

Volume 42
Number 4
October - December
2020

JIAFM is a UGC approved journal. It is Indexed with Scopus, Index Copernicus, IndMED & IMSEAR

JOURNAL OF INDIAN ACADEMY OF FORENSIC MEDICINE



Editor
Dr. Tanuj Kanchan

Joint Editor
Dr. Manish Nigam

Publication Quarterly
ISSN : 0971 - 0973
e- ISSN : 0974-0848

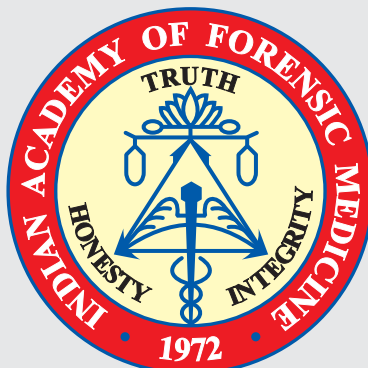
(A Peer Reviewed Journal)

(Official Publication of the Indian Academy of Forensic Medicine)

www.iafmonline.in

Indian Academy of Forensic Medicine

Registration No.349, Panaji, Goa



Official website - www.iafmonline.in

Governing Council (2019-2022)

President

Dr. P.C. Vyas

General Secretary

Dr. Mukesh Yadav

Treasurer

Dr. C.B. Jani

Vice-President

North Zone: Dr. Vijay Pal Khanagwal

West Zone: Dr. Mohd. Iliyas Sheikh

South Zone: Dr. Cyriac Job

East Zone: Dr. T.K. Bose

Central Zone: Dr. Anil Kumar Mittal

Joint Secretary

North Zone: Dr. Ajay Kumar

West Zone: Dr. Saumil Merchant

South Zone: Dr. Siddhartha Das

East Zone: Dr. Tulsi Mahto

Central Zone: Dr. Manish Kumath

Editor: Dr. Tanuj Kanchan

Joint Editor: Dr. Manish Nigam

Executive Members

Ex-Officio Members

Past President: Dr. Kalpesh Shah

Past General Secretary: Dr. Madhu Ghodkirekar

Elected Members

North Zone:

Dr. Pankaj Gupta

Dr. Amandeep

South Zone:

Dr. R. Sudha

Dr. Vinod Chaudhari

East Zone:

Dr. A.J. Patowary

Dr. Gunajit Das

West Zone:

Dr. Sudhir Ninave

Dr. Dharmesh A. Silajiya

Central Zone:

Dr. S.K. Dadu

Dr. P.K. Tiwari

Journal of Indian Academy of Forensic Medicine (JIAFM)

The Official Publication of Indian Academy of Forensic Medicine

Editor

Dr. Tanuj Kanchan

Dept. of Forensic Medicine & Toxicology

All India Institute of Medical Sciences

Jodhpur, Rajasthan

Mobile: +91-9448252394

Email: editor.jiafm@gmail.com

tanujkanchan@yahoo.co.in

Editorial Team

Dr. Raghvendra Singh Shekhawat (AIIMS, Jodhpur)

Dr. Vikas P Meshram (AIIMS, Jodhpur)

International Advisory Board

Dr. B L Meel, South Africa

Dr. B N Yadav, Nepal

Dr. Clifford Perera, Sri Lanka

Dr. D N Vieira, Portugal

Dr. Dan Dermengiu, Romania

Dr. Derrick J Pounder, UK

Dr. George Paul, Singapore

Dr. Imran Sabri, KSA

Dr. John Clark, UK

Dr. K P Saha, Bangladesh

Dr. K P Shubhakar, UK

Dr. Leandro Duarte De Carvalho, Brazil

Dr. Magdy A Kharoshah, KSA

Dr. Michael S Pollanen, Canada

Dr. Peter Vanezis, UK

Dr. R K Gorea, KSA

Dr. Roger W Byard, Australia

Dr. Serap Annette Akgür, Turkey

National Advisory Board

Dr. A J Patowary (Assam)

Dr. A K Srivastava (U.P.)

Dr. Adarsh Kumar (New Delhi)

Dr. Aditya Sharma (Himachal Pradesh)

Dr. Akhilesh Pathak (Gujarat)

Dr. Anil Aggrawal (New Delhi)

Dr. B Shantha Kumar (Tamil Nadu)

Dr. B D Gupta (MP)

Dr. C B Jani (Gujarat)

Dr. Cyriac Job (Kerala)

Dr. Dasari Harish (Chandigarh)

Dr. Francis N P Monteiro (Karnataka)

Dr. G Pradeep Kumar (Karnataka)

Dr. Gaurav Sharma (Haryana)

Dr. K. Ravindran (Puducherry)

Dr. K H Chavali (Chhattisgarh)

Dr. K R Nagesh (Karnataka)

Dr. Kusa Kumar Shaha (Puducherry)

Dr. L Fimate (Manipur)

Dr. M K Mohanty (Odisha)

Dr. O P Murty (New Delhi)

Dr. P P Mukhopadhyay (West Bengal)

Dr. Parmod K Goyal (Punjab)

Dr. Pooja Rastogi (U.P.)

Dr. Prateek Rastogi (Karnataka)

Dr. R S Bangal (Maharashtra)

Dr. RK Singh (Chhatisgarh)

Dr. S K Verma (New Delhi)

Dr. S R Kochar (Rajasthan)

Dr. Sanjay Gupta (Gujarat)

Dr. Sanjoy Das (Uttarakhand)

Dr. S C Mahapatra (Odisha)

Dr. Shailesh Mohite (Maharashtra)

Dr. S S Oberoi (Punjab)

Dr. T K Bose (West Bengal)

Dr. Tulsi Mahto (Jharkhand)

Dr. V Khanagwal (Haryana)

Dr. V V Pillay (Kerala)

Dr. Yogendra Bansal (Chandigarh)

Published by:

Dr. Tanuj Kanchan, Editor, JIAFM and Dr. Manish Nigam, Joint Editor, JIAFM
on behalf of the Indian Academy of Forensic Medicine

The Journal of Indian Academy of Forensic Medicine (JIAFM)

About the Journal (Print ISSN: 0971-0973 Electronic ISSN:0974-0848):

JIAFM is a peer reviewed medical journal published quarterly by the Editor of the Academy on behalf of the Indian Academy of Forensic Medicine.

Aim and Scope of the Journal:

The Journal covers all technical, medico-legal and clinical aspects including the ethical and social issues related to the subject specialty of Forensic Medicine and Toxicology and allied specialities. The journal promotes dissemination of original research findings.

Abstracting and Indexing:

The journal is included in Scopus, Index Copernicus, IndMED, Index Medicus for South East Asia Region, Indian Citation Index, JIAFM is a UGC Approved Journal (No. 28596). Journal issues are available online at: www.iafmonline.in; <http://indmed.nic.in>; and www.indianjournals.com

Research ethics and Authorship:

JIAFM follows the ICMJE's Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. JIAFM take issues of copyright infringement, plagiarism or any other act of academic dishonesty very seriously, and encourages the authors to ensure that the submitted manuscripts are their original work and free of any plagiarism.

Copyrights:

The entire contents of the JIAFM are protected under Indian and International copyrights. The journal, however, grants to all users a free, irrevocable, worldwide, perpetual right of access to and a license to copy, use, distribute, perform and display the work publicly and to make and distribute derivative works in any digital medium for any reasonable non-commercial purpose, subject to proper attribution of authorship and ownership of the rights. No part of this publication may be reprinted or publish without the prior permission of the Editor, JIAFM. Submission of all manuscripts to the journal is understood to imply that it is not being considered for publication elsewhere. Submission of multi authored papers implies that the consent of each author has been obtained. In this journal, every effort has been made NOT to publish inaccurate or misleading information. However editorial and advisory board accept NO liability in consequences of such statement. The opinions expressed in the articles are those of the authors only.

Subscription Information:

JIAFM is published quarterly, and following are its annual subscription rates:

Individual: ₹1000 (In India) and USD 200 or equivalent (Rest of the world)

Institutions: ₹7500 (In India) and USD 400 or equivalent (Rest of the world)

Subscription orders and payments should be made in favour of "Editor IAFM", payable at Jodhpur, Rajasthan. All communications in this regard should be made with the Editor at the address given below.

Claims for missing issue(s):

A copy will be sent free to the member/ subscriber provided the claim is made within 2 months of publication of the issue & a self-addressed envelope of the size 9" x 12" is sent to the Editor. (Those who want the journal to be dispatched by 'Registered Post' must affix postage stamps of ₹ 50).

Editorial Office

Dr. Tanuj Kanchan (Editor, JIAFM)

Room No. 3050,

Department of Forensic Medicine & Toxicology

All India Institute of Medical Sciences, Jodhpur

Basni Industrial Area, Phase-2, Jodhpur-342005, Rajasthan

Mobile: +91-9448252394

Email: editor.jiafm@gmail.com

Contents

Editorial

- Surge of ethical conundrums during the ongoing COVID-19 pandemic 240-242
Tanuj Kanchan, Raghvendra Singh Shekhawat, Vikas P Meshram, Sanjeev Misra

Original Articles

- Estimation of stature based on anthropometry of percutaneous length of arm among males of Central India Region 243-246
Devesh Pateria, PS Thakur, BK Singh, JS Tomar, Mohit Shrivastava
- Stature estimation using foot length and BMI among students at a tertiary health care centre in Maharashtra, India 247-250
Shashank S. Waghmare, Rajesh V. Kachare, Kailash U. Zine, Vishwajeet G. Pawar
- Age determination from epiphysial fusion around elbow joint and their correlation with gender: a radiological study 251-253
Archana Kaul, Rajesh Kumar Rai, Priyanka Agarwal, Shweta Saroj
- Assessment of chronological age based on radiological closure of cranial sutures in Jodhpur region of Rajasthan 254-257
Narendra Kumar Vaishnawa, Jagdish Jugtawat, Anil Bishnoi, P. C. Vyas
- Fingerprint as a tool for identification: a descriptive study 258-260
Madhab Ch. Rajbongshi, Arup Kumar Rabha, Malamoni Dutta, Sumi Deka, Md. Kalim Ullah, Putul Mahanta, Nomi Dounge
- Awareness, perceived barriers and factors affecting willingness for Organ Donation among the first- and second-degree relatives of deceased in a tertiary care hospital of Northern India 261-264
Rajanikanta Swain, Hari Prasad, Sanjeev Lalwani, Shashank Pooniya
- Students' perspective towards e-assessment in Forensic Medicine 265-267
Akhilesh Pathak
- Forensic - AETCOM to medical undergraduates: A journey from introduction to evaluation 268-271
Sanjay Gupta, Utsav Parekh
- Study of atherosclerotic coronary artery disease in young adults- an autopsy based prospective study 272-277
Vedant Kulshrestha
- Manner wise load of firearm injury at SMS Medical College, Jaipur 278-281
Shanti Lal Pargi, Lovekumar R Bhagora, Manish Sharma

Serum cholinesterase level in postmortem cases of pesticide poisoning: Devising a protocol for identifying exposure to organophosphate and carbamate compounds <i>Tushar Bhutada, Asis Kumar Ray, Braja Kishore Dash, Ansuman Panigrahi</i>	282-287
Profile of Deaths Due to Poisoning at Tertiary Care hospital of Central India <i>Sudhir Ninave, Swapnil Patond, Shikha Verma, Sanjot Ninave</i>	288-291
Atypical Gunshot Wounds: A Series of Cases <i>Dhiraj D Buchade, Arun Kumar Siddamsetty, Raj Kumar, Kishore Singh Thakur, Sreenivas Myst</i>	292-295
Analysis of tattoos in an autopsy population: A two-year study <i>Rajesh Bardale, Nitin Ninal</i>	296-299
Pattern of Neonatal Deaths autopsied at Victoria Hospital, Bangalore - A Three year study <i>Vidusha Vijay, S. Venkata Raghava</i>	300-303
Review Article	
COVID –19: The Novel Corona Virus infectious disease that halted the world <i>Prakash Mohite, Deepali Mohite, Anil Anjankar</i>	304-307
Case Reports	
Improper disposal of human foetuses and uterus: A case of violation of biomedical waste management and handling rules in India <i>Ashok Kumar Rastogi, Bajrang K Singh, Binay Kumar, Prabhat Kumar, Amrendra Kumar</i>	308-310
Perspective	
Cadaver dogs: The nose knows something <i>Nagendra Singh Sonwani, Navneet Ateriya, Arvind Kumar, Puneet Setia, Anil Kohli</i>	311-312
Issues and gaps in the Section 174 CrPC and amendments required <i>Governing Council (2019-2022), Indian Academy of Forensic Medicine</i>	313-315
Reforms in Criminal Justice System of India: Recommendations of the Indian Academy of Forensic Medicine <i>Governing Council (2019-2022), Indian Academy of Forensic Medicine</i>	316-318
Acknowledging the reviewers of 2020	319

EDITORIAL

Surge of ethical conundrums during the ongoing COVID-19 pandemic

Tanuj Kanchan¹, Raghvendra Singh Shekhawat¹, Vikas P Meshram¹, Sanjeev Misra²

¹ Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences, Jodhpur

² Director and CEO, All India Institute of Medical Sciences, Jodhpur

The COVID-19 pandemic offered the world a devastating surprise on patient care, social, cultural and economic forums. The Disaster Management Act 2005 lays stress on the legislative intent to, “provide for the effective management of disasters” and the National Disaster Management Authority (NDMA) is the nodal centre for coordinating disaster management. From a legal and administrative perspective, the act has bestowed the Central government with extensive powers, especially in the ongoing era of COVID-19 pandemic. Similarly, the colonial Epidemic Diseases Act, 1897 (the “1897 Act”) is the other enactment used as an administrative response to the COVID-19 pandemic.¹ The pandemic not only compelled the health care administrators to revisit their managerial capabilities but also opened a Pandora box in context to the ethical issues related to patient management, patient confidentiality, rights of the patients and healthcare workers, social taboo, equity and fairness in treatment, civil liberties, mass testing, immunity passports, etc.²⁻⁸

One of the authors (Shekhawat R S) encountered a situation when one of his relatives, a 65-year-old male called him and informed that he is suffering from myalgia, high fever and breathlessness. The oxygen saturation was 92 per cent. He was advised to get tested for COVID-19. He did not visit any healthcare facility due to the fear of involuntary admission, apprehension about the treatment's fairness, and trepidation about the treatment to his body if he dies. The relative's clinical condition deteriorated for the next few days, and unfortunately, he passed away after a brief illness of three days. This incidence raises a severe issue in context to 'patient's inability to make intelligent choices' towards his welfare. Clinical scenarios like this also raise a concern about whether the patients' fundamental rights have a more significant quantum over public safety, legislation, and infection control measures.⁹ Likewise, there have been instances where people have self-quarantined themselves without being tested for COVID-19 for fear of hospitalization.

On the other hand, there lies a serious problem of intensive care units' admissions versus non-admission policies, especially in older patients, for whom the benefits are less sure.¹⁰ Some patient care facilities have to decide regarding admission versus

the non-admission based on a score-based triage with inadequacies of infrastructural resources. The physicians face situations where the principle of beneficence and patient autonomy conflict with the availability of resources like hospital beds, ventilators etc.^{11,12}

The ongoing pandemic also came with issues about the patient's right to medical confidentiality. In context to medical practice, the doctrine of confidentiality restricts access to personal and identifiable medical information held by their health care providers, which should be kept private and confidential and not generally divulged to the other agencies without consent. Under s. 7.14 of Professional Conduct, Etiquette and Ethics Regulations, 2002 of Indian Medical Council, a Registered Medical Practitioner should not disclose the patient's medical information, except in specific circumstances such as on the order of a court of law, where there is a serious and identified risk to a specific person and/or community and in cases of notifiable diseases, etc.¹³ The Ministry of Health and Family Welfare, Government of India issued guidelines for the compulsory notification of information regarding COVID-19 cases by the state health agencies to the concerned district surveillance units.³

Many countries like China, Singapore, Israel, South Korea, etc. have used the latest mass surveillance techniques like drawing Global Positioning System data from mobile phone networks, using drones, facial recognition cameras, and credit card information, etc.¹⁴ These tracking technologies and mass surveillance strategies indeed are tools for implementing public health policies, epidemiological monitoring follow up and assessing individual at-risk behaviours. Simultaneously, it is inevitable that the bulk collection from the community ultimately contains data from individuals regarding their lifestyles, personal choices, and social affiliations.¹⁵ In such scenarios, it's imperative to address fundamental rights and the patients' civil liberties.

In the context of COVID-19 pandemic, individual governments have suggested using immunity passports which are the documents to prove that the individual had already suffered the infection and is professedly now immune to SARS-CoV-2. Such individuals could be exempted from the policy of isolation and resume to their professional work.¹⁶ The recent research has shown that the acquired immunity secondary to SARS-CoV-2 infection is short-lived, and many individuals have

Corresponding Author

Tanuj Kanchan (Editor-in-chief; Journal of Indian Academy of Forensic Medicine)
Email: tanujkanchan@yahoo.co.in, kanchant@aiimsjodhpur.edu.in
Mobile: +91 9448252394

subsequently contracted the infection again.^{17, 18} This observation raises a question on the credibility of the so-called immunity passports and the civil rights of the infected individuals versus the non-infected individuals.

Since antiquity, quarantine, lockdown and isolation have been the cornerstone policies to curb infectious diseases.^{19,20} These measures become more meaningful when the aim is to protect the more significant population, particularly given the lack of specific treatment, deficiency of resources, and an effective vaccine²¹ Simultaneously, there have been apprehensions about the rights of essential workers, detainees, women and children amidst the COVID-19 pandemic.²¹⁻²⁴

The infectious potential of the COVID-19 virus led to severe restrictions for the relatives in the hospital, and even during the last rites. There have been incidences where the family members couldn't meet their relatives and say a final goodbye. The families not having access to the dead relative obviously results in complicated grief. These distortions in the process of dying, the process of grieving, and apprehensions about the handling of dead bodies have an enormous impact on stakeholders involved.^{25, 26} Ours is a nation of multiple ethnicities and religious backgrounds. In the initial phase of the COVID-19 pandemic, there were issues regarding the method of disposal of the COVID-19 sensitivities. It is essential to balance the administrative protocols and infection control policies while respecting religious sensitivities.²⁷ In the same context, the health care personals have faced issues like work overload, deficiency of resources, social discrimination, fear and anxiety about getting infected.²⁸ The upcoming research shows that COVID-19 pandemic is an independent factor in the causation of work-related stress among healthcare workers.²⁹ More significantly, it has become more difficult for the health care providers to render health care services since they have to balance between their duty to society and their commitment towards their family obligations.³⁰

The ongoing pandemic is associated with social discrimination, life-insecurity, compromised social solidarity, social capital loss, etc. The spread of non-scientific information, rumours and falsehoods has caused ramification of social taboos.³¹ On the ethical fronts, the ongoing pandemic has presented the world with new challenges. Various governments and healthcare agencies have strived hard to manage COVID-19 pandemic and materialised several public health strategies for the community good. However, while doing so, due consideration should be given to the ethical rights of the living as well as the dead.

References

1. Ghosh A, Nundy S, Mallick TK. How India is dealing with

COVID-19 pandemic. *Sensors International*. 2020;1:100021-.

2. Studdert DM, Hall MA. Disease Control, Civil Liberties, and Mass Testing — Calibrating Restrictions during the Covid-19 Pandemic. *New England Journal of Medicine*. 2020;383(2):102-4.
3. Shekhawat RS, Meshram VP, Kanchan T, Misra S. Privacy and patient confidentiality in times of Covid-19. *Medico-Legal Journal*. 2020;88(4):229-30.
4. Valerio C. Human Rights and Covid-19 pandemic. *JBRA Assist Reprod*. 2020;24(3):379-81.
5. Shadmi E, Chen Y, Dourado I, Faran-Perach I, Furler J, Hangoma P, et al. Health equity and COVID-19: global perspectives. *Int J Equity Health*. 2020;19(1):104-.
6. Chopra KK, Arora VK. Covid-19 and social stigma: Role of scientific community. *Indian J Tuberc*. 2020;67(3):284-5.
7. Iyengar KP, Ish P, Upadhyaya GK, Malhotra N, Vaishya R, Jain VK. COVID-19 and mortality in doctors. *Diabetes Metab Syndr*. 2020;14(6):1743-6.
8. Brown RCH, Kelly D, Wilkinson D, Savulescu J. The scientific and ethical feasibility of immunity passports. *Lancet Infect Dis*. 2020:S1473-3099(20)30766-0.
9. Russ MJ, Sisti D, Wilner PJ. When patients refuse COVID-19 testing, quarantine, and social distancing in inpatient psychiatry: clinical and ethical challenges. *Journal of Medical Ethics*. 2020;46(9):579-80.
10. Le Guen J, Boumendil A, Guidet B, Corvol A, Saint-Jean O, Somme D. Are elderly patients' opinions sought before admission to an intensive care unit? Results of the ICE-CUB study. *Age Ageing*. 2016;45(2):303-9.
11. Ho EP, Neo H-Y. COVID 19: prioritise autonomy, beneficence and conversations before score-based triage. *Age and Ageing*. 2020.
12. Rosenbaum L. Facing Covid-19 in Italy - Ethics, Logistics, and Therapeutics on the Epidemic's Front Line. *N Engl J Med*. 2020;382(20):1873-5.
13. Markose A, Krishnan R, Ramesh M. Medical ethics. *J Pharm Bioallied Sci*. 2016;8(Suppl 1):S1-S4.
14. Nay O. Can a virus undermine human rights? *Lancet Public Health*. 2020;5(5):e238-e9.
15. Ancker JS, Witteman HO, Hafeez B, Provencher T, Van de Graaf M, Wei E. The invisible work of personal health information management among people with multiple chronic conditions: qualitative interview study among patients and providers. *J Med Internet Res*. 2015;17(6):e137.
16. Bartlett J. Chile's "immunity passport" will allow recovered coronavirus patients to break free from lockdown, get back to work. *Washington Post*. 2020;20.
17. Edridge AWD, Kaczorowska J, Hoste ACR, Bakker M, Klein M, Loens K, et al. Seasonal coronavirus protective immunity is short-lasting. *Nat Med*. 2020;26(11):1691-3.
18. Iwasaki A. What reinfections mean for COVID-19. *Lancet Infect Dis*. 2020.
19. Krishan K, Kanchan T. Lockdown is an effective 'vaccine' against COVID-19: A message from India. *J Infect Dev Ctries*. 2020;14(6):545-6.

20. Sjödin H, Wilder-Smith A, Osman S, Farooq Z, Rocklöv J. Only strict quarantine measures can curb the coronavirus disease (COVID-19) outbreak in Italy, 2020. *Euro Surveill.* 2020;25(13).
21. Openshaw JJ, Travassos MA. COVID-19, Quarantines, Sheltering-in-Place, and Human Rights: The Developing Crisis. *Am J Trop Med Hyg.* 2020;103(2):578-80.
22. Walter D. Implications of Covid-19 for Labour and Employment in India. *Indian J Labour Econ.* 2020:1-5.
23. Irudaya Rajan S, Sivakumar P, Srinivasan A. The COVID-19 Pandemic and Internal Labour Migration in India: A 'Crisis of Mobility'. *Indian J Labour Econ.* 2020:1-19.
24. Gupta A, Stahl A. For abused women, a pandemic lockdown holds dangers of its own. *New York Times.* 2020.
25. Chochinov HM, Bolton J, Sareen J. Death, Dying, and Dignity in the Time of the COVID-19 Pandemic. *J Palliat Med.* 2020;23(10):1294-5.
26. Shrestha R, Krishan K, Kanchan T. Dignity and rights of the dead and their families: A compromise in the time of coronavirus disease 2019. *Med Sci Law.* 2020:25802420945937.
27. Kumar A, Nayar KR. COVID-19 and Mass Fatality Management: A Public Health Challenge. *Disaster Med Public Health Prep.* 2020;14(4):e38-e9.
28. Kanchan T, Meshram VP, Shekhawat RS, Misra S. Healthcare workers and COVID-19 Pandemic: A fight amidst fear of burnout. *J Indian Acad Forensic Med.* 2020 Jul-Sep;42(3):153-54.
29. Spoorthy MS, Pratapa SK, Mahant S. Mental health problems faced by healthcare workers due to the COVID-19 pandemic-A review. *Asian J Psychiatr.* 2020;51:102119-.
30. Abdelhafiz AS, Alorabi M. Social Stigma: The Hidden Threat of COVID-19. *Frontiers in Public Health.* 2020;8(429).
31. Mahmud A, Islam MR. Social Stigma as a Barrier to Covid-19 Responses to Community Well-Being in Bangladesh. *International Journal of Community Well-Being.* 2020:1-7.

ORIGINAL ARTICLE

Estimation of stature based on anthropometry of percutaneous length of arm among males of Central India Region

Devesh Pateria, PS Thakur, BK Singh, JS Tomar, Mohit Shrivastava

Department of Forensic Medicine & Toxicology M.G.M. Medical College, Indore, Madhya Pradesh, India

Abstract

Identification means determination of exact individuality of a person. It is one of the important criteria for conducting autopsy, apart from finding the cause and time since death. Stature is an important parameter to establish identity of an unknown corpse. It is being used by medico legal experts when either complete or parts of human body are recovered. Establishing the identity of an individual from mutilated, decomposed and amputated body fragments has become an important necessity in recent times due to natural disasters like earthquakes, tsunamis, cyclones, floods and man-made disasters like terror attacks, bomb-blasts, mass accidents, wars, and plane crashes etc. Hence the present study has been undertaken and is aimed at and concentrated on finding the co-relation between supine length and anthropometric measurements of both sides (right and left) arm of male in central India population belonging to age group 21 to 60 years in mortuary of Forensic Medicine Department, M.G.M. Medical College and M.Y. Hospital, Indore (M.P.). The mean percutaneous arm length on right side and left (32.53 ± 1.527) and (32.56 ± 1.565), cm respectively, whereas the mean stature was found to be 165.64 ± 5.038 cm. In this study maximum stature in males was found to be 180.2 cm and minimum stature was found to be 152.0 cm. Percutaneous arm length and stature was found to be positively correlated and association was highly significant. The multiplication factor for percutaneous arm length was found to be 5.09. .

Keywords

Identification; Anthropometry; Stature; Percutaneous Arm Length

Introduction

Identification means determination of exact individuality of a person and is a crucial aspect of forensic investigation. The question of identification may arise in living and dead and also in civil and criminal cases. Identification is basic responsibility of investigative agencies. In case of difficulties the expertise of forensic persons are sought. The identification of dead bodies is required in cases of sudden and unexpected deaths, fire explosions, and railway or aircraft accidents. Identification plays an important role in living persons (a) in civil cases like marriage, inheritance, insurance, employment, recruitment and disputed sex etc. and (b) in criminal cases like absconding soldiers, person accused of assault, murder, rape, and interchange of newborn babies, disputed paternity, etc. and in case of impersonation.¹

Stature is one of the important criteria for establishing identification of unknown person/dead body. Stature refers to body length from the crown to the bottom of the feet in standing position. Supine length refers to the body length taken in supine position from the vertex of skull to heel of feet. Body

length increases after death by about 2 cm due to loss of muscle tone, relaxation of joints and tensions of inter vertebral discs.¹ Correlation between supine length and percutaneous measurements of various parts like inter acromial, arm, and forearm and hand length in cadavers can be subsequently used for determination of stature. Stature varies with race and is determined by genetics of a person, geographical location, environment and climatic conditions.² Estimation of stature is an important objective in the identification of an individual from dismembered and skeletal remains in forensic case work.³ Stature estimation, however, is a constantly changing target for forensic anthropologists because of the secular trends in stature, allometric changes in long bones, and the migration of world population.

Many studies have been conducted on the determination of stature from percutaneous measurements of various body parts including arm⁴, forearm⁵, hand⁶, foot etc.² This is usually conducted by correlating various measurements of body with height of the person using scientifically derived formula such as multiplication factors and regression equations. The formula derived by various authors is from length of bone.

A number of multiplication factors and regression equations have been developed from long bones throughout the world. Multiplication factors as given by Pan (1924) for East Indians (Hindus) are as follows: Humerus (5.30), Radius (6.90), Ulna (6.30), Femur (3.70) and Tibia & Fibula (4.48).¹ Even within our vast homeland of India there are many different ethnic populations, having their own variations.⁷ of all the

Corresponding Author

Dr. Mohit Shrivastava (Junior Resident)

Email: dr.mohit11@yahoo.com

Mobile: +91-9981292111

Article History

Received: 4th April, 2020; Accepted: 24th September, 2020

mathematical methods used, regression formulae based on long-bone measurements yield the most accurate result. Some of the studies^{8,9,10} have reported a significant difference in the proportion of the limb bone dimensions due to environmental, hereditary and dietary factors of the population, and have influenced the stature of a person. In a vast country like India the climatic condition and dietary habit of different regions vary considerably, in addition to the racial and ethical variation. It is opined that, the study of residents of one state are not necessarily applicable to residents of another state.¹¹

Materials and Methods

The present cross-sectional study was conducted on 250 deceased male individuals brought to Department of Forensic Medicine, M.G.M. Medical College Indore (M.P.) after obtaining approval from Institutional Ethical Committee. In the present study males of age more than 21-60 years were included. The study was carried out from June 2018 to July 2019 for a period of one year. In the study population, subjects included are irrespective of caste, religion, dietary habits and socioeconomic status. The measurement taken includes height in centimeters, percutaneous length of arm in centimeters to the nearest millimeters.

The detailed history was taken for both regarding the incident and complete clinical history, including operative procedures, if any. Detailed individual demographic data including the height, sex, age etc were also recorded on the pre-structured Proforma. The procedure, aims and objectives of the study was explained to each relative of the study subjects.

Written informed consent was taken prior to the research after giving detailed information to the next of kin/relatives of the subjects regarding the study. Anthropometric measurements of percutaneous length of arm was taken independently from the left and right side of each individual. Stature of each subject was also recorded. Both right handed and left handed subjects were included in the study. All the measurements were taken in a well lit room. To avoid inter-observer error the measurements were taken by one observer. Diurnal variations have been reported in the stature of an individual^{1,12} therefore all measurements were taken during afternoon hours to avoid diurnal variations, if any.

Cases with physical deformity, disease (e.g., fracture, dislocations, poliomyelitis, osteoporosis, rickets, scoliosis and kypho-scoliosis etc.) or defect affecting the growth in general or of bones. Cases either suffering from gigantism or dwarfism, mutilated and decomposed body, and those individuals who are not the native of Madhya Pradesh were excluded from the study. All the measurements were recorded on a pre-structured proforma. Before taking the measurements rigor mortis was broken by standard technique of treating the dead body

thoroughly with warm water and then breaking it manually if required. Dead body was placed in supine position on the flat hard surfaced autopsy table, with the knee and hip joints extended, and the neck and feet in a same plane and thus supine length was measured from vertex of head to the base of heel.¹³ Arm length- distance between acromion process of scapula and tip of olecranon process¹⁴ by using a standard measuring instrument (Sliding caliper).

At first the researcher selected and analyzed the variables, and then the base line data was represented using tables. Statistical analysis was carried out using IBM SPSS Statistics (IBM, version 2015) software package to calculate linear regression equations and compute multiplication factor. Every questionnaire had a code number to input into the SPSS software. Multiplication factors for percutaneous arm length dimensions were calculated by dividing the stature of an individual by percutaneous length of arm for each subject in males. The mean values & standard deviation (SD) of percutaneous arm length dimensions were calculated. Pearson's correlation coefficient was calculated to establish the correlation between the stature and percutaneous arm length dimensions. Paired sample t-test was performed to find the right and left side differences in percutaneous arm length dimensions among males. The significance of results was tested using Student's t-test. Correlation between two parametric variables was calculated using Pearson Coefficient of Correlation 'r' value. P value was used for testing statistical hypothesis. P-value of less than 0.05 was considered as significant and less than 0.001 as highly significant.

Results

In the present study a total of 250 deceased males were brought to Department of Forensic Medicine, M.G.M. Medical College Indore (M.P.). The mean age of the study subjects was found to be 39.34 ± 11.1 years. Table 1 shows the age wise distribution of the study population. It can be observed that the maximum number of subjects were in age group of 21-25 years (14.0%) while minimum number of cases was in age group 56-60 year (9.6%). The mean stature of the study population was observed to be 165.64 ± 5.038 cm. In this study maximum height was 180.2 cm. and minimum height was 152.0 cm. Table 2 shows the statistical analysis for percutaneous arm length in study subjects. The Table shows the mean percutaneous arm length on right side (RPAL) to be 32.53 ± 1.527 cm, which is less than mean percutaneous arm length on left side (LPAL) (32.56 ± 1.565 cm). In this study maximum percutaneous arm length was 38.5 cm and the range was 28.2 -38.5 cm, while minimum percutaneous arm length was 28.2 cm and the range was 28.2 -38.5 cm. In this study the average percutaneous arm length 32.55 ± 1.57 cm. Maximum average combined

percutaneous arm length was 38.5 cm. and minimum average combined percutaneous arm length was 28.2 cm.

Table 3 shows the regression equations to estimate stature using the percutaneous arm length. The equation obtained is $100.07 + 2.02 \times \text{RPAL}$, $102.89 + 1.93 \times \text{LPAL}$ and $100.76 + 1.99 \times \text{APAL}$. In the present study, statistically significant correlation was found between right and left percutaneous arm length ($r = 0.977$, $p < 0.05$). A significant correlation was found between average percutaneous arm length and stature ($r = 0.608$, $p < 0.05$). The multiplication factor for both the right and the left percutaneous arm lengths was observed to be 5.09.

Table 1: Age wise distribution of the study population

Age group (years)	N	Percentage
21-25	35	14.0
26-30	33	13.2
31-35	30	12.0
36-40	33	13.2
41-45	33	13.2
46-50	31	12.4
51-55	28	11.2
56-60	24	9.6

Table 2: Distribution of anthropometric parameters for percutaneous arm length in male

Variables	Range (cm)	Mean \pm SD
RPALLP	28.20 – 38.50	32.53 \pm 1.527
ALAv	28.20 – 38.50	32.56 \pm 1.565
PAL	28.20 – 38.50	32.55 \pm 1.537

RPAL – Right percutaneous arm length; LPAL – Left percutaneous arm length; AvPAL – Average percutaneous arm length

Table 3: Regression models based on percutaneous arm length for estimation of stature

Variable	Regression equation
RPAL	$100.07 + 2.02 \times \text{RPAL}$
LPAL	$102.89 + 1.93 \times \text{LPAL}$
Av PAL	$100.76 + 1.99 \times \text{APAL}$

RPAL – Right percutaneous arm length; LPAL – Left percutaneous arm length; AvPAL – Average percutaneous arm length



Figure 1: Measurement of the percutaneous arm length

Discussion

In the present study the mean stature of male subjects was found to be 165.64 ± 5.038 cm which was slightly lower than the findings of the other studies Kaur et al.⁵ (175 ± 6.76), Ahmed et al.¹⁵ (180.52 ± 5.77), Borker¹⁶ (173.8 ± 8.8), Airan et al.¹⁷ (168 ± 6.21) and Chauhan et al.¹⁸ (175.46 ± 5.76), while it was slightly higher than the study done by Ahmed et al.¹⁹ (160.32 ± 8.44) and similar to the findings of Mrudula et al.¹⁹ (165.35 ± 5.025). In the present study mean average percutaneous arm length was found nearly similar to results of Ahmed et al.¹⁵ and Airan et al.¹⁷

The present study did not show any statistical difference for all parameters on left and right side. However left side presented with slightly higher value and is statistically significant ($p < 0.001$ and $r = 0.977$). Similar results were obtained by Airan et al.¹⁷ and Borker¹⁶. Similarly correlation between average percutaneous arm length and height shows strong positive statistically significant correlation ($p < 0.001$ and $r = 0.68$).

The measurements of the stature obtained using regression

equation were compared with the actual measurements and significant association was found between the measurements. So stature can be predicted with high accuracy using regression equations. In the present study regression equation for estimation of stature in males for right and left Arm was $100.07 + 2.02 \times \text{RPAL (HT with RPAL)}$ & $102.89 + 1.93 \times \text{LPAL (HT with LPAL)}$ respectively. The regression equations derived in the present study showed a different pattern than earlier studies.^{15,17,18} This clearly shows variations in the regression equations in different ethnic groups in India. So, regression equations of the present study cannot be applied to other population groups. In this study shows that in case of male MF was 5.09 which was different from other study in India at different regions. In a vast country like India the climatic condition and dietary habit of different regions vary considerably, in addition to the racial and ethnic variation. It is opined that, the study of residents of one state are not necessarily applicable to residents of another state.¹¹ Due to improved socioeconomic condition, population specially in India, is getting taller, and relationship between height and length of long bones is changed. Hence, fresh formulae are needed for current generations.^{11,13}

Conclusion

Multiplication factors derived in the present study were found to be slightly lower with previous studies, but linear regression equations were statistically superior and more reliable than multiplication factors. While anthropometric measurements (stature and built) differ in different ethnic groups due to demographic factors and are strongly influenced by genetic and environmental factors, suggesting the need for different nomograms for each endogamous group. These types of studies are of medico legal importance, as the first step in forensic analysis is establishing the identity of the person in question, where stature remains one of the primary characteristics of identification. So the findings of the present study will be useful for forensic experts and anthropologists. These studies also help to know the differences between different population groups. The standard values of the present studies have also relevance in ergo-design applications of percutaneous arm length tools and devices. There are scarce availabilities of the research studies in central Indian region. So further studies should be carried out on such a large scale in central region to get more valid results. On this basis, the study should be expanded to get more and better results.

Ethical clearance: A prior approval was obtained from institutional ethical committee.

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Dikshit PC. Textbook of forensic medicine and toxicology. 2nd t Edition. New Delhi PEEPEE Publishers 2014:55-78.
2. Akhlaghi M, Hajibeygi M, Zamani N, Moradi B. Estimation of stature from upper limb anthropometry in Iranian population. *J Forensic Leg Med.* 2012; 19: 280-4.
3. Agnihotri A K, Kachhwaha S, Jowaheer V, Singh A P. Estimation of stature from percutaneous length of tibia and ulna in Indo-Mauritian population. *Forensic Sci Int.* 2009; 187:109.e1–109.e3.
4. Siddiqui MAH, Shah MA. Estimation of stature from long bones of Punjabis. *Ind J Med Res.* 1944;32:105-8
5. Kaur M, Mahajan A, Khurana B S, Arora A K, Batra A P S. Estimation of stature from upper arm length in north indians – an anthropometric study. *Indian J Fundamental and Applied Life Sciences.* 2011; 1(4):151-4.
6. Agnihotri A K, Agnihotri S, Jeebun N, Googoolye K. Prediction of stature using hand dimensions. *J Forensic Leg Med.* 2008; 15: 479–82.
7. Ozaslan A, Iscan M Y, Ozaslan I, Tugcu H, Koc S. Estimation of stature from body parts. *Forensic Sci Int.* 2003; 132: 40-5.
8. Nath BS. Use of Lower Limb Measurements in Reconstructing Stature among Shia Muslims. *Internet Journal of Biological Anthropology.* 2009;2(2):86-97.
9. Steele DG. Estimation of stature from Fragments of long limb bones. Stewart TD ed. *Personal Identification in Mass Disasters.* Washington DC: Smithsonian Institute; 1970, p. 85-97.
10. Nat BS. Estimation of stature from long bones in Indians of United Province: A Medico-Legal enquiry on Anthropometry. *Ind J Med Res.* 1931;18:1245-53.
11. Trotter M, Gleser GC. Estimation of stature from long bones of Americal Whites and Negroes. *AM J Phys Anthropol* 1952; 10:463-514.
12. Chaturvedi D, Priyanka. Determination of Correlation Between Supine Length And Percutaneous Measurements of Tibial Length in Cadavers. *IOSR J Dent Med Sci.* 2016; 15(11):46-54
13. Vallois H. Anthropometric techniques. *Current Anthropology.* 1965; 6(2):127-43
14. Airan N, Dwivedi AK, Das AR, Mishra SK. Estimation of stature from length of arm in adult population of Garhwal region of Uttarakhand, India. *Int J Biomed Res;*2016; 7(12): 842-846.
15. Siddiqui MAH, Shah MA. Estimation of stature from long bones of Punjabis. *Ind J Med Res.* 1944;32:105-8.
16. Meenakshi P. Borker. Estimation of height from the length of humerus in western region of Maharashtra. Borker MP. *Int. J. Res. Med. Sci.* 2014;2(2):498-500
17. Lal CS, Lala JK. Estimation of height from tibial and ulnar lengths in North Bihar. *J Indian Med Assoc.* 1972;58(4):120-1.
18. Shadan N, Tahmineh M, Tahereh A, Ali A, Golamreza H. Determination of Stature from Upper Arm Length in Medical Students. *Anat Sci.* 2014; 11(3):135-9.
19. Mrudula C and Naveena S. Comparative study of estimation of stature using femur length humerus length: an anthropometric study. *J Sci.* 2015;5(10): 865-7

ORIGINAL ARTICLE

Stature estimation using foot length and BMI among students at a tertiary health care centre in Maharashtra, India

Shashank S. Waghmare,¹ Rajesh V. Kachare,¹ Kailash U. Zine,² Vishwajeet G. Pawar¹

¹ Department of Forensic Medicine, Swami Ramanand Teerth Rural Government Medical College, Ambajogai, Maharashtra, India.

² Department of Forensic Medicine, Government Medical College, Aurangabad, Maharashtra, India

Abstract

Stature can be estimated easily with primary anatomic structures in intact corpses. It becomes very difficult to identify parted bodies especially after a natural disaster, traffic accidents, war, terror and bombing in which people are dead and became unrecognizable. As most of the time foot is protected by shoes it can be useful in these types of situation.¹⁰⁻¹² We observed that foot was studied in many cases to obtain information in identification when there was no other body part available. The aim of the present study was to estimate stature from foot length and BMI based on statistical equations and formulae. The present study included 300 medical students from SRTR Government Medical College, Ambajogai, Dist. Beed, Maharashtra, India. The participants (150 female and 150 male) were young adults between 18 and 24 years, and did not have any foot or related operation. We measured stature, foot length, BMI and attempt were made to find correlation between them. In the present study it was observed that the minimum right foot length (RFL) and left foot length (LFL) was 20.50 and 20 cm respectively, Maximum RFL and LFL was 28 and 27.80 respectively. The mean RFL and LFL was 24.25 and 24.10 cm respectively. The coefficients of correlation between stature and foot length and BMI were found to be statistically significant (p value <0.0001). Though supremacy of long bones for estimation of stature cannot be ignored, it is more likely to come across footprints/isolated body parts during forensic investigation, thus justifying the measurement of foot length as important determinant of stature.

Keywords

Stature; Right Foot Length; Left Foot Length; BMI

Introduction

In forensic medicine, to estimate how tall one is quite important during the identity defining stage. Beside the body appearance, some parts of a skeleton and bones, private/personal clothes and other belongings, and the other numerous data can be made use of to justify one's stature in fatal or harmless incidents.¹⁻⁴

Stature estimations can easily be done with primary anatomic structures in intact corpses. It becomes very difficult to identify parted bodies especially after a natural disaster, traffic accidents, war, terror and bombing in which people are dead and became unrecognizable. So, it become need of time to develop alternative methods to solve these difficulties. There are some attempts for identifying the person by hand measurements,⁵⁻⁹ vertebral column length¹⁰, inferior extremity length¹¹ and footstep length in alive person. Besides, there are some studies on the stature estimation from foot length and BMI.¹²⁻¹⁴

As most of the time foot is protected by shoes it can be useful

in these types of situation.¹⁰⁻¹² We observed that foot was studied in many cases to obtain information in identification when there was no other body part available. In the present study we made attempt to estimate stature from foot length and BMI based on statistical equations and formulae. Medical faculties have worked on anthropometry of foot since many years, and they realized that foot anthropometry differ in various communities. Anthropometry of the foot is affected by regional variations by nutrition conditions, climatic factors, hereditary patterns, physical activities and used shoe type also. These measurements also help us see the difference among the populations.¹⁵ Most of the times stature of the individual can be determined by using anthropometric methods.¹⁶

The purpose of the present study is to develop formulae to estimate the stature of an unknown individual by using foot length and BMI. As there are very few studies available on the estimation of stature from foot measurements in Indian population. The present study was conducted with the aim of studying the efficacy of foot length and BMI in estimation of stature in human beings and to develop regression formulae to estimate the stature of an individual by using foot length and foot width.

Materials and Methods

The present cross-sectional study consisted of 300 (150 female and 150 male) Maharashtrian medical students between the age

Corresponding Author

Dr. Vishwajeet G. Pawar (Associate Professor)

Email: pawar.drviswajeet@gmail.com

Mobile: +91-9922086138

Article History

Received: 13th May, 2020; Revision received on: 19th August, 2020

Accepted: 23rd August, 2020

group of 18-24 years of SRTR Government Medical College, Ambajogai, Dist. Beed, Maharashtra, India. The study was conducted in SRTR Government Medical College, Ambajogai, Dist. Beed, Maharashtra, India. Prior to study approval of ethics committee of institute was taken. The period of study was from September 2018 to March 2019. The objectives and the methods of the study were explained to the sample population, and informed written consent was obtained, by taking their signatures. All the measurements were taken in a reasonably well-lit room, at a fixed time between 9.00 a.m. to 5.00 p.m. to eliminate diurnal variation. It was measured and recorded only by me, to avoid inter observer error in methodology. Students having deformities in the foot like amputation of finger, congenitally malformed limbs, metabolic disorders and also developmental defects were excluded from the study along with non-consenting students.

Measurement of stature, foot length and the weight of participants were measured as follows: Stature was measured as vertical distance from the vertex to the floor. Measurement was taken by making the subject to stand erect on a horizontal resisting plane, bare footed with shoulder blocks and buttocks touching the wall. Palms of hand were turned inwards and fingers horizontally pointing downwards. Stadiometer was placed in straight vertical position in front of the subject with head oriented in Frankfurt Plane (eye-ear-eye plane). The movable rod of the Stadiometer is brought in contact with vertex in the mid sagittal plane. Foot length was measured in cm first on right foot with the help of sliding caliper (dial) as a straight distance between the most posterior projecting points of the heel to the most anterior projecting point of the first or second toe whichever was bigger. Then by same technique left foot length was also measured. Weight of study subjects was measured with help of Weight was measured by digital weighing machine in kilogram. All measurements were evaluated in centimeter. Obtained results were tabulated and analyzed with the help of SPSS software.

Results

In the present study we found that the minimum right foot length (RFL) and left foot length (LFL) was 20.50 and 20 cm respectively, Maximum RFL and LFL was 28 and 27.80 cm respectively. The mean RFL and LFL was 24.25 and 24.10 cm respectively (Table 1). The minimum BMI was 15, Maximum BMI was 32 while mean BMI was found to be 21.97 (Table 2). Highly significant positive correlation was observed between both foot length, BMI and stature of the individual, indicating the reliability of foot length as well as BMI as parameters for stature estimation (Table 3). In this study the coefficients of correlation between stature and foot length and BMI were found to be statistically significant (p value < 0.0001). The

correlation coefficient between these parameters and lowest SEE proves us that the foot length provides highest accuracy and reliability in estimating stature of an unknown individual.¹⁹ Right foot length (RFL), left foot length (LFL), BMI were evaluated to develop formulae in stature estimation using linear regression analysis (Table 4). Stature was estimated by linear regression equations using foot length and BMI. The formula for stature estimation with the help of foot length is $D = b_0 + b_1 FL \pm SEE$, where b_0 & b_1 is coefficient of discriminant function, FL is foot length, SEE is Standard Error of Estimation.



Figure 1: Measurement of stature of a participant



Figure 2: Measurement of the foot length

Table 1: Descriptive statistics of the foot length of the study participants

Foot Length	Range (cm)	Mean \pm SD (cm)	Median (cm)	SE
RFL	20.50-28.00	24.25 \pm 1.717	24.65	0.0991
LFL	20.00-27.80	24.10 \pm 1.735	24.60	0.1002

RFL = Right foot length; LFL = Left foot length; SE = Standard error

Table 2: Descriptive statistics of the height, weight, and BMI of the study participants

	Range (cm)	Mean \pm SD (cm)	Median (cm)	SE
Height	141-188	164.2 \pm 8.972	165.6	0.5180
Weight	40-95	59.07 \pm 10.34	58	0.5971
BMI	15-32	21.97 \pm 3.593	21.50	0.2074

SE = Standard error

Table 3: Correlation between stature and feet length and BMI

Stature	RFL	LFL	BMI
r	0.803	0.801	0.211
p-value	<0.001	<0.001	<0.001

RFL = Right foot length; LFL = Left foot length

Table 4: Regression models to estimate stature using feet length and the BMI

Estimation of stature using RFL	$62.492 + 4.194 \times \text{RFL} \pm 4.39$
Estimation of stature using LFL	$64.39 + 4.142 \times \text{LFL} \pm 4.333$
Estimation of stature using BMI	$175.9 + (-0.5333 \times \text{BMI}) \pm 3.186$

RFL = Right foot length; LFL = Left foot length

Discussion

In the present study we found that the minimum RFL and LFL was 20.50 and 20 cm respectively, Maximum RFL and LFL was 28 and 27.80 respectively. The mean RFL and LFL was 24.25 and 24.10 cm respectively (Table 1). Similar results were found in the study done by Zeybek et al.,¹⁶ Ogbonnaya et al.,¹⁷ Phang et al.¹⁸ The minimum BMI was 15, Maximum BMI was 32 while mean BMI was found to be 21.97 (Table 2). Similar results were found in the study done by Zeybek et al.¹⁶

Highly significant positive correlation was observed between both foot length, BMI and stature of the individual, indicating the reliability of foot length as well as BMI as parameters for stature estimation (Table 3). In this study the coefficients of correlation between stature and foot length and BMI were found to be statistically significant (p value <0.0001). The correlation coefficient between these parameters and lowest SEE proves us that the foot length provides highest accuracy and reliability in estimating stature of an unknown individual.¹⁹

Right foot length (RFL), left foot length (LFL), BMI were evaluated to develop formulae in stature estimation using linear

regression analysis (Table 4). Stature was estimated by linear regression equations using foot length and BMI. Krishan et al.,¹⁵ Agnihotri et al.,²⁰ also found similar equations in their study.

Conclusion

Though supremacy of long bones for estimation of stature cannot be ignored, it is more likely to come across footprints/isolated body parts during forensic investigation, thus justifying the measurement of foot length as important determinant of stature. Foot measurements can provide splendid reliability in prediction of stature in forensic investigations. Foot length gives better estimation of stature and sex than BMI and weight. However, the limitation in this study is that, the formulae generated in this study is applicable for the population residing in this region only and that could be applied for people residing in this region from aged 18-24 years old. In future studies should be carried out on more diverse population for future implications.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

- İşcan MY, Miller-Shaivitz P. Discriminant function sexing of the tibia. *Journal of Forensic Science*. 1984; 29(4):1087-93.
- Hoyme LE, Iscan MY. Determination of sex and race: accuracy and assumptions. *Reconstruction of Life from the Skeleton*. 1989:53-93.
- Ashizawa K, Kumakura C, Kusumoto A, Narasaki S. Relative foot size and shape to general body size in Javanese, Filipinas and Japanese with special reference to habitual footwear types. *Ann Hum Biol*. 1997; 24(2):117-29.
- Ozden H, Balci Y, Demirüstü C, Turgut A, Ertugrul M. Stature and sex estimate using foot and shoe dimensions. *Forensic Sci Int*. 2005;147(2-3):181-4.
- Krogman WM, İşcan MY. *The human skeleton in forensic medicine*, Charles C. Thomas, Springfield, IL. 1986:202-08.
- Sanli SG, Kizilkanat ED, Boyan N, Ozsahin ET, Bozkir MG, Soames R, Erol H, Oguz O. Stature estimation based on hand length and foot length. *Clin Anat*. 2005;18(8):589-96.
- Abdel-Malek AK, Ahmed AM, El Sharkawi SA, El NA. Prediction of stature from hand measurements. *Forensic Sci Int*. 1990;46(3):181-7.
- Saxena SK. A study of correlations and estimation of stature from hand length, hand breadth and sole length. *Z Morphol Anthropol*. 1984:271-6.
- Rastogi P, Nagesh KR, Yoganarasimha K. Estimation of stature

- from hand dimensions of north and south Indians. *Leg Med.* 2008; 10(4):185-9.
10. Nagesh KR, Kumar GP. Estimation of stature from vertebral column length in South Indians. *Leg Med.* 2006; 8(5):269-72.
 11. Özaslan A, İşcan MY, Özaslan I, Tuğcu H, Koç S. Estimation of stature from body parts. *Forensic Sci Int.* 2003; 132(1):40-5.
 12. Jasuja OP, Harbhajan S, Anupama K. Estimation of stature from stride length while walking fast. *Forensic Sci Int.* 1997; 86(3):181-6.
 13. Jasuja OP. Estimation of stature from footstep length. *Forensic Sci Int.* 1993; 61(1):1-5.
 14. Grivas TB, Mihas C, Arapaki A, Vasiliadis E. Correlation of foot length with height and weight in school age children. *J Forensic Leg Med.* 2008;15(2):89-95.
 15. Krishan K. Anthropometry in forensic medicine and forensic science-'Forensic Anthropometry'. *Internet J Forensic Sci.* 2006;2(1).
 16. Zeybek G, Ergur I, Demiroglu Z. Stature and gender estimation using foot measurements. *Forensic Sci Int.* 2008;181(1-3):54-61.
 17. Ogbonnaya IO, Frank ET, Olasubomi SA, David UN. Sex estimation using foot measurements, stature and body mass index (BMI) in a Nigerian population. *Acta Scientifica Naturalis.* 2018;5(2):32-7.
 18. Phang SF, Normaizatun AI, Lai PS Stature and Sex Estimation Using Foot Measurements. *J Forensic Sci Criminol.* 2017; 5(1): 105.
 19. Agnihotri AK, Purwar B, Googoolye K, Agnihotri S, Jeebun N. Estimation of stature by foot length. *J Forensic Leg Med.* 2007; 14(5):279-83.

ORIGINAL ARTICLE

Age determination from epiphysial fusion around elbow joint and their correlation with gender: a radiological study

Archana Kaul, Rajesh Kumar Rai, Priyanka Agarwal, Shweta Saroj

Department of Forensic Medicine and Toxicology, Moti Lal Nehru Medical College, Allahabad

Abstract

The present study aims to determine the age from epiphysis fusion around elbow joint. In this study, the X-ray films of the subjects were divided into three groups on the basis of degree of fusion. Firstly, those which were showing Non fusion (NF), secondly those showing Partial fusion (PF) & thirdly those showing Complete Fusion (CF). Observations made were compared with previous radiological studies. The fusion of conjoint epiphysis to shaft of humerus, upper end of radius and medial epicondyle with its shaft in male and female completed in all instances (100%) at the age groups of 17-18 years & 16-17 years respectively.

Keywords

Radius, Fusion, Epiphysis, Humerus, Elbow joint

Introduction

Age estimation in the living is one of the most important tasks of a forensic practitioner especially in developing countries where birth records are often not well maintained. Because of this, we need some objective methods to find out exact age of a particular individual. The principal means, which enable a medical man to opine about the age of a person, are teeth, height, weight, puberty changes and ossification of bones etc. Among various methods of age determination, ages of appearance and union of epiphysis with diaphysis, as observed radiologically is considered to be a reliable guide and in many cases, it is the only guide for the estimation of age of the individual.

While most researchers determine union visually, some scholars advocate the use of radiograph to determine the degree of fusion. Estimation of age is routinely conducted using methods that assess the indicators of skeletal maturity, dental maturity, secondary sexual characters, etc. In medico legal practice a combined view is taken & opinion is expressed after considering all methods. However radiological examination is must & the court of law did not believe any conclusion without it. The present study has been undertaken to find out the fusion of head of radius & medial epicondyle with their respective shaft as one of the data in determination of age in the living. The aims and objectives of the present study are to assess the

skeletal maturity at elbow joint for a known chronological age in subjects of Allahabad region, comparative study of fusion of ossification centers at elbow joint with known standards, to evaluate sex related variation and its content with age and to know variation if any and exception of fusion of centers of ossification.

Material and Methods

The present series of work was carried out between Aug 2014 to July 2015 at the Departments of Forensic Medicine & Radiology of Moti Lal Nehru Medical College, Prayagraj. The study was performed in a total of 108 participants up to the age of 18 years. The subjects did not have any disease/deformity pertaining to bones or chronic disease affecting the general health. X-ray of elbow joint was taken & films were developed with the help of experienced technicians. The epiphyseal fusion was graded as 1, 2 and 3 for the three stages of fusion, and its correlation with age is presented in tables.

Results

Table 1 depicts the number of male and female subjects in each age group. Youngest age group showing complete union of this epiphysis in 100% subject is 17-18 years in case of male and 16-17 years in case of female. (Table 2). In case of medial epicondyle of humerus, earliest age showing complete union in 100% cases is 17-18 years for males and 16-17 years for females. (Table 3). Earliest age group showing complete union of upper end of radius in 100% subject is 17-18 years for males and 16-17 years for females. (Table 4).

Corresponding Author

Dr. Shweta Saroj (Junior Resident)

Email: drshwetasaroj@gmail.com

Mobile: +91-9456007333

Article History

Received: 1st April, 2020; Accepted: 25th September, 2020

Table 1: Distribution of cases among different age groups

Age Group	N		Total	%
	Males	Females		
<1	1	1	2	1.85%
1-2	6	2	8	7.40%
2-3	6	4	10	9.26%
3-4	5	2	7	6.48%
4-5	4	1	5	4.63%
5-6	7	7	14	12.96%
6-7	4	3	7	6.48%
7-8	6	4	10	9.26%
8-9	2	0	2	1.85%
9-10	4	2	6	5.56%
10-11	5	2	7	6.48%
11-12	5	2	7	6.48%
12-13	1	0	1	0.93%
13-14	2	0	2	1.85%
14-15	1	3	4	3.72%
15-16	5	3	8	7.40%
16-17	2	3	5	4.63%
17-18	3	0	3	2.78%
Total	69	39	108	100%

Table 2: Status of fusion of conjoint epiphysis with lower end of humerus in the study population

Age group	Fusion of Conjoint Epiphysis					
	Male			Female		
	NF	PF	CF	NF	PF	CF
12-13	1	-	-	-	-	-
13-14	2	-	-	-	-	-
14-15	-	1	-	-	3	-
15-16	-	4	1	-	2	1
16-17	-	1	1	-	-	3
17-18	-	-	3	-	-	-

NF – Not fused; PF – Partially fused; CF – Completely fused

Table 3: Status of fusion of medial epicondyle of humerus with its shaft in the study population

Age group	Fusion of Medial Epicondyle with shaft					
	Male			Female		
	NF	PF	CF	NF	PF	CF
12-13	1	-	-	-	-	-
13-14	2	-	-	-	-	-
14-15	1	-	-	3	-	-
15-16	2	3	-	-	2	1
16-17	-	1	1	-	-	3
17-18	-	-	3	-	-	-

NF – Not fused; PF – Partially fused; CF – Completely fused

Table 4: Status of fusion of head of radius with its shaft in the study population

Age group (years)	Fusion of upper end of Radius with shaft					
	Male			Female		
	NF	PF	CF	NF	PF	CF
12-13	1	-	-	-	-	-
13-14	2	-	-	-	-	-
14-15	-	1	-	-	3	-
15-16	-	5	-	-	1	2
16-17	-	1	1	-	-	3
17-18	-	-	3	-	-	-

Discussion

In present study, age of union of epiphysis around elbow joint has been worked out and composite epiphysis of lower end of humerus is found to unite at 15-18 years for males and 15-17 years for females. In males, complete fusion of conjoint epiphysis with shaft has been observed. Studies of Galstaun,¹ Kothari,² Nemade et al.,³ Bhise and Nanandkar,⁴ Jnanesh et al.,⁵ Sidhom and Derry,⁶ have mentioned ages within the same range. Fusion of conjoint epiphysis has been found incomplete till 20 years in the study of Jit and Singh⁷ in few subjects from Punjab whereas it has been reported at an early age of 14 years in the study of Pillai,⁸ Ledger and Wasson.⁹ Our study also confirms age of appearance mentioned by Suttan,¹⁰ Halim,¹¹ and Reddy.¹² In females, age group observed in present study is consistent with Kothari,² and Bhise and Nanandkar,⁴ Galstaun,¹ Pillai,⁸ and Paterson,¹³ reported it early around 14 years of age however Jit and Singh,⁷ in Punjab reported age of fusion up to 19.5 years. The medial epicondyle of humerus is found to unite at 16-18 years in males and 15-17 years in females in present

study. In males, Flecker,¹⁴ Lal and Nat,¹⁵ Galstaun,¹ Patel et al.,¹⁶ Nemade et al.,³ Bhise and Nanandkar,⁴ Ledger and Wasson.⁹ Pillai,⁸ observed earlier fusion of medial epicondyle with shaft up to the age 14.5 years, however, at later age in the study of Jnanesh et al.,⁵ Gupta et al.,¹⁷ and also mentioned by Halim.¹¹ In females, our study reported similar age groups as mentioned by Flecker,¹⁴ Dixit et al.,¹⁸ Nemade et al.,³ Patel et al.¹⁶ Ledger and Wasson,⁹ Galstaun,¹ Aggarwal and Pathak,¹⁹ Kripalani et al.,²⁰ Basu and Basu,²¹ Bhise and Nanandkar,⁴ and Jnanesh et al.,⁵ reported earlier appearance in age group between 12.5-15 years.

Epiphysis of upper end of radius is found to unite at 16-18 years in males and at 15-17 years in females in present study. In males, Flecker,¹⁴ Lal and Nat,¹⁵ Galstaun,¹ and Bhise and Nanandkar,⁴ reported similar age group. The upper limit of age in present study corresponds with the age reported by Sidhom and Derry,⁶ and Ledger and Wasson.⁹ In females, age group observed in our study is consistent with Dixit et al.²² in Garhwal. Paterson,¹³ Flecker,¹⁴ Galstaun,¹ Basu and Basu,²¹ and Bhise and Nanandkar⁴ reported early fusion between 13-15 years of age, however Kripalani et al.²⁰ in Bengali girls observed wider range of age of fusion between 11-16 years. This study along with other studies have consensus on the fact that fusion of different epiphysis around elbow joint occurs earlier in females than males.

Conclusion

Age determination based on epiphysis union of bones radiologically is an accepted scientific method worldwide. Comparison with other studies in India and different parts of the world pointed out that age of fusion of epiphysis varies not only in various parts of globe but also with in same country, especially in a country like India with a diverse environmental, dietetic, genetic and cultural factors.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

- Galstaun G. A study of ossification as observed in Indian subjects. *Indian J. Med.* 1937; 25: 267-324
- Kothari DR. Age of epiphyseal Union at the Elbow and Wrist Joints in Marwar Region of Rajasthan, *J Indian Med Assoc.* 1974; 63:68
- Nemade K.S., Kamdi N.Y., Meshram M.M. The Age Order of Epiphyseal Union around Elbow Joint - A Radiological Study in Vidarbha. *Int J Recent Trends Sci Technol.* 2014;10(2): 251-255
- Bhise SS, Chikhalkar BG, Nanandkar SD, Chavan GS. Age Determination from Radiological Study of Epiphysal Appearance and Union around Wrist Joint and Hand. *J Indian Acad Forensic Med.* 2011; 33(4): 292-295
- Jnanesh RS, Thomas ST, Gowd HS. Estimation of Age by roentgenologic Study of Epiphyseal Union at the Lower end of Humerus in Karnataka. *Anat Karnataka.* 2011; 5(1):06-10.
- Sidhom G. and Derry DE. Dates of union of some epiphyses in Egyptian from X-ray photographs. *J Anat.* 1931;65(2): 196-211.
- Jit I, Singh B. A radiological study of time of fusion of certain epiphysis in Punjabis. *J Anat Soc India.* 1971; 20: 1-27.
- Pillai MJS. The study of epiphyseal union for determining the age of South Indians. *Indian J Med Res.* 1936; 23:1015-7
- Ledger LK and Wasson TC. Ages of epiphyseal union at the elbow and wrist joints amongst 238 children in North - West frontier province. *Indian Med Gaz.* 1941; 76: 81-4
- Sutton D. Textbook of Radiology and Imaging. 7th Edition. Elsevier Publications. 2014
- Halim A. Textbook of surface and radiological anatomy. Reprint 2014, 3rd Ed. CBS Publishers and Distributors, New Delhi. 91-96
- Reddy KSN 'The Essentials of Forensic Medicine and Toxicology. 33rd Ed. Medical Book Company, Hyderabad. 74-75
- Patterson RS. A Radiological investigation of the Epiphysis of the long bones. *J. Anat.* 1929; 64:28-46. In: Hepworth SM. On the Determination of Age in Indians from a Study of the Ossification of the Epiphyses of the long bones. *Indian Med Gaz.* 1929; 64:128.
- Flecker H. Roentgenographic observations of the times of appearance of epiphyses and their fusion with the diaphysis. *J Anat.* 1999; 67:118-164
- Lal R and Nat BS. Ages of epiphyseal union at the elbow and wrist joints amongst Indians. *Indian J Med Res.* 1934; 21: 683-689
- Dharmesh SP, Agarwal H, Shah JV. Epiphyseal Fusion at Lower End of Radius and Ulna Valuable Tool for Age Determination. *J Indian Acad Forensic Med.* 2011; 33(2): 125-129
- Gupta et. al. A roentgenologic study of epiphyseal union around elbow, wrist and knee joints and pelvis in Boys and Girls of Uttar Pradesh. *J Indian Med Assoc.* 1974; 62:10-12.
- Dixit SP, Bansal RK. Study of Ossification Centers Fusion of Elbow Joint in 15 to 17 Years Garhwali Females of Dehradun Region *J Indian Acad Forensic Med.* 2014; 36 (4): 396 -398
- Aggarwal ML, Pathak IC. Roentgenologic Study of Epiphyseal Union in Punjabi Girls for Determination of Age. *Indian J Med Res.* 1957; 45: 283-9
- Kripalani G, Banerjee AK, Rao MN. Ossification Centres At The Elbow Joint In Bengali Girls. *Indian J Pediatr.* 1970; 37(267) : 128-133
- Basu SK and Basu S. A contribution to the study of diaphyseal-epiphysal relations at the elbow of young Bengali girls. *Indian J Paediatr.* 1938; 5: 202-204

Assessment of chronological age based on radiological closure of cranial sutures in Jodhpur region of Rajasthan

Narendra Kumar Vaishnawa,¹ Jagdish Jugtawat,² Anil Bishnoi,¹ P. C. Vyas¹

¹ Department of Forensic Medicine and Toxicology, Dr. Sampurnanand Medical College, Jodhpur, Rajasthan, India

² Department of Forensic Medicine, Jaipur National University, Jaipur, Rajasthan, India

Abstract

Age estimation from radiological study of bones is often required in medicolegal practice. Correct age is essential in legal medicine, medical, social and administrative matters to validate documents. In this study 100 individuals (53 males & 37 females) of 20 to 70 years age group attending M.G. and MDM Hospitals were selected and Skiagram of skull advised after consenting. We studied and compared upper, mid and lower components of sagittal, upper and lower half coronal, and lambdoid sutures in males and females, and observed that suture closure starts earlier in lower 1/3rd part of sagittal suture among both males and females, however the suture fusion is earlier in males than in females. Furthermore, suture closure starts with in 31 years in males and 33 years in female, for each suture. Closure is earlier in males as compared to females. Overall, coronal suture was found to close early followed by sagittal and lambdoid suture respectively.

Keywords

Chronological age; Suture obliteration; Closure; Skiagram; Informed consent

Introduction

Age estimation from radiological study of bones is often required in medico legal practice. In individuals of age less than 22 years many landmarks for references are available which help in estimation of age with close approximation. However, after the epiphysis of long bones & clavicle have fused with metaphysic, the task of age estimation becomes very difficult. Correct age is essential in legal medicine, medical, social & administrative matters (i.e. pension settlement, senior citizen behavior, validity of marriage, entrance examinations). Age estimation also essential to validate documents, many times due to illiteracy /corruption documents are forged or misplaced at that incident we need to produced estimated age. There are other criteria also by which we can give estimated age like dental, body growth, secondary sexual characters but we need more reliable or precise method. In order to establish the chronological age of an individual from their skeletal development, at least one of the three phases of osseous development must be assessed:

-The age of appearance ossification of the different parts of the bone.

-The morphological appearance and/or size of bone and its constituent parts.

-The timing of fusion of different parts of a bone

Closure of cranial sutures considering coronal, sagittal & lambdoid – The idea that cranial bone fuse progressively has been in existence since 10th century,¹ however, its utilization as method of age assessment has been quite controversial since mid-20th century, hence required frequent studies.

The present study is based on multi factorial factor approach to narrow the resulting age range.

Materials and Methods

To achieve the aims and objectives, 100 cases were selected between the study period i.e. June 2018 to June 2019 visiting to MLC OPD at MG & MDM Hospitals, Jodhpur, who were fulfilling the selection criteria were selected and after proper history taken in relation to age estimation, availability of certificate indicating the age of birth, or any such relevant document, and physical examination, skiagraphy was conducted after informed consent.

Inclusion criteria:

- All individuals from both sexes of 20 to 70 years age group, attending MGH/MDM Hospital OPD & their attendants.
- Of the above, those consenting for skiagraphy and history taking will be included in the study.

Exclusion criteria:

- Cases showing any disease having major endocrinal and metabolic disease or damage in respect to anterior chest wall and skull vault will not considered, on medication (steroids, hormonal therapy, having chronic or with congenital deformities are also excluded (based on history taken from subject)

Corresponding Author

Dr Narendra Kumar Vaishnawa (Senior Demonstrator)

Email: narendravaishnawakota@gmail.com

Mobile: +91-9460372395

Article History

Received: 13th May, 2020; Revision received on: 12th August, 2020

Accepted: 21st August, 2020

Each individual was subjected to following radiological examination of skull with a view to study the Sagittal, Coronal and Lambdoid sutures. A special view (Gaur, Sahni, and Saxena² will evolved by trial in order to get all the basic three sutures in one film. The patient was positioned for the true lateral view, but the tube head will be kept at 30 degree towards feet and 15 degree towards nose, keeping the distance of the tube head at 36 inches. All the observations were noted on a common standard Performa and later the findings were tabulated to draw necessary conclusions. A predesigned Performa was filled up for every case, master chart was prepared. The results obtained after statistical analysis will be analyzed and compared with the works of previous authors.

Results

Among 100 cases maximum numbers of subjects were from the 31–40 & 71 and above in males and in females 41–50 age group. Minimum numbers of subjects were from above 61–70 age group (Table 1). Earliest ages of fusion of sagittal suture upper 1/3rd, middle 1/3rd, and lower 1/3rd, were 43 years, 54 years and 33 years respectively in males. Median age of fusion of sagittal suture upper 1/3rd, middle 1/3rd, and lower 1/3rd were 50 years, 56 years, 44 years respectively for males (Table 2).

Table 1: Age and sex wise distribution of cases

Age group in years	Male	Female	Total
21-30	7	7	14
31-40	14	9	23
41-50	9	11	20
51-60	5	8	13
61-70	4	6	10
71 & Above	14	6	20
Total	53	37	100

Table 2: Fusion of sagittal suture in males

Age (years)	N	Anterior 1/3 rd			Middle 1/3 rd			Posterior 1/3 rd		
		Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused
21-30	7	2	5	0	5	2	0	2	5	0
31-40	14	8	6	0	6	8	0	0	5	9
41-50	9	0	3	6	4	5	0	0	3	6
51-60	5	0	0	5	0	4	1	0	1	4
61-70	4	0	0	4	0	1	3	0	0	4
70<	14	0	0	14	0	0	14	0	0	14
Total	53	10	14	29	15	20	18	2	14	37

Table 3: Fusion of sagittal suture in females

Age (years)	N	Anterior 1/3 rd			Middle 1/3 rd			Posterior 1/3 rd		
		Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused
21-30	7	5	2	0	7	0	0	2	5	0
31-40	9	4	5	0	4	5	0	0	3	6
41-50	11	0	2	7	0	4	7	0	3	8
51-60	8	0	2	6	0	2	6	0	1	7
61-70	6	0	0	6	0	0	6	0	0	6
70<	6	0	1	5	0	1	5	0	1	5
Total	47	9	12	24	11	12	19	2	13	32

Table 4: Fusion of coronal suture in males

Age (years)	N	Upper half			Lower half		
		Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused
21-30	7	7	0	0	5	2	0
31-40	14	11	3	0	0	4	10
41-50	9	0	4	5	0	3	6
51-60	5	0	1	4	0	1	4
61-70	4	0	0	4	0	0	4
70<	14	0	0	14	0	0	14
Total	53	18	9	28	5	10	38

Table 5: Fusion of coronal suture in females

Age (years)	N	Upper half			Lower half		
		Non-Closure	Active Fusion	Fused	Non-Closure	Active Fusion	Fused
21-30	7	5	2	0	2	5	0
31-40	9	0	6	3	1	2	7
41-50	11	0	5	6	0	5	6
51-60	8	0	1	7	0	0	8
61-70	6	0	0	6	0	0	6
70<	6	0	0	6	0	0	6
Total	47	5	14	28	3	12	33

Earliest ages of fusion of sagittal suture upper 1/3rd, middle 1/3rd, and lower 1/3rd, were 44 years, 56 years and 36 years respectively in females. Median age of fusion of sagittal suture upper 1/3rd, middle 1/3rd, and lower 1/3rd were 52 years, 58 years, 46 years respectively in females (Table 3).

Earliest ages of beginning of fusion of the coronal suture in upper

Table 6: Fusion of lambdoid suture in males

Age (years)	N	Non-Closure	Active Fusion	Fused
21–30	7	7	0	0
31–40	14	7	7	0
41–50	9	0	7	2
51–60	5	0	1	4
61–70	4	0	0	4
70<	14	0	0	14
Total	53	14	15	24

Table 7: Fusion of lambdoid suture in females

Age (years)	N	Non-Closure	Active Fusion	Fused
21–30	7	7	0	0
31–40	9	8	1	0
41–50	11	0	7	3
51–60	8	0	2	6
61–70	6	0	0	6
70<	6	0	0	6
Total	47	15	10	24

Table 8: Comparison of time of closure of sagittal sutures across literature

Literature	Method	Time of closure (years)
Reddy ⁵	X-ray	Anterior 1/3 – 40 to 50 Middle 1/3 50 to 60 Posterior 1/3 – 30 to 40
Nandy ¹³	X-ray	Start – 24 to 25
Vij ¹⁰	X-ray	Anterior 1/3 – 40 to 50 Middle 1/3 – 50 to 60 Posterior 1/3 – 30 to 40
Pillay ¹¹	X-ray	30 to 40
Dwight ¹⁴	X-ray	Start – 22 Complete – 35
Parson and Box ¹⁵	X-ray	Start – 22 Complete – 35
Todd and Lyon ³	X-ray	Start – 22 Complete – 35
Mckern and Stewart ¹⁷	X-ray	Start – 18 Compete – 31 to 40
Modi ²⁰	Gross skeletal	>70 (lapsed union)
Shetty ¹⁶	Gross skeletal	>70 (lapsed union)
Present study	X-ray	Complete Closure: Anterior 1/3: male 35 to 54; Female 43 to 65 Middle 1/3: male 58 to 37; Female 42 to 62 Posterior 1/3: male 38 to 57; Female 41 to 64

half and lower half were 29 years and 26 years respectively for males and 30 years and 29 years respectively for females. Median age of complete fusion of upper and lower half were 58 years and 48 years respectively for males and 56 and 54 years respectively for females (Tables 4 and 5).

Earliest age of lambdoid suture fusion was 46 years in males and 47 years in females. The median age for coronal suture fusion was 48 years in males and 49 years in females. (Tables 6 and 7)

Table 9: Comparison of time of closure of coronal suture across literature

Literature	Method	Time of closure (years)
Krogman ¹⁸	Gross skeletal	24 to 41
Reddy ⁵	X-ray	Lower half 40 to 50 Upper half 50 to 60
Nandy ¹³	X-ray	Start 24 to 25 Complete 45 to 50
Vij ¹⁰	X-ray	Lower half 40 to 50 Upper half 50 to 60
Pillay ¹¹	X-ray	40 to 50
Parikh ⁶	X-ray	35 to 40
Ramachandran ⁹	X-ray	Lower half 40 to 60 Upper half 50 to 60
Singh et al. ¹⁹	X-ray	45 to 50
Modi ²⁰	Gross skeletal	>70 (lapsed union)
Shetty ¹⁶	Gross skeletal	>70 (lapsed union)
Present study	X-ray	Lower half: Male 38 to 62; Female 43 to 65 Upper half Male 36 to 63; Female 43 to 64

Discussion

In our present study we have found that the sagittal suture, starts fusing at the end of 31- 40 years and completion is perfected at the age of 51-60 years, and this observation conforms with that reported by Todd & Lyon (1924),³ Modi (1988),⁴ Reddy (2010),⁵ and Parikh (1990)⁶ while it is in contrast to the observation reported by Pommerol,⁷ and Topinard,⁸ who indicated endocrinal commencement of sagittal suture at a much later age at about 40 years. These latter workers have reported on very scanty specimens so it can't be considered as authentic. Ectocranially sagittal suture closure was never complete. It implies that lapsed union is a significant problem in ectocranial sutures. Youngest age at which sagittal suture union was seen in 31 years in upper part 35 years in mid part and 31 years in lower part. Our observation differs in pattern of chronology of closing of segment of Sagittal suture. Reddy,⁵ and Vij⁷ found the order of closing of segment of

Sagittal suture to be: Posterior 1/3rd followed by anterior 1/3rd and lastly the middle 1/3rd. But in our study, we observed closing of segment of Sagittal suture to be: Anterior 1/3rd first, posterior 1/3rd next, and lastly the middle 1/3rd for males & middle 1/3rd first, posterior 1/3rd second, and then the anterior 1/3rd in female. This may be due to lapsed union of anterior 1/3 part of Sagittal suture in males (Table 8).

In the present study, fusion of coronal suture was observed as early as 31-40 years in lower half and at 41-50 years in the upper half. Both the halves showed complete fusion by the age of 51-60 years in all the cases. This is in agreement with the studies by Pommerol,⁷ Topinard,⁸ and Ribbe⁹ who reported coronal suture closure to be between 40-50 years. In coronal suture, the earliest age at which complete union was seen was 33 years in lower half and 40 years in upper half. The range we observed for coronal suture closure correlates with observations by Vij,¹⁰ Pillay,¹¹ Ramachandran,¹² and the chronology of closing of segment of Coronal suture is C1 > C2 > C3 in both the sexes (Table 9).

In the present study, the lambdoid suture obliteration started at the age of 41-50 years making it similar to the findings by Todd and Lyon.³ In the present study, the lambdoid suture gets completely obliterated at the age of 50-59 years.

Conclusion

We studied and compared upper, mid and lower components of sagittal, upper and lower half coronal, and lambdoid sutures in males and females, and observed that suture closure starts earlier in lower 1/3rd part of sagittal suture among males and females, however the suture fusion is earlier in males than in females. Furthermore, suture closure starts within 31 years in males and 33 years in female, for each suture. Closure is earlier in males as compared to females. Overall, coronal suture was found to close early followed by sagittal and lambdoid suture respectively. From the study of cranial sutures fusion, we can accurately estimate the decade of age in the living. A more precise measure of determination of age in the living would be either invasive procedure or higher radiation exposure (CT scan) which is both not desirable and less feasible. As India, is a developing country where resources should be utilized to its best the cases for age determination in the elderly can be best and most feasibly determined with the combination of general physical examination and radiology of skull. The procedures being quick and non-invasive have good patient acceptance and a reasonable fair degree of accuracy.

References

1. White TD. Skull. In: Human otology 2nd Ed. San Diego Academic press. California 2000; 55
2. Sahni D, Indar J and Neelam S. Time of closure of cranial sutures in northeast Indian adults. *Forensic Sci Int.* 148:199-205.
3. Todd TW, Lyon DW. Endocrinal suture closure its progress and age relationship: Part I Adult Males of the white stock. *Am J Phys Anthropol.* 1924; 7:325-384.
4. Mathiharan K. and Patnaik AK. *Modi's Medical Jurisprudence and Toxicology.* 23rd ed, 2005.
5. Reddy KSN. In: *The Essential of Forensic Medicine and Toxicology Medical book.* 37th ed 2010:72
6. Parikh. *Personal Identity.* In: *Parikhs textbook of Medical Jurisprudence & Toxicology* 5th ed. CBS. 1990:39-45
7. Pommerol F. *Sur la synostose des os du crane.* Thèse de Médecine. Paris. 1869:1-118
8. Garson JG. Topinard's "General Anthropology." *Nature.* 1885;33(836):3-5.
9. Ribbe, FC. *Etude sur l'ordre d'oblitération des sutures du crâne dans les races humaines.* Thèse de Médecine, Paris. 1885
10. Vij K. *Text book of Forensic Medicine: Principle and Practice.* BI Churchil Livingston. 2001. Identification; 74-82
11. Pillay VV. *Text book of Forensic Medicine and Toxicology,* 10th ed, 2004; 218-229.
12. Ramachandran C. *Skeletal Anatomy, Medico-legal Radiological age determination.* Hyderabad: Paras Medical Publishers; 2003;15-31,79-87, 92-96.
13. Apurba Nandy, *Principles of Forensic Medicine,* 2nd ed, 2000.
14. Dwight T. The closure of the suture as a sign of age. *Bost Med Surg J.* 1890,122:389-392.
15. Parsons FG, Box CR. The relation of cranial suture to age, *J R Anthropol Inst.* 1905:352-8
16. Shetty U. *Macroscopic study of cranial suture closure at autopsy for estimation of age* (thesis submitted to the university of Delhi, 2008, for MD in Forensic Medicine and Toxicology, 2009; Volume 10, Number 2, available at http://www.gerads.com/anil/ij/vol10no002/other/thesis/ullas_thesis.pdf).
17. Mckem TW, Stewart TD. *Skeletal age changes in young American males: Environmental protection Research Division, Technical ReportEP-45,, Headquarters Quartermaster Research and Development Command, Natrick MA.* 1957;26-28.
18. Krogman, WM. *The human skeleton in forensic science.* Charles c. Thomas, Springfield, III. 1962:76-132.
19. Singh P, Gorea RK, Oberoi SS, Kapila AK. Age Estimation from Medial End of Clavicle by x-ray examination. *J Indian Acad Forensic Med.* 2010;32(1):28-30.
20. Modi KA. *A study of the closure of the cranial suture as a relation to age of the individual in native of Gujarat [PG Dissertation].* Ahmedabad, Gujarat: The Gujarat University; 2015.

Fingerprint as a tool for identification: a descriptive study

Madhab Ch. Rajbongshi,¹ Arup Kumar Rabha,² Malamoni Dutta,³ Sumi Deka,⁴ Md. Kalim Ullah,² Putul Mahanta,⁵ Nomi DOUNGEL⁶

¹ Department of General Surgery, Gauhati Medical College and Hospital, Guwahati, Assam, India

² Department of Dentistry, Tezpur Medical College and Hospital, Tezpur, Assam, India

³ Department of Anatomy, Assam Medical College and Hospital, Dibrugarh, Assam, India

⁴ Department of Biochemistry, Gauhati Medical College and Hospital, Guwahati Assam, India

⁵ Department of Forensic Medicine and Toxicology, Assam Medical College and Hospital, Dibrugarh, Assam, India

⁶ Department of Physiology, Tezpur Medical College and Hospital, Assam, India

Abstract

The recognition of impressions of the fingers left at a crime scene establish the identity of the criminal. Fingerprints retrieved from the crime scene can be analysed and compared to be used to create a relationship between the crime with the criminals. This paper has aimed to find out the variation of the same patterns of the fingerprint concerning fingers between male and female. It was a cross-sectional descriptive study. The analysis was done by SPSS 20.0 package for windows. Ethical clearance was taken before the collection of the data. Overall, the Whorl pattern of the fingerprint was to be the most common (44.8%) followed by Loop (35.4%), Arch (12.5%) and Composite (7.3%). The Whorl pattern of the fingerprint was also the most common print comprising 4 (8.9%), followed by Loop 2(4.4%) among the same fingerprint pattern in all five fingers. In the same fingerprint pattern in all four fingers category, it was the Loop pattern of comprising 5 (11.1%), followed by Whorl 4(8.9%). The Arch and Composite pattern of the fingerprint was the most common print containing 4(8.9%), followed by Loop and Whorl 3 (6.7%) among the three same fingerprint pattern categories. In the same fingerprint pattern in all two fingers category, the Whorl pattern of the fingerprint was the most common print comprising 7 (15.6%), followed by Arch 5 (11.1%) and Loop 4 (8.9%). The same fingerprint pattern in different finger groups can be analysed and compared to establish an identity of an individual.

Keywords

Absolute identity; Cross-sectional study; Dactylography; Papillary ridges

Introduction

Fingerprints system, which is well-known as dermatoglyphics,¹⁻³ have been the gold standard for personal identification of an individual for more than a hundred years. It is to provide the most potent means of unique identification available to police and courts,⁴ both civil and criminal. Fingerprint recognition, which is considered to be a reliable method for human identification, has been used in many applications ranging from law enforcement and forensics to unlocking mobile phones,⁵ its use has expanded to personal authentication to government-to-citizen applications as well,⁶ above the age of 14 years as the patterns of finger tips become fixed by this time.⁷ The pattern of epidermal ridges is individual, as it develops at the 16th weeks of intrauterine life and remains the same for life. No two person's fingerprints are precisely the same, not even those of identical twins,⁸ who also share similar DNA fingerprint pattern.⁹ Therefore this system is called the surest sign of identification as the possibility of another person having the

same fingerprints is one in 64 thousand million, i.e., three times of the population of the world.¹⁰ As per Sir Galton, the four primary patterns of prints based on the arrangement of papillary ridges are loops, whorls and arches that can be found in fingerprints⁸ for analysis, comparison, to verify or to establish the identity of an individual. In criminals, impressions of all the ten fingers are taken, but for civil purposes, only the left thumb impression is considered.⁸

The current knowledge base for assessing the identity from the fingerprint analysis is still inadequate. The scientific studies performed, though representing an essential contribution to our knowledge of this system, it even needs more research to see the frequency of the same fingerprint in two, three, four and five fingers together. Hence, the present study has aimed to analyse the fingerprint pattern showing the 'same fingerprint pattern in all five fingers', 'same fingerprint pattern in four fingers', 'same fingerprint pattern in three fingers', and 'same fingerprint pattern in two fingers' amongst the undergraduate medical students and to see whether there is any difference between male and female in the categories mentioned above.

Materials and Methods

This study was a cross-sectional descriptive study that was conducted in the Department of Forensic Medicine of Tezpur Medical College in Tezpur, Assam and India over the undergraduate medical students during the period from July

Corresponding Author

Dr Putul Mahanta (Professor and Head)

Email: drpmahanta@gmail.com

Mobile: +91-9435017802

Article History

Received: 19th April, 2020; Accepted: 22nd August, 2020

2017 to July 2018. The reference population for this study was the people of Assam aged 18 years and above. This present study has included 96 individuals comprising male 45 and female 51 with intact fingerprints. The different parameters thus obtained were recorded in a predesigned and pretested schedule. Descriptive statistical methods, viz., frequency and percentage were computed along with the diagrammatic and graphical method. Fisher's exact test tested statistical significance. The analysis was performed by SPSS 20.0 package for windows. Ethical clearance was taken from the institutional ethics committee before the start of this study.

Results

The present study showed the most common pattern of fingerprint as Whorl, followed by Loop, Arch and Composite, respectively, in all the four categories of fingers (Table 1). Here, the overall, the Whorl pattern of the fingerprint was the most common (44.8%) followed by Loop (35.4%), Arch (12.5%) and Composite (7.3%). The Whorl pattern of the fingerprint was the most common print in both male and female with 4 individuals each of both the sexes showing the same core pattern in all their fingers as shown in Table 2. However, the differences in proportions among the male and female were not found to be statistically significant ($p>0.05$).

In the present study, among same patterns in any four fingers, the loop pattern most common in males, with 5 individuals having it, while whorls were second common with 4 individuals showing this pattern in their 4 fingers. In females most common pattern across the 4 fingers was found to be Whorl (7 individuals) followed by Loop (4 individuals) as shown in Table 3. However, these differences of proportions among the male and female were not found to be statistically significant.

In the present study, among same patterns in any three fingers, the arch and composite pattern of the fingerprint were the most common in males, with 4 individuals having such a pattern. The loop and whorl patterns were next most common in males, with three individuals showing such patterns in any of their 3 fingers (Table 4). In females, the whorl pattern was the most common, with 10 individuals showing it in three of their fingers (Table 4). However, the differences in proportions among the male and female were not found to be statistically significant.

In the present study, among same patterns in any two fingers, whorls were the most common prints in the males, followed by arches and loops as shown in Table 5. In females, loops were the most common followed by whorls (Table 5). No statistically significant differences existed between males and females.

Table 1: Frequency of same fingerprint pattern

Patterns of fingerprint	Same fingerprint pattern in								Overall	
	All five fingers		Four fingers		Three fingers		Two fingers			
	N	%	N	%	N	%	N	%	N	%
Loop	3	25.0	9	45.0	11	32.4	11	36.7	34	35.4
Arch	1	8.3	0	0	4	11.8	7	23.3	12	12.5
Whorl	8	66.7	11	55.0	13	38.2	11	36.7	43	44.8
Composite	0	0	0	0	6	17.6	1	3.3	7	7.3
Total	12	100	20	100	34	100	30	100	96	100

Table 2: Same fingerprint pattern among the gender in all five fingers

Patterns of fingerprint	Male (n=45)		Female (n=51)		p-value
	Frequency	%	Frequency	%	
Loop	2	4.4	1	2.0	1.00
Arch	0	0	1	2.0	-
Whorl	4	8.9	4	7.8	1.00
Composite	0	0	0	0	-

Table 3: Same fingerprint pattern among the gender in four fingers

Patterns of fingerprint	Male (n=45)		Female (n=51)		p-value
	Frequency	%	Frequency	%	
Loop	5	11.1	4	7.8	0.653
Arch	0	0	0	0	-
Whorl	4	8.9	7	13.7	0.653
Composite	0	0	0	0	-

Table 4: Same fingerprint pattern among the gender in three fingers

Patterns of fingerprint	Male (n=45)		Female (n=51)		p-value
	Frequency	%	Frequency	%	
Loop	3	6.7	8	15.7	0.295
Arch	4	8.9	0	0	-
Whorl	3	6.7	10	19.6	0.153
Composite	4	8.9	2	3.9	0.202

Table 5: Same fingerprint pattern among the gender in two fingers

Patterns of fingerprint	Male (n=45)		Female (n=51)		p-value
	Frequency	%	Frequency	%	
Loop	4	8.9	7	13.7	0.257
Arch	5	11.1	2	3.9	0.399
Whorl	7	15.6	4	7.8	0.466
Composite	0	0	1	2.0	0.467

Discussion

A good number of researches has studied on the fingerprint system. In most of the studies, it was concluded that the Loop pattern of the fingerprint was the most common, followed by Whorl, Arch and Composite pattern.^{11,12} The current findings differ with those reported as it reveals the Loop pattern, to be the second in frequency next to Whorl, which may be because of the smaller number of participants and the different comparison methods used in the current study. However, the remaining frequencies of the present study are consistent with the frequent observations. Vij Krishan¹³ also in his textbook reported frequencies of the fingerprint, Loop as 65%, Whorl 25%, Arch 7% and Composite 2-3% which differ with the Loop variant only with the current study. The Loop pattern was found to be the most frequent fingerprint pattern in the sex-wise distribution,⁹ but here in the present study loop pattern was the second common group in both the sexes.

The Whorl pattern of the fingerprint was ahead of the Loop pattern among the same fingerprint pattern in all five fingers though the differences were not significant in both the sexes. However, the frequency of the Loop pattern of the fingerprint was higher, followed by Whorl in the same fingerprint pattern when seen in four fingers. Furthermore, the Arch and Composite pattern of the fingerprint was the most common prints observed followed by Loop and Whorl among the three same fingerprint pattern categories. Still, in the same fingerprint pattern in all two fingers category, the Whorl pattern of the fingerprint is the most common print followed by Arch and Loop. The differences of frequencies of distribution of fingerprints among male and female were not statistically found significant and also no studies were found to compare these results.

Conclusion

The distribution of fingerprint core patterns in the five, four, three and two fingers categories has not been analysed thoroughly. This system may allow for better identification in the future.

Acknowledgement: We are wholeheartedly grateful to all the participants, Dr. H Saikia for helping us in guiding the analysis and the authority of Tezpur Medical College and Hospital for giving us the permission to carry out this study.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Srilekha N, Anuradha A, Vijay Srinivas G, Sabitha Devi R. Correlation among lip print pattern, finger print pattern and ABO blood group. *J Clin Diagn Res.* 2014;8(3):49-51
2. Nagasupriya A, Dhanapal Raghu, Reena K, Saraswathi TR, Ramachandran CR. Patterns - a crime solver. *J Forensic Dent Sci.* 2011;3(1):3-7
3. Patel S, Paul I, Madhusudan AS, Ramesh G, Sowmya GV. A study of lip prints in relation to gender, family and blood group. *Int J Oral Maxillofac Pathol.* 2010;1(1):4-7
4. Kaushal Nitin, Kaushal Purnima Parasher. Human identification and fingerprints: a review. *J Biom Biostat.* 2011;2(4):2:123
5. Yoona Soweon, Jain Anil K. Longitudinal study of fingerprint recognition. *Proc Natl Acad Sci USA.* 2015;112(28):8555-8560
6. Michael D Frick, Shimon K Modi, Stephen J Elliot, Eric P Kukula. Impact of gender on fingerprint recognition systems. 5th international conference on information technology and application, 2008.
7. Hsieh Ching-Tang, Shyu Shys-Rong, Hu Chia-Shing. An effective method of fingerprint classification combined with AFIS. Embedded and Ubiquitous Computing- EUC 2005. Lecture Notes in Computer Science, vol 3824. Springer, Berlin, Heidelberg; 2005. p. 1107-1122.
8. Mahanta P, SN Vijayamahantesh, V Vijayanath, Sabri Imran. Identification. In: Mahanta Putul, editor. Modern textbook of forensic medicine and toxicology. 1st ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2014:92-94.
9. MD Nithin, BM Balaraj, B Manjunatha, SC Mestri. Study of fingerprint classification and their gender distribution among South Indian population. *J Forensic Leg Med.* 2009;16(8):460-3
10. Ignatius PC. Forensic medicine and toxicology. 3rd ed. Irinjalakuda, Kerala: Letterwave Books; 2018. p. 97-8.
11. Rastogi Prateek, Pillai Keerthi R. A study of fingerprints in relation to gender and blood group. *J Indian Acad Forensic Med.* 2010;32(1):11-4
12. VS Mutalik, A Menon, N Jayalakshmi, A Kamath, AR Raghu. Utility of cheiloscopy, rugoscopy and ductyloscopy for human identification in a defined cohort. *J Forensic Dent Sci.* 2013;5(1):2-6
13. Vij Krishan. Textbook of forensic medicine and toxicology. 5th ed. Kundli, Haryana: Elsevier; 2011. p. 63-64.

ORIGINAL ARTICLE

Awareness, perceived barriers and factors affecting willingness for Organ Donation among the first- and second-degree relatives of deceased in a tertiary care hospital of Northern India

Rajanikanta Swain,¹ Hari Prasad,² Sanjeev Lalwani,³ Shashank Pooniya⁴

¹ Department of Forensic Medicine, All India Institute of Medical Sciences, Kalyani, West Bengal, India

² Department of Forensic Medicine, NIMS Medical College & Hospital, Shobha Nagar, Jaipur, Rajasthan, India.

³ Division of Forensic Pathology & Molecular DNA Lab, JPNATC, All India Institute of Medical Sciences, New Delhi, India.

⁴ Clinical Radiology, Ninewells Hospital, Dundee, UK

Abstract

Increased demand and poor availability of organs are the causes of illicit trade of organs. Inadequate availability of organs is due to poor awareness for organs donation. In recent past, law (Transplantation of Human Organ and tissue act) has been amended to curb the illicit organ trafficking, facilitate organs donation and create awareness. To know the awareness, perceived threat and factors affecting the willingness to donate organs after the amendment of recent act a study was conducted in a tertiary care hospital from October 2014 to September 2015. All participants are the 1st and 2nd degree relatives of the deceased persons came to the tertiary care hospital for autopsy. Data was collected in a semi-structured pretested questionnaire. Around 69% of participants have heard about organ donation. Perceived barriers included complication after donation (42%), tedious process (31.6%), religious beliefs (22%) and no improvement of receiver after transplantation (12%). Knowledge and attitude are main dependent factors associated with willingness to donate organs. Hence Organ donation is critical for patients requiring organ transplantation. It can be improved by increasing awareness.

Keywords

Cadaver; Organ Donation; Organ trafficking.

Introduction

Organ donation is the evolving concept of saving patients with end organ damage and provides them a new life.¹ In 2005 World Health Organization (WHO) reported that around one lakh organ transplants were conducted all over the world.² Poor organ donation rate and increased demand for organs is related not only to the health but also to crimes like illegal organ donation.^{2,3} Main steps to prevent this illegal organ trade and protect the poor are by increasing the voluntary organ donation and by formulating strict laws against illegal organ trade.⁴ Many countries including India have strong laws to prevent the same.

Presence of such strict laws prevents illegal transplants, but on the other hand it also increases the suffering of those requiring the same.⁵ Thus the best possible method to curb these problems is by increasing the voluntary organ donation, both live and deceased. The common barriers in the organ donation are lack of knowledge and various misconceptions related to it.⁶⁻

⁸ The levels of misconceptions are higher in case of deceased organ donation than living organ donation. The main objectives of our study are to assess the knowledge attitude and practices

of the first- and second-degree relatives of deceased in relation to organ donation and to relate the willingness to donate organ with various socio-demographic factors, knowledge and attitude.

Materials and Methods

Before starting the study, Ethical Clearance was taken from the ethical committee of All India Institute of Medical Sciences, New Delhi. The study was carried out in Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences (AIIMS), New Delhi, India from October 2014 to September 2015. This institute is catering medico-legal services to a population of 5millions in south and south-east Delhi. In case where medico-legal autopsy has to be done, relatives come to the mortuary to identify the body in the cold storage room before autopsy procedure and the same is handed to the relatives by investigating officer after autopsy. Before the autopsy the dead bodies are checked whether the body is eligible for the organ donation or not. If the body is eligible for organ donation counselling of the relatives is done to obtain an informed consent for organ donation.

During the study period an informed consent was taken from legally authorized relatives (1st and 2nd degree) of the deceased. All cases who came to the forensic department during the study period were included in the study. Exclusion included the cases where deceased were not accompanied by 1st and 2nd degree relatives and unknown and unclaimed cases. During same time, relatives of the deceased were approached and informed about

Corresponding Author

Dr Rajanikanta Swain (Assistant Professor)

Email: rajanikanta.swain09@gmail.com

Mobile: +91-9013644226

Article History

Received: 22nd April, 2020; Accepted: 29th September, 2020

the study by the autopsy surgeon, with the help of patient information sheet and then the data was collected

Data was collected using a semi-structured pretested questionnaire. Demographic details of the deceased and the relatives of the deceased were filled in Proforma-A by the Doctor. Then relatives were provided with Proforma B in which they were asked about the knowledge regarding organ donation, any existing acts/rules pertaining to organ donation in India, willingness for organ donation, reasons for refusal of donation. . Sufficient time was given to the relatives for discussion and filling the Proforma-B. Data was collected about the socio-demographic factors, perceived barriers and factors affecting willingness to donate organs.

All the collected data was entered concurrently into Microsoft Excel 2007 and was analysed by STATA version 12. Data expressed in terms of proportion. Knowledge and attitude scores were calculated from questions pertaining to knowledge and attitude respectively. Higher knowledge and attitude scores related to higher chance to donate Multivariate logistic analysis were done taking willingness to donate as the outcome factor. Results of multivariate analysis were expressed in terms of odds ratio with confidence interval.

Results

A total of 166 participants were recruited in the study. Majority of participants were male and majority of participants were well educated (studied up to 12th or more) whereas 8% were illiterate. Majority of participants belongs to above poverty line as mentioned by the Rangarajan committee criteria for Delhi.⁹ Rest of the socio-demographic characters are given in Table 1.

Awareness: When asked about the organ donation from 166 participants only 68.7% (114) have heard about organ donation previously. Out of those 68.7%, 40.4% knew that organ can be donated from a living person while 77.2% knew that it can be donated from a dead person also. Only 2.4% knew that both living and dead person can donate organ. Around half of participants who heard about organ donation knew that eyes and liver can be donated. One third of the participants were of the thought that organs should be removed from the dead body within half an hour. Around 23% of participants did not know where to contact if they want to donate organs. About 60% participants were aware of any law to prevent illicit organ trade and only 32% thought that organ can only be donated to relatives. (Table 2)

Perceived barriers: About the beliefs, 31.6% participants felt that organ donation is a tedious process and 42% felt that the recipient of organ transplantation has higher chances of development of complications. Around 2% of participants believed that the donor becomes handicapped in the next birth and 22% accepted that their religion prevents them from

Table 1: Socio-demographic characteristics of participants

Characteristics	Feature	N	(%)
Sex	Male	158	95.2
	Female	8	4.8
Education Status	Illiterate	14	8.64
	Primary	12	7.41
	Middle school	32	19.76
	Up to 12th	60	37.04
	Graduate or more	32	19.75
	Professional	12	7.41
Income status of family	APL	120	72.3
	BPL	18	10.8
	Not Available	28	16.9

Table 2: Awareness about Organ donation

Characteristics	Response	%
Knew about organ donation	---	68.7
From whom organ can be donated (n=114)	From alive person only	40.4
	From dead person	66.7
	From brain dead person	10.5
	All	2.4
Which organs can be donated (n=114)	Eyes	52.5
	Liver	56.1
	Kidney	41.1
	Heart	13.1
	Skin	14.0
	Bone marrow	8.8
	All options	2.4
Willingness to pay for organs (n=114)	---	53.6
Organs can be legally donated to relatives only (n=114)	---	31.8
Law to prevent illicit organ trade (n=114)	Knew	59.7
Where to contact if anyone wants to donate organ (n=114)	Private hospitals	9.4
	Govt. Hospital	28.3
	Organ banks	39.6
	Don't know	22.7
Organs from dead person should be removed within ½ hr. after which they were damaged (n=114)	---	37.7

donating organ. Around 12% of the participants believed that the receiver of organ transplant receives no health improvement after organ transplantation. Still 89% believed that organ transplantation is good. When it comes to practice 80% said that if it is required, they will opt for organ transplant. (Table 3)

About 46.3% of participants had thought to donate organ sometime in past. From these 46.3%, only 40.3% wanted to get registered for organ donation. Around 1/3rd of the participants agreed that some kind of recognition to the donors will lead to rise in the number of the registered donors. Multivariate Logistic regression analysis was performed taking willingness to donate as the outcome factor. Knowledge score more than median and attitude score more than median male gender of diseased and income per-capita in the APL category was associated with attitude to donate organ which was assessed by asking question whether they want to donate organ or not. (Table 4)

Table 3: Perceived barriers and willingness for Organ donation (n-114)

Character	%
Organ donation is a tedious process	31.6
Receiver has high chance of complications	42.1
Donor becomes handicapped in the next birth	1.8
Organ donation is good	89.5
Religion prevents from organ donation	22.8
Illegal trafficking of donated organs is done	18.5
Thought to donate organ	46.3
Willingness to donate Organ	40.4

Table 4: Logistic Regression Showing relation to willingness to donate and other independent variables (n-114)

Variable	Odds ratio (95% CI)	P value
Male sex	1.2(0.2-6.7)	0.78
Age >40 years	0.5 (0.2-1.2)	0.108
Knowledge score more than median	2.4 (1.1-5.6)	0.029
Attitude score more than median	2.5 (1.2-5.5)	0.019
Education more than 10th	0.7 (0.3-1.5)	0.405
Age > 40 years of diseased	0.8 (0.4-1.9)	0.681
Education of diseased more than 10th	2.8 (0.6-12.3)	0.170
Age more than 40 years of diseased	0.8 (0.4-1.9)	0.681
Income per capita of family	6.4 (1.2-34.6)	0.032

Discussion

The study was conducted among the 1st and 2nd degree relatives of the deceased who came for autopsy at the mortuary of All India Institute of Medical Sciences. Knowledge of the participants about organ donation was found to be poor. Only 69% of the participants were aware of organ donation. From these only 2% knew that organ can be donated from dead, brain dead and living persons also. Only 2% people knew that eyes, liver, kidney, heart, skin and bone marrow can be donated.

A community based study by Balwani et al. showed that 86% of participants were aware about organ donation whereas in our study the organ donation awareness was around 69%.⁶ This less awareness can be attributed to the different study settings. A study by Reddy et al found that the awareness was as high as 96% among patients attending the same tertiary care hospital.¹⁰ The difference may be due to the different methodology used in both the studies.

A study conducted by the Tondon R. among the post-mortem cases in a tertiary care hospital about the cornea donation found that knowledge about cornea donation was 55% and prior knowledge, education, socioeconomic status has no relation with willingness to donate.¹¹ In our study, around 53% knew about cornea donation, which is very similar to the study of Tondon R.

In our study, the willingness to donate organ was found to be associated with knowledge, attitude, and per-capita income. Study by Saleem et al. found that the socioeconomic status, education and adequate knowledge was associated with Organ donation.¹² Study by Marck et al. also found that knowledge about organ donation is one of the determinants of the organ donation.¹³ Another study in the emergency department of the tertiary hospital of Tehran was found to be associated with the poor knowledge of the participants about the organ donation.¹⁴ This difference could be due to the difference in the study population as such.

Conclusion

Organ transplantation is the only definite mode of treatment in patient with end stage organ disease. Poor awareness and the misconceptions among the public are the main reasons for low organs donation rate. There is need to increase the awareness of the individuals in the community and utilization of missed opportunity to sensitize individuals about this issue, specifically those coming to the hospitals, as adopted in Tamil Nadu.¹⁵ This model includes the integration of public, private organizations and local bodies to create awareness and motivate people for organ donation.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Abbud-Filho M, Ramalho H, Pires HS, Silveira JA. Attitudes and awareness regarding organ donation in the western region of Sao Paulo, Brazil. *Transplant Proc.* 1995;27:1835.
2. WHO | The state of the international organ trade: a provisional picture based on integration of available information [Internet]. WHO. [cited 2019 dec 25]. Available from: <http://www.who.int/bulletin/volumes/85/12/06-039370/en/>
3. Budiani-Saberi DA, Raja KR, Findley KC, Kerketta P, Anand V. Human trafficking for organ removal in India: a victim-centered, evidence-based report. *Transplantation.* 2014;97:380–4.
4. Jafar TH. Organ trafficking: global solutions for a global problem. *Am J Kidney Dis.* 2009;54:1145–57.
5. Kishore R. Human organs, scarcities, and sale: morality revisited. *J Med Ethics.* 2005;31:362–5.
6. Balwani MR, Gumber MR, Shah PR, Kute VB, Patel HV, Engineer DP, et al. Attitude and awareness towards organ donation in western India. *Ren Fail.* 2015;37:582–8.
7. Vijayalakshmi P, Sunitha TS, Gandhi S, Thimmaiah R, Math SB. Knowledge, attitude and behaviour of the general population towards organ donation: An Indian perspective. *Natl Med J India.* 2016;29:257–61.
8. Indudhara R, Singh SK, Minz M. Opinion poll regarding knowledge, attitudes, and suggestions for developing a cadaver donor program. *Transplant Proc.* 1992;24:2069.
9. Report of the expert group to review the methodology for measurement of poverty [Internet]. Govt. Of India; 2014 [cited 2019 Dec 25]. Available from: http://planningcommission.nic.in/reports/genrep/pov_rep0707.pdf
10. Reddy AVR, Guleria S, Khazanchi RK, Bhardwaj M, Aggarwal S, Mandal S. Attitude of patients, the public, doctors, and nurses toward organ donation. *Transplant Proc.* 2003;35:18.
11. Tandon R, Verma K, Vanathi M, Pandey RM, Vajpayee RB. Factors affecting eye donation from postmortem cases in a tertiary care hospital. *Cornea.* 2004;23: 597–601.
12. Saleem T, Ishaque S, Habib N, Hussain SS, Jawed A, Khan AA, et al. Knowledge, attitudes and practices survey on organ donation among a selected adult population of Pakistan. *BMC Med Ethics.* 2009;10: 1–12.
13. Marck CH, Neate SL, Skinner MR, Dwyer BM, Hickey BB, D'Costa R, et al. Factors relating to consent for organ donation: prospective data on potential organ donors. *Intern Med J.* 2015;45: 40–7.
14. Pouraghaei M, Tagizadieh M, Tagizadieh A, Moharamzadeh P, Esfahanian S, Shahsavari Nia K. Knowledge and Attitude Regarding Organ Donation among Relatives of Patients Referred to the Emergency Department. *Emerg Tehran Iran.* 2015;3:33–9.
15. Annadurai K, Mani G, Danasekaran R. Road Map to Organ Donation in Tamil Nadu: An Excellent Model for India. *Int J Prev Med.* 2015;06:21.

ORIGINAL ARTICLE

Students' perspective towards e-assessment in Forensic Medicine

Akhilesh Pathak

Forensic Medicine and Toxicology Department, All India Institute of Medical Sciences, Bathinda-151001, Punjab.

Abstract

The use of PowerPoint (PPT) for teaching has been widely used all over the world. Despite a drastic change in teaching-learning techniques in medical education, the majority of medical colleges still follow the traditional methods of practical examination. Due to a sudden increase in the number of students in a batch, the teachers find a difficulty in evaluating the students with traditional methods of practical examinations. Hence, this study was undertaken to analyze the effectiveness of the use of digital techniques for assessment of practical examination during spotting. During this study, we observed that there are many advantages associated with the use of e-assessment in the assessment of practical examinations, especially when we are going to evaluate a batch of students having 150-250 numbers. This article describes the rationale of the use of e-assessment in the practical assessment and provides an overview of its advantages. It also reviews the advantages and disadvantages associated with use of e-assessment of practical examination and proposes some guidelines and strategies that need be considered when it is applied.

Keywords

PowerPoint; Spotters; Practical examination; e-assessment; Medical education.

Introduction

Medical education, the artwork, and technology behind scientific mastering and teaching, has advanced remarkably. With the recent advances in technology, teaching and learning in medical education is continuously changing and it has come to be more active and self-learning. The instructors have progressed from the function of problem-identifier to that of the answer-issuer.¹

With the introduction of a new competency-based medical education, the goal of medical education is to bring desirable changes in knowledge, skills, and attitudes in the learner. The Medical Council of India has described the basic competencies required of an Indian Medical Graduate and designed a competency-based module on attitudes and communication.^{2,3,4}

The powerful and green transport of healthcare requires no longer simplest knowledge and technical competencies however; a medical graduate should be good in attitude and communication, interdisciplinary care, counseling, proof and machine-primarily based care. This warrants our evaluation structures to be comprehensive, sound, and strong enough to evaluate the requisite attributes along with checking out for various competencies, critical knowledge, and abilities. Despite of advancements in teaching-learning techniques in medical education, the majority of medical colleges still follow the traditional methods of assessments, especially during practical examinations. In forensic medicine, practical assessments are

carried out by various exercises, spotting, and viva and it is a difficult task when the number of students are more e.g. 150-250 in a batch. This article describes the rationale of the use of e-assessment and provides an overview of its advantages. It elaborates on how the implementation of e-assessment can be beneficial in practical examination in medical education.

Material and Methods

This prospective experimental study was undertaken in the department of forensic medicine and toxicology. There are 150 undergraduate students in a batch and at the end of their session, students are supposed to evaluate theoretically as well as practically. The methods of assessment in practical examination in nonclinical and paraclinical subjects are almost similar all over India, where we used to evaluate the students by practical exercises, spotting, and viva-voice. The present study was done after taking approval from the institutional ethical committee. In this study, e-assessment with the help of the power-point technique applied the first time at our institute to conduct the practical examination. Since e-assessment was being introduced the first time, students were oriented toward it in advance as well as during their pre-university examinations. Different sets of power-point slides including 10 slides of all varieties of spotters with questions were prepared for different batches of students and were peer-reviewed, expert validated and pilot tested before administration. During the examination, one set was selected at random and projected on a screen in a lecture hall. The time was set to change the slides automatically after 2 minutes. After finishing of the presentation, the students were allowed to review the all the slides from once again from the beginning. In the end, faculty perspectives regarding usefulness, advantages, and disadvantages, and the structure of e-assessment were obtained by asking them to respond to a

Corresponding Author

Dr. Akhilesh Pathak (Professor & Head)
email: dr.akhilesh_pathak@yahoo.co.in

Article History

Received: 24th April, 2020; Revision received on:
Accepted:

Likert scale questionnaire.

Results

Faculty perspectives regarding evaluation by e-assessment were obtained from 12 faculty members of our department. (Table 1) All faculty members were agreed that conducting practical examination by e-assessment was an hassle free system, which requires fewer numbers of trained staff to complete the examination in very less time. All of them were in agreement that it should be continued for spotting in forensic medicine and should be extended to other departments also.

Table 1: Faculty perspectives regarding assessment by e-assessment

Sr.	Statement	Agree (%)	Neither agree/ Nor disagree (%)	Disagree (%)
1	E-assessment is more comprehensive as compared to traditional method of spotting	91.7	00	8.3
2	E-assessment is uniform as compared to TM	66.7	00	33.3
3	E-assessment provides comfort and hassle examination	100	00	00
4	Conducting examination by e-assessment requires less numbers of trained staff	100	00	00
5	Conducting examination by e-assessment reduces time significantly	100	00	00
6	Students can better identify specimens in traditional method of spotting	66.7	00	33.3
7	Psychomotor domains of the students cant be evaluated in case of e-assessment techniques.	41.7	25	33.3
8	Assessment of slides and X-rays in e-assessment is easier as compared to traditional method	91.7	00	8.3
9	Assessment with e-assessment measures practical skills better as compared to traditional method	16.7	41.7	41.7
10	E-assessment provides continuous improvement in assessment method	91.7	00	8.3
11	There are lots of advantages of e-assessment over traditional method	88.3	00	16.7
12	E-assessment should be continued for spotting in forensic medicine	100	00	00
13	Assessment by e-assessment should be extended to other departments also	100	00	00

Discussion

There are diverse assessment methods, which are available to assess the various competencies of students during the examination and one assessment method will not assess all domains of competency, as each has its advantages and disadvantages.⁵ The assessment by spotting techniques is almost similar to OSPE (objectively structured practical examination) which is primarily used to assess basic clinical skills.⁶ At each station different specimens, photographs, x-rays, slides or case

study may be used to assess the knowledge and skills of the students about the specific domains.⁷

Benefits of e-assessment for conducting practical examinations include arrangement of spotting is commonly done just before the starting of practical examination, and 4-5 days schedule of practical examinations causes lots of disturbances in the arrangement of museum specimens, which is not there if we use e-assessment technique, occupying of specimens in spotting cause deficiency of the same for viva-voice, which is not there in case of e-assessment technique. Due to lack of time and hurry, the framing of questions for spotting is usually not proper, which is not a case in the e-assessment technique, poor handwriting during the framing of questions is commonly observed in traditional methods of spotting, which can be avoided in e-assessment, arrangement of spotters is temporary for that particular day and there is no scope of improvement in the future, while in the case of e-assessment technique permanent sets are available that gives a chance to improvement in future, extra efforts to make key and model answers of spotting is again a tedious job for the examiner, which can be easily done in e-assessment techniques. Traditional method is time-consuming and cant be applied for large groups of students like 150-250 students. for 250 students 500 minutes are required to complete the whole spotting, which can be done only in 20 minutes.

The traditional method of spotting requires lots of extra space to accommodate and aggregate the students, which is not required in the case of e-assessment techniques, aggregation of students who have appeared for spotting from the remaining is challenging to the accessor, which is not in the case of e-assessment techniques, for traditional methods, lots of trained staff members are required to handle the whole procedure, which is not required in case of e-assessment techniques. Time management for each spot requires to stopwatch and ringing well with trained staff to handle that. The chances of variation in time are very high, which is not there in the case of e-assessment techniques and colour and texture with shape and size of specimens kept in the museum may change with time and can confuse the students, which is not there in case of e-assessment techniques.

Dirty containers or change of container may cause problems in the identification of the particular specimen, which is not there in case of e-assessment techniques. There are lots of chances for damage to the specimens used in spotting during the transportation or by students, which is not there in case of e-assessment techniques, the chances of transmission of infections are there during handling of specimens when it is used physically, which is not there in case of e-assessment techniques. Moving to different stations, observing a particular spot and writing about that is a challenging task to the students and causes lots of anxiety as well, which can be reduced a lot by writing about a specimen in a comfortable sitting position in one place. There is no possibility of the review of specimens after crossing

the stations, while review can be easily provided to the students in case of e-assessment techniques, uniformity at different centers can not be achieved in the traditional method, while by e-evaluation uniformity can be achieved at different centers.

The use of pointer to point out the specific things is difficult and may change by any students during the process of visualization, which is not there in case of e-assessment techniques, presentation of slides in the microscope is a difficult task as different students have a different visions to see that, and chances of changing the field in slide can cause lots of problems to next coming students, which is not there in case of e-assessment techniques. Even displaying of large fields in high definition in PPT is an easy task to the examiners. Procurement of different histology and pathology slides and their physical storage is a difficult task, which is not there if we are ready to use the high-quality digital images of these slides. E-assessment also maintains a higher level of confidentiality as all students are engaged simultaneously and there is no possibility of communication of questions to each other.

Advantages of traditional methods over e-assessment technique include students can see the specimens and spots in its actual physical form, which is not there in case of e-assessment techniques, previous museum visits and observing the specimens by students in its actual physical form will increase the identification of specimens in practical examinations and three dimensional views is available in case of actual specimen examination, which is not there in case of e-assessment techniques. The actual size and shape of specimens remain the same, which can be changed in the case of e-assessment techniques, psychomotor domains of the students cant be evaluated in case of e-assessment techniques and affective domains cant be evaluated properly in case of e-assessment techniques.

The different techniques are used to assess the knowledge, comprehension, and skills of the students in medical education.⁸ During the last decade, OSPE (Objectively Structured Practical Examination) has been proved as a reliable method of assessment by various authors.⁹⁻¹³

The traditional methods of assessment in practical examination in nonclinical and paraclinical subjects are almost similar all over the India, where the use of spotting exercises is done to assess the knowledge and skills of the undergraduate students. The traditional method of spotting raises concerns about the time and confidentiality and also required lots of supporting staff with space.

In the present study, we replaced the traditional method of spotting with e-assessment in which the spotters were displayed with structured questions through PowerPoint in a lecture hall. The advantages and disadvantages of the e-assessment were analyzed after taking feedback of examiners and faculty members and it was found that all the faculty members were satisfied and motivated to implement this newer technique of e-assessment as an examination tool in practical examinations of

forensic medicine as well as in other departments.

Conclusion

Implementation of e-assessment in practical examination not only improves evaluation but also provides a hassle free comfortable environment for the students and teachers and hence its consideration as an effective and innovative tool should be encouraged in forensic medicine and other subjects.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Syed Amin T. Assessment Methods in Medical Education. *Int J Health Sci (Qassim)*. 2008; 2(2): 3–7.
2. Shah N, Desai C, Jorwekar G, Badyal D, Singh T. Competency-based medical education: An overview and application in pharmacology. *Indian J Pharmacol*. 2016; 48(Suppl 1): S5–S9.
3. Touchie C, ten Cate O. The promise, perils, problems and progress of competency-based medical education. *Med Educ*. 2016; 50(1): 93–100.
4. Fernandez N, Dory V, Ste-Marie LG, Chaput M, Charlin B, Boucher A. Varying conceptions of competence: an analysis of how health sciences educators define competence. *Med Educ*. 2012; 46(4): 357–65.
5. Al-Wardy NM. Assessment Methods in Undergraduate Medical Education. *Sultan Qaboos Univ Med J*. 2010; 10(2): 203–209.
6. Harden RM, Gleeson FA. ASME Medical Education Booklet No. 8: Assessment of clinical competence using an objective structured clinical examination (OSCE) *Med Educ*. 1979; 13:41–54.
7. Collins JP, Harden RM. AMEE Education Guide No. 13: The use of real patients, simulated patients and simulators in clinical examinations. *Med Teach*. 1998; 20:508–21.
8. Jaswal S, Chattwal J, Kaur J, Gupta S, Singh T. Assessment for learning with objectivity structured practical examination in biochemistry. *Int J of Applied and Basic Research*. 2015; 5(4): 71–75.
9. Hilliard RI, Tallett SE. The use of an objective structured clinical examination with postgraduate residents in paediatrics. *Arch Pediatr Adolesc Med*. 1998; 152:74–78.
10. Sloan DA, Donnelly MB, Schwartz RW, Strodel WE. The objective structured clinical examination. The new gold standard for evaluating postgraduate clinical performance. *Ann Surg*. 1995; 222:735–42.
11. Feroze M, Jacob AJ. OSPE in pathology. *Indian J Pathol Microbiol*. 2002; 45:53–7.
12. Abraham RR, Raghavendra R, Surekha K, Asha K. A trial of the objective structured practical examination in physiology at Melaka Manipal Medical College, India. *Adv Physiol Educ*. 2009; 33:21–3.
13. Sandila MP, Ahad A, Khani ZK. An objective structured practical examination to test students in experimental physiology. *J Pak Med Assoc*. 2001; 51:207–10.

ORIGINAL ARTICLE

Forensic - AETCOM to medical undergraduates: A journey from introduction to evaluation

Sanjay Gupta, Utsav Parekh

Department of Forensic Medicine, Pramukhswami Medical College, Karamsad, Gujarat, India

Abstract

Since ancient time the philosophy is not just to treat a disease but to treat an individual as whole. Knowledge and skills have their significant value in the treatment of patient but attitude, ethics and communication are important if a health professional wish to treat an individual. So, it becomes vital that our medical students shall inculcate and develop these attributes in their habit of offering patient care. Health professionals are healer and that role cannot be play effectively without acquiring soft skills like attitude, ethics and communication. Lack of these soft skills may be one of the important reasons for violence against health care professionals. So, there is a strong need of explicit formal but structured curriculum to teach attitude, ethics and communication. Looking into the above background, Medical Council of India (MCI) came out with AETCOM [Attitude, Ethics and Communication] booklet and incorporated this module in Graduate Medical Education Regulation [GMER 2019] across the phases. The department of Forensic Medicine & Toxicology at our institute has introduced this module including use of role play. After successful implementation of the module, students' perceptions were collected, evaluated and analyzed for the purpose of this study. They perceived that this method motivates them for active learning process as well as to build better understanding for relevance of the aspects. Students have also appreciated teaching learning approach used by facilitators for delivering these contents. They have mentioned that method of teaching, pattern of presentation; example explanation and interactivity even in the large group and involving them in the process were extremely useful in their view for better understanding of soft skills. Overall, it's a very good initiative by Medical Council of India but implementation and monitoring will certainly tell the impact of this module.

Keywords

AETCOM, Attitude, Communication, Ethics, Learning, Medical education, Teaching

Introduction

Health care profession is a complex entity as human body is full of variations with an unpredictable outcome. There is significant difference in dealing with humans as compared to machine and that is why medical profession is a noble one. Since ancient time the philosophy is not just to treat a disease but to treat an individual as whole. When we think in direction of treating a human then it reminds us about holistic approach. Knowledge and skills have their significant value in the treatment of patient but attitude, ethics and communication are important if a health professional wishes to treat an individual. So, it becomes vital that our medical students should inculcate and develop these attributes in their habit of offering patient care. Health professionals are healers and that role cannot be executed effectively without acquiring soft skills like attitude, ethics and communication. Role modeling plays an important role in teaching these soft skills to medical students but this implicit teaching does not really seem effective because of the

large ratio of medical students to teachers especially in India. Medical Council of India has set minimum standard requirements where the student teacher ratio is not really attractive.¹ Though these standards are basic/minimum and colleges can have medical teachers over and above it most of colleges keep number of medical teachers as per MCI basic standard, some even have fewer medical teachers in comparison. Looking into the scenario, it appears that role modeling alone cannot be an effective method in inculcating soft skills among students. Lack of these soft skills may be one of the important reasons for violence against health care professionals.²⁻⁴ So, there is a strong need of explicit formal but structured curriculum to teach attitude, ethics and communication. Looking into the above background, Medical Council of India (MCI) came out with AETCOM [Attitude, Ethics and Communication] booklet and incorporated this module in Graduate Medical Education Regulation [GMER 2019] across the phases.⁵

The department of Forensic Medicine & Toxicology, Pramukhswami Medical College, Karamsad has introduced this module informally in 2018 and formally (structured) in 2019. This AETCOM module was integrated with medical law and ethics to sensitize and orient students about importance of softer skills in health care delivery. After successful implementation of the module, students' perceptions were collected, evaluated and analyzed for the purpose of this study.

Corresponding Author

Dr. Sanjay Gupta (Professor and Head)

E-mail: drsanjaymdfm@gmail.com

Mobile: +91-9427149010

Article History

Received: 28th May, 2020; Revision received on: 25th August, 2020

Accepted: 30th August, 2020

Materials and Methods

The objective of the study was to evaluate students' perceptions about the introduction of AETCOM module in Forensic Medicine. The study, was conducted at Department of Forensic Medicine and Toxicology, Pramukhswami Medical College, Karamsad Gujarat India after approval from Institutional Ethics Committee. This is a tertiary care rural based center located in central part of Gujarat and western part of India. The center is designated by the Medical Council of India as a 'Nodal Center' for delivery of continuous professional development in medical education. Pramukhswami Medical College was established in 1987 and admits students every year for a five-and-a-half-year course (including one year of compulsory internship) culminating in a Bachelor of Medicine and Bachelor of Surgery (MBBS) degree. Medical students in their second phase are undergoing teaching in Forensic medicine and toxicology for a period of one and half year as a prescribed part of their curriculum. All admitted second phase medical students were initially taught for medical law and ethics as a part of their routine curriculum through interactive lectures. This was followed by relevant part/cases of AETCOM given to them for discussion in small groups, which was followed by plenary sessions. Students during their practical session of one and half hour duration were divided in to five small groups and AETCOM cases were given to them for discussion. The study module involved following scenarios of 'cover up' (highlights full disclosure and its exception), 'seeking immunity' (highlights medical errors), 'do not tell my wife' (highlights issues like professional secrecy, autonomy, beneficence, privilege communication), 'the angry brick kiln owner' (highlights importance of organ donation, counseling skills, ethical issues), 'the offer – industry relationship' (highlights about unethical practices), 'cruel parents' (highlights child abuse and doctor's role). These case scenarios were given in a booklet provided by Medical Council of India.⁵ This booklet comprises of total five sections and two appendices which is available online.⁵

A 12-minute role play demonstrating many aspects of doctor patient relationship, professional misconducts, communication, attitude, various aspects of medical ethics, etc. was utilized as important teaching learning method for building deep understanding and relevance about vital attributes of patient care. Following implementation of the module, a validated questionnaire was provided to them considering their perceptions about the module. The validation was done with help of internal and external experts as there was no such tool found in literature. The validated questionnaire comprised of 10 close ended questions. Their responses were required on five-points Likert scale ranging from 'strongly agree' to 'strongly disagree'. Apart from this, three open ended statements were also included in questionnaire. All feedbacks were anonymous and voluntary. Descriptive statistical analysis was utilized to analyze the data.

Results

Total 114 students responded to the questionnaire. All results to the closed ended questions are tabulated. For the open-ended questions; in response to the question "what you like most about AETCOM sessions?" 'Role play by faculties' was liked by most of the students. They have mentioned in their feedback that several aspects of AETCOM modules were depicted through role play in an interesting manner. Other aspect they mentioned was group activities where real-life situation cases were discussed and debated. They perceived that this method motivated them for active learning process as well as to build better understanding for relevance of the aspects. Students have also appreciated teaching learning approach used by facilitators for delivering these contents. They have mentioned that method of teaching, pattern of presentation, example explanation and interactivity even in the large group and involving them in the process were extremely useful in their view for better understanding of soft skills. They have also specified that giving them opportunities for hands on experiences about issues like empathy during their practical session were absolutely useful in learning attitude, communication and ethics.

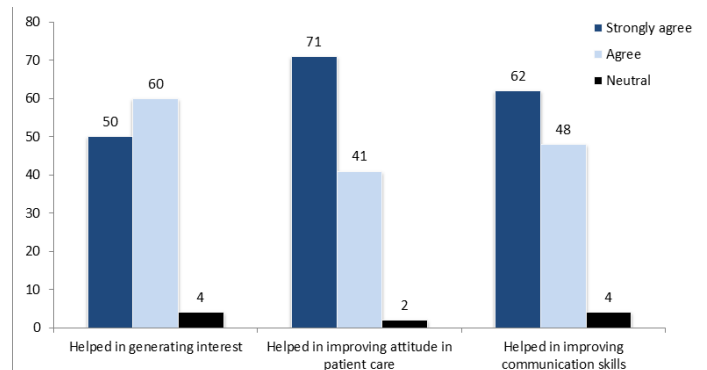


Figure 1: Student's perceptions about AETCOM Module helped in generating interest, improving attitude in patient care & communication skills

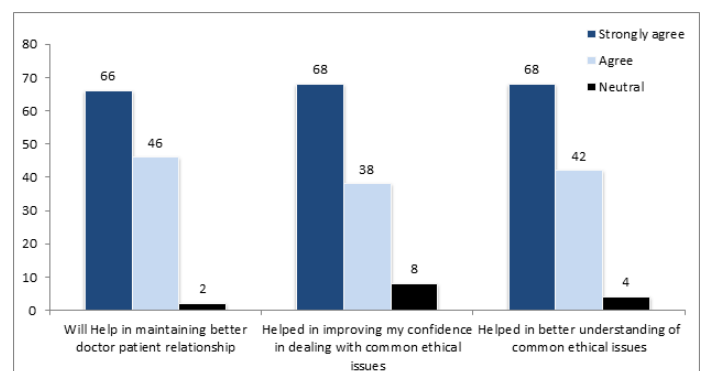


Figure 1: Student's perceptions about AETCOM Module helped in better doctor patient relationship & in dealing ethical issues

In response to identify scope of improvement, most of students felt that the way AETCOM module was implemented was the best way of its implementation and nothing could be better than this but few handful students have mentioned that having more such real-life scenarios, adding more related videos and having more frequencies of such sessions would be better.

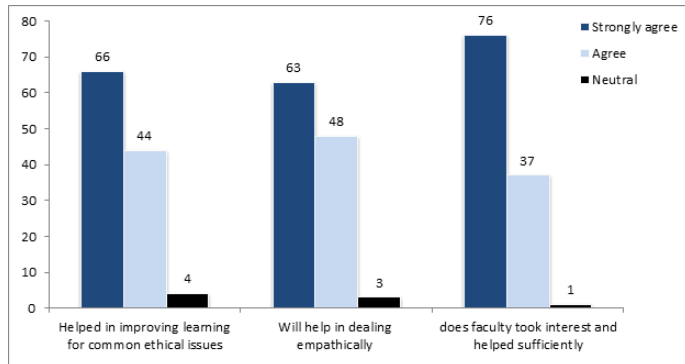


Figure 1: Student's perceptions about AETCOM Module helped in learning ethical issues, dealing empathically & faculty interest

Discussion

Our study focuses on and provides vital information regarding perception of medical students about attitude, ethics and communication module. We have conducted this study at a tertiary care rural based Centre in western India. After implementation of the AETCOM module, students' perception was collected in a structured validated questionnaire. In response to role of the module in generating interest, better understanding and learning about the dry topic like medical law and ethics, 96.5% students provided responses of 'strongly agree' and 'agree' in the favor of the statement. This reflects that medical students are interested in learning softer skills though formal curriculum and learning happens if such curriculum is formally implemented in a structured manner. In response to the role of module in attitudinal change, 98% responded in favor which is one of the vital parts of this module. As far as communication skills are concerned, 96.5% students were in agreement and only 3.5% were remained neutral on this aspect (Figure 1). Learning communication skills is need of hour. Effective communications are helpful in shared decision making, conflict resolution and may reduce violence against medical professionals. Students' perceptions reflect that 98% were found this module would be useful in establishing and maintaining better doctor - patient relationship (Figure 2). Medicines have always been a noble profession but due to commercialization of medical services the profession is losing its glory and suits against doctors are increasing day by day in the court of law. Trust in the doctor patient relationship is key for its success and if that understanding builds up among these

budding doctors, the purpose of medicine would be achieved. Studies suggest that students are not comfortable in dealing with ethics and challenging situation.^{7,8} Lack of this confidence may create a sense of fear of taking appropriate risk in patient care.^{9,10} Implementation of this AETCOM module at our place, indicate that 93% students felt confident after undergone this formal teaching which is significant percentage. Rests 7% were neutral but they have not said that they were not confident. The reason may be that they may not be able to decide and analyze their abilities to deal with ethical situations confidently. One of the vital components of doctor patient relationship is empathy. 97.4% students perceived that this module can help them in dealing patients empathically (Figure 3). The authors believe that those health care professionals who practice empathy are able to establish better doctor patient relationship in comparison. Gaining and winning trust of patients always work better for health care delivery and patient satisfaction.

Conclusion

In the present era of specialization and super-specialization, psychomotor skills are not really a problem in patient care delivery system but practice and orientation about softer skills like attitude, ethics and communications are aspects of current system. Hidden curriculum (implicit) is not really able to address the present need. We, the authors, suggest that explicit, formal but structured curriculum has to put into the place for inculcating these vital attributes among medical students. Incorporating, inculcating and imbibing such softer skills will definitely be helpful in improving doctor patient relationship; reducing law suits cases and violence against health care providers. More such studies at larger scale shall have to be conducted to support the current data and bring some other different aspects about this AETCOM module. Overall, it's a very good initiative by Medical Council of India but implementation and monitoring will certainly tell the impact of this module.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

11. Minimum Standard Requirements for the medical college for 150 admissions annually regulations, 1999. Medical Council of India. Available from: <https://www.mciindia.org/CMS/wp-content/uploads/2017/10/Minimum-Standard-Requirements-for-150-Admissions.pdf>
2. Ghosh K. Violence against doctors: A wake-up call. Indian J Med Res. 2018;148(2):130–133.

3. Ambesh P. Violence against doctors in the Indian subcontinent: A rising bane. *Indian Heart J.* 2016;68:749–50.
4. Anand T, Grover S, Kumar R, Kumar M, Ingle GK. Workplace violence against resident doctors in a tertiary care hospital in Delhi. *Natl Med J India.* 2016;29:344–8.
5. Medical Council of India; Attitude, Ethics & Communication Booklet; 2018; P. 1-94
6. The Indian Medical Council (Professional Conduct, Etiquette and Ethics) Regulations, 2002
7. Makoul G. Essential elements of communication in medical encounters: the Kalamazoo consensus statement. *Acad Med.* 2001; 76(4): 390-3.
8. Maria C, Hausberg M et al. Enhancing medical students' communication skills: development and evaluation of an undergraduate training program. *BMC Medical Education.* 2012;12:16
9. Clever SL, Jin L, Levinson W, Meltzer DO: Does doctor-patient communication affect patient satisfaction with hospital care? Results of an analysis with a novel instrumental variable. *Health Serv Res.* 2008; 43:1505-1519.
10. Clever et al. Ethics and Communication: Does Students' Comfort Addressing: Ethical Issues Vary by Specialty Team? *J Gen Intern Med.* 2001 Aug; 16(8): 560–566

ORIGINAL ARTICLE

Study of atherosclerotic coronary artery disease in young adults- an autopsy based prospective study

Vedant Kulshrestha

Assistant Professor, Department of Forensic Medicine & Toxicology, Lady Hardinge Medical College & Smt. S. K. Hospital, New Delhi.

Abstract

Cardiovascular disease is now the most common cause of death worldwide. The sudden death in apparently healthy young individuals is always a devastating and shocking event. According to WHO, Ischemic Heart Disease is our modern epidemic. The occurrence of Ischemic Heart Disease in developing countries is a decade earlier compared with the age incidence in developed countries. Now because of change in lifestyle and habits, atherosclerotic coronary artery disease is noticed in comparatively younger age group even in a developing country like India. Bangalore is an IT hub. Many IT Professionals are working in this city. We have noticed atherosclerotic coronary artery disease, occurring in young IT professionals because of their sedentary lifestyles, smoking and drinking (alcohol) habits. Hence an autopsy based prospective study was conducted at the department of Forensic Medicine, Victoria Hospital, Bangalore Medical College & Research Institute, Bangalore, over a period of 18 months from November 2013 to May 2015, in young adults aged between 18 to 40 years dying due to various reasons like road traffic accidents, poisoning, burns, hanging, sudden natural deaths, assaults, electrocution, snake bite etc, and autopsy findings of total 200 cases subjected for medicolegal autopsy were studied, to know the incidence and study the pattern of underlying atherosclerotic coronary artery disease so that we can counsel the close family members of the deceased to go through essential investigations and take preventive measures. In this way we can protect the close family members of the deceased from fatal inheritable atherosclerotic coronary artery disease in future. Out of 200 cases, majority of cases 143 (71.5%) cases showed underlying Atherosclerotic Coronary Artery Disease which also included fixed coronary obstruction, thrombus, recent and healed Myocardial Infarction. Out of that, 117 (81.8%) were males and 26 (18.2%) were females. Out of total 143 cases of atherosclerotic coronary artery disease 27 (18.9%) cases were associated with myocardial infarction (Ischemic Heart Disease). Among that 26 (96.3%) were males and 1 (3.7%) was female. Out of total 27 myocardial infarction (Ischemic Heart Disease) cases, 15 (55.5%) cases showed recent (fresh) infarct in the myocardium. Overall Grade 2 AHA grade of atherosclerosis was found in majority of cases 46 (32.2%), in both the sexes. Majority of cases 14 (40%) in 18-25 years age group and 23 (38.3%) cases in 26-33 years age group showed Grade 2 atherosclerosis followed by Grade 3. While in 34-40 years age group majority 15 (31.2%) of cases showed Grade 4 atherosclerosis followed by Grade 5. Majority of cases 123 (86%) showed atherosclerosis in Left main coronary artery but in 55 (44.7%) cases the lumen was normal while 35 (28.5%) cases showed less than 25% lumen narrowing. Whereas 117 (81.8%) cases showed atherosclerosis in Left anterior descending artery. Out of that 34 (29.1%) cases showed more than 75% narrowing of the lumen. Most 66 (46.2%) of the cases showed atherosclerosis in all four major coronary vessels. Out of total 143 atherosclerotic coronary artery disease cases coronary thrombus was found in 23 (16.1%) cases, calcification in 3 (2.1%) cases and cardiac rupture in 1 (0.7%) case. Atherosclerotic coronary artery disease was the most frequently encountered underlying cardiac pathology even in young adults in a country like India. It is very significant and is a matter of concern.

Keywords

Cardiovascular disease; Sudden death; Atherosclerotic coronary artery disease; Myocardial infarction; Medicolegal autopsy

Introduction

The human heart is a remarkably efficient, durable, and reliable pump, distributing more than 6000 litres of blood through the body each day, and beating 30 to 40 million times a year-providing tissues with vital nutrients and facilitating waste excretion. Consequently, cardiac dysfunction can have

devastating physiologic consequences. Cardiovascular disease is the number one cause of worldwide mortality, with about 80% of the burden occurring in developing countries.

Sudden cardiac death is most commonly defined as unexpected death from cardiac causes either without symptoms, or within 1 to 24 hours of symptom onset (different authors use different criteria). Coronary artery disease is the leading cause of sudden cardiac death, responsible for 80% to 90% of cases. Unfortunately, sudden cardiac death is often the first manifestation of ischemic heart disease.¹ The causes of sudden cardiac death differ greatly among various age groups. In individuals > 40 years old, atherosclerotic coronary heart disease is the most common cause. Between 1 to 40 years of age, the causes of sudden cardiac death are commonly

Corresponding Author

Dr. Vedant Kulshrestha (Assistant Professor)

E-mail: vedant_kulshrestha@yahoo.co.in

Mob. No.- 8105979445.

Article History

Received: 28th April, 2020; Accepted: 28th September, 2020

hypertrophic cardiomyopathy, myocarditis, congenital heart disease, arrhythmogenic right ventricular dysplasia/cardiomyopathy etc.²

Approximately 80% of sudden cardiac deaths are caused by atherosclerotic coronary artery disease in all its manifestations—fixed coronary obstruction, coronary spasm, plaque rupture and erosion with coronary thrombosis, acute and healed myocardial infarction and chronic ischemia.³ The majority of sudden coronary deaths are the result of disease in the proximal 2.5cm of the left anterior descending artery or the proximal 4.5cm of the right main coronary artery.⁴ Because essential hypertension is a frequent comorbidity of atherosclerotic heart disease, left ventricular hypertrophy may also be present. Any disease in left ventricular mass worsens the imbalance between myocardial oxygen supply and demand, thereby increasing the likelihood of ischemia and sudden death.

Coronary atherosclerosis is sometimes called 'the Captain of the Men of Death'. This is certainly the most frequent cause of sudden death in Western societies.⁵ According to WHO, Ischemic Heart Disease is our modern epidemic. The occurrence of Ischemic Heart Disease in developing countries is a decade earlier compared with the age incidence in developed countries. The sudden death in apparently healthy young individuals is always a devastating and shocking event. Now because of change in lifestyle and habits, atherosclerotic coronary artery disease is noticed in comparatively younger age group even in a developing country like India.

Bangalore is an IT hub. Many IT Professionals are working in this city. We have noticed atherosclerotic coronary artery disease, occurring in young IT professionals because of their sedentary lifestyles, smoking and drinking (alcohol) habits. Hence an autopsy based prospective study in young adults aged between 18 to 40 years dying due to various reasons like road traffic accidents, poisoning, burns, hanging, sudden natural deaths, assaults, electrocution, snake bite etc. was conducted to know the incidence and study the pattern of underlying atherosclerotic coronary artery disease so that we can counsel the close family members of the deceased to go through essential investigations and take preventive measures. In this way we can protect the close family members of the deceased from fatal inheritable atherosclerotic coronary artery disease in future. The objective of the present study was to analyse the incidence and study the pattern of atherosclerotic coronary artery disease in young adults dying due to various reasons.

Materials and Methods

The present study has been carried out in the Department of Forensic Medicine and Toxicology and Department of Pathology, Victoria Hospital, attached to Bangalore Medical College and Research Institute, Bangalore during the period

November 2013 to May 2015. Dead bodies of young adults aged between 18 to 40 years dying due to various reasons like road traffic accidents, poisoning, burns, hanging, sudden natural deaths, assaults, electrocution, snake bite etc, subjected for medicolegal autopsy in the mortuary of Department of Forensic Medicine and Toxicology, Victoria Hospital, Bangalore. The inclusion criteria included young adults (both males and females) aged between 18-40 years with the cause of death varying from different reasons like road accidents, poisoning, burns, hanging, sudden natural deaths, assaults etc. The exclusion criteria comprised of individuals aged less than 18 and greater than 40 years, decomposed bodies, extensively mutilated bodies, cases in which there is a mechanical injury to the heart, and, unknown bodies. Total 200 cases were selected randomly by simple random sampling method for this prospective study. Ethical clearance for this study was obtained from the Institution's Ethical Committee, Bangalore Medical College & Research Institute, Bangalore prior to the conduction of study.

After explaining the details of the study, the history related to the deceased was obtained from close relatives in each case and entered in a proforma prepared for this particular study. The proforma contains demographic information related to the deceased like age, sex, address, education, occupation, monthly family income etc. After taking detailed history from the concerned police about the incidence thorough post mortem examination was conducted.

After examining the pericardium heart was removed and examined thoroughly. First gross examination was done and relevant photographs were taken. In each case heart was dissected according to inflow-outflow technique described by Virchow. The parameters which were recorded are weight of heart, left ventricular wall thickness, right ventricular wall thickness, inter ventricular septum thickness, condition of valves, condition of main vessels including right & left coronaries, aorta & pulmonary trunk, assessment of chamber size and assessment of papillary muscles & chordae tendinae. The patency of the four major epicardial coronary trunks was analyzed by taking transverse sections at 3-mm intervals. Representative sections were taken for histopathological examination after fixing in 10% Formalin solution. Then after subjecting the tissue sections to routine tissue processing, paraffin blocks were prepared by embedding the tissue in paraffin wax and 4 to 5 micron thick slide sections were prepared and stained with haematoxylin & eosin. Special stains were employed wherever it was necessary. Finally, the gross findings and the histopathological findings were correlated and entered in the proforma. Data was analyzed using descriptive statistics. Suitable statistical software was utilized for analysis and presented in the form of tables wherever necessary.

Results

During the study period from November 2013 to May 2015, autopsy findings of total 200 cases were studied prospectively in the Department of Forensic Medicine, Victoria Hospital, Bangalore Medical College and Research Institute, Bangalore.

Out of total 200 cases which included 156 (78%) males and 44 (22%) females of age between 18 years to 40 years, dying due to various reasons like road traffic accidents, poisoning, burns, hanging, sudden natural deaths, assaults, electrocution, snake bite etc, total 143(71.5%) cases showed atherosclerotic coronary artery disease (including fixed coronary obstruction, thrombus, recent and healed myocardial infarction). Out of which 117 (81.8%) were males and 26 (18.2%) were females. Majority of cases of Atherosclerotic coronary artery disease were in the age group 26-33 years which include 35% males and 7% females, followed by 34-40 years which include 27.2% males and 6.3% females, and 18-25 years which include 19.6% males and 4.9% females respectively. (Table 1)

Out of total 143 cases of atherosclerotic coronary artery disease 27 (18.9%) cases were associated with myocardial infarction (Ischemic heart disease). Out of these 27 myocardial infarction cases 12 (44.4%) cases were in the age group 26-33 years which include 11 (40.7%) males and only 1 (3.7%) female. Age group 34-40 years also showed 12 (44.4%) cases which include all males, while 18-25 years age group showed only 3 (11.1%) cases which include all males (Table 2). Out of total 27 myocardial infarction (Ischemic Heart Disease) cases, 15 (55.5%) cases showed recent (fresh) infarct in the myocardium, 7 (26%) cases showed old (healed) infarct, while 5 (18.5%) cases showed both recent and healed infarct in the myocardium of heart.

Atherosclerosis in coronaries was graded according to American Heart Association (AHA) grading system.^{6,7} Overall Grade 2 atherosclerosis was found in majority of cases 46 (32.2%) followed by Grade 3 and Grade 4. In males Grade 2 atherosclerosis was found highest 37 (25.9%) followed by Grade 3, Grade 4 and Grade 5. In females also Grade 2 atherosclerosis was found highest 9 (6.3%) followed by Grade 3, Grade 1 and Grade 4. Grade 5 and Grade 6 atherosclerosis was not seen in females. In 18-25 years age group Grade 2 atherosclerosis was seen in majority of cases 14 (40%) followed by Grade 3. In 26-33 years age group also majority 23 (38.3%) of cases showed Grade 2 atherosclerosis followed by Grade 3. While in 34-40 years age group majority 15 (31.2%) of cases showed Grade 4 atherosclerosis followed by Grade 5. In 18-25 years age group majority of males (34.3%) showed Grade 2 atherosclerosis followed by Grade 3. While in females Grade 2, Grade 3 and Grade 4 atherosclerosis was seen in equal number of cases (5.7%). In 26-33 years age group majority of males (28.3%) showed Grade 2 atherosclerosis followed by Grade 4. In females

Table 1: Age and sex incidence of atherosclerotic coronary artery disease

Age range (years)	Sex		Total
	Male	Female	
18 to 25	28 (19.6%)	7 (4.9%)	35 (24.5%)
26 to 33	50 (35%)	10 (7%)	60 (42%)
34 to 40	39 (27.2%)	9 (6.3%)	48 (33.5%)
Total	117 (81.8%)	26 (18.2%)	143 (100%)

Table 2: Age and sex incidence of ischemic heart disease (Myocardial Infarction)

Age Groups (years)	Sex		Total
	Male	Female	
18 to 25 Years	3 (11.1%)	0 (0%)	3 (11.1%)
26 to 33 Years	11 (40.7%)	1 (3.7%)	12 (44.4%)
34 to 40 Years	12 (44.4%)	0 (0%)	12 (44.4%)

Table 3: Distribution of AHA Grading of Atherosclerosis in coronaries according age and sex

Age Groups (Years)	AHA Grading of Atherosclerosis in coronaries	Sex		Total
		Male	Female	
18 to 25	Grade 1	3 (8.6%)	1 (2.9%)	4 (11.4%)
	Grade 2	12 (34.3%)	2 (5.7%)	14 (40%)
	Grade 3	10 (28.6%)	2 (5.7%)	12 (34.3%)
	Grade 4	2 (5.7%)	2 (5.7%)	4 (11.4%)
	Grade 5	0 (0%)	0 (0%)	0 (0%)
	Grade 6	1 (2.9%)	0 (0%)	1 (2.9%)
Total		28 (80%)	7 (20%)	35 (100%)
26 to 33	Grade 1	4 (6.7%)	1 (1.7%)	5 (8.3%)
	Grade 2	17 (28.3%)	6 (10%)	23 (38.3%)
	Grade 3	10 (16.7%)	3 (5%)	13 (21.7%)
	Grade 4	11 (18.3%)	0 (0%)	11 (18.3%)
	Grade 5	8 (13.3%)	0 (0%)	8 (13.3%)
	Grade 6	0 (0%)	0 (0%)	0 (0%)
Total		50 (83.3%)	10 (16.7%)	60 (100%)
34 to 40	Grade 1	0 (0%)	3 (6.2%)	3 (6.2%)
	Grade 2	8 (16.7%)	1 (2.1%)	9 (18.8%)
	Grade 3	7 (14.6%)	2 (4.2%)	9 (18.8%)
	Grade 4	12 (25%)	3 (6.2%)	15 (31.2%)
	Grade 5	11 (22.9%)	0 (0%)	11 (22.9%)
	Grade 6	1 (2.1%)	0 (0%)	1 (2.1%)

also majority of cases (10%) showed Grade 2 atherosclerosis. In 34-40 years age group majority of males (25%) showed Grade 4 atherosclerosis followed by Grade 5. While in females Grade 1 and Grade 4 atherosclerosis was seen in equal number of cases (6.2%). Grade 5 and Grade 6 atherosclerosis was not seen in females of all three age groups (Table 3).

Total 123 cases showed atherosclerosis in Left coronary artery but in 55 (44.7%) cases the lumen was normal while 35 (28.5%) cases showed less than 25% lumen narrowing. Left anterior descending artery showed atherosclerosis in 117 cases. Out of that 34 (29.1%) cases showed more than 75% narrowing of the lumen while in 32 (27.4%) cases lumen was normal. Left circumflex artery showed atherosclerosis in 85 cases. Out of that 36 (42.4%) cases showed normal lumen and 34 (40%) cases showed less than 25% narrowing of the lumen. Right coronary artery showed atherosclerosis in 86 cases. Out of that 38 (44.2%) cases showed normal lumen while the same number of cases 38 (44.2%) showed less than 25% narrowing of the lumen (Table 4).

Table 4: Distribution of percentage of luminal narrowing for all coronaries in atherosclerotic coronary artery disease

Coronary artery	Percentage of luminal narrowing					Total
	Normal	<25%	25-50%	50-75%	>75%	
LCA	55 (44.7%)	35 (28.5%)	16 (13%)	6 (4.9%)	11 (8.9%)	123 (100%)
LAD	32 (27.4%)	30 (25.6%)	14 (12%)	7 (6%)	34 (29.1%)	117 (100%)
LCX	36 (42.4%)	34 (40%)	11 (12.9%)	2 (2.4%)	2 (2.4%)	85 (100%)
RCA	38 (44.2%)	38 (44.2%)	4 (4.7%)	3 (3.5%)	3 (3.5%)	86 (100%)

LCA – Left main coronary artery; LAD – Left anterior descending artery; LCX – Left circumflex artery; RCA – Right coronary artery

Out of total 143 atherosclerotic coronary artery disease cases coronary thrombus was found in 23 (16.1%) cases, calcification in 3 (2.1%) cases and cardiac rupture in 1 (0.7%) case. Out of total 143 cases of atherosclerotic coronary artery disease majority 66 (46.2%) cases showed atherosclerosis in all four major coronary vessels followed by 33 (23.1%) cases which showed atherosclerosis in only one of the coronaries.

Discussion

Cardiovascular disease is now the most common cause of death worldwide.⁸ Although with the advancement in diagnostic modalities, the correct and complete diagnosis of cardiovascular diseases is now possible, but the world of cardiac pathology is largely autopsy based. A detailed gross study of the heart with photographic records, and histopathological analysis is still the gold standard against

which antemortem cardiologic findings are measured. Hence we did an autopsy based prospective study, at the department of Forensic Medicine, Victoria Hospital, Bangalore Medical College & Research Institute, Bangalore, in young adults aged between 18 to 40 years dying due to various reasons like road traffic accidents, poisoning, burns, hanging, sudden natural deaths, assaults, electrocution, snake bite etc, to know the incidence and study the pattern of underlying atherosclerotic coronary artery disease so that we can counsel the close family members of the deceased to go through essential investigations and take preventive measures. The study period was November 2013 to May 2015 and total 200 cases were studied during study period.

In the present study the ages ranged from 18 to 40 years. Total 156 (78%) were males and 44 (22%) were females. In the study by Arzamendi et al.⁹, in 243 cases of <40 years age, majority 146 cases were in 31-40 years age group. Study by Kumar et al.¹⁰, in 50 cases aged between 30-60 years showed 43(86%) males and 7 (14%) females. Out of that 21 males and 2 females were in 30-40 years age group. While study conducted by Joseph et al.¹¹, in 111 cases aged between 14-35 years showed 95 (85.5%) males and 16 (14.5%) females. In all these studies males dominated females by large numbers.

In the present study, out of total 200 cases, majority of cases 143 (71.5%) cases showed underlying Atherosclerotic Coronary Artery Disease which also included fixed coronary obstruction, thrombus, recent and healed Myocardial Infarction. Out of that, 117 (81.8%) were males and 26 (18.2%) were females. Majority of cases 60 (42%) of Atherosclerotic coronary artery disease were in the age group 26-33 years followed by 34-40 years 48 (33.5%) cases and 18-25 years 35 (24.5%) cases.

According to a report on medical certification of cause of death 2011 by Government of Karnataka, a total of 123221 medically certified deaths were reported in Karnataka state of India in the year 2011. Among them 26987 were young adults of age group 15-44 years, died due to various reasons. Out of them 16773 were male and 10214 were female. It was also seen that total 4499 (12.18%) deaths were due to diseases of circulatory system in age group 15-44 years. Out of them 3081 were male and 1418 were female. Among various cardiac diseases 1127 males and 339 females died due to Ischemic heart diseases.¹²

In a study done by Chugh et al. in US, they analysed 13 years (1984-1996) of autopsy series of sudden cardiac death and found that women aged 35 to 44 years constituted 32% of all women in the series in contrast to men, who constituted 24% of total male cases. There was a higher proportion of significant coronary artery disease in men compared to women. Most patients had evidence of ≥ 1 nonspecific structural cardiac abnormalities like mitral valve prolapse, left ventricular hypertrophy and non-specific myocardial interstitial fibrosis.¹³

In a study done by Ogeng'o et al in Nairobi from December 2005 to November 2009, they found that cardiovascular causes comprised 13.2% of all autopsy cases. Among various cardiac pathologies most common was myocardial infarction (18.7%) and next common was cardiomyopathy (17.2%).¹⁴ Sarita Nibhoria et al did a study in Faridkot, Punjab between 2009 and 2011. A wide spectrum of heart diseases were diagnosed during the study which revealed maximum cases of cardiomegaly (16%) followed by myocardial infarction (14%), mural thrombus (06%), fibrosis (06%), and a rare diagnosis of neutrophilic myocarditis.¹⁵

In the study by Kumar et al.¹⁰, among 43 males, 36 (83.72%) were noted with Atherosclerosis and in 7 females, atheromatous lesions were found in 4 (57.14%) hearts. Out of which 21 males and 2 females of age group 30-40 years, 18 (85.71%) males and 1(50%) female were affected. In the study by Joseph et al.¹¹, in 111 cases aged between 14-35 years 87 (78.3%) cases showed atherosclerotic coronary artery disease. Out of total 95 males cases coronary atherosclerosis was seen in 72 hearts for an overall incidence of 75.8%.

In the study by Arzamendi et al.⁹, Of the total 97 individuals who died of sudden cardiac death (SCD), 58 (59.8%) died of Coronary Artery Disease (CAD). In individuals <20 years old, there was no death from CAD. However, CAD became the most important cause of SCD in individuals >20 years old, being responsible for up to 44% of cases. The occurrence of CAD as a cause of SCD increased with age, being 37% in the group of 20 to 30 years old and rising up to 80% in the group of 31 to 40 years old. Among the 185 individuals who died of causes other than CAD, significant CAD was observed in up to 38 (20.5%), evidently without any signs of acute complication.

The high incidence of atherosclerotic coronary artery disease even in relatively younger age group is because of life style changes, smoking cigarettes/beedis, alcohol consumption habits and lack of physical exercise.

As the age progresses the incidence of atherosclerotic coronary artery disease increases. This is because age is also a risk factor of cardiac pathology mainly atherosclerotic coronary artery disease. But in contrast to other studies, in present study we found that age group 26-33 years showed higher number of cases than 18-25 years and 34-40 years age group. This may be explained by the reason that although non modifiable risk factor of atherosclerotic CAD like age is an important factor, modifiable risk factor like habit of smoking and alcohol is more important risk factor than age for atherosclerotic CAD. This is supported by the fact that the frequency of smoking in deceased of 26-33 years was more than 34-40 years age group and alcohol drinking habits were also different among both age groups.

The incidence of atherosclerotic coronary artery disease in females is less than in males both in the present study as well as in all other

similar autopsy studies. This is because of the fact that females in the reproductive age group are less prone to atherosclerosis probably attributed to the protective effect of hormones (estrogen) and absence of other risk factors like smoking and alcohol.

In the present study, out of total 143 cases of atherosclerotic coronary artery disease 27 (18.9%) cases were associated with myocardial infarction (Ischemic heart disease). Among that 26 (96.3%) were males and 1 (3.7%) was female. While 18-25 years age group showed only 3 (11.1%) cases which include all males.

In the study by Arzamendi et al.⁹, among the 58 individuals who died of CAD, acute myocardial infarction was found in 25 decedents (43.1%). This may be due to the fact that sudden death is most often due to ventricular fibrillation caused by myocardial irritability induced by ischemia or infarction. In the setting of significant coronary artery atherosclerosis and no frank infarction changes in the heart, arrhythmia related to acute ischemia is the likely cause of sudden death. In patients with healed infarcts, new ischemia is the major cause of ventricular arrhythmia leading to sudden death.

In the present study, overall Grade 2 AHA grade of atherosclerosis was found in majority of cases 46 (32.2%) followed by Grade 3, in both the sexes. As the age increases incidence of higher grades like Grade 4 and Grade 5 also increases in males. But in females Grade 5 and Grade 6 atherosclerosis was not seen in the young age of 18-40 years. In the present study, out of total 143 cases of atherosclerotic coronary artery disease, majority of cases 123 (86%) showed atherosclerotic in Left main coronary artery followed by Left anterior descending artery 117 (81.8%) cases. But majority 55 (44.7%) of cases which showed atherosclerosis in Left main coronary artery showed normal lumen. While majority 34 (29.1%) of cases which showed atherosclerosis in Left anterior descending artery showed more than 75% lumen narrowing. In the study by Arzamendi et al.⁹, the left anterior descending coronary artery presented a significant narrowing in 53 (91.4%) of the cases among the 58 individuals who died of CAD. The reason behind Left anterior descending artery showing significant narrowing of lumen due to atherosclerosis in most of the cases is possibly due to the hemodynamic stress.

In the present study, out of total 143 cases of atherosclerotic coronary artery disease majority 66 (46.2%) cases showed atherosclerosis in all four major coronary vessels followed by 33 (23.1%) cases which showed atherosclerosis in only one of the coronaries. In the study by Arzamendi et al.⁹, among the 58 individuals who died of CAD, 18 (31%) presented single-vessel disease, 17 (29.3%) had 2-vessel disease, and importantly, up to 23 (39.7%) had 3-vessel disease.

In the present study, out of total 143 atherosclerotic coronary artery disease cases coronary thrombus was found in 23 (16.1%) cases, calcification in 3 (2.1%) cases and cardiac rupture in 1

(0.7%) case. While in the study by Arzamendi et al.⁹, among the 58 individuals who died of CAD, plaque rupture associated with thrombi was observed in 33 (56.9%) of the autopsies.

The less incidence of coronary thrombus in present study as compared to the study by Arzamendi et al.⁹ might be because the present study involved individuals dying due to various reason including CAD while study by Arzamendi et al.⁹ is showing the incidence of coronary thrombus in individuals who died only due to CAD.

Conclusion

In the present study during the study period from November 2013 to May 2015, autopsy findings of total 200 young adults of 18-40 years age, who died due to various reasons like sudden death, hanging, poisoning, burns, electrocution, road traffic accidents etc were studied prospectively. Majority of them were male and from 26-33 years age group. Majority of cases 71.5% showed underlying Atherosclerotic Coronary Artery Disease which also included fixed coronary obstruction, thrombus, recent and healed Myocardial Infarction. Most of them were male belonged to 26-33 years age group. Frank myocardial infarction was seen only in few cases despite severe atherosclerotic changes in coronary arteries, due to the fact that sudden death is most often due to ventricular fibrillation caused by myocardial irritability induced by ischemia. Overall Grade 2 AHA grade of atherosclerosis was found in majority of cases followed by Grade 3 in both males and females. Left main coronary artery showed atherosclerosis in majority of cases followed by Left anterior descending artery. Most of the cases of LCA showed normal lumen while lumen was narrowed more than 75% in majority of cases of LAD. Most of the cases of atherosclerotic coronary artery disease showed involvement of all four major coronary vessels. This study emphasizes that, close family members of the deceased should be counselled about requirement of essential investigations and preventive measures to prevent sudden cardiac death in family members due to inheritable cardiac diseases like atherosclerotic coronary artery disease in future.

Acknowledgements

I would like to thank and acknowledge Dr. P. K. Devadass, Retd. Professor of Forensic Medicine, Ex. Dean & Director, and Dr. Dayanand S. Biligi, Professor & Head, Dept. of Pathology, Bangalore Medical College & Research Institute, Bangalore for their guidance, constant support and encouragement.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

Source of funding: None to declare

References

1. Schoen FJ, Mitchell RN. The heart. In: Kumar V, Abbas AK, Aster JC, editors. Robbins and Cotran pathologic basis of disease. South Asia ed. Elsevier; 2015. p. 523,551. (vol 1).
2. Zheng ZJ, Croft JB, Giles WH, Mensah A. Out-of-hospital cardiac deaths in adolescents and young adults in the United States, 1989 to 1998. *Am J Prev Med.* 2005;29(5 suppl 1):36-41.
3. Gulino SP. Examination of the cardiac conduction system, Forensic application in cases of sudden cardiac death. *Am J Forensic Med & Path.* 2003;24(3):227-238.
4. Gallagher PJ. The investigation of cardiac death, *Recent Adv Histopathol.* 16, 123-140.
5. Saukko P, Knight B. Knight's forensic pathology. 3rd ed. UK: Hodder Arnold (publishers)Ltd; 2004. p. 493,507.
6. Strydom HC, Chandler AB, Dinsmore RE, Fuster V, Glagov S, Insull W Jr et al. A definition of advanced types of atherosclerotic lesions and a histological classification of atherosclerosis: a report from the committee on vascular lesions of the council of arteriosclerosis. *Circulation.* 1995;92:1355-1374.
7. Strydom HC. Natural history and histological classification of atherosclerotic lesions: An update. *Arterioscler Thromb Vasc Biol.* 2000;20:1177-1178.
8. Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J. Harrison's principles of internal medicine. 18th ed. USA: Mc Graw-Hill Companies Inc; 2012. p.1811. (vol 2).
9. Arzamendi D, Benito B, Marcos HT, Flores J, Tanguay JF, Ly H et al. Increase in sudden death from coronary artery disease in young adults. *Am Heart J.* 2011;161(3):574-580.
10. Kumar S, Verma AK, Kumar N, Verma RK. Prevalence of coronary atherosclerosis in different age groups: a post-mortem study. *Biomed Res.* 2013;24(1):139-141.
11. Joseph A, Ackerman D, Talley JD, Johnstone J, Kupersmith J. Manifestations of coronary atherosclerosis in young trauma victims- an autopsy study. *J Am Coll Cardiol.* 1993;22(2):459-67.
12. Report on medical certification of cause of death 2011. Government of Karnataka. Office of the chief registrar of births & deaths and directorate of economics & statistics, Bangalore; 2013. p.13,21,100-102.
13. Chugh SS, Chung K, Zheng ZJ, John B, Titus JL. Cardiac pathologic findings reveal a high rate of sudden cardiac death of undetermined etiology in younger women. *Am Heart J.* 2003;146(4):635-639.
14. Ogeng'o JA, Gatonga P, Olabu BO. Cardiovascular causes of death in an east African country: an autopsy study. *Cardiol J.* 2011;18(1):67-72.
15. Nibhoria S, Jhaji KK, Nibhoria VK, Sandhu SK, Bamra NS, Padda P. A case study-Role of heart autopsy in evaluating the cause of death. *Indian J Forensic Med Toxicol.* 2013;7(1):72-75.

ORIGINAL ARTICLE

Manner wise load of firearm injury at SMS Medical College, Jaipur

Shanti Lal Pargi,¹ Lovekumar R Bhagora,² Manish Sharma³

1 Department of Forensic Medicine & Toxicology, Ananta Institute of Medical Science & Research centre, Rajsamand, Udaipur, Rajasthan, India

2 Department of Forensic Medicine & Toxicology, Nootan Medical College & Research centre, Visnagar, Gujarat, India

3 Department of Forensic Medicine & Toxicology RNT Medical College, Udaipur, Rajasthan, India

Abstract

Deaths due to firearm injuries are one of the most important indicators of level of social and mental health. There is a deep psychological and social impact of firearm injuries on the victim, their family, and the community as a whole. The present study was performed with the aim of investigating the manner wise pattern of firearm injuries over the course of a year and half in Jaipur, India. The present study was conducted in the Department of Forensic Medicine, SMS Medical College & Hospital, Jaipur, Rajasthan from May 2014 to October 2015. All cases of firearm injuries that were received dead or live at SMS Hospital and its attached Hospitals, Jaipur was included in this study. It was observed that the majority of the incidences of gun-shot injuries were homicidal in nature (78.26%) followed by accidental episodes (16.52%). In our study majority of firearm injury case [44 cases (38.26%)] were observed in the age group of 20-29 years followed by the age group of 30-39 years [33 cases (28.70%)]. Homicides were preponderant in villages. Main motive of crime in cases of firearm injuries were property disputes in 42.61%, in 13.91% cases, it was revenge, 12.17% of robbery and 2.61% due to love affairs. Chest (31.3%) remained the most commonly targeted body region in this study followed by abdominal region (18.26%) and, head & face (14.78%).

Keywords

Clinical Forensic Medicine; Firearm Injury; Gun shot; Manner of death

Introduction

Firearm is any weapon which discharges a missile by the expansive force of the gases produced by burning of an explosive substance.¹ Now a days Firearm weapon are available in large scale not even in India but also in other parts of the world. Higher number of cases can give reflection of its law and order in particular geographic area. Firearm mostly used for homicidal as well as suicidal purpose because of very easy and quick method of death. Firearm weapon become a weapon of choice because it provide a person can be killed without any physical contact and also provide an opportunity for escape by the offender.

Many people from all over the world dies every day due to firearm related injuries. Nowadays, mass production of advanced firearms and their availability in worldwide result in increased rate of death and injuries by these weapons. In developing countries, illegal firearms and locally made or country guns are available without licensing. These guns are commonly used in criminal cases.²

The aim of the present study was to assess the frequency and analyze the cases of firearm injuries and associated deaths

reported at the Department of Forensic Medicine, SMS Hospital, Jaipur during the study period (May, 2014 to October, 2015). The objectives of the present study were:

1. To study the load of firearm injuries and associated deaths reported at the Department of Forensic Medicine during the study period (May, 2014 to October, 2015).
2. To study the manner wise pattern of firearm injuries.
3. To study the socio-demographic profile of victims of firearm injuries.

Material and Methods

All cases of firearm injuries that were received dead and admitted at SMS Hospital and its attached Hospitals, Jaipur were included in our study. The personal details pertaining to socio-demographic profile were recorded in detail followed by physical examination regarding the wounds sustained, their number, size, shape, site and characteristic features of firearm injuries, extent of injuries, clinical condition of the patient and final outcome. The cases either received dead or who succumb to the firearm injuries sustained in due course of treatment were subjected to post mortem examination at the mortuary of SMS Hospital, Jaipur. The details of firearm wounds were noted as mentioned above along with the examination into cause of death in those cases. All the observations were recorded in the pre proposed Performa as detailed above. The results of the present study were further compared to other contemporary studies from various parts of the country.

Corresponding Author

Dr. Lovekumar R. Bhagora (Associate Professor)

Email: lovebhagora2000@yahoo.com

Mobile: +91-9586502020

Article History

Received: 5th March, 2020; Revision received on: 16th June, 2020

Accepted: 20th June, 2020

Results

Majority of the incidences of gun-shot injuries were homicidal in nature (78.26%) followed by accidental episodes (16.52%). Surprisingly, there were only 2 cases (01.74%) of suicidal gun-shot injury and in 3.48% cases, the manner of the incidence remained undetermined. There were only two suicidal cases, both males in 3rd and 5th decades of life. Majority of victims of each manner were in the 3rd to 5th decades of life. Least number of victims of homicide were in extremes of age i.e. in age group of less than 10 years and greater than 60 years. All suicidal cases were fatal and none of the accidental episode resulted in fatality.

Homicides were preponderant in villages. The two suicidal events of gun-shot injuries occurred at home and workplace. The cases that occurred at state highways were of robbery resulting in homicidal incidence of firearm injuries. Main motive of crime in homicidal cases of fire arm injuries were property disputes in 41.74%, in 13.91% cases, it was revenge, 12.17% of robbery and 2.61% due to love affairs. 5.22% accidental cases occurred during group quarrel and 1.74% during defensive action. The motive remained undetermined in suicidal cases. Homicides majorly occurred in evening and afternoon and (41.11% each) whereas majority of accidental cases took place in evening hours followed by afternoon hours. Suicidal episodes were either committed early morning or late evening.

Table 1: Manner wise distribution of firearm injuries cases

Manner of incidence	No. of cases	Percentage (%)
Homicidal	90	78.26
Accidental	19	16.52
Suicidal	02	01.74
Not Known	04	03.48
Total	115	100

Table 2: Manner of incidence and age group wise distribution of firearm injuries cases

Age Group (in years)	Homicidal	Accidental	Suicidal	Unknown	Total	Percentage (%)
<10	01	00	00	01	02	1.74
10-19	05	04	00	00	09	7.83
20-29	33	09	01	01	44	38.26
30-39	26	06	00	01	33	28.70
40-49	12	00	01	01	14	12.17
50-59	11	00	00	00	11	9.57
>60	02	00	00	00	02	1.74
Total	90	19	02	04	115	100

Table 3: Manner and place of incidence wise distribution of firearm injuries cases

Manner of Incidence	Homicidal	Accidental	Unknown	Suicidal	Total	Percentage (%)
Incidence Place						
Village	37	09	01	0	47	40.87
Home	23	06	00	01	30	26.09
Farm	09	02	00	00	11	9.57
State highways	07	00	02	00	09	7.83
Work place	04	01	00	01	06	5.22
City & Streets	01	01	01	00	10	8.70
School	01	00	00	00	01	0.87
Unknown	01	00	00	00	01	0.87
Grand Total	90	19	04	02	115	100

Table 4: Manner and motive of incidence wise distribution of firearm injuries cases

Manner of Incidence	Homicidal	Accidental	Unknown	Suicidal	Total	Percentage (%)
Motive of Incidence						
Property	48	01	00	00	49	42.61
Revenge	16	00	00	00	16	13.91
Robbery	14	00	00	00	14	12.17
Unknown	06	00	04	02	12	10.43
Accidental	00	10	00	00	10	8.70
Group Quarrel	02	06	00	00	08	6.96
Defence	01	02	00	00	03	2.61
Love affair	03	00	00	00	03	2.61
Total	90	19	04	02	115	100

Table 5: Manner and time of incidence wise distribution of firearm injuries cases

Time of Incidence	Manner				Total	Percentage (%)
	Homicidal	Accidental	Unknown	Suicidal		
Evening	37	10	01	01	49	42.61
Afternoon	37	06	00	00	43	37.39
Morning	09	01	01	01	12	10.43
Night	06	02	02	00	10	8.70
Unknown	01	00	00	00	01	0.87
Total	90 (78.26%)	19 (16.52%)	04 (3.48%)	02 (1.74%)	115	100

Trunk region was the most common target in homicidal cases in 50% cases with extremities being the next common site of gun-shot injuries. Head was the vulnerable target in suicidal cases (100%). Accidental gun-shot injuries was seen in all body parts almost with equal preponderance. The least commonly affected body part was neck in all types of cases.

Table 6: Manner of incidences and targeted body part in gun-shot injuries wise distribution of firearm injuries cases

Body Parts	Manner of incidence				Total	Percentage (%)
	Homicidal	Accidental	Unknown	Homicidal	Accidental	
Periphery	32	06	00	00	38	33.04
Chest	28	07	01	00	36	31.30
Abdomen	17	02	02	00	21	18.26
Head	11	03	01	02	17	14.78
Neck	02	01	00	00	3	2.61
Total	90	19	04	02	115	100

Discussion

Homicides (78.26%) were the most common manner of firearm injuries in the present study followed by 19 (16.52%) accidental and 02 (1.74%) suicidal firearm injuries. The manner remained undetermined in 04 cases (3.48%). Homicidal intent was predominant in most other studies [Sachan et al.³ (92%); Kumar et al.⁴ (96%); Kumari et al.⁵ (88.34%)]. Other studies have considered either only homicidal [Patowary et al.⁶] or suicidal firearm injuries. The preponderance of homicide in gun-shot injuries is explainable as these deadly weapons are generally used in planned manner or more so impulsively in a planned assault. It is not very easy to procure such weapons and not that very easy to carry it due to legal restraints, so, they are not the weapon of choice in fights and assaults. They are mostly used in planned episodes of homicidal or suicidal injuries. Accidental injuries with firearms are also not uncommon as users are prone to such episodes while cleaning, maintenance or erratic handling of loaded guns. Accidental injuries were seen in this study in 16.52% cases but these results are quite high as compared to other study like Kumar et al.⁴ and Kumari et al.⁵ were Accidental injuries were 1.73% and 6.67% respectively (Table 1).

In the present study, almost all age groups were represented ranging from 0 to 80 years of age, with majority being young adult and middle aged persons (20-49 years). Maximum numbers of cases were from 20-29 years of age (36.26%) followed by 30-39 years (28.70%). This age group are most active members of the society. This type of finding is similar with study of Sachan R et al.³, Kumar K et al.⁴ and Patowary AJ et al.⁶, where incidence occur between 21-40 years of age

group. The results of our study are slightly contrast with study of Kumari S et al.⁷, who reported maximum number of cases in 11-20 years followed by 21-30 years. This variation is due to minor cultural and periodical differences. Moreover, the age group of 11-20 years is quite young for use of such deadly weapons and thus, this variation does not have much significance. The least affected age groups in the resent study were < 10 and > 60 years of age as also reported by Kumar et al.⁵ (Table 2)

Maximum number of incidences in the present study occurred in the rural regions- in the village & farms (50.44%). This is also evident by the preponderance of rural victims, agricultural workers in the study population, where property and land disputes remained the most common motives behind it. 8.70% cases happened in urban limits, and, 7.83% cases took place on state highways. Work place remained the scene in 5.22% cases. So, In our study Maximum incidence were occur in outdoor place (66.95%), while 33.05 % cases occurred in indoor settings like home, school and work place. For personal enmity and revenge in planned homicide, home (26.09 %) was most preferable place for attack by accused because at home generally victim become relaxed. Our results are similar with study of Kumar K et al.⁴ where 79% incidence occur in outdoors and 21% incidence occur in indoors place. (Table 3).

Most common reason behind firearm injuries were due to land and property disputes (42.61%) followed by revenge (13.91%) & robbery (12.17%); group quarrel accounted for another 6.96% cases; and, there were 03 cases each (2.61%) for defense and love matters/ sexual jealousy. In 12 cases (10.43%), the motive remained undetermined. As per Kumar et al.⁴; the motive remained undetermined in a single case of accidental firing (1.73%). This difference is attributable to the variation in the proportion of accidental incidences in the two studies. There were 10 cases of purely accidental gun-shot injuries where motive was lacking. According to Patowary et al.⁶ and, Pradipkumar et al.,⁷ most cases were due to militant activities, encounters, riots, robberies or family quarrel. This variation from our study is due to the regional variations in the areas of study as Guwahati and Imphal are militant activity prone areas.

Considering manner and motive of incidences together, it was observed that about half of accidental firearm injuries were inflicted accidentally whilst in rage with no intention behind the incidence. Two cases of accidental gun-shot injuries occurred in defensive action. In both the suicidal cases of fatal gunshot injuries, the motive behind the act remained undetermined which was also missing in all four cases of undetermined intent. The motives behind the homicidal attack with firearm weapons were well represented in different cases with property land disputes majorly responsible followed by personal enmity and robbery (Table 4).

Most of the events of firearm injuries occurred during evening

hours (42.61%) followed by afternoon (37.39%). These are the hours of work and business, thus prone to activity during which the untoward event took place. 10.43% incidences took place in morning hours. Thus, it was observed that in 47.82% cases, the incidence took place in broad daylight and 51.31% cases occurred after sunset; as also reported by Kumar et al.⁴ The late night hours witnessed the least numbers of gun-shot injuries (8.7%) in the present study which is in contrast to the findings of Kumari et al.⁵ (> 50% gun-shot injuries occurred in night hours). The homicides were conducted in all hours of the day and night with more in evening and afternoon hours. The suicides (two cases) were committed in morning and evening each. (Table 5)

Chest(31.3%) remained the most commonly targeted body region in this study followed by abdominal region (18.26%) and, head & face (14.78%). These results bear slight variation with those of Kumari et al.⁵ (most common site was abdomen-30.9%, followed by chest- 21% and head- 16%). In 33.04% cases firearm wounds were found on peripheries and neck was the least affected part of the body (2.61%); and those of Sachan et al.³ where abdomen followed by head & neck was the most common site.

Head region also remained the target in both cases of suicidal deaths being the most vulnerable site for suicide with firearm weapon. But, these are variable from those of Patowary et al.⁶ and Kumar et al.⁸ In the present study, peripheries and neck were not affected in fatal gun-shot injuries as also reported by Kumar et al.⁴, who reported only 7% firearm wounds in lower limbs in fatal cases.

Chest (28 cases) followed by abdomen (17 cases) were the most commonly targeted region in homicidal gun-shot injuries. The peripheries, upper & lower limbs were targeted in 32 cases of homicidal gun-shot injuries. Accidental firearm injuries were quite evenly distributed over all body regions, as accidents can happen anyway without a set pattern (Table 6).

Conclusion

Our study concluded that certain changes at community and law enforcing agencies level may decrease burden of fatalities due

to fire arm injuries. In our study majority of fire arm cases reported with use of home made gun, so the use of home made guns strictly prohibited by government to reduce fatalities. Accidental injuries are next to homicidal injuries because of majority of victim are illiterate and unaware to use of fire arm weapons so there should be proper training and minimum education criteria by concern issuing authority at the time of given license to individual. There were rising trends to use fire arm weapons to commit suicide in this regard there should be enhance the role of forensic expert, ballistic expert to establish manner of death. It was concluded that in many times only injury pattern over body were unable to establish manner of death due to lack of gun shot residue swab from hand, crime scene report and ballistic report thus combine approach of detailed postmortem examination by forensic expert, crime scene examination, proper hand swabbing and ballistic examination to establish exact manner of death.

References

1. Reddy KSN. The Essentials of Forensic Medicine and Toxicology. 35th Edition, 2017.
2. Saleh S. A preliminary study of firearm injury and death in Qena Governorate, Egypt in year 2008. Ain Shams J Forensic Med Clin Toxicol 2010. XIV
3. Sachan R, Kumar AA, Verma AA. Frequency of fire arm injuries, death and related factor in Kanpur India. Int J Medical Toxicol Forensic Med. 2013; 3(3): 88-95
4. Kumar K, Mohanty S et al. Factors Influencing the Pattern Of Firearm Injuries In Ganjam – A Ten Years Retrospective Study. Sci Park J. 2014. 1(32) 2014:1-7
5. Kumari S, Rajput AS, Agarwal A, Arif A, Chaturvedi RK. Medico-legal Aspects of Firearm Injury Cases in Agra Region. J Indian Acad Forensic Med. 2014; 36(4):387-90.
6. Patowary A, Study of pattern of injuries in homicidal firearm injury cases. J Indian Acad Forensic Med 2005; 27(2):92-95
7. Pradip Kumar Kh, Marak FK, Keisham S, Phom M, Momonchand A. Homicidal Fatal Firearm Injuries. J Indian Acad Forensic Med 2005 ;27(4):222-225
8. Kumar R. Study of wounds in victims of homicide by firearms and explosives. J Evol Med Dent Sci 2013; 2(44):8517-8539.

ORIGINAL ARTICLE

Serum cholinesterase level in postmortem cases of pesticide poisoning: Devising a protocol for identifying exposure to organophosphate and carbamate compounds

Tushar Bhutada¹, Asis Kumar Ray¹, Braja Kishore Dash², Ansuman Panigrahi³

¹ Department of Forensic Medicine and Toxicology, Kalinga Institute of Medical Sciences, KIIT University, Bhubaneswar, Odisha, India

² Additional DMET, Odisha, India

³ Department of Community Medicine, Kalinga Institute of Medical Sciences, KIIT University, Bhubaneswar, Odisha, India

Abstract

The present study was designed with the aim to suggest a protocol based on a simple, cost-effective method for investigating the postmortem cases of organophosphate and carbamate compounds (OPCC) poisonings. A prospective case-control study was conducted during the year 2015-16 involving 48 subjects aged 20-70 years old who died due to OPCC as cases and another 48 age-matched controls who died due to poisoning other than OPCC. Serum cholinesterase estimation and bioassay test on an isolated strip of toad rectus abdominis muscle were done to demonstrate the presence or absence of OPCC in the serum of a deceased. Phorate (22.9%) was the commonest OPCC compound found to be abused by the cases followed by chlorpyrifos (14.6%). Histopathology showed that individual cell necrosis (75%), alveolar hemorrhage (81.3%), central vein dilation (77.1%), and necrosis of tubular epithelium (95.8%) were the predominant signs in brain, lung, liver, and kidney respectively of the cases. Postmortem serum cholinesterase level was significantly less in cases as compared to that in controls. Toad test revealed that the amplitude of submaximal dose with test serum and the percentage change in amplitude were significantly higher in the OPCC group than the non OPCC group. Toad test can be used as a simple, cost-effective and sensitive measure for detection of OPCC in blood particularly in resource constraint settings while dealing with postmortem cases due to poisoning.

Keywords

Postmortem; Serum cholinesterase; Pesticide poisoning; Organophosphate; Carbamate; Submaximal dose

Introduction

Organophosphate and carbamate compounds (OPCC) are widely used pesticides and are responsible for a large number of suicidal or accidental poisonings. Worldwide, approximately 110,000 pesticide self-poisoning deaths occurred each year between 2010 and 2014, comprising 13.7% of all global suicides. ¹ In India, OPCCs are cheap and easily available, hence a source of both intentional and unintentional poisonings. As per the estimates of the National Crime Bureau of India, suicides by consumption of pesticides account for 19.7% of all cases of suicidal poisoning in the year 2007. ² Although Organophosphates and carbamates are structurally different, both are potent inhibitors of serum cholinesterase (butyrylcholinesterase) and thus cholinesterase assays are used as a sensitive marker of exposure to most OPCCs. ³ However, estimation of serum cholinesterase level is costly and is not routinely available in all the laboratories especially in the rural hospitals which bear the brunt of the caseload. ⁴ Hence, simple, cheap and less time-consuming methods of screening for

detection of OPCCs in the blood of the subject can prove helpful.

With this background, the present study was planned to be undertaken with the aim to explicate a protocol for investigating cases of OPCC poisonings by conducting a bioassay test on isolated strip of toad rectus abdominis muscle so as to demonstrate the presence or absence of OPCC in the serum of a deceased to have died due to OPCC poisoning and corroborating the results by performing chemical assay of serum cholinesterase. Also, histopathological changes in OPCC poisoning were elucidated and a screening test for the presence of alcohol in postmortem vitreous humor was done to find out whether the deceased had consumed alcohol along with OPCC before death.

Material and Methods

It was a prospective case-control study conducted during the year 2015-16 prior to which a pilot study was carried out involving 5 cases and 5 controls. Assuming effect size 0.8, α error probability as 0.05 and the power of the study 95%, the total sample size was calculated as 84 considering 42 cases and 42 controls. However, we selected 48 subjects aged between 20 and 70 years who died due to OPCC poisoning (cases) and another 48 subjects matched with the case on age (± 3 years) who died due to poisoning other than OPCC (controls) such as organochlorine compounds, pyrethroid compounds, chemicals,

Corresponding Author

Dr. Ansuman Panigrahi (Professor)

Email: dr.ansuman3@gmail.com

Phone: +91-9861412403

Article History

Received: 22nd April, 2020; Accepted: 27th September, 2020

plant poisons etc. Cases brought to the mortuary on working days on or before 12 noon were considered for the study. Based on treatment records and relevant history from police and relatives, cases, where death was known to be caused due to OPCC poisoning or other poisoning were included as cases or controls. Also, postmortem diagnosis of OPCC poisoning was done by the following criteria: (1) autopsy features like froth from mouth/nostrils, characteristic odor (garlicky or kerosene-like), congested stomach mucosa, suspicious stomach content etc.; (2) chemical analysis of the viscera at the Forensic Science Laboratory (FSL) using procedures like solvent extraction method, screening test (color test, paper chromatography), thin layer chromatography method, and high-performance liquid chromatography method in a sequential manner. Dead body brought to the mortuary where time since death was more than 12 hours during autopsy examination was excluded. Presence of acute infection, inflammation, chronic malnutrition, liver damage, obstructive jaundice, metastasis, pregnancy and history of use of contraceptive pills in subjects were the other exclusion criteria. Institutional Ethics Committee approval for the research protocol was obtained prior to initiation of the study. After obtaining informed consent from the legal representative/relative of the deceased, detailed information of each case was recorded with the help of a structured schedule.

Autopsy of all the deceased was done as per the standard autopsy procedure of the department. Blood and vitreous humor samples were collected using the standard procedures. Half of the extracted serum was sent to the biochemistry laboratory for estimation of serum cholinesterase and the remaining serum was sent to the pharmacology laboratory and placed in the refrigerator at 4°C after labeling it as test serum.

Toad test

A healthy toad was taken from the froggeery. Pithing of the spinal cord was done. Then the rectus abdominis muscle of one side was dissected from its origin till insertion. A purse-string suture was given at the lower end before it was tied with the glass rod present in the organ bath containing 10 ml of freshly prepared frog's ringer solution. Adequate hydration was maintained and after applying a load of 1gm, the tissue was allowed to relax for about 45 minutes. A base line was obtained after 45 minutes keeping the load off. Graded solution of acetylcholine stock solution was injected in the organ bath after 15 seconds of starting the rolling of the drum which continued to rotate for the next 45 seconds. The contractions of the tissue were amplified about 10 times and recorded on the smoked drum (kymograph) with the help of a simple lever. This process continued for 4-5 times after a rest period of 2 minutes each applying 1gm load, after flushing the frog's ringer solution. The

process was continued until the ceiling effect was obtained. The sub-maximal dose (SMD) was determined as the dose which provided 75% of contraction of that of the ceiling dose. SMD was selected for recording the activity, so that muscle will not get fatigued by repeated maximal dose and at the same time giving space for potentiation due to cholinesterase inhibition by OPCC poisoning. A baseline was obtained again and 0.1ml of freshly prepared pooled serum (a mixture of serum collected from healthy subjects) was injected in the organ bath and allowed to stand for 2 minutes, after which the submaximal dose was injected within 15 seconds of starting of the drum and the reading was taken for the next 45 seconds. After a rest period of 2 minutes, the same procedure was repeated with the test serum. The pooled serum was used as a procedural control in all the experiments, before adding the test serum to the bath, so as to negate the effect of any possible confounding factors present in the frog's ringer solution. The presence of OPCC was represented by a potentiation of contraction of the same dose of acetylcholine producing the submaximal response and the absence of OPCC in the serum was demonstrated as attenuation of contraction of the same dose of acetylcholine producing the submaximal response. The amplitude of submaximal dose of acetylcholine (SMD-A), the amplitude of submaximal dose with pooled serum (SMD-PS), and amplitude of submaximal dose with test serum (SMD-TS) was noted. Percent change in amplitude was calculated by the following formula:

$$\frac{(\text{SMD-TS}) - (\text{SMD-A})}{(\text{SMD-A})} \times 100$$

Histo-pathological study of vital organs in OPCC group

Sections from the left lobe of liver parenchyma, lower lobe of right lung, kidney, and brain were cut into smaller slices and preserved in 10 % formaldehyde solution (Formalin – 100 ml, Sodium chloride – 8.5 grams & Distilled water – 900 ml) in separate wide-mouthed containers with proper labeling for histopathology study. The dissected specimen was kept in fixative for a period of 48-72 hours with the exception of the brain which was fixed for 3 weeks before gross dissection and histopathology. Then tissue was prepared for section cutting by paraffin wax method using the following steps: (1) dehydration by washing thoroughly with water and passing through ascending grades of ethyl alcohol; (2) clearing the specimen and removing alcohol by adding xylene; (3) paraffin wax impregnation with molten wax contained in electrically heated paraffin wax embedding water bath at 58°C temperature; (4) casting with Lockhart's L-shaped molds of required sizes; (5) sectioning with rotary microtome (5-7µ thickness) after trimming the paraffin wax block; (6) fixation of sections on the slides smeared with a drop of Mayer's egg albumin. Staining

was done with hematoxylin and eosin stain. Microscopic observation (with 100X and 200X magnification) for the brain (cerebral cortex and thalamus), liver (left lobe), kidney (cortex and medulla), and lung (right lower lobe) were done and the findings were noted.

Data were analyzed by using SPSS version 21.0 software. All the quantitative data were expressed as mean and standard deviation and compared using paired t-test and unpaired t-test for within-group and between groups analyses respectively whereas qualitative data were presented as frequency and percentage and compared using the chi-square test. P-value less than 0.05 was considered as statistically significant.

Results

In total, 96 subjects aged between 20 to 70 years were included in the study choosing 48 subjects as cases and 48 as controls. Out of them, 55 were males and 41 were females. The mean age of the study population was 36.3 (14.8) years. Both the cases and controls were comparable with respect to age and sex as revealed in Table 1.

Table 1: Demographic and clinical characteristics of the study population (n = 96)

Variable	Characteristics	Cases (%)	Control (%)	p-value
Sex	Male	26 (54.2)	29 (60.4)	0.536
	Female	22 (45.8)	19 (39.6)	
Froth from mouth/nostrils	Yes	48 (100)	-	0.000
	No	-	48 (100)	
Stomach mucosa	Congested	48 (100)	11 (22.9)	0.000
	Non-congested	-	37 (77.1)	
Stomach contents	Suspicious	48 (100)	7 (14.6)	0.000
	Non-suspicious	-	41 (85.4)	
Screening for alcohol	Positive	20 (41.7)	9 (18.8)	0.014
	Negative	28 (58.3)	39 (81.3)	

Autopsy features such as froth from mouth/nostril, congested stomach mucosa, garlicky or kerosene-like odor from stomach contents and chemical analysis of the viscera at FSL significantly differentiated the cases from the controls in our study. Postmortem screening tests for alcohol in vitreous fluid showed that alcohol was more prevalent in the OPCC group. The test was also positive in 77% of males who committed deliberate self-poisoning with OPCC.

Table 2 shows that the commonest OPCC compound found to be abused among the study subjects was phorate (22.9%) followed by chlorpyrifos (14.6%) whereas in one-third of cases the compound could not be determined. Histopathological

findings such as individual cell necrosis (36, 75%), alveolar hemorrhage (39, 81.3%), central vein dilation (37, 77.1%), and necrosis of tubular epithelium (46, 95.8%) were the predominant signs observed in brain, lung, liver, and kidney respectively (Table 3).

Table 2: Types of organophosphorous compounds used in cases (n = 48)

Organophosphorous compounds	N (%)
Phorate	11 (22.9)
Chlorpyrifos	7 (14.6)
Dichlorovos	4 (8.3)
Monocrotophos	3 (6.2)
Dimethoate	3 (6.2)
Malathion	2 (4.2)
Diazinon	1 (2.1)
Parathion	1 (2.1)
Unknown	16 (33.3)

Table 3: Histopathological findings of vital organs in cases (n = 48)

	Histopathological findings	N (%)
Brain	Individual cell necrosis	36 (75.0)
	Cellular incrustation	30 (62.5)
	Eccentrically placed nucleus	17 (35.4)
	Cytoplasmic vacuolations	14 (29.2)
	Ballooning of cells	14 (29.2)
Lungs	Alveolar hemorrhage	39 (81.3)
	Interstitial edema	31 (64.6)
	Disruption of alveolar wall	18 (37.5)
Liver	Central vein dilation	37 (77.1)
	Macro and micro vesicular steatosis	25 (52.1)
	Sinusoidal dilation	19 (39.6)
	Patchy necrosis	10 (20.8)
Kidney	Necrosis of tubular epithelium	46 (95.8)
	Increase in Bowman's space	10 (20.8)
	Intratubular hemorrhage	11 (22.9)
	Dilation of glomerular capillaries	13 (27.1)
	Conglomeration of glomerulus	15 (31.3)

Postmortem serum cholinesterase level was significantly less in cases as compared to that in controls (Table 4). The amplitude

of SMD of acetylcholine in frog' ringer solution and that of SMD with pooled serum did not show any significant difference between the two groups whereas the amplitude of SMD with test serum and the percentage change in amplitude were significantly higher in OPCC group than the non OPCC group.

Figure 1 depicts the toad test approach in the identification of OPCC poisoning in postmortem cases. Potentiation of SMD by acetylcholine confirms OPCC exposure and indicates no further action whereas non exposure to OPCC indicates further chemical examination at FSL.

Table 4: Descriptive statistics of the postmortem serum cholinesterase, and amplitude of submaximal dose (SMD) of acetylcholine in cases (n = 48) and controls (n = 48)

	Cases Mean \pm SD	Controls Mean \pm SD	p value
Serum cholinesterase	860.9 \pm 556.8	5274.8 \pm 1522.1	0.000
Amplitude of SMD of Ach (cm)	2.05 \pm 0.38	2.17 \pm 0.23	0.072
Amplitude of SMD with pooled serum (in cm)	1.93 \pm 0.36	2.00 \pm 0.20	0.213
Amplitude of SMD with test serum (in cm)	2.22 \pm 0.40	2.01 \pm 0.20	0.002
Percentage change in amplitude	8.12 \pm 2.72	-7.03 \pm 4.95	0.000

SMD - Submaximal dose

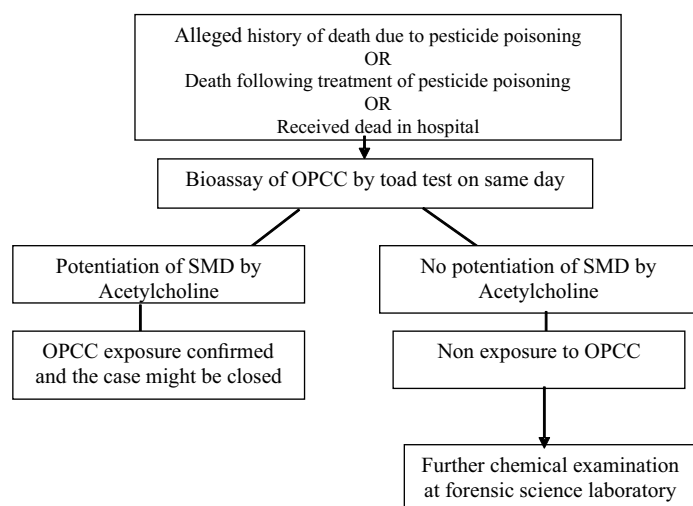


Figure 1: Flow chart showing the toad test approach towards identification of OPCC poisoning in postmortem cases

Discussion

In the present study, phorate and chlorpyrifos were the most commonly abused OPCC compounds and in one-third of cases, the offending agent was unknown. This might be explained by the fact that these compounds were relatively cheap and easily available because of their extensive use in the region. Govsavi

et al. showed in their study that in 40% of cases, the offending compound was unknown and dimethoate was the commonest compound (43.5%) involved followed by mixed intake (37%).⁵ Nigam et al. reported the trend of organophosphorus poisoning in decreasing order as monocrotophos followed by phorate, dimethoate, diazinon, malathion, and parathion.⁶ This variation in choice of the compound might depend on the low cost and availability of the material in the respective region.

Though blood and urine are the body fluids of choice for ethanol estimation in living subjects, Kugelberg et al. strongly recommended vitreous humor as an ideal body fluid for determining ethanol in postmortem toxicology to help establish whether the deceased had consumed ethanol before death.⁷ In the present study, we found the screening test for alcohol in post mortem vitreous fluid to be positive in 41.7% of cases as compared to 18.8% in controls. This result is consistent with the finding of an earlier study that reported that 51% of cases of OPCC poisoned patients had detectable blood alcohol.⁸ Nigam et al. observed that 24 out of 117 cases of poisoning had blood alcohol in significant concentration.⁶ Co-ingestion of alcohol might increase the amount of OPCC drunk by an individual; reasons might be impairment of the ability to judge the quantity of poison ingested, dulled taste sensation, and disinhibition.⁸ Alcohol intoxication along with OPCC ingestion leads to increased mortality due to exacerbation of the suppressive effect of the OPCC on the consciousness by alcohol, leading to increased risk of aspiration. It also leads to suppression of the respiratory drive resulting in hypoxic injury. In our study, although OPCC was the predominant cause of mortality, the presence of alcohol might have aggravated the situation.

Hypoxia and extreme hypotension for a prolonged period can cause ischemic cell damage in vital organs like the brain, liver, kidney, lungs and can manifest as histopathological changes in these organs if the person survives for several hours before death. Hypoxia, hypotension and seizures seen in case of OPCC poisoning put the poisoned patients at risk of hypoxic-ischemic brain damage. The present study demonstrated focal ischemic cell changes in the cerebral cortex and thalamus suggesting hypoxic-ischemic brain damage similar to those described by Petras et al in their study.⁹ Adams et al. reported that the hypoxic changes could be focal neuronal necrosis associated with an episode of profound hypotension or diffuse neuronal necrosis associated with acute circulatory catastrophe.¹⁰ Focal individual cell necrosis found in our study indicates the occurrence of profound hypotension for a prolonged period before death caused due to OPCC poisoning. Adams further emphasized that the involvement of thalamus was very common in hypoxic brain injuries. This was supported by the finding of our study as thalamus was involved in the majority of cases.

In our study histopathology of the kidney revealed necrosis of tubular epithelium in 95.8% of cases. Swelling and necrosis of the tubular epithelial cells was the most consistently reported finding in various human and animal studies.^{11,15} We observed that central vein dilation and micro/macrovacular steatosis were the major findings in histopathology of the liver in OPCC poisoning. A similar result was also reported in earlier studies.^{13,16} while Gorea et al. observed fatty change as the predominant finding.¹¹ Different studies on animal models also showed similar histopathological changes as found in our study.^{12,15,17,18} We observed alveolar hemorrhage and interstitial edema as the most common features in the postmortem histopathology done in OPCC poisoning cases. Nigam et al. in their study reported alveolar hemorrhage, interstitial edema, and disruption of the alveolar membrane in 62%, 62% and 44% of cases respectively.¹³ Similar findings were also reported in various animal studies.^{19,21}

Organophosphates and carbamates inhibit acetylcholinesterase in synapses, on red cell membranes, and butyrylcholine esterase in plasma.²² This causes an accumulation of acetylcholine at nerve endings, stimulating neuro-effector junctions, skeletal neuro-muscular junctions, autonomic ganglia and in the brain. Thus, serum cholinesterase assays are used as a sensitive marker to detect exposure to OPCC in antemortem poisoning cases. Studies have shown that cholinesterase remains constant after death, having no significant changes from antemortem levels even in non refrigerated samples obtained 3 weeks after death.²³ In the present study, the mean serum cholinesterase level in non OPCC group was almost within the normal reference range (4000 U/l – 10,000 U/l) whereas the OPCC group showed a gross decrease in the mean serum cholinesterase level. This supports the idea that postmortem serum cholinesterase can be used as evidence of poisoning with OPCC compounds within 12 hours of death. The detection of OPCC in the serum of a person alleged to have died during treatment for the same would be of immense forensic value and would prove to be the most useful of all other indices.

In the present study, we used an isolated strip of rectus abdominis muscle of the toad to demonstrate the effect of OPCC. The amplitude of SMD in pooled serum was less than that of the SMD (frog's ringer alone) in each of the cases and controls. Further in the control group, the amplitude of SMD with test serum did not show any marked variation from that of the SMD with pooled serum whereas in the OPCC group, the difference was significant. Between-group analysis revealed that the amplitude of SMD with test serum showed a significant rise in the OPCC group as compared to non OPCC group. Also, all the cases with OPCC poisoning had a positive value for percent change in amplitude whereas the non OPCC subjects were showing negative value in percent change in amplitude.

These findings clearly indicate that presence OPCC in the blood causes potentiation of muscle contraction with the same dose of acetylcholine producing submaximal response whereas the absence of OPCC in the blood is demonstrated by attenuation of muscle contraction with the same dose of acetylcholine producing a submaximal response. Therefore, in resource constraint settings and where facilities for estimation of serum cholinesterase are unavailable, the toad test can be used as a simple, fast, cost-effective as well as a sensitive measure for qualitative assay of OPCC in the blood. However, a large scale study comparing this method to the present gold standard is required to validate this method as evidence in the court of law.

Conclusion

From the findings of the present study, a flow chart was developed which might be very useful in dealing with postmortem cases due to poisoning particularly in resource constraint settings and where facilities for estimation of serum cholinesterase are unavailable (Figure 1). It might guide the health professionals to identify deaths due to OPCC poisoning and thus closing the cases then and there thereby saving a lot of time, energy and money or else send samples for further investigation in the forensic science laboratory for deaths due to causes other than OPCC poisoning.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Mew EJ, Padmanathan P, Konradsen F, Eddleston M, Chang S Sen, Phillips MR, et al. The global burden of fatal self-poisoning with pesticides 2006-15: Systematic review. *J Affect Disord* [Internet] 2017; 219: 93–104. Available from: <http://dx.doi.org/10.1016/j.jad.2017.05.002>
2. Bairy KL, Vidyasagar S, Sharma A, Sammad V. Controversies in the management of organophosphate pesticide poisoning. *Indian J Pharmacol*. 2007;39:71–4
3. Colovic MB, Krstic DZ, Lazarevic-Pasti TD, Bondzic AM, Vasic VM. Acetylcholinesterase Inhibitors: Pharmacology and Toxicology. *Curr Neuropharmacol*. 2013;11:315–35
4. Chethan Kumar R, Sahna E. Correlation of serum pseudocholinesterase level and peradeniya organophosphorus poisoning scale with the severity and inhospital outcome of acute organophosphorus poisoning. *Int J Contemp Med Res*. 2017;4:1702–5
5. Govsavi V, Shegokar VE, Bhelkar SM, Tungikar S. A Study of profile of patients with organophosphorus compound poisoning at a teaching hospital. *MRIMS J Heal Sci*. 2014;2:23–7.

6. Nigam M, Jain AK, Dubey BP, Sharma VK. Trends of organophosphorus poisoning in Bhopal region – A autopsy based study. *J Indian Acad Forensic Med.* 2004;26:62–5
7. Kugelberg FC, Jones AW. Interpreting results of ethanol analysis in postmortem specimens: A review of the literature. *Forensic Sci Int.* 2007;165:10–29
8. Eddleston M, Gunnell D, Von Meyer L, Eyer P. Relationship between blood alcohol concentration on admission and outcome in dimethoate organophosphorus self-poisoning. *Br J Clin Pharmacol.* 2009;68:916–9
9. Petras JM. Neurology and neuropathology of soman-induced brain injury: An overview. *J Exp Anal Behav.* 1994;61:319–29
10. Adams JH, Graham DI, Jennett B. The neuropathology of the vegetative state after an acute brain insult. *Brain.* 2000;123:1327–38
11. Gorea RK, Dalal JS, Gargi J, Rai H. Pattern of poisoning in Punjab. *J Punjab Acad Forensic Med Toxicol [Internet]* 2001;1. Available from: http://pafmat.com/2001_3.htm
12. Deka S, Mahanta R. A Study on the effect of organophosphorus pesticide malathion on hepato-renal and reproductive organs of heteropneustes fossilis (Bloch). *Sci Probe.* 2012;1:1–13
13. Nigam MK, Jain BB, Banerjee U, Roy DG, Chatterjee S. Pesticide poisoning – an epidemiological and histopathological study. *Pacific J Med Sci.* 2013;12
14. Rekha, Raina S, Hamid S. Histopathological effects of pesticide-chlorpyrifos on kidney in albino rats. *Int J Res Med Sci.* 2013;1:465–75
15. El-bendary HM, Shaker MH, Saleh AA, Negm SE, Khadey ME, Eldeen FAH, Histopathological changes associated with exposure of male mice to profenofos and chlorpyrifos. *Annu Res Rev Biol.* 2014;4:766–77
16. Sutay SS, Tirpude BH. Pattern of histo pathological changes of liver in poisoning. *J Indian Acad Forensic Med.* 2008;30:63–8
17. Ksheerasagar RL, Hiremath MB, Kaliwal BB. Impairment of hepatic biochemical contents and enzymes activities during carbosulfan intoxication in albino mice. *Int Multidiscip Res J.* 2011;1:6–15
18. Benjamin N, Kushwah A, Sharma RK, Katiyar AK. Histopathological changes in liver, kidney and muscles of pesticides exposed malnourished and diabetic rats. *Indian J Exp Biol.* 2006;44:228–32
19. Tos-Luty S, Prezbirowska D, Latuszynska J, Tokarska-Rodak M. Histological and ultrastructural studies of rats exposed to carbaryl. *Ann Agric Env Med.* 2001;8:137–44
20. Hulse EJ, Clutton RE, Drummond G, Eddleston M. Translational toxicological research: Investigating and preventing acute lung injury in organophosphorus insecticide poisoning. *J R Army Med Corps.* 2014;160:191–2
21. Budin SB, Saimin H, Taib IS, Jayusman PA, Mohamed J. A Histological Studies of Rats' Lung Subacutely Treated with Fenitrothion. *Int J Collab Res Intern Med Public Heal.* 2012;4:744–52
22. Roberts DM, Aaron CK. Managing acute organophosphorus pesticide poisoning. *Br Med J.* 2007;334:629–34
23. Coe JI. Postmortem update: Emphasis on forensic application. *Am J Forensic Med Pathol.* 1993;14:91–117

ORIGINAL ARTICLE

Profile of Deaths Due to Poisoning at Tertiary Care hospital of Central India

Sudhir Ninave,¹ Swapnil Patond,¹ Shikha Verma,² Sanjot Ninave³

1 Department of Forensic Medicine, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

2 Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

3 Department of Anesthesia, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

Abstract

Poisoning is a major public health problem worldwide, with thousands of deaths occurring every year in the developing countries. India, holding 2/3 of agricultural land, accounts for one third of pesticide poisoning cases and the agricultural workers being the worst affected. Most of the poisonings occur due to self-ingestion of the poison. Organo-phosphorus compounds occupy the major burden of poisoning related morbidity and mortality. The present study was aimed to know the profile of various poisoning cases admitted to AVBRH hospital JNMC Wardha, India. The objectives of this study were to determine the profile of poisoning cases reported to assess their pattern and outcome. A retrospective study with the data regarding age, gender, residence, type of poison; manner, route of poisoning, outcome was collected in a structured proforma. The data was analysed using standard statistical methods. In present study, rural males were among the highest reported cases, with maximum number of cases reported during the summer season. Irritant poisons accounts to the highest incidence. Pesticides, Organophosphorus compound in particular form the major type of poisons among irritants. Present study highlights the profile of poisoning cases admitted to the AVBRH Hospital Wardha District, Maharashtra, India, which clearly indicates the high-risk population involved and the common poisons encountered in this region. Early detection of suicidal tendency and circumstantial causes among the persons in the society can be done, which will be beneficial in preventing the suicidal deaths by creating awareness.

Keywords

Poisoning; Pesticide; Organophosphorus; Profile; Tertiary care hospital

Introduction

Poisoning is a significant global public health problem ranking 45th in total death worldwide. Nearly a million people die each year because of suicide and it is estimated that deliberate ingestion of pesticide causes 370000 deaths each year. According to WHO 2012 an estimated 1, 93, 460 people died worldwide from unintentional poisoning of these deaths, 84% occurred developing countries. In the same year, unintentional poisoning caused the loss of over 10.7 million years of healthy life.¹

Suicidal poisons are silent major weapons, which can be easily used without violence and often without exciting doubt. Poisoning cases can be liberating intentional or accidental poisons are still weapons and easily available which can be easily used without exciting doubt.²

According to World Health Organisation reports every forty seconds a suicide is reported somewhere in the world and one of every three suicides take place in India.³ The nature of death includes homicidal and suicidal, poisonous animal bite, illness and intoxication and death due to medicinal misuse.⁴ In developed

countries death due to poisoning is only one to two percent but in developing countries like India, it varies from 15-30% and is common causes of death in rural areas and urban areas.

This outline of poisoning depends on the fata insecticide used in that region, culture, occupation, demography, belief, socio-economic status, education and custom of the religion as well struggle for in receipt of more yield in the field for that more pesticide are used than the required amount. Poisoning, both accidental and intentional is a significant contributor to mortality and morbidity throughout the world. There are more than four thousand species of medicinal plants growing are herbs, shrubs and trees in India many of which are poisonous when administrated in large doses.

Suicidal and homicidal cases of poisoning are common in India, as poisons can be easily obtained and many poisonous plants grow wild, e.g. datura, oleanders, aconite, nux vomica etc. kerosene, pesticide, drugs and household chemicals are commonly involved.

The characters of an ideal suicidal poison should be cheap, easily available, highly toxic, tasteless or of pleasant taste, capable of being easily taken in food or drink and capable of producing painless death. Opium and Barbiturates satisfy several of above criteria. Organophosphorus compounds and Endrin are commonly used as suicidal poisons. Stupefying poisons Datura, Cannabis indica, Chloral hydrate. Poisons for abortion are Calotropis, Oleanders, Ergot, Lead, Arsenic etc.

Corresponding Author

Dr. Swapnil Patond (Associate Professor)

Email: patondswapnil@gmail.com

Mobile: +91-9049093630

Article History

Received: 29th April, 2020; Accepted: 29th September, 2020

Materials and Methods

This retrospective study was conducted at the department of Forensic medicine, JNMC & AVBRH, Sawangi (Meghe), Wardha. Permission and approval were obtained from the institutional ethics committee. All cases admitted to the emergency department of the AVBRH hospital over a period of 3 months was evaluated retrospectively and data was obtained from the hospital. As the study was retrospective, case sheet of the admitted patients was studied after checking for inclusion and exclusion criteria. 200 cases were included in this study. Specified proforma used to record the patient's history and all details. Data was collected by the investigator through the case sheet of all the poisoning cases available in medical record department. The cases were reviewed for gender, age, route and reason of poisoning, seasonal variation and agents. Detailed analysis of police inquest, history, signs and symptom were done.

Statistical analysis was done by using descriptive and inferential statistics using chi-square test and software used in the analysis were SPSS 22.0 version and GraphPad Prism 7.0

version. Descriptive analysis of age, sex, associated complications was performed. Continuous variables, which are normally distributed, were described using mean and standard error. $p < 0.05$ is considered as level of significance.

Results

The age-wise distribution of the 200 cases studied in the present study is shown in Table 1. Among the 200 cases studied, 81.50 % were males ($n=163$) as shown in Table 2. Among total 200 cases 87.50% were married and related to agriculture occupation which consist about 35.50% of total number of which most belong to lower socioeconomic status (59.50%) as shown in Table 3, 4, 5 respectively. Along with above observation it shows that maximum numbers of cases received in winter season 42.50% followed by summer 23% (Table 6).

Amongst total cases majority of cases were of suicidal in nature 61.36% followed by accidental 22, 73 % of which 79% cases were admitted (Table 7-8).

Table 1: Age wise distribution of poisoning cases

Poisoning	1-20 years	21-40 years	41-60 years	61-80 years	Total
	N (%)	N (%)	N (%)	N (%)	N (%)
Organophosphorus	7(5.69%)	71(57.72%)	40(32.52%)	5(4.07%)	123(61.50%)
Alcohol	2(18.18%)	7(63.64%)	2(18.18%)	0(0%)	11(5.50%)
Phenobarbitone	1(25%)	1(25%)	1(25%)	1(25%)	4(2%)
Carbamate Insecticide	3(7.32%)	27(65.85%)	11(26.83%)	0(0%)	41(20.50%)
Rat	1(25%)	3(75%)	0(0%)	0(0%)	4(2%)
Abrus	1(100%)	0(0%)	0(0%)	0(0%)	1(0.50%)
Snake Venom	4(25%)	9(56.25%)	3(18.75%)	0(0%)	16(8%)
Total	19(9.50%)	118(59%)	57(28.50%)	6(3%)	200(100%)
N2-value	31.84, p-value=0.023				

Table 2: Sex wise distribution of poisoning cases

Poisoning	Married	Unmarried	Total
	N (%)	N (%)	N (%)
Organophosphorus	105(85.37%)	18(14.63%)	123(61.50%)
Alcohol	10(90.91%)	1(9.09%)	11(5.50%)
Phenobarbitone	4(100%)	0(0%)	4(2%)
Carbamate Insecticide	32(78.05%)	9(21.95%)	41(20.50%)
Rat	2(50%)	2(50%)	4(2%)
Abrus	0(0%)	1(100%)	1(0.50%)
Snake Venom	10(62.50%)	6(37.50%)	16(8%)
Total	163(81.50%)	37(18.50%)	200(100%)
N2-value	13.96, p-value=0.030		

Table 3: Distribution of poisoning cases according to marital status

Poisoning	Married	Unmarried	Total
	N (%)	N (%)	N (%)
Organophosphorus	115(93.50%)	8(6.50%)	123(61.50%)
Alcohol	8(72.73%)	3(27.27%)	11(5.50%)
Phenobarbitone	3(75%)	1(25%)	4(2%)
Carbamate Insecticide	34(82.93%)	7(17.07%)	41(20.50%)
Rat	3(75%)	1(25%)	4(2%)
Abrus	0(0%)	1(100%)	1(0.50%)
Snake Venom	12(75%)	4(25%)	16(8%)
Total	175(87.50%)	25(12.50%)	200(100%)
N2-value	17.45, p-value=0.008		

Table 4: Distribution of poisoning cases according of occupation

Poisoning	Entrepreneur	Farmer	House-wife	Labouer	Student	Unemployed	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Organophosphorus	10 (8.13%)	45 (36.59%)	9 (7.32%)	23 (18.70%)	4 (3.25%)	17 (13.82%)	15 (12.20%)	123 (61.50%)
Alcohol	2 (18.18%)	4 (36.36%)	0 (0%)	1 (9.09%)	1 (9.09%)	2 (18.18%)	1 (9.09%)	11 (5.50%)
Phenobarbitone	0 (0%)	3 (75%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)	4 (2%)
Carbamate Insecticide	1 (2.44%)	12 (29.27%)	3 (7.32%)	5 (12.20%)	6 (14.63%)	4 (9.76%)	10 (24.39%)	41 (20.50%)
Rat	0 (0%)	1 (25%)	1 (25%)	0 (0%)	0 (0%)	1 (25%)	1 (25%)	4 (2%)
Abrus	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (0.50%)
Snake Venom	0 (0%)	6 (37.50%)	1 (6.25%)	2 (12.50%)	2 (12.50%)	2 (12.50%)	3 (18.75%)	16 (8%)
Total	13 (6.50%)	71 (35.50%)	14 (7%)	31 (15.50%)	13 (6.50%)	27 (13.50%)	31 (15.50%)	200 (100%)
N2-value	32.94, p-value=0.615							

Table 5: Distribution of poisoning cases according to Socio economic status

Poisoning	Lower	Lower Middle	Upper Lower	Upper Middle	Total
	N (%)	N (%)	N (%)	N (%)	N (%)
Organophosphorus	74(60.16%)	14(11.38%)	29(23.58%)	6(4.88%)	123(61.50%)
Alcohol	7(63.64%)	1(9.09%)	2(18.18%)	1(9.09%)	11(5.50%)
Phenobarbitone	4(100%)	0(0%)	0(0%)	0(0%)	4(2%)
Carbamate Insecticide	24(58.54%)	5(12.20%)	8(19.51%)	4(9.76%)	41(20.50%)
Rat	2(50%)	0(0%)	1(25%)	1(25%)	4(2%)
Abrus	1(100%)	0(0%)	0(0%)	0(0%)	1(0.50%)
Snake Venom	7(43.75%)	4(25%)	3(18.75%)	2(12.50%)	16(8%)
Total	119(59.50%)	24(12%)	43(21.50%)	14(7%)	200(100%)
N2-value	11.33, p-value=0.880				

Table 6: Distribution of poisoning cases according to seasonal variation

Poisoning	Autumn	Monsoon	Spring	Summer	Winter	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Organophosphorus	10(8.13%)	8(6.50%)	11(8.94%)	28(22.76%)	66(53.66%)	123(61.50%)
Alcohol	1(9.09%)	1(9.09%)	3(27.27%)	4(36.36%)	2(18.18%)	11(5.50%)
Phenobarbitone	0(0%)	2(50%)	1(25%)	0(0%)	1(25%)	4(2%)
Carbamate Insecticide	12(29.27%)	10(24.39%)	3(7.32%)	4(9.76%)	12(29.27%)	41(20.50%)
Rat	0(0%)	0(0%)	1(25%)	3(75%)	0(0%)	4(2%)
Abrus	0(0%)	0(0%)	0(0%)	1(100%)	0(0%)	1(0.50%)
Snake Venom	1(6.25%)	5(31.25%)	0(0%)	6(37.50%)	4(25%)	16(8%)
Total	24(12%)	26(13%)	19(9.50%)	46(23%)	85(42.50%)	200(100%)
N2-value	62.07, p-value=0.0001					

Table 7: Distribution of poisoning cases according to severity

Poisoning	Admitted case	Brought dead	Dead during testing	Total
	N (%)	N (%)	N (%)	N (%)
Organophosphorus	97(78.86%)	8(6.50%)	18(14.63%)	123(61.50%)
Alcohol	9(81.82%)	0(0%)	2(18.18%)	11(5.50%)
Phenobarbitone	4(100%)	0(0%)	0(0%)	4(2%)
Carbamate Insecticide	31(75.61%)	4(9.76%)	6(14.63%)	41(20.50%)
Rat	4(100%)	0(0%)	0(0%)	4(2%)
Abrus	0(0%)	0(0%)	1(100%)	1(0.50%)
Snake Venom	13(81.25%)	1(6.25%)	2(12.50%)	16(8%)
Total	158(79%)	13(6.50%)	29(14.50%)	200(100%)
N2-value	9.63, p-value=0.648			

Table 8: Distribution of poisoning cases according to type of death

Poisoning	Accidental	Suicidal	Miscellaneous	Total
	N (%)	N (%)	N (%)	N (%)
Organophosphorus	3(11.11%)	17(62.96%)	7(25.93%)	27(61.36%)
Alcohol	0(0%)	2(100%)	0(0%)	2(4.55%)
Phenobarbitone	0(0%)	0(0%)	0(0%)	0(0%)
Carbamate Insecticide	3(27.27%)	8(72.73%)	0(0%)	11(25%)
Rat	0(0%)	0(0%)	0(0%)	0(0%)
Abrus	1(100%)	0(0%)	0(0%)	1(2.27%)
Snake Venom	3(100%)	0(0%)	0(0%)	3(6.82%)
Total	10(22.73%)	27(61.36%)	7(15.91%)	44(100%)
N2-value	20.25, p-value=0.009			

Discussion

India is a developing nation, and the economy is mainly based on agriculture. Among rural regions, pesticide poisoning from occupational, accidental and intentional exposure is a major problem. In present study, there was a higher incidence of poisoning in males 81.50 % as compared to females and most of the poisonings were in the age group of 21-40 years (59%).

Results of this study are similar to studies conducted by Rao et al. where they observed that two thirds of the patients were less than 30 years age, 57% were male and 96% intentionally poisoned themselves.⁵ Similarly, Purnanand et al. found that male (79.48%) predominated females eight cases (20.51%) with majority (41.02%) belonging to 41-50 years age group. The most common poison encountered was Organophosphorus compounds (48.71%) of which suicide (79.48%) was the most common manner as compared to accidental poisoning.⁶

Sharma et al. found that 63% were males. The 21-25-year age group accounted for the maximum number of cases (28%).⁷ Ramesha et al. observed that poisoning is more common in young males. The overall mortality is substantially high, mainly contributed by suicidal poisoning with insecticides and corrosives.⁸

These high incidences in this age group among males are attributed to point that males are more exposed to stress and other financial liabilities. Irritant poisons accounts to the highest incidence among poisoning in this study. Pesticides, organophosphorus compound in particular form the major type of poisons among irritants. Similar results were noted in South Indian studies done by Ramesha et al.⁹, Jesslin et al.¹⁰, Jaiprakash et al.¹¹ and Vinay et al.¹² However, in contrast, studies done in North India by Bajaj et al.¹³ and Singh et al.¹⁴ shows that the incidence of aluminium phosphide was found to be high.

As agriculture is the main occupation of the people in India and organophosphorus compounds was commonly used pesticide in these localities, the most commonly used agent for poisoning was organophosphorus compound. Though majority of the patients have not revealed the exact reason for committing suicide by poison, it appears that family problems, dependence on climate, unemployment, crop failure, financial crisis were the prime reasons for committing such an act.

Similar theories have also been put up by some researchers which state that factors like dowry, cruelty by the in-laws, family quarrels, maladjustment in married life and dependence of women on husband are responsible for the higher incidence of poisoning among house wives or inability to cope up the high expectation from parents and teachers has increased the incidence of poisoning among students.¹⁴

Conclusion

Early detection of suicidal tendency and circumstantial causes among the persons in the society can be done which will be preventing the suicidal deaths. By creating awareness and providing antidote, kit in rural hospital, deaths and mortality of poisoning can be prevented.

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

Conflict of interest: None to declare

Source of funding: None to declare

References

1. World Health Organisation. Poisoning Prevention and Management. http://www.who.int/mental_health/prevention/suicide/in (accessed 18 August 2016).
2. Saxena V, Atal DK, Das S. Retrospective analysis of pattern of poisoning in Uttarakhand. *J Indian Acad Forensic Med.* 2014; 36(3): 230-3
3. WHO report, www.who.int/mental_health/prevention/suicide/in. (vol 6, Issue 9, 972-978)
4. Sharma DC, Bhullar DS. Profile of poisoning cases reported by State Chemical Laboratory, Punjab. *J Punjab Acad Forensic Med Toxicol.* 2005; 5(5):20-2
5. Rao CHS, Venkateswarlu V, Surender T, Eddleston M, Buckley NA. Pesticide poisoning in South India opportunities for prevention and improved medical management. *Trop Med Int Health.* 2005;10(6):581- 8.
6. Purnanand NS, Huddar MG. Pesticide poisoning among agriculturists of Dharwad district: a study. *Recent Research Sci Tech.* 2010;2(4):109-11.
7. Sharma BR. Toxicological emergencies and their management at different health care levels in Northern India an overview. *J Pharmacia Toxicol.* 2006;1(1):69-81.
8. Ramesha KN, Rao KBH, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. *Indian J Crit Care Med.* 2009;13(3):152-5.
9. Jaiprakash H, Sarala N, Venkatarathnamma PN, Kumar TN. Analysis of different types of poisoning in a tertiary care hospital in rural south India. *Food Chem Toxicol.* 2011;49(1):248-50.
10. Vinay BS, Gurudatta S, Pawar, Inamadaa PI. Profile of poisoning cases in district and medical college hospitals of north Karnataka. *Indian J Forensic Med Toxicol.* 2008;2(2):7-12.
11. Bajaj R, Wasir H S. Epidemic of aluminium phosphide poisoning in northern India. *Lancet.* 1988;11:820.
12. Singh VP, Sharma BR, Harish D, Vij K. A ten year study of poisoning cases in a tertiary care hospital. *Indian J Forensic Med Toxicol.* 2004;2(1).
13. Bajaj R, Wasir H S. Epidemic of aluminium phosphide poisoning in northern India. *Lancet.* 1988;11:820.
14. Singh VP, Sharma BR, Harish D, Vij K. A ten year study of poisoning cases in a tertiary care hospital. *Indian J Forensic Med Toxicol.* 2004;2(1).

ORIGINAL ARTICLE

Atypical Gunshot Wounds: A Series of Cases

Dhiraj D Buchade,¹ Arun Kumar Siddamsetty,² Raj Kumar,¹ Kishore Singh Thakur,³ Sreenivas Myst¹

¹ Department of Forensic Medicine, Maulana Azad Medical College, New Delhi, India

² Department of Forensic Medicine & Toxicology, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh, India

³ District Hospital, Dantewada, Chhattisgarh, India

Abstract

Appearance of firearm injury depends on the distance of muzzle from skin and the distance determines the deposition of gunshot residues in relation to entry wound of firearm. In some cases of firearm wounds, atypical features were found which were very difficult for interpretation as to whether it was a gunshot injury and if gunshot injury then whether it were an entry or an exit wounds. Interpretation of these firearm wounds helps in identification of relative position and distance of assailant from victim. This case series highlights unusual presentation of gunshot injury which should be kept in mind when dealing with firearm injury cases.

Keywords

Gunshot wound; Entry wound; Atypical gunshot wound; Pseudo-blackening

Introduction

A firearm is a device, which ejects out a projectile through its muzzle because of expansive force of gases generated by combustion of explosive gunpowder particles. Typical gunshot injury consists of entry, tract and exit wounds. Wide variations in morphological features have been noted in gunshot wounds both at entry and exit points. Abrasion collar, blackening, burning, grease collar, contusion collar or tattooing etc were typical features of an entry wound of firearms. While atypical entrance wound shows large and/or irregular size or shape, pseudo-blackening of surrounding skin or features mimicking an exit wound. Pseudo-blackening shows features like blackening, which was unrelated to causes other than smoke; such as subcutaneous hemorrhage, drying of edges of gunshot wound (giving it blackish appearance) and fingerprinting dusting powder. In this article we discuss series of three cases with atypical gunshot injuries. This article emphasizes the importance of being aware of atypical presentation of gunshot injury, while dealing with firearm death.

CASE 1:

A 38-year-old male was brought from Haryana jail to be produced in Rohini Courts, Delhi. While he was being taken back to prisoner van, he was shot from left side following which he was taken to Hospital where he was declared as brought dead. Body was sent to mortuary for postmortem examination.

Corresponding Author

Dr Arun Kumar Siddamsetty (Assistant Professor)

Email: dr_arunsid@aiimsmangalagiri.edu.in, dr_arunsid@yahoo.com

Mobile: +91-9990905809

Article History

Received: 6th of May, 2020; Revision received on: 13th August, 2020

Accepted: 18th August, 2020

Postmortem findings

Black color full sleeve shirt worn by the deceased displayed four tears located on the outer and inner aspects of the left sleeve, left side back part just behind the arm hole and on the right-side chest region associated with blood staining. Tears in the clothing corresponded with the firearm ammunition wounds present on the body of deceased.

Atypical injury

On external examination firearm entry wound was present over back of left arm. The ammunition pierced the skin, subcutaneous tissue, muscle layers of arm and exited the body producing exit wound over postero-medial aspect of left arm. The ammunition after exiting the arm re-entered the body through left lateral aspect of chest producing re-entry wound, surrounded by bluish contusion of size 5.5cm X 4.5cm and then re-exited the body causing exit wound, situated on right side of chest. (Figure 1). Extravasation of blood was present throughout the tract.



Figure 1: A) Entry, Exit and Re-entry wound of the projectile B) Exit wound of the projectile and re-entry wound of the projectile showing contusions C) Closeup of the re-entry wound showing contusion D) Final exit wound

CASE 2

A 25-year-old male was shot thrice while taking meals with his friends (once at head and twice over abdomen). He was hospitalized and died while on treatment.

Postmortem findings

Swelling and blackening was present on right eye. The upper and lower eyelids of right eye were stitched together. On removal of stitches right eyeball popped out. Conjunctival hemorrhages were present in the right eye.

Atypical injuries

Surgically stitched firearm ammunition wound was present over right side fronto-temporal region of head. On exploration, it was found to communicate with the track of firearm ammunition. Track was through scalp layers, entire thickness of the right frontal bone, dura matter (surgical repaired) and brain through & through of right frontal lobe. The track then involved the dura causing a defect of size 1.5 cm in diameter and then traversed through the base of skull involving superior surface of orbital cavity making a punched-out hole measuring 1.6 cm in diameter with rough margins. The ammunition has then traversed the orbital cavity lacerating right eyeball causing hemorrhagic contusion and exited through palpebral fissure of right eye. Extravasation of blood was present throughout the track and in the surrounding tissues along with bone chips. Blood clots were present in situ in the right eyeball. (Figures 2A and 2B).



Figure 2: A) Operated entry wound of firearm on skull. B) Exit wound of firearm through palpebral fissure of right eye. C) Closer view of bullet graze injury showing surrounding contusion. D) Bullet graze injury showing surrounding contusion

Firearm wound in the form of graze injury (making a gutter), subcutaneous deep was horizontally present over lateral aspect of right-side abdomen with dark brown scabbed abrasion collar of 0.2 cm diameter present over anterior aspect. The wound was surrounded by bluish contusion of size 8 cm × 6 cm. The width of

wound was 0.4 cm anteriorly, decreasing as extends backwards and was 0.2 cm posteriorly. Depth of the wound at the anterior aspect was 0.2 cm and becomes superficial as extends backwards and was 0.1 cm posteriorly (Figures 2C and 2D).



Figure 2: A) Bullet graze injury surrounding tattooing of firearm. B) Close up of the bullet graze injury. C) Superficial perforating wound on chest. D) Track of bullet in relation to 3B and 3C

CASE 3

Police encounter case in which three rounds were fired on deceased following which he was taken to hospital and expired on the same day during the course of treatment.

Post mortem examination

Atypical injuries

Tangential firearm ammunition wound in the form of gutter was present obliquely over front of left forearm with abrasion collar on its lower inner end. Tattooing was present on postero-medial aspect of forearm. Track of the wound extended upwards and outwards lacerating skin and subcutaneous tissue with extravasation of blood. (Figures 3A and 3B)

Firearm ammunition entry wound oval in shape was present obliquely on left side of chest with abrasion collar on its lower outer end. Track of the wound lacerated skin and subcutaneous tissue; and was directed upwards & medially in subcutaneous plane making firearm ammunition exit wound oval in shape, present obliquely placed on left side of chest with abrasion of upper inner end. (Figures 3C and 3D).

Discussion

In these 3 cases, Atypical gunshot wounds were found which were re-entry wound, concealed exit wound, grazed wound, tangential wound and superficial perforating wound.

Re-entry wound

In case series Case No – 1, Figure 1A the gunshot wound shows Entry – Exit – Re-entry wounds. Re-entry wounds occur when a bullet has passed through one part of the body and then re-entered another part which is in near proximity. The portion of the body initially perforated serves as an intermediary target. Re-entry wounds were most commonly seen when a bullet perforates an arm and enters the trunk.¹ The re-entry wound shows features of large irregular entrance hole, edges ragged and wide, irregular abrasion ring.¹ Re-entry wound was difficult to interpret, when a bullet has exited from the body, ricocheted from external object/surface and re-enters the body.² Re-entry wounds of axilla often occurs by missiles which passed through the arm and shows atypical appearance like oval to slit-shaped wound with a very thin or even absent abrasion ring and re-entry wound often resemble an exit wound.¹

Shored Exit Wound

It is an exception an exception to the rule that only entrance wounds have an associated margin of abrasion. Shored exit wounds shows abrasion collar which occurred when exit site was against a hard surface/object like belt, necktie or brassier.³ The exiting bullet pushes the skin into the supporting surface, which scrapes and abrades it.⁴ Re-entry wound over the chest by a bullet that perforated the arm shows shoring of an entrance wound which occurs when the arm was against the chest at the time the bullet perforated the arm and entered the chest. Hence the arm “shores up” the entrance in the chest and the chest “shores up” the exit in the arm. The shored entrance wounds were occurred due to skin around the re-entry site slapping back against the arm that was against the chest.¹ In Case No – 1, Figure 1A, re-entry wound over chest shows contusion surrounding the entry wound.

Concealed exit wound

Concealment of firearm wound occurs due to treatment given by physician or decomposition or as a result of an unusual entrance wound.¹ Exit wounds were rarely concealed. 'Kennedy phenomenon' is surgical alteration or suturing of the gunshot wound causing difficulty in interpretation of firearm wound.⁵ In case no – 2, three shots were fired one at head and two were at abdomen. One firearm entry wound was present over right-side frontal region of skull and exited through right eye. To the best of our knowledge, this is a rare case report in the literature describing a case of a bullet exited through palpebral fissure of eye after a gunshot injury over the head concealing the exit wound (Case No – 2, Figure 2B). Surgical interventions over the firearm wounds often causes difficulty in interpretation of the entrance and exit wounds.

Grazed wound

Graze gunshot wounds occur when a bullet scrapes or grazes over the skin without penetrating more deeply.⁴ If the bullet

strikes at a very shallow angle then an abrasion approximately the width of the bullet was produced.³ The common appearance of a graze wound consists of an elliptical furrow in the skin of variable depth.⁶ The initial point of contact or the proximal corner of a graze wound may have a partially round or crescentic margin of abrasion resembling a portion of a typical entrance wound margin of abrasion which helps in distinguishing a graze wound from a laceration and in determining direction.⁶ The second firearm wound in Case No – 2, Figure 2C and 2D show graze injury making a gutter wound over lateral aspect of right side of abdomen surrounded by area of contusion. Such grazed wound shows track of bullet and helps to determine the direction of firing of bullet.

Tangential wound

Tangential firearm wound occur because of the bullet striking at a shallow angle which was similar to graze wound; but in tangential wound subcutaneous tissue was involved as the skin was torn and lacerated by bullet.¹ However A tangential gunshot wound (TGSW) to the head is defined as a gunshot wound to the head in which the bullet or bullet fragments do not penetrate the inner table of the skull.⁷ This was depicted by the first injury in the Case No – 3, Figures 3A and 3B where skin of forearm is lacerated by bullet.

Superficial perforating wound

In Case No – 3, Figures 3C and 3D, the firearm wound shows tangential firearm wound making a gutter over inner aspect of left forearm followed by superficial perforating firearm wounds over left side of chest. Superficial perforating wounds were shallow through & through wounds with the entrance and exit were closer together so they may be difficult to interpret.¹ The entrance will usually have a complete but eccentric abrasion ring, whereas the exit will have abrasion of only a portion of the circumference. The overlying skin may show traumatic stretch stria of skin, if the track of the bullet was immediately under the skin.¹

Conclusion

Firearm injury resulting in death of victim highlights the importance of position and posture of the victim. The detailed examination of crime scene, meticulous autopsy, collaboration and information exchange among investigators and Forensic specialists will help in correct interpretation of these interesting cases. Every firearm case was unique, in the sense that behavior of the missile and injury produced by it.

The direction of firing may become a point of great medico-legal interest in determining the relative position and moment of the victim. A body at moment it sustains a gunshot wound may be in some twisted or bent position, then body will be straightened out during the autopsy, where the tracking and description of wound path takes place.⁸ So during autopsy of

firearm cases careful examination of gunshot wounds plays a major role.

Concealment of a wound may occur not only through the treatment of a physician but also as a consequence of an unusual entrance and exit sites. In rare cases the bullet enters either through the nostril or open mouth and it will not show entry wound on external examination of the body. Advanced decomposition may also conceal a gunshot wound and, in such cases, radiological examination of the body will prevent missing such cases of concealed firearm wounds.

Atypical presentations may result in misinterpretation of findings at autopsy by an inexperienced or inattentive examiner. The similarity of appearances between the entry wound and exit wound may have serious implications for parties implicated in such shootings. Similarly, failure to appreciate that a single discharge of a firearm may result in multiple (two, or even three) entrance wounds - some of which may have atypical features also result in miscarriages of justice. Thorough initial examination and assessment of these wound tell us not only about the individual wound but also aid in reconstruction of scene.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. DiMaio V, DiMaio D. Gunshot Wounds: Practical Aspects of Firearms, ballistics, and Forensic Techniques. 3rd ed. Boca Raton: CRC Press; 2015. Chapter 4: Introduction to the classification of Gunshot wounds; p. 57–108.
2. Saukko P, Knight B. Knight's Forensic Pathology. 4th ed. Boca Raton: CRC Press; 2016. Chapter 8: Gunshot and explosion deaths; p. 241–76.
3. Spitz WU, Spitz DJ. Spitz and Fisher's Medicolegal Investigation of Death. 4th ed. Springfield: Charles C Thomas Pub Ltd; 2006. Chapter 12: Injury by gunfire; p. 607–746.
4. Denton JS, Segovia A, Filkins JA. Practical Pathology of Gunshot Wounds. Arch Pathol Lab Med. 2006 Sep;130(9):1283-9.
5. Aggrawal A. Textbook of Forensic Medicine and Toxicology. New Delhi: Avichal Publishing House; 2014. Chapter 13: Firearm Injury; p. 255-98.
6. Michael M. Heninger. An Unusual Feature of Graze Gunshot Wounds. Acad Forensic Pathol. 2016 Jun; 6(2): 291–300.
7. Anglin D, Hutson HR, Luftman J, Qualls S, Moradzadeh D. Intracranial hemorrhage associated with tangential gunshot wounds to the head. Acad Emerg Med. 1998 Jul;5(7):672-8.
8. Haag MG, Haag LC. Shooting Incident Reconstruction. 2nd ed. Amsterdam: Elsevier; 2011. Chapter 11: Determining bullet track ("Trajectory") in gunshot victims; p. 191–206.

ORIGINAL ARTICLE

Analysis of tattoos in an autopsy population: A two-year study

Rajesh Bardale,¹ Nitin Ninal²

¹ Department of Forensic Medicine, Government Medical College Miraj, Maharashtra, India

² Department of Forensic Medicine, Government Medical College Aurangabad, Maharashtra, India

Abstract

Traditionally tattoos have forensic significance for the establishment of identity. Additionally, they can provide information regarding the religion, culture, lifestyle, region, history, war, occupation, sex interest, gang members and drug abuse. The aim of the present study is to examine and analyse the distribution of tattoos in autopsy cases from a forensic point of view. This is a post-mortem examination based retrospective study conducted at Department of Forensic Medicine, Government Medical College and Hospital, Miraj. We examined all available files of inquest papers, autopsy reports and toxicological analysis reports into the death of people through 1 January 2017 to 31 December 2018. A standard proforma was designed to collect the information to ensure consistency for the whole sample. Out of the total 1390 autopsies that were conducted, 269 deceased were identified to have at least one tattoo. The mean age of study population was 42.64 (SD 16.13) years. In 269 cases, 360 tattoos were noted. All tattoos were green in colour. The present study was able to identify the trends of tattoos based on autopsy cases from India.

Keywords

Tattoo; Identification; Autopsy; Death; Forensics

Introduction

Traditionally tattoos have forensic significance for the establishment of identity. Additionally, they can provide information regarding the religion, culture, lifestyle, region, history, war, occupation, sex interest, gang members and drug abuse.¹ Tattooing has been practised since ancient time. In India it has been in practice since many centuries. In fact, certain tribes have a unique pattern of tattooing. Such practices are believed to ward off the evil eye or to ensure fertility or may be seen as a usual way of expression of faith in different populations.² However, during the last three decades, tattooing has undergone dramatic redefinitions and has shifted from a form of stigma to an acceptable form of expression.³ With increasing social acceptability, artistic expression and symbols of fashion the trend of tattooing is increasing. The aim of present study is to examine and analyse the distribution of tattoos in autopsy cases from forensic point of view.

Material and Methods

This is a post-mortem examination based retrospective study conducted at Department of Forensic Medicine, Government Medical College and Hospital, Miraj. We examined all available files of inquest papers, autopsy reports and toxicological analysis

reports into the death of people through 1 January 2017 to 31 December 2018. A standard proforma was designed to collect the information to ensure consistency for the whole sample. Out of a total 1390 autopsies that were conducted; 269 deceased were identified to have at least one tattoo. Tattoo designs were divided into three main categories – Figures (God, Animal and Plants), Symbols and traditional designs (like traditional symbols, traditional designs, heart shape, sword etc.) and, Text (like name, initials/alphabets, phrases, religious messages etc.). The parts of the body where tattoos were present were also recorded. Skeletonised bodies, dismembered bodies and fetuses were excluded from the study.

Results

Distribution of cases with tattoos among autopsy cases is shown in Table 1. A total 269 deceased were identified to have at least one tattoo. The sex-wise and age-wise distribution of cases is presented in Table 2 and Figure 1. The mean age of study population was found to be 42.64 (SD 16.13) years. Maximum numbers of cases (n = 70, 26.02%) were from age-group of 21-30 years followed by age-group of 41-50 years (n = 62, 23.04%). 203 (75.46%) cases were married, 24 (8.92%) were unmarried, 18 (6.69%) were widow or widower and in 24 (8.92%) cases marital status was unknown. Amongst the studied population, 204 (75.83%) deceased were from rural area, 41(15.24%) were from urban area and locality for 24 (8.92%) cases was unknown. Maximum number of cases (n = 114, 42.37%) were the result of accidents, followed by, natural deaths (n = 79, 29.36%), suicide (n = 70, 26.02%) and homicide (n = 6, 2.97%). For 3 cases (4.28%) of suicide where tattoo marks were present, old hesitation cuts were noted over forearm. In 269 cases, 360 tattoos were noted. All tattoos were

Corresponding Author

Dr. Nitin Ninal (Assistant Professor)

Email: drnitinninal@gmail.com / drnitinninal@rediffmail.com

Mobile: +91-8888824099

Article History

Received: 16th May, 2020; Revision received on: 22nd August, 2020

Accepted: 29th August, 2020

green in colour. Table 3 shows distribution of tattoos on different body parts.

Maximum number of tattoos (66.17%) was seen on right forearm, flexor aspect followed by forehead (35.68%). Table 4

Table 1: Distribution of cases

	Male (%)	Female (%)	Total
Number of autopsies	1061 (76.33%)	329 (23.66%)	1390
Subjects with tattoo	152 (56.50%)	117 (43.49%)	269
Known subjects with tattoo	130 (53.06%)	115 (46.93%)	245
Unknown subjects with tattoo	22 (91.66%)	02 (8.33%)	24

Table 2: Age-wise and sex-wise descriptive statistics

Sex	Range (years)	Mean \pm SD (years)
Male	19 – 85	40.26 \pm 13.78
Female	14 – 90	45.90 \pm 18.35
Total	14 – 90	42.64 \pm 16.13

Table 3: Distribution of tattoos on body

Body area	N	%
Forehead	96	26.66
Chin	02	0.55
Right Arm	21	5.83
Right Forearm	178	49.44
Right wrist	03	0.83
Right hand	12	3.33
Right middle finger	05	1.38
Left Arm	03	0.83
Left Forearm	23	6.38
Left hand	06	1.66
Right Chest	04	1.11
Left Chest	07	1.94
Total number of tattoos	360	

Table 4: Numbers of tattoos present on body

Number of tattoos	N	%
One	198	55
Two	55	15.27
Three	12	3.33
Four	04	1.11
Total number of tattoos	360	

Table 5: Contents of tattoos

Content		N	%
Figure of God	Hanuman	31	8.61
	Om	18	5
	Vitthal Rakhumai	04	1.11
	Devi Maa	01	0.27
	Sun	01	0.27
	Krishna	01	0.27
	Ganpati	03	0.83
	Shri Ram	01	0.27
	Trishul with Damru	07	1.94
	Gautam Buddha	01	0.27
Figure of animal	Cobra	08	2.22
	Scorpion	02	0.55
	Tiger	01	0.27
Figure of plant	Rose flower	02	0.55
	Tree	01	0.27
	Lotus flower	02	0.55
	Leaf	02	0.55
Symbols and traditional designs	Traditional design	98	27.22
	Heart shape	14	3.88
	Sword	02	0.55
Text	Name	55	15.27
	Initials/ alphabets	24	6.66
	Religious words	06	1.66
	Phrases	03	0.83
	Text depicting a relationship	11	3.05
	Text depicting valour	04	1.11
Language for text	Marathi	72	69.90
	English	27	26.21
	Kannada	04	3.88
Indistinct tattoos		57	15.83
Total number of tattoos		360	

shows distribution of number of tattoos present on the body parts. In 198 cases (73.60%) single tattoo was noted while in 4 cases (1.48%) maximum number of tattoos i.e., four tattoos were noted. Table 5 shows the content of tattoos. Traditional designs (Figure 2) were seen in maximum number of cases (n =

98, 27.22%) followed by tattoos in text form ($n = 55$, 15.27%) (Figure 3). Amongst the figure design, tattoo of Lord Hanuman (Figure 4) was noted in 31 cases (8.61%) followed by design of "OM" in 18 cases (5%). In animal design, cobra tattoos were recorded in 8 cases (2.22%). Analysing text written as tattoo; name of person was noted in 55 cases (15.27%). Marathi ($n = 72$, 69.90%) was the most common language used for tattoo text followed by English ($n = 27$, 26.21%). In 57 cases (15.83%) tattoos were indistinct.

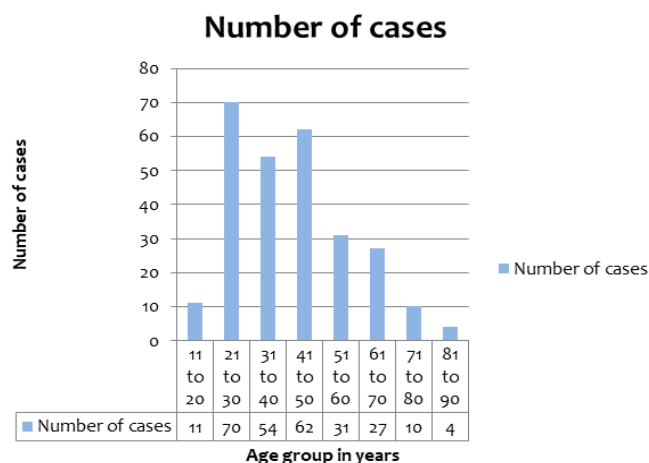


Figure 1: Age-wise distribution of cases

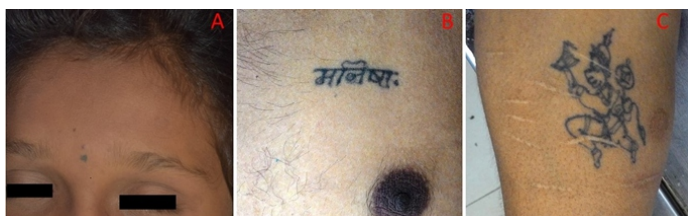


Figure 2: A-Traditional tattoo design on forehead; B – Name inscribed as a tattoo on chest; C – Figure of Lord Hanuman on forearm

Discussion

Tattoos are seen across all age groups. Tattooing has been in practice for thousands of years.² Some tattoos symbolize tradition, some culture and some tattoos represent fashion or artistic presentation. In certain tribal groups the act of tattooing is believed to act as a healer. West Africa healers will draw a thin line on the forehead to treat epilepsy or draw tattoos on the hands and legs for the treatment of peripheral neuropathy.²

Literature search reveals that tattoos are associated with high-risk behaviour like substance abuse, violent nature, sexual abuse, anti-social behaviour or relations with some gangs.^{3,4} According to Bhargava et al., twenty-four subjects were taking steroids for purpose of bodybuilding and athletics and most of them had at least one lion tattoo of different style. Twenty-two subjects were cannabis and other narcotic drug abusers. Tattoo

marks of an eagle were mostly observed in subjects and in some cases, there were multiple tattoos.¹ Katsos et al. analysed a Greek population with tattoos and noted that the lion tattoo was common in heroin and cannabis users.⁵

Carson noted that persons with tattoos are significantly more likely to possess an illicit drug when compared to persons without tattoos and are more likely to die as a result of consumption of drugs or alcohol.⁴ Dhossche et al. stated that tattoos may be possible markers for lethality from suicide and accidental death.⁶ Blackburn et al. noted that specific types of tattoos like memorial tattoos but not all tattoos may be risk factors for homicide.⁷ However, study conducted by Stephenson et al. states that there is no significant association between the number of tattoos and premature mortality or between the cause and manner of death and the presence or absence of tattoos.⁸

In the present study, maximum mortality was noted for the age group of 21 to 30 years (26.02%) followed by age group of 41 to 50 years (23.04%). Maximum numbers of deaths (42.37%) were the result of accidents. Suicide contributed about 26.02% of deaths. While analysing total autopsies and autopsies with tattoo, only 19.35% of autopsy population had at least one tattoo at the time of death. Therefore, a rough inference can be drawn that there is no association between cause and manner of death and presence or absence of tattoo. The findings are consistent with Stephenson et al.⁸ In the present study chemical analysis reports did not revealed presence of any narcotic substances. In three cases (4.28%) of suicide with tattoo marks; old hesitation cuts were noted over forearm. Albeit the percentage is small but cannot be ignored. Further larger studies are required to support or refute the association of tattoo as a possible marker for suicide.

Traditional tattoos were found in maximum number of cases (27.22%) followed by text tattoos (15.27%). Similarly, in 8.61% of cases, figures of favourite deity and 1.66% religious words were inscribed. Analysing population-wise data, older population either preferred traditional design or figures of God or religious words whereas in young population their name or name of loved ones or initials or alphabets or figure of heart or rose flower was inscribed. The difference is self-explanatory. However, in small number of populations, figure of sword (0.55%), cobra (2.22%), scorpion (0.55%), tiger (0.27%) or valour words (1.11%) were also noted. Though the casual relationship between death and presence of such tattoos cannot be established statistically but the trend indicates necessity of further research in this direction.

Nowadays medical information or instructions are inscribed in tattoos like "No Resuscitation", "No Life Support" or "consent for Organ Donation"⁹ or "Diabetes"¹⁰ or "S.O.S. Scoline apnoea"¹¹ or "DNR" or "No PEG".¹² Presence of such tattoos may assist during clinical management or help to take clinical

decisions.¹² These tattoos are nowadays called as “Medical Tattoos”. No such tattoos were noted in the present study. The advantage of the present study is that it has identified the trends of tattoos in autopsy cases of India. However, the limitations of present study are the retrospective nature of study, the small study population and the origin of samples from a single region.

Conclusion

It can be said that tattoos can give significant forensic information like identity of deceased, cultural background, religious background or association of tattoos with risk taking behaviour. In this study certain trends or traits are identified and certain facts cannot be correlated because of small sample size or cultural or ethnic differences between India and other part of world. But this study certainly points out the necessity of larger multi-centric studies especially considering the Indian cultural values, social behaviour and moral values.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Bhargava S, Singh R. A short screening of tattoo marks amongst drug addicts. *Ann Forensic Res Anal* 2016; 3: 1024-26
2. Byard RW. Tattoos: Forensic considerations. *Forensic Sci Med Pathol*. 2013; 9:534-42
3. Bhargava S, Singh R, Kumari K. Significance of tattoo marks in forensic psychology: A review. *Int J Curr Adv Res* 2016; 5: 857-59
4. Carson HJ. How tattoos correlate with early mortality. *Am J Clin Pathol* 2014;42: 99-103
5. Katsos K, Moraitis K, Papadodima S, Spiliopoulou C. Tattoos and abuse of psychoactive substances in an autopsy population sample from Greece. *Rom Leg Med* 2018;26:21-28
6. Dhassche D, Snell KS, Lord S. A case-control study of tattoos in young suicide victims as a possible marker of risk. *J Affect Disord*. 2000;59:165-68
7. Blackburn J, Cleveland J, Griffin R, Davis G, Lienert J, McGwin G. Tattoo frequency and types among homicides and other deaths, 2007-2008: A matched case-control study. *Am J Forensic Med Pathol* 2012;33:202-205
8. Stephenson L, Byard RW. Causes, manner and age of death in a series of decedents with tattoos presenting for medicolegal autopsy. *J Forensic Legal Med* 2019;64:49-51
9. Kamarainen A, Lankimaki S. A tattooed consent for organ donation. *Resuscitation* 2009;80:284-85
10. Aldasouqi S. A medical alert tattoo. *Am Fam Physician*. 2011;83:796
11. Barday P, King H. Tattoo medi-alert. *Anaesthesia*. 2002;57:625
12. Byard RW. Tattoos containing useful messages. *Am J Clin Pathol*. 2015;143:908

ORIGINAL ARTICLE

Pattern of Neonatal Deaths autopsied at Victoria Hospital, Bangalore - A Three year study

Vidusha Vijay, S. Venkata Raghava

Department of Forensic Medicine and Toxicology, Bangalore Medical College and Research Institute, Bangalore.

Abstract

A study of trends in neonatal deaths is of vital importance which can be better understood through autopsy studies. Autopsy studies are of greater help when the clinical manifestations are obscure. The study was based on autopsies conducted on neonatal deaths for a duration of three years i.e. from January 2017 to December 2019 at Department of Forensic Medicine and Toxicology, Victoria Hospital, Bangalore Medical College and Research Institute, Bangalore. A meticulous post mortem examination coupled with use of relevant autopsy ancillary investigations helped in arriving at the cause of death. In the present study it was observed that 50% of cases were known and other 50% were unknown. Male and female babies constituted equal numbers. Majority (26%) were viable. 28.12% babies received treatment. Among preterm babies, hyaline membrane disease was the most common cause of death followed by pneumonia. Among full term babies, respiratory failure was the common cause of death followed by head injury

Keywords

Neonatal Deaths; Autopsy; Viable; Hyaline Membrane Disease; Respiratory Failure

Introduction

A study of trends in neonatal deaths is of vital importance which can be better understood through autopsy studies. Globally in the year 2016, 2.6 million deaths, or roughly 46% of all under-five deaths, were neonatal deaths. This translates to 7000 newborn deaths every day.¹ As of 2015, 20% (12,01,000) of global under-five deaths occurred in India, meaning that one in every five global child deaths occurred in India.² Over 50% of under-five deaths and 70% of infant deaths occur during the first 4 weeks of life.³

Neonatal mortality rate is defined as the number of infant deaths of less than 29 days per thousand live births during the year. The neonatal mortality rate (NMR) declined from 52 per 1000 live births in 1990 to 32 per 1000 live births in 2013 to 30 per 1000 in 2016.^{4,5} Perinatal deaths comprise stillbirths (pregnancy loss that occurs after seven months of gestation) and early neonatal deaths (deaths of live births within the first seven days of life). The perinatal mortality rate (PMR) is calculated as the number of perinatal deaths per 1,000 pregnancies of seven or more months duration. The perinatal mortality rate is highest in Uttar Pradesh (56 deaths per 1,000 pregnancies) and lowest in Kerala (8 deaths per 1,000 pregnancies).⁵ Three major causes have been identified that contributes to 85% of all neonatal deaths, namely, prematurity, infections and birth asphyxia.⁶ Viability or the capacity to lead separate life outside the body of

the mother depends on many biological and physical factors and also on the extrinsic factors. The acceptable age of viable fetus has been fixed at 210 days i.e., 7 months.⁷

Autopsy studies many times help to arrive not only at the precise cause of death, but also confirming the provisional diagnosis in cases where clinical manifestations are obscure. Autopsy has contributed to medical care since the advent of modern medicine. Whether by establishing the cause of death, assisting in determining the manner of death, comparing the ante mortem and postmortem findings, producing vital statistics, or monitoring public health, the value of autopsy has been well documented.^{8,9} The loss of a viable fetus has multi-dimensional repercussions on society. It is a great psychological trauma and a tremendous strain on the health of the mother. To the family, it is psychological trauma coupled with financial strain.¹⁰ Meticulous post-mortem examination with the aid of proper antenatal and perinatal history, relevant clinical investigations and histopathological examination can help to arrive at the cause of death.

In addition to regular clinical autopsies, medico-legal autopsies also significantly give insight into the cause of death and manner of death. Other associated medico-legal issues like estimation of age of the neonate, birth status viz., live born / still born / dead born and collection of evidence in the form of DNA are also dealt with by medico-legal autopsies. This study assumes a greater importance as all the cases underwent medico-legal autopsy where cause of death was well established, in comparison to most other studies where only clinical autopsies were conducted.

Materials and Methods

The present retrospective autopsy study was conducted at the Department of Forensic Medicine, Victoria hospital attached to

Corresponding Author

Dr S Venkata Raghava (Professor)

Email: svrbmcric@gmail.com

Mobile: +91 9845231132

Article History

Received: 30th April, 2020; Accepted: 2nd October 2020

Bangalore Medical College and Research Institute, Bangalore. The study was done on neonatal autopsies conducted from January 1st 2017 to December 31st 2019 for 3 years. After going through the facts given by the police and the relatives, complete medico legal autopsy was done along with study of the hospital case sheets and histopathological examination in relevant cases to arrive at the conclusions. This was accompanied by visit to scene of incident coupled with analysis of photographs produced by the police in circumstances where visit was not possible. The babies with advanced decomposition changes were excluded. Data obtained was analyzed using Statistical Package for the Social Sciences (SPSS 20).

Results

In this study period, 3173 autopsies were conducted in the year 2017, 3208 autopsies were conducted in the year 2018, and 3108 autopsies were conducted in the year 2019. Out of these, 32 cases were neonatal deaths. In the present study, 16 cases viz., 50% were known and 16 cases viz., 50% were of unknown identity. In majority of the cases, i.e. 15 cases (46.87%), the survival period of the babies was unknown (Table 1). At autopsy, it was discovered that majority of neonates i.e., 26 cases (81.25%) were viable, of which 15 cases (46.87%) were full term babies, 8 cases (25%) were of 7-8 months gestational age and 3 cases (9.37%) were of 8-9 months gestational age. 6 cases (18.75%) were < 7 months gestational age (non – viable). Among 16 known cases, 10 cases (31.25%) were live born and 6 cases (18.75%) were still born. Male and female babies constituted equal numbers i.e., 16 cases (50%) each. Hindu community contributed to maximum number of known cases with 14 cases (43.75%), followed by 2 cases (6.25%) each in the Muslim community.

Table 1: Survival period

Age	N (%)
< 24 hours	1 (3.12%)
1 -7 days	13 (40.62%)
8 -14 days	1 (3.12%)
15 – 21 days	0
22 – 30 days	2 (6.25%)
Unknown	15 (46.87%)

In this study, 9 cases (28.12%) underwent treatment whereas 23 cases (71.87%) did not receive any treatment. Among the treated cases, identity was unknown in 4 cases (12.50%). Majority of the unknown babies i.e., 6 cases (18.75%) were

found on footpath, followed by 3 cases (9.37%) in dustbin (Table 2). 10 cases (31.25%) each were booked under section 318 IPC and 174 CrPC whereas 6 cases (18.75%) were booked under 317 IPC (Table 3).

Table 2: Disposal sites of unknown cases

Location	N (%)
Footpath	6 (18.75%)
Dustbin	3 (9.37%)
Temple premises	2 (6.25%)
Drain	1 (3.12%)
Public toilet	1 (3.12%)
School ground	1 (3.12%)
Empty plot	1 (3.12%)
In bushes	1 (3.12%)

Table 3: Sections of law imposed

Section	N (%)
318 IPC	10 (31.25%)
174 CrPC	10 (31.25%)
317 IPC	6 (18.75%)
376 IPC	3 (9.37%)
498 (a) IPC	2 (6.25%)
174 (c) CrPC	1 (3.12%)

Among preterm babies, 4 cases (12.50%) were found to have hyaline membrane disease, 3 cases (9.37%) had pneumonia, followed by 2 cases (6.25%) with septicemia and 2 cases (6.25%) with congenital anomalies viz., spina bifida. Among full term babies, respiratory failure was the most common cause of death (6 cases – 18.75%). Of these, pneumonia was found in 3 cases (9.37%), followed by aspiration of gastric contents in 2 cases (6.25%), aspiration pneumonia in 1 case (3.12%) and amniotic fluid aspiration in 1 case (3.12%). Next common causes of death were head injury in 3 cases (9.37%), Organophosphorus compound poisoning in 2 cases (6.25%) and ligature strangulation in 1 case (3.12%). In 2 cases (6.25%), cause of death could not be established as no significant findings were detected in autopsy and histopathological examination (negative autopsy).

Among known cases, 10 cases (31.25%) were live born and 4 cases (12.50%) were still born cases. Of the 10 live born cases, there were 2 cases (6.25%) with congenital anomalies viz., spina bifida, 2 cases (6.25%) with organophosphorus compound

poisoning, followed by 1 case (3.12%) each of pneumonia, septicemia, aspiration of gastric contents and aspiration pneumonia. Of the 4 still born cases, there were 2 cases (6.25%) with hyaline membrane disease, 2 cases (6.25%) of negative autopsy and 1 case (3.12%) with amniotic fluid aspiration. Among unknown cases, 7 cases (21.87%) were live born and 5 cases (15.62%) were still born. Of the 7 live born cases, head injury was observed in 3 cases (9.37%), pneumonia was seen in 2 cases (6.25%) and 1 case (3.12%) each of hyaline membrane disease and aspiration of gastric contents. Of the 5 still born cases, pneumonia was observed in 3 cases (9.37%) and 1 case (3.12%) each of septicemia and hyaline membrane disease.

Discussion

Neonatal death has been defined by the World Health Organization (WHO) as "Deaths among live births during the first 28 completed days of life" which can be further subdivided into early neonatal deaths - deaths between 0 and 7 completed days of birth and late neonatal deaths - deaths after 7 days to 28 completed days of birth.¹¹

Sections 317 and 318 of the Indian Penal Code are relevant to our study. Section 317 IPC states that the exposure and abandonment of child under twelve years, by parent or person having care of it - Whoever being the father or mother of a child under the age of twelve years, or having the care of such child, shall expose or leave such child in any place with the intention of wholly abandoning such child, shall be punished with imprisonment of either description for a term which may extend to seven years, or with fine, or with both. Section 318 IPC states that the concealment of birth by secret disposal of dead body - Whoever, by secretly burying or otherwise disposing of the dead body of a child whether such child die before or after or during its birth, intentionally conceals or endeavours to conceal the birth of such child, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both.

In our study 50% were of unknown identity and 50% were known cases. As all the studied cases were medico-legal cases, all abandoned neonates were brought for autopsy. This is contrast with the study conducted by Venkata Raghava S and Shashikantha Naik CR¹² where 76.9% of cases were of unknown identity. The causes for abandoning of infants could be attributed to unwanted pregnancy, restrictions regarding access to abortion, lack of sexual education, single parenthood, ignorance about family planning methods, financial difficulties and postnatal depression. Among the known cases autopsied, spontaneous abortion due to maternal assault, ligature strangulation and suicide attempt by the mother were some of the causes for death among known cases, apart from medical causes.

It was observed in this study that majority of neonates i.e., 26 cases (81.25%) were viable. This is in contrast with the study conducted by Prabhala et. al.¹³ where majority of cases were non-viable fetuses. In the present study, it was observed that majority of cases i.e., 15 cases were full term (> 37 weeks gestational age), followed by 11 preterm cases and 6 non-viable fetuses. This is in contrast with the study conducted by Naidu et al.¹⁴ where the mean gestational age of fetal death was 31 weeks. In our study, there were 10 cases (31.25%) of live birth, which is in contrast with the study conducted by Pradhan et. al.¹⁵ where maximum numbers of cases i.e., 88.57% were still born. In this study, majority of the unknown babies i.e., 6 cases (18.75%) were found on footpath. This is in accordance with the study conducted by Venkata Raghava S and Shashikantha Naik CR¹² where 38.5% of babies were found near roadside.

In the present study, cause of death could not be established in 2 cases (6.25%), as no significant findings were detected in autopsy and histopathological examination (negative autopsy). A study conducted by Nayak et.al.¹⁶ noted that the cause for fetal loss could not be determined in 17% of cases. It was observed in this study that the most common cause of death in preterm babies was hyaline membrane disease in 4 cases (12.50%) and the most common cause of death in full term babies was respiratory failure i.e., pneumonia in 3 cases (9.37%), aspiration of gastric contents in 2 cases (6.25%), aspiration pneumonia in 1 case (3.12%) and amniotic fluid aspiration in 1 case (3.12%). The study conducted by Kumar et al.¹⁷ observed that hyaline membrane disease was the most common cause of death in preterm infants (36%), which is in accordance with our study; whereas congenital malformations were the leading cause of death in full term infants (50%), which is in contrast with our study.

Conclusion

The analysis of autopsied neonatal deaths was an effort to elucidate the various aspects of neonatal deaths and establish a profile of neonatal deaths in the city. Ascertaining the cause of death in neonatal deaths is a hardship and an arduous task for the Forensic doctor. A conglomeration of all the available facts, thorough autopsy and ancillary investigations can chaperone the cause of death. Owing to the insubstantial studies in this arena, this study assumes a greater importance. Assessing the various rationales of neonatal deaths by virtue of autopsy can help steer the preventive strategies.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

Conflict of interest: None to declare

Source of funding: None to declare

References

- World Health Organization. Global Health Observatory (GHO) data [Internet]. Geneva: World Health Organization [cited 2020 Mar 25]. Available from : https://www.who.int/gho/child_health/mortality/neonatal_text/en/
- United Nations Children's Fund. Committing to Child Survival: A Promise Renewed, Progress Report 2015. New York: UNICEF; September 2015. 96p.
- Zodpey S and Paul VK. State of India's Newborns 2014. New Delhi: Public Health Foundation of India, All India Institute of Medical Sciences, Save the Children; 2014. 206p.
- M J Sankar, S B Neogi, J Sharma, M Chauhan, R Srivastava, P K Prabhakar, A Khera, R Kumar, S Zodpey , V K Paul. State of newborn health in India. *J Perinatol*. 2016; 36(3): S3–S8.
- Ministry of Health and Family Welfare, Government of India. National Family Health Survey (NFHS -4). Mumbai: International Institute for Population Sciences; 2015-16. 637p.
- Himani Pandya. Overview of newborn health in India - A literature review. *Glob. J. Res. Anal*. 2013; 2(7): 171-3.
- Nandy A. Principles of Forensic Medicine. 2nd ed. Kolkata: New Central Book Agency; 2005. 409p.
- Goldman L, Sayson R, Robbins S, Cohn LH, Bettman M, Weisberg M. Value of autopsy in three medical eras. *N Engl J Med*. 1983; 308: 1000-10.
- Lundberg GD. Medical students, truth, and autopsies. *JAMA*. 1983; 50: 1199-1200.
- Grace Francis D'costa, Yoganand Patil. Causes of mortality in still birth – An autopsy study. *Bombay Hosp J*. April 2007; 49 (2): 329-48.
- Jayani Pathirana, Flor M. Muñoz, Victoria Abbing-Karahagopian, Niranjana Bhat, Tara Harris, Ambujam Kapoor et al. Neonatal death: Case definition & guidelines for data collection, analysis, and presentation of immunization safety data. *Vaccine*. 2016; 34(49): 6027–37.
- Venkata Raghava S, Shashikantha Naik CR. Retrospective autopsy study of deaths in new born babies. *J South India Medicolegal Assoc*. 2014; 6(1): 27-30.
- Shailaja Prabhala, Padmaja Korti, Jayashankar Erukkambattu, Ramamurti Tanikella. Fetal Autopsy Study over a Two Year Period. *J Evol Med Dent Sci*. 2015; 4(14): 2243-49.
- Naidu S, Moodley J, Adhikari M, Ramsaroop R, Morar N, Dunmoye OO. Clinico-pathological study of causes of perinatal mortality in a developing country. *J Obstet Gynaecol*. 2001; 21(5):443-7.
- Rajashree Pradhan, Sajeeb Mondal, Shouvanik Adhya, Gargi Raychaudhuri. Perinatal Autopsy: A Study from India. *J Indian Acad Forensic Med*. Jan-March 2013; 35(1): 10-13.
- Shalini S Nayak, Anju Shukla, Leslie Lewis, Rajagopal Kadavigere, Mary Mathew, Prashanth K Adiga et.al. *Prenat Diagn*. July 2015; 35(7): 685-91.
- Praveen Kumar, Denise B Angst, Jerome Taxy, Henry H Mangurten. Neonatal Autopsies - A 10-Year Experience. *Arch Pediatr Adolesc Med*. 2000; 154(1): 38-42. tertiary care hospital. *Indian J Forensic Med Toxicol*. 2004;2(1).

REVIEW

COVID –19: The Novel Corona Virus infectious disease that halted the world

Prakash Mohite,¹ Deepali Mohite,² Anil Anjankar¹

1 Department of Forensic Medicine, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India

2 Department of Oral Pathology and Microbiology, Swargiya Dadasaheb Kalmegh Smruti Dental College, Hingna, Nagpur, Maharashtra, India

Abstract

In late 2019, Wuhan in Hubei province of China suffered an outbreak in the form of acute respiratory disease-causing severe mortality due to the novel corona virus which was later declared and identified as COVID-19 by World Health Organisation (WHO) in January 2020. By the end of March 2020 more than 160 countries and regions around the world were affected. The causative agent of COVID-19, is closely related to SARS-CoV-like bat Corona viruses, bat-SL-CoVZC45 and bat-SL-CoVZXC2. The whole genome sequencing and systematic analysis showed that this novel Corona virus is a distinct clad from β -Corona virus associated with human Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), which was officially named “SARS-CoV-2” by WHO. In January the transmission of the virus breached international borders and first case outside China was seen in Philippines and Thailand and then in USA. After that WHO declared it a global public-health emergency in January 30, 2020 and later declared it a pandemic in March 2020. All nations then adopted stringent measures to contain the spread of the disease. In India the first cases of COVID 19 positive were reported in the state of Kerala in January 2020 amongst Indians studying in China with a history of travel from China. The number of cases then increased and as on April 11, 2020 there were 6761 positive COVID-19 cases. The major concern to both human and animal health is viral infection of the respiratory tract which is the most commonly occurring health problem and is one of the leading causes of morbidity and mortality. Commonly seen in children, elderly and immunocompromised patients. It is now important and mandatory to take the stringent preventive and precautionary measure which is the need of the hour like strictly following social distancing, screening of disease, using the protective masks at the public places, Regular hand wash, use of personal protective equipment (PPE) by the practitioner's, paramedics, health care workers, sanitary people etc. to prevent the spread of this dangerous Novel viral infectious disease COVID-19. To curb the disease, following altered social norms along with good sanitization and opting for active treatment using chloroquine or other drugs and prophylaxis using Hydroxychloroquine (HCQ). Though its use is yet to provide satisfactory results and to continue on research with the help of researchers to develop vaccines to restrain and combat the dread disease.

Keywords

COVID-19; SARS; SARI; Infectious disease

Introduction

In early December 2019, an acute respiratory infectious disease resembling pneumonia and causing increased mortality was reported in Wuhan in Hubei Province in China. The causative agent now officially named as “Corona virus disease 19 (COVID-19)” by WHO in **January, 2020** has been responsible for the symptoms. The COVID 19 disease has spread rapidly from Wuhan to other regions and on March 17, 2020, a total of 80,881 COVID-19-positive cases were reported in China. At present, confirmed cases of COVID-19 have been reported in >160 countries and regions around the world.¹

Early phylogenetic studies revealed that Severe Acute

Respiratory Syndrome (SARS) Coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19, is closely related to SARS-CoV-like bat Corona viruses, bat-SL-CoVZC45 and bat-SL-CoVZXC2.² Whole genome sequencing and systematic analysis have demonstrated that this novel Corona virus is a distinct clad from β -Corona virus associated with human Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), which was officially named “SARS-CoV-2” by WHO, which produces symptoms similar to SARS and MERS (Middle East Respiratory Syndrome).¹ Although the origin of SARS-CoV-2 is still being investigated, current evidence suggests that its transmission to humans began through animals sold in Huainan Seafood Wholesale Market in Wuhan, China. Further case reports have also confirmed the interpersonal and asymptomatic transmission of SARS-CoV.^{1,2}

Case reports by Huang et al. of 41 positive cases suggested that most of them had history of exposure to Seafood Wholesale Market. The patient's clinical symptoms include fever, unproductive cough, dyspnoea, myalgia, fatigue, normal or decreased white blood cell count and imaging evidence of

Corresponding Author

Dr Prakash Mohite (Professor)

E-mail: drprakashmohite@rediffmail.com

Mobile: 9850397120, 9511252830

Article History

Received: 1st June, 2020; Accepted: 18th September, 2020

pneumonia whereas productive cough, headache, haemoptysis, and diarrhoea were fewer common symptoms.² Wang et al. studied 138 hospitalized COVID-19-confirmed cases, presumed to be hospital-related transmission of SARS-CoV-2. Of these 41% of patients had hospital-related transmission, 26% of patients had received intensive care unit (ICU) care and the mortality rate in these cases was found to be 4.3%.¹ A follow up and history of these cases indicated contact with the identified cases directly or an indirect spread through a public gathering place, suggesting indirect method of spread. Detailed probing revealed the potential route of transmission to be through droplet transmission.³ Virus transmission in this outbreak by droplet transmission may be assisted by a strong gust of airflow causing the large respiratory droplets ($>5\ \mu\text{m}$) to remain suspended in the air and travel distances generally $<1\ \text{m}$ and infect individuals in close vicinity. Hence droplet infection forms the main mode of transmission of this virus. In a short span of time, China recorded a sudden increase in the number of cases of COVID-19 with a death amongst cases of about more than 800 persons where first COVID-19 death was reported on January 11, 2020.

The transmission of the virus breached international borders and first case outside of China was registered in Philippines and Thailand on January 12, 2020 and then in USA on January 20, 2020. Since then, there have been more than 83,500 cases reported in China and in the past three months there have been more than 1.9 million cases worldwide. With the rapid spread of the infection throughout the world, WHO declared it a global public-health emergency in January 30, 2020 and declared it as a pandemic disease in March 2020 and instructed all nations to adopt stringent measures to contain the spread of the disease. As a result, all international travel was stopped and individuals who had a history of travel abroad were quarantined for a period of two weeks in all countries. Amongst the countries severely affected by the COVID-19, Italy, for reasons not yet clear, seemed to be the worst affected with 1,47,626 confirmed cases and death in 18,849 cases as of April 11, 2020, followed by USA (18,777 deaths out of 4,27,460 cases). This Italian crisis provoked by COVID-19 is the most serious event in Italian history after the Second World War, a national human health and economic tragedy. COVID 19 mortality rate in Italy has been 12.72%, highest amongst all countries.⁴ The reason for this high mortality rate in Italy has been attributed to greater number of individuals above the age group of 80-years who also had other co-morbidity factors.

The other reasons behind mortality of COVID-19 and its rapid spread might be: Delay in social containment which is the most effective measure for the spread of disease; Improper preparation to combat the situation as it was the first European nation to be affected by COVID-19; Lack of awareness and delay in identifying symptoms of the disease which were

very similar to the normal seasonal influenza; The tests were carried out mainly on symptomatic subjects for COVID-19. Suspects and carriers were ignored in initial phase; Tests were not carried out initially in healthcare professionals or in patient's sick in home quarantine which cause rapid spread of the disease. Deficient protective measures such as masks, PPE etc were not sufficient for health personnel as a result of which Doctors and Nurses have to pay a very high price; Inadequate ventilators for all patients who needed them, raising important ethical issues. The importance of social containment was overruled in favour of economic activities.

As the virus and its impact spread, healthcare systems and governments around the world started responding with large-scale protective measures and reallocation of resources.⁵ Protective measures adopted by the nations include lockdown (social and economic) and social distancing, encouraging participation of masses by following self-isolation protocols. Increased awareness amongst masses on the methods of containing disease spread. In addition to this, researchers are being encouraged and have been provided facilities to arrive at a vaccine or other means of active treatment. The available information is that like other Coronaviruses, SARS-CoV-2 virus enters the cell membrane via endocytosis into the endosomal pathway. In the context of an independent study by Gautret et al., suggesting that Chloroquine is an effective and safe treatment for the SARS-CoV-2 virus associated with the COVID-19 pandemic, and the regulatory systems in various countries should consider fast-tracking the approval of its use with strict guideline to minimize the consequence of COVID-19 pandemic. Although the molecular mechanism underlying the action of Chloroquine remains to be defined, it is envisioned that in addition to directly affecting the endosomal viral entry and release via inhibiting endosomal function, Chloroquine may potentially affect the viral assembly at the ER-Golgi intermediate compartment (ERGIC) and/or viral release from the trans-Golgi network (TGN) indirectly.⁶

Coronaviruses, SARS-CoV-2 enters the cell membrane via endocytosis into the endosomal pathway. Cell biologists and virologists have identified several inhibitors to the endocytic pathway and they are traditionally used to perturb the function of the endocytic pathway which indirectly also affects the secretory pathway. These inhibitors include Ammonium Chloride (NH_4Cl), Chloroquine, Bafilomycin A1, Concanamycin A1, and Monensin. Therefore, scientists have hypothesised that inhibiting the function of the endocytic and secretory pathways will directly or indirectly suppress viral infection, replication, assembly and/or release if the side-effects are managed well.⁶ Among these inhibitors, only Chloroquine (which inhibits acidification of endosomes) is a Food and Drug Administration (FDA)-approved drug used for treating malaria infection and therefore it has attracted the most attention during

the past few months. Chloroquine has been shown by in vitro experiments to inhibit the replication of SARS-CoV and SARS-CoV-2. Therefore, studies have been conducted to test the effect of Chloroquine on infected patients to see its therapeutic benefit on COVID-19. In this timely clinical study report, the clinical effects of Chloroquine were tested and efficacy was assessed by improvement in lung function by computerized tomography (CT) scanning, and T-cell counts.⁶ In the study Chloroquine was found to be more effective than other antiviral agents (Lopinavir/Ritonavir). Though administration of Chloroquine is associated with side effects such as vomiting, abdominal pain, nausea, diarrhoea, rash or itchy, cough and shortness of breath, these could be managed well by strengthening patient monitoring and strictly following the standard oral dosage of the drug.⁶

In view of the potential use of hydroxychloroquine (HCQ) in active treatment of COVID 19 to prevent its spread and cure the disease, India has been one of the leading countries in manufacturing the HCQ and now is also supplying the drug to other countries including developed countries like America in this hour of International crisis, setting a good example of humanity.

In India the first case of COVID 19 positive was reported in the state of Kerala on January 30, 2020 and second case on February 2, 2020. Both of them were Indian students in China and had a history of travel from China. The number of cases since then have seen a constant increase and as on April 11, 2020 there were 6761 positive COVID-19 cases. Death occurred in 206 cases bringing the mortality rate to 3.04%. Of these 63% of cases were above 60-years of age, 30% cases were between 40-60 yrs and 7% individuals were less than 40 yrs of age. In Maharashtra the mortality rate is higher at 6.84% where 160 cases reported death out of 2334 COVID positive cases. More number of cases is seen in Mumbai, which may be because of higher density of population which is more than the global death rate 5.98%. The control in the number of positive cases in India is mainly due to the stringent precautionary measures taken and implemented by the Government of India like total lock down from March 24, 2020, maintaining social distancing, public awareness - use of alcohol based sanitisers, covering of mouth and nose with protective covering, frequent washing of hands with soap etc, have immensely helped to curb the rapid spike as observed in other countries.

Discussion

As pneumonia of unknown cause was first reported on 31 December 2019 and on 30 January 2020 the outbreak was declared a Public Health Emergency of International concern. On 11 February 2020 the World Health Organization (WHO) announced a name for this novel virus COVID-19 and on 7

March the WHO marked the milestone of 100,000 confirmed cases worldwide. There is consensus that eventually Covid-19 will become the fifth circulating human coronavirus.⁷ This virus is suspected to have a zoonotic origin and is estimated to have resulted in 17,04,565 cases in 176 countries with 1,03,257 deaths and 3,78,838 individuals recovered from the disease as of April 11, 2020. COVID-19 was first reported in the United States (U.S.) on January 20, 2020 and accounted for a total number of 5,01,615 cases and 18,777 deaths as of April 11, 2020 which is amongst highest number of confirmed cases in the affected nations. This is followed by Italy which has the highest number of recorded deaths due to COVID 19 (18,849 out of 1,47,577 confirmed cases). The morbidity and mortality associated with COVID-19 exceeds previous coronavirus infection outbreaks including SARS (8,098 infections, 774 deaths) and MERS (2,458 infections, 848 deaths) and hence greater efforts are required to combat the spread and to provide appropriate treatment of affected individuals.

Apart from this, with the development of artificial intelligence techniques in clinical settings, an attempt to speed up constructing the framework of online consultation and internet hospitals, as well as carrying out telemedicine is the need of the hour.⁸ Effective treatments for COVID-19 outbreak are urgently needed. While anti-viral approaches and vaccines are being considered, immediate countermeasures are unavailable. Other therapeutic agents that are being considered are also directed towards improving pulmonary function are current mainstays of treatment.⁹

To slow the transmission of COVID-19 in community and protecting the most vulnerable people to cope with this novel virus, Cochrane has put together a special collection using all the systematic reviews assessing infection control in order to provide the best evidence for those coping with this situation. Handwashing and the use of alcohol-based hand rub (ABHR) are the simplest and most effective ways to prevent the spread of respiratory infections. Barrier measures such as the use of masks, gloves and gowns by health workers are also effective ways of reducing transmission. It would be prudent and would help adherence to standard procedures to remind healthcare workers of standard healthcare precautions to reduce transmission. Increasing the visibility and availability of handwashing stations and ABHR is beneficial and reduces transmission.¹⁰ With the outbreak of COVID-19, many extreme measures have been taken to contain the spread of the disease, which include converting general medical wards to quarantine wards for patients who contracted the disease, locking down the communities, suspending routine outpatient clinics, stopping all elective procedures, and providing treatment only for very highly selective cases. Less commonly associated symptoms of GI disturbances like anorexia, nausea, vomiting, abdominal pain, and/or diarrhoea reported in affected individuals may

indicate the possibility for faecal-oral transmission although it is unclear if the viral concentration in the stool is sufficient for transmission.⁷

Conclusion

Viral infection of the respiratory tract is the most commonly occurring health problem and yet a major concern to both human and animal health. Respiratory infection is one of the leading causes of morbidity and mortality. It is seen more in children, elderly and immunocompromised patients. To prevent the spread of this dangerous Novel viral infectious disease COVID-19 affecting the respiratory tract it is important to take the stringent preventive and precautionary measure which is the need of the hour like strictly following social distancing, Screening of disease, using the protective masks at the public places, Regular hand wash at intervals frequently, Use of PPE by the practitioner's, paramedics, health care workers, sanitary people etc. All the nations are following the instructions as per the guidelines of WHO. Social distancing is the only way to curb the disease along with good sanitization and opting for the active treatment using chloroquine or other drugs and prophylaxis using Hydroxychloroquine (HCQ) though its use is yet not approved and to continue on research with the help of researchers to develop vaccines to restrain and combat the dread disease.

Conflict of interest: None to declare

Source of funding: None to declare

References

1. Luwen Wang, Xun Li, Hui Chen, Shaonan Yan, Dong Li, Yan Li, Zuojiang Gong. Coronavirus Disease 19 Infection Does Not Result in Acute Kidney Injury: An Analysis of 116 Hospitalized Patients from Wuhan, China. *Am J American Journal of Nephrology*. 2020;1-06.
2. Chunyang Li, Fang Ji, Liang Wang, Liping Wang, JunguiHao, Mingjia Dai, et al. Asymptomatic and Human-to-Human Transmission of SARS-CoV-2 in a 2-Family Cluster, Xuzhou, China. *Emerg Infect Dis*. 2020;26(7):1626-1628.
3. Jianyun Lu, JieniGu, Kuibiao Li, Conghui Xu, Wenzhe Su, Zhisheng Lai et al. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, *Emerg Infect Dis*. 2020; 26(7):1628-1631.
4. Indolfi C, Spaccarotella C. The Outbreak of COVID-19 in Italy: Fighting the Pandemic. *JACC Case Rep*. 2020 Jul 15;2(9):1414-1418. Erratum in: *JACC Case Rep*. 2020 Aug;2(10):1656.
5. Rasmussen TE, Koelling EE. A military perspective on the vascular surgeon's response to the COVID-19 pandemic. *J Vasc Surg*. 2020;71(6):1821-1822.
6. Hong W. Combating COVID-19 with Chloroquine. *J Mol Cell Biol*. 2020;12(4):249-250.
7. Sultan S, Lim JK, Altayar O, Davitkov P, Feuerstein JD, Siddique SM, et al. Rapid Recommendations for Gastrointestinal Procedures During the COVID-19 Pandemic. *Gastroenterology*. 2020;159(2):739-758.e4.
8. Cui, L.-B., Wang, X.-H. and Wang, H.-N. Challenges of facing coronavirus disease 2019: Psychiatric services for patients with mental disorders. *Psychiatry Clin. Neurosci*. 2020, 74: 371-372.
9. Solaimanzadeh I. Acetazolamide, Nifedipine and Phosphodiesterase Inhibitors: Rationale for Their Utilization as Adjunctive Countermeasures in the Treatment of Coronavirus Disease 2019 (COVID-19); *Cureus*2020; 12(3): e7343.
10. Vanessa Jordan. Coronavirus (COVID-19): infection control and prevention measures; *Journal of Prim Health Care* 2020;12(1):96-97.

CASE REPORT

Improper disposal of human fetuses and uterus: A case of violation of biomedical waste management and handling rules in India

Ashok Kumar Rastogi¹, Bajrang K Singh,² Binay Kumar,¹ Prabhat Kumar,¹ Amrendra Kumar¹

¹ Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences, Patna, Bihar, India

² Department of Forensic Medicine and Toxicology, MGM Medical College Indore, Madhya Pradesh, India

Abstract

One sealed cardboard box containing 8 sealed plastic jars out of which 7 jars were containing human foetus of various gestational ages and one jar containing uterus with formalin preservatives and preserved foetus separately were received for examination at mortuary of forensic medicine department MGM medical college Indore (MP). As per the police history the card box was recovered Sirpur pond Indore.

Keywords

Foetus; Uterus; Gestational age; Formalin; Mortuary; Preservative; Human Anatomical Waste

Introduction

Biomedical waste is defined as “Any waste that is generated during diagnosis, treatment or immunisation of human beings or animals, or in the research activities pertaining to the production or testing of biologicals and includes categories mentioned in Schedule I of the Government of India's Biomedical Waste (Management and Handling) Rules 1998”.¹ Bio-Medical waste has been categorized into ten different categories. Human Anatomical Waste includes human tissues, organs body waste parts and comes under Category No.1. Schedule 01 (rule no.05).² Improper management in bio-medical waste causes stern environmental problems that leads to air, water and land pollution. Bio-Medical Waste (Management and Handling) Rules 1998 have been notified by the Government of India in the exercise of power to protect the environment (Protection) Act, 1986. National Guidelines on Bio-Medical Waste Management put forth by the Ministry of Health and Family welfare which have been laid down in March 2002 for safety measures, training, management and administrative functions were specified waste management procedures.³ Human anatomical waste consisting of human tissues, organs, and body parts, must be incinerated in a biomedical waste incinerator, or destroyed in a crematorium incinerator. For religious or ethical reasons, human anatomical waste consisting of organs or body parts may in some cases be buried with human remains in a cemetery. Any violation of the

provisions of the said Rules attracts action under the Environment (protection) Act 1986 as punishment with imprisonment for a term which may extend to five years or with fine which may extent to one lack rupees or with both and in case the failure or contravention continues with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention³ where source of biomedical waste are hospital origin.⁴

Case history

Foetus of various intrauterine ages and 1 uterus recovered by the police at Sirpur pond Indore (MP) and suspected as a case of multiple female feticides. A cotton bag contains 7 fetuses and one uterus in plastic jars preserved in formalin and one foetus without jars. All Jars were sealed by sticking leucoplast. All jar and open specimen were stained with soil, and formalin smell was coming out. Examination of all foetus suggests non-viable age group. Sex was identified in 4 cases only, as 2 male and 2 female and remaining 4 were unidentified. Out of eight foetus, two fetuses were found mummified with brownish discoloration. (Table 1) Similarly, uterus was found in preserved from with brownish discoloration. Examination started with marking of numbering 1-9 over the specimen (Figure 1 and 2). All foetus and uterus were preserved in formalin for further investigation (DNA examination and identification). Opinion given after post-mortem examination: 1. Nine unsealed specimens received out of these eight specimens were in plastic jar and one without jar. 2. Opinion regarding time since expulsion of the all the foetus not possible because foetus was preserved in formalin. 3. Recovered eight fetuses out of four fetuses' sex could not be determined and two fetuses identified as male and two identified as female.

Corresponding Author

Dr. Ashok Kumar Rastogi (Assistant Professor)

Email: ashokforensic@yahoo.com

Mobile: +91-9300030477

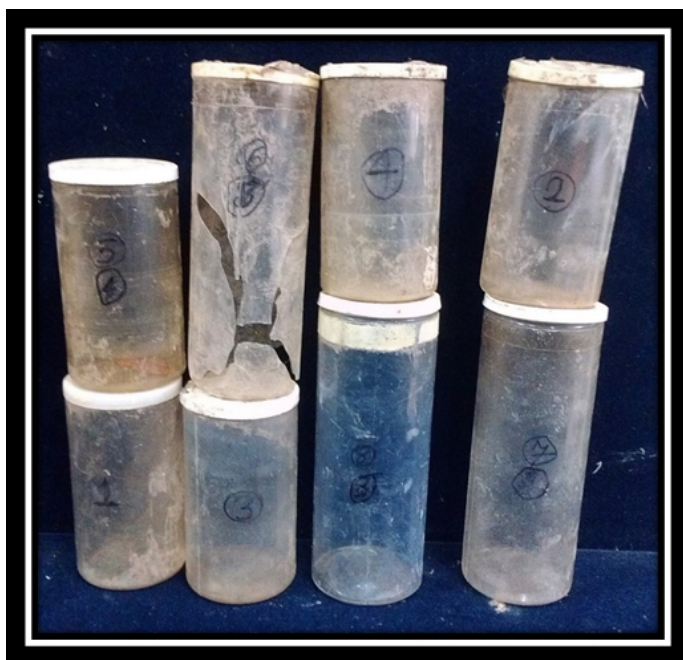
Article History

Received: 26th May, 2020; Revision received on: 21st August, 2020

Accepted: 28th August, 2020

Table 1: Measurements description of received foetus and uterus

	Length (cm)	Weight (g)	Foot length (cm)	Age (month)	Sex
Foetus No.01	8.7	07	0.7	2-3	Not identified
Foetus No.02	9.5	10	1.0	3-4	Not identified
Foetus No.03	6.5	10	0.6	2-3	Not identified
Foetus No.04	14	150	1.6	3-4	Not identified
Foetus No.05	21	250	2.5	4-5	F
Foetus No.06	19	220	2.4	4-5	M
Foetus No.07	21	245	3.0	4-5	F
Foetus No.08	28	470	4.0	5-6	M

**Figure 1:** All received specimen displayed in a tray**Figure 1:** Showing Plastic jars in which foetus and uterus were discovered

Discussion

By the examination of foetus, we can establish the age, sex and viability of foetus.⁴ Report for H R 3515 Medical waste Tracking Act introduced in 1988, was finally approved by the house and senate (enrolled) in United States of America. In this act medical wastes also includes pathological waste including tissues, organ, and body parts that are removed during surgery or autopsy blood, including serum, plasma and other blood components. Punishments of violation of this provision were endangerment to any person who knowingly violates any provision of subsection(b) who knows at that time that he thereby places another person in danger of death of serious bodily injury, shall upon conviction be subject to a fine of not more than US Dollar 250,00 of imprisonment for not more than 15 years or both. A defendant that is an organization shall upon conviction under this subsection be subject to a fine of not more than US dollar 1,000,000. The terms of this paragraph shall be interpreted in accordance with the rules provided under section 3008 (f) of this act.⁵ In India punishment described as Any violation of the provisions of the said Rules attracts action under the Environment (Protection) Act 1986 as punishment with imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees or with both and in case the failure or contravention continues with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.³ Human organ and tissue should be disposed by Incineration or plasma pyrolysis or deep burial.⁶

Conclusion

Based on findings observed during examination i.e. preservation of foetus and uterus in specimen jars, use of preservative formalin and sealing of specimen jar lids by leucoplasts, the case appears to be that of wet specimens of foetus and uterus. Hence possibility of its possession with teaching institution or any hospital cannot be ruled out. Similarly, its recovery in the outskirts of city near Sirpur pond itself suggests that it is a case of improper disposal of human anatomical waste. Investigating officer of the case was advised to perform meticulous investigation to finalize the case.

Conflict of interest: None to declare

Source of funding: None to declare

References

1. The bio medical waste (management and handling) rule, 1998 [Internet]. Delhi: Ministry of Environment and forest; 1998. Available from :

- http://www.pccdaman.info/pdf/BMW/BMW_Notification_1998.pdf
2. Mathur P, Patan S, Environment AS-CW, 2012 U. Need of biomedical waste management system in hospitals-An emerging issue-a review. Curr World Environ [Internet]. 2012 [cited 2019 Aug 1]; 7(1):117124. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.402.6967&rep=rep1&type=pdf>
 3. Ministry of environment & forests. The environment (Protection) Act [Internet]. Delhi: govt of india; 1986. Available from: <https://www.mendeley.com/viewer/?fileId=4cc1841b-c2bf-20bf-22d5-e9912e99ce91&documentId=670d6d48-f4ff-33c3-9a13-c5914093576e>
 4. Kumar Mandal S, Dutta J. Integrated Bio-Medical Waste Management Plan for Patna City [Internet]. [cited 2019 Jun 14]. Available from: http://www.itpi.org.in/pdfs/apr1_09.pdf
 5. Anil Aggarwal. APC Essentials of Forensic Medicine and Toxicology - Anil Aggarwal - Google Books [Internet]. avichal publicationcompony. 2016 [cited 2019 Aug 10]. p. 59–60. Available from: <https://books.google.co.in/books?id=iSH8CgAAQBAJ&printsec=frontcover&dq=dr+anil+aggarwal+essentials+of+forensic+medicine+and+toxicology&hl=en&sa=X&ved=0ahUKEwiL2c6T3vfjAhVMLI8KHfp1D9AQ6AEIKDAA#v=onepage&q&f=false>
 6. Medical waste tracking act of 1988 [Internet]. washington: house and senate USA; 1988. Available from: <https://archive.epa.gov/epawaste/nonhaz/industrial/medical/web/pdf/mwta.pdf>
 7. Singh A, Joshi HS, Katyal R, Singh R, Singh H. Biomedical Waste Management Rules, 2016: A Brief Review. Int J Adv Integr Med Sci. 2017;2(4):201–4.

PERSPECTIVE

Cadaver dogs: The nose knows something

Nagendra Singh Sonwani,¹ Navneet Ateriya,² Arvind Kumar,¹ Puneet Setia,³ Anil Kohli¹

¹ Department of Forensic Medicine, University College of Medical Sciences & GTB Hospital, Delhi, India

² Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences, Gorakhpur, India

³ Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences, Jodhpur, India

Introduction

"Who let the dogs out.... Woof, woof, woof, woof, woof.... Who let the dogs out" is a popular song worldwide. However, for us, this also tells the important and curious aspect of the use of dogs in forensic crime scene search. Dogs are commonly used to locate or identify explosives, narcotic substances, and other illegal materials. In the forensic setting, dogs referred to as cadaver dogs (sometimes referred to as cadaver detection dogs or human remains detection dogs, *Canis familiaris*) are trained specially to detect human body odour, and in turn, they signal their handler.¹⁻³

Cadaver dogs are trained to give an alert to the specific scent of human (as opposed to other animals) decomposition. They are very sensitive to the odour coming from the fresh dead body. They can also identify the odour of highly decomposed bodies; skeleton remains including soil contaminated body fluids. Similarly, those objects coming in contact with dead bodies can also sometimes identified by the trained dogs. A frequent problem in crime investigation is to find out the location and identification of objects or weapon of an offence related to crime.²

Areas of Forensic utility

Cadaver detection dogs can be deployed to detect the scent in various forensically important conditions. Commonly encountered one is the detection of bodies buried under the ground or to detect skeletal remains at the gravesite or other places. Sometimes human body or any other biological materials are alleged to be submerged in water, and sometimes they can be present at the dumpsite, which makes it difficult to detect the human remains without the help of cadaver dogs. Same is the case with aviation incidents where the body remains can be scattered over a larger area including land, water, and even the trees. The cadaver dogs can also be deployed in various other situations such as body hidden in sewer or compost facility, detection of biological fluids present in buildings, vehicles, clothing etc..⁴ Studies have shown that cadaveric dogs can discriminate among target human odours

and non-target odours. These dogs also possess good accuracy in discriminating the target substances even when the non-target odour was present in higher concentrations.¹

The important factor that can affect the performance of cadaver dog in scent identification is ageing of odour evidence.⁵ Dogs can locate the smallest of the amount of biological material best within 48 hours.⁶ Scent source is possibly another factor affecting the delectability of biological material. The olfactory ability of a cadaver dog can also vary due to various hormonal changes, possible disease or adaptation, uneven terrain, ambient heat, humidity, wind and time limitations.^{1,7}

Ethical and medico-legal issues

The common concern that comes up with the dogs is about protecting them while they are performing their duty in dangerous situations and not about whether dogs should be used in this way at all. However, when we consider animal rights, then the use of dogs for human purposes violates the rights of dog to remain free. There are chances that during duty operations dogs can be killed or get seriously injured, but unlike the human, they never knowingly consented to the risk. If the situation is dangerous for a human, then it will be dangerous for a dog also, and they are more likely to be injured or killed by the criminals. It is essential that cadaver dogs should be used with the highest professional and ethical standard involving honesty, discretion, and respect for dogs.⁸

There are varieties of medico-legal issues dealing with dog and handlers need to be aware of the prevalent laws at that particular time. Following are some of the issues:

- 1. License and vaccination:** Every country has specific regulatory policies which to are mainly targeted to prevent the diseases in dogs such as rabies and the fact that these dogs may cause damage to person and property. All the dog handlers must have proper license to train and use them for crime investigation effectively. Having a valid license may aid in transporting the dogs across the states, and this also assures the handling staff that the dog is not harbouring any communicable disease.⁹
- 2. Negligence and liability:** Cadaver dog handlers need to be aware of the law of tort. The dog handlers must exercise their duty with reasonable competence. The cadaver dogs' work under strict training and guidance of their handlers. Any act done by dogs, which resulted in damage to person or property, the dog handler will be liable for that. A

Corresponding Author

Dr Navneet Ateriya (Assistant Professor)

Email: dr.navneet06@gmail.com

Mobile: +91-9971629313

Article History

Received: 6th May, 2020; Revision received on: 11th August, 2020

Accepted: 15th August, 2020

handler may also be found liable where damage occurs to the area which is not a part of the search. The liability will also apply if the dog is found to be dangerous. The victims must show that the dog was too dangerous at that particular time that may include previous bite, abnormal behaviour of the dog at the time of the attack, and so on. The tort law may also impose *joint and several liabilities* on certain occasions. An organised search by the team may be held liable for the actions of one of its team members.^{9,10}

3. **Search, seizure, and admissibility in the court of law:** When searching, a dog/handler team look for evidence. . The two primary areas of concern in the court of law are the acquisition of evidence and the acceptance of that evidence by a court. Unless the search team is operating within the guidelines set down by the prevalent laws or Court, any evidence recovered during the search may not be admissible in the court of law.⁹

In India, different courts of law have given a different opinion regarding the admissibility of evidence given by dogs/handlers. In Gade Lakshmi Mangaraju alias Ramesh v. the State of A.P., the Court observed that “the life and liberty of human being should not be made to depend on an animal's sensibilities and that the possibility of a dog misjudging the smell or mistaking the track cannot be ruled out, for many a time such mistakes have happened”.¹¹ In Dinesh Borthakur v. the State of Assam, the court opined that “the law in this behalf, therefore, is settled that while the services of a sniffer dog may be taken for investigation, its faculties cannot be taken as evidence for establishing the guilt of an accused”.¹² While in another case, Fast Track (Adhoc-I) vs By Adv. Sri. S. Sachithananda Pai, the fact that the sniffer dog smelt the body of the victim and stood near the accused twice was taken into consideration positively by the court of law and held the accused person guilty of committing a crime.¹³

There is a lack of specific laws about cadaver dog in India. Substantial evidence is necessary for a search to be admissible in a court of law. It must be shown that the evidence is connected to criminal activity and also that it is in the place to be searched. The cadaver dog team must report the findings of search to the proper authority. Such coordination, along with proper documentation and handling of evidence, including the chain of custody is of paramount importance in the court of law.

Future directives

Cadaver dog studies are available regarding detection of decomposed or buried bodies. However, investigation studies dealing with the identification of the human body remains, or scent at different post-mortem interval is mostly absent. The reliability and accuracy of the cadaver dog search may be enhanced if at least two or more cadaver dog/handler teams are used independently and simultaneously at the crime scene. The teams then can compare the result of these searches. This will support the findings of the crime scene at the court of law in a better way.

Conclusion

Trained cadaver dogs are an efficient and reliable tool in detecting a human biological odour from varieties of the crime scene. They can also be used effectively to determine the directionality of an odour trail from a human. Use of trained dogs significantly reduces the workforce and time in the search process. They have been successfully used by different police across the world to solve the crime. We also feel that cadaver dogs can successfully be used as a reliable tool to detect the body of crime when used judiciously.

References

1. Riezzo I, Neri M, Rendine M, Bellifemina A, Cantatore S, Fiore C et al. Cadaver dogs: Unscientific myth or reliable biological devices?. *Forensic Sci. Int.* 2014; 244:213-221.
2. Simon N, Cassella J. A study of the use of cadaver dogs for blood scent detection in criminal investigations [Internet]. *Staffs.ac.uk*. 2008 [cited 24 Feb, 2020]. Available from: https://www.staffs.ac.uk/assets/Simon%20Newbery_tcm44-19866.pdf
3. Komar D. The Use of Cadaver Dogs in Locating Scattered, Scavenged Human Remains: Preliminary Field Test Results. *J Forensic Sci.* 1999;44(2):405-8.
4. Rebmann A, David E, Sorg M, Koenig M. *Cadaver dog handbook*. Boca Raton, Fla.: CRC Press; 2000.
5. Cadaver Detector Dog Certification Scenarios [Internet]. *Site.utah.gov*. 2015 [cited 24 Feb, 2020]. Available from: <https://site.utah.gov/dps-post/wp-content/uploads/sites/24/2015/04/CadaverDogCertStandards20130301.pdf>
6. Schoon G, De Bruin J. The ability of dogs to recognize and cross-match human odours. *Forensic Sci Int.* 1994;69(2):111-118.
7. Skalleberg A, Bouzga M. Detecting and collecting traces of semen and blood from outdoor crime scenes using crime scene dogs and presumptive tests. *Forensic Sci Int.* 2016; 264:146-152.
8. Migala A, Brown S. Use of Human Remains Detection Dogs for Wide Area Search After Wildfire: A New Experience for Texas Task Force 1 Search and Rescue Resources. *Wilderness Environ Med.* 2012;23(4):337-342.
9. Lin D. Police, Search and Rescue Dogs: The Animal Rights Debate [Internet]. *ThoughtCo*. 2019 [cited 24 Feb, 2020]. Available from: <https://www.thoughtco.com/issues-with-police-dogs-and-search-and-rescue-dogs-127902>
10. Reddy KSN, Murty OP. *The Essentials of Forensic Medicine & Toxicology*. New Delhi: Jaypee Brothers Medical Publishers; 2017.
11. Ramesh Singh @ Photti vs State Of A.P [Internet]. *Sci.gov.in*. 2004 [cited 24 Feb, 2020]. Available from: <https://www.sci.gov.in/jonew/judis/26001.pdf>
12. Dinesh Borthakur vs State of Assam [Internet]. *Sci.gov.in*. 2008 [cited 24 Feb, 2020]. Available from: <https://www.sci.gov.in/jonew/judis/30872.pdf>
13. Fast Track (Adhoc-I) vs By Adv. Sri.S.Sachithananda Pai [Internet]. *Indiankanoon.org*. 2012 [cited 24 Feb, 2020]. Available from: <https://indiankanoon.org/doc/113137947/>

PERSPECTIVE

Issues and gaps in the Section 174 CrPC and amendments required

Governing Council (2019-2022), Indian Academy of Forensic Medicine

Issues and gaps in the Section 174 CrPC and desired amendments

No	Issue/ Existing Problem	Loopholes in existing 174 Criminal Procedure Code (CrPC)	Amendments needed	Remarks
1.	In India, around 80-90 % Post-mortems are carried out by untrained doctors. Mostly carried out by plain MBBS doctors, medical officers, gynaecologist, paediatricians, surgeons, etc without having any training in Forensic Medicine. This practice has resulted into horrendous quality of postmortem examination and mockery of administration of justice.	Law nowhere prescribes that the post-mortem examination shall be carried out by trained doctors in Forensic Medicine. Law says: Medical examination of dead body by the nearest Civil Surgeon, or other qualified medical man appointed in this behalf by the State Government. (Refer Subsection 3 (v) of 174 crPC. NOTE: this is the biggest loophole in the existing law that has resulted into the mockery and horrendous quality of Post-mortem examination in the country.	Law must prescribe the minimum qualification and training in forensic medicine that a medical practitioner should have to carry out forensic post-mortem examination.	Please see Section 2 (d) of The Medical Termination Of Pregnancy Act, 1971 (Act No. 34 of 1971) and MTP regulations which clearly prescribes the qualification and training required for the medical practitioner to carry out MTP. Also see The Mental Health Care Act, 2017.
2.	Attendants/ Sweepers assist the doctors to carry out the post-mortem examinations, collections of viscera and other forensic evidence from the body, its sealing and labelling etc. They do not have any special training for such work.	The existing 174 CrPC nowhere prescribes that the trained staff in forensic procedures shall assist the doctors who carry out the post-mortem examination etc. In other acts for example The Mental Health Care (MHC) Act 2017, prescribes what is meant by other persons who assist the psychiatrist/ medical practitioner in relation to care of mentally ill persons. The MHC act not only defines “psychiatrist” but also defines all other persons (other than doctors) who are required in the care of mentally ill persons i.e., “mental health nurse”, “psychiatric social worker”, “psychologist” etc.	Law must prescribe that trained staff in forensics shall assist the doctors in carrying out post-mortem examinations.	Please refer, The Mental Health Care Act, 2017 that prescribes qualification for all health care workers.
3.	Autopsies are carried out at any place, even in open place without having any basic facilities. So many incidences have been reported where dead bodies have been eaten by rats/ dogs due to improper storage facilities.	Existing law nowhere prescribes any rules for establishments of Forensic Autopsy Centers.	174 CrPC must make mandatory for the central governments to frame the rules/ regulations for establishments of Forensic Medical Autopsy Centers across the country.	MTP act, Mental health care act, PCPNDT act- all prescribes rules for establishment of respective health care facility.

No	Issue/ Existing Problem	Loopholes in existing 174 Criminal Procedure Code (CrPC)	Amendments needed	Remarks
4.	<p>Lakhs of Unnecessary autopsies are carried out in our country.</p> <p>Autopsies are conducted even when the patient dies after taking treatment in the hospital and treating doctor is able to give cause of death as the per the Provision of Section 10 (3) of Registration of Births and Deaths Act.</p>	<p>1. Law does not make it mandatory for the police officer to take into account the cause of death certificate issued by the treating doctor in form No. 4/4 A as per the provisions of Section 10 (3) of Registration of Births and Deaths Act.</p> <p>2. Due to this legal loophole police department is sending the dead body for autopsy to know the cause of death even when the cause of death is issued by the treating doctors in cases where deceased was admitted in the hospital for considerable period of time even for more than 1 months and having adequate investigation report to know the cause of death.</p>	<p>174 CrPC shall make it mandatory for the police officer while conducting inquest to take into account the cause of death certificate issued by the treating doctor in form No. 4/4 A as per the provisions of Section 10 (3) of Registration of Births and Deaths Act before forwarding the dead body for autopsy. When cause of death is not given by the treating doctor and there is doubt in the cause of death only then police shall forward the dead body for autopsy to know the cause of death.</p>	
5.	<p>There is no uniformity in the procedures carried out by the doctors for post-mortem examinations. Even the printed formats used for the autopsy are different from state to state and some are highly inadequate and does not conform to the minimum basic international standards. Due to which important forensic findings are missed .</p>	<p>Law does not give power to central government to frame the regulations/ rules for conduction of Forensic Medical Post-mortem Examinations.</p>	<p>Law must give power to central government to prescribe the rules and format for forensic medical post-mortem examination. This will not only improve the standard but also bring uniformity all over the country.</p>	<p>The PCPNDT act and rules made therein has prescribed format for various procedures contemplated in the said law. That's why there is uniformity in country about the same.</p>
6.	<p>Autopsy on female person is not carried out in presence of female attendant.</p>	<p>Law nowhere prescribes that the autopsy on female person shall be made in presence of female attendant. However, various other sections of CrPC prescribes that if live female person is to be examined it should be made in presence of female attendant. Please see Section 53 CrPC, 54 CrPC,</p>	<p>Law must make specific provisions regarding the presence of female attendant for the said purpose.</p>	

No	Issue/ Existing Problem	Loopholes in existing 174 Criminal Procedure Code (CrPC)	Amendments needed	Remarks
7.	Relatives face tremendous problems for getting the copy of post-mortem report.	Law nowhere prescribes the procedure for handing over the copy to relatives. However, there are section in CrPC which specifically prescribe the procedure for handing over the report to arrested person about his medical examination. Please see section 54 CrPC.	Relevant amendments shall be made in 174 CrPC about the handing over of copy of post-mortem report to relatives of the deceased.	54 CrPC says: copy of the report of medical examination of arrested person shall be furnished to the arrested person by the medical practitioner.
8.	Illegible handwriting of doctors on post-mortem reports causes tremendous problems to police, prosecuting agency and judiciary. This has been highlighted by the court in various instances.	No mandatory provision for issuing computerised reports. Even Bombay High Court, Punjab and Haryana High court, Delhi Court has issued directions for the computerization of medicolegal report ¹ .	Law must make special provisions for the digital formatting of the medicolegal reports.	Please refers directions of Punjab and Haryana high court and Bombay High court.
9.	No rules for constitution of boards to carry out the post-mortem examination, no rules to carry out re-post-mortem and exhumation.	Existing law does not bind the government to make rules for the said issues.	Law must make mandatory for the central government to make rules for constitution of boards, re-post-mortem examination, exhumation etc.	

¹One of the members of this IAFM committee had filed PIL in Bombay High Court- Nagpur bench for Computerization of medicolegal reports, wherein high court has directed the Maharashtra Govt to take steps to issue printed post mortem and medicolegal reports. PIL no. 03/2013 titled Dr Indrajit Khandekar vs State of Maharashtra.

PERSPECTIVE

Need for Reforms in Criminal Justice System of India: Recommendations of the Indian Academy of Forensic Medicine

Governing Council (2019-2022), Indian Academy of Forensic Medicine

Draft of the suggested amendments in 174 CrPC (Subsection and Para-wise)

Subject: Amendments to Criminal Procedure Code, 1973 – Provisions Relating to inquest and forensic medical post-mortem examination of dead body.

Amendment of section 174- In the Code of Criminal Procedure, 1973 (2 of 1974) (hereinafter referred to as the Code of Criminal Procedure), in section 174,-

1. in title of the said section for the words, “Police to enquire and report on suicide, etc.”, the words, “Police to enquire and report on suicide, etc. and the procedure for Forensic Medical Examination of dead body” shall be substituted.
2. in sub-section (3), in clause (v) for the words “with a view to its being examined”, the words, “for forensic medical examination” shall be substituted.
3. in sub-section (3), in clause (v) for the words, “to the nearest Civil Surgeon, or other qualified medical man”, the words, “Forensic Medicine Specialist” shall be substituted.
4. in sub-section (3), in clause (iv), for the words, “there is any doubt regarding the cause of death; or”, the words, “there is any doubt regarding the cause of death; or if the cause of death is not issued by the medical practitioner as per the provisions of section 10 (3) of registration of births and deaths act; or there is any doubt regarding the cause of death in spite of cause of death issued by the treating or attending doctor; or” shall be substituted.
5. in sub-section (3), in clause (v) for the words, “subject to such rules as the State Government may prescribe”, the words “subject to such rules as the Central and State Government may prescribe” shall be substituted
6. after sub-section (4), the following subsections shall be inserted, namely:-
 - I. “(5) Place where “forensic medical examination” shall be conducted by the “Forensic Medicine Specialist”:- all forensic medical examinations shall be made in accordance with this section at a Forensic Medical Autopsy Center developed as per the rules/ regulations prescribed by the Central Government under this section/act and authorized by the State government for the purposes of this section”.
 - ii. “(6) all 'forensic medical examination' for the purposes of this section shall be carried out by 'forensic

medicine specialist' as per the regulations/ rules prescribed by the Central Government under this section/act and authorized by the State government for the purposes of this section”.

- iii. “(7) forensic technician shall assist the forensic medicine specialist in carrying out the forensic medical examination in accordance with this section”.
- iv. “(8) Whenever the person of a female is to be examined under this section, the examination shall be made by, female forensic medicine specialist or if such examination is made by male forensic medicine specialist then it should be done in presence of female forensic technician or any female attendant.
- v. “(9)
 - (1) Any medicolegal document purporting to be a report under the hand of a Forensic Medicine Specialist to whom this section applies, may be used as evidence in any inquiry, trial or other proceeding under this Code.
 - (2) The Court may, if it thinks fit, summon and examine any such expert as to the subject- matter of his report.
 - (3) Where any such Forensic Medicine Specialist is summoned by a Court and he is unable to attend personally, he may, unless the Court has expressly directed him to appear personally, depute any responsible officer working with him to attend the Court, if such officer is conversant with the facts of the case and can satisfactorily depose in Court on his behalf.
 - (4) Where any such Forensic Medicine Specialist is summoned by a Court and he has left the hospital/ institute where he had prepared the report, then court may direct the head of the department or hospital to depute another forensic medicine specialist working with him to attend the Court, if such officer is conversant with the facts of the case and can satisfactorily depose in Court on the behalf forensic medicine specialist who has prepared the report.
- vi. “(10) Power to make rules/regulations:
 - I. The Central and State Government shall, by notification in the Official Gazette, make rules/regulations to carry out the provisions of this section/act.
 - II. In particular, and without prejudice to the generality of the foregoing power, rules made under sub-section (a) may provide for all or any of the following matters,

namely:—

- a. the training in Forensic Medicine which a forensic medicine specialist shall have to carry out the forensic medical examination in accordance with this section;
- b. the training in Forensic Medicine which a forensic technician shall have to assist the forensic medicine specialist in carrying out the forensic medical examination in accordance with this section;
- c. the requirements for the facilities, infrastructure, manpower and operation of Forensic Medical Autopsy Center;
- d. the Principles, Standard Operating Procedures and guidelines for forensic medical post mortem examination and other related works that are required to be carried out in accordance with this section;
- e. the form for carrying out forensic medical examination and other works that are required to be carried out in accordance with this section;
- f. for issuing forensic medical examination and other reports to the relatives/ or next of kin/ legal heirs of the deceased etc.;
- g. the constitution of boards/panel of forensic medicine specialist for conduction of forensic medical examination and or review of post mortem / medicolegal reports if needed;
- h. the re-forensic medical examination/ re-post-mortem examination;
- i. the exhumation of dead body for the purposes of this section or any other section of this code;
- j. for forwarding the body by police officer for forensic medical examination in accordance with this section;
- k. the form and manner in which the forensic medical autopsy center and other authorities shall maintain all the reports, register, formats etc related to the work in accordance with this section in digital format;
- l. involvement of the Forensic Medicine Specialist in the Crime Investigating Team right from approaching the scene of incident (Inquest onwards) till disposal of case.
- m. Disposal of unknown/ unclaimed dead body and or skeletal remains.
- n. Timings of carrying out inquest and post mortem examination.
- o. the special allowances payable to, and the other terms and conditions of service (including the qualifications, experience and manner of appointment) of, the forensic medicine specialist, forensic nurse and other staff appointed in forensic medical autopsy center;

III. All the rules/regulations in accordance with this section shall be made by the central and state government within one year from the date of publication of these amendments in official gazette.

vii. Protection of action taken in good faith: - No suit, prosecution or other legal proceeding shall lie against the appropriate Government or against the forensic medicine specialist or forensic technician or any other person, as the case may be, for anything which is in good faith done or intended to be done in pursuance of this section/Act or any rule or regulation made thereunder in the discharge of official duties.

viii. Laying of rules and regulations: (Note under this clause- Procedure for the laying of rules rule made by the Central Government shall be prescribed so that the said rules get the legal binding all over the country).

ix. Power to remove difficulties: If any difficulty arises in giving effect to the provisions of this section, the Central & State Government may, by order, published in the Official Gazette, make such provisions, not inconsistent with the provisions of this Act, as may appear to be necessary or expedient for removing the difficulty.

7. in section 174 of the CrPC, following explanation shall be inserted at appropriate place namely:

a. “Explanation 1: for this section "Forensic Medicine Specialist" means a registered medical practitioner possessing a post-graduate degree or diploma in Forensic Medicine awarded by an university recognised by the University Grants Commission established under the University Grants Commission Act, 1956, or awarded or recognised by the National Board of Examinations and included in the First Schedule to the Indian Medical Council Act, 1956, or recognised by the Medical Council of India, constituted under the Indian Medical Council Act, 1956, and includes, in relation to any State, any registered medical practitioner who has training in Forensic Medicine for the minimum period of six months as per the rules prescribed by the central government under this Act and has been declared by the Government of that State to be a “Forensic Medicine Specialist” for the purposes of this section”;

b. “Explanation 2: for this section "Registered Medical Practitioner" means a medical practitioner who possesses any recognized medical qualification as defined in Cl.(h) of Sec. 2 of the Indian Medical

Council Act, 1956 (102 of 1956), whose name has been entered in a State Medical Register”;

- c. **“Explanation 3:** for this section “Forensic Technician” means a person with a diploma or degree in forensic science or general nursing and having training in forensic medicine as per the rules prescribed by the central government under this section/act or with a diploma or degree in forensic science;

- d. **“Explanation 4:** if the cause of death is issued by the medical practitioner as per the provisions of section 10 (3) of registration of births and deaths act, 1969 and no doubt is raised about the said cause of death and for no other reasons police officer considers forensic medical examination expedient so to do then there is no need to send the dead body for forensic medical examination to know the cause of death”.

Acknowledging the reviewers of 2020

Abhishek Das

Assistant Professor, Medical College And Hospital, Kolkata

AJ Patowary

Professor and Head, NEIGRIHMS, Shillong

Akhilesh Pathak

Professor and Head, All India Institute of Medical Sciences, Bathinda

Anand Mugadlimath

Associate Professor, S. Nijalingapa Medical College, Bagalkot

Anand P Rayamane

Assistant Professor, Mysore Medical College and Research Institute, Mysuru

Ashish Saraf

Assistant Professor, All India Institute of Medical Sciences, Gorakhpur

Dayananda R

Associate Professor, Mysore Medical College and Research Institute, Mysuru

Deepali Pathak

Associate Professor, SMS Medical College, Jaipur

Francis Monteiro

Professor and Head, AJ Institute of Medical Sciences, Mangaluru

Hitesh Chawla

Associate Professor, S.H.K.M. Government Medical College, Nalhar, Nuh, Haryana

Kewal Krishan

Head/Chairperson, Dept of Anthropology, Panjab University, Chandigarh

M Arun

Professor and Head, JSS Medical College, Mysuru

Mandar Ramachandra Sane

Assistant Professor, All India Institute of Medical Sciences, Nagpur

Manoj Kumar Mohanty

Professor and Head, All India Institute of Medical Sciences, Bhubaneswar

Mohammed Ziyauddin Gyasuddin Saiyed

Associate Professor, GCS Medical College, Hospital & Research Centre, Ahmedabad

Nagesh KR

Professor and Head, Father Muller Medical College, Mangaluru

Nayneet Ateriya

Assistant Professor, All India Institute of Medical Sciences, Gorakhpur

Prateek Rastogi

Professor and Head, Kasturba Medical College, Mangaluru

Putul Mahanta

Associate Professor, Tezpur Medical College, Tezpur

Raghendra Babu YP

Professor and Head, Koppal Institute of Medical Sciences, Koppal

Raghendra Singh Shekhawat

Associate Professor, All India Institute of Medical Sciences, Jodhpur

Raktim Tamuli

Assistant Professor, Assam Medical College, Dibrugarh

Sanjay Gupta

Professor and Head, Pramukhswami Medical College, Karamsad, Anand

Shaloo Malik

Additional Director, Regional Forensic Science Laboratory, Jodhpur

Shankar M Bakkannavar

Associate Professor, Kasturba Medical College, Manipal

Siddhartha Das

Additional Professor, JIPMER, Puducherry

Tabin Milo

Professor, All India Institute of Medical Sciences, New Delhi

Utsav N Parekh

Associate Professor, Pramukhswami Medical College, Karamsad, Anand

Vikas P Meshram

Associate Professor, All India Institute of Medical Sciences, Jodhpur

Vinod Chaudhari

Associate Professor, JIPMER, Puducherry

Vipul Ambade

Professor, Government Medical College, Nagpur

Tanuj Kanchan (Editor, JIAFM)

Additional Professor, All India Institute of Medical Sciences, Jodhpur

Manish Nigam (Joint Editor, JIAFM)

Professor and Head, Government Medical College, Vidisha

The Editorial Team

Journal of Indian Academy of Forensic Medicine (JIAFM)



Editor

Dr. Tanuj Kanchan

Vice Dean (Examinations)
Additional Professor Department of Forensic Medicine & Toxicology
All India Institute of Medical Sciences, Jodhpur, Rajasthan
Mobile: +91-9448252394
Email: editor.jiafm@gmail.com; tanujkanchan@yahoo.co.in



Joint Editor

Dr. Manish Nigam

Professor and Head, Department of Forensic Medicine & Toxicology
Government Medical College, Vidisha, Madhya Pradesh
Mobile: +91-9826213412
Email: jointeditorjiafm2019@gmail.com; jurimanish@gmail.com



Member

Dr. Raghvendra Singh Shekhawat

Associate Professor, Department of Forensic Medicine & Toxicology
All India Institute of Medical Sciences, Jodhpur, Rajasthan
Mobile: +91-9116433938
Email: drraghavendrasinghshekhawat@gmail.com



Member

Dr. Vikas P Meshram

Associate Professor, Department of Forensic Medicine & Toxicology
All India Institute of Medical Sciences, Jodhpur, Rajasthan
Mobile: +91-7300345821
Email: drvpm26@gmail.com

WJFJIA

