PATTERN OF INJURIES IN FALL FROM HEIGHT AN AUTOPSY BASED STUDY

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Abstract

Deaths due to falls from heights are not uncommon. In general, these cases present with complicated multiple organ injuries. A retrospective study was conducted on 72 cases with history of fall, brought to mortuary for medico legal autopsy during 2006-2010, to know the pattern of injuries. Most of the victims were males, employed in construction works as coolies. Maximum incidents occurred from a height of less than 20 feet and in daytime. Most of the victims died in a period of less than 24 hours after the incident. Among injuries, abrasions were the common injuries present externally. Head injuries with skull fractures and intracranial haemorrhages were fatal in most of the cases. Adequate preventive measures and group insurance may provide relief to the victims in morbidity cases and to the kith and kin in mortality cases.

Keywords: Fall from height ,Injuries, Autopsy.

Introduction

Falls remain a significant cause of morbidity and mortality. Factors determining the probability of serious injury in a fall are the distance of the fall, the landing surface, duration and intensity of the impact force, human factors like body weight and velocity which influence kinetic energy, body orientation at the moment of impact, elasticity and viscosity of the tissue of the contact body region and whether the fall was broken or not. Factors contributing to fall from height include faulty equipment, such as ladders and scaffold structures, human factors such as intoxication, inattention, natural diseases, senility associated - visual problems. Lack of preventive measures like handrails and poor lighting may increase the frequency in work places. Medico-legal autopsy aims at deciding whether the death was attributed purely to the height or in ruling out the various contributing factors like alcohol, drugs and co-existing natural diseases. The study of pattern of external and internal injuries may together indicate the primary site of impact and intensity of injuries, and occasionally height from which the fall has occurred. The determination of probable anatomical site of primary impact may be useful in reconstruction of the events. In occupational settings, the most common type of accident is fall from a height.[1] Brain, spinal cord, and extremities are the most commonly injured organs. Falls from more than 20 feet have historically been triaged to trauma centers, but even low-level falls can cause serious head injuries.[2,3]

Materials & Methods

The authors present a retrospective study of 72 individuals who sustained injuries as a result of fall from height on solid surfaces, including fall from standing height, brought to Sri Ramachandra Medical College and Research

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institute between January 2006 and December 2010, by reviewing the autopsy records. These include cases admitted in our hospital and brought dead from outside also. Fall from height was diagnosed based on the history provided by patients and their relatives in inquest and First Information Reports. The epidemiological factors like age, sex, occupation, work place and height of fall were studied. Chronological factors like time of fall, duration of hospital stay were also studied. Pattern of injuries externally and internally along with cause and manner of death were studied.

Results & discussion

Falls are the second leading cause, accounting for 11% of all unintentional injury deaths worldwide.[4] In the present study, 72 cases were recorded as fall from height out of total 1150 autopsy cases from 2006 to 2010. The maximum (44.44%) cases belong to age group of 21-40 years, followed by 41-60 years (25%). This indicates that working age group is more prone to occupational accidents than dependents. But in the study by Jagnoor et al,[5] Mortality rates increased progressively after the age of 14 years and were highest among people aged 70 years or older.

The study sample included 60 males (83.33%) and 12 females (16.66%), which can be explained by dominant employment culture of males in Indian society, which coincides with others studies.[5, 6] Most of the victims were daily labourers (43.05%) in construction work, below matriculation dropouts, with low socio economic status. In urban society, the dropouts, with low socio economic status, usually get employed as daily laborers in construction or other technical works, falling as a victim of occupational hazard. National Statistics of United Kingdom: Workplace fatalities and injuries - falls from a height study[7] also revealed that construction workers are being affected maximum. The other victims were mostly house owners, who came to supervise the construction work or inmates of the house falling down because of senility associated problems. Almost 50% of victims sustained injuries when they are involved in their professional work.

Half (50%) of victims fell down from a height of 10 feet followed by fall between 11-20feet (35%). Most of the falls in this study were from less than 20 feet which suggest the less number of measures taken in these floors and general limitation of construction to 1st and 2nd floors, with a height of 10-20 feet. Most of the victims (80%) fell down during daytime between 6am-6pm, which suggests the more human activity and work culture during daytime, coinciding with Guillaume Perret study.[8]

Among the 72 deaths, 13 were spot deaths and 4 of them died with in one hour after the incident. Most (30.55%) of them died with in a period of 24 hours followed by 17 victims, died in a period of one week and 16 victims between one week to one month. This finding does not correlate with Guillaume Perret study where most of deaths were spot deaths as the height of fall was more compared to our study.[8] More deaths in first 24 hours can be explained by severity of injuries, delay in hospitalization, and lack of life saving measures in industries etc... History of previous medical diseases was found in 12 cases (16.66%), in which cardiovascular diseases formed 50% of them. Loss of consciousness on arrival to casualty was present in 17cases (28.81%) among 59 cases admitted in the hospital.

Among the facial and scalp injuries, abrasions were seen in 13(18.05%) cases, contusions in 36 cases (50%), and lacerations on

20 cases (27.77%). Black eyes were noted in 7(9.72%) cases. Higher incidence of contusions in face and scalp can be explained by direct, blunt trauma to head against the hard surface of ground, and limited mobility receiving maximum force more number of times as compared to other body parts.

Skull fractures were present in 30(41.05%) cases, among which temporal bone fracture was dominant (figure 4). The lack of significance in fracture incidence in individual bones can be attributed to the anatomy of skull acting as single unit, differences in types of fall and ground surfaces, and variations in body position during and after fall. Base of skull was fractured in 22 cases, in which middle cranial fossa fractures were dominant. Among types, Fissured fracture of skull was dominant (figure 5). Maxilla and mandible was fractured in 3 cases each. The dominant fissured fracture can be explained by the transmission of more force in the fracture line than in other directions.

Among the brain injuries (figure 6), sub dural haemorrhage was the most common (48.61%) followed by Sub arachnoid (44.44%) and extra dural haemorrhages (15.27%). The high incidence of brain injuries can be attributed to the soft tissues hitting against the hard surface of the skull bones inside a closed compartment with development of shear strains, failure of velocity exchange between skull & brain, fractures of skull injuring brain causing tearing of vessels, and taut dura. The dominance of skull fractures, contusions of brain and sub dural haemorrhages in head injuries were also observed in Tatjana C. Atanasijevic et al study.[9] Cerebral oedema was present at autopsy in 17 cases along with one case of cerebral infarct.

In chest injuries, abrasions and contusions were seen in 5 cases each, followed by laceration in one case externally. Fractures of ribs were observed in 25% of cases; sternal fractures were seen in 4 cases and fracture of clavicle in one case. Lung injury was present in 7 cases, whereas heart injury was seen in 3 cases. Accumulation of blood and blood clots in chest cavity was present in 20 cases. Fractures of ribs were common due to the broad covering of chest by rib cage anteriorly, posteriorly, and laterally; weaker nature of the ribs as compared to other bones and rolling nature of trunk in different types of fall. Accumulation of blood and blood clots in chest cavity can be explained by fracture of ribs, injury to internal organs of chest like lungs, heart and direct blunt trauma to chest injuring vessels etc… The dominance of rib fractures, lung injuries and haemothorax in chest injuries were also observed in Guillaume Perret et al [8], Tatjana C. Atanasijevic et al studies.[9]

In the abdomen, lacerations (8.33%) were more common than abrasions and contusions externally. Fewer incidences of injuries in trunk compared to head can be explained by rolling trunk during and after falls so that force received is not maximum, reflex protection and partial anatomical covering of trunk by upper limbs. In abdominal viscera, kidneys suffered maximum injury in 8 cases followed by Intestines in 5 cases, and liver in 4 cases. Kidneys got contused in 7 cases, whereas liver contusion and laceration was seen in 2 cases each. Intestines suffered injury with 3 cases of laceration and 2 cases of contusion and bladder was injured in one case. No case of splenic injury was reported. The lesser mass of the spleen makes it less susceptible to pure decelerative forces.[9] Blood was present in stomach in 4 cases. Blood and blood clots in abdominal cavity were found in 15 cases. The high incidence of injuries in kidneys can be attributed to their position and direct trauma; where as organs inside abdominal

cavity can move comparatively free to escape injuries. The blood and blood clots accumulation in abdominal cavity can be attributed to organ injury like liver, intestinal injury, major vessel injury etc… In study by Tatjana C. Atanasijevic et al[9] liver was injured more than other abdominal organs which differs with our study.

Fractures of cervical vertebrae (11.11%) were common (figure 3), which can be explained by maximum mobility when compared to other vertebrae and transmission of force from head to neck, because of their close anatomical and physiological proximity. Complete transection of spinal cord was present in 2 cases. In study by Guillaume Perret[8] thoracic vertebrae were injured more than other vertebrae which differ with our study.

In extremities, abrasions were the most common injuries (26%) followed by lacerations (10.5%) and contusions (7.5%) externally. The free movements of limbs avoid severe impact on them, causing abrasions more than other injuries unlike head. In long bones injuries, Femur was fractured more (figure 1). More incidence of femur fractures can be explained by the weight bearing nature of the bone in falls, transmission of force from feet to upwards during a fall, anatomical angulation and alignment of femur compared to other bones and direct impact on femur. In hip bones, Ilium was found fractured in 5 cases followed by pubis fracture in 3 cases and there was no fracture of ischium bone. Pubic symphysis was dislocated in one case. Among dislocations of joints, wrist dislocation was present in 2 cases; and ankle dislocation in one case.

Majority (55.55%) of the victims died from Head injury (figure 7), followed by Multiple injuries in 11 cases. The high incidence of fatal head injuries can be due to brain sustaining more injuries qualitatively and quantitatively, susceptibility of brain to injuries and underdevelopment of neurosciences as compared to other branches like cardiology etc… Tatjana C. Atanasijevic et al[9] study also revealed maximum injuries were in head region in fatal falls. Gupta et al. [10] stated that a high incidence of head injuries is found in falls from heights below 12m which was also observed in our study. Most of the deaths were accidental in nature (90.27%); can be explained by fall during work with lack of preventive measures, awareness regarding safety.

Conclusions

Males in working age, coolies in construction works, during working hours in daytime, fell down from a height of 10-20 feet and died in 24 hours. Head injuries were fatal in most of the cases, among which brain suffered maximum with subdural haemorrhage being dominant. Skull, rib, long bone fractures were seen in descending order of frequency. Linear skull fracture was the commonest type of fracture, with temporal bone being dominant. Middle cranial fossa fractures were more common. Cervical vertebrae were injured more than other vertebrae. Lungs and kidneys suffered injury more than other organs. Blood clots were present in body cavities in 50% of cases. Accidental fall was the most common manner observed.

Preventive measures & Suggestions

Construct temporary railings during the period of work even at lower heights. Helmet and Professional dress with cushion must be provided to all persons working at heights.

Persons suffering with senility associated problems, cardiovascular diseases, vertigo,

hypertension; diabetes, epilepsy, acrophobia etc… and who are under the influence of alcohol, drugs etc should not be allowed to work.

Providing early ambulance services and Restriction of working hours may avoid exhaustion and decrease the number of incidents and thereby fatalities.

Identity cards and Group insurance schemes must be provided to the workers with minimum premium. In case of fatal accident, compensation must be given to dependents. In case of morbidity, Rehabilitation pension and hospital expenses should be given to the victims in time by insurance companies. Awareness education regarding preventive measures among coolies will help them to avoid carelessness during work.

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Figure 1 - Pattern of bone injuries

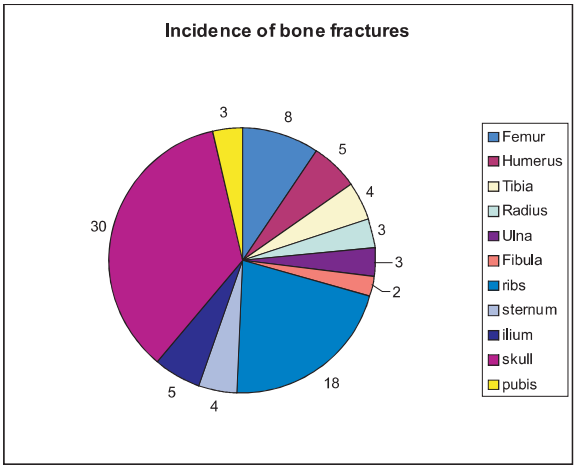

Figure 2

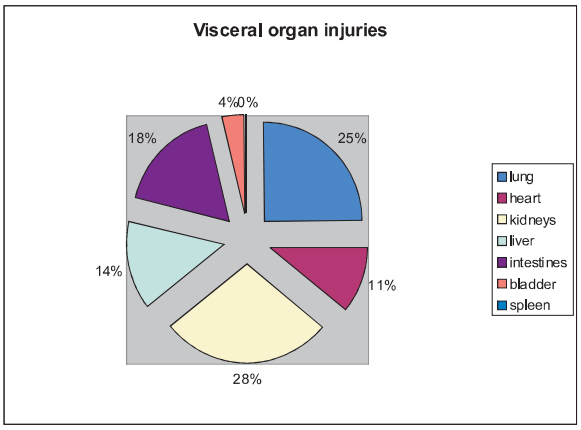

Figure 3

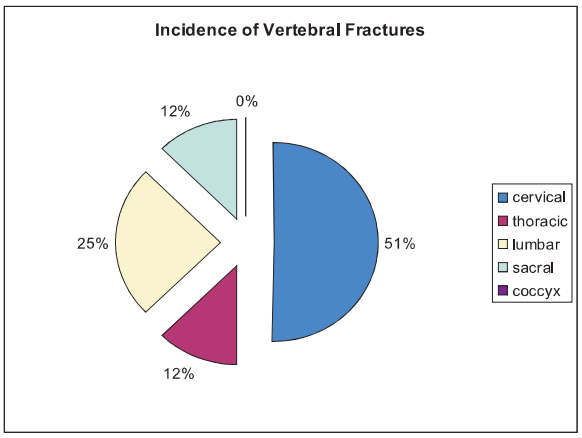

Figure 4

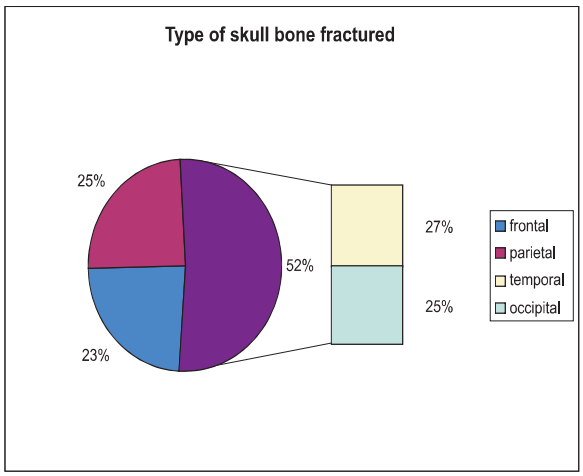

Figure 5

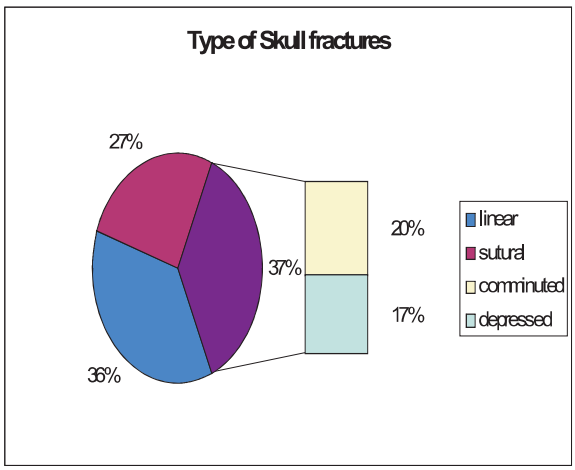

Figure 6

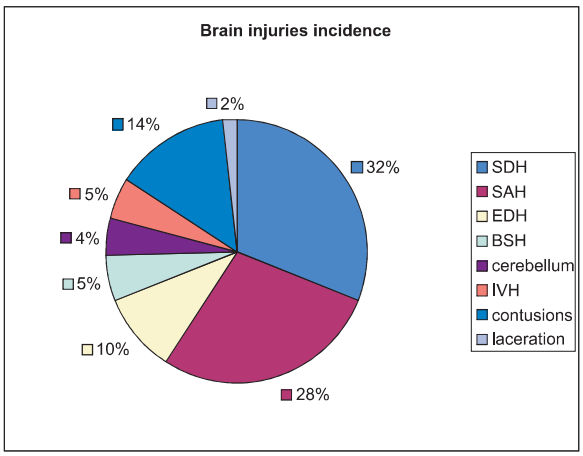

Figure 7