lesser knowledge than graduates and above (p= <0.05). Figure 2 shows that 89% had favourable attitudes and female participants had more positive attitude than male participants. Table 3 shows that participants ≥ 34 years had more positive attitude towards medicolegal autopsies than participants ≤ 34 years, (p= <0.05). The participants who were illiterate had a positive attitude compared to the educated participants as shown in Table 4. Table 5 shows that participants belonging to the Meitei community had more positive attitude compared to other communities. Table 6 shows that the participants who had adequate knowledge about medicolegal examination showed more positive attitude (98.9%).

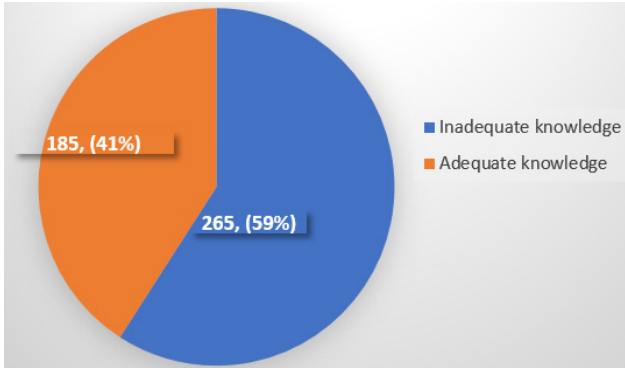

Figure 1: Showing knowledge level of the participants

Table 1: Showing age group of the participants and their knowledge levels

Age group (year)	Knowledge level		P-value
	Inadequate knowledge n (%)	Adequate knowledge n (%)	
≤ 34	59.3%	40.7%	0.923
≥ 34	58.9%	41.1%	

Table 2: showing education status of the participants and their knowledge level

Education level	Knowledge level		P-value
	Inadequate knowledge n (%)	Adequate knowledge n (%)	
Illiterate	17 (89.5%)	2 (10.5%)	0.00
Up to diploma and certification courses	186 (66.2%)	95 (33.8%)	
Graduate and above	63 (42.0%)	87 (58.0%)	

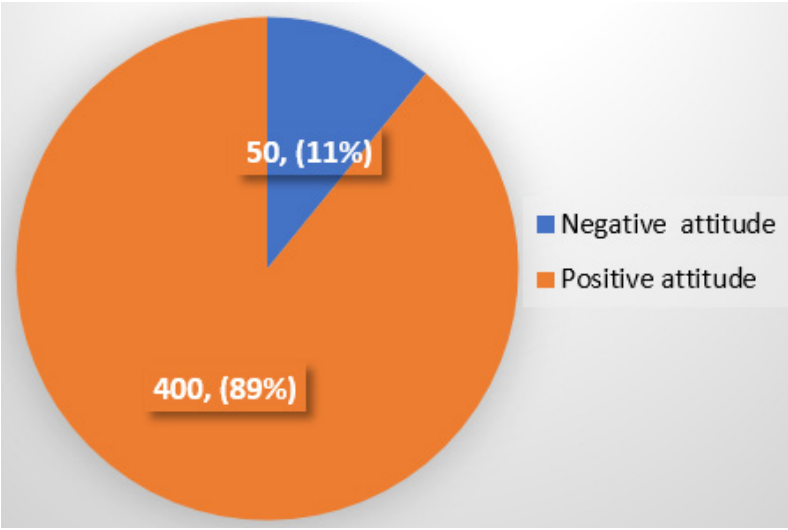

Figure 2: showing attitude level of the participants

Table 3: showing age group of the participants and their attitude level

Age group (year)	Attitude level		P-value
	Negative attitude n (%)	Positive attitude n (%)	
≤ 34	38 (17.8%)	176 (82.2%)	0.00
≥ 34	11 (4.7%)	225 (95.3%)	

Table 4: showing education status of the participants and their attitude level

Education level	Attitude level		P-value
	Negative attitude n (%)	Positive attitude n (%)	
Illiterate	0 (0.%)	19 (100.%)	0.043
Up to diploma and certification courses	38 (13.5%)	243 (86.5%)	
Graduate and above	11 (7.3%)	139 (92.7%)	

Table 5: showing community of the participants and their attitude level

Community	Attitude level		P-value
	Negative attitude n (%)	Positive attitude n (%)	
Meitei	26 (8.5%)	279 (91.5%)	0.030
Manipuri- Tribal	12 (13.8%)	75 (86.2%)	
Manipuri- Muslim	6 (27.3%)	16 (72.7%)	
Non- Manipuris	5 (13.9%)	31 (86.1%)	

Table 6: showing both knowledge and attitude level of the participants

Knowledge level	Attitude level		P-value
	Negative attitude n(%)	Positive attitude n(%)	
Inadequate	47 (17.7%)	219 (82.3%)	0.000
Adequate	2 (1.1%)	182 (98.9%)	

Discussion

Autopsy, a specialized procedure, involving the complete dissection of the body was comparable to a surgical procedure. Yet, when it comes to the autopsy, the general public has concerns about autopsy. Only 15% of the participants being able to give the correct answer in this study showed that people were not properly aware of what a medicolegal case was. However, 82% of the participants knew that postmortem examination is required for deaths under sudden, suspicious, and unnatural circumstances which are comparatively higher than the findings of Curwen et al[3], where only 75.86% of people claimed that they knew about autopsy and other related procedures. In our study, regarding the knowledge question of who conducts postmortem examination, 408 (90.7%) participants gave the answer as doctors. Similar findings were observed by Saukko P[4]. Consents of the relatives of deceased persons in medicolegal autopsies are not required. However, in our study, only a few participants answered correctly that consent is not required for medicolegal postmortem examinations (12.4%). This may be favourably compared with the study of Subedi et al[5], where 71.92% had incorrectly responded that consent should be provided by the relatives of the deceased before performing a medico-legal autopsy. This is an issue which needs to be addressed as it often poses impediments in conducting medicolegal autopsies in this part of the country. Apostmortem report is to be made based on the judgment of the pathologist (doctor) engaged in a specific case and without proper request, it cannot be issued to any third-party members.[6]Interestingly, in our study, only 21.8% of the participants knew that a postmortem report is a confidential document. This poor response showed that people still think that the postmortem report is a document available in the public domain. From our study, it was found that, 41% of the participants had adequate knowledge about postmortem examinations. In a study by Kaoje et al[7], it was observed that 55% of respondents demonstrated good knowledge of postmortem examination whereas 20% had poor knowledge and 25% had fair knowledge. Even though most of the people were educated, they were yet to be aware of the essence and significance of autopsies. In our study, a total of 49 (11%) participants showed negative attitude and 401(89%) showed positive attitude towards postmortem examination. This negative attitude may be because of lack of trust in the procedures however, the overall attitude of the general public was positive and may translate into more acceptance of the procedure when the value of the examination is presented, and the details of the procedure are adequately explained. According to our study, we found that the participants above 34 years of age (95.3%) had a positive attitude towards postmortem

examinations when compared to those below 34 years of age. This is similar to the study of Mihailovic et al[8], where the attitude towards autopsies among the older age groups was positive, which could be due to the experiences they gain and their interaction with other people. We also observed that the participants who had educational qualifications as graduates and above (92.7 %) had a favourable attitude towards postmortem examination. This may be compared with the findings of Kaoje et al[7], where the graduates had favourable attitudes towards postmortem examinations when compared to others, who are less educated. This shows the importance of education in clarifying the myths and misunderstandings about medicolegal autopsies.

Conclusion

Medicolegal autopsies are procedures which are carried out in any sudden, suspicious, unnatural deaths. Despite having an important role in the machinery of justice, the knowledge and compliance of the general public towards autopsy is still poor. The myths and misconceptions regarding this procedure still need clarification. The spread of awareness in this regard is a necessity as it is an important tool in the administration of justice.

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Retrospective Observational Study on Relevance of Delayed Clinical Examination in Cases of Sexual Assault Survivor

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Abstract

Rape is a heinous crime that can have devastating effects on the survivor, The immediate medical examination and treatment of a rape survivor are crucial for their well-being and to-gather the necessary evidence to strengthen the case. Proper evidence collection is important for a successful legal prosecution. The earlier a survivor arrives for evaluation in the emergency department, the greater the chance of obtaining critical forensic evidence such as DNA samples. When patients delay presentation, or shower and change their clothes, relevant microscopic and macroscopic evidence is often lost. Evidence collection, including injury documentation, becomes less fruitful as time passes and tissue heals. Medical documentation has been shown to be positively associated with filing of charges and conviction. A Retrospective analysis of 67 cases of sexual assault examined at Department of Forensic Medicine at SMS medical college from 1st Jan to 31st Oct, 2020 was done, The clinical findings of the survivors were correlated to the time duration elapsed between incidence and medico-legal examination for all cases. 15 out of 67 cases (22%) were reported within 72 hrs; out of which 9 (60%) cases had corroborative clinical findings, 45 (67%) cases, who had reported later than 7 days only 1 (2%) had corroborative clinical findings. delayed reporting is most common hurdle for corroboration of material evidence and alleged accusation in these cases, The correlation of time of examination and clinical findings, in the present study, questions the relevance of mandatory medical examination in all cases.

Key words: sexual assault, sexual assault survivor clinical findings, delayed clinical examination, reporting/disclosure.

Introduction

Torment over body may heal without scar but not on soul. Rape is a heinous crime that can have devastating effects on the survivor. Sexual assault is a violation of the dignity of a person. Sexual assault is the most common violence against women in India. It is a heinous crime since it not only abuses the body of a female, but also causes permanent injuries to her mental and emotional well-being as well as to her dignity, modesty and reputation. Recent statistics suggest that every 22 minutes a rape case is getting reported in our country.[1,2] As time progress psychological trauma impact start rooting deeper and deeper but physical injuries they are most evident at initial time period from rape incidence and start fainting as time progresses. This crucial time where survivor needs your attention most. Attention

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to provide care, psychological support, medical treatment, medical examination and to preserve the evidences. The immediate medical examination and treatment of a rape survivor are crucial for their well-being and to gather the necessary evidence to strengthen the case. However, sometimes survivors may delay the examination due to various reasons such as fear, shame, guilt, or lack of awareness of the importance of medical examination.

Bodily injuries start fainting soon after trauma but trauma lasts forever in memories and leads to stress, anxiety, grief also leading to post traumatic stress disorders, when trauma of such devilish kind like rape is inflicted upon. medical treatment and examination of the survivor are crucial not only for the immediate relief to the survivor but also provide intrinsic evidence for the cases relating to rape. This means that the evidence collected during the medical examination can be used to strengthen the case against the accused. Therefore, it is highly recommended that a rape survivor seeks medical attention as soon as possible after the assault. Few adolescent and adult women seek out formal support services in the acute period (7 days or less) following a sexual assault. Instead, many women choose to disclose weeks, months, or even years later. This delayed disclosure may be challenging to support workers, including those in health-care settings.[3]

Medico-legal services have increasingly been developed worldwide to improve the collection of medico-legal evidence and provide better care to survivors. These services document and collect available evidence (e.g., injuries and semen) in order to corroborate accounts of sexual assault for courts of law. The settings, staff and protocols of such services operate on different models and are unevenly developed and implemented across and within regions.[4]

Sexual assault includes all these survivor involving unwanted sexual contact occurring between the survivor and assailant. Sexual assault is one of the offenses most under reported to the law enforcement. Sexual assault follows the iceberg phenomena. The amount of it visible to our eyes is much less than the amount beneath the burden of social ethics. Most of the cases of crime related to sex go unannounced due the social stigma related to such events.[5,6] Sexual offenses have social and legal obligations and their investigation is in need of justifiable revisions in alignment to amendments in the law. Proper evidence collection is important for a successful legal prosecution. The earlier a survivor arrives for evaluation in the emergency department, the greater the chance of obtaining critical forensic evidence such as DNA samples. When patients delay presentation, or shower and change their clothes, relevant microscopic and macroscopic evidence is often lost. Evidence collection, including injury documentation, becomes less fruitful as time passes and tissue heals. Medical documentation has been shown to be positively associated with filing of charges and conviction.[7]

There are several reasons why timely medical examination is important for rape survivors. Some of them are:

- To assess and treat physical injuries: Rape is a violent crime that can cause serious physical injuries to the survivor. The medical examination can help identify and treat these injuries, prevent infections, and provide necessary medication to the survivor.
- To collect evidence: Medical examination can help collect physical evidence that can be used in court to prosecute the accused. This includes DNA samples, semen samples, hair samples, and other bodily fluids.
- To assess psychological trauma: Rape can cause severe emotional and psychological trauma to the survivor. A medical examination can help assess the psychological condition of the survivor and provide necessary counseling and support.
- Medical examination should be conducted as soon as possible after the crime. Delaying it can lead to the following problems:
- Degradation of evidence: Physical evidence can degrade over time, making it difficult or impossible to collect DNA or other intrinsic evidence.
- Loss of information: Delaying the medical examination can lead to the loss of crucial information, including the survivor's memory of the perpetrator's appearance, the location of the crime, and the details of the crime itself.

- Hinders the prosecution process: Delaying the medical examination can hinder the prosecution process by making it difficult to prove the crime in court.

Objective

To study the relevance of medico-legal/clinical examination in cases of sexual assault examined at SMS Hospital, Jaipur during Jan to Oct, 2020.

Methodology

After receiving institutional review board approval we conducted a Retrospective analysis of 67 cases of sexual assault examined at Department of Forensic Medicine from 1st Jan to 31st Oct, 2020 was done. Records of sexual assault swill thoroughly and focused on time of sexual assault and survivor presented for medico-legal examination to hospital Alleged History of sexual assault given by survivors and presented injuries at the time of examination were noted, chart was prepared and the clinical findings of the survivors were correlated to the time duration elapsed between incidence and medico-legal examination for all cases. On the basis of data collected analysis done and Cases with and without corroborative clinical findings for various duration were represented as percentages for correlation.

Result

Table 1: Sexual assault survivor reporting time and corroborative clinical findings

Reporting time	Case reported	Corroborative clinical findings	Percentage
0-3 days	15	9	60 %
4-7 days	7	2	28%
>7 days	45	1	2%

1. 15 out of 67 cases (22%) were reported within 72 hrs; out of which 9 (60%) cases had corroborative clinical findings.
2. 7 out of 67 (11%) cases were reported within 4 to 7 days out of which 2 (28%) has corroborative clinical findings.
3. In rest 45 (67%) cases, who had reported later than 7 days only 1 (2%) had corroborative clinical findings; which is quite obvious, but represents the challenge to the legal application of medical examination in such cases.

After went through records of sexual assault survivor reports during period of January to October 2020 at SMS medical college, Jaipur, 67 cases taken up for analysis of this study, its been observed that most of the sexual assault survivor 45 out of 67 reported and medico-legal examination done after 7 days of sexual assault and most of the corroborative clinical finding observed in survivor which reported and medico-legal examination done within 3 days or 72hours from the incidence. 7 out of 67 cases were reported with in 4 to 7 days after incidence. It been observed that frequencies of corroborative clinical findings decreased as time progress, injuries start fainting which makes them less remarkable and notable. cases which reported earlier with in 72 hours had 60 % corroborative clinical findings followed by cases which reported between 4 to 7 days had 28% followed by only 2% corroborative clinical findings in cases which reported after 7 days.

Discussion

Sexual offenses have social and legal obligations. From that survivor point of view social stigma plays one of the important role in these obligations, sure there are multiple more reason for that but psychological trauma due to heinous assault and consequences to it make it more worse. To accept the cruel reality, handle her self, take action and report such crime is time consuming process. our study demonstrate most of the cases reported in delayed fashion. It is clear that sooner the survivor reported, the better the potential evidence and impact of care. This is true with regard to HIV post-exposure prophylaxis, pregnancy prophylaxis, injury documentation, and legal outcomes

The guidelines issued by The Ministry of health and family welfare, Government of India recommends refraining from preservation of swabs for spermatozoa, if a woman reports after 96 hours as chances of to spot spermatozoa or fragments of spermatozoa are very less. Abrasions and bruises are the most commonly encountered injuries in sexual offenses which heal within two weeks. The only way to corroborate application of mouth is the detection of salivary stains in swabs preserved, possibility of which is meager even after a single douche/ urination. As time passes survivor took bath and change cloths

make it more difficult for evidence collections. These data may also have significant utility in legal settings, where delays in presentation and reporting are often characterized as exceptional or unusual, and suggestive of false or exaggerated accusations. Data also suggest that among reported sexual assaults delayed presentation is more common than prompt presentation.it is useful for investigators to know that most survivors present in a delayed fashion and it is therefore not unusual or known to be an indicator of veracity in the reporting of such events.

Conflict of Interest:

Despite the importance of immediate medical examinations, there are several conflicting interests that often lead to delays such as survival well being, legal procedure, medical system.

Survivors may hesitate to seek immediate medical attention due to fear, shame, or lack of awareness about available resources. Additionally, survivors may face conflicting emotions, making it challenging to make decisions promptly. This delay can have long-term physical and psychological consequences for the survivor. The legal system's interests often clash with the urgency of medical examinations. The need for accurate forensic evidence requires survivors to undergo examinations as soon as possible. The survivor's willingness to participate in these procedures may also be influenced by external factors. efforts must be made to minimize delays and ensure survivors receive timely and comprehensive care. Addressing these conflicts and improving coordination among stakeholders can play a crucial role in supporting survivors and facilitating a fair and efficient justice system. Timely medical examinations, coupled with education, awareness, and legal reforms, can help bridge the gap and provide survivors with the necessary support they deserve.

Conclusion

Sexual offenses are a rampant crime in our society with profound legal implications But, their delayed reporting is most common hurdle for corroboration of material evidence and alleged accusation in these cases.it is useful for investigators to know that most survivors present in a delayed fashion and it is therefore not unusual. The correlation of time of examination and clinical findings, in the present study, questions the relevance of mandatory medical examination in all cases, which is only corroborative and at times, may not even play the slightest role in implementation of justice.

Delayed clinical examination in sexual offenses is an asset for the defense. known to be an indicator of veracity in the reporting of such events. Then, why subject the already traumatized survivor to the pain of medical examination in all cases?

Limitation

There are several limitation in our study and most significant is reporting by various individual persons which are not involved in this study and without specific intention. We had to depend on recorded information regarding time of assault, time to presentation. It is not possible to verify each and every information. However, strength database used for recorders.

Ethical Clearence: Taken from institutional ethics committee of SMS medical college, Jaipur.

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Original Research Article

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Electrocution Related Deaths in Catchment Area of East Point Hospital: A 3-Year Retrospective Study

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Abstract

The present retrospective study has been carried out to find the occurrence of deaths due to electrocution in Eastern part of Bengaluru with special emphasis on finding out the conditions along with pattern of injuries sustained by the victims. Medico legal autopsy cases with history of electrocution over period of three years between January 2019 to December 2021 were included in this study. A total of 799 cases were autopsied at our Institute during that period, out of which 51 deaths (6.38%) were deaths due to electrocution, in which male's outnumbered females. The highest number of cases were observed in the age group of 21-30 years (n=18, 35.3%). 27 victims (52.9%) were electrocuted by low tensions domestic supply. Majority of the victims (n=31, 60.8%) died on the spot. Most cases (n=38, 74.5%) were reported during the daytime between 7 am and 7 pm. The incidence of deaths during rainy season were typically higher (n=29, 56.9%). Limbs were the most common body parts affected by electrocution (n=27, 52.9%). 37 (72.5%) victims were electrocuted in dry conditions according to the surrounding places of incidence. As per police documents and history by relatives all cases of the electrocution deaths in the present series were accidental in nature.

The hazard of getting electrocuted in domestic surroundings from the chaotically connected electric wires without correct maintenance is certainly a matter of worry. Implementation of correct insulation safety procedures are important factors required for prevention of fatal electrocution.

Keywords: Electrocution; Domestic supply; Accidental; Safety.

Introduction

Electricity is such an integral part of modern life, that it is hard to imagine life without it. But, with the advantages and convenience of electricity come the hazards as well.[1,2]The use of electricity may result in cases of morbidity or mortality which are usually preventable with simple safety measures.[2] Almost all fatalities by electrocution are accidental, while homicides and suicides from electricity are rare or uncommon.[1,3]

Any deaths occurring due to electrical shock to the body is called electrocution. The invent of

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electricity was taken as a boon to the evolution, but use of electricity in domestic households has continued to show an increase in fatality either due to lack of public awareness or absolute negligence on the part of the general public. In today's human life electric current plays a very vital role in their domestic and occupational places. Electric current can cause damage to the human body and the exact amount of damage is dependent on the type of electric current, the strength of electric current and duration of exposure of the electric current. In developed countries, even with the significant advance in safety of the product and proper execution of the rules and regulations there are substantial mortality and morbidity due to electrical injuries.[4]

Electrocutions may result from contacts with an object as seemingly innocuous as a broken light bulb or as lethal as an overhead power line and might have affected workers, since the first electrical fatality was recorded in France in 1879 when a stage carpenter was killed by an alternating current (AC) of 250 volts.[5] The current drawn by an electric appliance as tiny as a 7.5 W, 120-V lamp, passed from hand to hand or hand to foot across the chest is sufficient to cause death by electrocution.[6] The National Electrical Code describes high voltage as greater than 600 V AC. Most utilization circuits and equipment operate at voltages lower than 600 V, including common household circuits (220/240 V).[7]

Low-voltage currents and high-voltage currents are equally able to cause electrocution-related fatality. However, most fatalities occurring in a common household or a minor industrial setting happen due to contact with low-voltage currents. The type of power system employed in India is an alternate current (AC) 220–240 V, 50 A.[8] Fatal injuries caused by electricity do occur and can present a challenge for the forensic pathologist performing the autopsy. One of the crucial signs on the body of a person who suffered a fatal injury from electric current is an electrical mark, which is often the only evidence of contact with electricity. There is a great diversity in the prevalence and appearance of electrical marks. Due to possible absence of distinctive morphological findings on the body, electrocution as a cause of death is often established by exclusion of other possible causes and supported by circumstantial evidence collected at the scene of the incident.[9]

Materials and Methods

The study was carried out retrospectively collecting the 3-years data of all the medicolegal autopsies of electrocution related deaths brought to the Morgue of East Point College of Medical Sciences and Research Centre, Bengaluru from January 2019 to December 2021. Relevant data on electrocution deaths were collected from the police inquest and the autopsy reports. Finally, the obtained data were tabulated and analyzed.

Results

A total of 799 cases were autopsied at our Institute during the study period, out of which 51 deaths (6.4%) were deaths due to electrocution (Fig. 01).The males (n=41, 80.4 %) outnumbered females (n=10, 19.6 %) (Fig. 02). The highest number of cases were observed in the age group of 21-30 years (n=18,35.3%), followed by 31-40 years (n=10, 19.6 %) and 41-50 years (n=6, 11.8 %) (Table. 01). 27 victims (52.9%) were electrocuted by low tensions domestic supply while using domestic appliances like iron box, switches, water heater, water pumps and other household appliance 7 victims (13.7 %) were electrocuted by overhead electric wires, 9 victims (17.7 %) were electrocuted in industries (work place) and 8 victims (15.7 %) electrocuted by other causes (Table. 02). 2 (3.9 %) victim was admitted in hospital and survived for 5 days, whereas18 (35.3 %) victims survived for period of 2 - 3 hours, while 31(60.8%) victims died on the spot (Fig. 03).

With respect to the presentation of electrocution cases according to the diurnal and seasonal variations, most cases (n=38,74.5%) were reported during the daytime between 7 am and 7 pm and 13 (25.5 %) cases were reported during night hours (Fig. 04).The incidence of deaths during rainy season were typically higher (n=29,56.9%), followed by 15(29.4%) cases in summer (Fig. 05). Limbs were the most common body parts affected by electrocution (n=27, 52.9 %), followed by chest (n=12, 23.5 %) and in 2 case there were no entry or exit wounds (Table. 03).37 (72.5%)victims were electrocuted in dry conditions according to the surrounding places of incidence (Table. 04). As per police documents and history by relatives all cases of the electrocution deaths in the present series were accidental in nature.

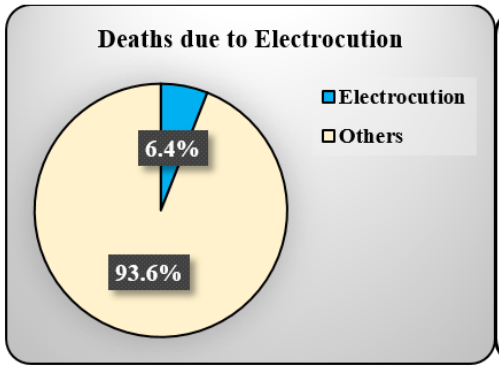

Fig. 1: Deaths due to Electrocution

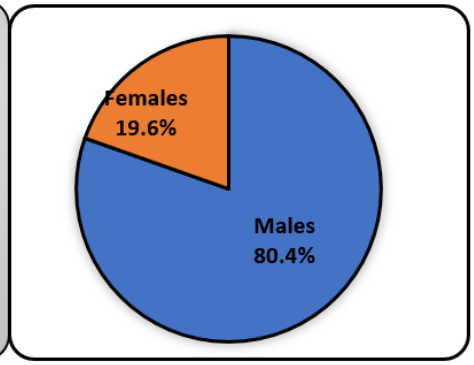

Fig. 2: Sex wise distribution of Cases

Table 1: Distribution of cases according to age

Age in Years	No. Cases	Percentage
0 – 10	3	5.9
11 – 20	5	9.8
21 – 30	18	35.3
31 – 40	10	19.6
41 – 50	6	11.8
51 – 60	5	9.8
61 – 70	4	7.8
Total	51	100

Table. 2: Distribution of cases according Place of Occurrence

Place of Occurrence	No. Cases	Percentage
House	27	52.9
Work Place	9	17.7
Overhead Wires	7	13.7
Others	8	15.7
Total	51	100

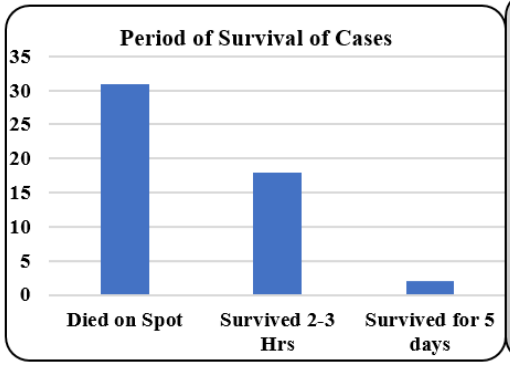

Fig. 3: Period of Survival of Cases

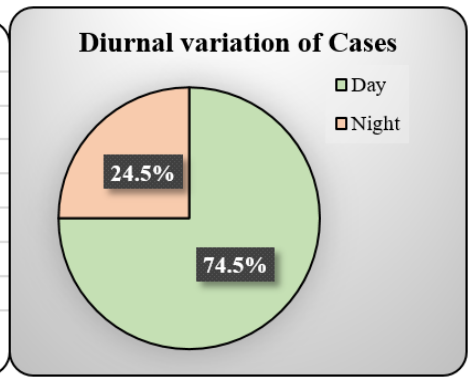

Fig. 4: Diurnal variation of Cases

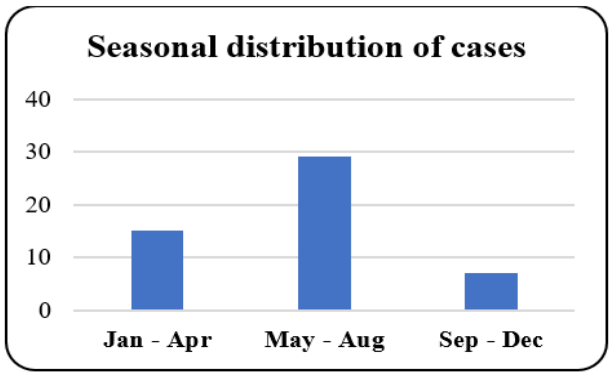

Fig. 5: Seasonal distribution of cases

Table. 3: Distribution of cases according Site of body involved.

Site of Injury	No. Cases	Percentage
Limbs	27	52.9
Chest	12	23.5
Abdomen	6	11.8
Head	4	7.8
No injury	2	3.9
Total	32	100

Table. 4: Distribution of cases according to surrounding of place of incident.

Condition	No. Cases	Percentage
Dry	37	72.5
Wet	14	27.5
Total	51	100

Discussion

In our study, the incidence of fatal electrocution was 6.4%, which was close to Choudhary UK[1] (2.15%) and B. D. Gupta[2] (2.02%), the studies done in India.

In present study males accounted for a major number of fatalities (80.4%), the findings are in consistent with the studies done by Choudhary UK[1], B. D. Gupta[2], Tirasci Y[3], Sachil Kumar[7], Ivana Kuhtic[9], Ardeshir[10], Akhilesh K Pathak[11], Manish Shrigiriwar[12], Biradar Gururaj[13], Rautji R[14], Dokov W[15].

In the present study Most of the cases fell in the age group of 21 – 30 years (35.3%). The finding is in consistent with the work of Akhilesh K Pathak[11], Manish Shrigiriwar[12], Biradar Gururaj[13], Iqbal Banu Hussain[16], Soreingam Raguil[17], Bharath Kumar Guntheti[18], Kusa Kumar Shaha[19], Ananda Reddy[20]. 0-10 years age group was also not spared. In our study there were 5.9% cases in this age group, while similar findings in another studies from India Choudhary UK[1] reported 4.05% cases, Bharat et al[18] reported 4.8% cases, Ananda Reddy et al[20] reported 18 per cent cases.

In our study most of the cases (n=27, 52.9%) suffered electrocution in the surroundings of home, similar to observations of many researchers Choudhary UK[1], B. D. Gupta[2], Ivana Kuhtic[9], Ardeshir Sheikhazadi[10], Akhilesh K Pathak[11], Biradar Gururaj[13], Dokov W[15], Iqbal Banu Hussain[16], Kusa Kumar Shaha[19], Ananda Reddy[20].Other researchers Manish Shrigiriwar[12], Soreingam Raguil[17] observed contrasting results of more electrocution at other locations like workplace.

In the present study 31 (60.8%) victims died on the spot which are similar to the observation of researchers Choudhary UK[1], B. D. Gupta[2], Tirasci Y[3], Ivana Kuhtic[9], Ardeshir Sheikhazadi[10], Akhilesh K Pathak[11], Biradar Gururaj[13], Iqbal Banu Hussain[16], Soreingam Raguil[17], Kusa Kumar Shaha[19].

Regarding the seasonal and diurnal variations, the present study recorded higher incidences in rainy season (n=29, 56.9%) and majority of the incidents (n=38, 74.5%) happened during the daytime, which is consistent with the observations made by B. D. Gupta[2], Biradar Gururaj[13]and Kumar S[21], however Shaha and Joe[22] found higher incidences in summer season.

In the present study we observed that most common part of body involved was limbs (n=27, 52.9%), the findings are consistent with the studies done by Choudhary UK[1], B. D. Gupta[2], Tirasci Y[3], Ivana Kuhtic[9], Ardeshir Sheikhazadi[10], Akhilesh K Pathak[11].

The present study shows dry surroundings of place of incident (n=37, 72.5%) cases. Similar findings were observed by Choudhary UK[1] (79.73%), but B. D. Gupta[2] observed 75% deaths in wet surroundings.

In our study, the manner of death in all reported cases of fatal electrocution was accidental in nature, which is similar to the other studies. However, B. D. Gupta[2] found one case of suicide, and Sheikhazadi[23] reported 10 cases of suicidal electrocution.

Conclusion

Majority of the electrocution deaths were accidental in nature. Males were the predominantly affected. More than 59.37% deaths occurred in domestic surroundings. It signifies that people living at home did not have elementary knowledge of risks of electrocution. Most of the deaths due to electrocution are preventable.

Conflict of Interest: Nil.

Source of Funding: Self.

Ethical Clearance: East Point College of Medical Sciences and Research INstitute, Institutional Ethical Committee dated 26.04.2023. Ref no EPCMSRC/ADM/IEC/2023-24/11

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Original Article

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Comparative Study of Mandibular Canine Index and Maxillary Canine Index in Sex Estimation among North Indian Population

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Abstract

Introduction: Since teeth are easily approachable and each having different morphology, they form an excellent medicolegal and anthropological tool for sex estimation. Sexual dimorphism is difference in size and appearance among male and female teeth that can be applied for determination of sex. The basis of estimation of sex is comparing tooth parameters in male and female individual. Canine teeth shows highest sexual dimorphism among all teeth. Mesiodistal width of maxillary and mandibular canine can be used for sex determination based on sexual dimorphism.

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

Materials and Methods: The sample comprised of dental impression from 120 individuals (60 males and 60 females), all young adults between 20 and 35 years of age. Impressions of the teeth were made using irreversible hydrocolloid (alginate) material and casts poured in dental stone. Mesiodistal dimensions and intercanine distance of mandibular and maxillary canine of both right and left side was measured by caliper. Mandibular and maxillary canine index was calculated by formula given by Nageshwar Rao et al.

Results: Data were summarized as Mean and SD. Groups (in Gender Male vs female) were compared by unpaired or independent Student's t test. When the level of accuracy for sex determination was measured using canine index it was found that 65% males and 65.83% females were predicted correctly. When maxillary canine index was used the sex was correctly predicted in it was found that 40.83% females and 32.50% males were predicted correctly.

Conclusion: Mandibular and maxillary canine index can be used for sex estimation in North Indian population but accuracy of mandibular canine index is better than maxillary canine index.

Keywords: Sex estimation, Sexual dimorphism, Mesiodistal width, Intercanine distance, Mandibular canine index, Maxillary canine index, Accuracy, Predictability.

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Introduction

Being superior and matchless material, teeth are used as investigating material in genetics, odontology, anthropology and in forensic medicine[1]. Teeth are hardest and most stable part of body, decay resistance and are buoyantin case of fire, air disaster, hurricane[2]. Hence teeth may be used for identification of an individual in decomposed bodies especially on skeletal remains[3]. Sex estimation from skeletal remains or mutilated or decompose bodies is an inevitable part of medicolegal examination[4]. Sex determination has various methods like cheiloscopy[5,6,7], odontometry[8], osteometry[9] and DNA analysis[10]. Among these methods only DNA analysis gives absolute proof of sex estimation, but analysis of DNA is extensive, expensive and exhaustive involves difficult DNA extraction technique and requires trained and qualified staff [11,12]. Since teeth are easily approachable and each having different morphology, they form an excellent medicolegal and anthropological tool for sex estimation[3]. Sexual dimorphism is difference in size, stature and appearance among male and female that can be applied for determination of sex[13]. The basis of estimation of sex is comparing tooth parameters in male and female individual. Canine teeth shows highest sexual dimorphism among all teeth[14]. Mesiodistal width of maxillary and mandibular canine can be used for sex determination based on sexual dimorphism[15]. The aim of our study was to evaluate the comparative sex estimation by mandibular canine index and maxillary canine index in north Indian population.

Material and Methods

Material required

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

The alginate dental impression forms an imprint (i.e., a 'negative' mould) of those teeth and gums, which can then be used to make a cast or 'positive' model of the patient's dentition (Figure 1).

Sample size

Sample selection:

sample size was calculated by formula

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

Where Z_{α} is critical value of z-score at αlevel of significance (at α= 5%, Z_{α}=1.96), p is proportion and E is permissible error. 65% of cases were correctly estimated for their sex (overall 57.5% by maxillary canine index and 72.5% by mandibular canine index. So average 65% of sex were correctly predicted using both mandibular and maxillary canine index)[16] So, p=65%, i.e., 0.65, 1-p=0.35, E=8.5% i.e., 0.085. So, n= $(1.96)^2\times0.65\times0.35/ (0.085)^2=119.38 \approx 120$.

The present study is cross sectional study conducted during the period of one year from January 2022 to December 2022. Study was conducted on 120 volunteer subject (60 male and 60 female) of both the sex having age group between 20 to 35 years at Hind Institute of Medical Sciences, Barabanki. Informed consent was taken from all participants.

Inclusion Criteria:

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

Exclusion Criteria:

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

Methodology and tooth measurements

Impressions of the teeth were taken using irreversible hydrocolloid (alginate) material and poured by dental stone (Figure 1).The alginate dental impression forms an imprint (i.e., a 'negative' mould) of those teeth and gums, which can then be used to make a cast or 'positive' model of the patient's dentition. Mesiodistal (MD) dimensions

of mandibular canine and maxillary canine of both right and left side, were measured on the casts using a digital caliper calibrated to 0.01 mm. The MD dimension was defined as the greatest distance between contact points on the approximate surfaces of the tooth crown and was measured with the caliper beaks placed occlusally and aligned with the long axis of the tooth (Figure 2&3). If teeth were rotated or misaligned, measurements were taken between points on the approximate surfaces of the crown where it was considered that contact with adjacent teeth would normally occur. The mandibular intercanine distance is measured by calliper as linear distance between tips of both side mandibular canine (Figure4). The maxillary intercanine distance is measured by calliper as linear distance between tips of both side maxillary canine (Figure 5).Mandibular canine index and maxillary canine index are calculated by following formula[17].

Mandibular Canine index (MnCI) = Mesiodistal crown width of mandibular canine / Mandibular canine arch width

Maxillary Canine index (MxCI) = Mesiodistal crown width of maxillary canine / Maxillary canine arch width

The mean values for both male MnCI & MxCI and female MnCI & MxCI were obtained. After that, the standard MnCI and MxCI value were calculated by using given belowformula[18]: -

Standard mandibular canine index (MnCI)

= (mean male MnCI − standard deviation [SD]) + (mean female MnCI + SD)/2.

Standard maxillary canine index (MxCI)

= (mean male MxCI − standard deviation [SD]) + (mean female MxCI + SD)/2.

In this study gender determination was based on observed canine index and standard canine index. We used standard canine index value as cut off value to differentiate the gender. All observed canine index value above the standard canine index values were consider as male and all observed canine index value below or up to standard canine index value were consider as female. Sexual dimorphism calculated by following formula[19].

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

Figure 1. Dental cast

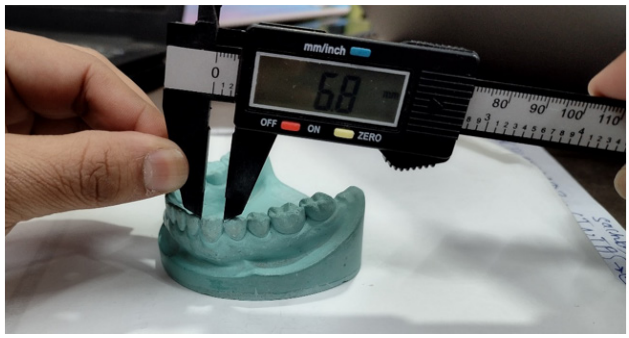

Figure 2: Measuring of mesiodistal dimension of mandibular canine by the digital caliper

Figure 3: Measurement of mandibular intercanine distance by digitalcaliper

Figure 4: Measurement of mesiodistal dimension of maxillary canine by caliper

Figure 5: Measurement of maxillary intercanine distance by digital caliper

Results

Data obtained were quantified and analysed statistically using SPSS (Statistical Package for the Social Sciences). All description shown in table 1 to 8. Data were summarized as Mean and SD. Groups (in Gender Male vs female) were compared by unpaired or independent Student's t test.

The value of right mandibular canine index was higher in male (mean .251308±.024137) than female (mean .232384±.02378) and was statistically significant (p value <.0001). Left mandibular canine index (Table 1) was also higher in male (mean .251376±.025765) than female(.233512±.026935) and was statistically significant (p value <.001) (Table 1). Whereas right and left maxillary canine index was higher in female (Mean value of right MxCI .212502±.021346 and

Table 1. Observed mandibular canine index among male and female

Sex	Right mandibular canine index (MnCI)			Left mandibular canine index (MnCI)		
	Mean	Standard deviation	p Value	Mean	Standard deviation	P Value
Male	.251308	.024137	<0.0001	.251376	.025765	< 0.001
Female	.232384	.02378		.233512	.026935	

Table 2. Observed maxillary canine index among male and female

Sex	Right maxillary canine index (MxCI)			Left maxillary canine index (MxCI)		
	Mean	Standard deviation	p Value	Mean	Standard deviation	P Value
Male	.203411	.017982	.0130	.205253	.018689	0.0177
Female	.212502	.021346		.214612	0.02363	

for left MxCI .214612±.02363) than male (for right MxCI .203411±.017982 for left MxCI .205253±.018689) and were statistically significant (p value <.05 in both right and left MxCI) (Table 2). Using right standard MnCI (Table 3) sex was correctly predicted in 65% male and 65% female while using left standard MnCI the sex was correctly predicted in 65% male and 66.66% in female(Table 5).Similarly using right standard MxCI (Table 4) sex was correctly predicted in

Table 3. Calculation of standard mandibular canine index among male and female

Standard mandibular canine index (MnCI)	
Right	**Left**
.2416475	.243029

Table 4. Calculation of standard maxillary canine index among male and female

Standard maxillary canine index (MxCI)	
Right	**Left**
.2096385	.212403

Table 5. Prediction of sex using Mandibular Canine Index

Sex	Using right MnCI	Using left MnCI
Male	39/60=65%	39/60=65%
Female	39/60=65%	37/60=66.66%

Table 6. Prediction of sex using Maxillary Canine Index

Sex	Using right MxCI	Using left MxCI
Male	21/60=33.33%	19/60=31.66%
Female	24/60=40%	25/60=41.66%

33.33% male and 40% female while using left standard MxCI (Table 4) the sex was correctly predicted in 31.66% male and 41.66% in female (Table 6). The overall sex prediction using mandibular canine index was 65% for male and 65.83% for female (Table 7, Figure6&8) whereas the overall sex prediction using maxillary canine index was 32.50% for male and 40.83% for female (Table 8, figure7&8).

Table 7. Overall accuracy of sex prediction using mandibular canine index

Sex	Mandibular canine index (MnCI)	% Of sex prediction	Overall, correctly predicted sex (%)
Male	Right MnCI	65%	65%
	Left MnCI	65%	
Female	Right MnCI	65%	65.83%
	Left MnCI	66.66%	

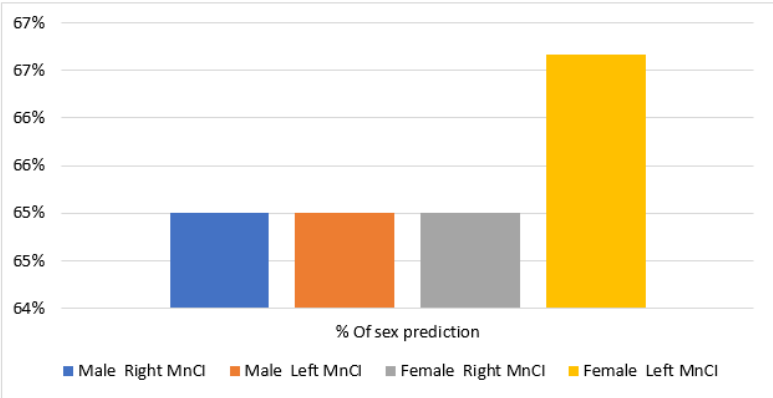

Figure 6. Showing % of sex prediction using right and left mandibular canine index

Table 8. Overall accuracy of sex prediction using maxillary canine index

Sex	Maxillary canine index (MxCI)	% Of sex prediction	Overall, correctly predicted sex (%)
Male	Right MxCI	33.33%	32.50%
	Left MxCI	31.66%	
Female	Right MxCI	40%	40.83%
	Left MxCI	41.66%	

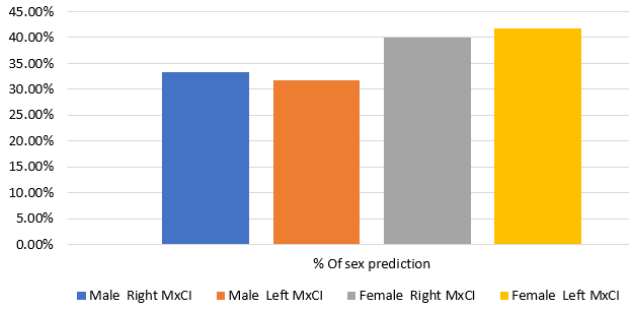

Figure 7. Showing % of sex prediction using right and left maxillary canine index

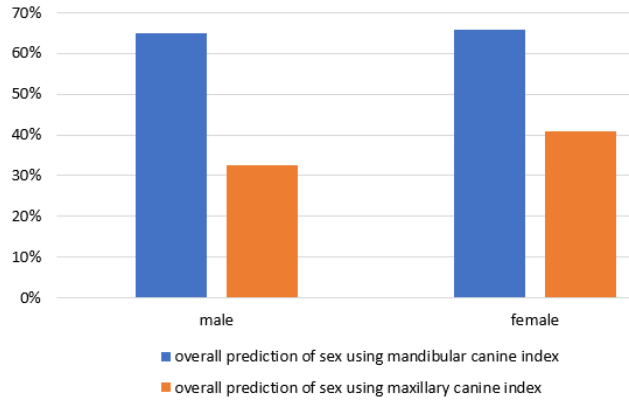

Figure 8. Showing overall sex prediction using mandibular and maxillary canine index

Discussion

Estimation of sex, age and race of an individual even in mutilated or decompose bodies from teet is an importance forensic aspect[20]. Sexual dimorphism is difference in physical appearance among male and female that is applicable in dental sex estimation[13]. Sexual dimorphism not only provide information about individual but also about evolution of population[20].In the present study using right mandibular canine index sex was correctly predicted in 65% male and 65% female with overall accuracy was 65% while using left mandibular canine index the sex was correctly predicted in 65% male and 66.66% in female with overall accuracy was 65.83%. Our study was comparable to the study done by Yuvenya Kaeswaren and Anita Zara Weinheimer in Malaysian population who found correct prediction of sex using right mandibular canine index was 67% in male and 71% in female with overall accuracy was 69% while using left mandibular canine index the sex was correctly predicted in 66% male and 64% in female with overall accuracy was 65%[21]. Higher sex prediction was found by Bakkannavar SM et al[22] who found correct prediction of sex using right mandibular canine index was 73.2% in males and 75.6% in females with overall accuracy of 74.2%whileusing left mandibular canine index the sex was correctly predicted in 73.2% in male and 76.8% in female with overall accuracy was 74.8%and Kaushal et al[3] in North Indian population who found correct prediction of sex using right mandibular canine index was 70% in males and 80% in females with overall accuracy of 75%while using left mandibular canine index the sex was correctly predicted in 66.67% in male and 83.33% in female with overall accuracy was 75%[3]. Lower accuracy of sex prediction was observed by Mohsenpour, K et al who found correct prediction of sex using right mandibular canine index was 44% in males and 62% in females with overall accuracy of 53%while using left mandibular canine index accuracy was 54% for males and 64% for females with overall accuracy of 59%[23].In our study the overall accuracy for prediction of sex using mandibular canine index (average of sex prediction using right and left mandibular canine index) was 65.42% (65% + 65.83%/2=65.42) which is similar with study done by Yuvenya Kaeswaren and Anita Zara We in heimer in Malaysian population with overall accuracy using mandibular canine index was 67%[21.] Higher overall sex prediction using mandibular canine index was observed by Mohsenpour, K et al[23], 75% by Kaushal et al[3]in North Indian populations, 85.9% by Rao NG et al[17]in south Indian population, 82.2% by Yadav et al[24] in central Karnataka. Overall lower sex predictability

than our study using mandibular canine index was observed by Mohsenpour, K et al[23] who found 56% sex predictability and Muller et al who found 59.57% in French population[25].

In the present study using right maxillary canine index sex was correctly predicted in 33.33% male and 40% female (lower in male than female) with overall accuracy was 36.66% while using left maxillary canine index the sex was correctly predicted in 31.66% male and 41.66% (lower in male than female) in female with overall accuracy of prediction of sex using maxillary canine index (average of sex prediction using right and left maxillary canine index) was 36.66% (31.66%+41.66%/2=36.66) whereas, Bakkannavar SM et al observed higher accuracy of sex prediction using right maxillary canine index in male (63%) than female (33.6%) with overall accuracy 48.4%while using left maxillary canine index the sex was correctly predicted in 64% male and 33.6%in female with overall accuracy was 36.66%[22]which is similar with our study in sense of overall accuracy of sex prediction using maxillary canine index, whereas it was observed 58% by Yuvenya Kaeswaren and Anita Zara Weinheimer in Malaysian population[21]. In our study statistically significant sexual dimorphism was observed by maxillary canine index in male and female whereas Bakkannavaret al[22] who observed no statistical significance of sexual dimorphism in Maxillary canine index values between male and female.

Conclusions

Present study reveals that mandibular canine index of both right and left side was higher in male than female and was statistically significant whereas maxillary canine index of both right and left side was lower in male than female. When the level of accuracy for sex determination was measured using canine index it was found that 65% males and 65.83% females were predicted correctly. When maxillary canine index was used the sex was correctly predicted in it was found that 40.83% females and 32.50% males were predicted correctly. So, from present study it can be concluded that mandibular canine index is better than maxillary canine index for correctly predicting the sex.

Conflict of Interest: Nil

Source of Funding: Nil

Ethical Clearence: Has been taken from the institutional ethical committee.

Abbreviations: MD: Mesiodistal dimension, MnCI: Mandibular canine index, MxCI: Maxillary canine index, SD: Standard deviation.

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Original Research

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Awareness, Attitude and Behavior of Dentists Towards Domestic Violence Victim Patients

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Abstract

Background: Domestic violence is referred as shadow pandemic because it is seen globally. Domestic violence abuse is usually considered a problem that requires involvement of police or social services and not a problem that requires dental interference, but it is important to take under consideration that other services may even not be approached by the victim due to various reasons[6]. However, they may approach a dentist for facial trauma. Hence it is important to understand awareness, attitude and behaviour of dentists towards domestic violence victim patients.

Materials and Methods: in this cross-sectional study, a self- administered, structured questionnaire was sent to dentists practicing in central India. Collected data were subjected to statistical analysis using Chi-square test, and $P < 0.05$ was considered statistically significant.

Result: Mostly dentists were aware about and have heard about domestic violence in practice. As many as 37.6% dentist have encountered domestic violence victims in their practice but only 11.7% participants took any measures to record or report or refer DV victims

Conclusion: As dental professionals are usually the first line of contact for patient with head and neck trauma, they would need to undergo special training to identify, support, and treat domestic violence patients.

Key words: shadow pandemic, AVDR, RADAR

Introduction

While the world grapples with the COVID- 19 pandemic situation since 2019, another issue that has emerged as a major cause of concern worldwide was the issue of domestic violence. During the lockdown situation enforced by the COVID-19 pandemic, the age-old issue of domestic violence came into the spotlight. Domestic violence was so concerning that the United Nations has referred to it as the "shadow pandemic."[1]

Globally, even before the COVID-19 pandemic began, 1 in 3 women and 1 in 10 men experienced physical or sexual violence mostly by an intimate partner[2]. But the cases of domestic violence have increased two-fold during pandemic. Domestic violence and abuse are described as a pattern of

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behavior that involves violence or other abuse by one person against another in a marriage, cohabitation or between family members[3]

Domestic abuse is not just physical violence, but also economic, verbal, emotional, sexual abuse and mostly the coercive control and gaslighting by the dominant partner. The alarm is set mostly if the physical violence is of great extend and require medical attention. Dental professionals are well placed to observed and identify cases of domestic violence because in physical assault the face is very commonly affected area. Studies have suggested that about 65% to 95% of assaults involve facial trauma[4,5].

Domestic violence abuse is usually considered a problem that requires involvement of police or social services and not a problem that requires dental interference, but it is important to take under consideration that other services may even not be approached by the victim due to various reasons[6]. However, they may approach a dentist for facial trauma.

Some may even think that this role is more appropriate for the medical practitioner rather than dentist but physicians receive minimal training in oral health and dental injury and may not detect dental aspects of abuse.[7] The role of dental professional in identifying and reporting domestic violence victim is pivot hence many dental schools teach students about domestic and child abuse[8] but it is unknown if this information is ever applied in practice. In previous study it was found that out of total 76% of the participants had head and neck injuries, and although 89% were not asked about their injuries, but 69% wanted to be asked[9]. This indicates the insensitivity from the dentist towards the victims.

Hence in this study we tried to access the awareness and attitude of dentist towards domestic violence victims and their willingness to further training.

Material and Method

Data for this cross-sectional study were collected in March 2021 after obtaining the approval of the research ethics committee. Data were collected using a questionnaire that was preceded by a brief explanation of the study purpose and explained that by responding, the dentist indicated consent to join the study. It took about 5 min to complete and was self-administered. Participants were approached by investigators via personal whatsapp messaging and emails, participants were also requested to forward the questionnaire to their colleagues in their city. Hence snowball sampling method was used for data collection.

The questionnaire was adopted from previous studies and was constructed and sent in English. It was modified to accommodate the objectives of our study.[13,14]

It had 4 main sections, a total of 16 questions. The first section contained the respondents' demographic information (for example, gender, age, years of clinical experience, practice setting, and clinical qualification). Then, there were descriptive questions assessing the dentists' awareness towards domestic violence patients. The next session accessed and attitude, experience towards DV and willingness to further training. The third section contains behavioral questions such as potential barriers to provide help and fear of negative impact. All the questions were closed ended to eliminate the chances of researcher bias.

The Statistical Package for the Social Sciences version 22 was used for data analysis, the chi-square test was used to test the significant difference between categorical variables at $p<0.05$ level of significance.

Results

Table 1: Demographic features of the study population.

Characteristics	**n**	%
Age		
Less than 30	185	34.3
30-50	243	45
Above 50	112	20.7
Gender		
Male	237	43.9
Female	303	56.1
Clinical qualification		
Specialist	168	31.1
General practitioner	372	68.9
Practice setting		
Institutional practice	36	6.7
Private practice	98	18.1
Both	406	75.2
Experience		
Less than 5 years	191	35.4
5 years -15 years	237	43.9
More than 15 years	112	20.7

Table 2: Respondents experience, behavior, and attitude.

Screening respondents experience, behavior, and attitude	YES	NO
Have you heard about domestic victims in practice	67.2%	32.8%
Do you think domestic violence is a health care problem that requires dentist's intervention	61.7%	38.3%
Are you aware most of injuries in DV victims is related to head & neck	86.5%	13.5%
Are you aware how to identify a domestic violence victim (intraoral and extraoral signs)	61.5%	38.5%
Do you usually screen trauma patient for domestic violence.	34.1%	65.9%
Have you come across any victims of domestic violence in your practice	37.6%	62.4%
If yes did you take any measures to record or report or refer DV victims.	11.7%	25.9%
Do you think dentist have a role in bringing down the prevalence of domestic violence	85.9%	14.1%
Would you like to take a course in identifying and reporting domestic violence	81.7%	18.3%

At Table 3: characteristics of respondents and their awareness towards domestic violence

Characteristics	Q1			Q2			Q3			Q4		
	Yes %	No %	p-value	Yes	No	p-value	Yes	No	p-value	Yes	No	p-value
Age												
Less than 30	62.7	37.3	0.001	85.9	14.1	0.001	60.9	39.1	0.655	10.5	89.5	0.001
30- 50	81.3	18.8		93.3	6.7		60.1	39.9		9.1	90.9	
Above 50	50	50		75	25		65.2	34.8		33	67	
Gender												
Female	70.1	29.9	0.01	84.9	15.1	0.067	70.6	29.4	0.001	18.8	81.2	0.001
Male	60.5	39.5		90.1	9.9		40.1	59.9		4.9	95.1	
Clinical qualification												
General practitioner	60.2	39.8	0.001	83.9	16.1	0.005	57.5	42.5	0.003	11.6	88.4	0.002
specialist	82.7	17.3		92.3	7.7		70.2	29.8		21.4	78.6	
Practice setting												
Institutionalpractice	48.1	51.9	0.001	73.4	26.6	0.001	74.7	25.3	0.021	7.6	92.4	0.001
Privatepractice	70.8	29.2		87.2	12.3		57.7	42.3		5.9	94.1	
Both	69.9	30.1		91.7	8.3		62.2	37.8		35.3	64.3	
Years of experience												
Less than 5years	63.5	36.5	0.001	84.3	15.7	0.001	63.5	36.5	0.264	10.4	89.6	0.001
5 years -15 years	81.3	18.7		95.5	4.5		57.1	42.9		9.1	90.9	
More than 15 years	50	50		75	25		65.2	34.8		33	67	

Q1: Have you heard about domestic victims in practice

Q2: Are you aware most of injuries in DV victims are related to head

Q3: Are you aware how to identify a domestic violence victim

Q4: Are you aware of domestic violence helpline number.

Table 4: characteristics of respondents and their attitude towards domestic violence

Characteristics	Q1			Q2			Q3		
	Yes	No	p-value	Yes %	No %	p-value	Yes	No	p-value
Age									
Less than 30	39.1	65.9	0.015	21.4%	78.6%		5.9%	15.5%	
30 -50	34.6	65.4		48.1%	51.9%	0.001	22.6%	25.5%	0.001
Above 50	23.2	76.8		50%	50 %		11.6%	38.4%	
Gender									
Female	40.2	59.8	0.001	43.1%	56.9%	0.001	14.6%	28.6%	0.000
Male	19.8	80.2		24.7%	75.3%		4.9%	19.8%	
Clinical qualification									
General practitioner	23.7	76.3	0.001	26.6%	73.4%	0.001	6.7%	19.9	0.001
Specialist	57.1	42.9		61.9%	38.1%		22.6%	39.3%	
Practice setting									
Institutionalpractice	55.7	44.3	0.001	20.3%	79.7%	0.003	0.00%	20.3%	0.001
Privatepractice	33.4	66.6		41.0%	59.0%		13.4%	27.5%	
Both	24.4	75.6		39.7%	60.3%		14.1%	25.6%	
Years of experience									
Less than 5 years	39.1	60.9	0.014	20.0%	80.0%	0.001	5.2%	14.8%	0.001
5 years -15 years	34.3	65.7		51.0%	49.0%		24.2%	26.7%	
More than 15 years	23.2	76.8		50%	50.0%		11.6%	38.4%	

Q1 Do you usually screen trauma patient for domestic violence

Q2 Have you come across any victims of domestic violence in your practice

Q3 If yes did you take any measures to record, report or refer DV victims

Table 5: The common barriers dentists face when managing domestic violence victims.

Barriers	Percentage
Believe domestic violence is beyond scope of dental practice.	6.9%
Believe patient would not follow up on referral	10.6%
Do not have enough time to raise the issue of domestic violence	3.1%
Embarrassed to bring up issue of domestic violence.	8.9%
It is not compulsory to report the case of domestic violence.	13.7%
Lack of training in identifying domestic violence	24.1%
Patient not willing to talk about it cause accompanied by partner or children	19.6%
Do not have a list or number of referral agencies (social services)	13.1%

A total of 540 responses were recorded. The demographic profile of respondents' is illustrated in table 1. The respondent's experience, behavior, attitude regarding DV and their willingness to further enhance their knowledge about domestic violence are presented in Table 2. Table 3 and table 4 shows the data on awareness and attitude of dentist respectively about domestic violence victim based on demographic characteristic of respondents.

Mostly dentist were aware about and have heard about domestic violence in practice 67.2%(table 2) out of which majority of respondents were female, specialist, between age group 30-50 having private practice and experience of between 5-15 years the result were statistically significant in each group(table 3).

Majority of respondents 86.5% (table 2) were aware that most of injuries in DV victims are related to head and neck region mostly belong to age group 30-50, male, specialist, having institutional as well as private practice and experience of between 5-15 years(table 3).

Majority of dentist 61.5% (table 2) are aware of how to identify domestic violence signs intra oral and extra oral. Awareness was significantly higher in female specialists, however no significant difference is found between age group and years of experience p-value 0.65 and 0.26 respectively (table3).

Despite of awareness only 34.1% dentist usually screen trauma patient for domestic violence (table 2) out of which mostly are female specialist with age less than 30 working in institution and experience less than 5 years (table 4).

Only 12.8% participants (table 2) are aware of domestic violence helpline number or any social service agencies dealing with domestic violence. Majority of which are female specialist above age of 50 years having private practice and experience above 15 years.

As many as 37.6% dentist have encountered domestic violence victims in their practice but only 11.7% participants took any measures to record or report or refer DV victims (table 2). Female specialists working in private setting have significantly encountered more victims.

Discussion

On an average a woman is assaulted by her partner or ex-partner 35 times before reporting it to the police[10]. Dentists are at unique position in identifying the victims of domestic violence much before because when DVA involves physical assault, the face is a very common target, with studies suggesting that between 65% and 95% of assaults involve trauma to the face[11].

However, it has been reported that health care professionals may miss opportunities to support women, especially where there was a lack of sensitivity towards the issue[12].

In previously conducted study on the expectations of domestic violence victims from dentist it was found that out of total 76% of the participants had head and neck injuries, and although 89% were not asked about their injuries, but 69% wanted to be asked[8]. This indicates the insensitivity from the dentist towards the victims. Hence it becomes necessity

Similarly, even in this study 67.2% dentist are aware they may encounter a domestic violence victim in their practice, and 61.5% are aware how to identify a domestic violence victim but only 34.1% usually screen patient for domestic violence. And only 11.7% dentist have reported or referred domestic violence to patient to authorities. the finding is our study. The findings were in contract and better to finding by Mythri et al where no dentist took any measures to record or report the victim[12]. This attitude of dentist could be because 38.9% of dentist feels that domestic violence is not a healthcare problem that requires dentist intervention. However, after completing the questionnaire only some respondents realized dentist can play a role in helping domestic violence victims, still 14.1% dentist denied the role of dentist in bringing down prevalence of domestic violence these findings are similar to previous study where 83% believed that dentist have role in decreasing domestic violence prevalence. 81.7% would like to be trained in identifying and reporting. The result is similar to previous study where majority of dental practitioner (76.4%) stated that they would like further training or education on domestic violence[13].

Lack of training is identified as a major barrier in helping and identifying domestic violence victim followed by patient was not willing to talk. The barriers to not to ask the reason were similar to finding of the study conducted by Mythri et al[12]. Previous studies discovered that those who had acquired any training about domestic violence were more likely to screen for domestic violence and to intervene than those who had obtained none[14]. Identifying violence is the first step in its prevention; therefore, oral health care providers could play a critical role in preventing violence and supporting victims[15].

Even if the dentist is willing to screening the patient for domestic violence, proper training is required. Improper Questioning by untrained staff, can be damaging and leave a woman vulnerable to further violence[16,17]. Hence proper training of dentist and dental staff is required to handle the issue sensitively.

Few articles have mentioned an efficient a tool for training of dentist called "AVDR," an acronym for "asking, validating, documenting, and referring"[12,18,19]. AVDR means: 1) asking the patient about the injury; 2) providing validating messages that battering is wrong and it is not the victim's fault in any circumstance; 3) documenting signs, symptoms, or any verbal disclosures that the patient has shown or given in the patient's records in writing and with any pictures; and 4) referring victims to a DV specialist, which may include counselors, authorities, or shelters[8,10].

This was developed to explain and simplify the dentist's role in addressing DV. This intervention can be used when abuse is suspected but not disclosed, and it allows dentists to help their patients.

Hence, AVDR tutorial is a quick & simple way to educate oral health professionals about the importance of recognizing DV among their patients and learning how to help them by providing strategies for assessment and intervention. program is based on the RADAR model developed by the Massachusetts Medical Society. RADAR stands for Routinely screen, Ask direct questions, Document findings, Assess patient safety, and Review options and refer as indicated[20].

According to a systematic review and meta-analysis it was found that in the studies, were dentist were digitally educated, all had improved knowledge, skills, attitudes, and self-efficacy, even though the studies employed different methodologies, sample sizes, sampling periods, settings, and types of domestic violence education[20]. Hence Domestic violence education in undergraduate dental school increased dentists' awareness of DV by 3.2 times. By the same token, dentists who had DV education in their continuing educational course increased the DV awareness by 6.3 times. Teaching dental students, the key concepts of DV will empower them to provide appropriate services and referrals[21].

Conclusion

By facilitating early detection and treatment through a well-structured system of education and support, dental health professionals could play an important role in promoting greater awareness on domestic violence, identifying survivors of violence, and enabling survivor protection. As dental professionals are usually the first line of contact for survivors, they would need to undergo special training to identify, support, and treat domestic violence patients. This would be of particular importance to conservative societies like ours where domestic violence is known to be severely underreported.

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Sensitivity of Preliminary Blood Test on Various Floor Surfaces After Washing with Different Cleansing Products. : Original Work

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Abstract

Blood is important evidence that can assist an investigator in solving a crime. It connects the suspect to a crime and aid in the reconstruction of the crime scene. Criminals frequently attempt to wipe away blood stained evidence at a crime scene. These efforts may result in the modification or partial or total elimination of blood on the stained parts. Numerous presumptive tests are employed to identify bloodstains on floor surfaces since they are frequently cleansed after a crime using various surfactants. However, the traces of stains remain there and if analysed with appropriate reagents will give conclusive results. In This study Blood-stained floor surfaces were cleaned using a commercially available and widely used floor cleaners and After repeated washings, the Kastle-Meyer (KM), Leucomalachite green (LMG), and Tetra methylbenzidine (TMB) tests were employed to determine the presence of blood on these surfaces, and their sensitivity were assessed, this study will help the forensic investigator to select the appropriate reagents for detection of blood stains on the various washed floor surfaces and effectiveness of reagents for detection of blood stains washed with various floor cleaners.

Keywords: Blood-Stained floor, Floor Cleaners, presumptive tests, TMB, KM, LMG

Introduction

The crime rate in India and the rest of the globe is skyrocketing, and there is an urgent need for characterisation and individualization of evidence gathered at crime scenes.

Among the investigations which fall under the purview of forensic science, the recognition of blood stain forms one of the most important problems which needs utmost attention and solution. Blood stains are significant evidence used in many forensic investigations.[1]

Blood is one of the most crucial biological evidence found at the crime scene in almost all assault cases [2] and it needs immediate characterization as it can help reconstruct the crime scene.

Perpetrators of a crime sometimes attempt to remove or destroy evidence that may link them to their crime. It is therefore important for crime scene investigators (CSIs) to understand the effects of certain scene-altering activities on the evidence they are attempting to locate [3] .In few cases where blood is washed off from the crime scene/surface, it

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becomes one of the most crucial problems faced in forensic examination of the criminal cases to detect the blood spots. [4]

Locating, investigation and interpreting such blood stains with unaided eyes then becomes a challenging task [4] .The identification of the alleged blood is thus required as the first step. There are a number of preliminary test employed for this purpose such as Tetra methyl benzidine test, Kastle Meyer test, Leucomalachite green test etc.

The present study has been taken up for the selection of the most efficient test for various flooring surfaces that have been washed with suitable floor cleaners.

Methodology

This study was carried out in the Department of Forensic Science of Sam Higginbottom University of Agriculture, Technology and Sciences.

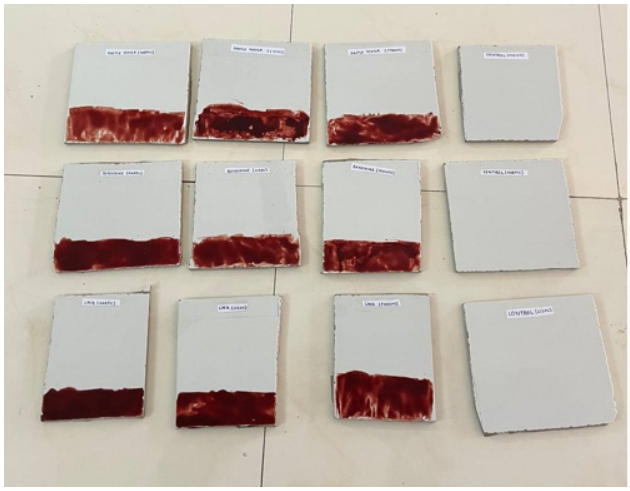
Sample Collection

Blood samples (discarded) were collected from Central pathology of Swaroop Rani Nehru Hospital Prayagraj and stored in anti-coagulant EDTA vials.

Surface preparation

All the three flooring surfaces viz. Marbles, Tiles and Concrete were cut in specific dimensions, labelled with all necessary details and stained with blood and left to dry for 24 hours.

The surfaces were washed with Harpic, Lizol and Phenyl until all the blood was completely washed off.



Figs. 1 Tiles surfaces stained with blood along with control tile samples.

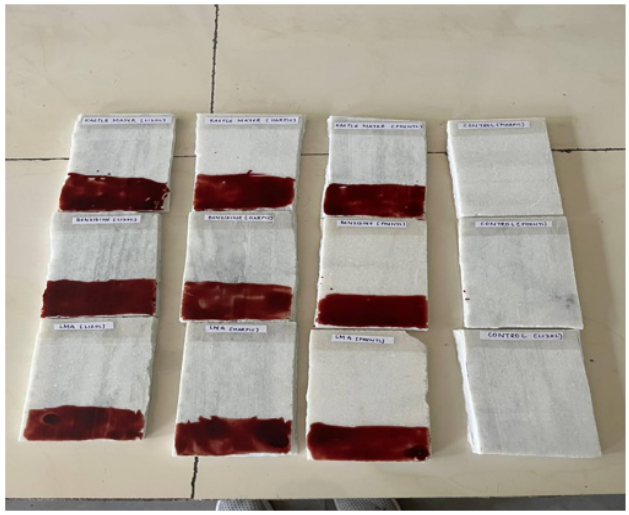


Fig. 2 Marble surfaces labelled and stained with blood along with the control samples.

Fig. 3 Concrete surfaces labelled and stained with blood along with control samples.

Examination

A cotton swab dipped in normal saline was swabbed over the surfaces and subjected to preliminary tests for detection of blood.

Similarly surfaces were washed for 5 subsequent washes and swabbed and then tested for preliminary tests.

Results and Discussion

All the flooring surfaces were washed for subsequent 5 washes and swabbed with normal saline for detection of blood.

Following observations were drawn:

Table 1: Detection of blood on tiles using tetra methyl benzidine test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	+	INC	--	--
Harpic	++	+	INC	--	--
Lizol	++	+	INC	--	--

Table 2: Detection of blood on tiles using Kastle Mayer test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	+	--	--	--
Harpic	++	+	--	--	--
Lizol	++	+	--	--	--

Table 3: Detection of blood on tiles using Leuco Malachite Green test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	+	--	--	--
Harpic	++	+	--	--	--
Lizol	++	++	--	--	--

Table 4: Detection of blood on marble using tetra methyl benzidine test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	+	INC	--	--
Harpic	++	+	INC	--	--
Lizol	++	+	INC	--	--

Table 5: Detection of blood on marbles using Kastle Mayer test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	++	+	--	--
Harpic	++	++	--	--	--
Lizol	++	++	+	--	--

Table 6: Detection of blood on marbles using Leuco Malachite green test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	+	--	--	--
Harpic	++	+	--	--	--
Lizol	++	++	--	--	--

Table 7: Detection of blood on concrete using tetra methyl benzidine test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	++	+	+	INC
Harpic	++	++	++	++	++
Lizol	++	++	+	+	INC

Table 8: Detection of blood on concrete using Kastle Mayer test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	++	+	+	+
Harpic	++	++	++	++	++
Lizol	++	++	+	+	+

Table 9: Detection of blood on concrete using Leuco malachite green test after washing them with different surfactants.

	Wash 1	Wash 2	Wash 3	Wash 4	Wash 5
Phenyl	++	++	++	++	++
Harpic	++	++	++	++	++
Lizol	++	++	++	++	++

++ Good
+ Fair
– Negative
INC Inconclusive

Discussion

The most common biological evidence at the crime scene is bloodstains. For this reason, bloodstain is one of the most important types of evidence in forensic science that can help investigators to solve a crime. It can link a suspect to a crime and also help reconstruct the crime scene. Criminals often tend to clear up and eliminate evidence from the scene[5]. After a criminal act, a perpetrator would try washing bloodstains either by washing in cold water or using a regular washing process. These attempts may cause the bloodstains to change and eventually to be partially or completely removed. In addition, bloodstains can be found on various surfaces at the scene. Due to this reason, floor such as Marble, tiles and concrete, which are mostly encountered at the scene, were chosen in this study.

The author concludes that the forensic serologist should consider the factors that are investigated in this study before rendering an opinion on the bloodstains which are retained on washed floor. In this study, bloodstained floor was washed with commercially available and frequently used Phenyl, harpic and lizol. Kastle-Meyer (KM), Leucomalachite green (LMG) and Tetramethylbenzidine (TMB) tests were used to detect the blood on these washed floors. The most sensitive test, which was found to be to detecting the washed stains on all floor, was Tetramethylbenzidine test. The Kastle Mayer test was found to be the least sensitive. The capacity of a floor to retain the amount of blood after washing depends not only upon the chemistry and upon manufacturing of the floor but also on the type of phenyl, harpic and lizol. The time of immersion of the floor with washing material also affects the removal of stains from[6]. However, (**Cox (1990)**[8] and (**Mushtaq S. *et al.*,**) [7] both stated only about the presumptive test of blood stains after washing. They could not explain the individualization method of washed blood stains and the sensitivity of blood stains after number of washings, which has been explained in this work.

Conclusion

During the course of this study it was concluded that concrete surfaces retain more blood on its surface than marbles which in turn retained more than tiles.

In this study it was concluded that for the detection of blood on flooring surfaces kastle mayer and leuco malachite green were found to be more sensitive.

According to the conditions of the present study, sensitivity of the preliminary blood tests was concluded as:

Kastle Meyer >Leuco Malachite Green > Tetra Methyl Benzidine

Ethical Clearance: Not required

Source of Funding: Department of Forensic Science

Conflict of interest: Nil

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Systemic Review

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Integrating Temperature Data with Other Forensic Methods for Time Since Death Estimation

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Abstract

To reliably calculate the time since death is most important for investigating officers in all unnatural death cases. Reliability of the study can be obtained only when potential influencing factors are considered during the calculation of time since death. One of the methods used for calculating the time since death is based on the cooling of the body. Cooling of the body is influenced by various internal as well as external factors. There are various body temperature-based methods in practice (Henssge's rectal nomogram, Henssge's brain nomogram, and Baccino's both interval and global formulae based on ear temperature) to estimate the post-mortem interval (PMI). The rectum has been traditionally used to determine the central core temperature after death, though the external auditory canal has been proposed as an alternative site. According to published research, techniques based on ear temperature are just as trustworthy as those based on rectal temperature for determining the early PMI and may be employed as rapid, easy, and non-invasive procedures on the scene. It is vital to keep in mind that other aspects such as rigor mortis, lividity, and decomposition must also be taken into account to achieve a more accurate estimate, even if calculating the time since death based on the cooling of the corpse might be informative.

Aim: The goal of this study is to thoroughly examine some of the available approaches, compare the accuracy of the results, and determine which method is more accurate (reliable) at estimating the time of death.

Methods: It was decided to evaluate some of the earlier research' published works from different publications and databases. A digital database was searched. Picks were made at random from the studies that were thought to be pertinent to the present goal.

Result: Therefore, in addition to the body's cooling rate, other factors like post-mortem lividity, rigor mortis, chemical changes in the body, and mechanical and electrical excitability of the skeletal muscles, are crucial for a more accurate prediction of the time of death**.**

Conclusion: It is usually advisable to take into account additional factors in addition to the algor mortis-based one when determining the time since death so that a more exact and trustworthy time of death can assist the investigating officer in more precisely resolving medico-legal matters.

Keywords: Algor mortis, Cooling rate, Body mass, Humidity, Rigor mortis, Time since death, etc.

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Introduction

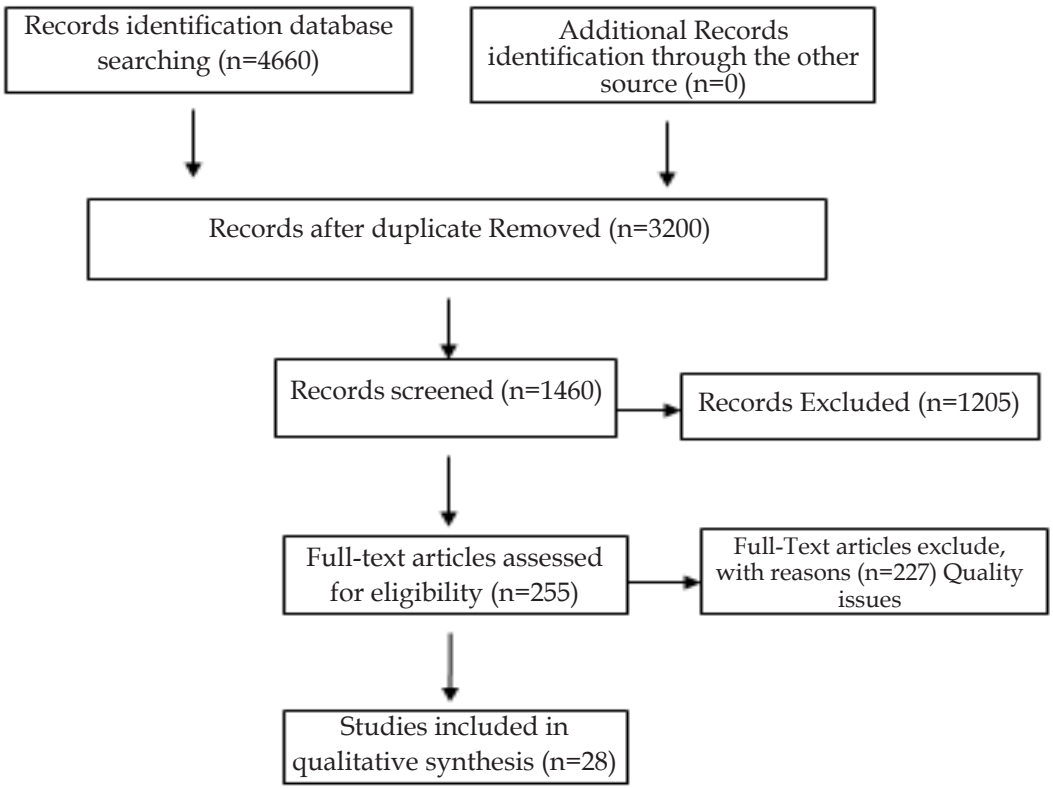
Based on the body's rate of cooling, or "cooling rate," also known as algor mortis or post-mortem cooling, one may calculate the time since death. [1] environmental temperature, humidity, clothing, and body size, all have an impact on how quickly a person, cools after passing away.[2] The environment in which the body is located may have an impact on the cooling rate. For instance, if the corpse is discovered in a cold environment, it will cool more quickly than if it is discovered in a warm one.[3] Similarly, to this, if the body is covered in clothing, the clothing may act as insulation and reduce the pace of cooling.[4] Based on the cooling rate, forensic investigators can determine the time of death using a variety of techniques. [5] The body's temperature can be measured and compared to the surrounding air temperature as one frequent technique.[6] Investigators can calculate the temperature differential and determine the period since death by accounting for the known rate of cooling.[7] Other elements, such as rigor mortis (the stiffening of the muscles), lividity (the settling of blood in the body), and decomposition, can also offer crucial hints regarding the time of death.[8] In forensic medicine, estimating the time since death involves two specialties: one looks at the early postmortem period, and the other at the late postmortem period, when the body has already begun to decompose. As the period after death grows, the estimation accuracy of the passing of time declines.[9]

Cooling Methods:

Based on how quickly the corpse is cooling, there are numerous techniques for estimating the time of death.[10] The Henssge approach is based on the idea that the temperature difference between the body and the environment affects how quickly the body cools after death. The following is Henssge's formula for calculating the time of death: TOD = T_0 + (T_{AMB} - T_0) / (1.5 x loge(T_0 - T_{MEAN})) where TOD is the time of death in hours, T_0 is the body's beginning temperature in degrees Celsius, T_{AMB} is the ambient temperature in degrees Celsius, and T_{MEAN} is the average body temperature during the cooling period in degrees Celsius.[11][12] The number of accumulated degree hours (ADH) is determined using the difference between the body temperature and the ambient temperature, which is determined by taking periodic measurements of body temperature.[13][14] Using the following formula, the ADH may then be used to determine the time of death: TOD = ADH / k where ADH is the accumulated degree hours, and k is the cooling constant. Another method of estimating time since death is the Modified Equation method. [15] This approach uses measurements of the body temperature, the surrounding air temperature, and the cooling medium (if present) to determine when a person passed away. [16]The following formula forms the foundation of the Modified Equation method: TOD = Ta + Tb + Tc + Td. [16] where Ta represents the period it takes for the body to cool from its initial temperature to the ambient air, Tb represents the period it takes for the body to cool from the air's temperature to that of the cooling medium, Tc represents the period it takes for the body to cool inside the cooling medium, and Td represents the period it takes for the body to cool from the cooling medium's temperature to the final temperature. The Hardy approach includes taking the body's temperature at two distinct times and extrapolating the results to determine when a person passed away. [17] Using Hardy's formula, the time of death may be calculated as follows: TOD = (T1 - T2) / (K x loge (T1 - T_{AMB}) - K x loge (T2 - T_{AMB})) where T_{AMB} is the outside temperature, K is the cooling constant, T1 is the body temperature at the moment of death, T2 is the body temperature at a later period.In another method known as the Thermistor probe technique, a temperature probe is inserted into the liver or brain of the organism, and the temperature is tracked over time.[18][19]The thermistor probe method's formula for calculating the time of death is as follows: TOD = Ta + (T_{AMB} - Tl) / (1.5 x loge (Ta - T_{MEAN})), Ta is the cooling period's mean body temperature, Tl is the liver temperature.[20] It's crucially important to remember to keep in mind that each of these approaches methods has its limits and limitations and that the rated pace of cooling alone cannot provide a precise itself and is unable to give an exact estimate of the time of death.[21]When determining the time of death, other characteristics other factors including rigor mortis, lividity, and decomposition must be taken into account considered when estimating the time of death.[22]

Methodology

The methodology of this study involved a literature review of previous research conducted on the topic. Various publications and databases were searched using a digital database. Bullion Words was searched for studies related to the current study's goal, and 47366 results were discovered. Only 42030 papers were chosen, and care was taken to ensure that they were a representative sample of the literature on the subject. papers were chosen for inclusion based on their quality and relevance. When we inspected the record in depth, we only identified 490 samples; at this point, we remove the 255 research samples since they were not downloaded correctly. After excluding the full-text article owing to quality difficulties, the full-text article was now examined for eligibility (n=227), and the final result was (n=28).



Prisma Flow chart:

Result

In comparison to a lower starting body temperature, a greater initial body temperature causes the body to cool rather quickly after death. In colder conditions, the body will cool more quickly, and in hotter ones, more slowly. Larger bodies, clothing, and other insulation will require more time to cool down. When compared to the following 24 hours, the rate of cooling is faster in the first 12 hours.

Discussion

In addition to additional criteria like rigor mortis, lividity, mechanical and electrical excitability of the skeletal muscles, and pharmacological excitability of the iris, Henßge et al. created a complicated technique based on the nomogram method.Compared to using just one approach, it provided more consistent and accurate constraints of the time of death.[23]Nokes LD et all in a study found that rectal temperature only needs to be measured once, and that seems feasible.They found another benefit of the nomogram method is the ability to account for individual circumstances quantitatively or empirically (e.g., body weight, ambient temperature, correction factors), as well as the ability to account for changes in cooling conditions between the time of death and the time of examination.[24]In one study conducted by Helmuth BS, it was found that one of the key elements affecting the rate of cooling was the initial

body temperature. The faster the process of cooling, the higher the body temperature was when the person passed away. However, a lower initial body temperature will result in a slower rate of cooling. [25]Another important element that might impact the rate at which the body cools is the temperature of the surroundings around it according to the research conducted by Raschke K. The body will cool more quickly in colder environments and more slowly in hot ones. The temperature differential between the body and the environment will determine how quickly heat is transferred between them.[26]The pace of cooling can also be influenced by the body's bulk and insulating qualities. In general, a bigger body will take longer to cool down, however, the cooling process can be slowed down by clothes or other insulations according to the research conducted by Stegmann Jr AT.[27]An estimated cooling rate may be computed using these variables. In the first 12 hours following death, it's typical for the body temperature to drop by 1.5 to 2°C every hour. Nevertheless, after the first 12 hours, this pace may decrease to about 1°C each hour.[28]

Conclusion

Based on several additional factors, such as humidity, wind speed, and sun exposure, the time since death calculations are susceptible to alter. As a result, it's crucial to include additional methods and factors in addition to the body's cooling rate for a more precise death time prediction.

Conflict of Interest: There is no conflict of interest

Source of funding: None

Ethical Clearance: Not Applicable

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Original Research

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Correlation of Canine Height to Overall Facial Height: An Observational Study

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Abstract

Background: Identifying individuals by determining their body parameters plays a major role in criminal investigation. These parameters play an integral role in the identification of a person. Teeth, particularly canines, can help in identification, as they are the most stable teeth in the oral cavity because of the labiolingual thickness of the crown and root anchorage in the alveolar process.

Aim: To establish a relationship, if any between the crown length of the maxillary canine tooth and the facial height of an adult individual and intersex differences.

Materials and methods: This study was conducted at a dental college where patients reported for treatment. The study group comprised 100 participants (50 men and 50 women, aged 18-23 years. To measure the facial height, photographs were taken and analyzed using Adobe Photoshop software. The face was divided into the upper, middle and lower thirds considering the hairlines, glabella, subnasalis, and menton as reference points. The length between the hairline and glabella is the upper facial height (UFH), that between the glabella and subnasalis is the middle facial height (MFH), and that between the subnasalis and menton is the lower facial height (LFH). For tooth measurements, impressions of the upper arches were made using alginate and dental stone casts were obtained. The length between the cervical line and cusp tip is the canine height(CH) and the mesiodistal length is the canine width(CW). Measurements of teeth were recorded using digital verniercalliper. Statistical analysis was performed using Statistical Package for the Social Sciences software (SSPS) version 16. The Mann-Whitney U test was used to determine the correlation between facial height and canine height.

Results: Total Facial Height (TFH), Canine Height (CH), Canine Width (CW) in males and females was done using descriptive statistics. This study demonstrated a correlation between TFH and CH in both men and women. This study showed that, as TFH increased, CH also increased. Therefore, TFH and CH were directly proportional, and hence there was a correlation between TFH and CH.

Conclusion: The total facial and canine heights are directly proportional to each other. There is a correlation between the facial height and canine height.

Key words: Face, Facial Height, Canine teeth, Canine Width

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Introduction

Forensic examination carries medicolegal importance and assist in individual identification. The identification of an individual is mainly done by determining body parameters, especially in the investigation of various crime scenes [1].These parameters play an integral role in identifying individuals. It is known fact that the individual identity depends on the facial features and also the facial measurements. Hence, facial measurements play a pivotal role in both ante- mortem and post-mortem cases, also in different facial reconstruction techniques. In this regard, odontometric analysis is invaluable, because these structures are highly resistant and indestructible, as they combat bacterial mortification[2]. Moreover there are various researches conducted in correlating the facial morphometrics with that of the odontometric morphometrics. In these studies the tooth length, clinical crown length, mesiodistal width of the crown, and labiolingual width of the anterior teeth were considered.

Among the anterior teeth, the use of canines can help in person identification,as these teeth are the most stable in the oral cavity owing to the labiolingual thickness of the crown and root anchorage in the alveolar process of the jaws. In addition, the crown portion of the canine is shaped in such a way that it promotes cleanliness, exposure to less plaque, calculus, abrasion from brushing, or heavy occlusal loading compared to other teeth, they are also less severely affected by periodontal disease and are usually the last teeth to be extracted with respect to age. This self-cleansing quality and efficient anchorage in the jaws tends to preserve these teeth throughout life. Therefore, they have been used for personal identification[3,4]. It is also reported that a study on permanent canine teeth offers several advantages and these teeth have can survive air and hurricane disasters [5].

This study was aimed to establish a relationship between the crown length of the maxillary canine tooth, facial height of adults, and intersex differences.

Materials and Methods

This study was conducted at a dental college where patients reported for treatment. The study group comprised 100 subjects (50 men and 50 women aged–18-23 years, Figure 1 and 2). Patients with a full set of dentitions in the maxillary and mandibular arches, no interdental spacing or crowding, no restoration of the permanent maxillary canine tooth, and no history of orthodontic treatment were included in the study. Patients with dental irregularities, apparent loss of tooth structure due to attrition, fracture, caries, or restorations were excluded from the study.

After informed consent was obtained, facial measurements were obtained from each subject using photographs. To measure the facial height, Adobe Photoshop software was used to assess the facial height in the photographs (Figure 3). The proposed landmarks were established on the face and were measured using the same software. The face was divided into the upper middle and lower thirds using the hairline, glabella, subnasalis, and menton as the reference points. The length between the hairline and glabella is the upper facial height (UFH), that between the glabella and subnasalis is the middle facial height (MFH), and that between the subnasalis and menton is the lower facial height (LFH).

For tooth measurements, impressions of the upper arches were made using alginate material and dental stone casts were obtained (Figure 4). The length between the cervical line and cusp tip is the canine height (CH) and the mesiodistal length is the canine width (CW). Measurements of the teeth were recorded using digital vernier-calliper (Figure 5).

Statistical analysis was performed using Statistical Package for Social Sciences software (SSPS) version 16. The data were subjected to descriptive analyses of the means and standard deviations. The Mann-Whitney U test was used to determine the correlation between facial height and canine height.

Figure 1: Female patient

Figure 2: Male patient

Figure 3: Adobe Photoshop for facial measurements

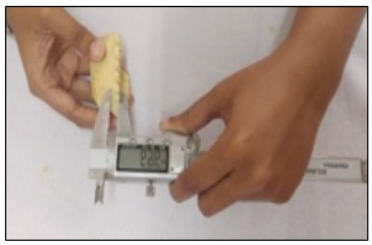

Figure 4: Dental cast **Figure 5:** Digital vernier callipers

Table 1: Descriptive Statistics

Gender		Minimum	Maximum	Mean	Std. Deviation
50Females	Upper Facial Height (UFH)	35.74	63.27	50.90	7.94553
	Middle Facial Height (MFH)	45.51	65.47	54.71	4.73174
	Lower Facial Height (LFH)	41.91	63.37	54.26	6.07886
	Total Facial Height (TFH)	131.08	181.28	159.89	14.25915
	Canine Height (CH)	5.22	11.35	8.73	1.17262
	Canine Width (CW)	7.00	9.29	7.88	.60039
50Males	Upper Facial Height (UFH)	45.33	62.06	53.58	5.14978
	Middle Facial Height (MFH)	41.52	68.82	55.26	6.38332
	Lower Facial Height (LFH)	45.93	71.63	56.03	6.36429
	Total Facial Height (TFH)	137.04	202.51	164.88	14.72946
	Canine Height (CH)	6.60	10.63	8.35	.98529
	Canine Width (CW)	6.1850	8.25	7.48	.45897

*All the values are expressed in millimeters (mm)

Table 2: Mann-Whitney U Test

	Gender	Mean Rank	Sum Of Ranks	Z	P Value
Upper Facial Height (UFH)	Female	23.72	593.00	-.863	.388
	Male	27.28	682.00		
Middle Facial Height (MFH)	Female	24.18	604.50	-.640	.522
	Male	26.82	670.50		
Lower Facial Height (LFH)	Female	24.12	603.00	-.669	.503
	Male	26.88	672.00		
Total Facial Height (TFH)	Female	23.64	591.00	-.902	.367
	Male	27.36	684.00		
Canine Height (CH)	Female	21.94	548.50	-1.727	.084
	Male	29.06	726.50		
Canine Width (CW)	Female	20.92	523.00	-2.222	.026**
	Male	30.08	752.00		

***P<0.05 Statistically Significant

Table 3: Correlation Coefficient(R) for Canine Height

Canine Height In Mm	Upper Facial Height In Mm	Middle Facial Height In Mm	Lower Facial Height In Mm	Total Facial Height In Mm	Canine Width In Mm
	.259	.289*	.526**	.475**	.401**
P Value	.069	.042***	.000***	.000***	.004***

***p<0.05 statistically significant

Table 4: Correlation Coefficient(R) for Canine width

Canine Width In Mm	Upper Facial Height In Mm	Middle Facial Height In Mm	Lower Facial Height In Mm	Total Facial Height In Mm	Canine Width In Mm
	-.003	-.050	.256	.052	.401**
P Value	.985	.731	.073	.722	.004***

***p<0.05 statistically significant

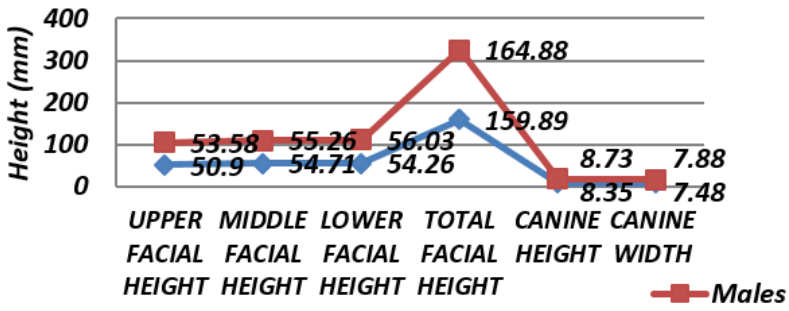

Figure 6: Comparison of different facial and dental measurements between males and females

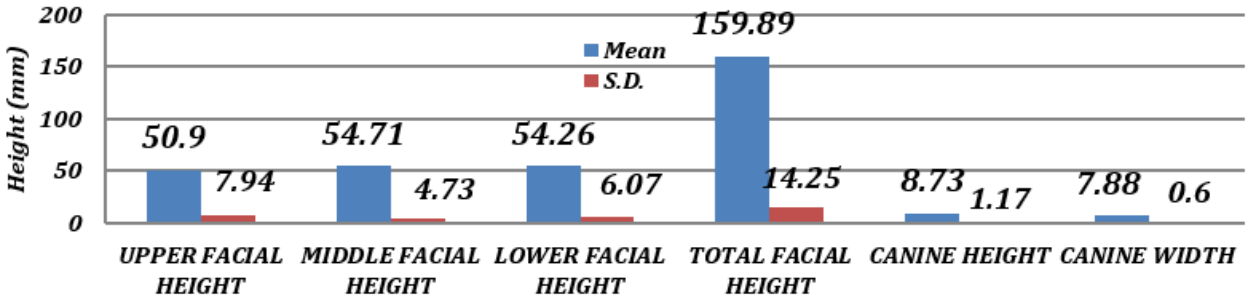

Figure 7: Comparison of different facial measurements in females

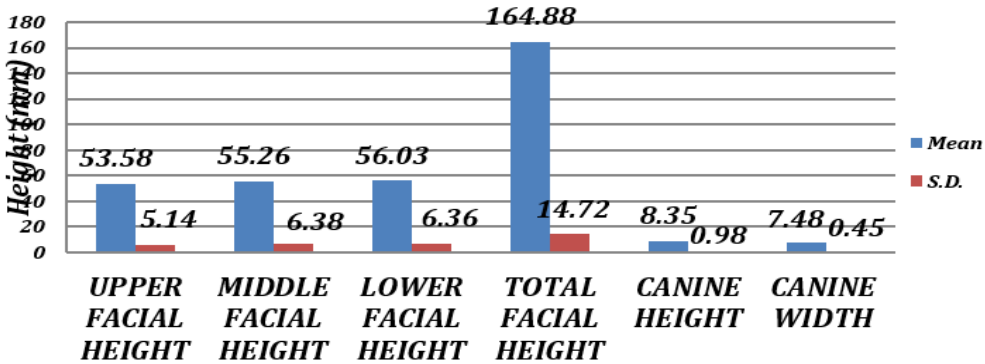

Figure 8: Comparison of different facial measurements in males

Results

This observational study included 100 participants (50 males and 50 females). The mean of Upper Facial Height in mm (UFH), Middle Facial Height in mm (MFH), Lower Facial Height in mm (LFH), Total Facial Height in mm (TFH), Canine Height in mm (CH), Canine Width (CW) in males and females was calculated using descriptive statistics (Table: 1). UFH, MFH, LFH, TFH, CH, CW in females were 50.90, 54.71, 54.26, 159.89, 8.73, 7.88 mm respectively. The mean UFH, MFH, LFH, TFH, CH, and CW in men were 53.58, 55.26, 56.03, 164.88, 8.35, 7.48 mm respectively.

This study demonstrated a correlation between TFH and CH in both men and women. This study showed that, as TFH increased, CH also increased, and hence, TFH and CH were directly proportional; hence, there was a correlation between TFH and CH (Table 1).

Statistical analysis was performed using the Mann–Whitney U test. The p-values for UFH, MFH, LFH, TFH, and CH in both men and women were not significant; however, the p-value for CW in both men and women was moderately significant ($p = 0.026$) (Table 2) (Figure 6).

The correlation coefficients (R) between CH and UFH, MFH, LFH, TFH, and CW were significant for both men and women (Table 3).The correlation coefficients (R) for CW and UFH, MFH, LFH, and TFH were not significant (Table 4). In men, the study showed a strong correlation between TFH and CH, which was directly proportional and statistically significant. In females, it showed moderate correlation between TFH and CH, which was directly proportional and statistically significant. Overall, there was a moderate correlation between CH and TFH, which was directly proportional to each other. Hence, this study showed that there was a correlation between TFH and CH.

Discussion

The relationship between crown length and facial height indicates the growth patterns and aids in the identification of individuals. Facial and odontometric measurements play important roles in person identification and facial reconstruction techniques. Various studies have shown that there is a possible relationship between tooth dimensions and body size. These study have dwelled on this subject with differing results.

Nalawade et al. [6]. found a definite relationship between the height of the individual, facial measurements, and their odontometric measurements. This study stated that the values of maxillary anterior teeth can be determined using regression equations. In the present study, canine height was directly correlated with the canine height to total facial height ratio, which also showed statistical significance.

Attokaran [7] showed the relationship between the teeth and facial parameters. The study found that the inner intercanthal distance and mesiodistal width of six maxillary anterior teeth in women showed high statistical significance, with no significance in men. However, the present study showed a relationship between the teeth and facial parameters in the vertical dimension in both sexes. A study by Banu et al[8] stated that there was a significant correlation between the interalar, intercommissural, intercanthal, and interpupillary distances and the mesiodistal width of maxillary anterior teeth in all subjects. In women, there was a significant correlation between the interalar, intercanthal, and interpupillary distances and mesiodistal width of the maxillary anterior teeth. SapnaRadia[9] also conducted a prospective clinical study to determine the relationship between maxillary central incisors, facial height and width in adults. The ratio of 1:18 was proposed for the maxillary central incisor height to total face height. They found a correlation between maxillary central incisor height and total face height, which is consistent with the present study that also showed a correlation between maxillary canine height and total face height. Raghavendra et al[10] conducted a study to establish the evidence of a statistical correlation between facial height and body height; however, no definitive correlation was found between the total crown length and body height. However, the present study was conducted to determine the correlation between facial and canine heights in both sexes.

Conclusion

The total facial and canine heights were directly proportional; hence, there was a correlation

between facial and canine heights. To the best of our knowledge, very few studies have been conducted to correlate facial parameters to that of the canine tooth. However, further research can be conducted using similar parameters, with larger sample sizes and different populations using newer technology and advanced imaging modalities.

Ethical Clearance: Ethical clearance was obtained from the institutional ethical board.

Informed consent: The authors certify that we have obtained all appropriate patient consent forms from the patient for clinical information to be reported in the journal.

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Conflicts of Interest: None

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Original Article

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Clinical Profile and Outcome of Drug Abuse Patients Admitted in Intensive Care Unit of a Tertiary Care Hospital in Kashmir: A Prospective Observational Study

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Abstract

Introduction: Drug abuse is a global public health issue that poses significant challenges to healthcare systems particularly in intensive care units (ICU). This study aims to assess the clinical profile and outcomes of drug abuse patients admitted to ICU of a tertiary care hospital in North India.

Methods: A prospective observational study was conducted over period of 3 years involving drug abuse patients admitted to the ICU. Demographic data, clinical characteristics, substance abuse patterns, co-morbidities, severity scores and outcomes were recorded.

Results: A total of 35 patients were included in the study. All patients were males with a mean age of 29.1(± 11.68). 25 patients were from rural areas. 42.8% were unemployed. Most of the patients (85.7%) were unmarried. 34.3% were students. Mean APACHE II score on ICU admission was 13. Most of patients were admitted for heroin overdose (60%). All 35 patients admitted in ICU had low Glasgow coma scale (GCS< 7). 32 (91.4%) patients had associated respiratory failure. 7 patients had cardiovascular instability. 4 (11.4%) patients developed multi-organ failure during the ICU stay. Mean duration of ICU stay was 3.4 (± 2.68). 23 (65.7%) patients got extubated within 24 hours of ICU admission. 4 patients expired (11.4% mortality) in study group. Sepsis was cause of death in one patient, 3 patients died of multi-organ failure

Conclusion: Most of the overdose was due to opioids specifically of heroin. CNS depression was found in all drug overdose patients followed by respiratory failure. Multi organ involvement have poor outcome. Mortality ensued in 11.4% of admitted patients as a result of sepsis and multi-organ failure. Majority of the patients had good outcome especially patients who presented early to healthcare facility.

Key words: Drug overdose, ICU, outcome

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Introduction

The incidence of drug overdose has increased substantially over the past decade. The availability of more potent novel agents and other potential drug combinations has put a great challenge in controlling this menace and in treating the addicts[1.] Intensive care unit (ICU) admissions of the patients having illicit drug abuse has been found to be rising and has become a major public health concern throughout the world. It has resulted in significant health care cost and hospital resource utilization increasing the burden on already overburdened healthcare system in our region[2].

The increased ICU admissions and higher percentage of deaths has been associated with unintentional drug overdose. Data from various publications show all ICU admissions around 3% to 14%.[3,4,5,6] Acute drug intoxication including alcohol intoxication accounts for 19% of ICU admissions in New York.[2] There has been an increase in ICU admissions by 34% from 2009 to 2015 in USA because of opiate drug overdose.[7] In the west, in-hospital mortality including mortality in ICU in patients with acute intoxication remains around 0.2-4%.[8]In India, prevalence of alcoholism is 4.6%, cannabis abuse 2.8% and opioid use of around 2.1% . Among opioids used in India, heroin remains the highest at 1.14%, followed by pharmaceutical opioids 0.96% and opium 0.52%. The prevalence of opium use in India is three times the global percentage.[9]

Although fatal drug overdose attracts much public attraction, the non-fatal overdoses with their sequelae causes more damage to organ systems like cardiac, renal, musculoskeletal, respiratory system, CNS and physical injuries at the time of intoxication[10]

The management of acute drug intoxication or its complications varies with the nature of the substance used, quantity of drug consumed and any other concomitant substance used. Critical care interventions involve airway and ventilatory management, hemodynamic stabilization and other life-saving procedures like dialysis. The lack or delay in the detection of the unknown substance may pose difficulty in effectively managing the patients in ICU. Substance abuse-related admissions to the ICU in India are common, however there is relatively little scientific literature available regarding characteristics and profile of this population. Specifically, use of ICU resources for chronic alcoholism and drug-related problems, such as complications have not been sufficiently described. Lack of data on drug abuse in ICU may prevent effective management of these patients. This observational study was primarily aimed to study the clinical profile and outcome of drug abuse patients admitted in the ICU of a tertiary care hospital in North India

Material and Methods

This prospective observational study was carried out in an ICU of a tertiary care hospital in North India. This study was conducted from January 2019 to December 2022 after approval from Institutional ethical committee. All patients admitted to ICU with diagnosis of acute intoxication and those with signs and symptoms of acute drug overdose were enrolled in the study. Patients having history of recreational drug abuse and positive urine toxicological screens but admitted in ICU for reasons other than acute intoxication were excluded from the study. Drug intoxication and overdose was referred to as a change in the behavior, consciousness level and/ or disturbance in vital function after having psychoactive drug consumption. Patients suspected of drug abuse were screened through blood/urine toxicological screen using liquid chromatography which is an immunoassay based on the principle of competitive binding. Written informed consent was obtained fromfirst degree relative of patients included in the study.

Demographic parameters like age, gender of patients included in the study were recorded. Other patient related parameters recorded included; reason of drug overdose (recreational, suicidal, accidental), previous history of drug abuse, psychiatry illness, clinical findings at ICU admission, need of mechanical ventilation, vasopressor therapy, urine toxicological screening results, any relevant laboratory finding, days of ICU stay and outcome at ICU discharge. Clinical parameters monitored in the ICU including pulse rate, peripheral oxygen saturation, mean arterial pressure and temperature were also recorded. Drugover dosage was managed as per institutional protocol.

Statistical Analysis:

The recorded data was compiled and exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean ±SD and categorical variables were summarized as frequencies and percentages.

Results

This study included a total of 35 patients admitted to ICU (and fulfilling the inclusion criteria) during the study period. The demographic and sociologic parameters of all patients were recorded.

The mean (± standard deviation SD) age was 29.1 (± 11.68) years with the range of 16 to 65 years.

All the 35 patients included in this study belonged to male gender, no female patient met the inclusion criteria during the study period. 25 patients out of 35 were from rural areas and 10 were from urban background. 42.8% were unemployed, (22.9Most of the patients (85.7%) were unmarried compared to 14.3% patients who were married.22.9% were employed and 34.3% were students. (Table 1)

Table 1: Socio-Demographic Profile

Variable		Number	Percentage (%)
Gender	Male	35	100
	Female	0	0
Marital Status	Unmarried	30	85.7
	Married	5	14.3
Type of Dwelling	Rural	25	71.4
	Urban	10	28.6
Profession	Student	12	34.3
	Unemployed	15	42.8
	Employed	8	22.9

Mean APACHE II score within 24 hours of ICU admission was 13. Most of patients were admitted for heroin overdose (60%). 25 patients had history of substance abuse for the first time, whereas 10 patients were chronic abusers. 34(97.1%) patients used drugs for re-creational purpose, only one patient had drug overdose with suicide intent. (Table 2).

Table 2: Clinical characteristics of study subjects

Variables		Number	Percentage (%)
Drug type	Heroin	21	60
	Synthetic Opioids	2	5.7
	Cannabis	5	14.3
	Benzodiazepine	3	8.6
	Alcohol	4	11.4
Abuse	Chronic abusers	10	29
	First time abusers	25	71
Reason of Overdose	Recreational	34	97.1
	Suicidal	1	2.9
	Accidental	0	0
	Homicidal	0	0

All 35 patients admitted in ICU had low score on Glasgow coma scale (GCS) (GCS< 7) and were mechanically ventilated. 32 (91.4%) patients had associated respiratory failure with type 1 respiratory failure in 29 patients and type 2 respiratory failure in 3 patients. 7 patients were hemodynamically unstable and had vasopressor requirement. 4 (11.4%) patients developed multi-organ failure during the ICU stay. (Table 3).

Table 3: Clinical status of patients at ICU admission

Parameter	Number	Percentage (%)
Low GCS (< 7/15)	35	100
Mechanical Ventilation	35	100
Type 1 respiratory failure	29	82.86
Type 2 respiratory failure	3	8.57
Vasopressor requirement	7	20
≥ two organ system involvement	4	11.4

Mean duration of ICU stay was 3.4 (± 2.68, range 2-11 days), 23 (65.7%) patients got extubated within 24 hours of ICU admission. 88.6% were discharged from ICU, however, 4 patients expired, accounting for 11.4% mortality in study group. (Table 4). Sepsis was cause of death in one patient, 3 patients died of multi-organ failure.

Table 4: ICU stay and Outcome

Parameter	Mean	SD
ICU Stay (Days)	3.4	2.68

ICU Outcome	Number	Percentage(%)
Extubated with 24 hours	23	65.7
Discharged	31	88.6
Mortality	4	11.4

Discussion

Substance abuse is a major problem concerning our population. The substance abuse accounts for significant mortality and morbidity in young population[11]

This is the only study in our region studying utilization of ICU in patients with drug overdose. 35 patients with drug overdose were admitted to ICU during the study period. The diagnosis of all admitted patients was confirmed on the basis of clinical features and laboratory reports. The number of drug overdose patients were 1.75% of total patients admitted in ICU over a period of 3 years. Mean APACHE score in these patients was 13 corresponding to a mortality of approximately 15%. A study by Jose et al found ICU mortality of 2-14% in opioid overdose patients.[2]

The percentage of deaths at ages 15–64 in 2016 in US that are estimated to be drug-associated is 22% for men and 16% for women[12].

The mean age of the patients in our study was 29 (±11.68) years with range of 16 to 65 years. A study on prevalence and patterns of drug abuse in Kashmir valley found most of the abusers were males in the age group of 20-29 years. All our patients were males and none of the patient was of female gender. A survey of United Nations drug control programme found 5.7 % of female drug abusers in Kashmir division. Another survey found 26% of female drug abusers in Kashmir[13]. Plausible cause of no female patient in our study could be due to small sample size.

In our study 85.7% of patients were unmarried as compared to 14.3% patients who were married, similar observation was made by Rather YH et al., who observed 72.34% patients were single (unmarried, divorced or separated) [14]. Possible reason could be marriage may act as a protective factor against drug abuse, long-term committed relationships, like marriage provide the primary form of social support for many individuals[15].When the data was analyzed for type of dwelling, we observed 25 (71.4%) patients were living in rural areas as compared to 10 (28.6%) from urban households.

We noticed 21 out of 35 patients (60%) admitted in ICU were having heroin intoxication. Most common presentation of heroin poisoning was low GCS, miotic pupil and respiratory failure. In one study, most fatal cases of heroin overdose occur in late 20's and early 30's after having intra-venous injections.[16] Cannabis abuse constituted 14.2% patients and was second common substance in our study. All these patients had decreased consciousness level with respiratory failure at presentation. In this study 4 patients had alcohol intoxication comprising 11.4% of all patients included in study. Baldwin et al., found an estimated 10-33% of patients admitted in their ICU had alcohol use disorders.[17] The low percentage in our patients compared to rest of India may be because of social and religious beliefs in majority population where alcohol is considered a taboo[15]The main symptoms of alcohol intoxication in our patients were CNS depression followed by respiratory failure. In this study only 3 patients (8.6%) had taken benzodiazepines in overdose with main symptom being CNS depression. In our study no case of mixed drug overdose was seen.

All 35 patients admitted in our ICU had low GCS (GCS<7) and needed mechanical ventilation. Respiratory failure was found in 32 (91.4%) patients with type 1 failure in 29 patients and type II respiratory in 3 patients. Type 1 respiratory failure was attributed to acute lung injury in 12 patients and 17 patients had aspiration pneumonia. The neurogenic-pulmonary edema secondary to central nervous system depression and increased pulmonary capillary leakage may contribute to acute lung injury in opioid poisoning.[18] Hemodynamic instability was present in 7 patients, which was managed with intravenous fluid and ionotropic support[2]. Multi-organ failure with sepsis developed in 4 patients, these patients deteriorated clinically and all of them expired. Gang et al studied multiple organ dysfunction syndrome in heroin intoxication and

found MODS as a consequences of the primary toxic role of heroin, hypoglycemia, prolonged hypoxia, and ischemia-reperfusion injury[19].

3 patients out of these 4 who died had alcohol intoxication and one had abused cannabis, who presented late to healthcare facility. 34 out of 35 patients had drug abuse for recreation purpose only. In our study 31(88.6%) out of 35 admitted patients in ICU 23 patients were extubated with 24 hours of ICU admission and were discharged. The mean ICU stay was 3.4 (± 2.68) days with minimum stay of 1 day for 23 patients and maximum stay of 12 days. Jayakrishnan et al in their study found that patients stay in the ICU for 1 to 20 days (median-2 days). Factors associated with a longer ICU stay included hypotension upon arrival (p=0.048) and the need for mechanical ventilation on the first (p=0.001) and second (p=0.001) days of hospitalization[4].

Limitations: This study was done as a prospective study for only three years, the study may be underpowered and larger study with larger sample and longer duration might be needed. This was a single institution study, we did not include patients admitted in other ICU's in the region. We did not study long term outcome in these patients.

Conclusion

There has been upsurge in the addiction of opioids among the people specifically of heroin use in our region. CNS depression was found in all drug overdose patients. The respiratory complications have been found at peak among them with acute lung injury followed by aspiration pneumonia and cardio-vascular instability. Multi organ involvement had poor outcome. Mortality ensued in 11.4% of admitted patients as a result of sepsis and multi-organ failure. Majority of the patients had good outcome especially patients who presented early to healthcare facility and remained stable with mild complications and had shorter ICU stay. A high degree of suspicion is to be kept in mind in young patients admitted in ER with CNS depression in whom other causes have been ruled out.

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Author contribution:

RAQ- Implementation of study protocol, data collection, interpretation of data. **SS-** Concept, manuscript preparation. **MJ-** concept, design, final approval, drafting the work. **AHM-** design, statistical analysis, **TK-** revising work for intellectual content. **AWM-** revision and editing. **MK-** statistical analysis, formulating tables.

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Original Article

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Trends of Poisoning Cases Coming to a Tertiary Care Center in Lucknow: A Retrospective Observational Study

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Abstract

Introduction: The term "suspected poisoning" describes the potential exposure of a human or animal to a poisonous chemical, which might result in a variety of symptoms ranging from minor symptoms to severe consequences. The kind and quantity of the poison implicated may affect the symptoms. If poisoning is suspected, it's crucial to get help right away so that the correct toxin can be identified and the proper management can be given.

Aim: To monitor the epidemiological traits and clinical trends of poisoning cases at the emergency department of Dr. RMLIMS Lucknow.

Methods: All 295 instances of acute poisoning were reported to the emergency department between April 2022 to March 2023. It is retrospective observational research of 12 months duration carried out in a tertiary care hospital. Data on the patient's age, gender, kind of poisoning, length of hospital stay, and result were gathered from hospital medical records and examined.

Result: The majority of victims have married housewives with poor socioeconomic and educational standing who were between the ages of 31 and 40. Agriculture poisons and domestic poisons were the two most often used toxins. Most of the time, the general health at the time of presentation was unstable.

Conclusion: Suspected poisoning is a serious medical emergency that might have life-altering effects on the victims. Knowledge of the probable causes and symptoms of poisoning is crucial to ensure prompt diagnosis and treatment. Those who have been exposed to harmful chemicals can recover and prevent long-term harm with the proper measures.

Keywords: Drug Overdose, Emergency department, Poisoning, Toxicity, Suicide, etc.

Introduction

When someone knowingly or inadvertently comes into contact with a hazardous material, it might cause suspected poisoning or a medical emergency.[1] Poisoning can happen when a person consumes, breathes in, or absorbs poisonous substances like

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chemicals, medications, or plants.[2] People of all ages and backgrounds can become ill from poisoning, which can occur at work, at home, or outside.[3] Depending on the type of toxin and the extent of exposure, the symptoms of suspected poisoning might vary greatly.[4] From little discomfort to circumstances that might be fatal, symptoms can include convulsions, unconsciousness, and respiratory failure.[5] To correctly evaluate the kind and severity of the poisoning and administer the necessary treatments, prompt medical assistance is needed.[6] Household cleaners, pesticides, carbon monoxide, alcohol, and prescription drugs are examples of well-known toxins. Poisoning can also result from exposure to less common toxins such as heavy metals and tainted food or water supplies.[7,8] The victim's age, state of health, and pre-existing medical disorders may also alter the poisoning symptoms.[9] The essential knowledge and training must be available to medical professionals and emergency services so they can quickly identify the warning signs and symptoms of suspected poisoning.[10,11] An accurate diagnosis and course of therapy can stop permanent harm, incapacity, or even death.[12] Efforts in prevention, such as raising awareness of dangerous compounds and encouraging safe handling procedures, can also assist lower the likelihood of suspected poisoning in the first place.[13,14] One pattern is that, as a result of a lack of legislation and safety precautions, poisoning incidents are more frequent in low- and middle-income nations.[15,16] Due to their exposure to harmful compounds in their surroundings, agricultural laborers, children, and women are more prone to poisoning.[17] A recurring trend across the world is food poisoning outbreaks, particularly in industrialized nations where there is a large demand for fast food and processed meals.[18,19] As a result, there are now more laws governing food safety and programs to stop food-borne diseases.[20]

Material and Methods

All 295 instances of suspected poisoning reported to the Emergency Department Dr. Ram Manohar Lohia Institute of Medical Sciences Lucknow between April 2022 to March 2023, were included in our retrospective observational research of 12 months duration. Data on the patient's age, gender, nature of poisoning, time to reach the hospital, GCS score at the time of presentation, and sociodemographic information were gathered from hospital medical records without directly involving human subjects. All data were analyzed by SPSS Statistics and Windows, version 11. The results are presented as Mean-SD and all categorical values are compared.

Inculcation Criteria: All instances of suspected poisoning who were reported to the Emergency Medicine Department of DRRMLIMS Lucknow within 24 hours.

Exclusion Criteria: Those cases of suspected poisoning who were brought dead were excluded from the study.

Result

According to the report, housewives between the ages of 31 and 40 who were from low socioeconomic and educational backgrounds made up the bulk of poisoning victims in Lucknow, Uttar Pradesh. Domestic and agricultural poisons were the two most often employed toxins. These results highlight the need for focused interventions and educational initiatives to enhance the safe use of these compounds and to promote alternative approaches to domestic cleaning and pest management. His interpretation is included with all the useful data in Tables 1, 2, and 3.

Table 1: Baseline demographic data and clinical characteristics of enrolled patients

Gender	**No Suspected Sample**
Male	108 (36.61%)
Female	187 (63.39%)
Age Group	
10-20	32 (10.85%)
21-30	57 (19.32%)
31-40	103 (34.91%)
41-50	74 (25.08%)
51-60	23 (7.80%)
61-70	7(2.37%)
Total	**295**
Time of presentation since exposure (in hours)	
Less than 3 hours	87(29.49%)
3 to 6 hours	152 (51.52%)
6 to 12 hours	43(14.58%)
More than 12 hours	13(4.40%)
Total	**295**

Interpretation:

Females (63.39%) of the age group 31-40 (34.91%) years, who reported to the emergency department between 3-6 (51.52%) hours of ingestion, were the most common victims.

Table 2: Baseline demographic data and clinical characteristics of enrolled patients

Nature of poison consumed	No Suspected Sample
Agriculture Poisoning (Organophosphorus compounds, Rodenticide)	84 (28.47%)
House Holds Poisoning (kerosene, Dye, toilet cleaner, phenyl, etc.)	69 (23.39%)
Occupational (Metals, chemicals, corrosives, etc.)	15
Snake Bite	36
Alcohol	31
Drug overdose (Benzodiazepines, etc)	27
Unknown	33
Total	**295**
GCS score of patients at presentation	
13-15	65
9-12	93
<8	137 (46.44%)
Total	**295**
In Hospital Status	
Stable	96 (32.54%)
Unstable	177(60%)
Lama	2(0.68%)
Death	20 (6.78%)
Total	**295**

Interpretation: Household and agricultural poisons together make up the majority (approximately 52%) of the substances found in suspected poisoning cases. General conditions at the time of presentation were poor with a low GCS score <8 in 137 (46.44%) cases. In-hospital status was unstable in 177(60%) cases, 96 (32.54%) cases were stable, 20 (6.78%) patients died and 2 patients left against medical advice (LAMA).

Table 3: Baseline demographic data and clinical characteristics of enrolled patients

Occupational	No Suspected Sample
Farmer	57 (19.32%)
Factory worker	21 (7.12%)
Housewife	73 (24.75%)
Student	47 (15.93%)
Unemployed	97 (32.88%)
Total	**295**
Marital Status	
Married	182 (61.69%)
Unmarried	113 (38.31%)
Total	**295**
Socio-economic	
Upper	18 (6.10%)
Middle	122 (41.36%)
Lower	155 (52.54%)
Total	**295**
Educational	
Illiterate	116 (39.32%)
Literate	
Postgraduation	28 (9.49%)
Graduation	33 (11.18%)
Intermediate	55 (18.64%)
Matric	66 (22.37%)
Total	**295**

Interpretation: The most common victims were unemployed 97 (32.88%), followed by housewives 73 (24.75%), farmers 57 (19.32%), students 47 (15.93%), and Factory workers 21(7.12%). The majority 182 (61.69%) were married, illiterate 116 (39.32%), and of lower socioeconomic status 155 (52.54%).

Discussion

295 individuals who visited the emergency room for treatment of suspected poisoning were included in our research. Patients between the ages of 31-40 years were the most common. Similar findings were obtained by prior research conducted by Reddy BS et al from South India. They found that 146 (or 52%) of the total 278 patients fell into the age group between 31-40. [21]The majority(98.19%) of poisoning cases were suicidal, which were comparable to another study conducted by Mahabal shetty AD et al. [22] In one study conducted by Chan YC et all in Hong

Kong (2867 patients) the majority of the patients in this research were young, with a mean age standard deviation of 36.327.78 years. Studies in Andhra Pradesh conducted by Kumar SV et al produced similar results. Another study conducted by Marahatta SB et al shows a similar result. The majority of the patients in this study were over 40 years old.[23,24,25] In our study, women are more prone to ingest the poison. A similar conclusion was reached in studies conducted by Güloglu C et al in Turkey (M:F = 1:3.5) and Nepal (M:F = 1:1.35). In contrast, male patients outnumbered female patients in the study carried out in Andhra Pradesh and Tamil Nadu (M:F = 1.58:1). [26] The bulk of the patients in the current study were housewives, followed by farmers, businesspeople, workers, and students. Similar results were seen in the Tamil Nadu research conducted by Maharani et al, where the majority of the poisoned patients were housewives (28%), workers (18.66%), students, and farmers.[27] The time interval between exposure to the toxin and admission to the hospital has been deemed to be extremely important for proper patient care. In another study conducted by Banerjee et al the average time between ingesting the poison and being admitted to the hospital was 6.4 hours (Mean SD: 6.4 2.29) as opposed to the study in Andhra Pradesh, where the average time was 3-6 hours.[28]According to our research, domestic poisoning, snake bites, alcohol intoxication, and drug overdose are the next most frequent causes of poisoning after agricultural poisoning. In a similar study conducted by Eyer P et al the results of earlier research (40%), the majority of poisonings (41%) were caused by ingesting organophosphates. A substantially higher figure of 73% was found in recent research.[29]

Conclusion

Reporting the patients to the tertiary care institution without wasting time traveling back and forth can reduce the morbidity and death linked to suspected poisoning. A poison information center can be quite helpful in providing accurate advice regarding what should be done and what shouldn't be done. Because the bulk of patients are ignorant and prefer seeing quacks, educating people that the management of the patient should be quick and only at a tertiary care center instead of going to a quack.

Conflict of Interest: There is no conflict of interest

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Ethical clearance: The institutional ethics committee of the hospital gave the study protocol IEC 1/20 of approval. Additionally, the participants' privacy and anonymity were ensured.

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Systematic Review

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Artificial Intelligence and its Role in Forensic Karyotyping: A Systematic Review

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Abstract

Introduction: One of the most important aspects of forensic investigations and genetic research is forensic karyotyping, which involves analyzing a person's chromosomes to find genetic anomalies and establish identification. The development of artificial intelligence (AI) technology offers a chance to improve and automate the forensic karyotyping procedure. This study examines the possible advantages and difficulties of artificial intelligence (AI) in forensic karyotyping. In forensic science, forensic karyotyping is essential for providing an accurate interpretation of genetic data for use in legal and investigative processes. It can offer useful details regarding genetic problems, such as chromosomal abnormalities or mutations, which can help with personal identification, paternity determination, or supplying proof in criminal investigations.

Aim: To give a general review of how artificial intelligence is used in forensic karyotyping, evaluate its possible advantages, and address any relevant issues. By being aware of Artificial Intelligence's promise and limitations in this field, we may set the stage for its efficient integration into forensic practitioner.

Methods: A database search we did to start the inquiry turned up 582 documents. There were 216 unique records left after duplicates were eliminated. 232 items were subsequently eliminated as a result of download problems. A final sample of 31 research was chosen from the 134 full-text papers that were evaluated (n=134), with 103 being eliminated owing to quality issues.

Result: The use of artificial intelligence (AI) in forensic karyotyping has several advantages, including automated chromosomal analysis, quicker abnormality discovery, and increased uniformity. For a successful application, challenges such as a lack of labelled datasets and ethical issues must be resolved.

Concussion: By increasing productivity, precision, and uniformity, artificial intelligence has the potential to transform forensic karyotyping. While there are obstacles, continued study and cooperation amongst several fields might help you get through them. The ethical and appropriate use of AI in forensic karyotyping will improve forensic investigations, boost genetic research, and expand the use of genetics in the legal system.

Keywords: Artificial Intelligence (AI), Criminal Investigations, Forensic Karyotyping, Genetic Abnormalities, Genetic Profiles, Labelled Datasets, etc.

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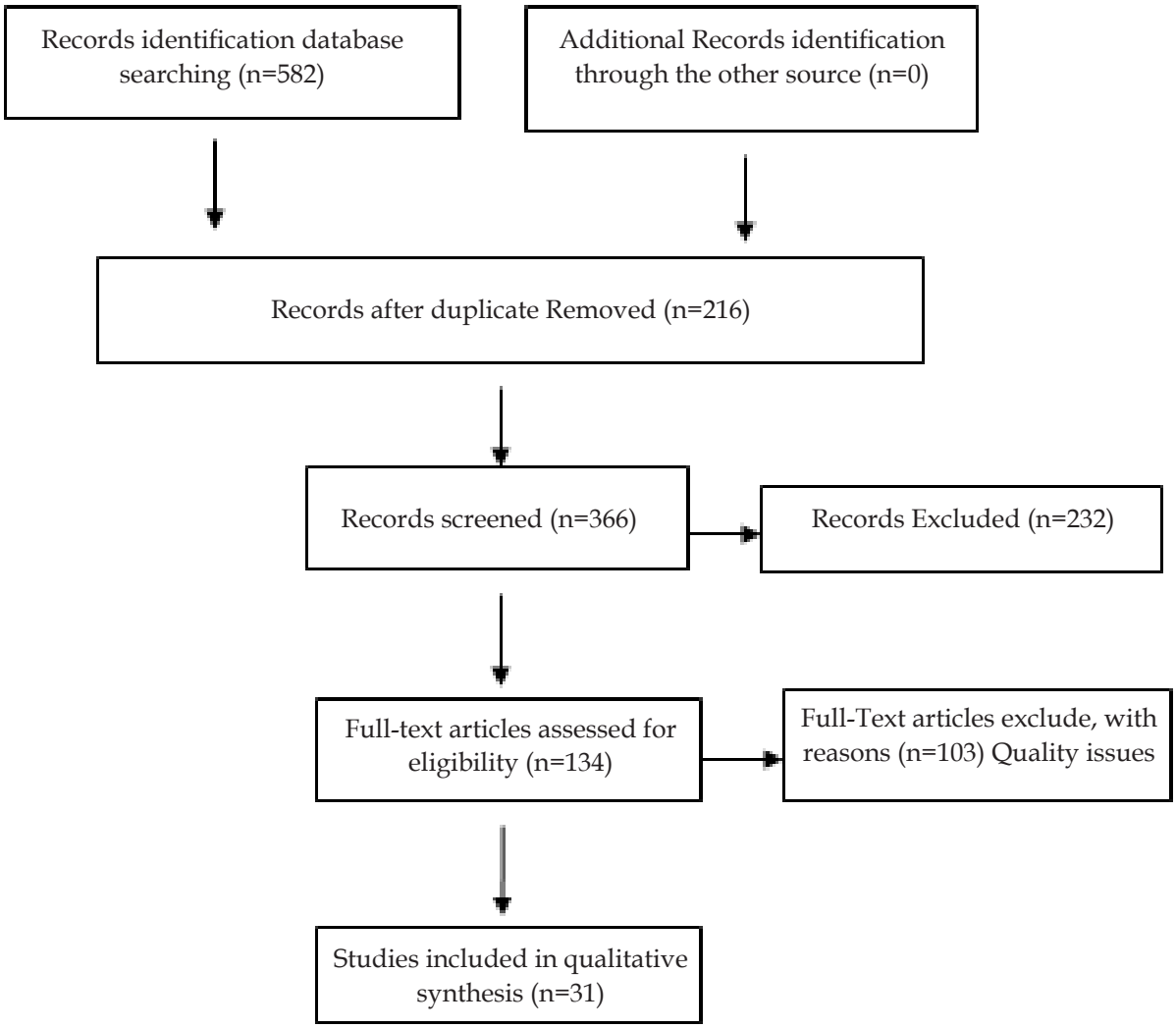
Introduction

In forensic investigations, forensic karyotyping is an essential part of the genetic study to identify an individual and identify genetic anomalies.[1] It includes the investigation and interpretation of a person's chromosomes, usually by manual inspection by forensic professionals.[2] But this procedure could involve a lot of work, take a long time, and involve mistakes made by people.[3] The use of AI approaches to automate and improve the process of forensic karyotyping is becoming more and more popular as a result of the fast breakthroughs in AI.[4] Artificial intelligence (AI) is the field of study that deals with the creation of computer systems that are capable of doing activities that normally require human intellect, including perception, reasoning, learning, and problem-solving.[5][6] The use of AI methods in forensic karyotyping has considerable promise for enhancing effectiveness, accuracy, and uniformity.[7] AI techniques, like machine learning and deep learning, have demonstrated significant potential in a variety of domains.[8] The use of AI in forensic karyotyping is multidimensional and has several important advantages.[9] First, AI algorithms can automate the time-consuming operation of chromosomal analysis, greatly cutting down on the amount of time and effort needed by forensic professionals.[10] AI can acquire the capacity to precisely detect and categorize chromosomal abnormalities by utilizing machine learning algorithms to learn from labelled information.[11] This can help to identify genetic abnormalities, provide genetic profiles for criminal investigations, and offer insightful data for genetic research. Additionally, uniformity in forensic karyotyping is a problem that AI can solve.[12][13] Traditional karyotyping techniques might be vulnerable to subjectivity and inter-observer variability, producing erratic findings.[14] Deep learning methods allow AI computers to learn from enormous datasets and provide uniform standards for classifying chromosomal anomalies.[15] The overall quality of forensic karyotyping analyses can be improved by this standardization, which can increase the results' dependability and repeatability.[16] Despite the potential advantages, incorporating AI into forensic karyotyping also poses certain difficulties. The lack of labelled datasets with annotated karyotypes for AI model training is a serious obstacle.[17] Building reliable and precise AI systems requires acquiring and curating such datasets that reflect diverse chromosomal abnormalities.[18] To overcome this issue and provide comprehensive datasets that can propel the development of AI in forensic karyotyping, a collaboration between geneticists, forensic specialists, and computer scientists is crucial.[19] The application of AI in forensic karyotyping also heavily relies on ethical issues. To guarantee the appropriate and ethical usage of AI algorithms, considerations for patient privacy, informed permission, and data security must be taken.[20] In the course of the forensic karyotyping procedure, security measures should be in place to safeguard private genetic data and guarantee that people's rights are upheld.[21] Artificial intelligence has the power to transform forensic karyotyping by increasing productivity, precision, and consistency.[22] Chromosome analysis automation and the creation of AI algorithms capable of precisely identifying and categorizing chromosomal anomalies can greatly improve forensic investigations and genetic research.[23] To integrate AI in forensic karyotyping responsibly, however, issues with the accessibility of labelled datasets and ethical issues must be resolved.[24] To overcome these obstacles and realize the full potential of AI in this area, further study and collaboration between computer scientists, geneticists, and forensic specialists are essential.[25] The effective use of AI-driven forensic karyotyping technologies can have wide-ranging effects, enhancing forensic investigations, expanding our understanding of genetics, and promoting the use of genetics in the legal system.[26]

Methodology

We began our investigation by searching the database for a specific term associated with our subject, which revealed 582 documents. We eliminated duplicate entries to confirm the veracity of our findings, leaving 216 unique records. Following a thorough review, 232 of these recordings were eliminated because of download problems. After the first screening, we continued to evaluate the full-text articles' suitability, reducing our selection to 134 articles for additional study. 103 items were eliminated after a comprehensive review due to quality issues. A final selection of 31 papers that satisfied our criteria and were included in the qualitative synthesis was obtained through this procedure.



Prisma Flow chart:

Result

There are several advantages to using artificial intelligence (AI) in forensic karyotyping. Automating the time-consuming process of chromosome analysis, it helps hasten the discovery and categorization of chromosomal abnormalities. AI has the ability to increase consistency by creating uniform interpretational standards and minimizing subjectivity among observers. For successful implementation, there are a few obstacles that must be overcome. The scarcity of labelled datasets, which are essential for training AI systems, is one issue. Furthermore, ethical issues related to AI in forensic karyotyping need to be thoroughly investigated and settled. It is essential to overcome these obstacles to properly utilize AI in forensic karyotyping and obtain improved consistency and efficiency.

Discussion

An overview of artificial intelligence and its uses in forensic science, particularly in the area of karyotyping, will be covered in this talk. It would investigate the possible advantages of automating and improving forensic karyotyping procedures using AI.[27] This debate would dive into the use of AI in forensic karyotyping to analyse chromosomal abnormalities. It would investigate how AI algorithms may help in the detection and classification of different abnormalities, including duplications, translocations, inversions, and deletions. The benefits and drawbacks of AI-assisted analysis would be looked at.[28] The use of machine learning approaches for pattern detection in karyotyping will be the main topic of this lecture. It would investigate the training of AI algorithms on

massive datasets to find trends and more precisely characterize chromosomes. We would also talk about the difficulties in creating reliable machine-learning models for karyotyping.[29] Karyotyping Workflow Automation Using AI. This conversation would focus on using AI technology to automate the karyotyping routine. It would investigate how automating time-consuming and repetitive operations like picture capture, chromosomal segmentation, and pairing may be aided by AI. The potential benefits of automation powered by AI for increasing productivity and lowering human mistakes will be highlighted.[30] This conversation would cover the moral questions raised by the use of AI in forensic karyotyping. It would include issues including privacy worries, the requirement for human monitoring of decision-making, and potential biases in AI algorithms, among others. We would talk about ways to guarantee openness, justice, and accountability in AI-driven karyotyping procedures.[31]

Conclusion

Through improved productivity, accuracy, and consistency, artificial intelligence (AI) has the potential to significantly improve forensic karyotyping. Even if there are difficulties, continued multidisciplinary research and cooperation can help remove these barriers. It is possible to enhance forensic investigations, promote genetic research, and expand the use of genetics in the legal system through the ethical and responsible use of AI in forensic karyotyping, opening the door for more effective and efficient methods in this important area.

Conflict of Interest: There is no conflict of interest

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Ethical clearance: Not applicable

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Pattern, Severity of Injuires Sustained in Road Traffic Accident: An Autopsy Based Study

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Abstract

Road Traffic Accidents (RTA's) constitute a significant public health problem, they are rising in an alarming rate and causing increased morbidity and mortality among people. Motor vehicle accidents are complex events resulting primarily from human, technical, and environmental contributing factors. That is the reason, road traffic accidents are creating the burden for people related to mortality and morbidity.

Objectives: The following study analyses the following: 1) Age and sex distribution of the deceased in RTA. 2) Month and Time of occurrence of RTA. 3) Pattern of injury sustained in RTA.

Methodology: A retrospective study was conducted for a period of three month (October 2022-December 2022), in cases of road traffic accidents brought for autopsy at tertiary care teaching hospital, Madurai. All the data regarding the age, sex, month, time and place of occurrence, type and site of injuries and outcome are collected based on autopsy report. Data was analysed using standard statistical method.

Results: Of the total 330 road traffic accidents cases, 81.8% cases were males, 18.2% females. Majority of the victims were in the age group of 41-50 years (21%), Urban victims found to be on the highest side (77.2%), compared to Rural victims 22.8%. Most of the RTA happened during the month of NOVEMBER (38.2%) and during the time period between 2 PM and 1 0PM (40.6%). Head injuries contributes the most common injury pattern (60.7%) compared to other pattern of injury.

Conclusion: The present study concluded that head injuries were the most common injury pattern in RTAs and it is the main factor for death. Proper awareness about usage of helmets, punishment regarding drunk & driving and rash driving among the common people will help to reduce the mortality due to Road traffic accidents.

Keywords: Road traffic accidents, Patterns of injuries, Helmets

Introduction

RTA constitute a major public health problem which affects people in emotional and economical aspects since most of the victims were male and who were the bread winner of the family. Road traffic crashes cost 3% of their Gross Domestic Product. More than 90% of road traffic deaths occur in low and middle income countries. An increase in average speed is directly related to likelihood of occurrence of RTA and mortality following it. Driving under

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the influence of alcohol or drug or any psychoactive substances increases the risk of RTA. Correct helmet use can reduce the occurrence of RTA to about 42% as per national survey. Drivers using mobile phones are approximately 4 times more likely to be involved in RTA than who don't use it[1]. Road Traffic Accidents are conceived to become the 3rd contributor to global disease burden by 2020.According to the WHO Road Traffic Injuries caused an estimated 1.2 million deaths worldwide in each year[2]Egypt, Injuries, Deaths. Road traffic accidents (RTAs.

According to Road Traffic Accident census 2021 issued by the Central Government Of India, Ministry Of Road And Highway Transport Research Wing, New Delhi, a total number of 4,12,432 RTA's have been reported by States and Union Territories during the calendar year 2021 claiming 1,53,972 lives. The number of RTAs in 2021 has been increased by 12.6% on an average compared to the previous year (2020). Similarly, the number of deaths and injuries has been increased by 16.9% compared to the previous year (2020)[1].In India a total number of 4,12,432 accidents have been reported in 2021.Among vehicle categories involved in RTA, two wheelers for the second consecutive year accounted for the highest share in the total accidents and fatalities during 2021. Urban area accounts for 31% of accident death in the country[1].Knowledge regarding time of incident, pattern of injuries, and severity of injuries will help us in reduction of mortality and disability due to RTA's.

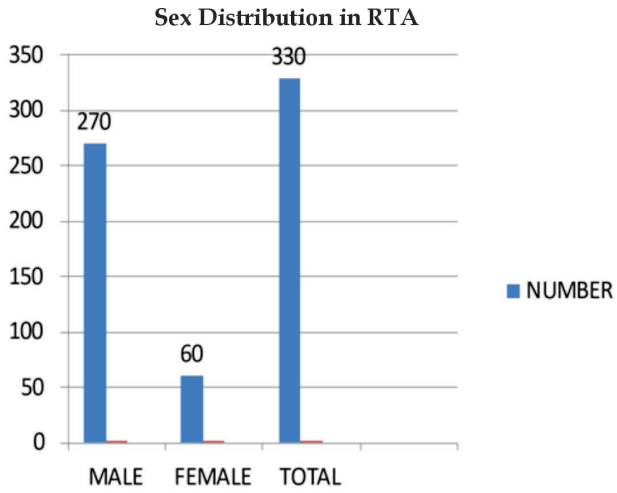
Materials and Methods

The present Retrospective study conducted for period of 3 months between October 2022 and December 2022, in the cases of death due to road traffic accidents, subjected to autopsy at Government Rajaji Hospital (GRH), Madurai, Tamil Nadu state. Cases of other form of traumatic injuries were excluded in the study. Autopsy reports of 330 deceased victims were analysed and necessary details were sort in terms of Age, Sex, month, time and place of occurrence, type and site of injuries. The data was analysed using standard statistical methods and the results were interpreted in terms of percentage and mean.

Findings

A total of 330 deceased victims autopsy reports were analysed and the following results were made.

The distribution of study subjects according to sex is depicted in



Of the total 330 deceased RTA victims 270 (81.8%) were found to be male, 60 (18.2%) found to be female. This shows the active part of males in outside home activities.

The distribution of study subject according to Age and Sex is depicted in Table 1:

The patient age ranged between 2.5 months and 90 years with the mean Age being 46.48.

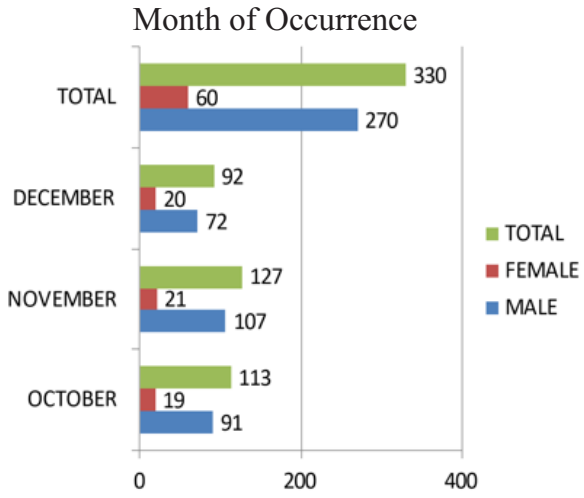
Age and sex wise distribution of study subjects

AGE GROUP (YEARS)	SEX		TOTAL	SEX RATIO
	MALE	FEMALE		(M:F)
BELOW 10 YEARS	4(1.45)	1(1.7)	5(1.5)	4:1
11-20 YEARS	21(7.8)	1(1.7)	22(6.7)	21:1
21-30 YEARS	48(17.8)	8(13.3)	56(17)	6:1
31-40 YEARS	49(18.2)	4(6.7)	53(16)	12.3:1
41-50 YEARS	48(17.8)	17(28.3)	65(20)	2.8:1
51-60 YEARS	50(18.5)	13(21.7)	63(19)	3.8:1
61-70 YEARS	27(10)	10(16.7)	37(11.2)	2.7:1
> THAN 70 YEARS	23(8.5)	6(10)	29(8.8)	3.8:1
TOTAL	270 (81.8)	60(18.2)	330(100)	4.5:1

Out of total of 330 deceased victims, highest number of victims fall in the age group of 41-50 accounting for 69(21%).

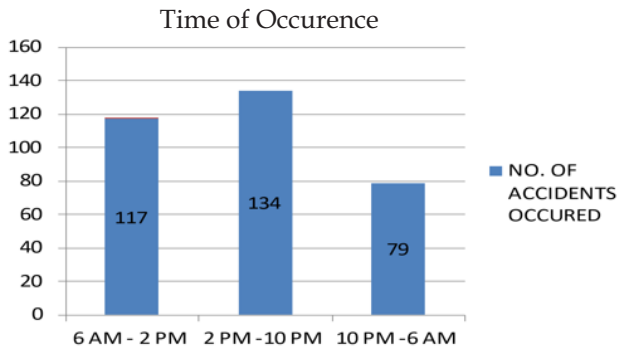
On applying Z test it is shown that age group between 51-60 years and 21-30 years are statistically significant.

With this data, Male: Female ratio was made. In this, maximum sex differentiate was observed in the age group of 31-40 years with male and female gender ratio of 12.3:1. While the overall male and female ratio was 4.5:1.



Various circumstances were attributed to the causation of RTA and is shown in Figure 2.

Of the total of 3 month which includes October, November, and December. Maximum RTA happened during November which rainfall was maximum during the year. Hence season of the contributes the major role in RTA.



Next comes to the times of occurrence which is presented in Figure 3.

Of the 330 autopsy report analysed, the maximum RTA happened during the time period between 2 pm and 10 pm which amounts to 134 in number (40.6%) followed by the time period (6 am- 2pm) which accounts to 117 (35.5%) in number.

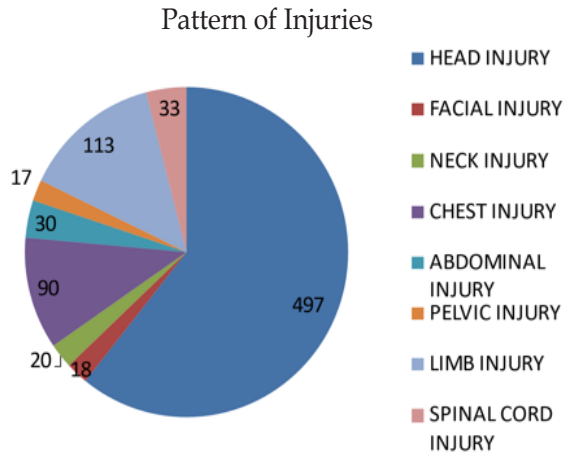
In this 2pm -10pm time period maximum RTA occurred during the time interval of 6-10 pm in which people return to their home from office /any domestic activity happens during that time period.

Hence avoiding rash driving, using proper helmets, avoiding usage of mobile phones while driving and following traffic rules greatly helps in avoidance of such RTA's.

Distribution of body region injured in RTA is depicted in the Table 2.

SITE OF INJURY	TOTAL INJURIES (NO)	PERCENTAGE
HEAD INJURY	497	60.7%
LIMB INJURY	113	13.8%
CHEST INJURY	90	11%
SPINAL CORD INJURY	33	4%
ABDOMINAL INJURY	30	3.7%
NECK INJURY	20	2.5%
FACIAL INJURY	18	2.2%
PELVIC INJURY	17	2.1%
TOTAL	818	100%

On analysis, the maximum region of the body injured in RTA is the head. Hence it indirectly reflects the improper use of helmet and quality of helmet used by the victims.



Head injury contributes to 497 in number of the total injuries of 818, which contributes (60.7%). Head injury is the most common cause of death in RTA's

which is followed by limb injuries. Limb injuries includes long bone fractures. Limb injuries found to be 113(13.8%).

Patterns of head injury depicted in the Table 3.

PATTERNS	NUMBERS	PERCENTAGE
SKULL FRACTURE	200	40.24%
MENINGEAL HEMORRHAGE	270	54.32%
INTRA CEREBRAL HEMORRHAGE	27	5.43%
TOTAL	497	100%

Chest injury accounts to 90 in number which is 11% of total injuries. Chest injury includes fracture ribs and visceral organ injuries (heart and lung). Visceral organ injury may or may not be associated with rib fractures.

Patterns of chest injury has been depicted in Table 4.

PATTERNS	NUMBERS	PERCENTAGE
FRACTURE RIBS	70	77.8%
VISCERAL ORGAN INJURIES (HEART & LUNG)	20	22.2%
TOTAL	90	100%

Spinal cord injury contributes 4% of total injuries. It includes fracture of vertebrae with laceration of spinal cord.

Abdominal injury constitutes about 3.7% (30) of total injuries. Abdominal injury includes visceral organ injury (liver, spleen, intestines).

Neck injury contributes 2.5% of total injuries which includes fracture of cervical vertebrae and major vessel injuries.

Facial injury contributes 2.2% of total injuries. Facial injuries includes fractures of the facial bone and mandible.

Pelvic injury contribute2.1% of total injuries which includes pelvic bone fractures.

Discussion

The rate of mortality due to road traffic accidents increasing day to day. The time of occurrence, alcohol intoxication, rash driving, and other factors are acting major role on it. Seasonal variation, fast driving without safety measures, work tension are resulting road traffic accidents. In our present study 330 total cases, out of 818 injuries, 497 cases account for head injury which is 60.7%. Almost similar pattern of head injury injuries in road traffic accidents observed in various studies. As in studies by Singh R, Singh-69%, Singh, Younis, Rehab & Adel, Rana-969.8%),Singh H, Dhattarwal SK-977.6%),Rao D-(87%), Gurjeet & Joshi(65%), Moharamzad, Yashar & Taghipour, Hamidreza -(9.58%) mostly on Skull injuries[32]Egypt, Injuries, Deaths. Road traffic accidents (RTAs[4567] . Urban residence as the common correlates with almost every study due to heavy traffic by over population. The most common gender was noted in our study male (81.8%), similar to findings by Singh R, Singh-(74.35%), Moharamzad, Yashar & Taghipour, Hamidreza-(80.5%), Tambuzzi, Stefano(54%)[378]. This shows though women are said to be less vehicle used, intoxication of alcohol is rare compared to men fall prey to thought of losing their lives. In our study also the time of occurrence between 2PM-10PM due to work exhausted and returning to home after finishing their jobs and so on and bit different from other studies. As per our study , majority of deceased belong to age group-41-50 yrs (21%), which is a bit different from other studies Tambuzzi, Stefano(54%)[8], where more predominant age group was adult (74.3%) by Younis, Rehab & Adel, Rana[2]Egypt, Injuries, Deaths. Road traffic accidents (RTAs. This variation might be possibly due to variation in working people compared to young adults. The working class bear more stress , are more addicted to substance abuse which often leads to rash driving ultimately ending up in deaths.

Conclusion

Head injury plays a major role in road traffic accidents causing death. Head injuries resulting from RTA's pose significant risk to individuals's health and well- being. Timely medical intervention,

rehabilitation, and support play essentials roles in minimizing the impact of the injuries affected individuals and families. Preventive measures such as seatbelt use, helmet enforcement, and adherence to traffic rules are crucial in reducing the incidence and severity of head injuries in RTAs. Continued public awareness, research, and policy implementation are vital in addressing this critical issue and enhancing road safety.

Public awareness campaigns, stringent enforcement of traffic regulations, infrastructure improvements, and technological advancements like advanced driver assistance systems (ADAS) all play crucial roles in reducing the frequency and severity of accidents. Education, training, and promoting responsible driving behaviours are equally important in fostering a culture of road safety. By combining these efforts, we can strive towards a safer road environment, saving lives, minimizing injuries, and ensuring the well-being of all road users.

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Original Article

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DNA Extraction from Postmortem Blood: A Pilot Study for Advancing Molecular Diagnostics in Forensic Medicine Casework

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Abstract

Background: DNA's role in forensic practice is widely acknowledged for its unparalleled accuracy in identification. While developed countries have established molecular autopsy programs as early as two decades ago, India is yet to initiate such a program. The isolation of DNA serves as the crucial first step in the molecular autopsy protocol. The postmortem blood sample is one of the good sources for DNA extraction which wasn't considered with rigor by the scientific community so far.

Aims and Objectives: The aim of this study was to investigate the specific time period within which DNA can be effectively extracted from postmortem blood samples. The objective was to identify if there are patterns in the quality and purity of the extracted DNA based on the postmortem interval. Additionally, the study aimed to investigate if the cause of death influenced DNA extractability.

Observation and Results: DNA can be extracted from postmortem blood within a timeframe of up to 72 hours after death, given that the deceased body was preserved in cold storage within 12 hours after death. Both the salting out method and the phenol chloroform method yielded bands of comparable quality, with the phenol chloroform method showing a slightly higher DNA yield. The average absorbance ratio was 1.4 for the salting out method and 1.6 for the phenol chloroform method, as determined using a Nanodrop.

Conclusion: This study concluded that DNA extraction from postmortem blood samples is feasible within 72 hours after death. The integrity of the DNA remained intact during this time, but the quality and purity gradually decreased as the postmortem interval increased. The cause of death did not significantly affect DNA extractability.

Keywords: DNA, Molecular Autopsy, Postmortem Blood, Sudden Death, Genomics.

Introduction

The role of DNA in the field of forensics is indispensable and it has attained the status of being referred to as the 'crystal ball of forensic science'. Traditionally, DNA data has been extensively used for identification in forensic pathology practice as

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well. However, with ever-increasing published data in molecular forensic medicine, postmortem DNA extraction will attain the status of a routine investigation like the vitreous humor chemistry, at least in all cases of sudden deaths in young individuals.

In Indian settings, the use of blood as a specimen for postmortem DNA caseworkis less due to the challenges associated with maintaining a cold chain and ensuring sample quality. As the extraction of DNA is usually carried out by forensic science laboratories, forensic pathologists regularly preserve the femur, sternum, or other bones as they withstand decomposition well and can be employed for the extraction of DNA successfully. The role of using blood for DNA extraction in Indian autopsy practice is often neglected and warrants exploration owing to its highly cost-effective nature.

The objective of this study is to investigate the timeframe within which DNA can be successfully extracted from postmortem blood samples for subsequent analysis. The study aimed to determine if there is a discernible pattern in the quality and purity of extracted DNA based on the time elapsed since death. Additionally, an attempt was made to identify any variations in DNA extractability based on the cause of death.

Materials and Methods

The present study was conducted at the Department of Forensic Medicine, Andhra Medical College, utilizing a convenient sample of 32 autopsy cases with known time since death. The study period spanned from May to July 2023. DNA isolation was performed at the Multi-Disciplinary Research Unit (MDRU) using two manual techniques: the salting out method and the phenol-chloroform method. Equipment employed in the study included a table top centrifuge, cooling centrifuge, electrophoresis unit, and Nanodrop. The consumables used were 5ml, 10 ml disposable syringes, EDTA vacutainers, 1.5 ml tubes, and pipette tips. Postmortem blood was collected directly from the heart of the deceased during the dissection and preserved at 4 degrees Celsius in EDTA vacutainers until they are transported to the laboratory. The process of extraction was carried out within a week after the collection of the specimen. The time required for each extraction method ranged from 1 to 1.30 hours. Ethical considerations were addressed through the inclusion of consent from the next of kin, ensuring adherence to ethical guidelines.

Results

The age and sex data were not collected to maintain utmost privacy in view of the fact that DNA is sensitive data, and they don't have any relevance to our study. The profile of the cause of death of cases in our study amongst the 32 cases is depicted in Figure 1.

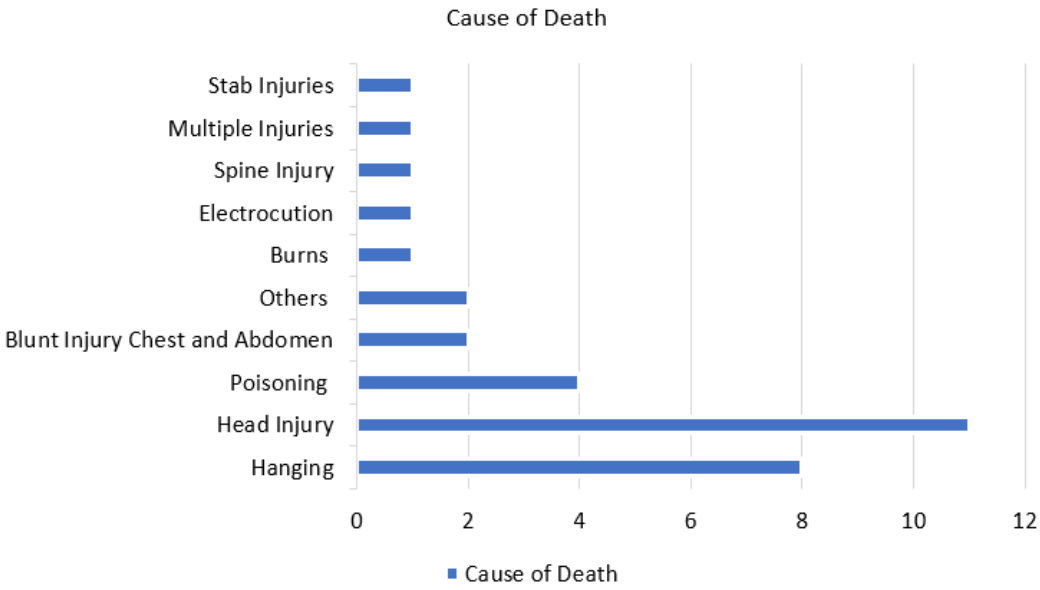

Figure 1: Medicolegal Profile of Cases in our Study

The two cases in the others section include an anaphylactic death due to a drug and crush injury of the pelvis.

In all cases, the time elapsed between the occurrence of death and the deposition of the deceased body in the freezer box was less than 12 hours. The timeframe varied, with some bodies being deposited as early as 1 hour after death, while others were placed in the freezer box within a maximum of 12 hours after the time of death.

DNA isolation was carried out using the salting out method and the phenol chloroform method to maintain cost efficiency. Throughout the process, challenges arose as most samples emitted unpleasant odors and exhibited clot formation, distinguishing them from the typical samples handled in the laboratory in clinical casework from live individuals.

The isolated DNA underwent assessment for both quality and quantity. The quality evaluation involved 0.8% Agarose gel electrophoresis to determine the intensity of DNA bands. Nucleic acid concentration, indicating DNA purity, was estimated using Nanodrop by calculating the absorbance ratio at 260 nm and 280 nm. A ratio of 1.8 is commonly accepted as indicative of "pure" DNA. Both the salting out method and the phenol chloroform method yielded bands of comparable quality. The phenol chloroform method showed a slightly higher DNA yield compared to the salting out method. The average absorbance ratio for the salting out method was 1.4, whereas, for the phenol chloroform method, it was 1.6.

The data pertaining to the relationship between time since death and extractability of DNA from postmortem blood using the salting out method and phenol-chloroformiso amyl alcohol method is tabulated in Table 1.

We encountered difficulties in obtaining blood samples without clots in cases where the time elapsed since death exceeded 72 hours, despite some of them being preserved in cold storage shortly after death. As a result, our attempts to extract DNA from these samples were unsuccessful. The quality evaluation of DNA using 0.8% agarose gel electrophoresis is shown in Figure 2.

Table 1: DNA Extractability (Different Methods) From Postmortem Blood and Time Since Death.

S.No.	Time Since Death Range	Number of Cases	Quality of DNA(Nanodrop) The ratio of absorbance at 260 nm and 280 nm	
			Salting out method	Phenol chloroform isoamyl alcohol method
1	0-12 hours	5	1.5 -1.6	1.6-1.7
2	12-24 hours	14	1.4 -1.5	1.6-1.7
3	24-48 hours	7	1.4-1.5	1.5-1.6
4	48-72 hours	6	1.3-1.4	1.5-1.6

The average values of the purity of the DNA and the corresponding quantity of the DNA are mentioned in Table 2.

Table 2: Average Purity and Quantity of DNA Extracted Using Different Methods

Extraction Method	Nanodrop (Absorbance at 260nm/280nm)	Quantity of DNA in ng/µl
Salting out method	1.4	104.276
Phenol chloroform isoamyl alcohol method	1.7	105.235

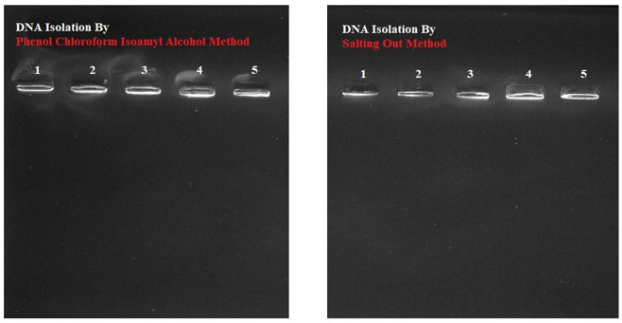

Figure 2: Quality Evaluation of DNA using 0.8% Agarose Gel Electrophoresis

Discussion

DNA extraction from nucleated cells can be carried out by various methods. The salting out method and phenol chloroform methods are time-tested and very economical in a low-cost setting wet lab. The commercial kit-based extraction is common in most laboratories these days.[1,2]

Molecular autopsy has become an integral part of modern forensic pathology, expanding the applications of DNA beyond its traditional role in identification. Over the past two decades, several developed countries have embraced the use of molecular autopsy programs, specifically through the development of genetic test panels aimed at investigating cases of sudden unexplained deaths in young individuals, believed to be of cardiac origin. In light of these developments, it is becoming essential to extract DNA from autopsy cases for ancillary investigations other than just for DNA profiling used in the identification business.[3] It is also worth a mention that researchers established a link between DNA degradation and Post Mortem Interval (PMI). The extracted DNA can be utilized for the purpose of studying the same in forensic casework.[4] The extracted DNA has to be stored at -20 degrees Celsius for further investigations.

Blood is widely regarded as an optimal source for DNA extraction, particularly when compared to challenging samples such as bone. In terms of ease of extraction, blood on FTA paper is highly recommended, while blood on gauze in a dried format also serves as a viable alternative. These blood-based samples offer the advantage of being relatively straightforward to collect and extract, making them cost-effective options in forensic investigations. However, to ensure the preservation of high-quality DNA for forensic casework, it is essential to establish the precise duration during which DNA can be reliably extracted from postmortem blood. This knowledge is crucial for developing robust protocols and maximizing the utility of blood samples in forensic applications.

The costs involved in the process of extracting the DNA and setting up a Molecular Forensic Medicine Unit (MFMU) in Forensic Medicine departments for that purpose are not as exorbitant as supposed by several people. The first step in molecular autopsy protocol is to extract high-quality and pure DNA which can be done by the forensic pathologist and his team with the bare minimum resources as demonstrated by us. Once the DNA is extracted, it can be subjected to a number of investigations like gene expression/polymorphism studies/mutation analysis using advanced genetic sequencing methods by collaborating with the molecular laboratory chain of ICMR.

This importance of genetic testing cannot be undermined in postmortem investigations, particularly in cases where there is uncertainty regarding the cause of death. Genetic testing can serve various purposes in postmortem work, including toxicogenomics studies to identify genetic factors associated with drug toxicity. Additionally, it plays a crucial role in investigating sudden cardiac death attributed to cardiomyopathies and other indications requiring molecular autopsy.[5,6]

In the context of India, the next critical step is to compile a comprehensive list of genes that should be included in molecular testing, considering the incidence and prevalence of arrhythmogenic cardiac diseases and other cardiomyopathies prevalent within the country. This preparatory phase is essential before launching a nationwide molecular autopsy program. It is of utmost importance to ensure that genetic testing is not conducted in isolation, but rather is accompanied by screening and counseling services for the next of kin.

The DNA isolation from samples collected within 72 hours of the time since death proved to

be effective. Beyond this timeframe, factors such as clotting of blood and contamination make the extraction of DNA more challenging. Furthermore, the DNA obtained through manual methods may not meet the quality requirements for Next Generation Sequencing work. It is important to emphasize that this study serves as a preliminary demonstration of the feasibility of isolating DNA from deceased individuals using minimal tools and resources.

We did not find any similar studies for comparison. There was no relation between the cause of death and the extractability of DNA from postmortem blood. Further studies are needed on higher samples to study this aspect of DNA extraction. Moreover, the preservation of the corpse in cold storage within 12 hours of death is one of the factors responsible for the successful extraction of DNA up to 72 hours after death in our study.

In a similar study, the integrity and extraction yield of DNA were higher in samples collected by emergency staff immediately after failed resuscitation whereas the DNA stability in autopsy specimens was highly variable and had unpredictable quality.[7]In contrast, our study established that postmortem blood can be a good source for DNA extraction up to 72 hours after death.

In another study, researchers reported that It was not possible to collect blood from 38 % of the autopsy cases (Post Mortem Interval ranging from 1 to 14 days) due to severe coagulation and hemolysis, whereas muscle tissue was available for all cases.[8]The consistency of DNA yields from blood samples varied due to sample inhomogeneity, although blood clots were found to be rich in DNA.[9]

The ability to extract DNA from postmortem blood samples is influenced by various factors that affect the decomposition process. It is important to consider these factors when applying the findings of our study in practical settings. Additionally, further studies with larger sample sizes should be conducted to explore seasonal variations and the impact of temperatures below 4 degrees Celsius on preserving corpses, with the aim of extending the timeframe for successful DNA extraction.

Conclusion

In conclusion, this study demonstrated that DNA can be successfully extracted from postmortem blood samples within a timeframe of up to 72 hours after death. The integrity of the DNA remained preserved during this period, although a gradual decline in the quality and purity of the extracted DNA was observed with increasing time since death. No significant variations in DNA extractability were found based on the cause of death. The departments of Forensic Medicine and Toxicology should consider the establishment of Molecular Forensic Medicine Units (MFMU) for advancing the cause of molecular autopsy in our routine casework in the interest of justice.

Ethical considerations: Addressed by the authors.

Conflicts of interest: None to declare

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Fasciotomy in Snake Bite Victims and Renal Outcome in a Tertiary Care Hospital

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Abstract

Background: Snake bite is a neglected tropical disease. More than 50% of death due to snake bite in the world occurs in India. Acute kidney injury (AKI) is the cause of morbidity and mortality in viper bite. The compartment syndrome is a rare manifestation of snake bite. There is paucity of data on the role of fasciotomy in viper bite.

Methods: A prospective observational study was done in patients admitted to a tertiary care hospital in south India, with snake bite-associated acute kidney injury, from March 2018 to March 2020.

Results: Sixteen % of patients underwent fasciotomy following snake bite. We compared the renal outcome of 21 patients, who had undergone fasciotomy following snake bite, with 65 patients with dialysis-requiring acute kidney injury following snake bite. The patients in the fasciotomy group had a lower peak serum creatinine (5.3 mg/dl), needed less number of dialysis sessions (3.9) and were on lesser number of days (6.1) on dialysis following snake bite, when compared with the group not needing fasciotomy.

Conclusion: In snake bite patients presenting with compartment syndrome, fasciotomy should be considered in view of favourable renal outcome.

Key words: Compartment syndrome, Fasciotomy, Renal outcome, Snake bite

Introduction

Snake bite is an occupational hazard of rural Indian population. In India about 0.5% of death is due to snake envenomation each year, mostly in young individuals.[1] Russel's viper is the most common cause of mortality due to snake bite in south India.[2] The presenting symptoms of Russel's viper bite are cellulitis (96.7%), regional lymphadenopathy (89.5%), and bleeding manifestations (23.8%).[3] Local manifestations are more severe in Russel's viper bite including swelling, bleeding, blistering, necrosis and sometimes, severe swelling and

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pain leading to compartment syndrome. The development of cellulitis is one of the risk factors for acute kidney injury.[2] Fasciotomy may be needed to reduce tissue pressure in some cases of viper bite. There is risk of fasciotomy, for the victim due to the combination of consumption coagulopathy, thrombocytopenia, and enhanced fibrinolysis.[4] We aimed to study the renal outcome of viper bite victim, who had undergone fasciotomy to reduce intra compartmental pressure.

Methods

This is a prospective observational study done in a tertiary care hospital, Government Mohankumaramangalam Medical College Hospital, Salem from March 2018 to March 2020. The study was approved by the Institutional ethics committee (GMKMCH/2623/IEC/01/2016 -63).

We included all snake bite patients in the age group of 15 to 70 years developing acute kidney injury, by elevation in serum creatinine of at least by 0.3 mg/dl within 48 hours or 1.5 times the reference creatinine by Kidney Disease Improving Global Outcome (KDIGO) criteria. The snake bite patients with pre-existing chronic kidney disease, with no cellulitis and with pure neurotoxic envenomation were excluded.

All patients underwent the following investigations: 20-minute whole blood clotting time, complete blood count, blood urea, serum creatinine, urine analysis and prothrombin time. The creatinine phosphokinase and lactate dehydrogenase estimation were done in selected patients. The patients who developed AKI underwent ultrasound abdomen. The patients were treated with intravenous (IV) fluids and IV antibiotics. Anti-snake venom (ASV) was given according to local symptoms or systemic envenomation in the form of coagulopathy or neurotoxicity. Some patients with features of clinical compartment syndrome in the form of pain on passive movement, pallor, pulseless limb, hypoesthesia over the territory of sensory nerve passing through the compartment underwent fasciotomy, after adequate antivenin administration and correction of coagulopathy according to the surgeon's clinical decision. Intra-compartmental pressure was not measured.

Early fasciotomy was defined as those who had undergone fasciotomy within 36 hours of bite, and late fasciotomy between 36 to 72 hours of bite. Patients who had undergone fasciotomy less than 72 hours after snake bite and developed renal failure, were compared to those patients with similar age and who had similar bite-to-ASV time and developed AKI, for renal outcome in the form of peak creatinine, oliguria (defined as less than 500ml/day) and duration of dialysis requirement. The AKI patients, managed conservatively were excluded from the final analysis.

The continuous variables were described as Mean ± standard deviation and categorical variables were described in %. Fisher's exact test was used for categorical variables. The statistical analysis was done using one-way ANOVA test (SPSS software). The P value < 0.05 was considered statistically significant.

Results

After obtaining informed written consent, the clinical details of 186 patients including 68(37%) females with snake bite AKI due to hemotoxic envenomation were collected. Among 186 patients, 47 patients with AKI were managed conservatively and 139 (75%) patients needed renal replacement therapy in the form of peritoneal dialysis or haemodialysis. Fasciotomy was done in 29(16%) patients.

Among the dialysis-requiring renal failure, 107(77%) patients were oliguric. Fasciotomy was done in 5 out of 47 patients with AKI managed conservatively and 24 (17%) out of 139 patients with dialysis-requiring AKI.

In the final analysis, 3 patients with bite-to-fasciotomy interval of more than 5 days were excluded. The remaining 21 patients including 5 females with dialysis-requiring snake bite AKI, who underwent fasciotomy were matched with those who did not need fasciotomy following snake bite AKI, with similar age and bite-to-ASV time.

After matching, 86 patients including 30(35%) females with dialysis-requiring snake bite-AKI were stratified into two groups and compared.

Group 1 underwent fasciotomy in less than 72 hours following snake bite– 21

Group 2 who did not undergo fasciotomy following snake bite – 65

The patients were in the age range of 15 to 70 years. The time delay in initiation of ASV after bite was similar in both groups in the range of 1 to 16 hours. The total dose of ASV received by the participants were a minimum of 10 vials and a maximum of 45 vials during the study period. The total dose of ASV received by the snake bite victims was significantly more in those who had developed compartment syndrome needing fasciotomy (Table 1).

Table 1: Comparison of Age of the patient, Dose and Timing of ASV

Parameters	Group 1	Group 2	Significance	
	Mean ± Standard deviation		F Stat	P-value
Age in years	41.1 ±15.7	46.3 ± 14.7	1.91	0.07
Time delay in ASV initiation (hours)	4.9 ± 3.8	5.2 ± 4.2	0.08	0.77
Total number of ASV vials given	31.5 ± 7.4	26.1 ± 7.1	8.93	0.004

ASV – anti-snake venom

Comparison of renal outcome

In the fasciotomy group, significantly a greater number of patients presented with non- oliguric AKI (43%) following snake bite (Table 2).

Table 2: Fasciotomy and Oliguric renal failure.

Group	Oliguric AKI	Non-oliguric AKI	Total
Fasciotomy	12	9	21
No Fasciotomy	53	12	65
Total	65	21	86

P- value = 0.04, AKI – acute kidney injury

The peak creatinine in the dialysis-requiring AKI patient following snake bite, who have undergone fasciotomy was significantly less. The number of days on dialysis and the number of dialysis sessions needed by the AKI patients following snake bite who have undergone fasciotomy were also significantly less (Table 3).

Table 3: Fasciotomy and Peak of serum creatinine and Dialysis vintage

Parameters	Group 1	Group 2	Significance	
	Mean ± standard deviation		F Stat	P-value
Peak serum creatinine mg/dl	5.3 ± 2.5	6.9 ± 2.5	6.98	0.01
No of days on dialysis	6.1 ± 3.9	10 ± 6.9	6.30	0.01
No of sessions of dialysis	3.9 ± 2.2	5.9 ± 3.2	6.81	0.01

Early vs Late Fasciotomy and Renal outcome

Early fasciotomy was done in 12 patients and 9 patients underwent late fasciotomy. In the early fasciotomy group, even though patients had low peak serum creatinine and needed a lesser number of dialysis sessions, when compared to those who underwent fasciotomy more than 36 hours after bite, it was not significant (Table 4). This may be due to low number of patients in both groups.

Table 4: Early vs Late fasciotomy and Renal outcome.

Parameters	Early fasciotomy	Late fasciotomy	Significance	
	Mean ± standard deviation		F Stat	P-value
Peak serum creatinine mg/dl	4.5 ± 2.5	6.3 ± 2.4	2.69	0.12
No of days on dialysis	5.1 ± 2.5	7.2 ± 5.1	1.59	0.22
No of sessions of dialysis	3.4 ± 1.5	4.7 ± 3.7	1.80	0.20

Discussion

In India, snake bite is commonly due to Russell's viper or Echis carinatus, which causes AKI.[5] The causes of AKI following snakebite are due to many factors including hypotension, haemolysis, rhabdomyolysis, disseminated intravascular coagulation and direct cytotoxicity.[6,7]

Snake envenomation mimics compartment syndrome.[8] However, true muscle compartment syndrome following snakebite is quite rare. The detection of arterial pulses by palpation or doppler ultrasound probes, does not exclude intra compartmental ischaemia.[4] In compartment syndrome, pulselessness is seen only at a late stage associated with vascular injury. The sensitive sign is loss of two-point discrimination.[9] The most reliable test is to measure intra compartmental pressure (ICP) directly through a cannula introduced into the compartment and connected to a pressure transducer or manometer. Normal resting muscle pressure is less than 8 mmHg and pain and paraesthesia appear at 20 to 30mmHg. If pressure is more than 30 mmHg, fasciotomy is indicated.[10] In patients with hypotension, muscle damage from compartment syndrome can occur at ICP of 20 mmHg for 6 hours.

According to Toschlog EA et al, the proportion of patients needing fasciotomy following snake bite was 3.4% to 13% of hospitalized patients.[11] According to Tanen DA et al, administration of adequate doses of antivenom reduces compartment pressure in animal experiments and eliminate the need for fasciotomy.[12] Antivenom administration is indicated in all cases of compartment syndrome and fasciotomy should be performed in cases where aggressive antivenom therapy fails to correct impaired tissue perfusion.[13] The fasciotomy has its own complication. The complications of fasciotomy include soft tissue infection, swollen limb, tethered scar, and venous insufficiency due to poor calf muscle function.[14,15]

Renal outcome

According to Chawla LS et al, predictors of long-term poor renal outcome following AKI include advanced age, presence of diabetes, low serum albumin levels, and severity of AKI, as assessed by serum creatinine levels during hospitalization. In their study each 1 mg/dl rise in serum creatinine, increases the Odds of reaching CKD stage 4, by 50%.[16] In addition to the severity of AKI, the duration of AKI is also an important prognostic determinant of long-term outcome. According to Mehta S et al, the duration of AKI was independently associated with long-term mortality, cardiovascular (CV) events, and development of incident CKD Stage 3.[17]

The increased pressure in the subcutaneous and sub-fascial compartments in limb is associated with venom sequestration. In our study, the reduced compartment pressure after fasciotomy, causes less sequestration of toxin and less local damage, leading to less inflammatory mediator release and it may be the factor for less severe renal failure, in the form of lower peak serum creatinine and shorter duration of dialysis dependency following snake bite AKI presenting with compartment syndrome.

Conclusion

Fasciotomy was needed in 16% of viper bite victims. The patients who had undergone fasciotomy, needed more anti-snake venom following snake bite. The peak creatinine and duration of dialysis dependency were less, in those who underwent fasciotomy following snake bite. In view of favourable renal outcome, early fasciotomy should be judiciously considered in viper bite victims with compartment syndrome, after adequate ASV administration.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Original Article

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Evaluation of the Effectiveness of an Alternate Diatom Extraction Procedure in Diatomological Study

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Abstract

Background: The "Diatom Test" is based on the recovery of diatoms in high concentration in the organs of drowned persons because diatoms pass through the alveoli into the great circulation. Acid digested extracts of various internal organs and water collected from waterbodies demonstrate the presence of diatoms. If quantitatively and qualitatively these diatoms match to each other, that is the confirmatory diagnosis of death due to drowning in that drowning medium. This study was conducted to analyze the effectiveness of alternate method of diatom extraction using diluted Sulphuric acid solution and to compare its effectiveness with the traditional method of extraction of diatoms using concentrated nitric acid.

Methods: It was a prospective study. Samples were collected from ten different water bodies which included lakes, rivers, canals and reservoirs, for a period of one year in all the seasons. The pH and temperature of water were recorded during sampling. From each of water samples, diatoms were extracted using both classical and alternate method. And then compared by observing the diatoms at 100X magnification under compound microscope. Total 22 genera of diatoms were identified. Most of them were pennales and few were centrales. The time demanded for complete digestion of samples with strong acids like concentrated nitric acid was much lesser time than with diluted acids as it hasstronger digestive capability in comparison to diluted sulphuric acid. The structures of different diatoms specifically Cyclotella, Cybella, Navicula were better found in almost intact state with clear background after digestion by diluted sulphuric acid.

Conclusion: Depending on different criterion, digestion by diluted sulphuric acid has procured better result than concentrated nitric acid digestion method. Therefore, for qualitative and quantitative diatom analysis alternate diatom extraction method is a better choice than traditional method.

Key Words: Diatom extraction, Drowning, Nitric acid, Diluted sulfuric acid

Introduction

The diatom test for the diagnosis of drowning is based on the assumption that diatoms, which are eukaryotic unicellular algae, reach the lung with inhalation of liquid and if effective cardio-circulatory activity exists, penetrate the pulmonary filter and disseminate to organs through the blood stream.[1] Conversely, if a corpse is submerged Postmortem, the diatoms may penetrate passively into the airways, but, owing to the lack of cardiac activity,

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will not be transported to other organs[2]. These diatom and algal communities can vary from one water body to another. Water bodies with similar chemical and physical compositions develop similar but not identical diatom community. Various genera and species of diatoms establish themselves within the specific water bodies based on their nutrient and light requirements and therefore they can differ from one water body to another both qualitatively and quantitatively with climatic or seasonal changes. Some local factors like mineral content of water, temperature, water stratification, acidity, the distance from shore, the depth of sea and the tide, etc. do affect the diatom concentration in any water bodies.[3]

Acid digested extracts of various internal organs and water collected from waterbodies demonstrate the presence of diatoms. If quantitatively and qualitatively these diatoms match to each other, then that is the confirmatory diagnosis of death due to drowning in that drowning medium.[5] In traditional method, this diatom test involves digestion of the tissues by strong acids: this treatment may destroy diatoms with the risk of a false negative test result.[7] On the other hand, the use of other methods such as enzymatic digestion with proteinase K, digestion by diluted acids are very uneconomical and not for the exhaustive extraction of some species of diatoms.[8,9]

As Malnad region of Karnataka has lot of freshwater resources which accounts to many deaths due to drowning, hence here an attempt was done to collect and analyze water samples for a period of one year from different freshwater bodies likes rivers, lakes, dams, canals etc., from in and around Shimoga city for diatom distribution.[4,6] After that a comparative analysis was conducted between the traditional method and alternate method of diatom extraction to evaluate their effectiveness.

Objective:

To compare the traditional method of diatom extraction using strong nitric acid at 90° C with alternate method of diatom extraction by addition of diluted 30% of H2 SO4 with a small amount of organic matter, maintaining overnight at room temperature.

Material and Method

Type of the study:

It is a comparative analytical study

Study period: For a period of 1 years from March, 2014 to February 2015

Materials used for analysis:

1. **Water Sampling Jar of one litre capacity**- for collection of water sample from the water bodies.
2. **Laboratory Thermometer**- which has engraved graduations, with a range of from -5º C to +100°C with 0.5°C divisions.
3. **pH meter**- ESICO, Model 1012 microprocessor-based pH system
4. **Conc. Nitric Acid**- used for extraction of diatoms by chemical digestion method (classical method)
5. **30% Sulphuric acid**- used for extraction of diatoms by chemical digestion method (alternate procedure)
6. **Sterile conical measuring glass jar**- used to hold the water and acid mixture
7. **Glass pipette**- to transfer test solutions
8. **Sterile plastic centrifuge tubes-** used for centrifugation in centrifuge machine
9. **Centrifuge Machine:** Remi, laboratory medical centrifuge.
10. Glass microslides and coverslip
11. Compound Microscope

Methodology

Collection of water sample:

Water samples were collected from different geographical localities of Malnad region. The water samples were collected from 10 different water bodies numbered S1- S10 (which include threelakes, two canals, two rivers, two dams and one domestic source) once in 2 months covering all the seasons.[6] Six collections were made during a span of one year. The water samples were collected just below the surface of water using sterilized plastic containers of one litre capacity. The pH and temperature of water were recorded during sampling. [4]

Extraction and Analysis of Diatoms:

Extraction of diatoms from water was done using chemical digestion by two methods concentrated nitric acid method and 30% Sulphuric acid method. From each of the water sample 200ml of water was

taken and divided into two equal parts of 100ml each and was transferred into an acid washed glass beaker. Samples were added with concentrated 25ml of nitric acid in one and 25 ml of 30% Sulphuric acid into the other and then samples were allowed to stand undisturbed for 2 h. These samples were transferred to properly label plastic centrifuge tubes and centrifuged at 3000 rpm for 10 min. The supernatant was pipetted out leaving behind only a residual material. This residual material was suspended in distilled water and centrifuged again in the same way to ensure that even the traces of acid were removed. After final centrifugation except for 1ml the whole supernatant was discarded by pipetting out. The left-over aspirate poured over a clean microscopic glass slide is dried, mounted with DPX and analyzed with optical compound microscope fitted with light source at different magnifications. Diatom species were identified on the basis of available literature.[3,4]

Diatom identification:

Both the methods were compared by identifying the diatoms separately at 100X magnification under compound microscope.

Results

After analysis of the water samples, diatoms were observed in all the samples. Totally 22 genera of diatoms were identified by these two techniques. Each of these diatoms showed distinguished pattern of morphological features. The cell wall or frustule of diatoms were of either of two body plans pennales and centrales, and most of them belong to pennales and few were centrales. The intact diatoms identified in different water bodies are summarized employing the two different extraction methods (table 1&2). Two different extraction methods were compared based on these four criteria:

1. **Time-consumption for complete digestion:** Strong acids like concentrated nitric acid have taken much lesser time than diluted acids for complete digestion of equal quantity of tissue.
2. **Digestive capability:** The degree of digestion for different tissues in the limited time (2 h) was also compared by the weight of the precipitate after digestion. Concentrated nitric acid had the strongest digestive capability in comparison to diluted 30% sulphuric acid.
3. **Destruction to diatoms:** The structures of different diatoms specifically Cyclotella, Cybella, Navicula were found inmostly in intact state with clear background and little impurity after digestion by diluted 30% sulphuric acid. However, they were destroyed to greater extent by traditional method of using strong acid. Few intact Cyclotella, Cybella and their fragments could be found in the residue, but no intact Navicula could be discovered after using traditional method of tissue digestion.
4. **Reclaiming ratio of diatoms:** Cyclotella, Cybella, Navicula were better found and remained almost intact with clear background in alternative method of digestion, thereby giving a better reclaiming ratio of diatoms in comparison to the traditional method of tissue digestion.

Table 1: Identification of intact Diatoms in various Water Bodies using classical method

Diatoms	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
Achnanthes	-	-	-	-	+	-	+	-	-	-
Amphora	-	-	-	+	-	+	-	-	-	-
Astrerionella	+	-	-	+	-	+	-	-	-	+
Brachysira	-	-	-	-	+	-	+	-	-	-
Calonies	-	+	-	-	-	-	-	-	+	-
Cyclotella	-	-	+	-	-	-	-	-	-	-
Cymbella	+	-	+	-	-	-	+	-	+	-
Cocconeis	+	-	-	-	-	-	-	+	-	-
Ctenophora	-	-	-	+	-	+	-	-	-	-

Continue.....

Diatoma	-	+	-	-	-	-	-	-	+	-
Eunotia Pectinalis	-	-	+	+	-	-	-	-	-	-
Fragilaria	-	-	-	-	+	-	+	-	-	-
Gomphonema	-	-	-	-	+	-	+	-	+	-
Melosira	-	-	-	-	+	-	+	-	-	-
Navicula	-	-	-	-	-	-	-	-	-	-
Nitzschia	-	-	-	-	-	-	-	+	-	-
Pinnularia	-	+	-	+	-	-	-	-	-	-
Pleurosira	-	-	-	-	-	-	-	+	-	-
Surirella	+	-	-	+	-	-	-	-	+	-
Synedra	+	+	-	+	+	+	-	+	+	-
Tabellaria	-	-	+	+	-	-	-	-	-	-
Talassiosira	-	+	-	-	-	-	-	+	-	-

Table 2: Identification of intact Diatoms in various Water Bodies using alternate method

Diatoms	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
Achnanthes	+	+	-	-	+	-	+	-	-	-
Amphora	-	-	-	+	-	+	-	-	-	-
Astrerionella	+	-	+	+	-	+	-	-	+	+
Brachysira	-	-	-	-	+	-	+	-	-	-
Calonies	-	+	-	-	-	-	-	-	+	-
Cyclotella	+	+	+	+	+	+	-	-	+	-
Cymbella	+	+	+	+	-	-	+	+	+	+
Cocconeis	+	-	-	-	-	-	-	+	-	-
Ctenophora	-	-	-	+	-	+	-	-	-	-
Diatoma	-	+	-	-	-	-	-	-	+	-
Eunotia Pectinalis	-	-	+	+	-	-	-	-	-	-
Fragilaria	-	-	-	-	+	+	+	-	-	-
Gomphonema	-	-	-	-	+	-	+	-	+	-
Melosira	-	-	-	-	+	-	+	-	-	-
Navicula	+	+	+	+	+	-	+	+	+	+
Nitzschia	-	-	-	-	-	-	-	+	-	-
Pinnularia	-	+	-	+	-	-	-	-	-	-
Pleurosira	-	-	-	-	-	-	-	+	-	-
Surirella	+	-	-	+	-	-	-	-	+	-
Synedra	+	+	+	+	+	+	+	+	+	-
Tabellaria	-	-	+	+	-	-	-	-	-	-
Talassiosira	-	+	-	-	-	-	-	+	-	-

Discussion

For qualitative and quantitative diatom analysis as far as the applicability concerned, an ideal diatom test should have-

(1) Simple, safe and time saving digestive process

(2) Cheaper instruments and reagents required

(3) The damage due digestive reagents to diatoms should be mild with higher reclaiming ratio of intact diatoms.

(4) The organic residue should be minimal and hardly interfere with microscopic observation.

Therefore, Proper digestive method should be chosen to increase the sensitivity of the diatom test to its maximum value.[10]

Our study compared the effectiveness of traditional and alternative digestive technique for diatom extraction in respect to the time demanded by the methods, digestive capacity, damage to the tissues and reclaiming ratio of the diatoms. Morphological examination of Diatoms revealed 22 genera of diatoms in both digestion methods. Most of these identified diatoms were belonged to ''Pennales" and few were of ''Centrale" diatoms.

The identification of diatom shells in lung and other internal organs requires the complete destruction of the organ tissues to be examined except for the diatom frustules. The most common extraction technique consists of chemical digestion by nitric or sulfuric acid, solubilizers (e.g., soluene 350), or enzymes (e.g., proteinase K). Incineration has been used for fatty-rich samples; the resulting ashes being treated by oxidizing acid.[7]

Several procedures have been developed to replace the original acid digestion method for extracting frustules from human tissues. Most of the methods rely on alternative chemical or physiochemical means to solubilize the tissue. Although many methods have been suggested as alternatives to acid digestion, there is no evidence for improved yield of frustules as in acid digestion.[9]

During acid digestion the tissue sample is digested using strong acids where the tissues get completely digested leaving behind the diatom frustules which are made up of silica shells and resist acid digestion.[10]

The extraction of diatoms is usually done by classical method. The addition of diluted 30% Sulphuric acid showed better results than the classical method in respect to the reclaiming ratio of diatoms. The advantage over this technique proposed in the literature is that it is also possible to use a smaller amount of organ and smaller volume of already diluted acid without increasing sediment and avoiding the consequent difficulties observed in microscopic analysis. [11]

In a study conducted in Italy on ten dead bodies where the investigator tested minimal amount of diluted Sulphuric acid solution to detect diatoms in tissues and the method was compared with traditional method of digestion with large amount of strong mixture of Sulphuric acid and nitric acid where diluted Sulphuric acid showed better results than the classical method with Sulphuric acid and nitric acid at high concentration.[12] Similarly in our study on water bodies also better results were observed using dilute Sulphuric acid rather than using concentrated nitric acid methods.

Regarding digestive capacity and the time required to digest same amount of tissue, traditional method was found to be more effective rather than the alternate method because of its aggressive nature. But the proposed alternate procedure is less chemically hazardous for the operator and the laboratory. It is also cheaper and yields more reliable results than those for the enzyme and the traditional methods.[13]

Conclusion

The purpose of an extraction system is that it should not be too aggressive and should not destroy the siliceous material, but it will ensure the complete extraction of these algae from the human organs. Our study demonstrated that different diatoms have different resistance to different digestive reagents. Therefore, in respect to the reliability and applicability of the diatom test concerned, digestion by diluted sulphuric acid is of the better choice than concentrated nitric acid. The classic extraction causes aggressive digestion with lesser amount of intact demonstrable diatoms and higher presence of destroyed fragments. So, this alternate method can be the substitute of the traditional extraction method.

Ethical Clearance: Yes. (Ref. no: SIMS/IEC/88/13-14- By IEC, Shimoga Institute of Medical Sciences, Karnataka) Date: 24 Nov, 2013

Conflict of Interest: None

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Original Article

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Age Estimation among 12-18 Years Children by Studying the Ossification Centers of Hip Joint and Pelvis

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Abstract

Background: Bone age is an indicator of the skeletal and biological maturity of an individual. Skeletal ossification progression studies are one of them and are admissible in court as unparalleled scientific evidence for age estimation. Age group of juveniles between 12 - 18 years is dealt with special laws for medico- legal cases.

Aims & Objective: To observe age of appearance and fusion of ossification centers of hip joint and pelvic bone in adolescent population of Jaipur.

Material & Methodology: An observational prospective study that used inclusion and exclusion criteria was conducted. Healthy Adolescents of 12-18 years of age group from Jaipur were taken in the study. The present study had been conducted in the Department of Forensic Medicine & Toxicology, SMS Hospital, Jaipur with Department of Radiology, SMS Medical College and Attached Hospitals, Jaipur during the period from June 2021 to May 2022.

Result & Observation: Appearance of triradiate cartilage was found earliest at the age of 12 – 13 years in both sexes, complete fusion was found earliest at the age 13 - 14 years in females and 14 – 15 years in males. Appearance of ossification centre of Ischial Tuberosity was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in females and was not found in males. Appearance of ossification centre of Iliac Crest was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in both male & females. Appearance of ossification centre of Pubis was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in females and was not found in males.

Conclusion: Appearance and fusion of ossification centers for hip joint & pelvis joint can be implemented in routine forensic practice for 12 – 18 years age group to opine about age of subjects with lesser age range.

Key word: Age estimation, Hip Joint, X-ray, Pelvis, Ossification.

Introduction

Bone age is an indicator of the skeletal and biological maturity of an individual[1]. Various radiological methods have been developed for skeletal age estimation, one of the simplest, oldest and most commonly used method of bone age calculation is the study of ossification centers[2].

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Skeletal ossification progression studies are one of them and are admissible in court as unparalleled scientific evidence for age estimation[3]. Age group of juveniles between 12 - 18 years is dealt with special laws for medico- legal cases. For forensic experts in India, age estimation is a challenging task as criminal responsibility of these juveniles depends on it[4] ; as In India, most of the children especially those residing in rural areas are facing much problems related to dietary habits, social customs, etc and diet deficient in essential components like vitamins and minerals influence the growth of bones[5]. Timing of epiphyseal union is an important means to estimate the age of adolescent and young adult skeletons[6]. There is scarcity of available literature for age of appearance and fusion of ossification centres of hip joint and pelvis in natives of Jaipur, hence this study is being undertaken to analysis age of fusion at hip joint and pelvis adolescent population of Jaipur.

Aim and objectives

Study was conducted to determine age of appearance and complete fusion of Tri-radiate cartilage, Ischial tuberosity, Iliac crest and Pubis among adolescent age group.

Materials and Method

A prospective analytical study was done from June 2021 to May 2022 for age determination by estimating the ossification centers of hip joint. The study was undertaken after taking institutional ethical committee approval at Department of Forensic, SMS Medical College and Attached Group of Hospitals, Jaipur in collaboration with Department of Radiology, SMS Medical College and Attached Hospitals, Jaipur. 10 subjects each of both genders were included for yearly interval for adolescent age group (12-13,13- 14,14-15,15-16,16-17,17-18) i.e. 20 in each group (10 males and 10 females); and 120 subjects were included in the study who gave written informed consent for participation in the study were included in this study. We excluded Subjects with Chronic illness, Endocrinal disorders, Severe malnutrition- weight/age <60%, Radiographs that displayed major anomalies or Previous skeletal trauma (e.g., fractures) of the bones and Chronic drug intake affecting development like e.g.-antiepileptic drug, steroid.Plain radiographs of Pelvis and Hip joints were done for each subject in the Department of Radiology on Digital X-ray machine and the X-ray film was obtained for observation of appearance and completed fusion of the various ossification centers of the Pelvis and Hip joint. All Radiographs were done on same machine using the same technique and the X-rays were observed by the same set of observers i.e., the investigator under supervision of the co-guide from the Department of Radiology.

The staging was done according to staging given by **Sankhyan,** 1993[7]

Stage 1: Ossification Center Not Appeared. Stage 2: Ossification Center Appeared. Stage 3: Partial fusion.

Stage 4: Recent Fusion

Stage 5: Old Fusion.

All data was gathered and stored in Microsoft Excel data sheet and further tabulated, charted and analysed.

Observations and Results

In present study we had taken 10 male & 10 female in each six group, A(12-13 years), B(13-14 years), C(14-15 years), D(15-16 years), E(16-17 years), F(17-18 years).

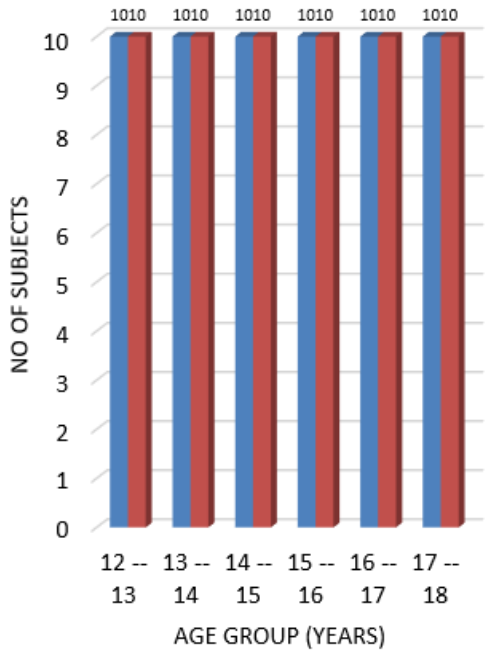

Figure 1: Showing Age Group & Gender Wise Distribution Of Subject

Table 1: Staging of Ossification Center in Age group 12 – 13 years.

12 – 13 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	04	03	03	00
	F	00	00	05	05	00
Ischial Tuberosity	M	09	01	00	00	00
	F	06	04	00	00	00
Iliac Crest	M	09	01	00	00	00
	F	06	04	00	00	00
Pubis	M	08	02	00	00	00
	F	04	06	00	00	00

Table 2: Staging of Ossification Center in Age group 13 – 14 years.

13 – 14 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	03	03	02	02
	F	00	00	01	09	00
Ischial Tuberosity	M	09	01	00	00	00
	F	05	05	00	00	00
Iliac Crest	M	08	02	00	00	00
	F	02	08	00	00	00
Pubis	M	07	03	00	00	00
	F	04	06	00	00	00

Table 3: Staging of Ossification Center in Age group 14 – 15 years.

14 – 15 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	01	04	03	02
	F	00	00	03	04	03
Ischial Tuberosity	M	06	04	00	00	00
	F	03	07	00	00	00
Iliac Crest	M	05	05	00	00	00
	F	01	09	00	00	00
Pubis	M	02	08	00	00	00
	F	01	09	00	00	00

Table 4: Staging of Ossification Center in Age group 15 – 16 years.

15 – 16 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	00	03	03	04
	F	00	00	00	04	06
Ischial Tuberosity	M	03	07	00	00	00
	F	00	08	02	00	00
Iliac Crest	M	02	08	00	00	00
	F	00	08	02	00	00
Pubis	M	00	09	01	00	00
	F	00	08	02	00	00

Table 5: Staging of Ossification Center in Age group 16 – 17 years.

16 – 17 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	00	00	02	08
	F	00	00	00	01	09
Ischial Tuberosity	M	00	09	01	00	00
	F	00	06	04	00	00
Iliac Crest	M	00	09	01	00	00
	F	00	07	03	00	00
Pubis	M	00	07	03	00	00
	F	00	05	04	01	00

Table 6: Staging of Ossification Center in Age group 17 – 18 years.

17 – 18 Years		I	II	III	IV	V
Triradiate Cartilage	M	00	00	00	00	10
	F	00	00	00	00	10
Ischial Tuberosity	M	00	05	03	02	00
	F	00	01	06	02	01
Iliac Crest	M	00	01	07	01	01
	F	00	01	04	04	01
Pubis	M	00	05	03	02	00
	F	00	01	05	02	02

Appearance of triradiate cartilage was found earliest at the age of 12 – 13 years in both sexes, complete fusion was found earliest at the age 13 - 14 years in females and 14 – 15 years in males.

Appearance of ossification centre of Ischial Tuberosity was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in females and was not found in males.

Appearance of ossification centre of Iliac Crest was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in both male & females.

Appearance of ossification centre of Pubis was found earliest at the age of 12 – 13 years in males and females; old fusion is earliest found at the age of 17 - 18 years in females and was not found in males.

Discussion

Table 7: Appearance and Fusion of the Ossification Centre of Tri-Radiate Cartilage:

	Tri-radiate Cartilage			
	Appears		Fusion	
	Male	Female	Male	Female
N. Reddy[46]	13		14	
Bhaisoria & Chaudhary[47]	10-13	12-13	14-15	14
Apurba Nandy[48]	10-14	12-14	14-16	15
Bardale Rajesh[49]	-	-	15-16	13-14
Krishnan MKR[50]	-	-	14-15	13-14
Yatiraj S[29]	-	-	16-17	15-16
Mathur I[42]	12-13	12-13	15-16	15-16
Srinivas NM[38]	-	-	15-16	14-15
Present study	12-13	12-13	15-16	15-16

In present study Ossification of triradiate cartilage appears at the age of 12 – 13 years in majority of subjects in both male & female which is comparable to the study of **N. Reddy; Bhaisoria & Chaudhary**; **Apurba Nandy** and **Mathur I,** however there is no comment about appearance of ossification center in study of **Bardale Rajesh**; **Krishnan MKR; Yatiraj S** and **Srinivas NM.**

In present study Ossification of triradiate cartilage complted by the age of 15 – 16 years in majority of male subjects & female subjects which is comparable to the study of **Apurba Nandy; Bardale Rajesh; Mathur I** and **Srinivas NM** in males and **ApurbaNandy**; **Yatiraj S** and **Mathur I** in females. However there is early fusion in males present in study of **N. Reddy; Bhaisoria & Chaudhary** and **Krishnan MKR** and early fusion in females present in study of **N. Reddy; Bhaisoria & Chaudhary; Bardale Rajesh**; **Krishnan MKR** and **Srinivas NM** and there is delayed fusion in males in study of **Yatiraj S.**

Table 8: Appearance and Fusion of the Ossification Centre of Iliac Crest:

	Iliac Crest			
	Appears		Fusion	
	Male	Female	Male	Female
N. Reddy[46]	14		20-21	
Bhaisoria & Chaudhary[47]	17	14	19-20	17-19
Apurba Nandy[48]	16	15	19-20	17-19
Bardale Rajesh[49]	17	14	19-20	17-19
Krishnan MKR[50]	15-17	14-16	19-20	18-19
Yatiraj S[29]	-	-	16-17	15-16
Mathur I[42]	15-16	15-16	20-21	19-20
Srinivas NM[38]	-	-	16-17	15-16
Present study	15-16	13-14	>17-18	>17-18

In present study Ossification of Iliac Crest appears at the age of 15 – 16 years in majority of subjects in male subjects & 13 – 14 years in majority of female subjects which is comparable to the study of **Apurba Nandy; Krishnan MKR** and **Mathur I** in males and study of **N. Reddy; Bhaisoria & Chaudhary**; **Bardale Rajesh**; **Krishna MKR** in females, there is delayed appearance in study of **Bhaisoria & Chaudhary** & **Bardale Rajesh** in males and in study of **Apurba Nandy** and **Mathur I** in Females, early appearance present in study of **N. Reddy** in males.

In present study Ossification of Iliac Crest does not completed by the age of 17 – 18 years in majority of male & female subjects which is comparable to the study of **N. Reddy; Bhaisoria & Chaudhary; Apurba Nandy; Bardale Rajesh; ApurbaNandy; Krishnan MKR** and **Mathur I,** however there is early fusion is present in both male and female subjects in study of **Yatiraj S** and **Srinivas NM.**

Table 9: Appearance and Fusion of the Ossification Centre of Ischial Tuberosity:

	Ischial Tuberosity			
	Appears		Fusion	
	Male	Female	Male	Female
N. Reddy[8]	16		20-21	
Bhaisoria& Chaudhary[9]	16-18	14-16	20	20
Apurba Nandy[10]	15-17	14-15	20	20
Bardale Rajesh[11]	16-18	14-16	20	20
Krishnan MKR[12]	16-18	15-17	20-21	19-20
Yatiraj S[13]	—	—	16-17	15-16
Mathur I[14]	18-19	17-18	20-21	20-21
Srinivas NM[15]	—	—	15-16	15-16
Present study	15-16	13-14	>17-18	>17-18

In present study Ossification of Ischial Tuberosity appears at the age of 15 – 16 years in majority of male subjects & 14 – 15 years in majority of female subjects which is comparable to the study of **Apurba Nandy** & **N. Reddy** in males and study of **Apurba Nandy** in females, there is delayed appearance in study of **Bhaisoria & Chaudhary; Bardale Rajesh; Krishnan MKR** and **Mathur I** in males and in study of **N. Reddy; Bhaisoria & Chaudhary**; **Bardale Rajesh;Krishnan MKR** and **Mathur I** in females**.**

In present study Ossification of Ischial tuberosity does not completed by the age of 17 – 18 years in majority of male & female subjects which is comparable to the study of **N. Reddy; Bhaisoria & Chaudhary; Bardale Rajesh; Apurba Nandy; Krishnan MKR** and **Mathur I,** however there is early fusion present in the study of **Yatiraj S** and **Srinivas NM.**

Table 10: Appearance and Fusion of the Ossification Centre of Pubis:

	Pubis			
	Appears		Fusion	
	Male	Female	Male	Female
Yatiraj S[13]	—	—	15-16	15-16
Srinivas NM[15]	—	—	16-17	15-16
Present study	15-16	14-15	>17-18	>17-18

In present study Ossification of Pubis appears at the age of 15 – 16 years in majority of male subjects & 14 – 15 years in majority of female subjects, however there were no comment on this section in the studies that we have taken for comparison.

In present study Ossification of Pubis does not completed by the age of 17 – 18 years in majority of male & female subjects, however there is early fusion present in both male & female subjects in study of **Yatiraj S** and **Srinivas NM.**

Conclusion

The present study concludes that the study of appearance and fusion of ossification centers for hip joint & pelvis joint can be implemented in routine forensic practice for 12 – 18 years age group to opine about age of subjects with lesser age range.

Source of funding: Self-Generated.

Ethical approval: From the institutional ethical committee.

Conflict of interest: Nil

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Epidemiologies of Fatal Ground Level Falls in Autopsies Conducted in A Tertiary Care Hospital: A cross sectional Study

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Abstract

Background: Falls are the second leading cause of unintentional injury deaths worldwide. Falls not only causes Mortality, but also Morbidity resulting in disabilities and loss of productivity. Death due to falls not only occurs in victims falling from a height but also in Ground level falls.

Aim: To study the age and sex distribution, place, surface, time, and outcome of fatal accidental Ground Level Falls.

Methods: The present study was carried out as a descriptive study in which medico legal autopsies of 115 victims of ground level fall victims were included. Lettule's method of en masse removal of viscera and dissection of organs was used for conducting medico legal autopsy. The Collected data was entered in MS excel and analysed.

Conclusion: The current study revealed that most victims of ground level falls were more than 50 years of age and indoor falls were more common than outdoor falls.62% of the victims had suffered head injury. Effective fall prevention programmes should be framed to reduce the number of people who fall.

Keywords: Falls, Ground Level, Head Injury

Introduction

According to World Health Organisation[1], Falls are the second leading cause of unintentional injury deaths worldwide. Each year an estimated 6,84 ,000 individuals die from falls globally of which over 80% are in low- and middle-income countries. Adults older than 60 years of age suffer the greatest number of fatal falls.

A fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level.[1] Fall-related injuries may be fatal or non-fatal, while all people who fall are at risk of injury. The age, gender and health of the individual can affect the type and severity of injury.

According to the Accident and suicide statistics of National Crime Records Bureau (NCRB) for the year 2019[2], a total of 12048 cases of fall from height were registered in India. Out of this, 11997 cases were fatal with male: female ratio being 5.4:1. The burden was seen more in victims belonging to age group between 30-45 years of age. According to International Classification of Diseases- 11[3], PA -60

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is the new code for Unintentional Falls on the same level or less than 1 metre.

Age is one of the key risk factors for falls. Older people have the highest risk of death or serious injury arising from a fall and the risk increases with age. Across all age groups and regions, both genders are at risk of falls. In some countries, it has been noted that males are more likely to die from a fall, while females suffer more non-fatal falls. Older women and younger children are especially prone to falls and increased injury severity. Occupations at elevated heights, comorbid conditions such as stroke, hypertension, vertigo, postural hypotension, visual disturbances in old age and unsafe environment related to buildings are other risk factors contributing to falls. Ground Level Falls are generally due to slips or trips. Injury results when the individual hits a walking or working surface or strikes some other object during the fall. Fall from short distance such as sofa, bed, chair or table less than 1.5 meter of heights are also included in Ground level falls.

Fatal ground level falls were due to accidental slipping and tripping owing to environmental factors like slimy and slippery floors indoor, spillage of water, insufficient lighting in rooms, rest rooms and lack of grab bars in balcony and staircases and congested pathways. Knight B. et al[4] study also states age, arthritis, postural instability, poor vision, dizziness as predisposing factors. Fatal ground level falls though can't be predicted are preventable with alteration of the above factors making room a safe environment.

Materials and Methods

The present study has been conducted as a cross sectional study in Department of Forensic Medicine, Madurai Medical College & Government Rajaji Hospital during January 2016 to December 2016.

Inclusion Criteria: All cases of deaths due to Ground level falls (falls in bathrooms, beds, chairs, streets, and balcony) during the above said time period were included in the study.115 cases of Ground level fall autopsies satisfied the inclusion criteria.

Exclusion Criteria: Falls from staircases in house, Decomposed case, Unknown cases, Cases where history and details not available, Fall from moving vehicle (road traffic and train traffic accident), Fall from burning building ,Fall into fire, Fall into water (with submersion or drowning) and Fall into machinery were excluded from the study. Lettule's method of en masse removal of viscera and dissection of organs was used for conducting medico legal autopsy. The study was done after obtaining approval from Institutional ethics committee.

Results and Discussion

Age

Age range starts from 4 years -85 years. The incidence peaked in the age group 61-70 years constituting 22.6 %(n=26) of the cases. 19.1% (n=22) of the victims belonged to the age group 51-60. Hence 39.1% of victims belonged to the age group of more than 60 years. Individuals <20 years were the least affected (4.3%, n=5). In the current study, it has been observed that the maximum number of ground level falls was observed in the age group 61-70 years. Elderly people in this age group are more susceptible to falls as they are more fragile and associated with co morbidities and age related changes like cataracts & refractive errors, dementia. The less incidence of ground level fall in younger age group (4.3%) is justified by the fact that they have a well-coordinated CNS and Motor system less vulnerable to falls. Karen M Chisholm et al[5] study done in Seattle – King medical Examiner's office in 2007 also supports the current study were 61% of the victims were >70 years of age.

Sex Distributon

76.5% of the Victims were Males (n=88) and 23.5% of the victims were females. Sex Ratio was 3.3:1. Males were 3 times more affected than Females. The study revealed that males were 3 times more affected of ground level falls than females. In Karen M Chisholm et al[5] study again 69% were Males similar to the current study. Study by Bardale et al[6] shows more victims were males aged >65 years and incident occurred mainly Indoor similar to our study.

Time of Fall

Most cases of ground level fall occurred between 12 noon – 6 p.m. i.e., during afternoon and evening (n=40, 34.8% cases). Least number of falls occurred during 12 midnight – early morning 6a.m. (n=8, 7% cases).

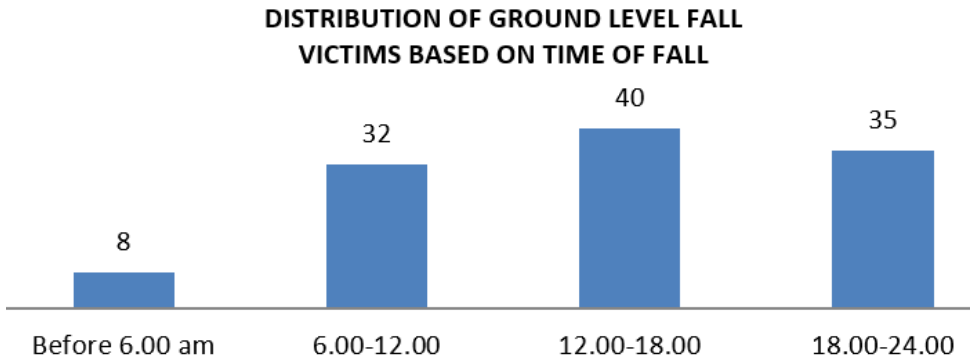

Figure 1: Distribution of Ground level fall victims based on Time of fall

Place of Fall

46% of the ground level fall deaths were due to fall in Indoor areas like bathrooms, beds/chairs and floor , while 36.5% of ground level falls were outdoor fall victims, like falls in streets and balcony . More falls, almost 35% of ground level falls had occurred in the time 12 noon – 6 pm. More of indoor falls can be owed to the slimy tiles inside the houses. Victims fall mainly in bathrooms, floors and mostly evening and night.

Surface of Fall

The surface of fall also plays a pivotal role in falls. Almost 58% of the ground level fall deaths were due to fall in tiles and marbles. The next most common surface of fall was hard soil (24.3%). Similar to our study, Karen M. Chisholm and Richard C. Harruff et al[5] also reported 79% of ground level falls on marbles and tiles.

Survival Period

The survival period after a ground level fall was variable. 59% of the victims (n=68) survived for a period of 1-10 days. 24.3% of the victims were 1 day survivors. Only 1 victim survived for a month after the fall which was the longest survival period. Karen M Chisholm et al study[5] revealed similar survival period of 9-23 days in their study. In Annette Thierauf et al study[7], about 77.9% of the ground-level falls were not immediately fatal, but present survival times from 3 hours to 349 days.

Table 1: Distribution of Survival Period in Ground level fall victims.

Survival period	No. of cases	Percentage
0 (Dead)	8	7%
1hour – 24 hours	18	24.3%
1 day – 10 days	68	59.1%
11 days – 30 days	10	8.7%
1 month	1	0.9%

Primary Impact

With regard to the site of primary impact, Head & Face was the most common site constituting 81.7% (n=94), the next common sites were trunk & buttocks constituting 13% (n=15). Feet/Lower limb constituting 5.3% (n=6) were the least common site of Primary impact. Head & Face was also the commonest primary site of impact in Vasudeva Murthy CR et al[8] study conducted in Davangere but the victims had fallen from a height contrastingly.

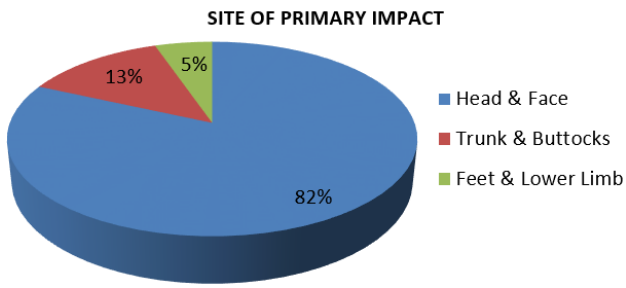

Figure 2: Distribution of Site of Primary Impact in Ground level fall victims.

Injury Pattern

The injury pattern in Ground level fall victims in the current study as Polymorphic, meaning the victims had multiple injuries all over the body. Preuß

et al[9] study done in Germany also supports the current study in which the injuries were Polymorphic – skull & brain injuries, loss of blood, cervical spine injuries were seen in the victims. 50 victims had died due to injury in multiple regions. In the current study, 89 victims had Head injury which being the commonest, 17 had sustained spine injury, and 11 had injuries of major bones. Abdominal injuries were the least. And only 7 of the victims had abdominal injuries. Similarly only 9 had abdominal injuries in the study conducted by Peru et al [9] in Germany.

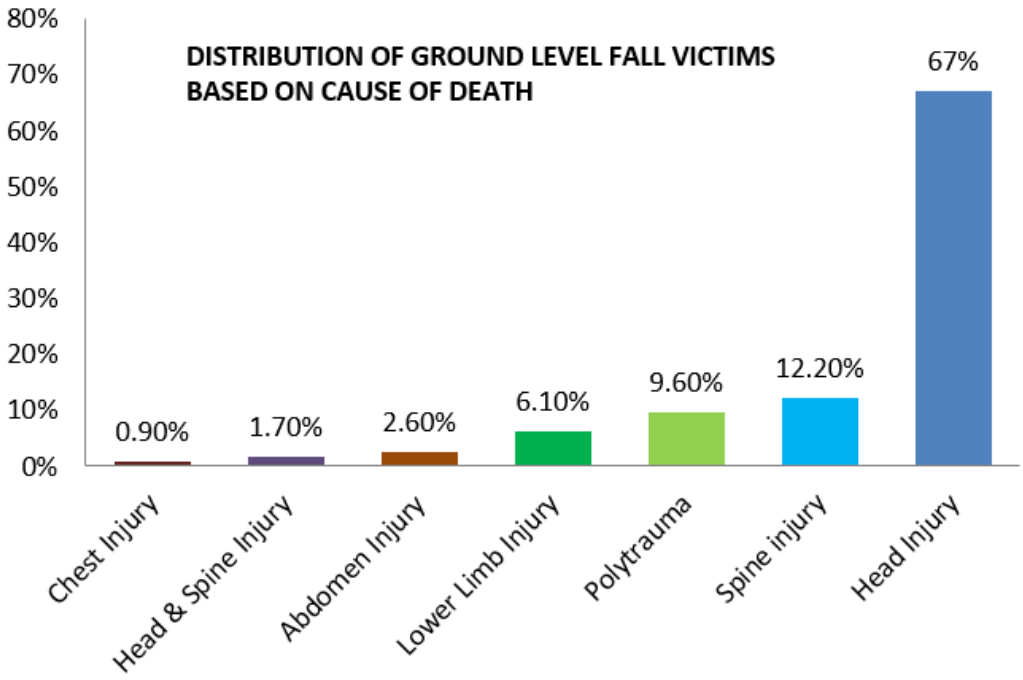

Figure 3: Distribution of Ground level fall victims based on cause of Death.

Head Injury

Subdural Haemorrhage (62%) and subarachnoid haemorrhage (61%) were the commonest pattern of head injury in victims of Ground level fall. Parlak et al[10], Ankara Turkey , CT findings of Ground level fall victims supported that Head injury victims had Traumatic Intra cranial Haemorrhage .

Spine Injury

In the present study, victims had sustained spine injuries too, 14 had sustained Cervical Spine injury and 3 had sustained Lumbosacral spine injury. Parlak et al[10] study done in Ankara Turkey, CT findings of Ground level fall victims documented that 52 out of 489 victims had spine injuries.

Conclusion

The current study revealed that most victims of ground level falls were more than 50 years of age and indoor falls were more common than outdoor falls. Effective fall prevention programmes should be framed to reduce the number of people who fall, the rate of falls and the severity of injury should a fall occur. Provision of safety devices such as grab handles high friction floors and footwear, as well as low power lighting at night. Home assessment and environmental modification for those with known risk factors or a history of falling. Community-based group programmes which may incorporate fall prevention education.

Conflict of Interest: Nil

Source of Funding: Nil

Ethical Clearance: Obtained from Institutional Ethics Committee, Madurai Medical College, Madurai, Tamil Nadu

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Original Research Article

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A Study on Pattern of Suicidal Deaths Brought for Medicolegal Autopsy at Mortuary of Siddhartha Medical College and Govt. General Hospital, Vijayawada, Andhra Pradesh

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Abstract

Background: The aim is to study the pattern of suicidal deaths, demographic profile including various contributary factors of victims and analyze the magnitude of deaths in and around Vijayawada part of Andhra Pradesh so that preventive measures can be set up to avoid such situation. A death by suicide is defined as the deliberate termination of life. For a death to be a suicide, it should be an un-natural death, the desire to die should originate within the person, and there should be a reason for ending their life, according to the National Crime Records Bureau. While India's suicide rate of 14.04/lakh population in 2019 puts it at 49th rank globally, the grim reality of the highest numbers of suicides being reported annually from India cannot be overlooked. When you look at suicide deaths, the highest suicide rates are in the south. In central India, including Maharashtra, Madhya Pradesh and Rajasthan, you have "middling suicide rates", and the rate falls up north, in Uttar Pradesh and Bihar.

Material & Methods: A five years retrospective and cross-sectional study was conducted in Forensic Medicine and Toxicology Department, Siddhartha Medical College, Vijayawada, Andhra Pradesh. All the autopsies conducted on victims of suicidal deaths during the period from Jan, 2016 to Dec, 2020 were studied from the available data. Inclusion criteria includes all the suicidal deaths due to poisoning, hanging and self-immolation by burns. Exclusion criteria includes suicidal deaths from causes other than poisoning, hanging and suicidal burns like drowning, electrocution, fall from height etc.

Results: It is clear that committing suicide by consuming poison accounts for major number of deaths followed by committing suicide by hanging and least followed by committing suicide by self-immolation. It is also clear that committing suicides has increased year by year from 2016 to 2020 irrespective of committing suicide by hanging, poisoning. Coming to sex pattern, suicide by hanging was observed more in males. Sex pattern in suicidal deaths due to poisoning clearly showed that females outnumbered males. Sex pattern in suicidal deaths due to self-immolation clearly showed that females outnumbered males with high margin. Coming to the age pattern in committing suicidal deaths by hanging, 30 – 45 years age group showed highest incidence year by year followed by 45 – 60 years and least among 15 – 25 years age group. Where as in case of suicidal deaths by poisoning and self-immolation, incidence was highest in 30 – 45 age group followed by 15 – 30 years age group and least among 45 – 60 years group.

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Conclusion: According to the World Health Organization, in India, suicide is an emerging and serious public health issue. Suicide rates in India have been rising over the past five decades. India's contribution to global suicide deaths increased from 25.3% in 1990 to 36.6% in 2016 among women, and from 18.7% to 24.3% among men. In 2016, suicide was the most common cause of death in both the age groups of 15–29 years and 15–39 years in India. Factors such as frustration, family problems, love affairs, poverty, harassment, sexual violence, social boycott, chronic diseases and bankruptcy were studied as the main reasons leading to committing of suicides in people.

The need for a strategy which will raise awareness and help make suicide prevention a national priority has to be recognized. Such a national strategy will need a comprehensive approach that encompasses the promotion, coordination, and support of activities to be implemented across the country at national, regional, and local levels. The program would need to be tailored for populations at risk.

Keywords: Suicidal Deaths, Hanging, Poisoning, Self-Immolation, Medicolegal Autopsy

Introduction

The Government of India classifies a death as suicide if it meets the following three criteria: 1. It is an unnatural death 2) the intent to die originated within the person 3) there is a reason for the person to end his or her life. The reason may have been specified in a suicide note or unspecified. If one of these criteria is not met, the death may be classified as death because of illness, murder or in another statistical.

Factors contributing to suicide in India in 2019. Following are the contributing factors for committing suicide in India with incidence in percentage (%). Family problems (32.4%), Illness (17.1%), Drug abuse/alcohol addiction (5.6%), Marriage related issues (5.5%), Love affairs (4.5%), Bankruptcy or indebtedness (4.2%), Failure in examination (2.0%), Unemployment (2.0), Professional/career problem (1.2%), Property dispute (1.1%), Death of dear person (0.9%), Poverty (0.8%), Suspected/illicit relation (0.5%), Fall in social reputation (0.4%), Impotency/ infertility (0.3%), Other causes (11.1%), causes not known(10.3%).[1]

Suicide mortality rate is the number of suicide deaths in a year per 100,000 population. India suicide rate for 2019 was 12.70, a 0.79% increase from 2018. India suicide rate for 2018 was 12.60, a 5% increase from 2017. India suicide rate for 2017 was 12.00, a 0.83% decline from 2016.India suicide rate for 2016 was 12.10, a 1.63% decline from 2015. The trend is frightening and alarming that is leading to a heart wrenching situations currently in the society.[2]

Maharashtra reported the highest number of suicides at 18,916, followed by Tamil Nadu, West Bengal, Madhya Pradesh and Karnataka. These five states collectively contributed to 49.5% of India's suicides in 2019. Nagaland reported only 41 suicides in the year. Maharashtra, Tamil Nadu, West Bengal, Madhya Pradesh and Karnataka have consistently accounted for about 8.0% (or more) suicides in India across 2017 to 2019. Among the Union Territories, Delhi reported the highest number of suicides followed by Puducherry. Lakshadweep reported zero suicides. Bihar and Punjab reported a significant increase in the percentage of suicides in 2019 over 2018.

In 2019, the age groups 18–30 and 30–45 years accounted for 35.1% and 31.8% suicides in India, respectively. Combined, this age group of young adults accounted for 67% of total suicides. Thus, out of the total 1.39 lakh total suicides in India, 93,061 were young adults. This indicates that they are the most vulnerable age groups. Compared to 2018, youth suicide rates have risen by 4%. In 2019, 12.6% victims of suicide were illiterate, 16.3% victims of suicide were educated up to primary level, 19.6% of the suicide victims were educated up to middle level and 23.3% of the suicide victims were educated up to matric level. Only 3.7% of total suicide victims were graduates and above.[3]

The number of deaths by suicide has seen an increasing trend from 2016 to 2019. In 2019, it increased by 4.6% compared to 2018. There were 25,891 suicides reported in the largest 53 mega cities of India in 2021. In the year 2021, Delhi City (2,760) recorded the highest number of deaths by suicide among the four metropolitan cities, followed by Chennai (2,699), Bengaluru (2,292) and Mumbai

(1,436). These four cities together reported almost 35.5% of the total suicides reported from the 53 mega cities.

The southern states of Kerala, Karnataka, Andhra Pradesh and Tamil Nadu have a suicide rate of >15 while in the Northern States of Punjab, Uttar Pradesh, Bihar and Jammu and Kashmir, the suicide rate is <3. This variable pattern has been stable for the last 20 years. Higher literacy, a better reporting system, lower external aggression, higher socioeconomic status and higher expectations are the possible explanations for the higher suicide rates in the southern states.

In 2021, the male-to-female ratio of suicide victims was 72.5 : 27.4, while (70.9 : 29.1) in 2020. The total number of male suicides was 1,18,979 and female suicides accounted for 45,026. A total of 28 transgender people died by suicide. The proportion of female victims were more due to "marriage-related issues". Of females who committed suicides, the highest number (23,178) was of house-wives followed by students (5,693) and daily wage earners (4,246). Among males, maximum suicides were by daily wage earners (37,751), followed by self-employed persons (18,803) and unemployed persons (11,724).[4]

Aim and Objectives

The aim and objectives are to study the pattern of suicidal deaths, demographic profile including various contributary factors of victims and analyze the magnitude of deaths in and around Vijayawadapart of Andhra Pradesh so that preventive measures can be set up to avoid such situation.

Materials and Methods

A five years retrospective and cross-sectional study was conducted in Forensic Medicine and Toxicology Department, Siddhartha Medical College, Vijayawada, Andhra Pradesh. All the autopsies conducted on victims of suicidal deaths during the period from Jan, 2016 to Dec, 2020 were studied from the available data. As per the institutional ethical committee guidelines, on paper permission for the study was not necessary as the study is done on already dead victims and is a retrospective study from the available data from the department. Demographic and other variables regarding the pattern of committing suicidal death and causes leading to committing of suicide were studied from the inquest papers, treatment records and post mortem reports. All the data was entered in preformed proforma and was analysed using statistical software.

Inclusion Criteria: All the suicidal deaths due to poisoning, hanging and self-immolation by burns.

Exclusion Criteria: Suicidal deaths from causes other than poisoning, hanging and suicidal burns like drowning, electrocution, fall from height etc.

Results

Table 1: Year wise incidence of suicidal deaths

Sl. No	Year	Total Cases	Hanging	Poisoning	Suicidal Burns
1.	2016	124	35 (28%)	79 (64%)	10 (8%)
2.	2017	133	40 (30%)	87 (65%)	6 (5%)
3.	2018	156	54 (35%)	93 (60%)	9 (5%)
4.	2019	177	65 (36%)	102 (58%)	10 (6%)
5.	2020	209	77 (37%)	123(59%)	9(4%)

Table 2: Sex pattern in Suicidal Deaths due to Hanging Year Wise

Sl. No	Year	No. of Cases	Males	Females
1.	2016	35	19 (54%)	16(46%)
2.	2017	40	26(65%)	14 (35%)
3.	2018	54	24 (44%)	30 (56%)
4.	2019	65	40 (62%)	25 (38%)
5.	2020	77	32 (42%)	45 (58%)

Table 3: Sex pattern in Suicidal Deaths due to Poisoning Year Wise

Sl. No	Year	No. of Cases	Males	Females
1.	2016	79	40 (51%)	39 (49%)
2.	2017	87	42(48%)	45 (52%)
3.	2018	93	41 (44%)	52 (56%)
4.	2019	102	48 (47%)	54 (53%)
5.	2020	123	50 (41%)	73 (59%)

Table 4: Sex pattern in Suicidal Deaths due to Suicidal Burns Year Wise

Sl. No	Year	No. of Cases	Males	Females
1.	2016	10	0	10 (100%)
2.	2017	6	1 (16%)	5 (84%)
3.	2018	9	1 (11%)	8(89%)
4.	2019	10	2 (20%)	8 (80%)
5.	2020	9	2 (22%)	7 (88%)

Table 5: Distribution based on Age Groups Year Wise

Sl. No	Year	Hanging			Poisoning			Burns		
		15-30 Years	30-45 Years	45-60 Years	15-30 Years	30-45 Years	45-60 Years	15-30 Years	30-45 Years	45-60 Years
1.	2016	5	20	10	28	42	9	1	8	1
2.	2017	7	21	12	30	45	12	0	6	0
3.	2018	10	28	16	33	47	13	1	8	0
4.	2019	15	30	20	23	68	11	2	7	1
5.	2020	20	34	23	40	73	10	1	6	2

Table 6: Marital Status of victims of suicidal death year wise

Sl. No	Year	Hanging		Poisoning		Suicidal Burns	
		Married	Unmarried	Married	Unmarried	Married	Unmarried
1.	2016	25	10	53	26	10	0
2.	2017	28	12	54	33	5	1
3.	2018	36	18	62	31	9	0
4.	2019	42	23	55	47	10	0
5.	2020	47	30	70	53	8	1

Table 7: Literacy among victims of suicidal deaths

Sl. No	Suicidal Death	Literate	Illiterate
1.	Hanging	79	192
2.	Poisoning	176	308
3.	Burns	11	33

Table 8: Distribution of suicidal deaths based on urban or rural area

Sl. No	Suicidal Death	Urban	Rural
1.	Hanging	168	103
2.	Poisoning	226	258
3.	Burns	26	18

Discussion

By analysing the results, it is clear that committing suicide by consuming poison accounts for major number of deaths followed by committing suicide by hanging and least followed by committing suicide by self-immolation. It is also clear that committing suicides has increased year by year from 2016 to 2020 irrespective of committing suicide by hanging, poisoning. Suicides by self-immolation, there was not much change in the incidence except during 2017 which recorded the lowest number of suicidal deaths by self-immolation. Similar findings were found by Silke Bachmann(2018) Johan Bilsen (2018).[5]

Coming to sex pattern, suicide by hanging was observed more in males when compared to females from 2016 to 2020 with exceptions of 2018 and 2020 during which the incidence of suicidal death by hanging was seen more in females. Sex pattern in suicidal deaths due to poisoning clearly showed that females outnumbered males during the years 2018, 2019 & 2020 while males committed suicide by consuming poison more than females during the years 2016 & 2017. Sex pattern in suicidal deaths due to self-immolation clearly showed that females outnumbered males with high margin from 2016 to 2020. Similar findings were found in their study by Rakhi Dandona, G Anil Kumar, R S Dhaliwal, Mohsen Naghavi (2018).[6]

Coming to the age pattern in committing suicidal deaths by hanging, 30 – 45 years age group showed highest incidence year by year followed by 45 – 60 years and least among 15 – 25 years age group. Where as in case of suicidal deaths by poisoning and self-immolation, incidence was highest in 30 – 45 age group followed by 15 – 30 years age group and least among 45 – 60 years group. Similar findings were found in their study by Suryakant Yadava, Aathavan K K, Solveig Argeseanu Cunningham, Pravat Bhandari, Udaya Shankar Mishra, Aditi and Ravita Yadav (2023).[7]

When marital status was analysed in the pattern of suicidal deaths, in hanging, poisoning and self-immolation, suicidal deaths incidence was more among married people when compared with unmarried people. Similar findings were found on marital status in patterns of suicidal deaths by Peter Mayer and Tahereh Ziaian (2002).[8] When literacy was analysed in the pattern of suicidal deaths, all the types are seen more in illiterate people when compared to literate people. Similar findings were found in their study of suicides in India and literacy rate by Rajiv Radhakrishnan and Chittaranjan Andrade (2012).[9] When the pattern of suicidal deaths was studied among urban and rural back ground, all types of suicidal deaths were more seen in urban setup when compared to the rural areas. Similar findingsof suicide incidence in urban and rural background were found in their study by M. Helbich, V. Bluml (2017).[10]

Conclusion

According to The World Health Organization, in India, suicide is an emerging and serious public health issue. Suicide rates in India have been rising over the past five decades. India's contribution to global suicide deaths increased from 25.3% in 1990 to 36.6% in 2016 among women, and from 18.7% to 24.3% among men. In 2016, suicide was the most common cause of death in both the age groups of 15–29 years and 15–39 years in India. Factors such as frustration, family problems, love affairs, poverty, harassment, sexual violence, social boycott, chronic diseases and bankruptcy give rise to a feeling of committing suicide in people.

The need for a strategy which will raise awareness and help make suicide prevention a national priority has to be recognized. Such a national strategy will need a comprehensive approach that encompasses the promotion, coordination, and support of activities to be implemented across the country at national, regional, and local levels. The program would need to be tailored for populations at risk. For example, prevention programs aimed at children and young adults would have to address issues related to gender inequality, physical/sexual abuse, violence and mental illness. Gatekeeper training focuses on skill development to enable community members such as teachers, coaches and others in the community to identify signs of depression and suicide-related behaviours among youth. It encourages individuals to maintain a high index of suspicion and to inquire directly about distress, persuade suicidal individuals to accept help, and serve as a link for local referrals. Such approaches would also require

a multidisciplinary team approach involving psychiatrists, general physicians, psychiatric nurses, psychiatric social workers, and non-governmental organizations (NGOs).

The role of the media is becoming increasingly relevant. A delicate balance needs to be maintained between press freedom and responsibility of the press to minimize the harm to vulnerable individuals. NGOs can play an important role in advocacy as exemplified by the proactive stance taken by the NGO Sneha which found that the suicide rate was highest among students who had failed in one subject. Subsequently, the government introduced a new scheme in 2002 wherein students who fail in one subject can rewrite their examination within a month and can pursue their further studies without losing an academic year.

The task of suicide prevention is daunting. Although suicide attempters are at increased risk of completed suicide, about 10% of attempters persistently deny suicidal intent. This group may continue to be vulnerable. Though restricting availability of lethal means appears to be a possible solution, an early study in India in West Bengal, where legislation was introduced to restrict sale of a pesticide, found no reduction in the overall suicide rate, but merely a change in the modes of suicide. The solutions to suicide prevention may prove to be more complex than the problem of suicide itself.

Source of Funding: Self

Conflict of Interest: Nil

Permission for Doing Study

As per the institutional ethical committee rules, no permission is required if study done on already dead victims and study is retrospective study and permission is taken from Professor & Head of Forensic Medicine Department of Siddhartha Medical College, Vijayawada, Andhra Pradesh

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