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Medicolegal Study of Fatal Road Traffic Accidents in Varanasi Region

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Abstract: ***Road traffic injury related deaths can be considered interplay of increasing speeds and rising traffic volume on our roads. Present study considers various circumstances and in depth analysis of fatal road accidents. This study on 100 fatal cases is an attempt to interpret various aspects of this so called rising pandemic of modern society. Out of 100, 88 % were male, 12 % female. Pedestrians and two-wheeler's rider victims were 37 % each. City roads and lanes were invariably equally risky since morning peak traffic hours till midnight. Highways were riskier since afternoon till late midnight hours. In 54.8 % on the spot death cases heavy motor vehicles were the offenders. 84.1 % cases opted for treatment at tertiary centers. Injuries to chest/abdomen/pelvis proved to be fatal within 1 day. Deaths on the way to hospital were due to coma and hemorrhagic shock. These facts highlight the need for availability of prompt resuscitative measures and an approach of zero tolerance for traffic related hazards***.

Keywords: Road Traffic Accident, Fatal, Medico-legal, Postmortem, Pedestrian, Vehicle Occupant

1. Introduction

India reports highest number of accident fatalities (1, 37,423 in 2013) in the world. More alarming than the sheer number of accidents is their severity (persons killed per 100 accidents). It steadily rose from 21.2 to 28.3 from 2003 to 2013. National figures report **377** deaths per day and **1287** injuries per day due to Road Accidents. **66** Deaths per day are by Truck/Lorry and **94** deaths by Two-wheeler. Uttar Pradesh shared 11.3 % in 2010, 15.1 % in 2011, 11.7 % in 2012 and 11.6 % in 2013 of total national road traffic deaths [1].

The problem of Road Traffic Accidents is compounded by the fact that, the age groups primarily involved in Road Traffic Accidents belong to the most productive age group of 15-40 years. Developing countries, such as India face the double burden of already existent communicable diseases and increasing burden of non-communicable diseases including Road Traffic Accidents.

Understanding a problem is one of the first steps towards averting the problem. Present study on fatal road traffic accidents in Varanasi region has been undertaken to analyze this most important yet the most neglected aspect of human sufferings. It is an effort to elucidate the multi-factorial causations leading to the rise in everyday fatal road traffic injuries. The objective of this study was to analyze the trend of fatal road traffic accidents and to find out the measures for the prevention of their causative factors.

2. Literature Survey

The term "accident", which is widely used, can give the impression, probably unintended, of inevitability and unpredictability – an event that cannot be managed. Contrary to 1956 definition, World Health Organization report on Road Traffic Injury prevention, 2004 prefers to use the term "crash". This is to denote something that is an event, or series of events, amenable to rational analysis and remedial action [2]. One reason for the historical neglect of "injury" in public health is the traditional view of accidents and injuries as random events that happen to others. Such events are looked upon as an inevitable outcome of road transport. While the risk of a crash is relatively low for most individual journeys, people travel many times each day, every week and every year. The sum of these small risks is considerable.

3. Method/Approach

Present study was done on the cases selected from the dead bodies brought into the mortuary of the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, for medico-legal postmortem examination from the various police stations of Varanasi region.

The data of the materials were sourced from 100 fatal Road Traffic Injury cases. *Fatal Injuries are* injuries which caused death in less than 30 days after the accident. Greece, Portugal, Spain use within 24 hours. France uses within 6 days, Italy uses within 7 days. Most other states use within 30 days. Since no uniform parameter defines fatal period after an accident in India, this study included cases which survived till 7 days after sustaining road traffic injuries. The victim's information and history of circumstances of Road Traffic Injury sustained were gathered from the interviews of relatives and of persons accompanying them if they had the first hand information of the sequence of events leading to such fatalities.

These served the bases for the epidemiological aspect of the study such as victim's age, educational, residential, occupational, socio-economic status. Date, time, place of incidence, type of road, whether victim was pedestrian or any vehicle rider, type of offending vehicle, number of people involved etc., were recorded on a scheduled pro

forma. Whether the victim died on spot, en-route hospital, in hospital, time and place since incident when first medical care could be given etc., were noted.

With background of above information all cases were examined thoroughly at medico-legal autopsy. It included external examination of cadavers, relevant findings were observed for the nature, manner and mode of death, helping in reconstructing the sequence of events. Victim's body built, parts of the body involved, nature of injuries sustained were seen.

Then further detailed internal examination of head and neck, thoracic and abdominal regions and extremities was done. Information collected included details of vital visceral organs involvement and of other affected body regions and examination of each. These included condition of: scalp, cranial bones, meninges, brain, intra-cranial hemorrhages', involvement of soft tissues of face, facial bones, vessels in the neck, trachea, esophagus, and spinal and vertebral involvement. Data thus compiled were studied and analyzed statistically using Statistical package for Social Sciences (SPSS® 16.0, SPSS Inc, Chicago, IL).

4. Problem Definition/Case Report

This study entitled "Medico-legal study of fatal road traffic accidents in Varanasi region" was undertaken with these objectives:

1) To evaluate the changing trends in incidence of fatal road traffic accidents confounded by exponential rise in traffic and population.
2) To evaluate medico-legal aspects of fatal road traffic accidents.
3) To study nature, pattern and distributions, contributing cumulative factors causing fatal road traffic accidents.
4) To ascertain which of the injured body part were most fatal.
5) To analyze post trauma aspects which will help formulate strategies to reduce tragic human losses due to fatal road traffic accidents.

5. Results & Discussion

88 % were males and 12 % female victims. 15-44 age brackets had 63 victims; of which there were 55 males and 8 females. Extreme age groups 0-14 and 60-75 had 18 % deaths. This observation is consistent with observations of Peden M et al. [2] who found that Road traffic mortality rates are higher in men than in women in all regions regardless of income level, and also across all age groups. The gender difference in mortality rates is probably related to both exposure and risk-taking behavior. Jain A et al (2008) too found majority (77%) of the victims in the age group 18–44 years. Accident rate among males (83%) was higher than that among females (17%) [3].

Out of 100 cases, pedestrians and riders of two-wheeler were 37 % each, cyclists were 15 %. In two-wheeler's riders; age groups 15-29 had highest 18(60 %, n=30) deaths. Pedestrian deaths in 60-75 age groups were 50 % signifying proneness of this age group to road accidents. Below 45 years as two-wheeler riders and above 45 as pedestrian were more prone to fatal traffic injuries. This suggests adventurous nature of this age group where in speed and traffic rule violations are the major factors claiming toll of their precious lives. Different natural diseases of pedestrians and motor vehicle drivers could be mentioned as possible risk factors for road traffic accidents. In addition to poor physiologic reserve, elderly pedestrians are thought to have slower response times and decreased ability to recognize dangerous situations while walking. Mental confusion and sensory changes such as hearing and visual loss may place elderly pedestrians at a disadvantage (Toro K et al., 2005) [4].

Maximum victims of users of two-wheelers were 12 (32.43%, n=37) from service class, next 10 (27.03%, n=37) were students. Students were maximum amongst cyclists followed by 4 each labourer's and agriculturists group. In pedestrians 20 (54 %, n=37) were agriculturists (highest). Maximum two-wheeler's users to suffer casualties were Graduates (45.9 %, n=37) followed by higher secondary level education (27 %, n=37). Most pedestrians were educated till primary (43.2 %, n=37).

Socioeconomic status is well known to be a risk factor for injury generally[5], and road traffic injury is no exception as exemplified above. Studies have found that individuals from disadvantaged socioeconomic groups or living in poorer areas are at greatest risk of being killed or injured as a result of a road traffic crash, even in high-income countries (Roberts I, Power C., 1996) [6].

Heavy motor vehicles dominated highway accidents (75 %, n=44) followed by light motor vehicles (18.2 %, n=44). On city roads (52.8 %, n=36), and lanes (65 %, n=20) the dominant offending vehicles were light motor vehicles. Next major offenders were heavy motor vehicles on both city and lane roads. Riders of two-wheeler's suffered maximum 20 (54 %, n=37) casualties due to collision with Heavy motor vehicles, their second highest toll was claimed by Light Motor Vehicles 12 (32.4 %, n=37). Cyclists too were major sufferers at the hands of above two categories of vehicles. Maximum 17 (45.9 %, n=37) pedestrian deaths were caused by Light Motor Vehicles, close followers of this were Heavy motor vehicles in causing 16 (43.2 %, n=37) pedestrian tolls. Thus, vehicular size and momentum were main reasons for deaths of pedestrians, cyclists and two-wheeler vehicle riders.

Highways claimed maximum deaths of two-wheeler's riders (59.4 %) and their joint death toll on city roads and lanes were 40.6 %. Most of the cyclists sustained fatal injuries on city roads (60 %). City roads and lanes together shared 70.3 % pedestrian fatalities. As observed by Nantulya VM et al., 2003 [7], there is concern over the vulnerability of people living along highways, since these roads are often built through areas where economic activity already exists, thus creating potential conflicts over space between the road users and the local population. Varanasi too records such fatal deaths due to the highway that passes through the city and adjoining villages.

Two-wheeler's riders (56.7 %), pedestrians (37.8 %) and cyclists (33.3 %) deaths were due to coma. Death due to hemorrhagic shock was seen in 40 % cyclists, 21.6 % two-wheeler riders and 18.9 % pedestrians. 29.7 % pedestrians, 20 % cyclists and 8.1 % two-wheeler riders died instantaneously due to crush injury. Thus, coma followed by hemorrhagic shock was the two leading causes of deaths. **Pedal cycle** injuries are common in India, but severity is less due to slow speeds. The injuries to the cyclist are similar in distribution and severity to those sustained by a pedestrian (Biswas G, 2012) [8].

City roads recorded maximum 9 (47.4 %, n=19) fatal road traffic injuries during morning peak hours (09:00-11:00 AM), during late evening hours too (20:00-24:00), 09 traffic injuries occurred. Afternoon (12:00-15:00) and evening traffic peak hours (16:00-19:00) had 7 and 6 fatal road traffic injury incidences. On lane roads too evening traffic peak hours (16:00-19:00), morning peak hours (09:00-11:00 AM), and late evening hours recorded 6, 5, 5 fatal road traffic related injuries. Thus, the risk of injuries due to road traffic accidents was more during morning and evening peak hours. Late evening hours too were more risky due to less traffic on roads allowing over speeding leading to fatal accidents. Rise in traffic accidents since afternoon till late night hours were also found in studies of Jain A et al, (2008) [9], Menon A et al [10] (2008). Maximum number of two wheeler accidents during late evening is because the traffic density is high during this time and is coupled with the poor infrastructure and fall in traffic discipline.

Contrary to these highways had the most 14 (53.8 %, n=26) fatal road traffic injuries during evening traffic peak hours (16:00-19:00), afternoon hours (12:00-15:00) recorded 10 (47.6 %, n=21) closely followed by late evening hours (20:00-24:00) with 9 (39.1 %, n=23) injuries. This indicates that traffic related injuries show rising trend since afternoon till late night on highways. This is in contrast with the findings of Kyada H.C. et al., (2012) [11] who reported maximum incidence of vehicular accidents in working hours between 12 pm-6 pm.

Maximum on spot deaths were seen amongst pedestrians 22 (59.4 %, n=37) followed next by 9 (24.3 %, n=37) two-wheeler's riders and 6 (40 %, n=15) cyclists. Cyclists and two-wheeler's riders were equal in numbers who died on their way to hospital. Deaths In hospital were maximum 22(59.4 %, n=37) of two-wheeler riders followed by 14 (37.8 %, n=37) of pedestrians. This suggests that pedestrians suffered more fatal injuries than occupants of two wheeled vehicles, since on spot deaths were seen more in pedestrians whereas deaths in hospital were more for two wheeled vehicle occupants. Maximum 23 (54.8 %, n=42) on spot deaths were caused by heavy motor vehicles and next 15 (35.7 %, n=42) by light motor vehicles. On the way to hospital deaths too were 71.4 % and 28.6 % due to injuries by heavy and light motor vehicles respectively. In hospital deaths were the most 47.7 % and 40.9 % due to injuries by light and heavy motor vehicles respectively. Edirisinghe Dr. P et al., (2014) [12] in their study found that 28% (n ¼ 92) of the victims had crushed/run over injuries and majority of them were seen in pedestrians (52 cases) as expected. These findings are consistent with present study.

The analysis of risk stratification in road traffic accidents reveals that two wheeler riders were more commonly injured than the pedestrians. These findings can be correlated to the involvement of younger age group who use two wheelers as a more common mode of transport. Dandona R et al., (2000) have studied the Risky behavior of drivers of motorized two wheeled vehicles in India [13]. Road traffic crashes are more frequent in urban areas, particularly as urbanization increases. However, injury severity is generally greater in rural areas. This could be related to road design and congestion in urban areas slowing traffic, while conditions in rural areas allow for travelling at greater speeds. In low-income and middle-income countries, fewer crashes happen in rural areas, but the overall costs to the families can be greater when they do occur (Mohan D. 2003) [14]There was no significant difference in each of the time slot of 1, 2 and 3 hours within which victims received their First Aid whether the accident occurred on highways, city road or lane road. From each place of accident first aid was invariably equally delayed. 84.1 % cases opted for treatment at tertiary centers which reflects the burden that our tertiary centers share in treating accident cases. Those who got their First Aid within an hour total 10 (34.5 %, n=29) survived beyond one day and 5 (17.2 %, n=29) survived till one week. Although survival time of victims is highly variable considering the severity of injuries sustained, still after accident each second matters. Out of 17 (38.6 %, n=44) cases which survived beyond one day till a week, head injuries survivors were 11 (64.7 %, n=17), head and other multiple injuries were 5 (29.4 %, n=17). Injuries to chest/abdomen/pelvis proved to be fatal within 1 day. Kanchan T. et al. (2012)[15] in their study found thoraco-abdominal injuries and injuries to the limbs to be the other common causes of death in fatal road traffic accidents. Thoraco-abdominal involvement in the road traffic accidents can be related to the anatomical location of this region that makes it easily susceptible to impact in any form of blunt force trauma. Shetty BSK et al (2012) [16], have reported similar pattern of thoraco-abdominal injuries sustained in fatal road traffic accidents.

Amongst on spot fatalities, maximum 18 (43%, n=42) deaths were instantaneous due to extensive crush injury. Next 10 (24 %, n=42) deaths were due to coma and hemorrhagic shock. 3 (7 %, n=42) persons died due to coma + hemorrhagic shock. Amongst victim's who died on their way to hospital, 8 (57 %, n=14) deaths were due to coma and rest 6 (43 %, n=14) deaths were due to hemorrhagic shock. In victim's who were hospitalized, Coma (54.5%, n=44) followed by hemorrhagic shock (22.7%, n=44) and coma + hemorrhagic shock (11.4%, n=44) were the top three leading causes of deaths. On spot deaths are more likely in mismatch vehicular collisions or in high speed collisions or heavy/light motor vehicle and pedestrian collisions (Kumar M, Kumar N., 2014) [17]. Menon A et al (2008) reported 62.75 % on spot deaths in their study [10]. Jain A et al (2008) too reported highest on spot deaths in their study [9]. Kanchan T, et al., (2012) found most common offending agents in road traffic accidents were heavy motor vehicles (35.2%) followed by light motor vehicles (31.7%) [15]. These findings are similar in this present study. In skull and facial bones fractures, Calvaria (skull) + maxilla and mandible (facial skeleton) had undergone crush injuries in 13 % (n=100), temporo-parietal area and frontal alone were

involved in 9 % and 8 % cases respectively. Occipital alone was involved in 5 %. Subdural hemorrhage was 26 % and Subdural + Extradural hemorrhage was seen in 11% cases. 29 % cases had pale brain substance primarily due to hemorrhagic shock. 13 (13 %, n=100) cases were having severe crush injuries of calvaria resulting in loss of brain substance. Menon A et al (2008) [10], Kumar A et al., (2008) [18] in their study too reported 52.63 % and 89.11 % subdural haemorrhage respectively.

Ribs were bilaterally involved in 21 % (n=100). In unilateral involvement right (7 %, n=100) side rib fractures were slightly more than left (6 %, n=100). Lungs showed bilateral involvement in 18 % (n=100) cases. Right sided involvement of lungs (10 %, n=100) were more than left (6 %, n=100). Ribs and lungs involvement shared similar pattern. Extensive crush injury of entire liver was seen in 9% cases. 10 % laceration injuries were noted on right lobe compared to 2 % left lobe of liver. Thus, right lobe of liver had significantly higher rate of sustaining injuries than left lobe. Laceration of spleen of varying degree was noted in 11 % cases. In 89 % cases spleen was not involved.

Left humerus was involved in 5 %, right in 3 % cases. Both right and left hands had equal 2 % crush injuries. Fracture of left radius + ulna was seen in 2 %, on the right side it was in 1 % case. Thus, left side had more predilection for involvement compared to the right. Bilateral femur fractures and bilateral tibia + fibula had 4 % fractures each. Right tibia + fibula fractures were in 8 % and left in 4 %.

Thus, right side had more predilection for involvement compared to the left in case of lower limbs. In 8 %, pelvic fracture cases were associated with rupture of urinary bladder. In 4 % cases although pelvic fracture was there, yet urinary bladder was spared and only contusion were seen in such cases. Rest 88 % cases neither had pelvic injuries, nor urinary bladder rupture.

Pedestrians and bicyclists (33%) suffered more pelvic and lower limb injuries than motor vehicle occupants (24 %) (Toro K et al., 2005) [4]. A combination of fractures of the bones of the legs and lumbar and head injuries is suggestive of a pedestrian traffic injury (Gordon I, Shapiro H.A., 1982) [19].

Table: Analysis of different variables in Pedestrians & Vehicle Occupant

Variable	*Pedestrians*	*Vehicle Occupants*	*P Value*
Male	29	59	0.023^{SIG}
Female	8	4	
<45 Years	22	51	0.019^{SIG}
>45 Years	15	12	
City Road	26	30	0.028^{SIG}
High Way	11	33	
Off Peak Hours	19	36	0.574
Peak Hours	18	27	
Light Motor Vehicle	21	28	0.234
Heavy Motor Vehicle	16	35	
Death On Spot Or En route Hospital	23	33	0.341
Death In Hospital	14	30	
Survival Till 1 Day	29	54	0.346
Survival Till 2-7 Days	8	9	
Death Due To Multiple Injuries	26	56	0.019^{SIG}
Instant Death Due To Crush Injury	11	7	
Cause Of Death -Coma Due To Head Injury	17	35	0.353
Cause Of Death-Other Than Head Injury	20	28	
Skull Injuries Present	25	31	0.074
Skull Injuries Absent	12	32	
Brain Injuries Present	35	60	0.887
Brain Injuries Absent	2	3	
Rib Injury Present	15	19	0.290
Rib Injury Absent	22	44	
Lung Injuries Present	15	19	0.290
Lung Injuries Absent	22	44	
Liver Injuries Present	10	11	0.257
Liver Injuries Absent	27	52	
Pelvic Bone Injuries Present	34	54	0.359
Pelvic Bone Injuries Absent	3	9	
Fracture Of Upper Limb Present	4	11	0.369
Fracture Of Upper Limb Absent	33	52	
Fracture Of Lower Limb Present	9	17	0.770
Fracture Of Lower Limb Absent	28	46	
SIG: Significant.			

Being male (P value-0.023^{SIG}) and above 45 years of age (P value-0.019^{SIG}) as a pedestrian was statistically significant compared to the vehicle occupants implicating that they were more vulnerable to suffer fatal road traffic injuries. Accidents on city roads were statistically significant for pedestrians (P value-0.028^{SIG}) compared to vehicle occupants on highways. Statistical Significance (P value-0.019^{SIG}) was seen for vehicle occupants compared to pedestrians in whom death due to multiple injuries was more compared to Instant Death Due To Crush Injury amongst pedestrians.

6. Conclusion

Fatal road traffic injuries are on the rise claiming precious human lives. This study finds that motor vehicle occupants suffered more severe injuries than the pedestrians. Whilst on the spot injuries requires preventive measures, a systematic approach needs to be incorporated to minimize deaths which occur on way to hospital and in the hospital. This study finds that on the way to hospital deaths were due to coma and hemorrhagic shock due to lack of prompt resuscitative measures in dealing with such emergencies. The success of the pre-hospital trauma management hinges on immediately making a triage and transport decision. Severely injured patients should be immediately transported to an appropriate hospital for definitive care using the "Load and go" philosophy, with all remaining care provided en route. Valuable pre-hospital care including a head to toe examination, continuous monitoring, placement of subsequent intravenous access, and environmental control

can be provided while the patient is being transported (Townsend C.M., et al., eds, 2012) [20].

7. Future Scope

More man power needs to be trained and educated to meet these needs. This also necessitates development of trauma care centers at those places where approach is easy and hassle free in case of emergencies. Our cities remain clogged almost round the clock by heavy traffic. This demands revamping of traffic systems with advanced traffic designs and vehicular norms that has respect for pedestrians and for riders of two wheeler vehicles since these two bear maximum accident related disabilities and fatalities. A futuristic approach may be the consideration to design systems which will lessen frequent transportation of people. Some steps feasible are design systems where in work place and homes are in close vicinity which will lessen surge in traffic during office going and returning hours. Encouragement of e-learning portals or development of boarding school culture will lead to less school bus accidents. Finally, this study concludes with the note that the rising problem of traffic accident related injuries and deaths needs to be addressed with utmost care. It's not that one life has suffered ill fate; we lose sheer numbers of working human population each moment as found throughout this study.

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