



Case Report

Transportation Injuries and the Affected Pedestrians

M Emdadur Rahman¹, D M Enamul Haque²

Abstract

Road traffic accident is one of the important causes of mortality and morbidity. Pedestrians frequently fall victim of injury and death. Among the causes of accidents are fault of victim, fault of driver, fault of vehicle, wrong signaling, type of vehicle etc. By means of identifying pattern of injuries, Police can ascertain the type of vehicle responsible for accident.

TAJ 2009; 22(1): 147-151

Introduction

Injuries to pedestrians; worldwide the most common road fatalities, probably accounting for over 50 percent of the third of a million road deaths each year. In the densely populated areas of the globe where vehicles are greatly outnumbered by people, such as Southern Asia, parts of Africa, and the Middle East and Central America, pedestrian casualties form a significant part of the total mortality. Most pedestrians are struck by motor cars or truck and the type of vehicle makes a difference to the dynamics of the impact, which unlike injuries to vehicle occupants is acceleration not a deceleration process. **The investigation of road traffic accident cases** involve the following purposes; (1) To identify the cause of accident. (2) To allow adequate compensation to the victim, if he is alive or the next-of-kin, if the victim is dead. (3) To punish the offender, if any offence is involved. (4) To search guidelines towards prevention of future accidents. **The investigation should include:** (1). Collection of history, (2) Examination of the deceased or the injured, (3) Examination of vehicle/vehicles involved in the accident, (4) Examination of the spot or place of

occurrence of the accident. **Causes of vehicular accidents**-Accidents may occur due to the following causes- (1) Fault of the victim, (2) Fault of the driver, (3) Fault of the vehicle, (4) Fault of another vehicle not involved in the accident, (5) Bad road condition, (6) Wrong signaling, (7) More than one of the above causes.

Road traffic injuries are blunt force injuries with forceful impact. They have three distinct types and according to the sequence of occurrence, these are- (1) **Primary impact injuries**, (2) **Secondary injuries**, (3) **Secondary impact injuries**. Primary injuries are caused by the first impact of the vehicle on the victim, while Secondary injuries are caused by subsequent contact with the ground. Some writers also use the term tertiary injuries to describe the impact with the ground reserving secondary for additional contact with the vehicle as when the pedestrian is hurled up against the windscreen. The usual sequence of events is as follows-

(a) The height of the car bumper bar (fender) is well below the centre of gravity of the adult pedestrian which lies in the abdominal region. Thus the first impact tends to knock the legs from

¹ Assistant Professor, Department of Forensic Medicine, Rajshahi Medical College, Rajshahi.

² Assistant Professor, Department of Forensic Medicine, Islami Bank Medical College, Rajshahi.

under the victim and rotate them towards the oncoming vehicle. Depending on the profile of the front of the car, the struck pedestrian is either thrown forwards in the direction of travel if the bonnet-front is high and blunt-or scooped up onto the bonnet top as with many slope fronted modern vehicles.

(b) If thrown forward, secondary injuries will be suffered as a result of striking the ground, as well as the primary impact on legs and often the hips. If the car speed is appreciable (anything over 20 km/hour is sufficient) the body can be thrown into the air or knocked down flat with a severe impact. The secondary injuries may fracture the skull, ribs, pelvis, arms or thighs.

(c) If scooped up, the victim will land on either the bonnet or against the windscreen of corner - supporting pillar (the 'A' frame). The flat bonnet usually does relatively little damage, though linear abrasions, brush grazes, or friction burns may be seen. Violent contact with the windscreen, especially the rim or side pillars are the most frequent cause of severe head injury from primary impact. Scooping-up can occur at speeds as low as 23 km/hour (about 15 mph below 19 km/hour the body will usually be projected forwards. If the speed is high the victim can be thrown up onto the car roof, sometimes somersaulting so that the head strikes the roof.

(d) In most cases, the scooped pedestrian falls off on one side of the car or the other, again to suffer secondary injuries in the road and perhaps be run over by another vehicle.

(e) In a high-speed impact, which may be anything over 50 km/hour (31 mph), the body can be flung high in the air and for a considerable distance, either to the side or in the path of the car-or even backwards over the roof. In general, the severity of the injuries-both primary and secondary will be the more severe the higher the speed. It is impossible to estimate the speed of impact from the nature of the injuries. In Ashton's series half the deaths occurred at speeds less than 48 km/hour (30mph).

In child victims, although the general pattern of injuries is similar, their shorter height and smaller

weight affects the mechanics of impact. The primary contact is higher up their body, so they tend to be hit forwards rather than rotated upwards, though many do become scooped up on to the bonnet.

(f) When a pedestrian is struck by a larger vehicle such as a van, truck or bus, the initial point of impact is higher and may cause primary damage to pelvis, abdomen, shoulder-girdle, arm or head. Because the profile of these vehicles, there is no scooping effect, and the victim is usually projected forward, suffer secondary damage from road contact sometimes to be run over.

(g) The nature of pedestrian injuries reflects the dynamic effects.

Method and materials

Post mortem examination is carried in the morgue of Rajshahi Medical College (RMC). After death of a person the police officer makes an inquest, sends the body of victim to the morgue, with a requisition addressing the head of the dept. of forensic medicine, escorted by police constable. Then the dead body is examined. Three (03) cases of transportation injuries were studied where the types and extent of injuries were noted. They are as follow.

Case-1 history

Ref: Rajpara P.S. U. D. case no 158, dated-15/04/08, Name of victim – Toslimuddin, Age is about 45 yrs, vill: Mougachhi, P. S. Mohanpur, Dist- Rajshahi. Inquest report and requisition were prepared by S. I. Zohurul Islam. Identification was done by c/no. 1780, Md.Khabiruddin. On 13/04/08 the victim, at 9:30 p.m was going home on foot. There was an accident at an area under Nachol P.S. & he got bodily injuries. He was admitted in ward no – 08, RMCH and died on 14/04/08 at 9.20 pm. Then the victim was sent to the Dept. of forensic medicine and P/M examination was done. Result- (a) External exam- Injuries found on the body were – (i) One lacerated wound on the left side of occipital region with 04 stitches. (ii) An abrasion on the left Elbow, 2" in diameter. (b) Internal exam. (Dissection)- Detailed dissection

was done. There was Intracranial haemorrhage (Extradural haemorrhage) on surface of brain, skull bones- healthy, Other bones - healthy, Other organs-healthy. Opinion –Opinion was given that death was due to shock and Intracranial haemorrhage due to above mentioned injuries, which were ante mortem in nature.

Case- 2 history

Ref- Boalia model P.S. case no 10, Dated- 09/04/08. Name of victim- Mohsin, Age is about 40 yrs, vill- yusufpur, P.S. Charghat, Dist. Rajshahi. Inquest report and requisition were prepared by – S.I. Abdus Samad, Identification was done by c/no. 1012, Md. Yunusur Rahman, Victim Mohsin was passing the road at 8.30 pm at vadra turning point when going back to his residence. A high speed bus pushed him from back, he was fallen on ground and got bodily injuries. He was taken to RMCH emergency dept but the duty doctor declared the victim as dead (brought dead), dated- 09/04/08 at 9.30 pm. Then the victim was sent to the Dept. of forensic medicine and P/M examination was done.

Result- (a) External exam- Injuries found on the body were – (i) One lacerated wound over the right side of frontal bone, size is $2\text{ cm} \times 0.5\text{ cm} \times \text{bone}$.(ii) An abrasion on the left side of the frontal bone 1" in diameter. (iii) One bruise over the right cheek, 3" in diameter. (iv) One bruise over the right shoulder, 3" in diameter. (v) Multiple abrasions over both knees and elbows were found. (b) **Internal exam-** (Dissection)–Detailed dissection was done. There was Intracranial haemorrhage (Extradural haemorrhage) on surface of brain, skull bone-healthy, other bones-healthy, other organs-healthy. **Opinion-** Opinion was given that death was due to shock and Intracranial haemorrhage due to above mentioned injuries, which were ante mortem in nature.

Case-3 history

Ref. Rajpara P.S. U.D. case no-171, Dated- 21/04/08, Name of Victim – Zosna Rani, Age is about 35 yrs. Vill – Zianagar, P.S, - Rajpara, Dist. Rajshahi. Inquest report and requisition were prepared by S.I. Zohurul Islam, Identification

was done by c/no. 1780, Md. Khabir Uddin. Victim Zosna Rani on 21/04/08 while crossing the road at a place under the P.S. Rajpara, there was an accident with a truck & she got bodily injuries to head and different parts of body. She was taken to RMCH emergency dept. on 21/04/09 at 7 p.m. & the duty doctor declared her as dead (brought dead). Then the victim was sent to the Dept. of forensic medicine and P/M examination was done.

Result – (a) External exam- Injuries found on the body were- (i) One abrasion over the frontal region of head, 2" in diameter. (ii) One lacerated wound over the occipital region size is $2\text{ cm} \times 0.5\text{ cm} \times \text{bone}$. (iii) An abrasion over the back of left knee, 1" in diameter. (b) **Internal exam.** (Dissection)- Detailed dissection was done. There was Intracranial haemorrhage (Extradural haemorrhage) on surface of brain, skull bones-healthy, other bones-healthy, other organs-healthy. **Opinion-** Opinion was given that death was due to shock and Intracranial haemorrhage due to above mentioned injuries, which were ante mortem in nature.

Discussion

In the above three cases, case no (1) & (3) were U.D. cases and case no (2) was a regular case though all of these cases were road traffic accident or transportation injuries to the pedestrians Cause of death in all the three cases was intracranial haemorrhage that is head injury. Among the cases, there was abrasions, bruises and lacerated wound without any fracture of skull or other bones. Usually light vehicle like cars hits knee or below the knee level and heavy vehicle like truck, etc. hits above the knee level like thigh, pelvis etc. The injuries like abrasions and lacerations, found on the frontal region of face, shoulder, head and skull should be due to secondary injuries due to fall on ground, hitting with the affected parts. The most common trauma is to the legs, some 85 percent of pedestrian casualties; having lower limb injuries. Abrasions and lacerations to the upper shin and knee area are typical of car bumper contact, and fractures of the tibia and fibula, often compound, are so common that they are present in a quarter of fatalities, according to Eckert. The femur is fractured less often, but is no rarity. The midshaft

may be broken or the head may be driven into the acetabulum, together with a fractured pelvis. In children, because of their small stature, by the low bumper bar. At autopsy, the skin of the lower legs should be incised to seek deep bruising, as the clothing often protects the surface from obvious marking.

When a bumper (fender) strikes a leg, the tibia is often fractured in a wedge-shaped manner, the base of the wedge indicates the impact (often from behind), the front of wedge pointing away from the side of contact. If the leg is weight bearing at the time of the impact, the tibial fracture tends to be oblique, whereas if not stressed as when being lifted during walking, the fracture line is often transverse. When both shins are damaged, the level may be different on each side; this indicates that the person was moving at the time, with one leg raised in walking or running. Sometimes the level of injury appears too low for the normal bumper height of most cars, but this may indicate that the vehicle was braking violently at the moment of impact, going down on its suspension as the front heels decelerated or locked, unless dip compensators were fitted. Because of impact with the windscreen pillars and roof, together with secondary contact with the ground, the head is the next frequently damaged region- and the one which leads to most causes of death. Any type of injuries may be sustained. Traffic accidents are the most frequent cause of skull fracture, especially of the base. Fractures of chest, arm and pelvis and injuries to the abdomen follow in frequency. Often injuries are concentrated on one side, usually opposite side to the point of primary impact, because the body was thrown down on to the road. Because of rotation and the variable posture from being thrown off the car structure, however, the injuries are often widespread and may show no particular pattern.

Soft tissue injuries are common and apart from a bruises and lacerations, muscle laceration and crushing can occur. A characteristic lesion from running-over, as opposed to knocking-down is the **flaying injury** where a rotating motor wheel tears the skin and muscle from a limb or head. The rotatory effect against a fixed limb may strip off

almost all tissue down to the bone. When a wheel passes over the abdomen or pelvis, multiple parallel striae or shallow lacerations may occur near the contact area because of ripping tension in the skin. When a wheel passes over the pelvis, abdomen or head, there may be great internal damage with little surface injury. The weight of a large vehicle can virtually flatten a head, crushing the cranial vault. Often the brain is extruded through scalp lacerations, as may be the intestine through an abdominal wound. The pelvis may flatten out when run over, the symphysis or superior rami breaking, and one or both sacroiliac joints becoming detached. In the chest, ribs, sternum and thoracic spine may fracture, and heart and lung damage occur from crushing or laceration from jagged ribs. A “**flail chest**” is sometimes produced when a heavy wheel runs across the supine body, breaking all the ribs on each side in the anterior axillary line.

Patterned injuries may be important, in that they can assist the police in identifying a vehicle in a hit-and-run accident. The most common is a tyre pattern outlined in intradermal bruising and these should be measured carefully and photographed. These marks are usually caused by the skin being forced into the grooves of the tyre tread, the edge of the raised rubber tracing out the pattern. The elevated parts do not leave bruises, but may imprint dirt on the skin. Paint, fragments and glass shards are also trace evidence that must be carefully retained. Parts of the vehicle may leave patterned imprints on the skin, such as headlamp, mirrors or other components. Metallic and plastic objects may still be found in the tissues from time to time, however a door handle were recovered from the interior of the liver and a chromium bonnet insignia from a cerebral hemisphere. Any such artifacts must be preserve for the police in cases in which the identity of the vehicle is not known.

In gross injuries this is often obvious, as in the crushed head with extrusion of brain or rupture of the aorta. Often multiple injuries make it difficult to decide which was the most serious and mortal lesion, but in such cases it is quite acceptable to use the term multiple injuries, preferably listing

several of the most lethal. When death occurs on the road or soon afterwards there is usually macroscopic evidence of gross musculoskeletal or organ damage, severe haemorrhage, blockage of air-passages from blood or traumatic asphyxia from fixation of the chest caused by crushing by some part of a vehicle. Delayed death can be caused by continuing bleeding, secondary haemorrhage, renal failure from hypotension and or extensive muscle damage, fat embolism local infection, chest or other systemic infections, myocardial or cerebral infarction and other sequelae. The presence of natural disease is always an important consideration in all transportation deaths, as a possible cause or contribution to the accident. In pedestrians, a sudden collapse in the roadway may lead to fatal injuries when a vehicle comes along or even a dead body being run over by the next car.

References

1. Forensic Medicine & Toxicology by Apurba Nandy, M.D., reprint 1998.
2. Forensic Pathology, Second Edition by Bernard Knight, CBE, MD. DSc(Hon), MRCP, FRCpth, DMJ (Path), Barrister.
3. Ashton, S.J. The cause and nature of head injuries sustained by pedestrians. Proc. 2nd conf. Biomech. Serious Trauma Lyon, 1975.
4. Ashton, S.J. Mackay. G.M. Pathology of violent Injury, 1st edn. London, Edward Arnold, 1978.
5. Clard, J; Milroy, C. Pedestrian injuries and death. In Mason, J.K' ed. Pathology of Trauma, 2nd edn, London, Pathol 1993.
6. Copeland, A. Pedestrian fatalities. AM J forensic Med Pathol 1991; 12:40-4.
7. Fisher, A.J. Hall. R.R. The influence of car frontal design on pedestrian trauma. Accid anal prev 1972;4:47-51.
8. Huelde, D.F; Davis, R.A. A Study of pedestrian Fatalities in wayen County, Michigan. HRSI Report, Ann Arbor, University of Michigan, 1969.
9. Mccarrol, J.R.. Faftal pedestrian automotive accidents. JA MA 1962; 180:127-30.
10. Simpson, K. The interpretation of the surface pattern of vehicular injuries. Med Sci Law 1: 420-8.
11. Bader, S.P; Spitz, W. An evaluation of the hazard created by natural death at the wheel. NEng IJ Med 1970; 283: 405-9.
12. Bader, S.P; Spitz, W. Age effects and autopsy evidence of disease in fatally injured. JAMA 1970; 214:1079-81.
13. Bako, G; Mackenzie, W.C, Smith, E.S. what is the risk of being burned in a motor vehicle crash? A Survey of crash fatalities in Alberta. J Traffic Med 1972;4:20-4.
14. Christian, M.S. Non-fatal injuries sustained by back seat passengers. Br Med J 1975; i: 320-2.
15. Dimaio, D. J. A survey of sudden unexpected deaths in automobile drivers. Proc 3rd Int Ass Traffic Med 1971; pp. 75-80.
16. Eckert, W. Traumatic pathology of traffic accidents; Review of 302 cases. J Foresic sci 1959; 4: 3-20.
17. Eckert. W. Transportation injuries. In: Tedeschi L, Eckert. W.B. Ed. Forensic medicine, Saunders. Philadelphia. 1977.
18. Edland, S.F. The suicide crash. Proc 3rd Congr Int Ass Acc Traffic Med 1971. pp.81-3.
19. Foster, G. R. Dunbar, J. A. Whittet, K. Fernando G.C. contributiion of alcohol to road deaths in fayside 1982-6. Br Med J 1988;296:1430-2.
20. Gissane, W; Bull, J. Motorway fatallities. Br Med J 1964; i: 75-6.
21. Gissane, W; Bull, J; Robeerts, B. Sequelae of road injuries. Injury 1970;1:195-200.
22. Huclke, D.F. Gikas, P.W. Ejection the leading cause of death in automobile accidents. Conf Proc Soc Automotive Eng, New York, December 1968.

All correspondence to:
M. Emdadur Rahman
 Assistant Professor
 Department of Forensic Medicine
 Rajshahi Medical College, Rajshahi