

Case Report

A RARE CASE REPORT OF DEATH IN A WASHING MACHINE WITH PATTERNED INJURIES TO TRUNK

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Case Report

A RARE CASE REPORT OF DEATH IN A WASHING MACHINE WITH PATTERNED INJURIES TO TRUNK

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Abstract:

Here we describe a case report of accidental death of an adult male in washing machine. A worker in an industrial washing unit working as a drier of clothes entered the washing unit to clean his undergarments and accidentally switched on the machine knob. This set him into rotations inside the machine and eventually got trapped in between the outer drum and the inner rotator drum of washing machine. The specific patterned abrasions over trunk corresponded with patterns found over inner drum of washing machine.

Key words: Washing machine death, patterned abrasion, Traumatic asphyxia

Introduction:

Asphyxia is common mode of death in India. Though hanging forms the commonest cause of asphyxia, instances of deaths due to traumatic asphyxia as a result of compression of the trunk by various means like a heavy weight compressing the chest or abdomen, wedging of the body within a narrow space, deaths in large crowds are also encountered¹⁻³. However an incidence of a man getting struck in between the two cylinders of a commercial washing machine is a rare phenomenon unless there is gross negligence of the operator or a fault in the machine. We present a fatal case of traumatic asphyxia with unique patterned abrasions over front of trunk. The force causing the chest compression was distinctly determined by the autopsy and scene investigation.

Case report:

The police brought a case to mortuary of department of Forensic Medicine of Victoria Hospital for postmortem examination with a history of body struck in an industrial washing machine. History was obtained from the police who had conducted enquiry in to the cause of death. According to them a healthy adult male (the deceased) was working as a drier of clothes in an industrial washing machine for past few years. He was an experienced skilled worker and use to do about 8 to 10 hours work in a day and he was non alcoholic.



Figure 1: shows the picture of washing machine with victim's legs upside the inlet, rest of the body has gone inside machine.

of inlet. This set himself in rotator motion inside the drum and after one round his body got

On the day incidence after finishing his work as a drier in the drier unit of the same washing machine, he removed his inner wear for washing and wrapped a towel around his waist. As he went to wash his inner wear in the same washing machine and peeped into the inlet of washing machine, accidentally switched on the uncovered machine knob with his hand, which was there just to the right

trapped in between the outer drum and the inner rotator drum and got compressed in between the two drums. He screamed for few minutes as told by other workers but could not rescue himself from this fatal event. The outer lid was cut open to remove the body by the police after taking photographs. The body was covered by a cloth and was transported to the Victoria hospital Bangalore, where it was declared as 'brought dead'. The Figure 1, shows the picture of washing machine with victim's legs upside the inlet, rest of the body has gone inside machine.



Figure 2. The hands high up above the head, rigor mortis was fixed in the same position

Autopsy findings: On examination on the table, body was that of moderately built and nourished male. The hands high up above the head, rigor mortis was fixed in the same position as shown in the Figure 2. The deep purple discoloration observed on the face, neck, hands and protruded tongue. Subconjunctival hemorrhages present in both the eyes. An interesting findings was the typical depressed patterned abrasions, 0.65cm in radius, uniformly seen

over the front of lower part of the chest and upper part of abdomen (Figure No 3 and 4).



Figure No 3 and 4: Depressed patterned abrasions of size 0.65 cm uniformly seen over the front of lower part of the chest and upper part of abdomen



Three horizontal linear pressure abrasions below the patterned lesions over front of abdomen and another similar horizontally placed pressure abrasion notated over front of chest (Figure No 5a and 5b).

Figure No 5a: Three horizontal linear pressure abrasions below the patterned lesions over front of abdomen.



Figure No 5b: A horizontal linear pressure abrasion over front of chest

The safety knobs of the outer door of washing machine was tampered so as to work even if it was not closed with a human interference and was made to work with a single button, which can trigger the machine to rotate, (similar to an elevator turning on even when only the outer door was closed). We also observed the outer drum and the inner rotator made up of yielding metallic plates. The later was having circular 0.65 cm sized uniformly arranged, centrally perforated elevations (Figure No. 6).



Figure No. 6: Washing machine showing circular 0.65 cm sized uniformly arranged, centrally perforated elevations over inner drum and on right side switch buttons without safety guard.

reported.¹⁻³ In this case it is a sort of entrapment in awkward position between outer drum and inner rotator. Though there was compression over trunk evidenced by presence of patterned abrasions but the fractures of ribs and injuries to internal organs of chest and abdomen were not observed, this could be due to yielding nature of inner rotating drum.

The outstanding feature of traumatic asphyxia is the intense cyanosis of deep purple or purple-red color, confined to the face, neck and shoulders up to the thoracic inlet. The mechanism of this gross discoloration of upper part of chest and face may be ascribed to the fact that heavy load/pressure upon the chest primarily might have compressed the thinner and less potent right side of the heart; whereas the more powerful left side of heart continued to pump the blood. This leads to considerable overfilling in the region of the head, resulting in such gross discoloration of the face and adjacent regions⁴. Similar discolorations with

A linear grazed abrasion of size 9cm x 2cm present over the back of the chest. The internal organs were intact and congested with multiple petechial hemorrhages over surface of lungs, heart and in white matter of brain.

The cause of death was opined as Traumatic asphyxia as a result of compression of the trunk.

Scene of crime: The machine which was responsible was not put to use until inspection as instructed at the time of postmortem examination. On examination of the same machine, it was observed that the

Discussion:

Traumatic asphyxia refers to a form of mechanical asphyxia where respiration is prevented by external pressure on the body: a heavy weight compressing the chest or abdomen, wedging of the body within a narrow space, death in large crowds have been

petechiae were noted in this case. 'Perthes' pressure congestion, a German term used to describe crush asphyxia has been coined after Perthes who described these characteristic features. Torso compression has been found to be the most common mechanism of asphyxiation of victims within vehicles.²

Chest compression resulting in death from crush asphyxia is usually inadvertent and accidental as also shown in the present case, although both suicides and homicides have been reported³. A similar case was reported by Bülent Eren et al⁶ of a 33-year-old man who was found 20 Cm upper of the floor, compressed by rubbish container in the elevator in an unusually awkward position. The scene investigation corresponded exactly with the localization of the injuries found in the victim.

Patterned abrasions occur when the force is applied at or around right angle to the surface of skin. If a weapon with patterned surface strike the body or body falls upon a patterned rough hard surface, the abrasions will follow the pattern of the object⁷. The specific patterned abrasions over trunk observed in this case corresponded with patterns found over inner drum of washing machine and is consistent with the findings in reviewed literature.

Asphyxia due to compression is not a rare cause however death resulting in a washing machine with this typical pattern is unusual. In this case the machine was not guarded with safety measures. The precaution of closing the outer case was ignored by the washing unit staff which enabled the machine to rotate directly by accidental triggering of the switch. The location of the switch was such that there was a possibility of accidentally pressing the switch while the operator is resting his hand on the panel for support. Hence it is need of an hour to ensure the proper functioning of such machines with safety measures and creating awareness in workers of such uneventful outcome through education.

Conclusion:

The deaths at work place are common but death in commercial washing machine is rare. The specific patterned abrasions over trunk corresponded with patterns found over inner drum of washing machine and visit to the scene of crime confirms the mechanism of causation of the injuries. This case highlights a need to ensure the proper functioning of such machines with safety measures and creating awareness in workers of such uneventful outcome through education.

References:

1. Sklar DP, Baack B, McFeeley P, Osler T, Marder E, Demarest G.. Traumatic asphyxia in New Mexico: a five-year experience. *Am J Emerg Med.* 1988;6:219–23.
2. Vega RS, Adams VI. Suffocation in motor vehicle crashes. *Am J Forensic Med. Pathol.* 2004;25:101–7.
3. Byard RW, Wick R, Simpson E, Gilbert JD. The pathological features and circumstances of death of lethal crush/traumatic asphyxia in adults-a 25-year study. *Forensic Sci Int.* 2006;159:200–5.
4. Krishan Vij. *Textbook of Forensic Medicine and Toxicology*, Elsevier publication, 4th edition 2008, Traumatic asphyxia;159.
5. Grellner W, Madea B. Zum Tod durch Perthes'sche Druckstauung. *Arch Kriminol.* 1996;198:167–75.
6. Bülent Eren, Nursel Türkmen, Recep Fedakar, "An unusual case of thorax compression", *J Ayub Med Coll Abbottabad* 2008;20(1)
7. Krishan Vij. *Textbook of Forensic Medicine and Toxicology*, Elsevier publication, 4th edition 2008, Injuries by Blunt Force; Patterned Abrasions; 283.

Case Report

ARRHYTHMOGENIC RIGHT VENTRICULAR DYSPLASIA/CARDIOMYOPATHY

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Case Report

ARRHYTHMOGENIC RIGHT VENTRICULAR DYSPLASIA/CARDIOMYOPATHY

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Abstract:

Sudden death in apparently healthy individual kindles suspicion and mostly such cases are registered as un-natural deaths by the police. It usually happens, because of some pre-existing, un-manifested, undiagnosed disease process. Arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) is considered to be one of the major causes of such sudden unexpected deaths, especially in young people. Hence, a meticulous autopsy and histopathological examination is the only method available to confirm the cause of death in such cases of sudden death. We report a case of sudden death of a young adult due to cardiac origin. The post mortem examination of heart showed thinning of left ventricular wall thickness (size-1.7 cm); widened circumference of all major valves with yellowish discoloration of valve cusps, chordae tendinae, and papillary musculature due to diffuse fatty infiltration. Gross findings in both atria were unremarkable. Aorta showed fatty streaks, but the lumen of both coronary arteries was patent. Cardiac microscopy revealed, fatty infiltration of right ventricular wall, chordae tendinae, papillary muscles and along right interventricular septum with atrophy of adjacent myocardial fibers. The autopsy examination confirmed the death was due to right ventricular dysplasia/cardiomyopathy (ARVD/C).

Keywords: sudden cardiac death, right ventricular cardiomyopathy, postmortem.

Introduction:

Death is a mystery to the living, and the living look to death for help. Sudden death of young adults is the most dramatic and emotional moment of a person's life. The sudden cardiac death (SCD) is the major cause of death in adults. The commonest cause of sudden cardiac death is coronary artery disease accounting for as many as 80% of cases, followed by cardiomyopathy in 10 to 15 %. Other causes account for 5 to 10 % of cases. Arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) is currently a definite cause of sudden unexpected death, especially in young people.¹ First time it was described by Dalla Volta and co-workers in 1961. However, Frank and Fontaine coined the term arrhythmogenic right ventricular dysplasia in 1978.² ARVD/C is a heart muscle disorder characterized pathologically by fatty or fibro-fatty replacement and electrical instability of the right ventricular myocardium. Although incidence and prevalence of ARVD are unknown, according to study conducted by Thiene G et.al it accounted for 20% of sudden deaths in all individuals younger than 35 years and 22% of sudden deaths in young athletes .³ More recent studies escalate this number to 2.5% of sudden deaths per year and a prevalence of 1 in 5,000 births.⁴ Familial occurrence of ARVD is about 30%–50% with mainly autosomal dominant inheritance.⁵⁻⁹

The pathogenesis of ARVD/C is unknown. The disease process starts in the subepicardial region and spreads towards the endocardial surface, leading to transmural involvement.¹⁰ Two morphologic variants of ARVD are fatty and fibrofatty.^{11,12} The fatty form is characterized by almost complete replacement of the myocardium without thinning of the ventricular wall, exclusively in the right ventricle. The fibrofatty variant is associated with significant thinning of the right ventricular wall, and the left ventricular myocardial wall

may also be involved. Different pathogenetic mechanism described are - apoptosis in 75 % of ARVD/C cases¹³, inflammation present in 2/3 of cases¹⁴ and trans-differentiation of myocardial cells into fibrous or fat cells.¹⁵

Unfortunately, the first manifestation of the disease may be a sudden cardiac death (7%–23%).¹⁶ Approximately 75% of these deaths occur during daily activities at home or at work.¹⁷ ARVD/C is classically characterized by ventricular tachycardia with LBBB, originating from the right ventricle.^{18,19} Palpitations, dizziness or even pre-syncope or syncope often related to physical exercise. Rarely, patients may complain of chest discomfort, which is not provoked by exertion.²⁰ Symptoms and signs of heart failure may be present in other patients.²¹ Screening of first degree relatives should include a medical history, a physical examination, a standard 12-lead and a 24-h ECG, a signal-averaged ECG, a bicycle stress test, a transthoracic echocardiography and a cardiac MRI.²² The most important diagnostic modalities for the detection of ARVD/C include conventional angiography, echocardiography, radionuclide angiography, ultrafast computed tomography (CT), and magnetic resonance (MR) imaging. Therapeutic options in patients with ARVD/C include antiarrhythmic agents, catheter ablation, implantable cardioverter defibrillators, and surgery.²³



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The body of a 32 years old male adult was brought for autopsy. As per history from his fellow workers, deceased was working at factory, had chest pain, and immediately he was taken to a private hospital where he was declared brought dead. Relatives of the deceased and his fellow workers did not give any significant past history of illness. Also there was no past history of sudden death within the family of the deceased.

Figure 1: The cavity of right ventricle showing thinning of ventricle wall (size-1.7cm) with fatty infiltration and increased sub-epicardial fat. Papillary muscle, chordate tendinae, endocardium, tricuspid valves and right atrium show fatty infiltration. Mouths of both coronary arteries are wide and patent.

Postmortem findings: Deceased was moderately built and moderately nourished. External injuries were absent. On dissection pericardium was intact. Minimal pericardial fluid was noted. Heart was normal in size and shape, weighed 262 grams. Coronary vessels were patent. Cut section showed right ventricle wall thinned out at lower lateral border with fatty infiltration. Papillary muscles, chordae tendinae, and endocardium of right ventricle showed fatty infiltration (Fig.1). Left ventricle wall was intact. Mitral and tricuspid valves were intact. Aortic and pulmonary artery valves were intact. Aorta was atherosclerotic. Other organs were intact and congested. Morbid gross pathology of heart was suggestive of arrhythmogenic right ventricular dysplasia/ cardiomyopathy (ARVD/C). Provisional cause of death was given as arrhythmogenic right ventricular dysplasia/ cardiomyopathy (ARVD/C), however final cause of death is reserved pending for histopathology report.

Histopathology: Grossly heart weighed 250 grams. Epicardial fat increased, Right Ventricle wall thickness measured 0.3 cm but thinned out at lower border. Left ventricle wall thickness measured 1.7 cm, mitral valve circumference was 12cm, tricuspid valve circumference was 13 cm and aortic valve circumference measured 8 cm. Right ventricle endocardium showed yellowish discoloration at valvular cusps, chordae tendinae, and papillary muscles. Right atrium, left atrium and left ventricle wall was unremarkable. Interatrioventricular septum showed fatty discoloration. Aorta shows fatty streaks. Both coronaries lumen was patent.

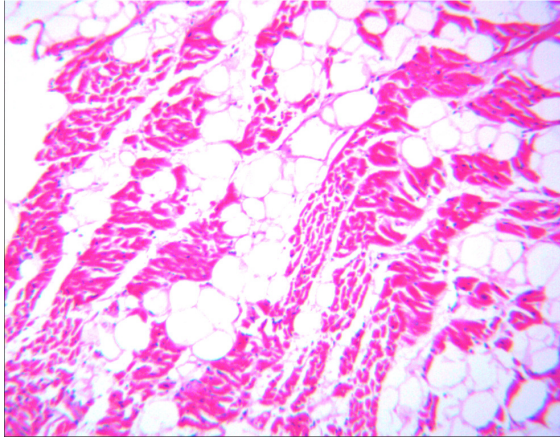


Figure 2: High power view of histopathology samples of right side heart, stained with Haematoxylin & Eosin show fatty infiltration with atrophy and necrosis of myocardium of ventricular wall; and, diffuse inflammatory cell infiltration. [40X, H&E Stained]

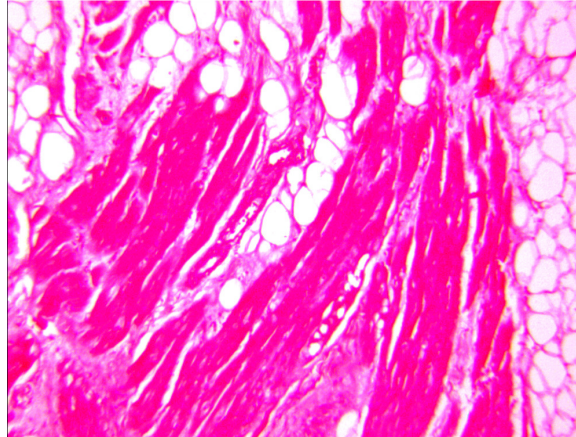


Figure 3: Right ventricle papillary muscle showing diffuse fatty infiltration [40X, H&E Staining]

Both atrial appendages were unremarkable. Microscopically right Ventricular wall (Fig. 2) along with chordae tendinae, papillary muscles (Fig.3), right interventricular septum showed fatty infiltration and atrophy of adjacent myocardial fibers. Gross findings in right and left atria were unremarkable. Left Ventricle wall along with chordae tendinae, papillary muscles showed no evidence of fatty infiltration. Aorta showed fatty streaks. Valve cusps showed microscopic evidence of fatty change predominantly in aortic cusps. Haematoxylin & Eosin (H&E) staining of right side heart showed myocardial cell necroses with diffuse inflammatory cell infiltration in to the interstitium (Fig.2). Coronaries were patent. Diagnosis- Arrhythmogenic right ventricular disease/cardiomyopathy (ARVD/C). The provisional diagnosis by the clinician was heart failure. Autopsy findings confirmed the cause of heart failure is due to Arrhythmogenic right ventricular disease or cardiomyopathy (ARVD/C).

Discussion:

Sudden death in ARVD/C is related to dysrhythmias generated at the junctional regions between atrophic and normal myocardium, hence the name of arrhythmogenic. Right ventricle is predominantly involved, but increasing recognition of biventricular involvement is also noted (arrhythmogenic cardiomyopathy).^{24,25} In his pathologic studies, Anderson appreciates that about 50% of cases have left ventricle involvement, including adolescents.²⁶

The histological findings i.e. fatty or fibrofatty replacement of the myocardium interfering with intraventricular conduction form the basis for the electrical reentrant phenomena which may trigger ventricular arrhythmias ranges from frequent premature ventricular complexes (PVCs) to ventricular tachycardia (VT) to ventricular fibrillation (VF).

There are two pathological patterns seen in ARVD, fatty infiltration and fibro fatty infiltration. Death is seen in 50% of cases.²⁷ The lipomatous form is characterized by dilatation of the right ventricle, while in the fibromatous pattern an inflammatory process with degenerated and necrotic myocytes is seen, which is part of a healing process in the context of myocarditis.²⁸ It is said in forensic medicine: "Eyes the most, Hands the next, Tongue the least". What the mind knows, the eyes will detect. In our case we suspected ARVD/C on gross postmortem findings of fatty infiltration of right ventricle. Histopathology examination confirmed fibrofatty infiltration of right ventricle and myocardial cell necrosis with inflammatory cells diagnostic of fibrofatty variety of ARVD/C.

Histological demonstration of transmural fibrofatty replacement of right ventricular myocardium at either autopsy or surgery is diagnostic of ARVD/C.²⁹ Clinically a definite diagnosis of ARVD/C is difficult to make and should be based on the criteria reported in the Task Force by McKenna et al. in 1994.³⁰

Conclusion:

Determination of cause of death in sudden unexpected death in young is challenging task for forensic experts. Knowledge of causes of death in such cases, clinical history, family history, and meticulous autopsy along with histopathology and ancillary investigations one can arrive at final cause of death. Screening of relatives of deceased family to rule out inheritance of disease in other family members is also an important aspect.

References

1. Anathasubramanian K, Khaja F. Arrhythmogenic right ventricular dysplasia/cardiomyopathy: review for the clinician. *Prog Cardiovasc Dis* 1998;41:237-46.
2. Frank R, Fontaine G, Vedel J, et al. Electrocardiologie de quatre cas de dysplasie ventriculaire droite arythmogène. *Arch Mal Coeur* 1978; 71:963-72
3. Thiene G, Nava A, Corrado D, Rossi L, Pennelli N. Right ventricular cardiomyopathy and sudden death in young people. *N Engl J Med* 1988; 318: 129-133.
4. Ahmad F, Li D, Karibe A, et al. Localization of gene responsible for arrhythmogenic right ventricular dysplasia to chromosome 3p23. *Circulation* 1998;98:2791-5.
5. Corrado D, Fontaine G, Marcus FI, et al. Arrhythmogenic right ventricular dysplasia/cardiomyopathy: need for an international registry. *Circulation* 2000; 101:E101-E106.
6. Ahmad F, Li D, Karibe A, et al. Localization of a gene responsible for arrhythmogenic right ventricular dysplasia to chromosome 3p23. *Circulation* 1998; 98:2791-2795.
7. Nava A, Thiene G, Canciani B, et al. Familial occurrence of right ventricular dysplasia: a study involving nine families. *J Am Coll Cardiol* 1988; 12: 1222-1228.
8. Rampazzo A, Nava A, Danieli GA, et al. The gene for arrhythmogenic right ventricular cardiomyopathy maps to chromosome 14q23-q24. *Hum Mol Genet* 1994; 3:959-962.

9. Rampazzo A, Nava A, Erne P, et al. A new locus for arrhythmogenic right ventricular cardiomyopathy (ARVD2) maps to chromosome 1q42-q43. *Hum Mol Genet* 1995; 4:2151–2154.
10. Corrado D, Basso C, Thiene G, McKenna WJ, Davies MJ, Fontaliran F, et al. Spectrum of clinicopathologic manifestations of arrhythmogenic right ventricular cardiomyopathy/dysplasia: A multicenter study. *J Am Coll Cardiol* 1997;30: 1512–1520.
11. Thiene G, Nava A, Corrado D, Rossi L, Pennelli N. Right ventricular cardiomyopathy and sudden death in young people. *N Engl J Med* 1988; 318: 129–133.
12. Corrado D, Basso C, Thiene G. Arrhythmogenic right ventricular cardiomyopathy: diagnosis, prognosis, and treatment. *Heart* 2000; 83:588–595.
13. Mallat Z, Tedgui A, Fontaliran F, Frank R, Durigon M, Fontaine G (1996) Evidence of apoptosis in arrhythmogenic right ventricular dysplasia. *N Engl J Med* 335:1190–1196
14. Basso C, Thiene G, Corrado D, Angelini A, Nava A, Valente M (1996) Arrhythmogenic right ventricular cardiomyopathy. Dysplasia, dystrophy, or myocarditis? *Circulation* 94:983–991
15. d’Amati G, di Gioia CR, Giordano C, Gallo P (2000) Myocyte transdifferentiation: a possible pathogenetic mechanism for arrhythmogenic right ventricular cardiomyopathy. *Arch Pathol Lab Med* 124:287–290
16. Priori SG, Aliot E, Blomstrom-Lundqvist C, Bossaert L, Breithardt G, Brugada P, Camm AJ, Cappato R, Cobbe SM, Di Mario C, Maron BJ, McKenna WJ, Pedersen AK, Ravens
17. U, Schwartz PJ, Trusz-Gluza M, Vardas P, Wellens HJ, Zipes DP (2001) Task Force on Sudden Cardiac Death of the European Society of Cardiology. *Eur Heart J* 22:1374–1450
18. Tabib A, Loire R, Chalabreysse L, Meyronnet D, Miras A, Malicier D, Thivolet F, Chevalier P, Bouvagnet P (2003) Circumstances of death and gross and microscopic observations in a series of 200 cases of sudden death associated with arrhythmogenic right ventricular cardiomyopathy and/or dysplasia. *Circulation* 108:3000–3005
19. van der Wall EE, Kayser HW, Bootsma MM, de Roos A, Schalij MJ. Arrhythmogenic right ventricular dysplasia: MRI findings. *Herz* 2000; 4:356–364.
20. Pinamonti B, Pagnan L, Bussani R, Ricci C, Silvestri F, Camerini F. Right ventricular dysplasia with biventricular involvement. *Circulation* 1998; 98:1943–1945.
21. Fontaine G, Fontaliran F, Hebert JL, Chemla D, Zenati O, Lecarpentier Y, Frank R (1999)
22. Arrhythmogenic right ventricular dysplasia. *Annu Rev Med* 50:17–35
23. Girard F, Fontaine G, Fontaliran F, Zenati O, Gajdos P (1997) Catastrophic global heart failure in a patient with non-arrhythmogenic right ventricular dysplasia. *Heart Vessels* 12:152–1
24. Zipes DP, ACC/AHA/ESC 2006 Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: *Circulation* 114:e385–484
25. Leclercq JF, Coumel P. Characteristics, prognosis and treatment of the ventricular arrhythmias of right ventricular dysplasia. *Eur Heart J* 1989; 10(suppl D):61–67
26. Fontaine G, Fontaliran F, Rosas Andrade F. The arrhythmogenic right ventricle dysplasia versus cardiomyopathy. *Heart Vessels* 1995; 10:227–235.

28. Sen-Chowdhry S, Surrís P, Ward D, McKenna WJ. Clinical and genetic characterization of families with arrhythmogenic right ventricular cardiomyopathy provides novel insights into patterns of disease expression. *Circulation* 2007; 115:1710-1720.
29. Anderson EL. Arrhythmogenic right ventricular dysplasia. *Am Fam Physician*. 2006; 73 (8): 1391-8.
30. Warrell, David A, Cox, Timothy M, Firth, John D., et al., (2003) Oxford textbook of medicine. Chapter: The cardiomyopathies: hypertrophic, dilated, restrictive and right ventricular. 4th edition. Oxford university press.
31. J. Hoogsteen et.al Arrhythmogenic right ventricular dysplasia and sudden cardiac death in endurance athletes Netherlands Heart Journal, Volume II, Number 1, January2003 28-33)
32. McKenna WJ, Thiene G, Nava A, et al. Diagnosis of arrhythmogenic right ventricular dysplasia/cardiomyopathy. *Br Heart J* 1994; 71:215–218.
33. McKenna WJ, et al Diagnosis of right ventricular dysplasia/cardiomyopathy. Task force of the working group myocardial and pericardial diseases of the European Society of Cardiology and the Scientific Council on Cardiomyopathies of the International Society and Federation of Cardiology. *BrHeartJ*1994;71:215-8.

Case Reports

ARTEFACTS AND ITS MEDICO-LEGAL PROBLEMS Dr. HT Thejaswi, Dr. AP Rayamane, Dr. R Puneeta, Dr. S Kalai, Dr. Jagadeesh H, Dr. Chandrashekaraiiah C

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Case Reports

ARTEFACTS AND ITS MEDICO-LEGAL PROBLEMS

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Abstract:

In the field of forensic medicine, often medico-legal problems arise due to postmortem Artefacts. Relatives of the deceased and general public often witness and wrongly interpret the external findings (Artefacts) which lead to serious suspicion about cause and manner of death and compel the police to book the case under Sec. 174 (C) CrPC or Sec. 302 IPC. Relatives of deceased put pressure or harass the doctors alleging the case is of murder etc., as doctors are always soft target of public. Medical officers fail to interpret these Artefacts and unwanted suspicion arises. Often such cases are referred to forensic experts for autopsy. Herewith cases that created medicolegal problems due to external Artefacts are reported and the importance of interpretation of these findings and convincing relatives, police, lawyers and the judiciary has been stressed.

Key Words: Post Mortem Artefact, Autopsy, Medicolegal Problem.

Introduction:

Postmortem Artefacts is any alteration or introduction of new features into the cadaver which is physiologically and pathologically unrelated to its natural state and are likely to cause misinterpretations for the investigators or for a layman who is unfamiliar with this phenomenon. It is imperative for the autopsy surgeons to know the various types of Artefacts, so that erroneous conclusions may be avoided which otherwise may lead to the inquest heading in the wrong direction and may lead to miscarriage of justice.¹

Relatives of the deceased often observe the external findings (artefacts) such as post mortem injuries, discoloration of the body, blood stains etc., and depending on the case suspicion and serious allegation of assault, poisoning, rape and murder etc. may be raised. If the relatives are not explained properly, many times they harass the doctors alleging them to be complacent in their duties and at times assault them as they are soft targets.

The issue gets further complicated because most of the medico-legal autopsies in India are carried by MBBS graduated medical officers without any special training in the field of Forensic Medicine. They are usually ignorant about various postmortem artefacts.

Hence police with their limited infrastructure are constrained to undertake elaborate investigations and at times book suspects under S. 302 IPC etc., all based on misconception/misunderstanding of facts.

Case reports.

Case No. 1

A 26 year old married lady was found hanging in the morning in a closed room, which was secured from inside. She was last seen alive the previous night. There was collection of blood on the floor and her clothes were blood stained (Fig 1.1), which raised serious suspicions of rape and murder. Relatives of deceased suspected foul play and forced police to register a case under S.174 (3) Cr P C. The body was taken to the nearby primary

health center where medical officers failed to interpret the injuries and referred to Forensic Medicine experts suspecting a case of rape and murder.



Pool of blood over floor

Ant bite marks on the lower limb



Ant bite marks along the lining of the Undergarments

During the postmortem examination there was the presence of irregular, serpiginous, scalloped areas of superficial skin loss, and small punctate and scratch-type lesions around the lining of her undergarments, and lower limbs. Some red ants were still crawling over the body. Thus it was concluded that the bleeding was the result of postmortem ant bites which were limited to the lining of the undergarment because of the presence of firm elastic bands lining it which limited the entry of ants further into the perineal area. Since the body was in the state of suspension for 6-8 hours, the resultant pooling of blood aggravated the Postmortem blood loss.



Case No. 2

Deceased, a young adult male, was last seen alive with his friends and was retrieved from the lake and sent to the mortuary with an alleged history of strangulation. When it was retrieved the relatives of the deceased who saw the dead body noticed presence of some injury marks on the neck which resembled a ligature mark and also an incised wound. Thus serious suspicion of foul play was raised. However, during medicolegal autopsy the body showed unequivocal features of ante-mortem drowning with the presence of pseudo-strangulation

ligature mark due to skin fold and superficial lacerated post-mortem wound of size 1 x 0.5 x

0.4 cms over the front of the mid-line of the neck, with irregular pale margins caused by aquatic animal. Postmortem bone deep lacerated wound was also found on the right hand.



Case No. 3

The Deceased found hanging in a closed room in lying down position over ground with slightly raised upper half of the body and ligature material tied at the window. Relatives of body noticed discoloration (darkening) over face, front of chest and abdomen and alleged it as a case of poisoning and murder. With great difficulty it was explained to them that the darkening of the body was due to the postmortem staining over dependent parts like face, chest, abdomen and both upper limbs.

Case No. 4



Ant bite abrasions over thighs and knee with trickled dried blood stains



Ant bite wound oozing blood from External Auditory Canal.

Deceased young adult male found hanging from a tree in the outdoor field. His pant and shirt was blood stained. Deceased relatives alleged it as a case of murder and a case was booked under S-174 (C) Cr P C. The police referred the case to the medical officer who failed to interpret the injuries and referred to forensic experts. Ant bite lesions were found over both lower limbs with the trickling of blood downwards staining pants. Discrete postmortem abrasions (Fig. 4.1) due to ant bites were found over front of chest and abdomen and all over back. Ant bite injury were also noted over external auditory canal leading to oozing blood (Fig. 4.2).

Discussion:

Often medical officers fail to interpret postmortem changes after death or postmortem injuries by ants, rodents, aquatic animals etc. and suspect it as a case of assault and refer to

forensic experts. Relatives put pressure on these medical officers claiming the death was of a suspicious nature. Medical officers in order to avoid unnecessary problems being created by relatives of deceased, refer the case to forensic experts. Police officers also fail to interpret these findings and sometimes it is difficult to convince them too. Few types of Artefacts are discussed below.

The Postmortem ecchymoses otherwise called '**vibices**' are tiny spots, at time round to oval bluish-black hemorrhages limited to dependant parts of body. It is the result of rupture of subcutaneous capillaries and smaller venules due to increased intravascular pressure from pooling of blood. This feature can again be mistaken for bruises.²

Patchy Lividity over neck and face, medial side of thighs, occiput area were misinterpreted as bruises and misdiagnosed as strangulation, sexual assault and blunt trauma to head respectively.³ Once rigor mortis sets in, the superficial venous blood cannot drain into deeper venous system so it appears as patchy lividity over upper chest and neck, which is often misinterpreted as contusions of throttling. In the cases of hanging described in this case report, lividity over the palms and the medial side of the thighs were misinterpreted as bruises and suspected cases that of assault, rape and murder.

Darkening of body due to well developed lividity created suspicion of poisoning in the case of partial hanging discussed in this case report, as people think poisoning changes the color of body.

Sometimes in hanging cases there may be postmortem bleeding from the anus if deceased had hemorrhoids and the suspension duration is long. Gravitational forces due to the upright position of the body facilitates post-mortem per-rectal bleeding from the ulcerated haemorrhoids.^{4,5} Same mechanism is responsible for oozing of blood from healing wound over great toe and rodent bite over great toe in cases of hanging discussed here.

Decomposition of body is responsible for perhaps the most common and the most significant of artefacts.⁶ Neck skin fold in early decomposed body of drowning case appears as ligature mark confused for ligature strangulation (pseudo-strangulation).

Aquatic animals fish, crab, etc., feed on drowned dead bodies especially eyes lids, ala of nose, lips, ears, scrotum etc. Margins are irregular (nibbled) and pale. Head down position in drowning case facilitates post-mortem congestion of head, face and neck and injuries over these region bleed.

In above mentioned cases postmortem laceration over front of neck and pseudo-stragulation mark led to suspicion of murder.

Postmortem injuries by rodents are present over exposed and unprotected and moist parts of body such as eyelids, nose, and mouth. Injuries appear as circular, crater like hollow defects. Margins were irregular, finely scalloped and serrated. Edges show protruding indentations up to 5 mm and focal distinct parallel cutaneous lacerations.⁷

Bite marks by ants can cause many irregular, serpiginous, scalloped areas of superficial skin loss, and small punctate and scratch-type lesions may be often observed in the body. Usually ant injuries are orange-pink to yellow in color and diffusely scattered over the skin surface. These injuries consist of small and rather shallow gnawed holes that can be easily misinterpreted as antemortem abrasions or resulting from strong acids. No bleeding is associated with such skin lesions but sometimes considerable hemorrhage can take place, especially where removal of superficial layers of the skin occurs in congested parts of the body. On histopathological examination signs of vital reaction are not found.⁸

In the three cases of hanging discusses here, ant bite injuries and blood oozed from these injuries were misinterpreted as antemortem injuries and suspicion of these cases being that of assault, rape and murder was raised.

Ignorance of knowledge of artefacts leads to:

- a. Wrong interpretation of cause of death.
- b. Wrong interpretation of manner of death.
- c. Wrong interpretation about time since death.
- d. Undue suspicion of criminal offense
- e. A halt in investigation of criminal death
- f. Wastage of time and effort as a result of misleading findings

It ultimately leads to miscarriage of justice.⁹

Problems faced by forensic experts due to Artefacts:

- Relatives of deceased create law and order problem.
- Relatives in huge numbers often put undue pressure on forensic experts.
- Difficult to explain layman and convince the relatives of deceased.
- Relatives of deceased threaten forensic experts by not receiving the deceased body or keeping body in front of the hospital and protesting.
- Many a time ill-informed media might spread false information due to misinterpretation.
- Lawyers may file a case in court due to false interpretation by seeing photographs and alleging involvement of experts for illegal gain.

Remedy for avoiding medicolegal problems by Artefacts.

- Conducting meticulous autopsy.
- Preserving viscera for FSL and other ancillary investigations such as histopathology etc.
- Photography or Video recording of the autopsy should be done.
- Detailed description of antemortem and postmortem injuries.
- Good communication and convincing relatives may help sometimes.
- Train medical officers periodically.
- Compulsory rotatory internship postings for interns in department of Forensic Medicine.
- In case of doubt, don't hesitate to take the opinion of senior colleagues.

Conclusion:

Post mortem artefacts are common phenomena in forensic practice. Medicolegal problems arising from these artefacts should be dealt with by performing a meticulous autopsy in every case along with ancillary investigations and photography. Ultimately being a forensic expert one should develop the public relations skills as most of these misunderstandings can be dealt effectively by taking the relatives of the deceased into confidence by explaining the case to them objectively.

References:

1. Saukko P, Knight BH. Knight's Forensic Pathology. 3rd Ed. London: Hodder Arnold; 2004.
2. Tsokos M. Forensic Pathology Reviews, Vol. 3. New Jersey: Humana Press; 2005. p. 183-237
3. Pollanen MS. Forensic pathology and the miscarriage of justice. Forensic Sci Med Pathol (2012) 8:285–289

4. Kanchan T, Menezes RG, Manipady S. Haemorrhoids leading to post-mortem bleeding artefact. *J Clin Forensic Med.* 2006 Jul;13(5):277-9.
5. Bhardwaj DN, Sharma SK, Gupta S. Haemorrhoids leading to post-mortem artefact: a case report. *Med Sci Law.* 2005 Jul;45(3):265-6.
6. Fateh Abdullah. Artefacts in forensic pathology. In: *Handbook of Forensic Pathology*, 1973; JB Lippincott Company, Philadelphia: 242.
7. Tsokos M, Matschke J, Gehl A, Koops E, Püschel K. Skin and soft tissue Artefacts due to postmortem damage caused by rodents. *Forensic Sci Int.* 1999 Sep 30;104(1):47-57.
8. Campobasso CP, Marchetti D, Introna F, Colonna MF. Postmortem Artefacts made by ants and the effect of ant activity on decompositional rates. *Am J Forensic Med Pathol.* 2009 Mar; 30(1):84-7.
9. Muthiharan K, Patnaik A K. *Modi's Medical Jurisprudence and Toxicology. Postmortem Artefacts.* 23rd ed. New Delhi: Lexis Nexis Butterworths India; 2005. p. 463-69.

Case Report

LIMITATIONS IN AUTOPSY DIAGNOSIS OF FATAL PULMONARY THROMBOEMBOLISM IN INDIAN SETUP

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Case Report

LIMITATIONS IN AUTOPSY DIAGNOSIS OF FATAL PULMONARY THROMBOEMBOLISM IN INDIAN SETUP

Dr. MR Sane, Dr. KU Zine, Dr. A Mugadlimath

Abstract:

Pulmonary thromboembolism (PTE) caused due to deep vein thrombosis (DVT) is an important cause of sudden natural death; however it is a commonly missed diagnosis at autopsies in Indian setup. This is a well-recognized complication of recumbency following trauma, especially fractures and surgical operation or prolonged bed rest in medical cases. However in some cases, no apparent predisposing condition is identified. In such cases, occult hereditary thrombophilias may play a causal role.

In the present case, an apparently healthy young man became suddenly unconscious while kick starting his motorcycle. He was immediately rushed to the hospital where he died during treatment within 3 hours of admission. His autopsy showed presence of deep vein thrombosis with pulmonary emboli. Histopathological examination of lungs revealed presence of pulmonary infarction and dating of residual leg vein thrombus indicated a thrombus of not more than 3 days. He was apparently healthy, without any predisposition for deep vein thrombosis. Fatal pulmonary thromboembolism with pulmonary infarct in such a young, healthy person without any predisposition of common risk factors is an unusual occurrence. This case emphasizes the need for improved methodology including dating of residual thrombus in leg veins and postmortem testing for hereditary thrombophilias in death of young people due to PTE.

Key words: deep vein thrombosis, dating of thrombus, hereditary thrombophilia

Introduction:

Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) are part of same spectrum of pulmonary thromboembolism (PTE). Homans first noted the relationship between DVT and PE.¹ Symptomatology of this disorder ranges from asymptomatic patients to fatal massive embolism. It is the one of the causes for sudden natural deaths. Thrombosis as per Virchow's triad must have predisposing conditions like stasis of blood, injury to vessel wall and hypercoagulability. 'Cause-effect' relationship, that is, presence of predisposing factors like injury, surgical operation or immobility in bed, are often present in most of the cases, however about 20% of the cases are ambulant and are apparently healthy.²

The overall annual incidence of PE increases as one ages, from 1 per 100,000 in childhood to 1 per 100 in old age.³ Incidence of fatal PTE is reported to be 10 to 12 %.^{1,4} The incidence of PE at autopsy is strongly influenced by the nature of the population surveyed (age and nature of patients), by the type of cases included in postmortem study and by the care with which autopsies are carried out.⁵ Fineschi et al reported that 4.5% of pulmonary embolisms originated in the iliac veins, 20.7% in femoral veins, and, 74.8 % in deep crural veins.⁶

The predisposition to form clots may be due to acquired or genetic risk factors. Acquired risk factors include immobilization, increasing age, surgery, malignancies, obesity, pregnancy, puerperium, oral contraceptives and long-haul air travels. Inherited conditions (hereditary thrombophilias) include factor V Leiden mutation to activated protein C resistance, prothrombin gene mutation, and deficiencies of antithrombin (I, II and III) and

protein C or protein S.⁷ Often, however, the precipitating event may not be apparent. In such cases, the etiology may be multifactorial.

Occurrence of fatal PTE in the absence of any apparent predisposing conditions in a healthy young person makes the present case unusual and presence of pulmonary infarct makes it rare.

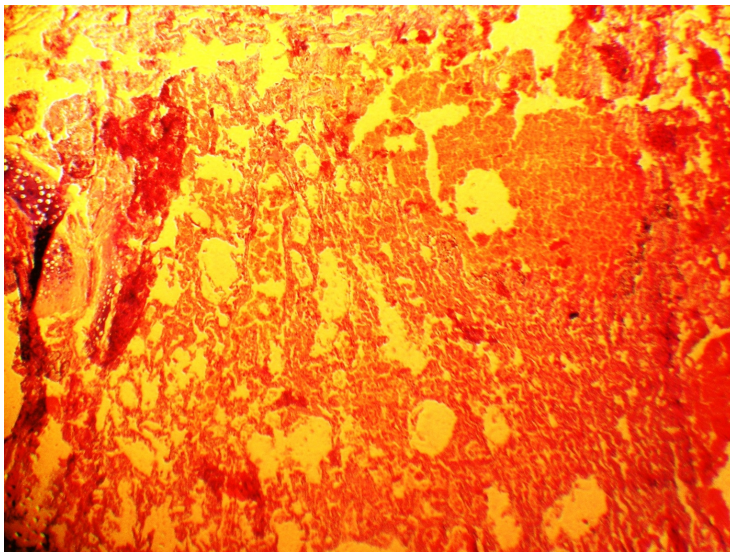
Case history:

A 24 year old healthy man, became suddenly unconscious while kick starting his motorcycle. He was immediately admitted to hospital and investigated.

At admission, his heart rate was 96 beats/min, blood pressure was 110/70mm of Hg, and respiratory rate was 34/min. The chest was clear on auscultation. Routine hematology testing revealed hemoglobin of 14.6 g/dL. Analysis of blood gas parameters showed pCO₂ of 46.8 mmHg, pO₂ of 163 mmHg, pH 7.12 and bicarbonate 14.6 mmol/L. International normalized ratio (INR) was 1.4. The oxygen saturation was 96%. X-ray chest was normal. CT scan of brain was normal. CT scan with contrast showed absence of contrast filling in pulmonary veins. ECG showed presence of S waves in lead I, and, Q and T waves in lead III (suggestive of pulmonary thromboembolism). He was diagnosed and treated as a case of pulmonary embolism. He died during the treatment, 3 hours after the admission.

At autopsy, on external examination, he was moderately built and nourished person. No injuries were present. On internal examination, both the lungs showed evidence of emboli in segmental and sub-segmental pulmonary arteries. Cut surface of thrombus was reddish brown in colour. Pulmonary infarction was noted in both the lungs with obliteration of air spaces with blood. Dissection of deep veins in the left leg showed thrombus in posterior tibial and popliteal veins, completely occluding the lumen. Other veins in both the legs did not contain any thrombus.

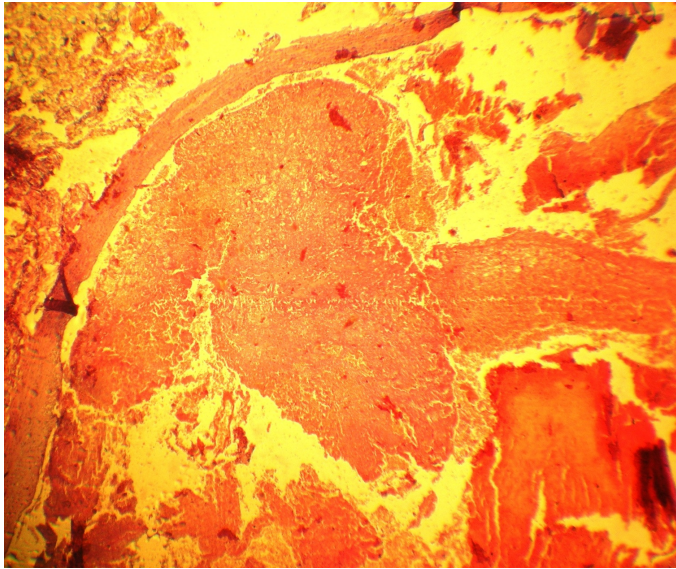
Fig. A. Histopathology of lung showing hemorrhagic infarction of lung parenchyma



Lungs and thrombus in-situ vessel wall were subjected for histopathological examination, which confirmed the presence of pulmonary infarction (Fig. A) and age of residual thrombus of not more than 3 days duration (Fig. B) respectively.

There was no history of trauma, immobility or injury to deep veins of leg by any other cause. There was no antecedent history of symptoms suggestive of deep vein thrombosis. Similarly there was no history of thrombotic events in first line surviving relatives of the deceased. Detection of genetic mutations which produce hypercoagulable state were not performed, because of unavailability of these investigations in this part of the country.

Fig. B. Histopathology of thrombus in the popliteal vessel wall



Discussion:

DVT occurs about three times more often than PE. About half of patients with pelvic vein thrombosis or proximal leg DVT develop PE, which is usually asymptomatic.⁸ Patients may present with symptoms like cardio respiratory shock as in the case discussed. Other symptoms that may be present are dyspnea, pleuritic pain, haemoptysis, tachycardia or anginal pain. Cardio respiratory shock is the presenting feature in 34.7% of patients of PTE.⁴ DVT and PTE should be suspected and actively searched

during autopsy in natural deaths with above symptoms. Of all the venous thromboembolic deaths, 7% were diagnosed with PTE and treated, 34% were sudden fatal PE, and 59% were as undetected PE.⁸

The incidence of PTE is approximately equal in men and women.⁹ 2.8% of sudden natural deaths in men are attributed to PTE.¹⁰ Young age is not known to be a risk factor for PTE. However, PTE in a person below 45 years of age is suggested as a criterion for screening for hereditary thrombophilia. Dickens et al noted only one case each of fatal pulmonary embolism in age group of 20-29 years in 97 and 60 cases of PTE deaths at Hongkong and Wales respectively.¹¹ However, we found no epidemiological data of PTE as a cause of sudden natural death and percentage of PTE detection in overall autopsy cases in Indian population. This may be due to the fact the many autopsies in Indian setup are conducted by Medical officers placed at peripheral health centers, who may have apathy towards detailed autopsy due to lack of adequate training or ignorance to add to malady.

Thorough autopsy in deaths due to PTE requires knowledge of the general and specific pathology of PTE. Once the thrombus dislodges and travels to the lung, depending on its size and coexisting cardiovascular diseases, it interferes with patient's haemodynamics. Because of the dual blood supply of the lungs (bronchial and pulmonary) and the rapidity of death, histological changes of infarction may not be evident in case of these sudden deaths.¹² Pulmonary infarction is reported to be in about 6% to 10% cases of PTE.^{7,13} In present case, pulmonary infarction in a death occurring in short duration makes it more peculiar.

The clinical diagnosis of pulmonary thromboembolism is notoriously inaccurate, with many cases either wrongly diagnosed (overdiagnosed) or missed (underdiagnosed), and autopsy is still regarded as the diagnostic gold standard. Detection rate can be improved by complete methodological approach, integrating clinical data by means of autopsy findings and histological study.⁵ Search for residual thrombus and age estimation of thrombus must be a routine workup in cases of PTE with DVT, as, these may be of concern at a later date. Bilateral dissection of the deep veins of the pelvis and legs in PTE deaths can provide valuable information regarding the proximate cause and manner of death. The detection of

thrombi in both legs can be seen with risk factors like stasis and decreased mobility as opposed to a direct injury of one leg which show presence of thrombus in injured vessel.¹² Thrombus along with surrounding vessel wall must be examined histopathologically for dating. It must always be remembered that other veins or other segments of same veins may have thrombi of different dates.² In the presented case, deceased was young and was not having any of the common acquired risk factors for PTE. Histological age of residual thrombus was not more than 3 days, as determined by histopathological grading reported by Irninger (1963), and, Fineschi et al (2009) as shown in Table 1. Autopsy in a case of PTE is never complete unless underlying predisposing factors are screened for.

Table 1: Histological age determination of thrombus at Phase I.⁶

2nd day (1st-3rd day) (after Irninger)	No reactions between endothelium and thrombus. White blood cells, fibrinous ribbons with blood platelets unchanged. Erythrocytes mainly densely packed in the center (agglomerated), peripherally looser.
1st-7th day	Flowing blood on an eroded endothelium, eliciting a platelet plug and fibrin deposition with a layered growth (Zahn's lines). No reaction between endothelium and thrombus is visible. Erythrocytes are preserved and agglomerated. Initial white blood cells pyknosis. Monocytes cells with enlarged nuclei.

Common acquired risk factors of PTE can be screened for by taking proper clinical history of the patient. However, uncommon risk factors like inherited thrombophilias also contribute to the likelihood of PTE and hence should be screened for. The two most common autosomal dominant genetic mutations are the factor V Leiden (FVL) and the prothrombin (PT) gene mutations. It is proposed that some of those persons who are immobilized, obese, postoperative, pregnant, taking OCP's, aged, leukemic, and/or have cancer and die as a result of a PTE because they also carry a heterozygous mutation of hereditary thrombophilias.¹⁴ The benefits of screening for these defects and the parameters of patient selection continue to be debated, and prophylactic treatment is controversial. We agree with conclusions of previous studies, that testing is not indicated for all individuals presenting with PTE, but rather should be reserved for those presenting at a young age (below 45 years of age) or with a compelling positive family history of thrombosis. In current case, tests for thrombophilia were not done due to absence of family history of thrombosis, and, lack of testing facilities and budgetary constraints.

Sparse data is available in Indian literature regarding epidemiology and causative factors of fatal PTE. This is mainly because, large amount of medicolegal autopsies are being conducted at rural primary health centres by medical officers who are not well trained. Unavailability of ancillary investigations makes the situation grimmer. This has lead to erratic reporting of 'cause of death' in sudden natural deaths, especially pulmonary thromboembolism being commonly missed one. Similarly at the other end, dating of residual thrombus and screening of precipitating factors (particularly hereditary thrombophilias) are less commonly looked for by many of the Forensic pathologists in India. Apart from medicolegal implications, detection and complete investigation of death due to PTE is necessary as it also has a potentially life-saving importance to surviving family members having compelling positive history of thrombosis.

Conclusion:

With the background of the above discussion, we emphasize the following measures for the investigation of sudden natural deaths-

1. High index of suspicion of PTE is necessary in sudden natural deaths, particularly in young asymptomatic persons.
2. Increased training of medical officers and provision of basic infrastructure for detection, collection, preservation, processing, and transport of necessary samples for further investigations.
3. Detection and dating of residual thrombus in fatal PTE cases.
4. Use of ancillary investigations like those for detection of hereditary thrombophilias at the higher medical centres, to facilitate further identification of similar disorder in blood relatives.
5. Further studies in Indian populations are needed to assess the role of hereditary thrombophilias in fatal PTE.

References:

1. Sandler DA, Martin JF. Autopsy proven pulmonary embolism in hospital patients: are we detecting enough deep vein thrombosis? *Journal of Royal Society of Medicine*. 1989; 82: 203-204.
2. Saukko P, Knight B. *Knight's Forensic Pathology*. 3rd edn. London: Arnold; 2004.
3. Miller EJ, Marques MB, Simmons GT. Etiology of pulmonary thromboembolism in the absence of commonly recognized risk factors. *Am. J. Forensic Med. Pathol.* 2003; 24: 329–333.
4. Hugo Uhland, Leonard MG. Pulmonary embolism: A commonly missed clinical Entity. *Chest*. 1964, 45, 533-536.
5. Fineschi V, Bafunno V, Bello S, Francesco De Stefano, Margaglione M, Neri M, Riezzo I. Fatal pulmonary thromboembolism. A retrospective autopsy study: Searching for genetic thrombophilias (Factor V Leiden (G1691A) and FII (G20210A) gene variants) and dating the thrombus. *Forensic science international*. 2012; 214: 152–158.
6. Fineschi V, Turillazzi E, Neri M, Pomara C, Riezzo I. Histological age determination of venous thrombosis: A neglected forensic task in fatal pulmonary thrombo-embolism. *Forensic science international*. 2009; 186: 22-28.
7. Lucena J, Rico A, Vázquez R, Marín R, Martínez C, Salguero M, Miguel L. Pulmonary embolism and sudden-unexpected death: prospective study on 2477 forensic autopsies performed at the Institute of Legal Medicine in Seville. *J Forensic Leg Med.* 2009; 16 (4): 196-201.
8. Goldhaber SZ. Deep vein thrombosis and pulmonary thromboembolism. In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL, et al editors. *Harrison's Principles of Internal Medicine*. 17th edn. New Delhi: The McGraw-Hill Companies; 2008.
9. White RH. The epidemiology of venous thromboembolism, *Circulation*. 2003; 107: I4–I8.
10. C Hunter-Craig. Deaths due to sudden or unexpected natural causes. In: Mant AK, editors. *Taylor's Principles and Practice of Medical jurisprudence*. 13th edn. New York: Churchill Livingstone; 1984.
11. Dickens P, Knight BH, P Ip, Fung WSY. Fatal pulmonary embolism: A comparative study of autopsy incidence in Hong Kong and Cardiff, Wales. *Forensic Science International*. 1997; 90: 171–174.

12. James RG. The Medicolegal Evaluation of Fatal Pulmonary Thromboembolism. In: Michael Tsokos, editors. Forensic Pathology Reviews Vol 3. New Jersey: Humana; 2005.
13. Husain AN, The Lung. In: Kumar V, Abbas AK, Fausto N, Aster JC, editors. Robins and Cotran Pathologic Basis of Disease. 8th edn. Saunders Elsevier; 2010.
14. Ely SF, Gill JR. Fatal Pulmonary Thromboembolism and Hereditary Thrombophilias. *J Forensic Sci.* 2005; 50(2): 1-7.

Review Article

CORPORAL PUNISHMENT IN SCHOOLS: A MEDICOLEGAL VIEW

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Review Article

CORPORAL PUNISHMENT IN SCHOOLS: A MEDICOLEGAL VIEW

Dr. CS Makhani

Abstract:

Corporal punishment in educational institutions is a problem accosting the society the world over. Its menace has neither spared the developing nations nor the developed ones.

The damage afflicted as result of corporal punishment to the all round physical and mental development of a child is acknowledged by one and all. What was once an accepted practice endorsed by the education boards is now perceived correctly as a threat to the young nubile generations which would hold the reigns of our nation.

Initiatives have been taken by the United Nations to curb this issue globally prompting many countries to ban corporal punishment. India too has taken significant steps in curbing it by various laws, directives issued by the legislative, judicial and central and state education bodies.

Despite these affirmative actions, sporadic incidences of corporal punishment do occur, leaving in their wake a maimed and helpless child and a rattled society.

Key Words: Corporal Punishment, IPC, Alternative Conflict Management Strategies, Injury, Assault

CORPORAL PUNISHMENT IN SCHOOLS: A MEDICOLEGAL VIEW

“Children do not lose their human rights by passing through the school gates.... education must be provided in a way that respects the inherent dignity of the child.. that respects the strict limits on discipline and promotes nonviolence in schools”

(UN Committee on the Rights of the Child, General Comment No. 1, 2001)

Introduction:

Good education is the bedrock of a prosperous society. Since times immemorial civilizations have nurtured and evolved due to education. The credit of any individuals and in turn the nation's accomplishments, goes to the diligence of the teachers who held those nubile hands guiding them through the labyrinth of life, delivering empowered generations to the mankind.

‘Arjuna’ would not have become the greatest archer had it not been the tutelage of Guru Dronacharya. Rightly said *Gurur Brahma, Gurur Vishnu, Gurur Devo Maheshwara Gurur Sakshat Parabrahmah Tasmai Shree Guru Veh Namah.*

However there have been instances where these nurturing tender hands have become tainted with blood of those it vowed to guide. Numerous incidences of punishments given by teachers to students, going awry, have occurred all across our country and world over bringing this revered profession in the cross hairs of law enforcement agencies and judiciary.

Corporal Punishment: Definition

“Any punishment in which physical force is used and intended to cause some degree of pain or discomfort, however light.”¹

*“Corporal punishment is the use of physical force causing pain, but not wounds, as a means of discipline”*²

What sets it apart from Physical Abuse is the *Intensity i.e. extent of injury* and *Intention i.e. Mens Rea*.

The provisions of the RTE Act 2009, includes Physical punishment, Mental harassment and discrimination as the various types of Corporal Punishments.

Managing student behavior has always been a challenge. At times teachers have resorted to corporal punishment to manage student behavior believing it to be an effective means.

Though numerous factors are said to be responsible for the prevalence of this menace in the educational institutions, however primarily the following can be considered:

- Perception of its appropriateness for children’s education
- Lack of awareness amongst educators
- Stress amongst educators
- Lack of awareness for alternative conflict management strategies

The present situation:

Corporal punishment is unlawful in 117 nations across the world. 43 % African, 52% of East Asian and Pacific, 96% European and Central Asian, 46% American and Caribbean, 57% Middle Eastern, and 25% in South Asian have made it unlawful.⁴ Despite these legal initiatives the incidences of corporal punishments are occurring unabated the world over.⁴

Despite the directives of the honorable Supreme Court issued in year 2000 banning corporal punishment studies have indicated that corporal punishment is quiet prevalent with even the Ministry of Women and Child development, Govt of India affirms that two out of three school going children have suffered physical abuse.⁵⁻⁷

The Impact:

Corporal punishment has been linked to adverse physical, psychological and educational outcomes including, increased aggressive and destructive behavior, increased disruptive classroom behavior, vandalism, poor school achievement, poor attention span, increased drop-out rate, school avoidance and school phobia, low self-esteem, anxiety, somatic complaints, depression, suicide and retaliation against teacher.

Meta analysis by E. Gershoff involving 88 studies has highlighted a significant association between Corporal Punishment and undesirable behavior outcomes.⁸

Numerous societies like American Medical Association, The American Academy of Pediatrics, The Society for Adolescent Medicine, The American Psychological Association, The Royal College of Paediatrics and Child Health, The Royal College of Psychiatrists, The Canadian Paediatric Society and the Australian Psychological Society oppose school corporal punishments in all forms.

Apart from the proven psychological impact another fall out of corporal punishment is physical injury. The following events which have happened in the recent past glaringly reflect the grave permanent physical incapacitation and at times fatal outcomes amongst students as a result of Corporal Punishment;

1. A seven year old girl, class 1 student of Tagore school, Jhunjhunu, lost vision in her left eye as a result of beating given by her teacher. A phenomenal price she paid for not doing her math’s homework. Hon’ble Justice Ajay Rastogi of Rajasthan High Court (Jaipur bench) issued notice to the School Management as well as the class teacher. After two years of the occurrence of the incidence the school administration

tendered an apology and agreed to pay a compensation of Rs 15 lakh. The victim underwent around eight unsuccessful surgeries to treat her eye condition ultimately succumbing to neuroblastoma at the age of nine years.⁹

2. Eleven years old Delhi school girl was allegedly forced by her teacher to 'sit like a hen' in scorching sun for nearly two hours after she failed to translate a word into English. The girls fainted and subsequently died.¹⁰
3. A class VII student of Sarvodaya School in North Delhi was beaten by the Principal with a stick for not bringing a textbook, resulting in fracture of the wrists. The Principal was arrested for the alleged assault.¹¹

In fact all teachers in the cases mentioned above *were probably acting in good faith*, and would not have acted had they known the outcome, but they did go overboard in their actions.

The reasons for these mishaps, lies in some anatomical facts which are peculiar to children.

- a. The surface area of the face in children is less than in an adult.
- b. The bones, tissues, eardrum, eyes etc are delicate compared to an adult.

Hence the amount of force required to cause injury in children is relatively less. A study conducted by Oluwakemi AB & Kayode A, reported a strong association between severe eye injuries in children and corporal punishment in schools.¹²

Medico Legal Aspects:

The existing Laws and policies in India on Corporal Punishment are as under

- a. **Supreme Court of India** has banned corporal punishment for children on 1st Dec' 2000 when it directed the state to ensure "that children are not to be subjected to corporal punishment in school & they receive education in an atmosphere of freedom & dignity, free from fear".⁷
- b. **Section 23 of the Juvenile Justice Act 2000** prescribes punishment for teachers who subject the students in their care to considerable emotional and physical abuse.¹³
- c. **National Commission for Protection of Child Rights (NCPCR)** has issued guidelines to all States/UTs as well as to the District Administrations for addressing the issue of corporal punishment in schools.¹⁴
- d. As per **Right of Children to Free and Compulsory Education Act 2009**, (Section 17b) no child shall be subjected to physical punishment or mental harassment.¹⁵
- e. High Court of Delhi in its directive to the Delhi Government and the three Municipal Corporations has asserted '**Zero Tolerance**' to corporal punishment.¹⁶
- f. **Central Board of Secondary Education** too has expressed its concern on this issue an to reiterate the same it has issued directives to all heads of institutions affiliated to it to ensure that no child is subjected to any corporal punishment at any point of time in the schooling process.¹⁷
- g. **UN Convention on the Rights of the Child** internationally acknowledges the children as active subjects with rights and not a passive object with right to be protected. India being a signatory to it acknowledges and abides by it.¹

Criminal Liabilities:

An act of Corporal Punishment can be a punishable offence under the various section of the Indian Penal Code (IPC). The various sections of IPC are as under:

- a. **IPC 320 : Grievous hurt**
- b. **IPC 319 : defines Hurt**

- c. **IPC 323 : Punishment for voluntarily causing Hurt**
- d. **IPC 324 : Punishment for Voluntarily causing Grievous Hurt**
- e. **IPC 325 : Voluntarily causing grievous hurt**
- f. **IPC 326 : Voluntarily causing hurt by dangerous weapons or means**
- g. **IPC 352 : Assault or use of criminal force otherwise than a grave provocation**
- h. **IPC 506 : Criminal intimidation**

Case laws:

Corporal punishment was accepted at some point of time as reflected by reviewing the following case laws. **Ganesh Chandra Saha vs Jiw Raj Somani on 10 April, 1964 in the High Court of Calcutta. AIR 1965 Cal 32, 1965 CriLJ 24, 68 CWN 1081.** The petitioner a head master of a school was tried under IPC sec 323 by the lower court for canning a student for stealing another student's notebook. He was punished with a fine of Rs 15/- and 3 days simple imprisonment. IPC sec 88 of the Indian Penal Code, *nothing which is not intended to cause death, is an offence by reason of any harm which it may cause to any person for whose benefit it is done in good faith, and who has given consent, whether express or implied, to suffer that harm,* was used as a defense in the case. The same was duly acknowledged by the court and judged that the petitioner had committed no offence under IPC sec 323. Reference was made by the honorable court of **Emperor v. Maung Ba Thaung, AIR 1926 Rang, 107 and G. B. Ghate v. Emperor, AIR 1949 Bom 226** which justified the punishment for enforcement of school discipline.^{18, 19}

A radical shift has occurred subsequently in the manner in which the honorable courts have responded to the evils of corporal punishment. The same is evident from the following case laws.

Parents Forum for Meaningful Education and others Vs Union Of India and others, High Court of Delhi, 1 December, 2000. Rule 37 of the Delhi School Education Rules, 1973 Sub-Rules (1)(a)(ii), 1(b)(ii) and (iii) and (4)(a) to (e) thereof which ratified corporal punishment by the school authorities. The honorable court held that the aforementioned rules were violative of the Articles 14 and 21 of the Constitution and hence were struck down.²⁰

Kishor Guleria Vs The Director Of Education, High Court Of Delhi, 3 July, 2012. The petitioner was a physical education teacher at New Era School, Mayapuri, New Delhi where on 25 Apr 2008 he subjected a few students (boys and girls) to corporal punishment. Taking cognizance of the gravity of the offence the Delhi School tribunal after due proceedings dismissed the petitioner from service. The petitioner appealed the honorable court to set aside the disciplinary order passed by the tribunal. Noting that a child is a **'Precious National resource'** and subjecting a child to corporal punishment for reforming him cannot be a part of education the honorable court dismissed the petition.²¹

Recommendations:

The author perceives that the following initiatives can be taken at the various levels to curb the occurrence of Corporal Punishment.

- a. Stress management in the teachers and students.
- b. Greater inclusion of Corporal Punishment and its various aspects in B. Ed, M. Ed. and various teacher training course curriculum.
- c. Educating educators in Alternative Conflict Management strategies in classrooms.

Conclusion:

Unintentional damage due to corporal punishment can result in penal provisions under the law. Corporal punishment has detrimental effects on the child and the society.

Well intended gestures and actions of innocent teachers can take a dramatic turn and result in irreconcilable damages for the students, teachers and their families.

Sensitization of teachers during B. Ed and M. Ed. to the gravity of these issues with exposure to alternative modes of conflict management in the classroom scenario followed by regular reinforcement during their career would go a long way in eradicating this problem.

References:

1. UN Committee on the Rights of the Child (2001) "General Comment No. 1:" par 11.
2. Educate don't punish! Awareness Campaign against Corporal Punishment of Children in families. UNICEF 1999. http://www.unicef.org/barbados/spmapping/Implementation/CP/Global/Educate_donthit_SaveManual.pdf. Accessed on 10 Oct 2013.
3. Guidelines for eliminating corporal punishment in schools. <http://www.ncpcr.gov.in/Guidelines/Guidelines%20for%20Eliminating%20Corporal%20Punishment%20in%20Schools.pdf>. Accessed on 12 Dec 2013
4. Corporal Punishment. Association of Childhood Education International TM. www.acei.org/corporal-punishment.html for Resources. Accessed on 12 Nov 2013.
5. Prohibiting all corporal punishment in schools: Global Report 2011. Global Initiative to End all Corporal Punishment of Children. <http://www.endcorporalpunishment.org/pages/pdfs/SchoolsReport2011.pdf>. Accessed on 12 Nov 2013
6. Kacker, L., S. Varadan & P. Kumar, 2007, Study on Child Abuse: India, 2007, New Delhi: Ministry of Women and Child Development, Government of India.
7. All you want to know about corporal punishment. http://www.unicef.org/india/reallives_5449.htm. Accessed on 20 Nov 2013.
8. Gershoff, E. T. Corporal punishment by parents and associated child behaviors and experiences: A meta-analytic and theoretical review. *Psychological Bulletin*, 2002; 128(4): 539-579
9. 9-yr-old who lost vision in one eye due to corporal punishment dies of cancer. <http://www.indianexpress.com/news/9yroid-who-lost-vision-in-one-eye-due-to-corporal-punishment-dies-of-cancer/1032414/>. accessed on 13 Sep 2013.
10. Punished, 11-yr-old student dies in hospital. The Indian Express 17 Apr 2009. Available at <http://www.indianexpress.com/news/punished-11yroid-student-dies-in-hospital/447841/>. Accessed on 13 Sep 2013.
11. School principal held for beating boy. The Times of India. 24 Nov 2013. <http://timesofindia.indiatimes.com/city/delhi/School-principal-held-for-beating-boy/articleshow/26282866.cms>. Accessed on 12 Dec 2013
12. Oluwakemi AB, Kayode A. Corporal punishment-related ocular injuries in Nigerian children. *J Indian Assoc Pediatr Surg* 2007;12:76-9.
13. The Juvenile Justice (Care And Protection Of Children) Act, 2000 (Act No. 56 Of 2000).Ministry of Law, Justice and Company Affairs (Legislative Department). Gazette of India 30 Dec 2000.

14. Guidelines for Eliminating Corporal Punishment in Schools. National Commission for Protection of Child Rights (NCPCR). http://www.ncpcr.gov.in/corporal_punishment.htm. Accessed on 12 Dec 2013
15. Right of Children to Free and Compulsory Education Act 2009. Ministry of Human Resource Development. Gazette of India 27 Aug 2009.
16. HC: End rampant corporal punishment in govt schools, Hindustan Times New Delhi, July 10, 2013. <http://www.hindustantimes.com/india-news/delhi-metro/hc-end-rampant-corporal-punishment-in-govt-schools/article1-1090504.aspx>. Accessed on 12 Dec 2013.
17. Central Board of Secondary Education Circular dates 20th Jul 2002. CBSE Update, Compendium of CBSE Circulars. CBSE Delhi. Apr 2005: 166
18. Ganesh Chandra Saha vs Jiw Raj Somani on 10 April, 1964. AIR 1965 Cal 32, 1965 CriLJ 24, 68 CWN 1081.
19. I.G. Singleton vs Emperor on 7 November, 1924. AIR 1925 Cal 501.
20. Parents Forum For Meaningful Education and others vs Union Of India and Others on 1 December, 2000 . The High Court of Delhi at New Delhi. 2001 IIAD Delhi 20, AIR 2001 Delhi 212
21. Kishor Guleria Vs The Director Of Education on 3 July, 2012 In The High Court of Delhi at New Delhi. W.P.(C) 5765/2011.

Review Article

RADIOLOGIST A PROMISING MEMBER IN FORENSIC TEAM

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Review Article

RADIOLOGIST A PROMISING MEMBER IN FORENSIC TEAM

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Abstract:

Forensic medicine as a science is not new, however forensic medicine has received more recognition from the general public in recent years. The importance of radiographic techniques in clinical forensic medicine is widely recognized. The forensic scientist is in the truest sense of the word, a detective—solving a mystery, telling a story, and often uncovering a crime. In recent years many newer advances have developed in forensic medicine. Branches like forensic radiology, forensic odontology, forensic bioinformatics, forensic microbiology, forensic psychiatry etc.... Forensic radiology is one of the most upcoming, entrusting, eligible and reliable branch. The scope of application is broad, sometimes underutilized and largely undefined. The situations in which forensic radiology can be applied to resolve legal matters are many and varied. This article reviews different important and useful aspects of radiology in relation with forensic medicine.

Keywords: Forensic radiology, forensic medicine, current trends, newer advances.

Introduction:

Forensic science is a unique scientific discipline requiring its practitioners to have, in addition to technical skills and knowledge, critical and analytical thinking skills, communication skills, and an awareness of the role of the scientist in our criminal justice system⁽¹⁾. The multidisciplinary nature of forensic medicine necessitates a team approach. Forensic radiology is one among them. Wilhelm Conrad Roentgen's discovery of the x-ray in 1895 led to increased use of the noninvasive technology to help diagnose disease. The first use of x-rays in criminal forensics actually occurred a few days before Roentgen submitted his discovery for publication when a radiograph helped demonstrate a bullet fragment lodged in a shooting victim's leg. Physics professor in Canada had conducted the x-ray examination; the radiograph was submitted as evidence of attempted murder in court⁽²⁾. The modern forensic system developed in the 20th century. Radiologic technology not only has provided evidence for legal cases but has helped lead to the development of new legal theories and practices regarding visual evidence. Forensic radiography is more than imaging of human remains or bullet fragments; it is the application of diagnostic imaging technology and examinations to questions of law⁽³⁾. Regardless of the current state of forensic radiography in the world, one fact remains clear: the law has influenced medicine, and medicine has influenced the law. Specifically, early use of medical x-rays was influenced by legal legitimization of the radiography as credible evidence and radiographs have helped influence legal decisions⁽⁴⁾. The article mainly reviews useful aspects of the implications of radiology in forensic medicine.

Discussion:

Forensic Medicine has come to be recognized as a special science or discipline that deals with relationships and applications of medical facts and knowledge to legal problems. Some prefer to call it legal medicine or medical jurisprudence. Forensic radiology encompasses the performance, interpretation, and reporting of radiological examinations and procedures connected to the courts and the law⁽⁵⁾. The forensic radiologist is an essential

member of the forensic team. By its nature, the science of radiology solves mysteries as it reveals secrets that may be hidden within the body. However, unlike standard diagnostic medical radiology, forensic radiology is not limited to the human body. It has also proven useful in a wide range of nonhuman applications, such as uncovering faked art, authenticating antiques, and detecting forged documents.

History of Forensic Radiology:

Evidence of legal medicine, in one form or another, extends throughout human history. Ancient Egyptian writings have shown that the scholar, physician, and pyramid architect, Imhotep (2980 BCE) applied medical principles to legal issues of the day ⁽²⁾. In ancient Babylon (modern-day Iraq) in approximately 2200 BCE, the king Hammurabi set formal medical laws into practice. Another early application of forensic medicine concerned the determination of suicide in the first century of the Christian era (CE) ⁽⁶⁾.

Wilhelm Conrad Roentgen discovered the x-ray in 1895, physicians, scientists, jurists, and journalists realized that the potential Roentgen's "new kind of ray" might have an application in legal medicine. In the October 1898 issue of the *American X-ray Journal*, Dr. Fovau d'Courmelles wrote, "Knowing the existence of a fracture in a person who has been burned or mutilated beyond recognition, we can hope to identify him by the x-ray."⁽⁷⁾

Actually, the first court case involving the x-rays in North America commenced on Christmas Eve, 1895 (three days before Röntgen submitted his first communication to the Physical-Medicine Society of Würzburg. The x-ray plate was submitted to the court during the trial, with the subsequent conviction of Mr. Holder for attempted murder. He was sentenced to 14 years in the penitentiary ⁽⁸⁾. The first instance in which a roentgenogram was brought to court in England was a personal injury case tried by Mr. Justice Hawkins and a special jury in Nottingham ⁽⁹⁾.

Implication of Forensic Radiology

Forensic radiology plays an important role in various medico legal investigations like identification, evaluation of various injuries, non violent crimes like smuggling, child abuse cases and civil cases etc.

Identification: Identifying the dead is the major challenge and responsibility for medico legal professionals. All the cases of unknown deaths need proper identification. It is not only related with civil and criminal cases but also with human emotions. Identification is required not only for individual but also in cases of mass casualty situations like railroad and aircraft accidents, natural disasters such as earthquakes, floods, hurricanes, collapse or fire in high-occupancy buildings such as hotels and factories etc. where multiple victims are involved. Forensic radiology is one of the most reliable parameters (like fingerprint, dental status, cranial sutures etc.) for identification.

Radiographs in Dental Identification: Dental identification is a comparative technique; the dentition of the decedent is compared to dental records of a suspect or comparison of ante-mortem and post-mortem radiographs. Number and arrangement of teeth (missing teeth, rotated teeth, spacing, extra teeth, impacted teeth), Caries and periodontal bone loss, Hidden restorations (bases under fillings, pins, root canal fillings, posts, and implants), Bony pathology, Dental anatomy, Trabecular bone pattern and crestal bone topography, Nutrient canals, Anatomic bony landmarks, Maxillary sinus and nasal aperture and Frontal sinus all these are compared. ^(10,11,12)

Bite marks analysis: The analysis of human or animal bite marks found on skin or objects at a crime scene are another challenging area in identification. The teeth are often used as a weapon when one person attacks another, or in self-defense against an attacker^(13, 14) Analysis of bite mark involves the examination, measurement, and comparison of victim and the suspect. Usually, the life-sized photographs of the bite mark are compared to models of the suspect's teeth.

Identification of Individual Remains can be done by comparison of skeletal tissues and also by soft tissues.

Identification by Comparison of Soft Tissues: Soft tissues may play a role in comparative identification with radiological techniques by some physiological or pathological calcification. Vascular calcifications and calcified falx cerebri have been matched on occasion. Calcified scars or posttraumatic calcifications/ossifications (e.g., post-traumatic myositis ossificans) can be distinctive. Enteric accretions (gallstones,⁽¹⁵⁾ kidney stones, bladder stones, phleboliths, parasitic encrustations, etc.) can be used for identification. Inclusions of foreign material in soft tissues (opaque clips, sutures, stents, filters, and connectors in surgical procedures, bullets, shrapnel, glass, gravel, etc.) may have unique appearances and locations.

Identification by Comparison of Skeletal Tissues: bones are the most durable of body tissues used for radiological identification. The identification is done by matching radiographs of (1) anomalous or unusual development; (2) disease or degeneration; (3) tumor; (4) trauma; (5) iatrogenic interference; and (6) vascular grooves and trabecular patterns.

Evaluation of Injury or Death: The forensic experts uses x-rays in evaluating gunshot wounds in several ways like location of the bullet (which saves much time and may avoid needless effort in searching for bullets that are inaccessible), number of bullets/ pellets, type of bullet, type of weapon, angle and direction of fire, range of fire and path of the wound^(16,17). By these we can say position of assailant/ victim and manner of death suicide/homicide/unintentional.

The location, type, severity of fracture can be assessed by configuration and direction of fracture. It can tell the impact point, direction of the impact and also the type of weapon. It is very much useful in vehicular injuries and in cases of asphyxia injuries like hanging/strangulation etc...Other foreign bodies One may find the snapped-off point of a knife, fragments of broken glass, bomb fragments or shrapnel, parts of the automobile or aircraft in which the victim was riding, and animal, mineral, or vegetable matter embedded, aspirated, or injected.

Aggressive bite mark injuries have been found in cases of homicide, attempted homicide, heterosexual and homosexual assault, aggravated assault, battery, and in cases involving the physical and sexual abuse of children. Bite marks are considered to be examples of physical evidence as well as biological evidence. (18)

Radiology is useful not only in injuries but also in situations like natural diseases, infections, infestations, metabolic processes, dietary abnormalities, tumors, poison, demonstrating air embolism, pneumothorax, pneumopericardium, pneumomediastinum, pneumoperitoneum.

Radiology in nonviolent crimes: Radiology is used in cases of non violent crimes like body packer, larceny, auto theft and auto forgery (19).

The “Body Packer”: In the 1970s the smugglers discovered a new method for smuggling, which could be recognized by the radiologic method.⁽²⁰⁾ That is “body packer”, who smuggled contraband drugs (mostly Cocaine, heroin, amphetamines, hashish, and marijuana) across borders in specially devised packages (condoms, the fingers of surgical gloves, or even toy balloons) secreted in the carrier’s rectum, vagina, or alimentary canal.^(21,22,23) These can be traced by radiology which looks regular shaped round or oval foreign bodies outlined by arcuate or encircling thin air shadows, sometimes in multiple layers.

Larceny is swallowing diamond/precious stones or jewels by thief. This can also be identified by roentgenography.⁽²⁴⁾ It is possible that computed tomography would offer greater sensitivity in the search for swallowed gemstones.

Radiology of Abuse: Domestic violence is a serious public health problem with a potentially fatal outcome. Abuse is an improper usage or treatment of an entity, often to unfairly or improperly gain benefit. It can be physical, sexual, emotional, maltreatment or neglect of any person. Battered women, children, and elderly persons reside in all segments of society. In children it is used as “Le Syndrome de Silverman” in France, “Le Syndrome de Caffey”, “Caffey’s Third Syndrome” and “The Syndrome of Ambroise Tardieu (25). Finally, in 1962, Kempe (26) intentionally coined the name *Battered Child Syndrome* to attract attention to this neglected clinical and social problem. Child abuse is newly arising problem in developing country like India. Spectrum of Child Abuse can be of any form like Physical abuse, Nutritional deprivation, Emotional abuse, Neglect of medical care or safety, Intentional drugging or poisoning, Sexual abuse. Following radiographic features are seen: traumatic bowing of the ends of the diaphyses, metaphyseal cupping, ectopic ossification, involucrum formation, metaphyseal fragmentation, and fractures of differing durations. Shaken baby syndrome subdural hematoma and intracranial bleeding is noted⁽²⁷⁾.

The usefulness of radiological images in cases of criminal litigation in violent crimes like murder, suicide, attempted murder, assault, battery, abuse, terrorism and nonviolent crimes such as smuggling, larceny and fraud, faking, or counterfeiting is now well established. In civil litigation the radiologist may be called as a defendant, witness, or expert witness in the court cases dealing with liability, be it professional liability or malpractice, personal liability, property liability, or product liability.

Conclusion:

Radiologic imaging plays a vital role at many of those intersections (both civil and criminal cases), from the identification of the dead to the authentication of priceless art. The various modalities of radiology can be used in routine investigations as well as confirmation of various medico legal cases, death reports etc. There is no set standard for a “Forensic Radiologist”. There is no specialized training or fellowship available in that field. The proper communication of the Forensic dept. and Radiology dept. both can help to solve various sequels in certain genuine cases. If we improve the support of forensic radiology field, truly it will be a promising member in forensic team.

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References:

1. CEWebSource.com is produced by Enterprises for Continuing Education Inc. (ECEI), PO Box300, Brighton, MI 48116-0300, (810) 229-3354. FORENSIC RADIOLOGY, Lois Roma, BS, RT (R) (CT) University of Michigan Hospitals Ann Arbor, MI E-mail: loisroma@med.umich.edu expirES August 15, 2013
2. Brogdon BG, Lichtenstein JE. Forensic radiology in historical perspective. In: Brogdon BG. Forensic Radiology. Boca Raton, FL: CRC Press LLC;1998:13-34.
3. Society and College of Radiographers and Association of Forensic Radiographers. Guidance for Radiographers Providing Forensic Radiography Services. [www.afr.org.uk/index/cmsfilessystemaction/documents/guidanceforensicradiography_final_\(2\).pdf](http://www.afr.org.uk/index/cmsfilessystemaction/documents/guidanceforensicradiography_final_(2).pdf). Published January 12, 2009.
4. Golan T. The emergence of the silent witness: the legal and medical reception of x-rays in the USA. Soc Stud Sci. 2004;34(4):469-499.
5. Brogdon, B.G. (Byron Gilliam), FORNSIC RADIOLOGY, CRC PRESS LLC, WASHINGTON,1998.
6. Spitz WU, ed. Spitz and Fisher's Medicolegal Investigation of Death: Guidelines for the Application of Pathology to Crime Investigation. 3rd ed. Springfield, Ill; Charles C. Thomas; 1993.
7. Brogdon BG, Lichtenstein JE. Chapter 2: Forensic Radiology in Historical Perspective. In: Brogdon BG. Forensic Radiology. Boca Raton, Fla: CRC Press; 1998:18-32.
8. Brecher, R. and Brecher, E., The Rays: A History of Radiology in the United States and Canada, Williams & Wilkins, Baltimore, 1969, 18
9. Glasser, O., First roentgen evidence, Radiology , 17, 789, 1931.
10. Nortje, C. J. and Harris, A. M. P., Maxillo-facial radiology in forensic dentistry: a review, J. Forensic Odonto-Stomatol., 4, 29, 1986.
11. DeVore, D. T., Radiology and photography in forensic dentistry, Dent. Clin. N. Am., 21, 69, 1977.
12. Fischman, S. L., The use of medical and dental radiographs in identification, Int. Dent. J.,35, 301, 1985.
13. Furness, J., A general review of bite-mark evidence, Am. J. Forensic Med. Pathol., 2, 49, 1981.
14. Walter, R. D., Anger biting: the hidden impulse, Am. J. Forensic Med. Pathol., 6, 219, 1985.
15. Nye, P. J., Tyle, T. L., Jarman, R. N., and Eaton, B. G., The role of radiology in the Oklahoma City bombing, Radiology, 200, 541, 1996.
16. Di Maio, V. J. M., Gunshot Wounds. Practical Aspects of Firearms, Ballistics, and Forensic Techniques , Elsevier, New York, 1985, chap. 11.
17. Fatteh, A. , Medicolegal Investigation of Gunshot Wounds , Lippincott, Philadelphia, 1976.
18. Sweet, D. J., Human bite marks — examination, recovery and analysis, in Manual of Forensic Odontology, 3rd ed., Bowers, C. M. and Bell, G. L., Eds., American Society of Forensic Odontology, Colorado Springs, 1995..
19. Springer, E. and Bergman, P., Applications of non-destructive testing (NDT) in vehicle forgery examinations, J. Forensic Sci., 39, 751, 1994.
20. Freed, T. A., Sweet, L. N., and Gauder, P. S., Balloon obturation bowel obstruction: a hazard of drug smuggling, Am. J. Roentgenol. , 127, 1033, 1976.

21. Dunne, J. W., Drug smuggling by internal body concealment, *Med. J. Aust.*, 2, 436, 1983.
22. Beerman, R., Nunez, D., Jr., and Weth, C.V., Radiographic evaluation off the cocaine smuggler, *Gastrointest. Radiol*, 11, 351, 1986.
23. Karhunen, P. J., Penttila, A., and Panula, A., Detection of heroin “body-packers” at Helsinki airport, *Lancet*, 1, 1265, 1987.
24. Brogdon, B. G., Larceny by ingestion, Presented at the Annu. Meet. American Academy of Forensic Sciences, Cincinnati, February 23, 1990.
25. Caffey, J., The parent-infant traumatic stress syndrome: (Caffey-Kempe syndrome), (battered baby syndrome), *Am. J. Roentgenol.*, 114, 217, 1972.
26. Kempe, C. H., Pediatric implications of the battered baby syndrome. Windermere Lecture, *Arch. Dis. Child.*, 46, 28, 1971.
27. Gilliland, M. G. F. and Folberg, R., Shaken babies — some have no impact injuries, *J. Forensic Sci.*, 41, 114, 1996.

ACTIVITIES OF MEDICAL ADMINISTRATION AT A GLANCE IN CORPORATE HOSPITALS

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ACTIVITIES OF MEDICAL ADMINISTRATION AT A GLANCE IN CORPORATE HOSPITALS

Dr. A. Shrivastava

Good hospital administration is tantamount to better patient care. In bigger hospital, if a check list of the administrative activities is not maintained and followed, it might affect the patient care as well as might lead to medicolegal issues. Below is an attempt to summarize the essential activities of medical administration in corporate hospitals, which might prevent potential medicolegal issues and improve patient care.

Hospital -		NAME:			
Date of REPORTING -					
	1	2	3	4	5
	IMMEDIATE Telephonically/SMS	DAILY	WEEKLY	FORTNIGHT	MONTHLY
1	Sentinel Event	New Admissions - Critical/ Right specialty/Notifiable Disease/Immediate - Unplanned OR Emergency Procedure/Refusals	Procedures in OPD under sedation - Pharmacy	MLC, OT, Narcotic register - compliance and usages	Review of Promotional activities of various departments
2	Mass Casualty (no. of patients > no. of beds in Casualty at a given time)	Drug Errors/Verbal Orders/Wrong Dilutions/Missed Drugs/Near Miss Medications/ Physiotherapy - Not as per prescription	Blood Transfusion Reaction and denial of blood components form wards.	Right specialty - late in follow up by Jr. Dr. OR Nurse	Consultant wise OPD details - First and Follow up visits

3	Surprise Inspection/Visits - DHS/FDA/PMC/MPCB etc.	Plan of care in all cases - to be completed within 24 hours	Monitor ALOS, Length of stay > 2 weeks	Delay in generating References and attending reference	HICC/ Antibiotic Stewardship Program
4	Untoward incidence	Discharges : Planned - 24 hours prior intimation by Consultant; Unplanned - Discharges declared during rounds; not according to planned care	Length of stay more than two weeks: brief summary, plan of care and social updates, briefing relatives	Review of services in Casualty, Critical care, OT and diagnostics	HDU/Wards/Isolation Rooms - CSSD Delivery
5	Contagious Disease Admission - Swine Flu, Chicken Pox, MDR, Oen Koch's, Swine Flu etc.	OT Schedule - Planned/Emergency Unplanned/Delay Cancellation.	Medical Board - Counseling	Compliances in Chemotherapy	PCPNDT, MTP, Birth & Death Records, Immunization, MLC, Narcotics, Notifiable diseases
6	Admission of MP/MLA	Reporting of Critical Value - includes immediate plan of action	Compliances - MLC, FDA, PCPNDT, MTP Compliances	Discuss for the delay in attending Critical Care, OT by Consultants and feedback required to minimize	Refusal of admission, change in name of consultant, DOR, DAMA, LAMA, TPA - deduction and denial - Consultantwise
7		Lab / Radiology findings which change the plan of treatment	Monitoring of Clinical Pathways defined by organisation - LSCS, G. B. lithotomy, Stroke - door to	Delay in receiving Medical Records after stipulated	HDU/Wards/Isolation Rooms - CSSD Delivery

			needle time, TKR, Angiography etc.	time	
8		Patient not attended by admitting Consultant OR designee OR locum within stipulated time defined by organisation for Critical Care Area and wards.		Discussion on DAMA/ LAMA/ DOR; negative feedbacks, extended ALOS;	Difficulty /Discrepancy /Liaison with interdepartmental functioning - issues
9		Daily feedback by junior doctors - Information to Consultants for status of their patients in terms of completion of the daily orders and followup.	TPA/Corporates/Insurance - feedback/Deial/Deductions	Mortuary Records	Meeting with Reporting Authority to update the status and outcome
10		References not attended within 24 hours OR defined time required for the case	Right Specialty Right Admission	OT Records	
11		Communication with the referring Consultants in concurrence with	Authentication of records by Consultants	Critical Care Areas (ICU /OT /Casualty) - CSSD Delivery	

		the Consultant Incharge			
12		File Audit: Open and Close File Audit	Reason of Delay/cancellation in scheduled OT	Difficulty /Discrepancy /Liaison with intradepartmental functioning - issues	
13		Audit of death files on daily basis	Daily feedback by junior doctors - Information to refereeing Doctors for status of their patients.	Update the status to Reporting Authority	
14			Junior Doctors Rota		
15			Training sessions taken by Consultants		