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Original Research Article

TYPE OF INJURIES ENCOUNTERED IN AN AUTOPSY BASED STUDY OF DEATHS DUE TO MOTORCYCLE ACCIDENTS AT A TERTIARY CARE CENTRE

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ABSTRACT

Background: Motorcycle accidents are a significant cause of morbidity and mortality, particularly in low- and middle-income countries like India. With an increasing number of motor vehicles on the road, the incidence of road traffic accidents (RTA) has surged. This study aims to analyze injury patterns and causes of death in motorcycle accident victims. **Objectives:** To assess the demographic distribution, injury patterns, and causes of death among motorcycle accident victims and establish the correlation between vehicle conditions and the severity of injuries in fatal cases.

Materials and Methods: A prospective observational study was conducted on 132 fatal motorcycle accident cases brought for autopsy at a tertiary care hospital from January 2016 to June 2017. Data were collected from post-mortem reports and analyzed for demographic variables, injury patterns, and associated risk factors using Microsoft Excel.

Results: Males (82.57%) constituted the majority of victims, with most cases occurring in the 21-40 years age group (56.1%). Urban residents (66.67%) were more affected. Only 30.30% of victims used helmets. Skull fractures were observed in 53.78% of cases, with linear fractures being most common (66.19%). The frontal region was the most affected cranial site (41.37% in riders). Subdural and subarachnoid hemorrhages were the most common intracranial injuries (78.57%). Lower limb fractures (33.92%) and thoracic injuries (32.14%) were frequent. Head injury was the leading cause of death (56.06%).

Conclusion: Motorcycle accident-related fatalities predominantly affect young males, with head injuries being the primary cause of death. Helmet use remains low despite its proven protective effect. Enhancing public awareness, enforcing helmet laws, and improving road conditions are essential to reducing motorcycle-related fatalities and injuries.

Keywords: Motorcycle accidents, Head injury, Road traffic accidents, Skull fractures, Helmet use.

INTRODUCTION

The growth of motor vehicles has been accompanied by growing number of fatal crashes. As per accidental and suicidal deaths (national bureau of crime record of India) over 1,48,707 were killed in road accidents in 2023 alone in India, that is more than number of people killed in all post-independence wars put together of India.[1] Due to growth of economic status of the people and passion to own a vehicle in recent years, there is a tremendous increase in the number of motor vehicles using the road. This Spectacular increase in the number of vehicles on the road had created a major problem of loss of lives and property through accidents. RTA is an unplanned event

occurring suddenly, unexpectedly and inadvertently in an unforeseen circumstance.[2]

Road Accidents cause 1 death every 9 minutes (160 every day and 60,000 every year) four and half times as many as non-fatal accidents. RTA injuries are currently ranked 9th globally amongst the leading cause of DALY (Disability adjusted life year).[3] Low Income and middle-income countries account for 85% of the death, and for 90% of the annual disability adjusted life years lost because of road traffic injuries.[4] Road Traffic Injuries in developing countries mostly affect pedestrians, passengers and motorcyclists as opposed to drives who are involved in most of the deaths and disabilities occurring in the developed world.[5] Incidences are more common among the two-wheeler vehicles. Motorcycle accidents accounts for 25% of total road crash deaths.[6]

Motorized two-wheeler vehicles constitute a large portion of the vehicle fleet in India. The exponentially increasing number of automobile vehicles, poor adherence to traffic rules and regulations such as maintaining lane discipline, driving in zigzag patterns by public, poorly maintained motorcycles, poorly maintained and congested roads, abuse of alcohol, and lack of awareness about helmets and new generation of high-speed vehicles are altogether responsible for accidents.[7] Rather incidence of road traffic accidents has been increasing at an alarming rate throughout the world, Road traffic accidents is the third major preventable cause of death.

Indeed, RTA are a major cause of severe injuries and demand on health system. On an average in industrialized countries and also in many developing countries, one hospital bed in ten is occupied by an accident victim. Present research was conducted to study the injury pattern and cause of death in motorcycle accidents and to suggest preventive measures in motorcycle accidents

MATERIALS AND METHODS

The present prospective observational study was carried out on persons died due fatal motorcycle accidents brought for post- mortem examination at Department of Forensic Medicine and Toxicology of a tertiary care hospital, during period of January 2016 to June 2017. This is the first study in India which establishes the relationship between condition of vehicle (tyre ridges depth and brake-pad thickness) and susceptibility to road traffic accidents. The ethical permission has been obtained from Institutional Ethics Committee for conducting the study. Total 132 cases of fatal motorcycle accident out of 1969 medicolegal post-mortems conducted during study period were considered with reference to epidemiology, pattern and various factors responsible for two-wheeler motorcycle accidents.

All cases of death including rider and / or pillion due to motorcycle accidents involving vehicles with gear and without gear brought to mortuary at this tertiary care centre, for postmortem examination during study period were included. Details regarding epidemiological factors required for study purpose were derived from documents received for post-mortem examination which includes, requisition letter from police, inquest panchanama, accidental death report, statements of relatives, spot inquest and hospital records in cases of admitted patients. There was no direct contact between the investigators and relatives of the deceased.

Detailed post-mortem examination was carried out and findings were noted. The pattern of injuries and various factors in causation of road traffic accidents was noted with the help of sketch diagrams, photographs, visiting the scene of crime and charts for easy understanding and interpretation. Internal organs were studied on naked eye examinations.

The data collected was filled in a special proforma prepared for this study purpose only. It was analyzed by using Microsoft excel.

RESULTS

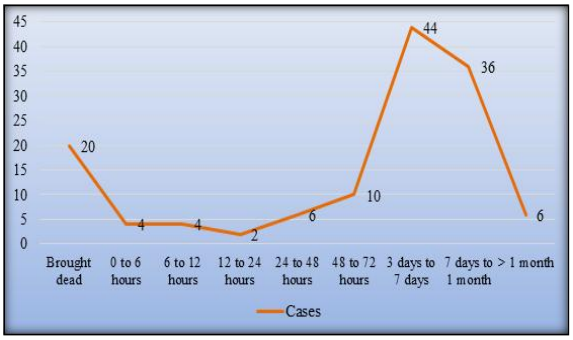
Demographic Characteristics of the cases

Present data included 132 medico-legal autopsies, purely related to two-wheeler related RTA deaths. Two-wheeler fatalities were significantly higher in males (82.57%) 109 cases than females (17.43%) 23 cases. Majority of victims were in the age group of 21 to 40 years (56.1%) i.e. more young patients were involved in two-wheeler road traffic accidents.

The majority of the victims belonged to urban population (66.67%). Maximum victims were educated involving graduates and high school certificates (73.47%). More frequently involved victims in two-wheeler fatalities were unskilled 28 (21.21%) followed by semi-profession 21(15.91%) and students 19 (14.40%). Most victims were from socio-economic class III 56 (42.42%) followed by class IV 39 (29.55%) as compared to class I (1.52%) and class V (6.82%) and 70 (53.03%) were married.

Distribution of cases as per survival period after incidence

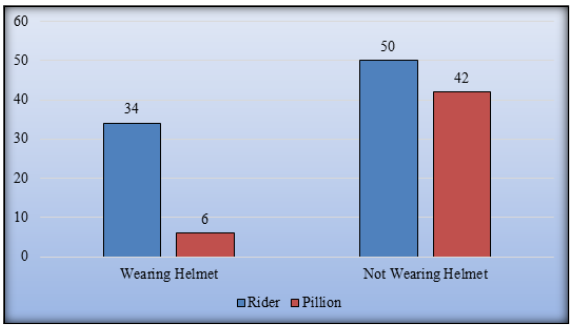
Maximum victim survived upto 3 to 7 days contributing 44 (33.33) cases. There were 20 (15.15%) cases brought dead to hospital. There were 10 (7.58%) victims who died within 24 hours of incidence. There were 86 (65.15%) victims who survived for more than 3 days of incidence and 6 (4.55%) victims survived for more than a month after incidence.



Graph 1: Distribution of cases as per survival period after incidence

Distribution of cases as per Rider and Pillion and use of helmet

Total number of 132 cases of two-wheeler Riders/Pillion road traffic accidents were recorded. There were 84 (63.64%) two-wheeler riders and 48 (36.36%) were pillion riders. Among the total 132 cases involving Riders and pillions, the evidence of Helmets used was recorded in 40 (30.30%) of the victims while 92 (69.70%) did not use it.



Graph 2: Distribution of cases as per Rider and Pillion and use of helmet

Out of 132 cases studied, no fracture was observed in 61 cases. Out 71 cases where skull fracture was observed, linear fracture was observed in 47 (66.19%) cases followed by comminuted fracture in 09 (12.67%) cases. [Table 1]

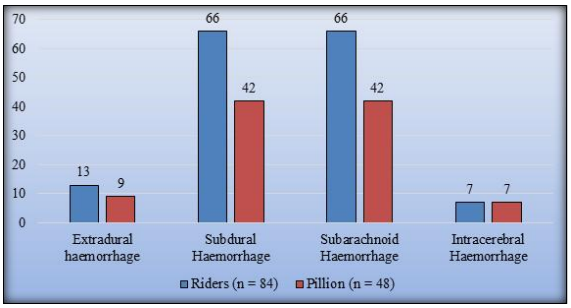
Fractures of cranial vault only were found in 29 cases in riders and 21 cases in Pillion. Frontal region alone had the maximum 12 (41.37%) cases in riders and 4 (19.05%) cases in pillion, followed by temporal region 05 (15.62%) in riders and 4 (19.05%) in pillion. Parieto- temporal regions 3 (9.38%) cases in riders and 3 (14.29%) cases in pillion riders. It also shows that in pillions occipital bone is most commonly fractured bone i.e. 05 (23.80%) cases. [Table 2]

Basal fractures were divided according to regions as anterior cranial fossa fractures (ACF), Middle cranial fossa fractures (MCF) and Posterior Cranial fossa fractures (PCF), the rest were grouped under the different combinations of the above three regions. Table no. 3 shows that middle cranial fossa in commonly involved in both riders and pillion in 7 (38.89%) cases and 4 (33.34%) cases respectively followed by anterior cranial fossa + middle cranial fossa in both riders and pillion in 3 (16.67%) and 3 (25.00%) cases respectively. [Table 3]

There were 18 cases where both basal fractures and cranial vault fractures were found. Basal fractures were associated with fractures in the frontal region in 5 (41.68%) cases in riders and with fractures in the occipital region in 03 (50.00%) cases in pillion.

Distribution as per Intracranial Haemorrhage:

In cases of riders most common intracranial haemorrhage was subdural and subarachnoid haemorrhage i.e. 66 (78.57%) cases each followed by extradural haemorrhage in 13 (15.47%). In cases of pillion also most common intracranial haemorrhage was subdural and subarachnoid haemorrhage i.e. 42 (87.50%) cases each followed by extradural haemorrhage in 09 (18.75%). The cases shown in table are grouped under different combinations of various intracranial haemorrhages. [Table 4]

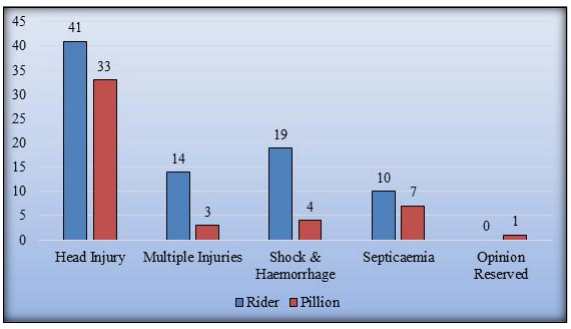


Graph 3: Distribution as per Intracranial Haemorrhage

Lower limb fracture i.e. 19 (33.92) cases are mostly involved in riders followed by thorax 18 (32.14%) cases. It also shows that upper limbs fracture i.e. 7 (31.81%) cases are involved in pillions followed by thorax and lower limbs 5 (22.72%) cases. In maximum cases brain was injured i.e. 29 (34.52%) cases in riders and 28 (58.33%) in pillion, followed by lungs 16 (19.04%) cases in riders and 3 (6.25%) in pillion. [Table 5]

Distribution of Cases as per Cause of Death

The head injury is the commonest cause of death in both riders and pillions 56.06% cases followed by Shock and haemorrhage in 17.42% cases.



Graph 4: Distribution of Cases as per Cause of Death

Table 1: Distribution of cases as per type of skull fracture

Type of Skull Fracture	Number of cases			
	Rider	%	Pillion	%
Linear	26	30.95	21	43.75
Depressed	0	00	2	4.17
Comminuted	7	8.34	2	4.17
Sutural	1	1.19	1	2.08
Crushed	2	2.38	2	4.17
Linear + Depressed	1	1.19	1	2.08
Linear+ Comminuted	1	1.19	0	00
Depressed + Comminuted	1	1.19	1	2.08
Linear + Sutural	1	1.19	0	00
Linear + crushed	0	00	0	00
Depressed + Sutural	0	00	0	00
Depressed + Crushed	0	00	0	00
Comminuted + Sutural	1	1.19	0	00
Comminuted + Crushed	0	00	0	00
No fracture	43	51.19	18	37.50
Total	84	63.64%	48	36.36

Table 2: Distribution of cases as per localization of fracture of cranial vault

Location of fracture of vault	Number of Cases			
	Riders	%	Pillion	%
Frontal	12	41.37	4	19.05
Parietal	03	9.38	1	4.76
Temporal	05	15.62	4	19.05
Occipital	0	00	5	23.80
Fronto-parietal	03	9.38	3	14.29
Parieto- Temporal	03	9.38	3	14.29
Temporo-occipital	0	0	1	4.76
Fronto-Parieto-occipital	1	3.12	0	0
Temporo- parieto-occipital	1	3.12	0	0
Fronto- Temporal	1	3.12	0	0
Total	29	58%	21	42%

Table 3: Distribution of cases as per localization of basal fractures in Riders and Pillions

Site of basal Fracture	No. of Cases			
	Rider	%	Pillion	%
Anterior Cranial Fossa	3	16.67	1	8.33
Middle Cranial Fossa	7	38.89	4	33.34
Posterior Cranial Fossa	1	5.55	3	25
ACF + MCF	3	16.67	3	25
MCF + PCF	2	11.11	0	00
ACF + PCF	0	0	0	00
ACF + MCF + PCF	2	11.11	1	8.33
Total	18	60.00	12	40.00

Table 4: Distribution of cases as per Basal Plus cranial vault Fracture

Basal Plus Cranial vault fracture	Number of Cases			
	Rider	%	Pillion	%
Basal + Frontal	5	41.68	1	16.67
Basal + Parietal	1	8.33	1	16.67
Basal + Temporal	2	16.67	0	00
Basal + Occipital	0	00	3	50.00
Basal + Fronto- parietal	1	8.33	1	16.66
Basal + Fronto-temporal	1	8.33	0	00
Basal + Parieto- occipital	0	00	0	00
Basal + Temporo- parieto-occipital	1	8.33	0	00
Basal + Fronto- parieto-temporal	0	00	0	00
Basal + Parieto-temporal	1	8.33	0	00
Basal + Fronto- parieto-occipital	0	0	0	00
Total	12	66.67%	6	33.33%

Table 5: Distribution of cases as per fractures to other parts of body and injuries to vital organs

Body parts and Vital organs		Rider (n = 56)	%	Pillion (n = 22)	%
Body parts	Upper limbs	10	17.85	7	31.81
	Lower limbs	19	33.92	5	22.72
	Thorax	18	32.14	5	22.72
	Spine	6	10.71	3	13.63
	Pelvis	3	5.35	2	9.09
Vital organs	Brain	29	34.52	28	58.33

	Heart	2	2.38	1	2.08
	Lungs	16	19.04	3	6.25
	Liver	6	7.14	1	2.08
	Spleen	4	4.76	3	6.25
	Kidney	4	4.76	2	4.16
	Spinal cord	7	8.33	3	6.25
	Genitals	2	2.38	0	0

Figure 1: Subdural Haemorrhage

Figure 2: Fissured Fracture

Figure 3: Depressed Comminuted Fracture

Figure 4: Motorcyclist's (Hinge) Fracture

Figure 5: Diastatic (Sutural) Fracture

DISCUSSION

Road Traffic Injuries are one of the leading causes of deaths, hospitalizations, disabilities and socio-economic losses in India with liberalized economic reforms, industrialization migration and changing values of the large, middle class young and middle age sections of the society.

Period of Survival

Maximum cases i.e. 44 (33.33%) were observed in which period of survival was 3 to 7 days. It was followed by 36 (27.27%) cases in which period of survival was 7 days to 01 month. There were 20 (15.15%) cases which were brought dead to hospital. This finding is not consistent with Jakkam Surender et al,[8] who observed that the victims of two-wheeler accidents succumbed to the injuries at varying period after the accident. Among them most of the deaths occurred between 6 to 24 hours, as there are 81 (27.27%) deaths reported in that time. Deaths occurring immediately on the spot tolled 66 (22.22%)

lives. Guntheti BK et al,[9] found 83 [76.85%] of the victims of died either on spot, 39 [36.11%] or 44 [40.745] within one hour of the incidence and rest could survive for a couple of days to maximum of two weeks after getting good medical and surgical procedures.

This difference in findings can be attributed to that the study was conducted at a tertiary care centre which is well equipped with more advance medical care facilities.

Use of Helmet

Helmet use was infrequent among Motorcyclists in our study 50 (59.52%) riders, among 84 riders has not been wearing a helmet at the time of accident. Only 06 (12.50%) pillion riders among 48 were wearing Helmet. This finding is consistent with HR Thube et al,[10] who observed Majority of the deceased (55.67%) were not using helmet while riding motorcycle at the time of accident, which suggested that use of the helmet, can be life saving measure during an accident. Shivkumar et al,[11] having similar observations. Sirathranont and Kasantikul et al,[12] noted that only 4% of the riders were wearing helmet at the time of accident matching with our observation. Pathak A et al (2008),[13] in their study of 39 cases of two wheelers accidental deaths reported that 12.82% victims used helmet while 87.18% did not use helmet at all.

Failure to wear a helmet resulted in a significantly higher incidence of head injury and death among both riders and pillion rider motorcycle crashes. Study by Mumtaz B et al et al,[14] where frequency of helmet use is 56.6% and that of non-users is 43.3%. Zargar.et al,[15] and Sauter C et al,[16] observed and confirmed failure to wear a helmet resulted in a significantly higher incidence of cranial injury and death in motor cycle crashes. Non-helmet riders and pillion riders are more likely to sustain a head trauma than helmet users.

Most of the riders had worn substandard helmets which resulted in severity of the head injury. Use of an approved helmet at the time of collision significantly reduces the likely-hood of sustaining head injuries, severe traumatic brain injuries, intracranial lesions and serious neuro-motor disability as suggested by Cawich SO et al.[17] Non-use of helmets results in a shift in the spectrum of injuries, not only to more fatalities but also to more severe nonfatal injuries.

In the present study the effectiveness of the motorcycles helmet use law, has shown a decrease in motorcycle-related injuries; decreases in severity of injury, associated injuries, and length of stay and better outcome, similar to study by Chiu et al.[18] Lack of wearing the helmet resulted in increased incidence of head injuries in pillion riders also. To reduce the incidence of head injury in pillion riders they should wear crash helmet as suggested by Modi (2001).[19]

Type of Skull fracture

Skull fractures are not a dictum to be present in all fatal motorcycle accident cases. The present study shows that skull fractures were present in 71 (53.78%) cases. This finding is similar with Reddy Ananda et al,[20] who found 56% skull fractures, Soni SK et al,[21] found 57% and Kumar A. et al,[22] found 69.63% cases.

Cranial Vault was involved in 45.07%, base of skull in 16.90% and both Vault and Base in 25.35% of cases. This finding is consistent with Soni SK et al,[21] who observed out of 57% of cases of skull fractures; cranial vault was involved in 38%, base of skull in 34%, and both vault and base in 28% of cases and in study conducted by Menon A et al,[23] of 62% of cases of skull fractures, cranial vault involved in 38%, base of skull in 34% and both Vault and Base of skull in 28% of cases.

The dominant type of skull fractures found in our study was the linear (fissured) fracture in 66.19% cases followed by Comminuted fracture in 12.67%. This is consistent with Menon A et al,[23] studied fissured fracture was the most commonly observed fracture (57%), 32% in study conducted by Reddy Ananda et al,[20] 57% in study done by Soni SK et al,[21] and 55% in study conducted by Khetre R.R et al.[24]

The sites of skull fractures most commonly involved in our study are frontal, followed by Temporal, temporo-Parietal and Middle cranial fossa in 32.00%, 18.00%, 12.00% and 36.66% of cases respectively. Honnunger RS et al,[25] studied frontal bone fracture was the most common bone fractured in the head (69.01% of cases) and Tandle RM et al,[26] found temporo-parietal region was involved predominately in 16 (20%) cases. Soni SK et al,[21] studied Middle cranial fossa and temporal bone were the commonly involved areas in fracture, which corresponds to 26% and 20% respectively. Menon A et al,[23] found 22%, 20% and 26% Parietal, Temporal and middle cranial fossa. Similar involvement of temporal bone is found in Kumar A et al.[22]

The reason for higher incidence of skull fracture in frontal, temporal and temporo-parietal region may be due to the fact that motorcyclists after the impact or skidding of vehicle tends to fall on either side.

Intracranial Haemorrhages

In the present study among intracranial hemorrhages, we noted a combination of subdural and subarachnoid in maximum (81.81%) cases which is in accordance with observations made by Tandle RM et al.[26]

The commonest variety of Intra Cranial Hemorrhage found in this study was subdural haemorrhage and subarachnoid haemorrage 81.81% followed by extradural hemorrhage found in 16.66% and least is Intra cerebral hemorrhage 10.60% of cases as compared to subdural hemorrhage 89.11%, Subarachnoid haemorrhage 72.98% and extradural hemorrhage in 20.25% cases of Kumar A et al,[22] and 94.94% of Subdural hemorrhage, 83.54% of Sub arachnoid hemorrhage, 20.25% of Intra cerebral hemorrhage and 10.13% of Extra Dural Hemorrhage in Pathak A et al.[13]

In contrast, subarachnoid haemorrhage was the most commonly observed intracranial hemorrhage in study

conducted by Husain et al.[27] The most common cause of death which was Intra Cranial Haemorrhage from head injury in study by Nzegwu et al.[28]

Fracture to Other Body Parts

The present study shows that maximum fractures occurred to lower limbs i.e. 24 (30.76%) cases followed by thorax in 23 (29.48%) cases and upper limbs in 17 (21.79%), least fractured seen in pelvis 5 (6.41%). These findings is consistent with Gupta SK et al,[29] found lower limbs facture 13.7% and thorax 7.7 %, Rao D et al,[30] found lower limbs fracture 25.20% and ribs fracture 8.27%, Bhengra A et al(31) found fracture of ribs (23%) and fracture of lower limbs (21%), Honnunger et al,[25] found ribs fracture in 35.5% and lower limbs fracture in 21.1%.

The reason for the high vulnerability of the extremity to injury in motorcycle accidents may be that the extremities are exposed, and as such, they are sites of impact during a crash.

Injuries to Vital organs

The present study shows that brain was mostly injured organ in 57 (43.18%) cases followed by lungs in 19 (14.39%), liver and spleen in 7 (5.30%) cases each. This finding is in agreement with Francis Faduyile et al,[32] who observed injury to brain in 56 (38%) followed by lungs in 22 (17.4%) cases. Jamebaseer M Farooqui et al,[33] found brain injury in 78 (38.61%) followed by lungs 25 (12.37%).

Similar findings were noted by Husain et al,[27] Tandle RM et al,[26] and Khajuria et al.[34]

CONCLUSION

Based on findings of present study, it is concluded that dominant type of skull fractures is seen as the linear (Fissured) fracture. Most common site is frontal, followed by Temporal, Parieto-temporal and Middle Cranial Fossa. Sub-dural Haemorrhage and subarachnoid haemorrhages in combination are the commonest intra-cranial haemorrhage seen in two wheeler RTA's. Lower limbs fracture and thorax fracture are common than other system injuries. Brain was most commonly injured organ followed by lungs.

Proper education of road users is must especially regarding speed driving, helmet use, alcohol abuse and driving, number of seat occupants, legal limits of brake-pads thickness and tyre ridges depth. Imparting road sense for two-wheeler riders who are more vulnerable among other vehicle users. Public awareness must be generated regarding preventing two-wheeler riders from driving vehicles when they are not physically or psychologically well. Since fatal head injuries are major cause of death it would be beneficial to educate the general public regarding management of traffic cases with head injuries. Also educating public regarding management of traffic emergencies (first aid) will be of high value.

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