

Study of patterns of cranio-cerebral injuries in deaths due to fatal vehicular accidents

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Abstract:

The present work entitled study of Patterns of Cranio-cerebral Injuries in Deaths due to Fatal Vehicular Accidents was undertaken at Forensic Medicine Department at M. R. Medical College, Gulbarga. The objective of the study is to find out the magnitude of the problem with reference to different host factors and to analyze the significance of nature of injury and the part of the brain injured with the time of survival and also to study the patterns of cranio-cerebral injuries in deaths due to fatal vehicular accidents. In this study 128 cases of head injury victims in fatal vehicular accidents autopsied from June 2003 to June 2008 were included. Maximum cases of road traffic accidents were among males (88%), male to female ratio was 5:1 and maximum incidence was in the age group of 21-40 years comprising 55%. Most common victims were pedestrians (36%) followed by occupants (34%) and drivers (25%). Incidence was more common among the four wheeler vehicles. Temporal (20%) and frontal (20%) bones were the commonest sites of fracture. Subdural hemorrhage was the commonest among the intracranial hemorrhages seen in 40% cases.

Keywords: Cranio-cerebral injuries, Vehicular accidents.

Introduction:

Cranium is the crown of the human body, not only from the point of view of situation but because it contains and protects the most vital organ, the super unbeatable computer, 'The Brain'. One of the characteristic features of brain is that once it is damaged, regeneration or complete healing does not occur. The brain is well protected within the bony cranial cage. But once the impact of a force crosses the protective threshold, then life is invariably in danger.

Head is that part of the body which is frequently injured as a result of accident and criminal violence. Because of its size and anatomical position, it is a major site of trauma in road accidents. Even with the improvement

in safety measures in vehicles and greater availability of state of the art resuscitative measures, the mortality rate in injuries has not declined. Head injury is one of the serious fatal injuries. So it is true to say that "no form of cranio cerebral injury is too trivial to be ignored or too serious to be despaired of".¹

In this study an attempt is made to analyze cases as regards victim's age, sex, vehicle involved, type of victims, distribution and patterns of cranio-cerebral injuries sustained in road traffic accidents and survival period. The medico legal importance of examination of road traffic injury case is to find out the cause of death and to reconstruct traffic accident. Such examination will also help to detect "hit and run" cases. Proper examination and evaluation of such traffic injuries will help us while facing the cross examination and also helps towards reconstruction of the whole accident.

Materials and Methods

The study was undertaken at M. R. Medical College, Gulbarga, during the period from June

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2003 to May 2006 (records of the cases were analyzed) and during June 2006 to June 2008 prospective study was conducted. Total 138 cases of cranio-cerebral injury in fatal vehicular accidents were included in this study. For noting the findings separate proforma was prepared and used.

Preliminary data related to name, age, sex, address, time of admission, treatment given and time of death were noted. The inquest report was carefully read, before starting the post-mortem examination. Detailed history regarding mode of cranio-cerebral injury was obtained from inquest report, indoor papers, from the investigating officer concerned and also from relatives. The clinical records of the admitted cases were also carefully studied to know the nature, extent and gravity of injury. The available record of radiological investigation including CT scan was

also carefully reviewed. After careful examination of each case, findings were recorded as per proforma and results are tabulated.

Results

The age of the victims in present study varied from 1-70 years. The peak incidence was observed in the age group of 31-40 years comprising 29.68% of cases. It was also observed that 25% belonged to the age group 21-30 years. Thus, 54.68% of the cases comprised of age group of 21-40 years in the study. Individuals in the age group of 0-10 years were the least affected 2.34% followed by older people i.e., 60 years and above in 5.46% of total cases. Males comprised a majority and constituted 112 (87.5%) compared to females who were only 16 (12.5%). The male to female ratio in the study was 7:1 (male=112; females=16). (Table-1).

Table 1. Age and sex wise distribution of cases

| Age range (years) | Male | Female | Total | Percentage |
|-------------------|--------------------|-------------------|------------|---------------|
| 0 – 10 | 2 | 1 | 3 | 2.35 |
| 11 – 20 | 14 | 2 | 16 | 12.50 |
| 21 – 30 | 30 | 2 | 32 | 25.00 |
| 31 – 40 | 35 | 3 | 38 | 29.68 |
| 41 – 50 | 18 | 1 | 19 | 14.87 |
| 51 – 60 | 8 | 5 | 13 | 10.15 |
| 61 – 70 | 5 | 2 | 7 | 5.46 |
| Total | 112 (87.5%) | 16 (12.5%) | 128 | 100.00 |

It is obvious from the table no. 2 that maximum number of victims i.e., 48.43% died within 24 hours, after sustaining injuries. While 28.12% died on the spot, 10.15% cases died between 2nd

- 3rd day and 7.81% cases died between 4th - 7th day, 5.46% patients survived for more than 7 days.

Among 128 cases, there was no fracture in 29

Table 2. Time lapse between injury and death

| Time of death | No. of cases | Percentage |
|---|--------------|---------------|
| Death on spot | 36 | 28.12 |
| Within 24 hours | 62 | 48.43 |
| Between 2 nd – 3 rd day | 13 | 10.15 |
| Between 4 th – 7 th day | 10 | 7.81 |
| Beyond 7 th day | 7 | 5.46 |
| Total | 128 | 100.00 |

cases. Table- 3 shows that, 51.5% cases showed fractures of vault and base, whereas 47% cases showed fractures of the vault only. In 1% cases basal solitary fracture of skull was observed.

From table - 4, it is obvious that in fatal cases of head injury linear fracture of skull is the commonest i.e. 52.53%. In 18.18 cases there was comminuted fracture while in 17.17% cases depressed fracture and in 9.09% cases depressed comminuted fracture. Sutural fracture separation associated with linear fracture in 2.02% cases and sutural fracture separation with depressed fracture in 1.01% cases. While there were no cases of pond fracture.

From the table no. 5, it is obvious that if type of hemorrhage is considered in isolation, then cases having subdural hemorrhage were the highest in number (40%) followed by cases of subarachnoid hemorrhage (9.93%), extradural hemorrhage (6.67%) and intracerebral hemorrhage (2.67%). If combinations of hemorrhages are taken into account, then also combination of subdural hemorrhage with subarachnoid hemorrhage was on the first place (30.67%), followed by various other combinations.

It is depicted in the table 6, that the contusion of brain matter is often seen in fatal head injury cases (61.54%) followed by laceration (26.37%) and combination of contusion and laceration (12.09%).

It is obvious from table 7 that, pedestrians are most commonly affected in vehicular accident i.e., 36%. It also reveals that the occupant is more commonly affected (34%), than the driver (20%) of the vehicle. The pedal cyclists were involved in 5% cases and in 5% cases the type of victim was unknown.

From table no. 8, it is obvious that the vehicles most commonly involved in fatal head injury cases are heavy four wheelers (60%), while next commonly involved vehicles are two wheelers (30%). 2.22% vehicles were bicycles, 2.2% were three wheelers and 5.56% vehicles were not known.

Discussion

In the present study the total numbers of cases studied are 128, out of which 87.5% were males and 12.5% were females with a sex ratio 7:1. In a study of acute injuries of head, the sex ratio was 5:1.2 As shown in table no. 1, high preponderance

Table 3. Location of fracture skull, vault and base

| Location | No. of cases | Percentage |
|--------------------------------------|--------------|---------------|
| Fracture of vault of skull | 47 | 47.50 |
| Basal fracture | 1 | 1.00 |
| Fracture of vault of skull and basal | 51 | 51.50 |
| Total | 99 | 100.00 |

of male in fatal head injury may be because males are bread earners, for which they go out of homes and major bulk of activities and assignment are carried by them as compared to females.

Head injury can occur at any age. In the present study, the maximum number of cases are (29.68%) in the age group of 31-40 years and if a broader age group of 21-40 years is considered then the percentage of head injury cases in this

age group comes to 54.68%. Janine Jagger et al³ in a study found that maximum occurrence of head injury for 20-29 years age group and then decline progressively. Katz Douglas⁴ in a study of 243 cases found that incidence to be the highest in 20-30 years age group as 47%.

Maximum number of victims died within 24 hours (48.43%) and on the spot (28.12%) after sustaining injury, 10.15% cases died between 2nd

Table 4. Percentage of type of fracture of skull

| Type of fracture | Total | Percentage |
|-------------------------------|-----------|---------------|
| Linear | 52 | 52.53 |
| Linear + Suture separation | 02 | 2.02 |
| Comminuted | 18 | 18.18 |
| Depressed comminuted | 09 | 9.09 |
| Depressed | 17 | 17.17 |
| Depressed + Suture separation | 01 | 1.01 |
| Pond | 00 | 0.00 |
| Total | 99 | 100.00 |

to 3rd day and 7.8% cases died between 4th to 7th day, 5.46% patients survived for more than 7days (Table- 2). The maximum number of deaths during first 24 hours can be explained by the fact that the contusions, lacerations, edema of brain or intracranial hemorrhages which are not-compatible with life can occur immediately or within 24 hours of the injury. In 28.12% cases death occurred on the spot, it indicates the severity of the injury and its graveness.

In the present study, 77.5% cases had fracture skull, of which 51.50% had fracture of vault and base, whereas 47.5% cases showed fracture of vault only. 1% cases solitary basal fracture of skull was observed (Table-3). In a study of 20 cases of fatal injury by Devadiga & Jain², 12 of these had fracture of vault as well as of the base of skull. Of the remaining cases, 8 had fracture of vault and 6 had basal fracture of skull. In fatal cases of head injury, linear fracture of skull was commonest i.e., 52.52%. In 18.18% cases there were comminuted fracture, 17.17% cases depressed fracture, 9.09% cases depressed comminuted fracture. Sutural fracture separation associated with linear fracture in 2.02% cases and

sutural fracture separation with depressed fracture in 1.01% while there was no case of pond fracture in our study (Table-4). The findings of the present study are also in accordance with the findings of a study at the Institute of Neurology, Madras.⁵

Intracranial haemorrhage was observed in 75 out of 128 cases of fatal head injury. If the isolated type of haemorrhage is considered then cases having subdural haemorrhages were maximum in number (40%) followed by subarachnoid haemorrhage 9.33%, extradural haemorrhage 6.67% and intracerebral haemorrhage 2.67% (Table-5). Walpole Levin⁶ in a study showed that in fatal head injury cases, subdural haemorrhage occurred in 60% cases and extradural haemorrhage in 50% cases. Reddy⁷ found that 25% of the haemorrhages were extradural, 53.5% subdural & 28% Subarachnoid. Devadiga & Jain² found that 13.9% were extradural haemorrhages, 72.3% subdural & 30.5% subarachnoid.

In the present study, occurrence of contusion of brain was 62.14% followed by laceration 26.55% and combination of contusion and laceration 10.77% (Table-6). Blackwood et al⁸ found that contusions of the brain are extremely common

Table 5. Type and percentage of intracranial hemorrhage

| Type of hemorrhage | Total | Percentage |
|--|-------|------------|
| Extradural hemorrhage | 5 | 6.67 |
| Subdural hemorrhage | 30 | 40.00 |
| Subarachnoid hemorrhage | 7 | 9.33 |
| Intracerebral hemorrhage | 2 | 2.67 |
| Subdural hemorrhage + subarachnoid hemorrhage | 23 | 30.67 |
| Extradural + subdural + subarachnoid hemorrhage | 1 | 1.33 |
| Subdural hemorrhage + interacerebral hemorrhage | 2 | 2.67 |
| Intraventricular hemorrhage + subdural hemorrhage | 1 | 1.33 |
| Intraventricular + Intracerebral hemorrhage | 1 | 1.33 |
| Extradural + Intercerebral | 1 | 1.33 |
| Subarachnoid hemorrhage + intracerebral hemorrhage | 1 | 1.33 |
| Extradural + subarachnoid hemorrhage | 1 | 1.33 |
| Total | 75 | 100.00 |

Table 6. Types of injuries to brain matter in fatal cases of head injuries

| Injury to brain matter | No. of cases | Percentage |
|------------------------|--------------|------------|
| Contusion | 56 | 61.54 |
| Laceration | 24 | 26.37 |
| Contusion + laceration | 11 | 12.09 |
| Total | 91 | 100.00 |

in fatal head injury. Sharma et al⁹ concluded that cerebral contusion was the commonest finding in head injury. Our observations are similar in correlation with the above documented series.

Percentage of type of victims in vehicular accident shows that pedestrians are most commonly affected i.e. 36% than occupant other than driver (34%) and driver (20%). The pedal cyclists were involved in 5% cases (Table-7). Karrae Solheim¹⁰ found that pedestrians are most commonly affected in vehicular accidents

as seen in the present study. It also suggested that the pedestrians should be made "More traffic minded". The factors contributing to the higher percentage of pedestrians are the congestion of pavement by street traders, forcing pedestrians on the roads, the poor street lighting and the general lack of road sense. In the present study, occupants are seen more involved than drivers, can be explained on the basis of crowding in the vehicles, lack of restricting devices i.e. chest belt, seat belt and difference in degree of alertness between driver and occupants in the developing

Table 7. Percentage of type of victims in vehicular accident

| Type of victim | No. of cases | Percentage |
|----------------|--------------|------------|
| Driver | 26 | 20.00 |
| Pedestrian | 46 | 36.00 |
| Occupant | 44 | 34.00 |
| Pedal cyclist | 6 | 5.00 |
| Unknown | 6 | 5.00 |
| Total | 128 | 100.00 |

Table 8. Involvement of type of vehicle in accident

| Type of vehicle | No. of vehicles | Percentage |
|-----------------|-----------------|------------|
| Bicycle | 2 | 2.22 |
| Two wheeler | 27 | 30.00 |
| Three wheeler | 2 | 2.22 |
| Four wheeler | 54 | 60.00 |
| Vehicle unknown | 5 | 5.56 |
| Total | 90 | 100.00 |

countries like India. The higher involvement of driver in this study could be explained due to environment of drivers in developing countries like India, young age, continuous strenuous driving, poor road conditions, and intake of alcohol and other drugs.

The vehicles most commonly involved in vehicular accident in fatal head injury cases are four wheelers i.e. 60%, while next commonly involved vehicles are two wheelers 30%. 2.22% bicycle are involved 2.22% were three wheelers are in 5.56% the involvement of vehicles are not

known (Table-8). As regards the type of vehicles there is common involvement of four wheelers. It can be on account of the problems of carrying heavy load to and fro and usually the drivers of such vehicles do not pay attention and due regards to the traffic rules and regulations. Similarly they do not offer appropriate signals or indicators. Karrae Solheim¹⁰ found that out of 168 vehicles in road traffic accidents, lorry, truck and bus were involved in 61 accidents, private car and taxi in 57 accidents, motor cycle in 6 accidents, and train in 25 accidents. In 17

accidents, involved vehicle was unknown. Another study found that heavy goods vehicles are main motor vehicles involved in road traffic accidents¹¹.

Conclusion

In this study 128 cases of head injury victims in fatal vehicular accidents autopsied from June 2003 to June 2008 were included. Maximum cases of road traffic accidents were among males (88%), male to female ratio was 7:1 and maximum incidence was in the age group of 21-40 years comprising 55%. Temporal (20%) and frontal (20%) bones were the commonest sites of fracture. Subdural hemorrhage was the commonest among the intracranial hemorrhages seen in 40% cases. Most common victims were pedestrians (36%) followed by occupants (34%) and drivers (25%). Incidence was more common among the four wheeler vehicles. Proper examination and evaluation of such traffic injuries will help us while facing the cross examination and also helps towards reconstruction of the whole accident.

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