SLJFMSL

Sri Lanka Journal of Forensic Medicine, Science & Law

Official Publication of the Department of Forensic Medicine
Faculty of Medicine, University of Peradeniya
Sri Lanka

CONTENTS

e-ISSN 2465 – 6089
Vol. 10 No.2 – December 2019
Biannually

Sri Lanka Journal of Forensic Medicine Science & Law

A peer reviewed journal
Published by Faculty of Medicine, University of Peradeniya, Sri Lanka

This journal is indexed in DOAJ, IMSEAR, NLM & Google Scholar

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7827

EDITORIAL

FORENSIC PRACTICE IN SRI LANKA: PRESENT AND FUTURE

Vadysinghe A.N.

Department of Forensic Medicine, Faculty of Medicine, University of Peradeniya, Sri Lanka

E-mail: amal_vadysinghe@yahoo.com https://orcid.org/0000-0002-1994-7830

Sri Lanka is a small island located in the Indian Ocean. It is divided into nine provinces and twenty five districts for administrative purposes including medico-legal services. Local medical faculties produce medical professionals for the needs of the country with a fraction coming from recognized foreign medical faculties.

Successful completion of the forensic medicine component of the undergraduate programme or successful completion of a separate examination which includes a forensic medicine component for foreign qualified medical graduates is required to practice medicine in Sri Lanka. This is regulated by the University Grants Commission and the Sri Lanka Medical Council. This mechanism ensures competent medico-legal management from the initial stages of healthcare provision.

There is a medico-legal unit or division in all government hospitals and departments of forensic medicine in all medical faculties of Sri Lankan universities. Most medicolegal units are manned by board certified specialists in forensic medicine or in the case of smaller hospitals Medical Officers with special training in forensic medicine further strengthening the medicolegal services within the country.

Postgraduate specialization or a doctorate in forensic medicine (MD) is awarded by the Postgraduate Institute of Medicine, University of Colombo to maintain the highest standards. Mandatory training in recognized forensic units locally and abroad, with evaluations conducted by eminent forensic specialists in other countries ensure training on par with internationally accepted training centres.

Till recently board certified specialists managed all cases in the fields of clinical forensic medicine, forensic pathology, anthropology, toxicology, paediatric pathology radiology and etc. However, the recently revised postgraduate curriculum incorporated subspecialty training in above mentioned areas after completion of the MD.

Once a candidate selects a subspecialty he is expected to complete a research project in that particular area while obtaining further training in a recognized oversees unit in the field for a minimum period of six months.

It is expected that once those who are so trained assume duties as forensic specialists with special interest in a specific subspecialty, that they will provide expertise in the field of subspecialisation in addition to the routine medico-legal work. These forensic specialist are placed in main forensic units to cover the work of the entire country to uplift the forensic services in Sri Lanka. It is expected that when adequate numbers of specialists with special interests are produced, further subspecialties of forensic medicine would be offered by the PGIM (eg. forensic histopathologist, forensic neuropathologist, forensic radiologist, forensic paediatric pathologist etc).

In conjunction with these changes, the existing Diploma in Forensic Medicine (DLM) has been upgraded to a Master in Forensic Medicine subsequent to strengthening the research component. The course leading to a masters is aimed at medical graduates who are in forensic practice or in medical administration.

This uplifting of the Forensic Medicine postgraduate program in Sri Lanka to a doctorate in Forensic Medicine with special interest areas or subspecialties and a Masters programme with a research component brings the postgraduate forensic medicine training in Sri Lanka on par with international standards.

This enhancement of the postgraduate Forensic Medicine training program may influence the undergraduate Forensic Medicine curriculum as the need for newly graduated doctors to attend to medico legal work would be less. Therefore credits allocation to the Forensic Medicine component of the undergraduate medical program may be reduced in future undergraduate medical curricular similar to Europe or North American systems. It is imperative that infrastructural development including buildings, technical and laboratory facilities of forensic units island wide need to occur to overcome future challenges.

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7822

ETHICAL DILEMMAS IN FORENSIC MEDICAL PRACTICE

Kitulwatte I.D.G. & Edirisinghe P.A.S.

Department of Forensic Medicine, Faculty of Medicine, Ragama, Sri Lanka

Corresponding Author: Kitulwatte I.D.G.

Email: indiradgk@yahoo.com https://orcid.org/0000-0002-6108-9059

Abstract

Forensic practitioners need to ensure that basic medical obligations towards individual patients, judiciary and the public are met while balancing their responsibilities to these parties. Unlike in clinical practice the patient does not present for treatment but for forensic evaluation. Even so, medical practitioners are expected to ensure that ethical standards like for any other medical discipline are maintained in medicolegal practice.

At a forensic medical examination, there is an obligation to act in the best interest of the patient and to attend to his/her critical needs. However, attending to the needs of the patient may be viewed as taking undue interest or being fractional by the judiciary. On the other hand, in medical practice, responsibility to patients should override the interests of third parties.

In examination of the dead for medico-legal purposes, the question that can arise is whether there is actually a doctor-patient relationship since the examinee is already dead. While there is a duty towards the judiciary to find out the truth about the cause and manner of death there is a duty towards the relatives of the deceased to reveal the true findings especially after having contact with them at the preliminary inquiry.

Many of the conclusions made in forensic practice are matters of opinion, and therefore, disagreement is expected which can lead to personal friction specially in handling cases of medical negligence. If forensic practitioners follow the basic principles of medical ethics, while maintaining the highest standards based on scientific evidence, they can overcome the majority of the conflicting issues and can perform their duty in the administration of justice.

Key words: *ethics, forensic medicine and pathology, best interest, doctor patient relationship, judiciary*

ETHICAL DILEMMAS IN FORENSIC MEDICAL PRACTICE

Forensic medicine is the application of principles and practice of medicine to aid the administration of justice. Thus, a forensic examiner will use his/her knowledge in medicine, to interpret the findings and to come to conclusions and opinion to exercise expert judgement. In both clinical and pathological forensic medical practice, basic ethical principles relevant to practice of clinical medicine such as autonomy (rights of the patient to make decisions), beneficence (obligation to act in the best interest of the patient), non maleficence (obligation to do no harm to the patient), and justice (fairness and giving what is rightfully due) has to be maintained in every instance.[1] Doctors practicing forensic medicine are first and foremost medical practitioners and are therefore subject to all other codes of ethics and behaviour that govern medical practice. Further, forensic practitioners should ensure that basic medical obligations towards individual patients, the justice system (Courts) and the general public are met. Therefore, it is necessary to balance their responsibilities to all these parties. Being aware of possible conflicts of interest between these three groups is essential in the forensic context.

The doctor patient relationship in a clinical encounter is fundamentally a moral activity that arises from the necessity to care for patients and to alleviate suffering[2,3] This relationship exists when a physician attends to medical needs of a patient with a mutual agreement or consent. However, on rare occasions treatment may be provided under a court order in clinical practice.[4] Even then the doctor's responsibility to the patient remains intact. In any kind of doctor patient relationship doctors are bound by ethical obligations, placing patients' welfare above self-interest and obligations to other groups.[5]

Autonomy, the duty of doctors to respect the freedom of patients to make decisions for themselves concerning how they want their body to be treated and whether, and to whom, information about them is to be disclosed exists in forensic medical practice as well. It is a general legal and ethical standard that valid consent must be obtained before commencing treatment or conducting physical examination of a patient.[6] It is the patient's right to determine what happens to their own bodies. Even in therapeutic medicine, when patients are brought by a court order, no procedure can be initiated without mutual agreement between the patient and the physician.[7] The same principle is applicable in forensic medical practice. In obtaining consent, the forensic practitioner must make clear to the examinee the purpose and the nature of the examination. In addition, the consent must be freely given and the examinee must be aware that there is no obligation to provide consent. Furthermore, it is important to inform such patients that forensic examinations are performed to obtain information which may ultimately be used as evidence in court proceedings against him.

When discharging their duties, forensic practitioners may face situations with conflicts of interest. Unlike in clinical practice, the patient does not present for treatment but for forensic evaluation.[8] Even so the public would expect the same ethical standards like that of any other medical profession in general. The forensic practitioner may be the first and only physician who evaluates a patient with critical needs. Therefore, there is an obligation on the part of the practitioner to act in the best interest of the patient or to attend to his critical needs.

The ethical principle, **beneficence,** recognizes the duty of doctors to do good for their patients and everyone must be provided with access to health care and emergency medical treatment.[9] For

example, there can be a victim of sexual abuse, who needs emergency contraceptives to prevent unwanted pregnancy and post exposure prophylaxis for HIV. However, the main obligation expected from a forensic medical practitioner is to assist the courts in the administration of justice. Presenting the evidence fairly and objectively without being supportive to a particular party or maintaining impartiality is expected in this exercise.[1] Attending to the needs of the victim, may be viewed as taking undue interest or being prejudiced by the judiciary. On the other hand, as this is a medical profession, failure to attend to the critical needs of the patient after recognizing them would lead to an act of negligence. When faced with dual loyalty conflicts such as this, forensic practitioners should act in the best interest of the patient first.

The principle of **non-maleficence** states that doctors should prevent harm that could occur to the body, mind or reputation of the patient.[10] Information obtained in the doctor patient relationship is expected to be confidential. This customary therapeutic agreement and assurances of confidentiality do not exist in a forensic context.[11] Forensic practitioners are bound by the legal obligations to divulge information. Therefore, the limit of confidentiality has to be informed at the outset of the evaluation. Further, forensic pathologists should treat bodies with dignity, and the confidentiality of persons should be maintained even after death especially in situations where stigmata are attached, unless the finding is something, which is relevant in the courts.

Victims and alleged perpetrators of crimes should be treated equally according to the basic ethical principle of **justice**.[11] Priority must be given to the clinical needs of the patient irrespective of being a victim or perpetrator. In a case of torture of a detainee who may be a threat to society, forensic practitioners should first attend to his medical needs and issue a report on torture without being partial or biased. On the other hand, there can be a situation where the forensic practitioner discovers that the patient who presented with blast injuries in his hands is a bomb handler. This may be an instance where duty towards society should supersede the patient's best interest. Still it is the responsibility of the forensic practitioner to inform the patient regarding the limitation of confidentiality.

Maintaining good professional relationships with colleagues is the expected ethical standards from a physician.[12] However, many of the conclusions made in forensic practice are matters of opinion and therefore, disagreement is expected which can lead to conflicts between experts. Forensic practitioners may discover mistakes of colleagues in their forensic evaluation. They are expected to be truthful and should allude to these mistakes in the report. However caution needs to be exercised in making comments and formulating an opinion with scientific reasoning. Forensic practitioners are not familiar with the specialties of medicine which are rapidly advancing. Therefore, it is important that a forensic practitioner recognises the limits of their expertise and provide balanced opinion based on scientific interpretations while limiting to his/her expertise. In addition, if the opinion is based on scientific evidence and directed towards justice without partiality towards an interested party, the disagreement, which is expected, can be minimized.

When forensic pathology is considered, the main question that can arise is whether there actually is a doctor patient relationship. The answer can be unclear since the subject is deceased. It is worthwhile to consider to whom a forensic pathologist owes a duty to. It is the general understanding that a forensic pathologist owes a duty to the memory or reputation of the deceased as requested by the courts to find out the truth about the cause and manner of death. Further, there is a duty towards the

community including the relatives of the deceased. Therefore, it is of utmost importance to reveal the true findings to the community, especially the relatives. One may argue that forensic pathologists act under the authority of the courts and therefore owe a duty only to the judiciary. Indeed, divulging true findings to the courts is definitely an obligation. However, after communicating with relatives of the deceased prior to autopsy, it is of equal importance to maintain the expected reputation of honesty and integrity with them by divulging the true facts while being cautious in making opinions.

The forensic medical profession must strive to preserve the trust patients hold in them while appreciating the responsibility they owe to the criminal justice system and to the public. Ethical standards cannot be abandoned simply because the relationship with the patient is not for alleviation of suffering. As the main obligation of a forensic medical practitioner is to assist the judiciary in determining the truth while protecting the patient from incompetent or illegal practices by others, he or she must always preserve integrity, truthfulness and exhibit competence at all times while abiding by the code of ethics and behavior that governs the medical profession.

REFERENCES

1. M.M. El-Nageh, Ethical practice in Laboratory Medicine and Forensic Pathology, WHO Regional Publication, Eastern Mediterranean Series, 1999: Volume 20; 29-41.

2. Baker RB, Caplan AL, Emanuel LL, Latham SR, eds. Baltimore. The American Medical Ethics Revolution: Johns Hopkins University Press; 1999: 17-51.

3. Bell J. to the 1847 Code of Ethics (Appednix B) In: *The American Medical Ethics Revolution*. Baker RB, Caplan AL, Emanuel LL, Latham SR, eds. Baltimore, Md: Johns Hopkins University Press; 1999:317-323.

4. Katsakou C, Priebe S "Outcomes of involuntary hospital admission—a review". *Acta Psychiatr Scand*. 2006:114 (4): 232–41.

5. I. Glenn Cohen, Holly Fernandez Lynch, and Christopher R. Deubert. A Proposal to Address NFL Club Doctors' Conflicts of Interest and to Promote Player Trust. Hastings Cent Rep. 2016; 46(Suppl Suppl 2): S2–S24.

6. Atyanarayana Rao KH. Informed consent: An ethical obligation or legal compulsion? J Cutan Aesthet Surg. 2008;1:33–5.

7. Arne Hantho, Lena Jensen & Kirsti Malterud Mutual understanding: a communication model for general practice, Scandinavian Journal of Primary Health Care, (2002) 20:4,244-251, DOI: 10.1080/ 028134302321004926.

8. Greenberg, S., & Shuman, D. Irreconcilable conflict between therapeutic and forensic roles. *Professional Psychology: Research and Practice.*1997: *28*; 50-57.

9. Ramesh P Aacharya, Chris Gastmans and Yvonne Denier. Emergency department triage: an ethical analysis. BMC Emergency Medicine 2011,11:16. http://www. biomedcentral.com/1471-227X/11/16.

10. Warren T. Jahn, DC, MPS. The 4 basic ethical principles that apply to forensic activities are respect for autonomy, beneficence, nonmaleficence, and justice. J Chiropr Med. 2011; 10(3): 225–226. doi: 10.1016/j.jcm.2011.08.004.

11. Karen C. Kalmbach, Phillip M. Lyons. Ethical Issues In Conducting Forensic Evaluations; Unique Nature of Forensic Mental Health Practice. Applied Psychology in Criminal Justice. 2006: 2(3); 261-189.

12. Guidebook for managing disruptive physician behavior. College of Physicians and Surgeons of Ontario.

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7828

MATERNAL DEATH DUE TO HEALTH CARE ASSOCIATED MITRAL VALVE ENDOCARDITIS

Perera W.N.S.[1] & Gangahawatte S.D.S.[2]

[1] Department of Forensic Medicine, Faculty of Medicine, University of Kelaniya, Sri Lanka
[2] Office of the Judicial Medical Officer, North Colombo Teaching Hospital, Ragama, Sri Lanka

Corresponding author: Perera W.N.S.

Email: nirperera2000@yahoo.com https://orcid.org/0000-0002-8733-7364

Abstract

Infective endocarditis in pregnancy is a rare disease accounting for 0.006% of incidents. Among the associated factors health care associated fatal infections are rarer. In this case a pregnant mother with 13 weeks of gestation was subjected to the autopsy with the history of fever following inward treatment for hyperemesis, which was the result of septic thrombophlebitis at cannula site. Suggested clinical diagnosis of bacterial endocarditis was confirmed macroscopically and microscopically during autopsy. Damage to the mitral valve, micro abscess formation, multiple thrombi formation and infractions in the organs, together with features of heart failure was evident as complications of bacterial endocarditis. This rare case highlights that the need of early diagnosis of bacterial endocarditis when a pregnant mother presents with fever and necessity of adherence to the infection control standard in clinical setting to prevent mortality and morbidity.

Keywords: *Bacterial endocarditis, Cross infection, Pregnancy*

INTRODUCTION

Indirect causes are leading maternal deaths, with heart disease being the most common.[1,2,3] Sri Lanka has a maternal mortality ratio of 33.7 per 100,000 live births, which is the lowest rate in South Asia.[4] Even though among the causes of death in pregnancy, incidents of infective endocarditis are rare as 0.006%, [5,6,7] maternal mortality rate as well as fetal mortality rate is significantly high as 22.1% and 14.7% respectively.[8] The diagnosis and treatment methods of infective endocarditis has improved significantly during the past few decades but mortality rate has not largely changed.[9,10,11] During the pregnancy, a physician faces management difficulties in infective endocarditis due to resistance to treatment and complications leading to fatal outcome, especially in health care associated infections.[12] In Sri Lanka all the maternal deaths are reviewed at institutional level as well as at national level with the participation of a management team and a forensic pathologist. Therefore, better understanding of sequelae of the disease is crucial in prevention of maternal deaths.

In this paper we present a case of fatal bacterial endocarditis at 13 weeks of gestation.

CASE HISTORY

An apparently well 29-year-old primi-gravida with 11 weeks of gestation was presented to a base hospital with a history of hyperemesis and was treated as an inward patient. She developed septic thrombophlebitis at the cannula site while in the ward and was treated with intravenous antibiotics for one day and was discharged with oral antibiotics. Three days later she developed fever, for which treatment was taken from a General Practitioner. Within the next 2 days she was seen by the Obstetrician, who referred her to a Physician due to fever with low blood pressure and gradually worsening shortness of breath. She was treated inward for 3 days and discharged from the hospital. On the same day, her fever got worse associated with severe head ache, cough and breathlessness. The next morning, she was seen by the Obstetrician and advised to immediately admit. She got admitted to a private hospital and following several investigations, including a positive Echocardiogram for mitral value vegetations, she was transferred to an Intensive Care Unit (ICU) of a tertiary care hospital with the history of intermittent fever for 8 days' duration, blood pressure 70/40 mmHg and pulse rate of 140 beats/min.

While she was in the ICU, she had fever (102 ^{0} F) with chills, investigations showed leukocytosis with Neutrophilia (26,000 mm^{3}, 91%), elevated C reactive proteins (389mg/l) and D dimer 7.2mg/dl. Blood culture was positive for gram positive cocci (*Staphylococcus aureus*) and repeated 2D Echocardiography confirmed vegetations on the mitral valve. Patient was treated with the antibiotics Meropenem, Vancomycin and Teicoplanin and anti-viral Tamiflu. In spite of treatment her condition deteriorated and died on the 10th day after the fever.

There was no history of previous heart disease, foreign material implant or infections such as urinary tract infection or caries in teeth.

Autopsy examination revealed multiple petechial haemorrhages and purpura on the body. A healing scar was seen on the previously infected cannula site. Internal examination revealed a pale, oedematous brain with areas of infarction. Intracranial haemorrhages were not present. Heart was flabby and weighed 382g. Epicardium had petechial haemorrhages. Mitral valve was thickened, and 6 cm in length. Valve cusps had multiple vegetations, the largest being

pedunculated, firm and non-calcified measuring 1.6 cm in diameter. Others were friable and smaller (Fig: 1). Chordae tendinae were thickened and shortened. tricuspid valve and chordae tendineae showed hyperaemia (Fig: 2). There was bilateral pleural effusion measuring 100 ml on each side with pulmonary oedema. Kidneys were swollen with wedge shaped infarctions. Spleen was enlarged. Dead fetus was found in the uterus.

Histology from the mitral valve showed bacterial vegetation over the valvular endocardium (Fig: 3) composed of neutrophils, necrotic debris and infected colonies of gram positive cocci. Inflamed granulation tissue was covered with fibrin and capillarization of valve was noted underneath the vegetation. Multiple thrombi were present. Valvular fibrosis and basophilic calcium salt deposits were not seen. Sections of the aortic, pulmonary and tricuspid valves were devoid of any structural abnormalities. Microscopy of myocardium showed distorted architecture with scattered areas of focal myocytolysis associated with neutrophil aggregation and few bacterial colonies, suggestive of developing abscesses (Fig: 4). This appearance (early abscess formation) was noted in the brain, lungs and kidneys as well (Fig: 5, 6). Areas of brain infarctions and renal infarctions were noted with thrombosis. With these observations pathological diagnosis of bacterial endocarditis was made. This overall appearance is suggestive of 10-14 days of time period since the initiation of the said pathological process. Features of the thrombophlebitis are more in favor of acute in origin (<2 weeks).

Following autopsy cause of death was given as complications of bacterial endocarditis following septic thrombophlebitis. The questions of medical negligence arises in this case whether the due standard of care was given to the patient.

DISCUSSION

Infective endocarditis is an infection of the endocardial surface of the heart which involves heart valves or cardiac chambers. Mostly it is caused by gram positive cocci such as *Streptococcus* or *Staphylococcus* amounting to 80% of cases.[11,13] Congenital heart diseases, Rheumatic valvular disease, intra-cardiac implants, intravenous drug abuse, periodontal disease and local infection are some of the risk factors.[14,15] A French study stated 47% of patients having endocarditis without previous knowledge of cardiac disease similar to this case.[9] It is also likely to have bacteraemia originated from nosocomial or iatrogenic infection even few months after hospital admission depending on the type of causative agent and its' virulence.[16] In this case intra venous therapy which led to the septic thrombophlebitis while in the hospital is the most likely cause.

In bacterial endocarditis pathophysiology starts even as a result of micro ulceration on the valvular endothelium producing small clot or coagulum. In this patient bacteraemia is possibly associated with septic thrombophlebitis. Circulating bacteria in the blood stream bind to the coagulum and activate monocytes resulting in progressive enlargement of vegetation and further adherence of bacteria. Vegetations are composed of fibrin, platelets, and infecting organisms. This is held together by antibodies produced by bacteria. Continuing inflammation leads to erosions, ulcerations and perforation of valve cusps.[17] Vegetations are mostly located in left cardiac chambers (84.7%) predominantly on native mitral value.[18] Larger vegetations lead to functional obstruction to the blood flow into the left ventricle and mitral regurgitation further reduces the ventricular filling causing pulmonary oedema and heart failure.[19] Large vegetations such as >10mm is significantly associated with embolic events.[20] Presence of perivalvular

abscesses indicate poor prognosis.[21] Myocardial abscesses, inflammation and necrosis of myocardial tissue affects nerve conduction of the heart causing arrhythmia and reducing ventricular contraction. It is evident from the studies that significant number of patients show multiple complications. [22,23]

Clinical features as well as investigations help in diagnosis of infective endocarditis using the modified Duke criteria.[24] Among the investigations blood cultures are the standard test to conclude the etiology since this is an endovascular infection associated with persistent bacteraemia. Presence of elevated CRP and D dimer, increased leukocyte count, vegetation size of >10 mm, perivalvular abscesses are significantly associated with high mortality rate of bacterial endocarditis like in this case.[25] Staphylococcal origin[26] and health care associated native valve bacterial endocarditis are some of the other factors associated with high mortality.[27,28] Hospital acquired *Staphylococcus aureus* infection with newly onset endocarditis is seen in studies by various proportions ranging from 5% -17%. [29, 30]

Fatal outcome of endocarditis is mostly related to complications such as valvular regurgitation, myocardial abscess formation and tissue destruction, heart failure and embolic metastasos.[22] In this case heart, brain, lung and kidney tissues showed micro abscesses. Pulmonary oedema is evident as a feature of heart failure.

In this patient bacteraemia following septic thrombophlebitis led to the bacterial endocarditis and destruction of the infected mitral value causing valvular dysfunction, leading to the acute heart failure and a fatal outcome. Abscess formation and infarctions in other organs further contributed to the death. However, with the myocytolysis conduction abnormalities and fatal arrhythmias cannot be excluded in the mechanism of death.

Valvular surgery as a treatment option is limited in this case due to multisystem involvement with rapid deterioration of the patient and scarcity of available resources for surgery.

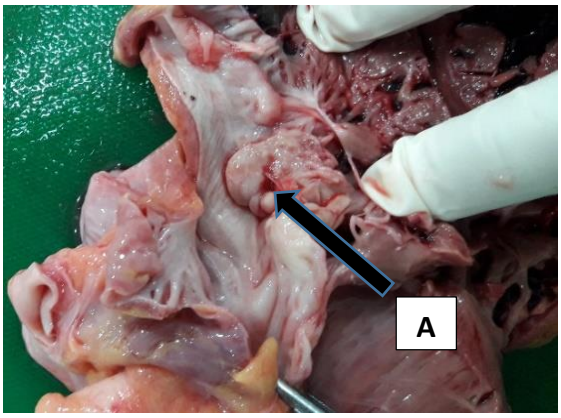

Fig 1: Photographs of the heart showing mitral valve and vegetation indicated by an arrow A

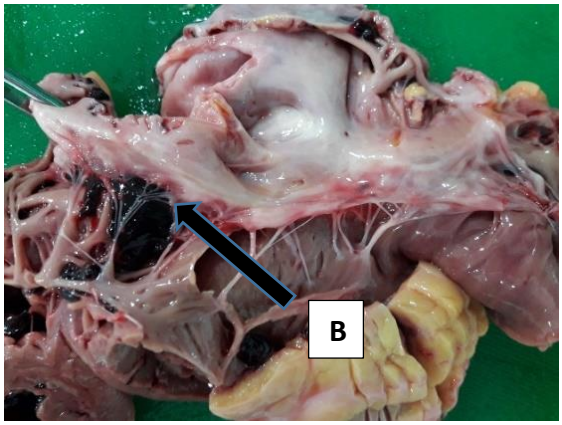

Fig 2: Photographs of the heart showing hyperaemia around the tricuspid valve indicated by an arrow B

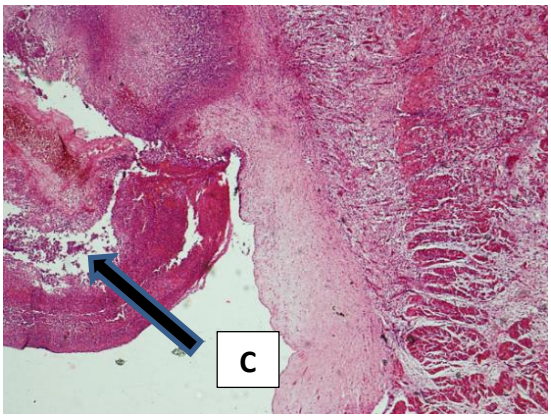

Fig 3: Microphotograph of the heart (H&E 4x10) showing vegetation on the mitral valve indicated by an arrow C

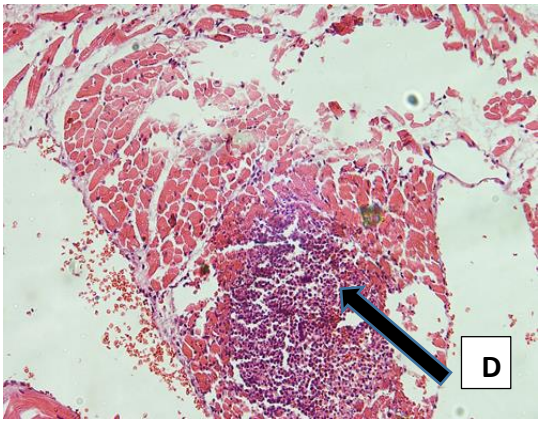

Fig 4: Microphotograph of the heart showing (Gram staining 4x10) micro abscess indicated by an arrow D

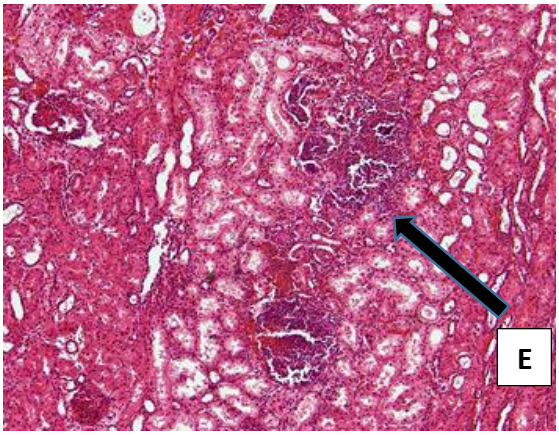

Fig 5: Microphotograph of the kidney showing (H & E 40x10) micro abscess indicated by an arrow E

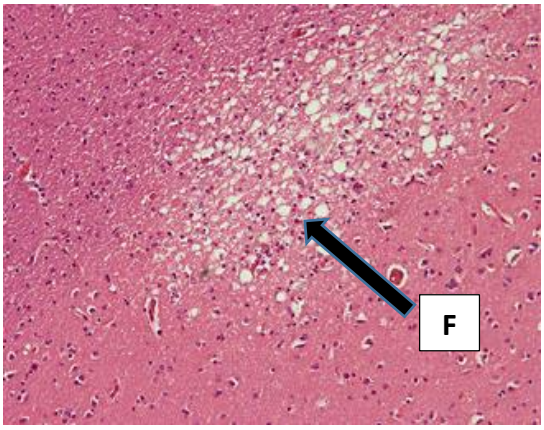

Fig 6: Microphotograph of the brain showing (H & E 4x10) micro abscess indicated by an arrow F

CONCLUSION

This case illustrates rare presentation of acute ulcerative polypoid endocarditis on a native valve with disseminated abscess formation due to septic embolization in a pregnant mother with 13 weeks of gestation. Special attention is needed to suspect bacterial endocarditis when pregnant mothers are presented with fever in a clinical setting. Early diagnosis of endocarditis based on modified Dukes criteria and identification of the most effective treatment is mandatory in reducing the complications and risk of fetal and maternal mortality. Infection control standard precautions in health care should be applied strictly in the ward setting to prevent health care associated infections.

ACKNOWLEDGEMENT

Dr. Pradeep Bandara (Consultant JMO) - for histopathology reporting.

REFERENCES

1. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels JD, et al. Global Causes of Maternal Death: A WHO Systematic Analysis. Lancet Global Health. 2014;2(6): e323-e333.

2. Umadethan B. Principal and practical of forensic medicine. 2nd ed. New Delhi: CBS Publishers and Distributers pvt;2016. p. 289.

3. A.Vadysinghe, R.Jayasooriya, G. K. Gunatilake & M. Sivasubramanium, Unexpected sudden death in pregnancy – arrhythmogenic right ventricular cardiomyopathy/dysplasia: a case report, Forensic Sciences Research, 2:3, 161-163, DOI: 10.1080/20961790. 2017.1325548.

4. D.Weerasekara, Presidential address, April 2017, Sri Lanka Journal of Obstetrics and Gynaecology, www.slcog.lk/sljog.

5. Cox SM, Hankins GD, Leveno KJ, Cunningham FG. Bacterial endocarditis. A serious pregnancy complication. J Reprod Med 1988; 33: 671-4.

6. Ward H, Hickman RC. Bacterial endocarditis in pregnancy. Aust.NZJ Obstet. Gynaecol. 1971;11:189–191.

7. Nazarian M, McCullough GH, Fielder DL. Bacterial endocarditis in pregnancy: successful surgical correction. J Thorac Cardiovasc Surg. 1976;71:880–883.

8. Campuzano K, Roquè H, Bolnick A, Leo MV, Campbell WA. Bacterial endocarditis complicating pregnancy: case report and systemic review of the literature. Arch Gynecol Obstet 2003; 268: 251-5.

9. Hoen B, Alla F, Selton-Suty C, et al. Changing profile of infective endocarditis. Results of a 1-year survey in France. JAMA. 2002;288(1):75–81.

10. Cabell CH, Jollis JG, Peterson GE, et al. Changing patient characteristics and the effect on mortality in endocarditis. Arch Intern Med. 2002;162(1):90–94.

11. Rhys P Beynon, V.K.Bahl,Bernard D Prendergast, Infective Endocarditis, BMJ. 2006 Aug 12; 333(7563): 334–339.

12. Mocchegiani R, Nataloni M. Complications of infective endocarditis. Cardiovasc Hematol Disord Drug Targets 2009; 9:240-8.

13. Liesman RM, Pritt BS, Maleszewski JJ, Patel R. 2017. Laboratory diagnosis of infective endocarditis. J Clin Microbiol 55:2599 –2608.

14. Ambrosioni J, Hernandez-Meneses M, Téllez A, et al. The Changing Epidemiology of Infective Endocarditis in the Twenty-First Century. Curr Infect Dis Rep 2017; 19:21.

15. Erbay AR, Erbay A, Canga A, et al. Risk factors for in-hospital mortality in infective endocarditis: five years' experience at a tertiary care hospital in Turkey. J Heart Valve Dis 2010; 19:216.

16. Bouza E, Menasalvas A, Munoz P, Vasallo FJ, del Mar Moreno M, Garcia Fernandez MA. Infective endocarditis—a prospective study at the end of the twentieth century: new predisposing conditions, new etiologic agents, and still a high mortality. Medicine (Baltimore) 2001;80: 298-307.

17. Thiene G, Basso C, Pathology and pathogenesis of infective endocarditis in native heart valves. Cardiovasc Pathol. 2006 Sep-Oct ;15(5):256-263. doi: 10.1016/j.carpath. 2006.05.009.

18. Marina Leitman, Yael Dreznik, Vladimir Tyomkin, Therese Fuchs, Ricardo Krakover, Zvi Vered, Vegetation size in patients with infective endocarditis, European Journal of Echocardiography, Volume 13, Issue 4, April 2012, 330–338.

19. Michael A. Hart, Infective endocarditis causing mitral valve stenosis – a rare but deadly complication: a case report, J Med Case Rep. 2017; 11: 44.

20. Kelechi E. Okontaa,Yahaya B. Addamu, What size of vegetation is an indication for surgery in endocarditis?. Interact Cardiovasc Thorac Surg. 2012 Dec; 15(6): 1052–1056., Published online 2012 Sep 7.

21. Mugge A, Daniel WG. Echocardiographic assessment of vegetations in patients with infective endocarditis: prognostic implications. Echocardiography. 1995;12:651–61.

22. Timothy E. Paterick, Rick A. Nishimura, James M. Steckelberg, Complexity and Subtlety of Infective Endocarditis, Mayo clinic proceedings, May 2007,Volume 82, Issue 5, Pages 615–621.

23. Gilleece A, Fenelon L, Nosocomial infective endocarditis, J Hosp Infect. 2000 Oct; 46(2):83-8.

24. Durack DT, Lukes AS, Bright DK, New criteria for diagnosis of infective endocarditis: utilization of specific echocardiographic findings, Am J Med. 1994 Mar; 96(3):200-9.

25. Demirbag R, Using the D- dimer test in infective endocarditis, Turk Kardiyol Dern Ars. 2013 Oct;41(7):595-7. doi: 10.5543/tkda.2013.09483.

26. V. Krcmery, et el, Etiology and Risk Factors of 339 Cases of Infective Endocarditis: Report from a 10-year National Prospective Survey in the Slovak Republic, Journal of Chemotherapy, Volume 15, 2003 - Issue 6.

27. Hill EE, Herijgers P, Claus P, Vanderschueren S, Herregods MC, Peetermans WE. Infective endocarditis: changing epidemiology and predictors of 6-month mortality: a prospective cohort study. Eur Heart J. 2007;28:196–203.

28. Hasbun R1, Vikram HR, Barakat LA, Buenconsejo J, Quagliarello VJ. Complicated left-sided native valve endocarditis in adults: risk classification for mortality, JAMA. 2003 Apr 16;289(15):1933-40.

29. Chang, Feng-Yee; MacDonald, Brent B.; Peacock, James E. Jr; Musher et al, A Prospective Multicenter Study of *Staphylococcus Aureus* Bacteremia: Incidence of Endocarditis, Risk Factors for Mortality, and Clinical Impact of Methicillin Resistance, Medicine: September 2003 - Volume 82 - Issue 5 - p 322-332.

30. Ronen Ben-Ami, Michael Giladi, Yehuda Carmeli, Ruth Orni-Wasserlauf, Yardena Siegman-Igra, Hospital-Acquired Infective Endocarditis: Should the Definition be Broadened? Clinical Infectious Diseases, Volume 38, Issue 6, 15 March 2004, Pages 843–850, https://doi.org/10.1086/381971

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7823

PROFILE OF SUICIDAL HANGING PRESENTED TO A TERTIARY CARE HOSPITAL: A DESCRIPTIVE STUDY

Kitulwatte I.G.D.[1], Edirisinghe P.A.S.[1], Senarathne U.D.[2], Mendis H.K.N.L.P.[1], Wijesinghe P.R.[1] & Fernando A.[1]

[1]Department of Forensic Medicine, Faculty of Medicine, University of Kelaniya, Sri Lanka
[2]Department of Bio-chemistry, Faculty of Medicine, University of Sri Jayawardenepura, Sri Lanka

Corresponding Author: Kitulwatte I.G.D.

Email: indiradgk@yahoo.com https://orcid.org/0000-0002-6108-9059

Abstract

When a body is found suspended, the forensic pathologist is expected to give an opinion on the manner of death excluding or confirming possible criminal involvement. Conclusion is easy when findings are classic. However, it is a dilemma when there are atypical findings.

Objectives

To analyze the autopsy findings in deaths due to hanging and to have an insight into the typical and atypical findings in order to appreciate the difficulties in interpretation.

Methods

A retrospective descriptive study on post mortem records of the victims of hanging during a period of three years, brought to a tertiary care hospital. The findings of death investigation including background information, scene, and autopsy examination were analysed.

Results

Total of hundred and twelve records of deaths due to suicidal hanging were perused and 97 (86.6%) out of them were males. The majority of victims (37%) were in the age group of 21 to 40 years. The complete suspensions was identified in most cases (79.5%). The commonest ligature material (25%) was the coir rope. Sixty-nine were having a ligature mark rising to an inverted 'V'. Classic signs were observed in 47% and the presence of classic signs was significantly associated with partial suspension ($p<0.001$). Internal injuries were observed in 34% and the majority were fractures. Internal injuries had no significant association to the degree of suspension ($p=0.11$).

Conclusion
The findings in hanging vary, and may be found in many combinations sometimes with exceptions to the generally accepted. Awareness of these combinations and the exceptions are of crucial importance in coming to a conclusion in a suspected case of hanging so as to avoid any erroneous opinion.

***Key words**: hanging, ligature material, ligature mark, internal injuries, fractures*

INTRODUCTION

Hanging, a form of ligature neck compression that involves suspension by the neck is a common method of suicide.[1] The role of the forensic pathologist when body is found suspended is to give an opinion on the manner of death and to exclude or confirm other forms of neck compression prior to being hung. Correlation of the neck markings together with the internal findings are of extreme importance in arriving at a conclusion. It is easy to arrive at a conclusion when one finds the 'classical features' i.e. imprint/ patterned abrasion or parched appearance surrounding the neck with asphyxial features.[2] However all features are seldom present together. An autopsy of a hanged body will often reveal neck markings but the ligature may be absent.[1] Findings resulting from application of pressure on the neck quite vary.[2] Thus a Forensic pathologist is caught in a dilemma when there are atypical findings in addition to the typical ligature mark. A proper assessment of various post-mortem findings is therefore necessary to arrive at a conclusion.

The nature of the neck markings depends on the type of noose.[1] According to existing literature, a noose made of soft material like a saree or a scarf is known to leave only a few marks or no mark at all leading to difficulties in interpretation.[1] A rope or a cord noose will leave a deep furrow, often with accompanying abrasions. In the case of a typical suspension the mark will rise to an inverted "V" shape with a gap at the back. This is often used to distinguish a hanging from a ligature strangulation. However, in a hanging from a low suspension point, the marks on the neck tend to be horizontal rather than diagonal simulating ligature strangulation.[3]

The pattern of external and internal injuries and other postmortem findings resulting from neck compression permit a Forensic pathologist to resolve many unanswered questions. However, there are many exceptions to the rule with atypical findings.[4] Thus, the experts in Forensic medicine must be aware of the exceptions in-order to arrive at balanced conclusions and scientifically based opinions.

In order to have an insight into the typical and atypical findings related to hanging we have conducted a retrospective descriptive study on deaths due to suicidal hanging reported to North Colombo Teaching Hospital, Ragama, Sri Lanka over a period of 3 years.

OBJECTIVES

The aim of the study was to analyze the findings of death investigation including autopsy in deaths due to hanging and to have an insight into the typical and atypical findings and the factors affecting them in order to appreciate the difficulties in interpretation.

METHODS

A retrospective descriptive study was conducted on the post mortem records of the victims of hanging during 3 years from 2013 brought to Colombo North Teaching Hospital, Ragama of Sri Lanka. Autopsy reports, scene and postmortem photographs and other case materials such as copies of the police scene investigation findings were perused. The historical details, scene findings, findings of autopsy external and internal examinations, the results of the post-mortem investigations and the opinion and conclusions given were obtained according to a pro-forma designed to fulfil study objectives. All cases presented as suicidal hanging during the period were included. Bodies that were decomposed, suspicious of homicidal suspension and those with poor records were excluded from the study.

ETHICAL CLEARANCE

Since the study was performed based on documented findings of already performed autopsies, and no identifiable data was retrieved there was no necessity for ethical clearance. Permission to retrieve data was obtained from the medical officers who performed the autopsies and from the Director of the Colombo North Teaching Hospital, Ragama.

Data collected were entered in Microsoft excel worksheets and analysed using Statistical Package for Social Sciences (SPSS) for frequencies and comparisons. Graphs and tables are used as appropriate to present the data.

RESULTS

During the period of 3 years, there were 112 cases of suicidal hanging deaths. Of them, 97 (86.6%) were males. Majority; 81 (72.3%) was in the age group of 21-60 years. (Table: 1)

Table1: Age distribution of the study group

Age group	Frequency
≤20 yrs.	9 (8%)
21-40 yrs.	41 (36.6%0
41-60 yrs.	40 (35.7%)
>60 yrs.	22 (19.6%)
Total	112 (100%)

Majority 78 (69.6%) were found hanging in their own home followed by 32 (28.6%) victims who were recovered from places that were known to the deceased. Only 2 (1.8%) victims were found hanging at an unknown place.

There were 23 (20.5%) of partial suspensions and 89 (79.5%) complete suspensions. Problems or stress related to education were the reason for suicide in 44 (39%) victims. 40 (35.7%) had family disputes and 9 (8%) committed suicide due to broken love affairs. There were 8 (7.1%) who had multiple other reasons. Note of suicide was found in only 16 (14.3%) cases.

Sixty one (54.5%) had used a rope (coir (25%) or a nylon (29.5%) as ligature material. Twenty six (23.2%) had used a soft fabric and 12 others had used various other materials including belts (10.7%). Thirteen (11.6%) were brought without a ligature.

Majority (102) were having only the imprint of ligature on the neck. While there were 6 having peri-ligature injuries in addition to the ligature mark. There were 4 (3.6%) with no injuries to the neck. The pattern of the ligature mark was continuous in 92 (82%). Twenty (20) out of 26 individuals who had used a soft fabric had a continuous ligature mark. The ligature mark was absent only in four of the victims and two of them were using a soft fabric. (Table: 2)

Table 2: ligature material Vs pattern of ligature mark

Pattern of ligature mark / Ligature Material	Intermittent pattern	Continuous pattern	No ligature mark	Total
Soft fabric	4	20	2	26
Coir rope	4	24	0	28
Nylon rope	4	28	1	33
Belt	0	1	0	1
Other	1	10	0	11
Not present	3	9	1	13
Total	16	92	4	112

Ligature mark was rising to an inverted V in a majority 81 (72.3%). However, there were 8 (7.1%) with a horizontal ligature mark and 2 (1.8%) with multiple marks. There were 17 (15.2%) with variable pattern in their ligature mark while 4 (3.6%) were having no ligature mark. The mark was placed high on the neck in 100 individuals. Eighty two (82) out of them were complete suspensions. Out of the 7 individuals with low ligature mark, 4 were partial suspensions. There was a significant difference between the two groups (p=0.018). (Table: 3)

Table 3: degree of suspension Vs placement of the ligature mark

Placement of ligature / Degree of hanging	**High on the neck**	**Lower on the neck**	**No ligature mark**	**Total**
Partial	18	4	1	23
Complete	82	3	4	89
Total	100	7	5	112

The gap or the point of suspension was found at the back of the neck (center of occiput) in a 52 (46%) while the mark was high on the neck in 51 (98%) out of them. 29 (85%) out of 34 individuals whose knot was found at the side had the ligature mark placed high on the neck. Out of the 7 low lying ligatures majority were having the point of suspension at the side of the neck. This was a statistically significant finding (p=0.018). (Table: 4)

Table 4: Placement of the ligature and placement of the point of suspension

Placement of ligature / Placement of gap	**High on the neck**	**Lower on the neck**	**Other**	**No ligature mark**	**Total**
Back of the neck (center of occiput)	51	1	0	0	52
Side behind the ear	29	5	0	0	34
Front of the neck	2	0	0	0	2
Other	1	0	1	0	2
No gap	17	1	0	0	18
No ligature mark	0	0	0	4	4
Total	100	7	1	4	112

On the other hand, the degree of suspension did not show any significant association with the type of hanging; typical or atypical. (p=0.082) (Table: 5)

Table 5: Type of hanging Vs degree of suspension

Placement of gap \ Degree of hanging	Partial	Complete	Total
Typical hanging	7	45	52
Atypical hanging	16	44	60
Total	23	89	112

Classical signs were found in 41 (36.6%) victims. Of them commonly observed classic sign was congestion (29, 25.9%) Twenty six out of 41 had petechial haemorrhages and 11 had oedema.

Presence of classic signs showed a statistically significant association to partial suspension (P<0.001). (Table: 6)

Table 6: Presence of classic signs Vs degree of suspension

Degree of hanging \ Classical signs	Present	Absent	Total
Partial	17	6	23
Complete	24	65	89
Total	41	71	112

Presence of classic signs did not show any significant association to the placement of the ligature mark. (p=0.6592) (Table: 7)

Table 7: Placement of ligature mark Vs classic signs

Classic signs \ Placement of ligature	High on the neck	Lower on the neck	Other	No ligature mark	Total
Present	36	4	0	1	41
Absent	64	3	1	3	71
Total	100	7	1	4	112

Internal injuries were observed in 38 (33.9%) and it was found directly underlying the external injuries in36. Commonly observed internal injuries were fractures (33). Underlying contusions were found among 10 and 2 had haematomas. In a majority, the fractures were placed on the thyroid cartilage & hyoid bone.

There is no significant association of the ligature material used with the presence or absence of internal injuries (P = 0.351) (table: 8).

Table 8: Ligature material Vs internal injuries

Ligature Material \ Internal injury	Present	Absent	Total
Soft fabric	10	16	26
Coir rope	12	16	28
Nylon rope	7	26	33
Belt	0	1	1
Other	5	6	11
Not present	4	9	13
Total	38	74	112

70% of the victims of complete suspension and 52% of the individuals with partial suspension had no internal injuries. Further, there is no significant difference between the two groups; partial and complete suspension concerning presence of internal injuries. (p = 0.11) (Table: 9)

Table 9: Partial or complete Vs internal injuries

Degree of hanging \ Internal injury	Present	Absent	Total
Partial	11(48%)	12 (52%)	23
Complete	27 (30%)	62(70%)	89
Total	38	74	112

DISCUSSION

In addition to the typical autopsy findings described, various atypical findings associated with death due to hanging are reported. The appearance of ligature mark and other findings at the autopsy depend on many factors.

This study revealed that the majority of the deaths due to hanging were of males who were young to middle aged. This is very well described in other studies as well.[5] Majority (70%) were found hanging inside their home. This is reported in many other studies as well.[6,7,8] Easy accessibility and the secluded environment may be the underlying reason for this finding. In a study on survivors of near fatal suicide attempts, it was found that the victims had

Considered hanging as an easy and straightforward method both in terms of access to materials and ease of implementation.[9] This was further confirmed in our study as well.

In this study the majority (80%) were complete suspensions. Findings were similar to this in many studies conducted in India[8,10,11,12] though there were few studies in which they have found partial suspension as a common presentation.[13]

Issues related to education was the underlying reason for suicide among majority (39%) followed by family disputes. Risk factors for suicide vary according to country, culture, religion, gender, age, and social values.[14] There is an increasing concern regarding study

pressure and its relationships with mental health problems. It is known that academic stress is associated with depression among adolescents.[15] The findings highlight the importance of targeting preventive strategies on the victims of highly competitive academic environment in this country. In a study done among the lower socioeconomic rural population depressive disorders, other psychiatric disorders and family matters were identified as the major risk factors for suicide.[16]

Finding a note of suicide is a strong corroborative evidence in concluding the manner of death. However, a note of suicide was found only in 16 (14.3%) cases. In a study done in Japan, the mean incidence of finding a note of suicide was 30.1%. [17] There may be cultural, ethnic, and racial variations associated with this behavior.

55% of the victims had used coir or a nylon rope as the ligature material followed by a soft fabric in 23%. This can be explained from easy availability and accessibility of nylon or coir ropes used for domestic work in Sri Lanka. Vipul, NamdeoraoAmbade et al found 62% of the victims were using a nylon rope as a ligature material in their study on ligature material used in hanging deaths.[8] Further, many other studies from Asia reports rope as the commonest ligature material[18]. There are other studies reporting soft fabric as the commonest ligature material which again can be considered as a cultural variation.[19]

A ligature mark was observed in 96%. There were associated peri-ligature injuries in 5.4% individuals. Mohammed Musaib M. Shaikh found peri-ligature injuries in the form of abrasion bruise and rope burns in 16.28% cases of hanging.[20] Nail marks over the neck are usually suggestive of manual strangulation and may mislead the forensic pathologist in drawing conclusions. However, they are also known to be caused as self-inflicted by the victim while trying to remove him/herself from the strangling grip of hanging at the last moment.[21]

The pattern of the ligature mark was continuous in 82% out of them. Even in individuals who had used a soft fabric majority had a continuous ligature mark. The ligature mark was absent only in 4 of the victims and 2 of them were using a soft fabric. Studies on the pattern of ligature mark being compared with the ligature material are scarce.[19,22,23] Our study revealed that there is no significant correlation of the pattern of the ligature mark to the ligature material.

The ligature mark was found high on the neck in 100 individuals and was rising to an inverted "v" shape in 72%. Association of complete suspension with a high ligature mark was observed in our study with a statistical significance. It is reported in other studies as well where partial suspension is found commonly associated with low ligature mark.[24] The high and rising / oblique ligature mark is described as a differentiating factor of hanging and ligature strangulation and it has been repeatedly shown in many studies.[20]

The mark was rising towards the point of suspension or the knot was found at the back of the neck (typical hanging) in 46 % followed by behind the ear in 30%. Thus the majority belonged in the group of atypical hanging where the knot is not at the back of the neck. This is commonly described in many other studies.[2,25] There was a significant association of the placement of the point of suspension whether back or front or side with the placement of ligature mark on the neck where high ligature was found to show an association with point of suspension at the back while low lying ligature was having an association with point of suspension at the side. However, there was no significant association of the degree of suspension with the placement of the knot. Many studies

have reported majority adopting complete and atypical hanging.[26]

Majority of the victims were not having classic signs (63%). Commonly observed "classic sign" was congestion followed by petechial haemorrhages. Classic signs were absent in majority of complete suspensions while they were commonly observed in partial suspensions with a statistically significant association ($p<0.001$). Classic signs are a result of purely mechanical vascular phenomena or obstructed venous return in the presence of continued arterial input. As pressure builds in venules and capillaries, particularly those with little surrounding connective tissue support, such as the conjunctivae and eyelids, vascular rupture produces petechiae.[27] Since partial suspension is adequate to obstruct the veins while arterial supply is continuing theoretically, classic signs are more commonly observed in partial suspensions though only few scientific studies are available to support this finding.[28] Our study further confirmed the theory and revealed a significant difference in presence of classic signs in partial suspensions compared to the complete suspension. On the other hand, high or low placement of ligature mark did not show any significant association to the presence of classic signs.

Internal injuries were absent in a majority. When present, they were found directly underlying the ligature mark in a majority. The commonest nature of the internal injury was fractures and they involved the thyroid cartilage or hyoid bone.

This contrast with other studies where internal injuries were commonly observed and the nature was soft tissue contusions.[29] Since the study was done retrospectively, possible handling artifacts at evisceration and proper documentation and discrimination cannot be assured. This suggested the need for a prospective study. There is no significant statistical association of presence or absence of internal injuries with the type of suspension; partial and complete or the ligature material used. This has been described in other studies as well.[30]

CONCLUSION

Correct interpretation of autopsy findings in a case of hanging is of extreme importance in making a confirmatory diagnosis of death owing to hanging. Our study revealed that the findings vary and could be found in many combinations, sometimes with exceptions to the generally accepted. Awareness of these combinations and the exceptions are of crucial importance in coming to a conclusion in a suspected case of hanging so as to avoid any erroneous opinion. Findings in our study confirmed the existing literature in many occasions but contrasted in some especially with regards to type of internal injury. This was identified as a limitation in a retrospective study where there is a possibility of handling artifacts.

REFERENCES

1. Sharma B. R., Harish D, Pal Singh V, Singh P. Ligature mark on neck: how informative?. JIAFM, 2005 : 27 (1).10-15.

2. Meera, M. Singh B K. Pattern of Neck Findings in Suicidal Hanging. A Study in Manipur. J Indian Acad Forensic Med. Oct 2011, Vol. 33, No. 4. 352 – 354.

3. Rao D. An autopsy study of death due to Suicidal Hanging – 264 cases, Egypt J Forensic Sci (2015), http://dx.doi.org/ 10.1016/j.ejfs.2015.01.004.

4. Cooke, C.T., Cadden, G.A., & Hilton, J.M. Unusual Hanging Deaths. Am J Forensic Med Pathol: Dec 1988 . Volume 9. Issue 4 pp: 277-365.

5. Chandegara P, Patel J, Zanzrukiya K, Patel U, Parkhe S, Gajera C, et al. Socio-demographic profile of hanging cases at New Civil Hospital, Surat.Int J Med Sci Public Health. 2014; 3(12): 1474-1477.doi: 10.5455/ijmsph.2014.130920141.

6. Vijayakumari N. Suicidal hanging: a prospective study. J Indian Acad Forensic Med, 33 (4) (2011), pp. 355–357.

7. Ahmad M, Hossain M. Z. Hanging as a method of suicide: Retrospective analysis of postmortem cases. J AFMC, Bangladesh, 6 (2) (2010), pp. 37–3.

8. Ambade V N, Tumram N, Meshram S, Borkar J. Ligature material in hanging deaths: The neglected area in forensic examination. Egypt J Forensic Sci. Volume 5, Issue 3, Sep 2015, Pages 109–11.

9. Biddle L, Donovan J, Owen-Smith A, Potokar J, Longson D, Hawton K, et al. Factors influencing the decision to use hanging as a method of suicide: qualitative study. Br J Psychiatry. Sep 2010, 197 (4) 320-325;
DOI: 10.1192/bjp.bp.109.076349.

10. Sharma BR, Harish D, Sharma A, Sharma S, Singh H. Injuries to neck structures in deaths due to constriction of neck, with a special reference to hanging. J Forensic Legal Med 2008 Jul;15(5): 298–305.

11. Saisudheer T, Nagaraja TV. A study of ligature mark in cases of hanging deaths. Int J Pharm Biomed Sci 2012;3(3):80–4.

12. Rao D. An autopsy study of death due to Suicidal Hanging – 264 cases. Egypt J Forensic Sci. 6; (3): Sep 2016, Pp 248-254 http://dx.doi.org/10.1016/j.ejfs.2015.01.004.

13. Dean DE, Kohler LJ, Sterbenz GC, Gillespie PJ, Gonzaga NS, Bauer LJ, et al. Observed characteristics of suicidal hangings: an11-year retrospective review. J Forensic Sci 2012 Sep;57(5):1226-30.

14. Wasnik RN. A two year study of suicidal deaths in Nagpur, central India. Indian J Forensic Med Toxicol. 2012;6:85–8.

15. P J Ayanthi, M T HirunavukarasuAnd, RajamanickamRajkumar Academic Stress and Depression among Adolescents: A Cross-sectional Study. Indian Pediatrics. Volume 52 Mar 15, 2015; 217-219.

16. Kosaraju SKM, Vadlamani LN, Mohammed Bashir MS, Kalasapati LK, Rao GLVC, Rao GP. Risk Factors for Suicidal Attempts Among Lower Socioeconomic Rural Population of Telangana Region. Indian J Psychol Med. 2015;37(1):30-35. doi:10.4103/0253-7176.150813.

17. Shioiri T, Nishimura A, Akazawa K , Abe R, Nushida H, Ueno Y, et al. Incidence of note-leaving remains constant despite increasing suicide rates. Psychiatry and Clinical Neurosciences (2005); 59, 226–228.

18. Pradhan A, Mandal BK, Tripathi CB. Hanging: nature of ligature material applied and type of hanging according to point of suspension. Nepal Med Coll J. 2012 Jun;14(2):103-6.

19. Momin S G., Mangal H M, Kyada H C., Vijapura M.T., Bhuva S.D.. Pattern of Ligature Mark in Cases of Compressed Neck in Rajkot Region: A Prospective Study. J Indian Acad Forensic Med. Jan-Mar 2012; 34 (1):40-43.

20. Shaikh M M M, Chotaliya H. J., Modi A.D., Parmar A. P., Kalele S. D.. A Study of Gross Postmortem Findings in Cases of Hanging and Ligature Strangulation. J Indian Acad Forensic Med. Jan-Mar 2013;35(1): 63-65.

21. Mohanty MK, Rastogi P, Kumar GP, Kumar V, Manipady. Periligature injuries in hanging. SJ Clin Forensic Med. 2003 Dec;10(4):255-8.

22. Arif M. Ligature mark on the neck; How elucidative?. Professional Med J 2015;22(6):798-803.

23. Bhausaheb NA, Baburao CS, Banerjee KK, Kohli A. Pattern of external and internal findings in deaths owing to hanging—a study in Northeast Delhi. Int J Med Sci Public Health 2015;4:1536-1539.

24. Jayaprakash S, Sreekumari K. Pattern of injuries to neck structures in hanging-an autopsy study. Am J Forensic Med Pathol. 2012 Dec;33(4):395-9.
DOI: 10.1097/PAF.0b013e3182662761.

25. Talukder MA, Mansur MA, Kadir MM. Incidence of typical and atypical hanging among 66 hanging cases. Mymensingh Med J. 2008 Jul;17(2):149-51.

26. Samanta A K, Nayak S R. Newer Trends in Hanging Death. J Indian Acad Forensic Med. Jan March 2012; 34 (1): 37-39.

27. Ely SF, Hirsch CS. Asphyxial deaths and petechiae: a review. J Forensic Sci 2000;45(6):1274–1277.

28. Clément R, Guay JP, Redpath M, Sauvageau A. Petechiae in hanging: a retrospective study of contributing variables. Am J Forensic Med Pathol. 2011 Dec;32(4):378-82.
DOI: 10.1097/PAF.0b013e3181db7ecf.

29. Vinita VE, Paul PM, Janani, Kumar PS. Pattern of neck tissue injuries in hanging -a prospective study. J Punjab Acad Forensic Med Toxicol 2014;14(2). 1-1-104.

30. Worawat A, Wongchanapai W, Thamtakerngkit S. Factors affecting neck injuries in hanging deaths. J Forensic Phys Assoc. 2008;2:23–32.

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7817

RADIOLOGICAL AGE ESTIMATION FROM FUSION AT XIPHI-STERNAL JOINT OF LIVING PERSONS THROUGH CT IMAGES OF THORACIC REGION

Herath L.H.M.I.M.[1], Senanayake G.[2] & Jeyasugiththan J.[3]

[1]Department of Radiography & Radiotherapy, Faculty of Allied Health Sciences, [2]Department of Pre-clinical, Faculty of Medicine, General Sir John Kotelawala Defense University, Sri Lanka.
[3]Department of Nuclear Science, Faculty of Science, University of Colombo, Sri Lanka

Corresponding Author: Herath L.H.M.I.M.

Email: indeewariherath23@gmail.com https://orcid.org/0000-0002-5202-1052

Abstract

Determination of age is really important and sometimes it is a difficult task in medico-legal practices. Aim of this study was to confirm whether the status of the fusion at xiphisternal joint can be used to estimate the age. Total of 275, who underwent computed tomography (CT) thoracic examination, were selected as the study sample. RadiAnt Digital Imaging and Communications in Medicine (DICOM) viewer was used to observe the fusion state. There was a negative correlation between fusion category and age in males ($r = -0.325$, $p < 0.001$), no significant correlation in females ($r = 0.094$, $p = 0.346$) and, a negatively significant correlation ($r = -0.165$, $p = 0.006$) in both sexes. There was a statistically significant difference in age between different fusion categories, $\chi 2\ (2) = 63.61$, $p < 0.001$ in males, $\chi 2\ (2) = 31.98$, $p < 0.001$ in females and, $\chi 2 = 97.76$, $p < 0.001$ in both sexes. There was a strong negative correlation between non-fusion age and distance of joint space in males ($r = -0.479$, $p = 0.006$), in females ($r = -0.963$, $p < 0.001$) and, in both sexes ($r = -0.758$, $p < 0.001$).

Keywords: *age estimation, fusion state, xiphisternal joint*

INTRODUCTION

One important parameter which helps for the identification of an individual is age whether the person is alive, dead or human remains. Every person whether dead or alive has right to be identified for several reasons. Living person may require age estimation when birth certificate is not available or records are doubtful, to determine the age in criminal liability, to assess whether the child has attained the age of criminal responsibility such as rape, kidnapping, employment, premature births, adoption, illegal immigration etc. and in cases of illegal marriages. Dead person may require age estimation during disaster victim identification such as fires, crashes, accidents, homicides etc. and aborted fetal age determination.

Determination of age is really important and sometimes it is a difficult task in medico-legal practices. Especially in the setting of a crime investigation or a mass disaster, it is difficult for investigators to determine the age of unknown human bodies since there is a large number of possible matches. Using various methods of estimating age, investigators estimate the age and try to identify the unknown body.

As mentioned above, not only in the criminal cases but also in the civil cases age determination plays a vital role. Most of the developing countries don't have a perfect way to record age in past and also most of the old age people don't have their birth certificate and national identity card (NIC) with them and even don't remember their age. According to the age of a person various government agencies give benefits like employment, pension, medical reimbursement and concession. In some countries railways authority gives concession of 40% to male senior citizens and 50% to female senior citizens where a senior citizen is considered as age more than 60 years[1].

In general, the method used for age estimation is not changed though the person is living or dead. It is carried out using methods relying on macroscopic morphological features, radiology, microscopic features, chemical and molecular biology and radiocarbon (14C) analysis[2].

Radiological assessment of age is really benefited in forensic anthropological cases like in mass graves and mass disasters where the soft tissue removal is not feasible or where a quick age determination is required as the initial step of person identification. Several of the above mentioned morphological methods have been studied using radiology.

When radiology is used to determine the age with the help of bones or joints, CT examinations play a vital role since CT scanners produce the detailed images of bones with high-resolution. These images can be used to evaluate the joint spaces. Since the modern cross-sectional imaging technology is incorporated into the CT machines, images generated are free of superimposition from other overlying structures. Usually, CT scanners generate images in the axial plane, but, modern scanners allow this volume of data to be reformatted in various planes such as sagittal and coronal. This volume of data can also be used to form volumetric (3D) representations of structures. Another importance of doing CT examination is because of high resolution data acquired in a single breath hold since it has a very short scan time[3].

Some literatures have shown that the sternum is also used as an important tool to determine the age especially in middle aged and old aged persons. When the sternum is used, the status of its fusions between manubrium and the body of the sternum and between xiphoid process and body of the sternum is considered and in comparison radiological examination of

sternum is easy and applicable to both dead as well as living[4].

Several research studies say that the fusion at xiphisternal joint can be used as an important tool to determine the age of an unknown person. According to the results given in those studies, it was noticed that there is a discrepancy in age of fusion at xiphisternal joint. This discrepancy motivated to do the present study. Further, there was no any published literature done on age determination using fusion at xiphisternal joint for Sri Lankan population. The objective of the present study was to confirm whether the status of the fusion at xiphisternal joint can be used as a tool to estimate the age.

MATERIALS AND METHOD

Present study was carried out on patients from both sexes in different ages who underwent CT thoracic examination done using TOSHIBA Alexion 16 slice Multi Detector Computed Tomography (MDCT) machine at Sri Jayewardenepura Hospital. Convenient sampling method was used to select the subjects for the study and data were collected through machine storage at the hospital with no inconvenience to the hospital setup. The study sample consisted of all the patients, who were not in the exclusion criteria, came for CT thoracic examination during the period of data collection from April 2018 to August 2018. Therefore 275 patients including 172 males (from 17 years of age to 86 years of age) and 103 females (from 19 years of age to 87 years of age) were selected after assessing against the exclusion criteria of having a disease or a damage in respect to anterior chest wall and/or the sternum. The ethical clearance for the study was taken from the Ethical Review Committee (ERC) of Faculty of Medicine, General Sir John Kotelawala Defence University and the permission was granted from the hospital after giving the ethical clearance certificate to the hospital. Axial images of thoracic region which were taken for each patient who underwent CT thoracic examination were copied into digital versatile discs (DVDs) monthly using storage data in the CT machine at Sri Jayewardenepura Hospital. Using RadiAnt DICOM viewer installed into the personal computer, the axial images were observed for any exclusion criteria with the help of a consultant radiologist. The copied data which showed any disease or damage to anterior chest wall and/or to the sternum were discarded and not included to the study sample. Then a 3D image of thoracic region was created for each study participant using collected axial images by '3D Volume Rendering' tool. Then the unwanted structures surrounded to the sternum were selected and deleted using 'Scalpel' tool available in the viewer for easy viewing of sternum. The image was rotated by '3D Rotate' tool to delete the structures which were posterior to the sternum. Then the xiphisternal joint was observed by rotating the image using '3D Rotate' tool and the state of the fusion of xiphoid process with the body of the sternum was decided by the same radiologist on zoomed in image. State of the fusion was categorized as partial fusion (partially fused), complete fusion (completely fused) and absence of fusion (separate/not fused) and recorded with the age and sex of each study participant in an Excel sheet. The average distance between body of the sternum and the xiphoid process was taken and recorded in millimeters (mm) using three distances measured at three different points of the joint space for the study participants who had unfused xiphoid process. All analysis was completed using IBM Statistical Package for the Social Sciences (SPSS) 20 software for Windows. An alpha level of 0.05 was used for significance in all statistic testing. Fusion state was ranked as 'partial fusion = 1', 'complete fusion = 2' and 'absence of fusion = 3' for easy analysis. All study cases were divided into age

groups as 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, and 85-94. The association of fusion ranks with the age and the association between non-fusion age and the distance of joint space were examined using Spearman correlation since data were not in the normal distribution. The K independent sample Kruskal-Wallis H test was used to examine whether there is a difference in ages which show each fusion state. Curve estimation was used to find the most fitted curve which show the relation between the joint space distance and the non-fusion age and then the non-linear regression was used to create a model to estimate the age of a person who is having an unfused xiphoid process. All analysis was done for males and females separately. Finally, results were compared with the results of similar literatures.

RESULTS

Table 1: Distribution of cases according to the age

Age Groups (Yrs.)	Sex				Total (%) n=275
	Male		Female		
	N	%	N	%	
15-24	4	2.32	1	0.97	5 (1.81)
25-34	12	6.97	2	1.94	14 (5.09)
35-44	20	11.62	6	5.82	26 (9.45)
45-54	19	11.04	16	15.53	35 (12.72)
55-64	34	19.76	25	24.27	59 (21.45)
65-74	48	27.9	31	30.09	79 (28.72)
75-84	33	19.18	18	17.47	51 (18.54)
85-94	2	1.16	4	3.88	6 (2.18)

Table 2: Relation between fusions at xiphisternum according to the age

Age Group (Yrs.)	Sex					
	Male			Female		
	Not-fused (%)	Partially Fused (%)	Completely Fused (%)	Not-fused (%)	Partially Fused (%)	Completely Fused (%)
15-24	3 (75.0)	0 (0.0)	1 (25.0)	1 (100.0)	0 (0.0)	0 (0.0)
25-34	11 (91.6)	0 (0.0)	1 (8.3)	2 (100.0)	0 (0.0)	0 (0.0)
35-44	15 (75.0)	5 (25.0)	0 (0.0)	5 (83.3)	0 (0.0)	1 (16.6)
45-54	0 (0.0)	7 (36.8)	12 (63.1)	2 (12.5)	13 (81.2)	1 (6.2)
55-64	0 (0.0)	0 (0.0)	34 (100.0)	0 (0.0)	8 (32.0)	17 (68.0)
65-74	1 (2.0)	1 (2.0)	46 (95.8)	2 (6.4)	0 (0.0)	29 (93.5)
75-84	1 (3.0)	1 (3.0)	31 (93.9)	1 (5.5)	2 (11.1)	15 (83.3)
85-94	0 (0.0)	0 (0.0)	2 (100.0)	1 (25.0)	0 (0.0)	3 (75.0)
Total	31(18.0)	14 (8.1)	127 (73.8)	14 (13.6)	23 (22.3)	66 (64.0)

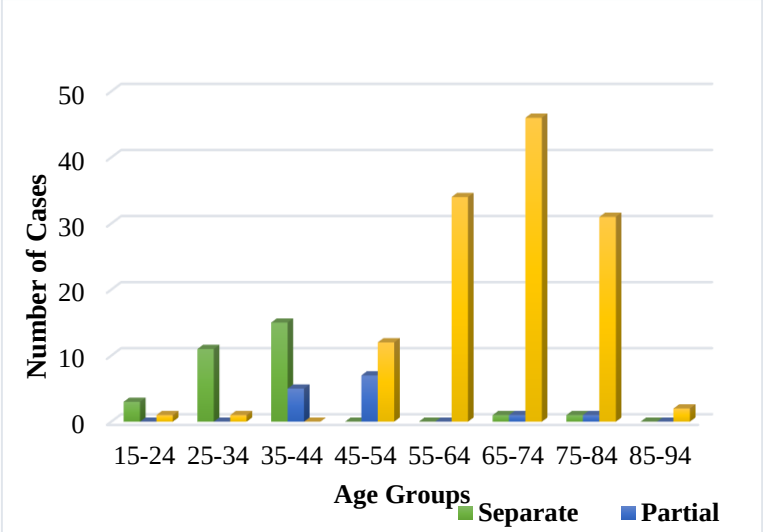

Fig. 1: Relation between fusions of xiphoid with sternal body according to the age group in male

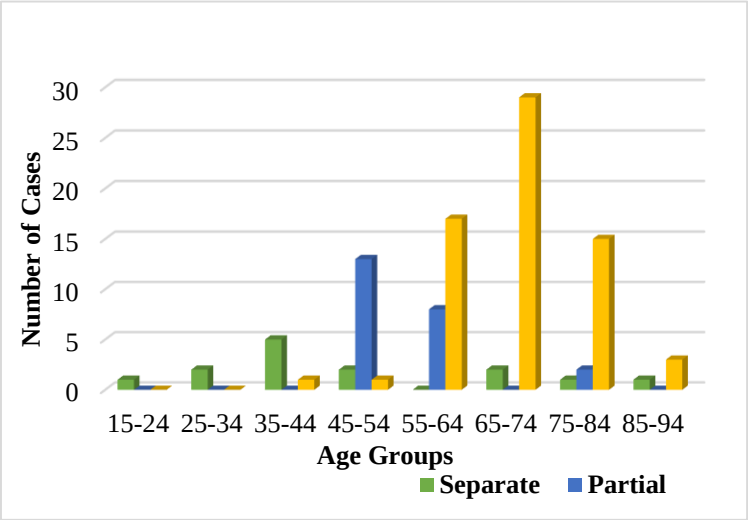

Fig. 2: Relation between fusions of xiphoid with sternal body according to the age group in females

Table 3: Correlation between fusion state and age with and without stratification by sex

Age	Sex	Spearman *r*	*p* value
All	Male	-0.325	< 0.001
	Female	0.094	0.346
	Both	-0.165	0.006

Table 4: Relation between fusion ranks and age

Age	Sex	Fusion Rank	Number of Cases	Mean Rank	Kruskal-Wallis test $\chi 2$, df= 2	*p* value
All	Male	Non-fusion	31	29.39	63.61	< 0.001
		Partial fusion	14	52.14		
		Complete fusion	127	104.23		
	Female	Non-fusion	14	27.29	31.98	< 0.001
		Partial fusion	23	31.39		
		Complete fusion	66	64.42		
	Both	Non-fusion	45	53.84	92.76	< 0.001
		Partial fusion	37	86.26		
		Complete fusion	193	167.54		

Table 5: Correlations of non-fusion age with distance of joint space between xiphoid process and body of the sternum for all age groups with and without stratification by sex

Age	Sex	Spearman *r*	*p* value
All	Male	-0.479	0.006
	Female	-0.963	< 0.001
	Both	-0.758	< 0.001

DISCUSSION

The model equation which can be used to estimate the non-fusion age of a male person when the distance at xiphisternal joint space is known was revealed as follows;

Non-fusion age = -30.569 + (744.23 / distance of joint space) .....(1)

The model equation which can be used to estimate the non-fusion age of a female person when the distance at xiphisternal joint space is known was revealed as follows;

Ln (non-fusion age) = 1.957 + (17.994 / distance of joint space) .....(2)

The present study measured the xiphoid process fusion from CT scans and, to best of our knowledge, is the first study of its kind to examine developmental trends in xiphoid process with the age in Sri Lanka. The results show no partial or complete fusion before 20 years of age in any sex. The early fusion was reported in the age of 20 years in males. This proves the statement given by Saladin & Kenneth (2010) where the xiphoid process may become joined to the body before the age of thirty[5]. This early fusion age revealed from the present study differs from the results given in some similar studies. One study was carried out on 192 living persons to study the radiological age estimation from xiphisternal joint and they concluded that the earliest age of fusion of xiphoid process with the body of the sternum was 36 years in males and 35 years in females[6].

The other study was carried out on 116 cases of age above 10 years including both sexes to determine the age by gross and radiological aspect of sternum and it revealed that the earliest age of complete fusion of xiphoid process was 31 years[7].

But when the early fusion age of 20 years in the present study compares with the results given by the study conducted to estimate the age from sternum for age group 25 years onwards, it was revealed that there is a similarity with the earliest age of fusion of 26 years in both males and females which showed in that study[1].

Further, another similarity was found from the study done on time of fusion of mesosternum with manubrium and xiphoid process[8]. According to their results, 03 male cases were recorded with complete fusion of xiphisternum within the age group of 18-20 years. Moreover, a study done in Punjab on time of fusion of the human mesosternum with manubrium & xiphoid process in sterna obtained from 772 male and 208 female subjects revealed that the xiphoid process did not fuse with the body of the sternum in males below 18 years and female below 21 years[9].

As said by some authors, results of the present study also show that ossification of xiphisternal joint delays up to late adulthood since the late fusion was reported in the age of 84 years in males and 86 years in females[10]. Similar result was found in another literature as they mention that the late fusion was found at 81 years in males and 80 years in females[1]. Further, this result of late fusion age revealed from the present study is confirmed by the result given in another similar literature[8]. As this study says 09 male cases were recorded with absence of fusion within the age group of 61 years and above. This observation on late fusion age of the present study is however in contradiction to the result given in a similar study done to estimate the age using fusion at xiphisternum since they concluded that their observation on latest age of fusion was 59 years in males and 56 years in females[6]. Further, the result on late fusion age of present study proves the statement given by Saladin & Kenneth (2010) where the xiphoid process sometimes remains ununited in old age[5].

According to the observations of present study, it was found that the majority of both males and females showed complete fusion as 127 cases (73.8%) in males and 66 cases (64%) in females. More than one third of them showed the complete fusion in the age group of 65-74 years in both sexes as 46 cases (36.2%) in males and 29 cases (44%) in females. This means the higher probability of occurrence of complete fusion (36.22% in males & 44% in females) was found in the age group of 65-74 years. As shown in the present study, average age of complete fusion in males is 65.70 years and in females is 68.83 years. When compare this result with the similar literatures, one study showed that it was 50.04 years in males and 46.42 years in females while another study said that it was 54.33 years in males and 57.86 years in females[6,1]. This discrepancy proves the statement given by Saladin & Kenneth (2010) where the union of xiphoid process with the body of the sternum occurs more frequently after forty[5].

According to the results, no case has been noted as ‘partially fused’ up to the age group of 35-44 years in males and 45-54 years in females. When see the result given in a study done on age determination using gross and radiological assessment of sternum, it showed that partial fusion started from the age group of 31-40 years in both males and females[7].

According to the observations in the present study, 6.45% were reported as not-fused and 64.28% were reported as partially-fused in males while 42.85% were reported as not-fused and 100% were reported as partially-fused in females after 44 years of

age. Therefore, present study agrees with the statement given in the study done in India 2011 where the forensic experts should be cautious when estimate the age of persons above 40 years on the basis of fusion of xiphisternal joint[6].

CONCLUSION

In conclusion, present study would like to say that fusion state alone has been shown to be insufficient to estimate the age. The age of an unknown person who is having a not-fused xiphisternum can be estimated using proposed regression models and additional measurements including density, thickness, length etc. of the sternal body and xiphoid process from CT scans would permit to modify the proposed regression models for absence of fusion. These additional measurements will be helpful to develop more accurate regression models to determine the age of an unknown person having completely fused and partially fused xiphoid process. The use of a clear fusion ranking system, such as the one used here can help clarify some of the inconsistencies in published research findings to date. This research provides a baseline for understanding typical xiphoid process fusion with possible implications for the field of forensic medicine, medico-legal practice and anatomy.

ACKNOWLEDGEMENT

We would like to express our gratitude to the Director, in-charge radiographer and all the other staff of the radiology department at Sri Jayewardenepura Hospital.

REFERENCES

1. Chopra, M., Singh, H., Kohil, K. & Aggarwal, O. P., 2014. Age Estimation from Sternum for Age Group 25 Years Onwards. J Indian Acad Forensic Med, 36(3), pp. 270-272.

2. Villa, C. & Lynnerup, N., 2014. Age estimation of skeletal remains. Research and Reports in Forensic Medical Science, (4), pp. 3-9.

3. Gakhar, G. K., Gupta, V., Jasuja, O. P. & Khandelwal, N., 2014. Determining the Ossification Status of Sternal End of the Clavicle using. Journal of Forensic Research, 5(2), pp. 1-6.

4. Silajiya, D. A. et al., 2013. Radiological Age Estimation from Sternum. National Journal of Integrated Research in Medicine, 4(4), pp. 108-114.

5. Saladin & Kenneth, S., 2010. Anatomy and Physiology: The Unity of Form and Function. Fifth Edition ed. New York: McGraw-Hill.

6. Garg, A., Goyal, N. & Gorea, R. K., 2011. Radiological Age Estimation from Xiphi-Sternal Joint in Living Person. J Indian Acad Forensic Med, 33(1), pp. 27-29.

7. Tailor, C. I. et al., 2013. Age Determination by Gross and Radiological Aspect of Sternum. J Indian Acad Forensic Med, 35(1), pp. 21-25.

8. Singh, D., Inderjit & Sanjeev, 1994. Time of fusion of mesosternum with manubrium and xiphoid process. Journal of the Anatomical Society of India, 43(2), pp. 125-135.

9. Jit, I. & Bukshi, 1986. Time of the human mesosternum with manubrium and xiphoid process. Indian Journal of Medical Research, Volume 83, pp. 322-331.

10. Neal, M. L., Dwornik, J. J., Ganey, T. M. & Ogden, J. A., 1998. Postnatal Development of the Human Sternum. J Pediatr Orthop, 18(3), pp. 398-405.

DOI: http://doi.org/10.4038/sljfmsl.v10i2.7829

FATAL CASE OF WASP STINGING

Senanayake S.M.H.M.K. & Senarathna K.N.

Teaching Hospital, Anuradhapura, Sri Lanka

Corresponding Author: Senanayake S.M.H.M.K.

E-mail: dilruksena62@yahoo.co.uk https://orcid.org/0000-0002-0441-5970

Abstract

History - While a 2 year and 9 month old girl was going for a bath with the grandmother, they encountered a wasp net on the ground. The wasps stung the child. She developed anaphylaxis and died during transport from local hospital eight hours after the attack.

Postmortem examination- Thirty two skin lesions of 2-3 mm wide, circular, black macules were seen on back and limbs. Every black spot was surrounded by a 0.5 – 2cm size elevated red margin. Pink fluid in pleural cavities and peritoneal cavity, shock lungs and congested viscera were the only internal findings. Blood was hemolyzed and unsuitable for serum beta tryptase test. Based on the skin lesion, medical history and evidence of eye witness, the cause of death was pronounced as anaphylaxis following wasp attack.

Conclusion- Familiarization with skin lesions of wasp stings are important for Srilankan forensic medicine practitioners. Collection and preservation of ante mortem blood samples or early postmortem blood sample with serum separation by centrifuging is advisable in suspected anaphylaxis cases for future confirmatory investigation.

Key words: *Vespa affinis, skin lesion, wasp sting, anaphylaxis, envenomation*

INTRODUCTION

In the animal kingdom, order Hymenoptera and suborder Apocrita includes bees, yellow jackets, hornets (wasps) and ants.[1] Wasps can be divided into social wasps and solitary wasps. Social wasps are aggressive and live as colonies in nests found in tree stumps, on rocks surfaces, tall structures like buildings, roof of caves, and mammal burrows. More than 25000 species of wasps exist in the world and cause more morbidity and mortality than other venomous animals.[2] In Sri Lanka, Vespa affinis (debara) species is mainly responsible for the highest number of deaths among Hymenoptera stings.[3,4]

The stinging apparatus is a modified ovipositor, hence the sting ability belongs to females.[3] Stinging apparatus is connected to a venom gland and used as an offensive or defensive weapon. Unlike bees, wasps can sting multiple times.[5] The venom of wasp contains a mixture of Histamine releasing factors, enzymes, hemolysins, neurotoxins, vasodilators, vasospastic amines and Phospholipase A. Hornet stinging is a common environmental hazard in Sri Lanka. When disturbed, hornets attack in a swarm. Majority of victims recover in hospitals but some die of complications.

Clinical features of hornet stings are localized redness, swelling, and pain over the site of the wasp sting. The pain begins immediately, and gradually worsens as the redness and edema gradually worsen. The localized reaction may last 6-12 hours. A minute punctate lesion is visible at the center of the lesion where the wasp sting occurred. Patients with a mild allergic reaction may experience itching and hives. Patients with severe allergic reactions and anaphylaxis may present with throat-closing sensation, dyspnoea, chest tightness, lightheadedness, increased anxiety, headache, nausea, abdominal cramps, palpitations, symptoms of Myasthenia gravis and optic neuropathy.[6] Death due to anaphylaxis can occur following single sting.[7] Envenomation occurs due to more than 20 stings and death is due to hemolysis, rhabdomyolysis and acute kidney injury.[8] Disseminated intravascular coagulation and allergic myocardial infarctions (kounis syndrome) are the late fatal complications.[9]

A range of clinical complications ranging from nonspecific skin lesions to anaphylactic shock can occur, in a previously sensitized person, following even a single hymenopteran bite (Vespa affinis).[10]

When there is a death, external examination for wasp stings, internal examination for organ failure and blood investigations for mast cell tryptase and Ig E levels will help the diagnosis. We report a fatal case of wasp sting with 32 skin lesions.

CASE REPORT

History- A two years and nine month old girl had approached a fallen wasp net on the ground. A swarm of wasp had attacked the girl and grandmother at about 2.30 pm. At 6.30 pm girl was transferred to tertiary care hospital from local hospital. Patient died at 8.40 pm on admission to the intensive care unit.

Postmortem examination- thirty two skin lesions were seen on limbs and back. Each lesion was a black circular macule 2-3 mm in size, surrounded by an elevated erythematous margin of 0.5 to 2cm in size. Internally, bilateral pleural effusion, ascitis, dark rubbery lungs and pale kidneys with unclear cortico-medullary junctions were seen. Histology of skin showed only ectatic blood vessels.

Fig. 1 : Skin lesions on legs

Fig. 2 : Skin lesions on back

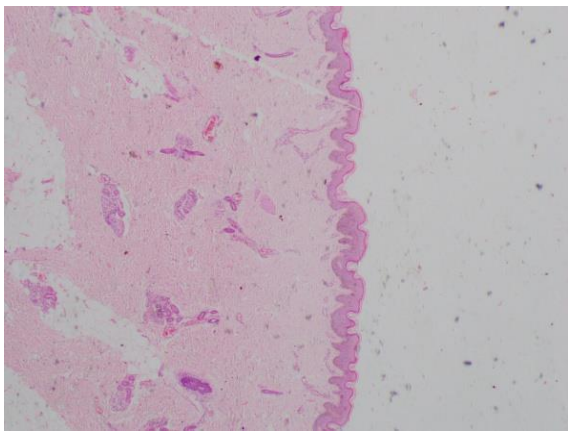

Fig. 3: Photomicrograph of (x4)
Section of skin with ectatic blood vessels (Hematoxylin and eosin stain)

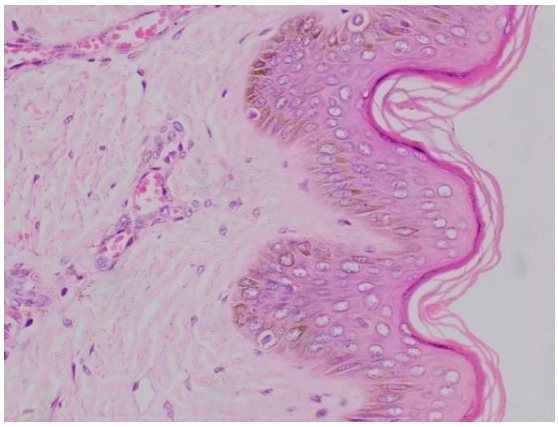

Fig. 4: Photomicrograph of (x40)
Section of skin with no increase complement of inflammatory sells (Hematoxylin and eosin stain)

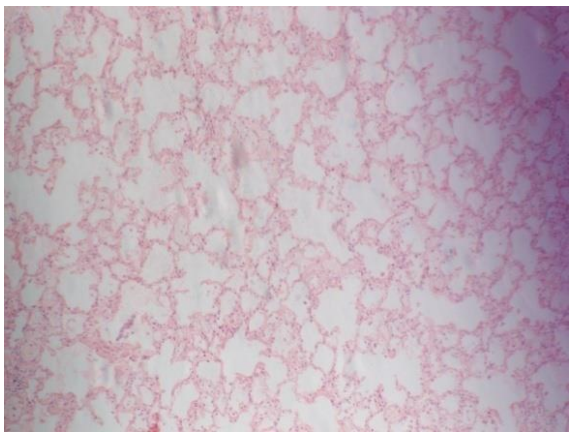

Fig. 5: Photomicrograph of Lung (x10)
Section of lung shows no pulmonary edema evidence or micro thrombi (Hematoxylin and eosin stain)

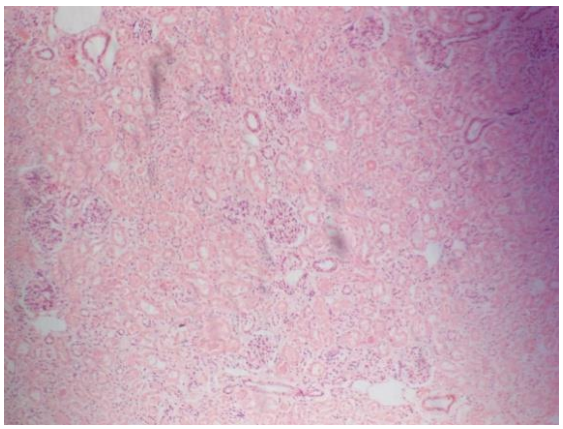

Fig. 6: Photomicrograph of Kidney Section of kidney show no of acute tubular necrosis (Hematoxylin and eosin stain)

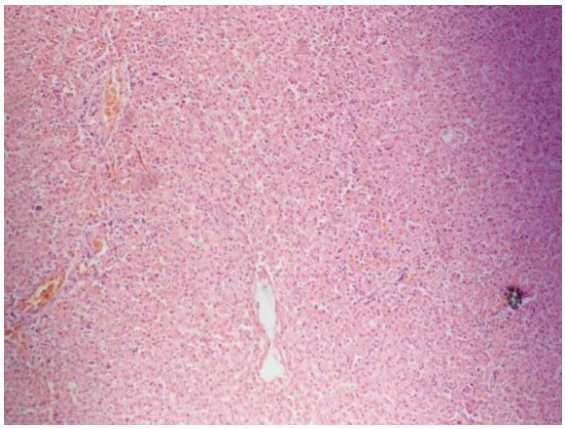

Fig. 7: Photomicrograph of Liver (x10) Section of liver show Congestion of Blood vessel with no evidence of micro thrombi (Hematoxylin and eosin stain)

Blood was hemolysed and unsuitable for beta trypatse investigation. After exclusion of trauma and natural diseases, with the help of eye witness and medical records of local hospital, the cause of death was pronounced as anaphylaxis following wasp stings.

DISCUSSION

This is a witnessed case of wasp sting and the diagnosis was obvious for the clinicians and forensic pathologists. Because wasps are abundant in Sri Lanka and nesting close to human dwelling, stings are frequently reported on unsuspecting children and adults. Other than the history the most important clinical feature is the skin lesion. Punctuate dark color circular centre (1-2mm) with raised red circular margin (1-2cm) was observed in all 32 lesions of this case. The skin lesion was the only helpful clinical criterion for the diagnosis of wasp sting. Familiarization of skin lesion of wasp sting is important for the forensic practitioner to medically establish the diagnosis in both, witnessed deaths and also in the investigations of unwitnessed deaths recovered from jungles to exclude the possibility of wasp sting. Internal examination will be helpful to establish immediate cause of deaths such as multi organ failure due to anaphylaxis, acute pulmonary oedema, cardiotoxicity and acute kidney injury due to envenomation.[6] Histology of skin lesions usually shows ectatic blood vessels and inflammatory cell infiltration. Absence of inflammatory cells in this case may be due to early death before cell migration.

To confirm anaphylaxis following wasp sting, needs blood investigations; but hemolysis would be an obstacle, as in this case. Therefore preservation of antemortem blood sample and early collection of postmortem blood samples should be a routine practice in all suspected deaths due to anaphylaxis. Failure of the medical management in this case may be due to acuteness and severity of the allergic reaction as well as the younger age.

CONCLUSION

Familiarization of skin lesions of wasp sting is important for forensic practitioners. Preservation of antemortem blood sample and early collection of postmortem serum sample after centrifuging blood should be a routine practice in all suspected deaths due to anaphylaxis.

REFERENCES

1. Akre RD, Reed HC: Ants, wasps and bees. Medical and veterinary Entomology. Edited by: Garry M, Lance D. 2002, London: Academic Press, 383-408.

2. Goulet H, Huber JT: Hymenoptera of the World: An Identification Guide to Families. 1993, Ottawa: Canada Communication Group.

3. Kularatne SAM, Gawarammana IB, De Silva PHJG: Severe multi-organ dydfunction following multiple wasp (Vespa affinis|) Stings. CMJ. 2003, 48: 146-147.

4. Kularathne K,Kannaagara T,Jayasena A,etal. Fatal acute pulmonary oedema and acute renal failure following wasp/hornetstinge in Sri Lanka: two case reports. Journal of medical case reports.2014 June13. https://www.researchgate.net/publication/263100451_Fatal_acute_pulmonary_oedema_and_acute_renal_failure_following_multiple_wasphornet_Vespa_affinis_stings_in_Sri_Lanka_Two_case_reports

5. Pick T: Wasp kinins and kinin analogues. Animal Toxins; Facts and Protocols. Edited by: Rochat H, Martin MF. 2000, Basel: Birkhauser, 100-103.

6. Maltzman JS, Lee AG, Miller NR: Optic neuropathy occurring after bee and wasp sting. Ophthalmology 2000, 107(1):193–195.

7. Sharmila R, Chetan G, Narayan P, Srinivasan S.Multiorgan dysfunction syndrome following single wasp sting. The Indian Journal of paediatrics. 2007 Dec; 74(12) 1111-2

8. Vettr RS, Visscher PK, Camzine S. Mass envenomation by honey bees and wasps. Western Journal of Medicine. 1999 Apr; 170(4): 223-227 (PMCID: PMC1305553)

9. George P, Pawar B, Calton N, Mathew P. Wasp sting: An unusual fatal outcome. Saudi Journal of kidney diseases and transplantation. 2008; 19(6) 969-972

10. Gunasekara WDVN, Ratnatunga NVI, Abeygunawardana AS: Acute renal failure following multiple wasp bites. Sri Lanka J Child Health 2007,36:67–68.13.

INSTRUCTIONS TO AUTHORS

The Sri Lanka Journal of Forensic Medicine, Science & Law (SLJFMSL) publishes original research papers, reviews, points of view, case reports, technical notes and letters to the editor, in all areas of Forensic Medicine, Forensic Sciences, relevant Law & Ethics.

Material received is assumed to be submitted exclusively to this journal. All papers will be **peer reviewed**. The editor reserves the right to amend style, correct English language, do editorial corrections where necessary, and determine priority and time of publication. When submitting papers, authors are advised to include a covering letter indicating that all authors have consented for the publication of the article in the Sri Lanka Journal of Forensic Medicine, Science and Law.

The manuscript, including figures and tables, should be submitted as a Microsoft Word document to sljfmsl@med.pdn.ac.lk

Dr. Deepthi Edussuriya/Prof. Dinesh Fernando,
Co-editors,
SLJFMSL,
Dept. of Forensic Medicine,
Faculty of Medicine,
University of Peradeniya

The paper should be typeset with double spacing. All pages should be numbered. The manuscript should be divided into the following sections:

Title Page
Summary/ Abstract
Text
Acknowledgements
References
Tables
Figures and Legends
Authors are encouraged to email or e-submit (through the webpage) articles in the above format.

The title page should give the full title, names of authors with qualifications, posts held during the study, department(s) and institution (s) where the work was carried out, and the name and full address (including telephone number, emails) of the author for correspondence. If available, please also include 16-digit ORCiDs of the author(s).

The summary/abstract should not exceed 250 words and should illustrate what was done, the main findings and conclusions. Up to five Key words should be given under the summary.

The text of research papers should be divided into Introduction, Materials and Methods, Results, and Discussion. Only generic names of drugs should be given, if applicable. Abbreviations should be spelt out when first used in the text. Scientific measurements should be given in SI units. Statistical methods should be specified in the methods section and any term which is not in common usage should be referenced.

Tables and figures should be referred to in the order of appearance in the text in Arabic numerals within parentheses, e.g. (Fig. 1). Tables should have brief titles. Figures should be used only when data cannot be expressed clearly in any other form. Photographs should have a figure number and caption and be attached as jpg files or incorporated into the MS word document.

References should be in the Vancouver style, and numbered consecutively using Arabic numerals in superscript form, in the order in which they appear in the text.
Note that the SLJFMSL requires the complete name of the journal and not its abbreviation. Where available, please include the DOI numbers of the references.

Journal article
Westaby S, Evans BJ, Ormerod O. Pulmonary-artery dissection in patients with Eisenmenger's syndrome. New England Journal of Medicine. 2007; 356: 2110-2.
DOI: 10.1056/NEJMc063492

Electronic Journal article
Stockhausen L, Turale S. An explorative study of Australian nursing scholars and contemporary scholarship. J Nurs Scholarsh [Internet]. 2011 Mar [cited 2013 Feb 19];43(1):89-96. Available from: http://search.proquest.com.ezproxy.lib.monash.edu.au/docview/858241255?accountid=12528

Book
Saukko P, Knight B. Knight's forensic pathology. 4th ed. New York (NY): CRC Press; 2016. 402 p.

Chapter in a book
Blaxter PS, Farnsworth TP. Social health and class inequalities. In: Carter C, Peel JR, editors. Equalities and inequalities in health. 2nd ed. London: Academic Press; 1976. p. 165-78.

Report
Rowe IL, Carson NE. Medical manpower in Victoria. East Bentleigh (AU): Monash University, Department of Community Practice; 1981. 35 p. Report No.: 4.

Web page
Diabetes Australia. Diabetes globally [Internet]. Canberra ACT: Diabetes Australia; 2012 [updated 2012 June 15; cited 2012 Nov 5]. Available from: http://www.diabetesaustralia.com.au/en/Understanding-Diabetes/Diabetes-Globally/

Conference paper
Patrias K. Computer-compatible writing and editing. Paper presented at: Interacting with the digital environment. 46th Annual Meeting of the Council of Science Editors; 2003 May 3-6; Pittsburgh, PA.

Ethical responsibilities
For studies involving human participants a statement detailing ethical approval and consent should be included in the methods section.

Conflicts of interest
Should be stated, if any.

Peer Reviewing Process
Each article submitted will be reviewed by two reviewers: One member from the journal's editorial board and one external expert in the field relevant to the article. The process will be double blinded; neither the author nor the reviewer will be informed each other's identity. The editor has the right to accept or reject articles based on reviewers' comments.

Plagiarism
Authors are advised to refrain from any form of plagiarism. All sources must be correctly cited. All articles may be subjected to a plagiarism detection software (CrossCheck) by the publisher/editor.

Fees
No fee will be charged for accepting, reviewing or publishing articles. However if the article requires extensive correction of English language, the editor may recommend the author to consult an English language expert at the author's expense.

Reprints of articles can be supplied at an approved cost. Inquiries regarding advertisements & subscription should be addressed to;

The Editor,
SLJFSL,
Dept. of Forensic Medicine,
Faculty of Medicine,
University of Peradeniya, Sri Lanka.

Individual copies of the Journal are available at Rs.350/- each. All cheques and drafts should be drawn in favour of the 'Sri Lanka Journal of Forensic Medicine, Science & Law, Dept. of Forensic Medicine, Faculty of Medicine'.

This journal is also published as an open access e journal through Sri Lanka Journals online.

Submission Preparation Checklist

As part of the submission process, authors are required to check their submission's compliance with all of the following items. Submissions that do not adhere to these guidelines may be returned to the authors.

1. The submission has not been previously published, nor is it before another journal for consideration concurrently.
2. The submission file is in Microsoft Word document file format.
3. All references have been provided correctly.
4. The text is double-spaced; font: 12-point Times New Roman; Illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
5. The text adheres to the stylistic and bibliographic requirements outlined in the author guidelines, which is found under submissions.
6. The corresponding author has obtained consent from all authors to submit the article for publication.
7. Ethical clearance and other legal or administrative permissions have been taken by the authors where necessary for conducting/publishing the research.
8. The authors are responsible for the work carried out in the study.

Copyright Notice

Privacy Statement

The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.

Typesetting: Ms. Vinodani Dharmasena, Dept. of Forensic Medicine, Peradeniya