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# Incidence of Cervical Spine Injuries in Autopsies on Fatal Head Injury Victims.

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**ABSTRACT**

Studies on the association of head injuries with cervical spine injuries from India are scant. We studied 391 fatal head injuries and 81 of them had an associated injury in the cervical spine. 57 of 81 were brought alive and were treated using ATLS protocol. Only three of 57 could have any had surgical intervention and only 25 survived the first 24 hours. Unlike studies from the western countries,which had more upper cervical spine involvement in fatal head injury victims, this study had a majority 65% of injuries in mid and lower cervical spinal regions. The study is unique in analyzing the incidence of cervical spinal injuries in a larger group of head injuries, while other studies analyzed the incidence of head injuries in a larger group of cervical spinal injuries.

**Keywords**: Fatal Head Injuries, Cervical Spine injuries, Post-mortem, Levels

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## INTRODUCTION

Principally vehicular accidents are getting higher in India [1]. Fatalities in such accidents is mainly due to head injury (HI). It is of much interest that if these head injuries are associated with cervical spinal injuries (CSI) also, there can be an analysis of severity of cervical spinal injuries. The data for such a profile described is lacking in India. We have only a few studies from around the globe which report such an observation [2-6]. However a direct comparison of these data to an Indian set up is not possible. This is due to various factors like different types of vehicles plying on the road, the type of the road and the law enforcement . Hence we have tried a study to understand the pattern of cervical lesions in our part of the country associating HI with CSI. Such a data-base helps to plan treatment of such injuries in India in future and the real magnitude of combination injuries HI and CSI will be made known primarily to medical personnel. So, we aimed a post mortem study of head injury victims, the incidence and pattern of these injuries, mode of the injuries, the personal details, in case of vehicular accidents, whether the safety measures were adhered to.

## METHODOLOGY

This autopsy study was done on all the fatal HI victims of one year due to different causes presented to a forensic department of a medical college hospital specifically looking for any associated CSI and their levels. All had first information reports registered and were sent with a police inquest. Their details are given in table1.After external examination of clothes and identification marks; the scalp is reflected to expose the calvarium. The vault was watchfully sawed transversely all around across. It was removed to expose the underlying brain. The areas of brain injury and the appearance of the brain substance were noted. These are presented in table 2. After reflecting the meningeal tissues, the brain is dissected away from the brainstem for further examination. The layers of meninges were dissected to observe fractures in the base of skull. In addition a median thoraco-abdominal midline incision is made from the mental protuberance superiorly to the pubic symphysis inferiorly. In the upper part of this incision, the trachea and larynx are dissected out and the longus colli muscles were erased off to examine the anterior aspect of the cervical spine. The levels of cervical spine injury were determined based on this dissection and identification by a forensic surgeon of 20 years' experience in this college. The dissection of the thoracic, abdomen and pelvic cavities, their viscera and collection of fluids in them, and also the dissection of major blood vessels and presence of fractures in limbs, is not within the scope of this paper. However these are documented in rough notes. Later the patient was put prone and a midline incision of the spine was done and by sub periosteal dissection the spinous processes and laminae were observed for fractures. Laminectomies of all the spines were done with an osteotome and nibbler. The levels and type of the appearances of the vertebrae are presented in table 3.

Additional investigative findings like viscera reports and chemical analysis are incorporated into a post mortem autopsy report. All HI patients did not get X-ray, CT, and MRI. Also X-rays of the dissected specimen were not done during the post mortem, as this is not the current protocol in our place. The study also does not involve any removal of organs or mutilation of bodies. Information was also added from the case records and police records for individual HI cases with CSI like the circumstances of the injury, scene of the

incident in individual cases and in case of vehicular accidents, the type of vehicle, the position of the victim with regard to the vehicle in vehicular accidents or any other object, sketches of the scene and photographs of the vehicles and deceased occupants. These details are provided in tables 4. The average time taken for the victim to be transferred from the place of vehicular accident to this hospital for these patients was 45 minutes. In all these cases ATLS principles were used in resuscitation. Only in the cases which were brought alive and admitted here the cervical-spine was imaged with X-rays.

## RESULTS

There were totally 391 HI victims mostly men ( 309 men) with less women (65), and children (13 boys and four girls).The details of cases that survived the shift to the hospital, their surgical interventions and those who died after a period of treatment and those surviving 24 hours are presented in table 1. Among the total 391 cases 81 had CSI. The variety of brain injuries are presented in table 2.

**Table 1: The details of head injury victims who underwent autopsy in one year.**

| Group | Did not survive shift to hospital brought dead | Survived shift to hospital brought alive | Total | Died within 24 hrs Column3-Column 5 | Surviving 24 hours among 3rd column | Intervention In brought alive patients |
|---|---|---|---|---|---|---|
| Group 1 Pure HI | 22 | 288 | 310 | 32(11%) | 256 | 40 |
| Group 2 HI CS | 24 | 57 | 81 | 32(56%) | 25 | 3 |
| Total | 46 | 345 | 391 | 64 (18.5) | 281 | 43 |

Among the 391 HI cases 81 were having an associated injury in the cervical spine HI+CSI. More HI+CSI cases 24 [29.6%] were brought dead. The severity of injury is too much that of the remaining 57 HI+CSI who were brought alive only three had surgical intervention and remaining 32 died within the first 24 hours this is due to the poor general condition and moribund status. Only 25 survived the first 24 hours (43%). In contrast, While in pure HI group 288 survived the shift to hospital and 32 of them have expired within 24 hours. 256 survived at least 24 hours.(73.4% ).

**Table 2: The types of brain injuries**

| Type of brain injury | Number | Percentage |
|---|---|---|
| Subarachnoid Subdural and Intracranial Hemorrhage | 292 | 75.7% |
| Subarachnoid and Subdural Hemorrhage | 23 | 6.1% |
| Subarachnoid and Subdural Hemorrhage with Petechial Hemorrhage | 1 | 0.002% |
| Extra Dural ,Subarachnoid ,Subdural and Intracranial Hemorrhage | 26 | 6.5% |
| Cerebellar injury | 1 | 0.002% |
| Others | 48 | 12% |
| Total | 391 | |

The combination of the brain injuries and their proportion are presented in table 2which occur in combination with petechial hemorrhage, crush injury of entire brain with skull, brain laceration accounting in the rest (48 cases).The type of violence causing the fatal

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HI+CSI group of 81 cases were vehicular accidents (44), deceleration injuries (11) falls from vehicles 15 (4 falls are from agricultural vehicle), paddy thresher injury1, falls from height or stairs7, direct assaults 3. The finer details of the vehicular accidents are given in table 3.

**Table 3: Split up of the Vehicular accidents (44 cases)**

| - | Hit by Auto | Hit by Bicycle | Hit by Van | Hit by lorry | Hit by Motor cycle | Hit by Mini-bus | Hit by Tractor | Hit by Bus | Hit by 4 wheeler | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Pedestrian | 1 | | 1 | 2 | 11 | 1 | - | 2 | 3 | 21 |
| Bicycle | - | 1 | - | 2 | 1 | | - | 1 | - | 5 |
| Motor cycle | - | - | 2 | 4 | 3 | | -1 | 5 | 1 | 16 |
| 4 wheeler | - | - | - | 1 | - | - | - | 1 | - | 2 |
| Total | | | | | | | | | | 44 |

From the table 3, victims and the vehicles which hit them could be noted. It was observed that the majority of victims were either pedestrians or motor cyclists who collided with a bigger vehicle. The distribution of the levels of cervical injury is given in table 4. Majority were in C4/5, C5/6, and C6/7. 24 HI cases with fracture C4-5 with laceration of the spinal cord also had subarachnoid, subdural and intracranial hemorrhage in brain. 17 HI cases had significant injury at C5/6. These included an assault with spade and wooden log, and one paddy thresher injury. Interestingly 65% (56/81) cases were injured in lower cervical spine i.e. C4/5, C5/6, C6/7.

**Table 4: The levels of cervical injury in head injury patients**

| Level | C2/ C3 | C3/ C4 | C4/ C5 | C5 | C5/ C6 | C6/ C7 | C7/ T1 | C3-7 | C 4-6 | C 3-5 | C 5-7 | Entire c-spine | Contusion | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | 2 | 1 | 24 | 1 | 17 | 15 | 1 | 2 | 6 | 5 | 4 | 2 | 1 | 81 |

## DISCUSSION

There were certain limitations of this study. Routine radiological examinations of all victims brought for autopsies are not performed mainly due to absence of such a protocol. We accept in this study that there can be a certain percentage of the cervical spinal injuries that could be missed. It is commonplace that in a clinical setting of a serious HI victim these CSI are overlooked or missed [7] 4% to 30% of cervical spine is missed especially of odontoid, tear drop, facets and Hangman's fracture largely due to insufficient radiographic examination.[8] We also accept that the postmortem reports are very variable and depends on the person who did the same. There is no chance of inter-observer bias as the same professor (author3) person did all these autopsies. It cannot be taken as the only reference for identifying cervical spine injuries. Apart from the victims of vehicular accidents, there were injuries from assaults, fall from height, paddy thresher injuries etc. Thus this study is not very specific about the cause of injury. It totally includes the head injury patients in one year. Only with specific injury causation, models can be planned. However with multi-factorial injury pattern we feel it is difficult to plan a biomechanical study with mannequins or cadavers.

The study points to certain problem to be addressed in preventing accidents on road. India's road network (road density is 1.25 km/sqkm) has improved in the last few decades. It is more than China (0.36 km/sqkm )or Brazil (0.20 km/sqkm ) .A large portion in total rural road network is still only has kutcha roads . These are particularly dangerous in rainy season. Since physical structure of the country varies, there is the need for greater surfaced road connectivity. [9] Coming to the traffic density, there is a startling 197 times increase in vehicle numbers in the Indian subcontinent from 1951 to 2002 and most of these (71%) are two wheelers.[1] This increased and heterogeneous traffic pattern in Indian subcontinent are accountable for repeated accidents. Traffic congestion coupled with lack of strict enforcement of rules and regulations, account for most deaths due to road accidents. As already discussed HI accounts for major deaths in vehicular accidents and due to its proximity the cervical spine also has the chance to get injured. Retrospectively looking at the etiology in the motor vehicle accidents in our study, the main defects noted were, none of the two wheeler victims wore a helmet and in certain instances three were travelling in a single two wheeler.

Clinical studies on cervical spine injuries specifically looking for of HI exist. [2,4,5] There are also a few works analyzing only the PM findings in fatal cervical spine injuries [3,6] Studies on the incidence of cervical spine injuries in HI victim are scant [6].The two post mortem studies only discuss the cervical spinal injuries without any mention about head injuries [3,6] . Among clinical studies of cervical spinal injuries there is a wide variation in occurrence of serious head injuries from 3.5% to 35% or 40 percent [5]. Such a difference may be due to absence of standardization of status of roads, make of vehicles and the type of law enforcement viz concerning wearing of helmet in all countries. The unique thing in this study is, as discussed above, most of the works both postmortem [3,6] or clinical [3,5] have focused on the percentage of head injury in cervical spine ,on the contrary this study has tried to analyze the prevalence of cervical spine injuries in a larger group of fatal head injuries. Thus a direct comparison between the studies cannot be made. Both clinical [4,5] and post mortem studies [3,6] mainly found upper cervical spinal injuries. However in our study there was more involvement of lower cervical spine injuries in fatal HI. This is possibly due to differences in the transport control mechanism in different countries.(no mention of the terrain differences that may lead to different injury patterns).Certain unique injuries like the paddy thresher injuries are common in this region,(as Cauvery delta is in this region a rice bowl of Tamil Nadu ) [10] apart from injuries from assaults. Interestingly none of these cases had only extra dural hemorrhage, in agreement with the literature that such injuries are potentially remediable [11] and those cases could have been operated and saved and hence not presented here in our study. The sheer number of the samples in our series is more than the other works. [3,6].

The significant association of 20 % between HI and CSI reiterated the traditional dictum of the need not only to protect the cervical spine to prevent a second injury in all head injured unconscious patients but also to do an objective evaluation of cervical spine along with brain with MR imaging of both head and the cervical spine in one go as a protocol. This will identify even subtle cervical spinal-injuries sooner in live head injury patients and help in protecting and caring for their spine.

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## CONCLUSION

This is the first study of its kind from Tamil Nadu giving a prototype of existing burden of cervical spine injury in head injury patients with certain limitations. Its findings were different from those of other international studies. Presenting such report in suitable fora shall cause awareness among doctors to look for such aspects like occult injuries and their pattern in fatal injuries in their own place. This will also make the enforcement agencies to take cognizance and react appropriately to address factors like alcoholism, driving on the wrong side, not wearing helmets. We feel a study of the present type will be useful in health care and traffic management

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