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### PATTERN OF INJURIES OCCURRING IN FATAL ROAD TRAFFIC ACCIDENTS: AN AUTOPSY BASED STUDY

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**Abstract:** Deaths due to Road Traffic Accidents RTA are increasing at an alarming rate throughout the world. Thereby it poses itself as a major epidemiological and medico legal problem. Victims in RTAs sustain large varieties of injuries and occurrence of impact injuries is extremely high in RTAs. The impact injuries associated with injury to the vital organs and acute massive hemorrhage are more fatal or dangerous to life. Pattern of impact injuries help in the reconstruction of RTA. The study of impact injuries associated with fatal outcome helps in implementation of measures to prevent fatalities due to RTAs. Hence, the present study was conducted to know, pattern of impact injuries in victims of fatal RTAs, type of victims along with the age and sex, survival period, type of offending vehicle, diurnal and seasonal variation. In addition, an attempt was also made to know the relation between the pattern of impact injuries and cause of death.

**Keywords:** Fatal RTA; impact injury; ICD-10, Medico Legal Autopsy; Victim; Offending vehicle; Cause of death

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## INTRODUCTION

Impact injuries have assumed paramount importance in recent times due to mechanization and industrialization. These injuries have shown an alarming rise in the recent times owing to fast modernization as a result of adaptation of man to machine and motor. Despite supreme measures in the form of sophisticated protective gadgets usage, tremendous advances in public education, and the subject continues to be a major cause of mortality and morbidity.

The mechanism, diagnosis and the management of head injury poses a definite challenge to the medical profession. Improvement in the economic standard of the people has resulted in substance and alcohol abuse, which has only complicated the subject, not only for the doctors, but also for the law enforcing agencies. The high incidences of morbidity and mortality due to head injuries obviates one to understand the underlying mechanisms, physiological changes, rationale of management and the sequelae of such injuries. Its importance lies not only in the physician's point of view, but also in their medico-legal implications like that of survival time, acts of volition, reconstruction of the events, the liability and compensation settlements.

According to an expert study group appointed by government of India, "RTAs have come to be considered as the third deadly killer, next to heart disease and cancer. Rapid growth of transportation system related to rapid economic growth industrialization, urbanization and increase in population is responsible for the veritable epidemic.

### Aims and objectives/Methodology

The present retrospective and prospective study is under taken at the autopsy block (mortuary) of Forensic Medicine Department, S.V. Medical College, Tirupathi from January 1999 to 2002 and 204(October December) on the victims of fatal road traffic accidents with impact injuries with the following objectives:

1. To know the pattern of impact in victims
2. To know the pattern of impact injuries in road users and offending vehicle
3. To analyze the cause of death with respect to impact injuries.
4. To deduce any preventive and safety measures if positive

The data obtained was recorded in the predesigned and pre tested Proforma, which comprised relevant data that is concerned with the objectives of the study and analyzed.

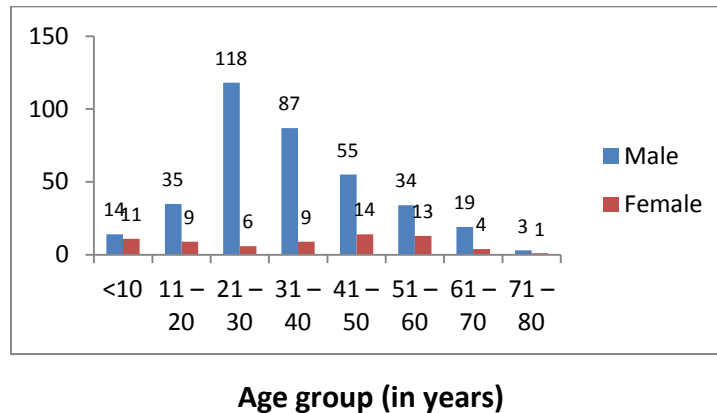
## RESULTS

### **1. Age and sex wise distribution of cases of fatal RTAs:**

Out of 432 cases, 365 (84.49%) were males and 67 (15.51%) females, indicating that majority of victims were males. Male to female ratio as 5.45:1 Maximum numbers of victims 124 cases

(28.70%) were in the age group 21 – 30 years, followed by 31 – 40 years, 90 cases (22.22%) Minimum numbers of victims were found in 71 -80 years age group 4 cases (0.93%). Youngest victim was 1 year old male child and eldest was 80 years old male, 66.90% of victims were between 21 to 50yars.

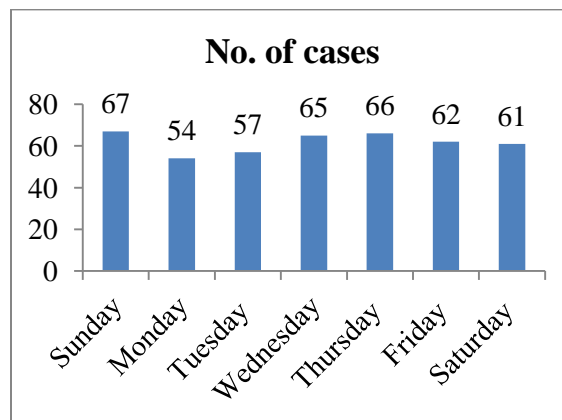
**Graph No.1: Graphical representation of cases with respect to Age & Sex in Fatal RTA**



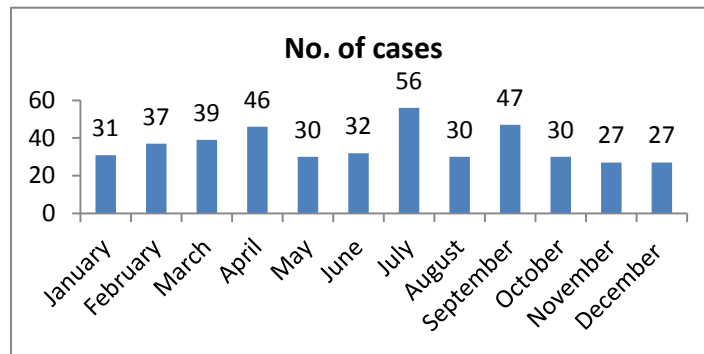
**2. Day and Month wise distribution of impact injury in RTAs:**

In the present study the peak occurrence of RTA was noted on Sundays 67 (15.5%) and least occurrence was noted on Mondays 54 cases (12.5%). The maximum numbers of cases are seen in the year 2002, 112 cases (25.92%) and minimum number of cases area seen in the year 2000, 72 cases (16.66%). This time pattern generally being that of Government and Public Sector holiday period, people usually tend to visit their hometowns traveling from their works/study places, or the time is supposed to be auspicious for marriage and other cultural activities. Association between RTA and day in our study was not found to be statistically significant as the ‘p’ value was greater than 0.05 and chi square value was 11.05.

**Graph No.2: Graphical representation of cases with respected to days in Fatal RTA**



**Graph No.3: Graphical representation of cases with respected to Months in Fatal RTA**



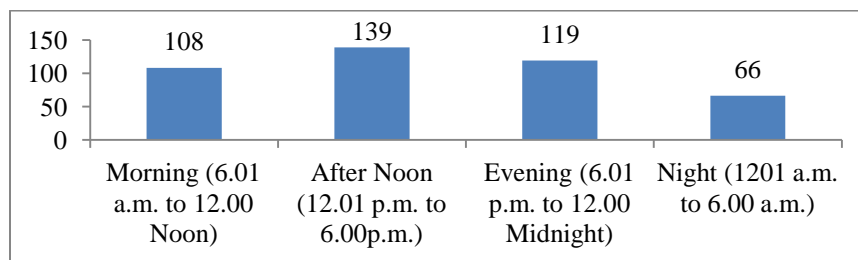
**3. Year wise distribution of impact injury in RTAs:**

The maximum number of cases are seen in the year 2002 was 112 cases (25.92%) and minimum number of cases are seen in the year 2000 was 72 cases (16.66%). This time pattern generally being that of Government and Public Sector holiday period, people usually tend to visit their hometowns traveling from their work/study places, or the time is supposed to be auspicious for marriage and other cultural activities. Association between RTA and day in our study was not found to be statistically significant as the ‘p’ value was greater than 0.05 and chi-square value was 11.05.

**4. Diurnal variation of cases of fatal RTAs:**

Maximum number of accidents in the afternoon hours 139 cases (32.18%) and minimum 66 cases (15.28%) in the night. There was no much difference in the number of accidents, which happened during morning 108 cases (25%) and evening 119 cases (27.55%) hours.

**Graph No.4: Graphical representation of cases with respect to Diurnal variation in fatal RTAs**



**Time of accident**

**5. Seasonal variation of cases of fatal RTAs:**

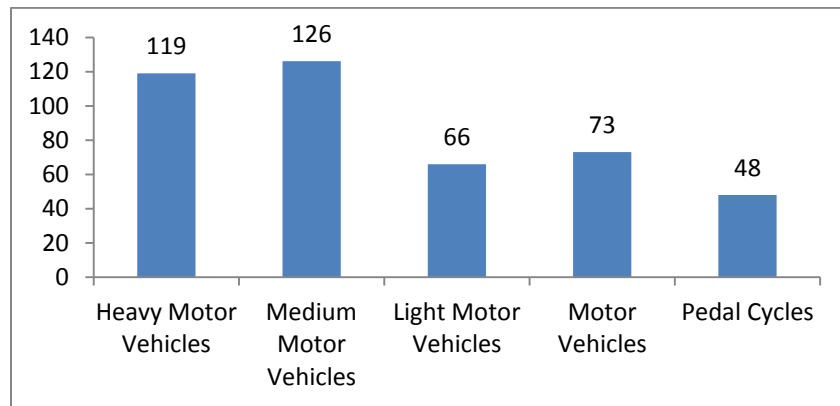
For assessment of seasonal variation, only those RTAs which occurred during the 5 years period (January 1999 to 2004) were considered. Out of total 432 cases, during the above said period, maximum number of cases 165 (38.19%) occurred during the summer season, followed by winter 152 cases (35.19%) and rainy season 115 cases (26.62%).

**6. Accident victim Vs. Offending vehicle:**

Out of 432 victims, 146 were pedestrians (33.80%), 104 were motorcyclists (24.07%), 16 were drivers of motor vehicle (3.70%), 118 were motor vehicle occupants (27.31%) and 6 were occupant of animal drawn vehicle (1.38%).

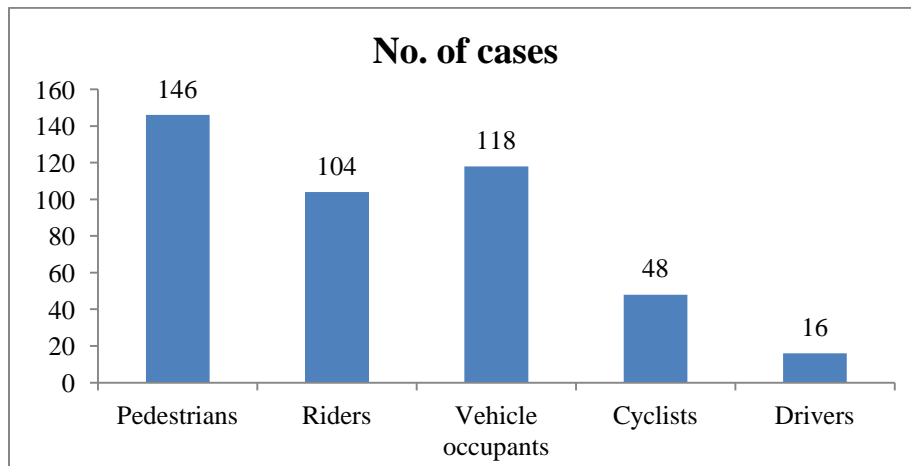
Medium Motor Vehicles topped the list of offending vehicles 126 (29.17%), followed by heavy motor vehicle 119 (27.55%), Light Motor Vehicles are 66 (15.28%), motor cycles 73 (16.67%), and in 28 cases (6.48%) the offending vehicle was not known hit and run cases, pedal cycles are 48 (11.11%). The order of the vehicles are busses 104 (24.07%), Lorries 83 (19.21%), Motor cycles 47 (10.88%), cycles 47 (10.88%), tractors 36 (8.33%), cars 27 (6.25%), Jeep 25 (5.79%), Scooters 25 (5.79%), Luna 19 (4.40%), Auto rickshaws 14 (3.24%), Tata Sumo 13 (3.01%), Van 9 (2.08%), bullock carts 6 (1.39%), rickshaws 1 (0.23%).

**Graph No.5: Graphical representation of cases with respect to type of vehicles in fatal RTAs**



**Type of vehicles**

**Graph No.6: Graphical representation of cases with respect to type of victims in fatal RTAs**

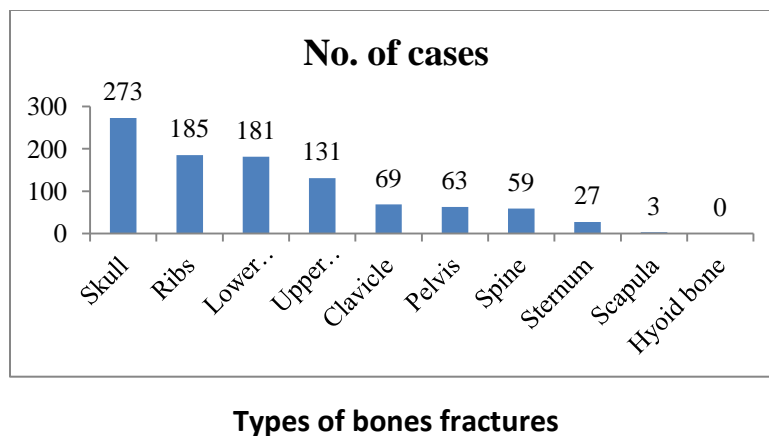


**Type of victims**

**7. Distribution of fractures of bones in victims in RTAs:**

In the present study, fractures of multiple bones were present in maximum number of victims. Skull fractures was present in maximum number of victims 273 (63.19%), followed by fractures of leg bones 181 (41.93%) and fractures of ribs (42.82%), fractures of upper limb bones 131 (30.32%), fractures of clavicles 69 (15.97%), fractures of pelvis 63 cases 14.58%, Fractures of spinal cord and vertebra 59 cases (13.66%), Fractures of Sternum 27 cases (6.25%) and Fractures of scapula was present in minimum number of 3 cases (0.69%). A fracture of the hyoid bone was not present in any case.

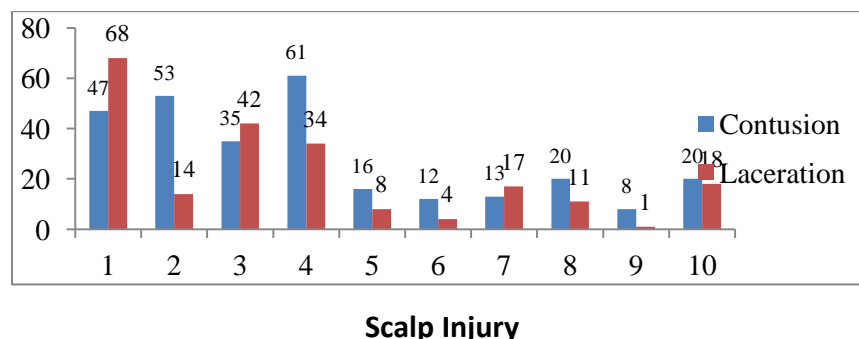
**Graph No.7: Graphical representation of cases with respect to fracture of bones in victims in fatal RTAs**



**8. Distribution of scalp injury in RTA:**

In the present study, the contusion in the road traffic accident was more common 285 (65.97) and the laceration were accounted for 217 (50.23), multiple site contusions were equally significant suggesting that any part of the head is vulnerable for injury in road traffic accident. The events area fast and do not give the victim enough time for his trauma evading reflexes to act and protect himself. These are present in the frontal area, followed by temporal, occipital and parietal areas of the head.

**Graph No.8: Graphical representation of cases with respect to Scalp injury in Fatal RTAs**



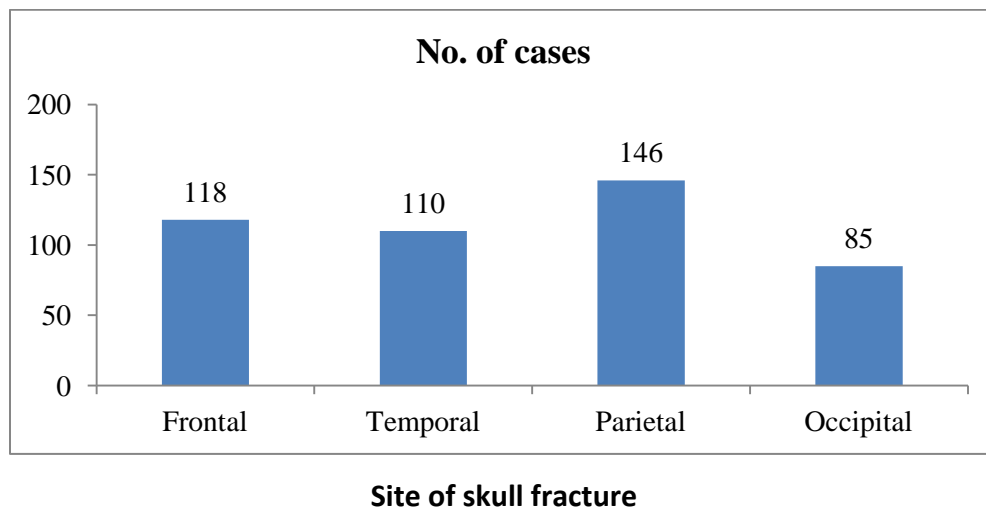
**9. Distribution of brain injuries in RTA:**

In the present study, a total of coup-contusions 57 (42.85%) and Contre Coup contusions were 6 (4.51%) are present these are seen in the frontal, parietal, temporal and occipital areas. Out of 64 (48.12%) cases of coup lacerations were present and Contre coup lacerations were 4 (3.00%), the Avulsed lacerations are 2 (1.50%). The above injuries are present in the regions of the internal area of brain. Lacerations of brain were more common with fracture of skull but also occurred on movement of brain within skull without any associated fracture.

**10. The site of skull fracture in RTAs:**

In the present study, the maximum number of fracture in the skull bone were present in the Parietal area 146 (31.80%), followed by Frontal area 118 (25.70%), Temporal area 110 (23.95%) and Occipital area 85 (18.52%).

**Graph No.10: Graphical representation of cases with respect to site of skull fracture in Fatal RTAs**



**11. Distribution of skull fracture in RTAs:**

Fracture of skull was present in 273 cases (63.19%) out of 432. Fractures were grouped in to fracture of vault alone, facial bones combination of vault and base. Fractures of the vault of skull alone were seen in 23 cases (5.32%), is less than the base of skull alone 52 cases (12.04%). Whereas combination of vault and base was significantly more than the vault alone 75 cases (17.36%), fracture of facial bones was present in 56 cases (12.96%).

**12. Intracranial Hemorrhages in RTAs:**

In the present study, the maximum number of intracranial Hemorrhages are Sub Arachnoids 279 (46.06), followed by Sub Dural 187 (31.01%), extra Dural 58 (9.61%), Pontine 31 (5.14%),

Cerebellar 31 (5.14%) and Intra Cerebellar Hemorrhages 17 (2.81%) all these are present in the temporal, parietal, frontal and occipital areas.

**13. Fractures of the base of skull in RTAs:**

In the present study, there were 432 victims with 245 fracture sites of the base of skull, linear fractures numbered 16 (6.53%), comminuted fractures 59 (27.08%), fissured fractures 100 (40.81%), crushed fractures 70 (28.57%). Anterior cranial fossa was the commonest fossa involved, having 115 (46.93%) out of 245 fractures followed by Middle cranial fossa having 81 (33.06%) out of 245 and posterior cranial fossa with 49 (20%) out of 245 fractures.

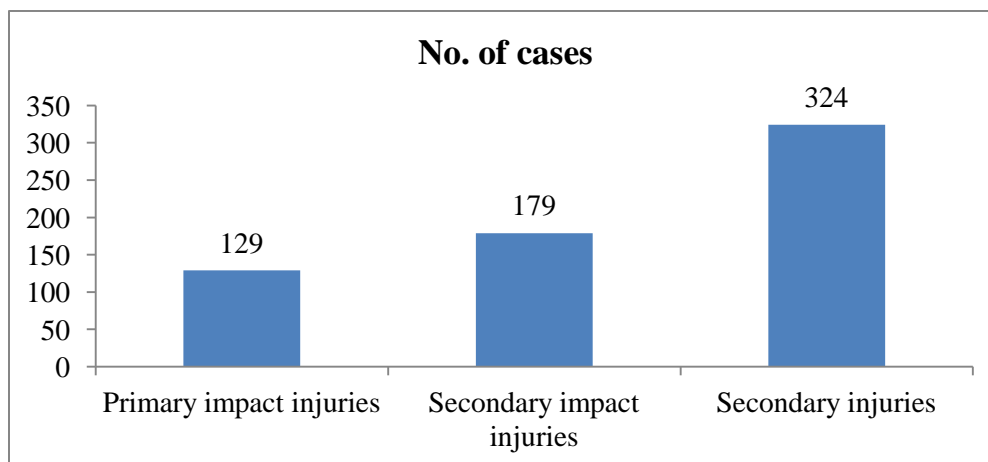
**14. Period of survival following accident:**

In the present study, 132 victims (30.55%) died instantaneously after the accident. 106 victims (24.53%) survived beyond 72 hours but died within one week. The number of cases decreased with increase in survival period. Only 7 victims (1.62%) survived for more than 4 weeks. The victim who survived for shortest period 1 hour are 22 victims had fracture of skull and leg bones. The victim who survived for maximum period 69 days after the accident died due septicemia.

**15. Impact injuries in causing death in RTAs**

The pattern of impact injuries resulting cause of death are primary impact injuries 129 (29.86%), Secondary impact injuries 179 (41.43%), secondary injuries or tertiary impact injuries 329 (76.15%). The maximum number of impact injuries causing cause of death in road traffic accidents are mainly due to secondary injuries associated with primary impact injuries in majority of cases.

**Graph No.11: Graphical representation of cases with respect to impact injuries associated with cause of death in Fatal RTAs**



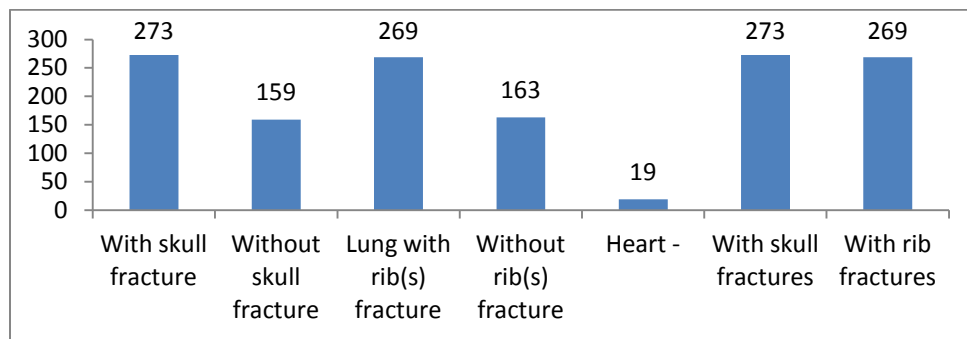
**Impact injuries in RTA**



**16. Relation between fracture and cause of death:**

In the present study, 273 victims (63.19%) died due to cranial cause alone. In 384 cases (88.88%) death was due to thoracic cause. Lungs were involved in all 84 cases (19.44%). Out of these 84 cases there were associated with ribs fracture 269 (62.26%) and 163 without ribs fracture (37.73%). There were 19 cases (4.39%) with injury to the heart. Combination of cranial and thoracic cause was responsible for death in 542 cases and out of these 542 cases, skull fracture was present in 273 cases (63.19%) and fracture of multiple ribs in 269 cases (62.26%). In 378 cases (87.5%) Hemorrhagic shock was the cause of death and fracture of multiple bones was present in all 378 case (87.5%), diffuse axonal injury causes death in 39 cases (9.02%), neurogenic shock cause death in 31 cases (7.17%), associated injuries resulting death in 382 cases (88.42%). 29 persons (6.71%) died due to septicemia in whom fracture of femur of left side was present but this did not contribute to the death.

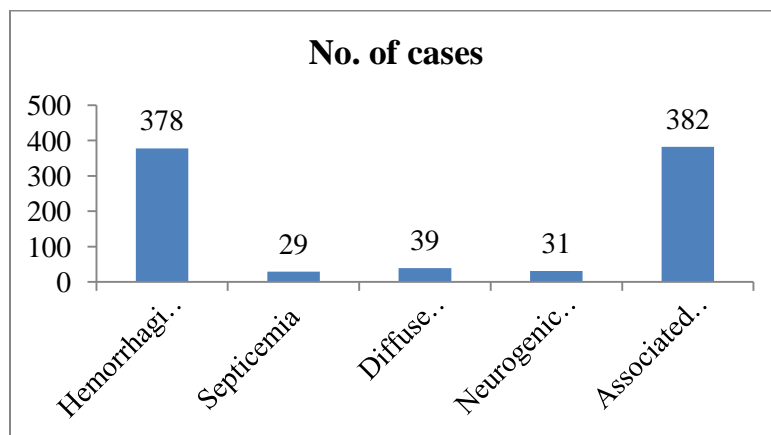
**Graph No.12: Graphical representation of cases with respect to cause of death in Fatal RTAs**



**Cranial cause alone    Thoracic cause alone    Cranial and thoracic cause**

**Skull fracture – Cause of death**

**Graph No.13: Graphical representation of cases with respect to cause of death in Fatal RTAs**



**Cause of death**

## **OBSERVATIONS AND DISCUSSION**

Detailed postmortem study was conducted on 432 cases, out of these 57 cases were analyzed prospectively and 375 cases were analyzed in retrospectively with respect to impact injury to the victims of fatal RTAs.

In the present study, all the victims of fatal RTA had fracture of one or the other bone. The difference in the number of RTA related deaths observed in different studies can be explained by the fact that RTA depends upon various epidemiological factors like geographical area, conditions prevailing in that region, category of road users, condition of road etc. The high percentage of RTA related deaths in our study might have been due to the more number of diversions and speed breakers at inappropriate distances as well as frequent change in their location without proper sign boards, during the laying of new highway.

### **Age and sex wise distribution:**

The male preponderance may be due to the paternalistic nature of our society where males keep themselves most of the time outdoors to earn bread and butter for families besides males lead a more active life and most of the time are involved in activities such as driving and traveling. On the contrary, females mostly keep themselves indoor mostly due to cultural background, lack of industries and low potential for employment owing to poor literacy, along with the tendency that some male members mostly accompany females and extra precautions are taken on roads. In total more than half (63%) of victims were in the age group 21 – 50 years. This may be due to the fact that persons of this age group lead more active life, more mobile and go out for work and keep themselves outdoors most of the time. Besides, they have a universal habit of taking risks like boarding a moving vehicle. Traveling on footboard of vehicle, crossing the roads carelessly, risky speed driving, etc., in our study, people in the extremes of age group comprised the minimum number of fatalities. Least fatalities in older persons may be due to more experience, more traffic sense, less tendency to take undue risks and they remain mostly indoors and lead less active life. Lesser involvement of children below 10 years may be because some senior member of the family accompanies them on road.

### **Diurnal variation:**

Minimum number of accidents in the night can be explained by the fact that it is the quietest period of the day and most of the people remain in door.

### **Seasonal variation:**

This may be due to the different environmental conditions in different seasons, which act as one of the important contributors to the occurrence of accidents. During rainy season the factors like worsening of the road and poor visibility to drivers due to rain; during winter longer hours of darkness, poor visibility to drivers at night and early hours of the day due to foggy

weather conditions and during summer the hot environment makes the person tired, irritable and rash, may lead to increase in the occurrence of accidents. There is no significant difference in the occurrence of accidents during summer, however, significantly more number of accidents happened during winter and less in the rainy season.

#### **Accident victim Vs. Offending vehicle:**

In our study, the most common offending vehicle was Medium Motor Vehicle (29.17%). Involvement of Heavy Motor Vehicle in accidents can be attributed to their high speed, presence of single space roads, fatigability, intoxication etc. Similar finding was observed in their studies also. However, percentage of Heavy Motor Vehicle involvement is significantly more than our study.

#### **Fractures of bones in victims**

Higher occurrence of skull fracture can be explained by the fact that pedestrians, motorcyclists and pedal cyclists whatever may be the site of primary impact secondary impact and secondary injuries are invariable to the head. In India, very motor vehicle occupants wear seatbelts. Because of this, following collision, head of the front seat occupants strikes the windscreen or upper windscreen rim and the headrest case of rear occupants, due to the forward movement of the body.

#### **Relation between fracture and cause of death:**

Fracture of multiple bones was present in all the five victims who died due to hemorrhagic shock. This may be due to the sudden and severe loss of blood because of injury to neighboring blood vessels by the fractured bones (the blood loss is, one to two liters in closed fracture of thigh, half to one liter in closed fracture of lower leg, quarter to half in fracture dislocation of ankle and two to two and half liters in fracture of pelvis). From the above results, it can be said that fractures in one or the other way, are associated with fatal outcome. The high percentage of deaths due to cranial cause (head injury) observed in our study can be explained by the present study, is a tertiary level hospital with well established neurosurgery unit and cases of head injury are referred from the various parts of Chittoor District, and also from places of neighboring districts Nellore and Kadapa.

#### **CONCLUSION**

RTAs are on the rise and have become a major public health problem. RTA cost a lot not only to the individuals affected and their families but also the nation. The injuries, disability and fatality resulting from injuries due to RTAs put a significant drain on the economy of the nation.

Constant rise in the number of motor vehicles, rampant encroachment of roads, nasty tendency of violating traffic rules and anarchic traffic systems have greatly contributed to rapid increase in RTAs. Population explosion is a catalyzing factor for a number of accidents.

In the present study, deaths due to RTA accounted for 20.37% of total medico legal autopsies conducted i.e. more than half of unnatural deaths were due to RTAs. All the victims of fatal RTA had fracture of one or the other bone. Fracture of skull was seen in 63.19% of cases. In majority of victims, impact injury and fracture contributed either directly or indirectly to death. Cranial cause alone was responsible for death in 63.09% of cases and skull fracture was present in 273 cases. This shows that fracture of skull is almost always associated with some injury to intra cranial vital organs. Various results were arrived at after detailed post mortem examination and review of PM reporters, regarding age, sex, their relation to impacts, various types of skull fractures, intracranial injuries and associated injuries. Causes of death in all the cases were inferred.

Epidemiological and scientific analysis of impact injury to head and other parts of body date was done to successfully meet the objectives listed in the initial stages of the study.

Most of the skull fractures and intra cranial injuries cannot be treated successfully, even in tertiary level hospitals; this may be because of their anatomical configuration. It is necessary for a general hospital to be equipped with the necessary equipment and trained medical and paramedical personnel to manage a head injury victim effectively. A separate neurosurgery and trauma care unit in every general hospital would be preferable in the interest of saving the life of head injury patient. Head injury due to impact to a patient, head injury due to impact to a victim by traffic accidents alone is a huge problem by its magnitude that prevention of an accident seems to be the only next best solution. Hence, fatalities due to skull fracture and fracture of other bones can be reduced by preventing the occurrence of such fractures. Therefore, the old saying, "Prevention is better than cure" holds good even here. After careful analysis of results obtained from the study we propose the following suggestion for prevention of mortality and morbidity in cases of Road traffic Accident

1. Strict enforcement of traffic rules.
2. Improvement of quality of roads by widening, proper asphaltting, incorporation of signal lights, sign boards, road dividers, lane segregation for slow, vehicles during both day and night.
3. Improve the road and traffic sense among road users by camps, road shows etc.
4. Observation of traffic weeks regularly to bring traffic awareness among various sections of population.
5. Proper education right from school level regarding the right way of using the roads.

6. Entry of animals into the roads must be checked.
7. Drivers should not be allowed to drink-drove; use mobile phones or engage in casuals' attitude while driving. Two wheeler drivers should wear protective crash helmets. Public transport driver and police should be trained in first aid and emergency management techniques.
8. Permissible limits of blood alcohol to be fixed and serious measures with respect to provisions in Indian Penal Code to be made to punish drunken drivers.
9. Regular health-check up of drivers to be made compulsory.
10. Vehicles should be conditioned and overhauled regularly and unfit vehicles to be condemned. Speed check devices to all vehicles should be made mandatory, halogen lamps on the vehicles to be avoided. The vehicle should be equipped with glare-proof infrared night vision system, encouraging the inclusion of air bags in new cars protective seat belts, collapsible steering wheel, crash resistant body and bucket seats. The interior of the vehicle should not be fitted with sharp and hard material. All such devices should be padded with soft foam. Sari guard, engine guard should be compulsorily installed in two wheelers.
11. Overloading of passengers in vehicles to be avoided.
12. Removing obstacle present on roads, vendors and hawkers should not be allowed on footpath or at the sides of road.
13. Different timing of schools, colleges and factories would help in reducing traffic congestion.
14. Laser and radar gadgets to be employed in checking the speed of the vehicles.
15. A sense of general awareness should be brought. Until the general public tries to bring a change in the traffic attitude from a personal level, the incidence of traffic accidents is fared to remain on the increasing verge. Public cooperation should be sought by the traffic enforcing authorities by gentle approach, but simultaneously should be strict to admonish and punish the traffic offender.

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