

# Study of Head and Spine Injuries by Non-Contrast Computed Tomography (NCCT) Following Road Traffic Accidents (RTA's)

Dr P Suresh

Associate Professor, Department of Radio-Diagnosis and Imaging, Oxford Hospital and Research Center, Bangalore

**Abstract:** ***Background:** Head injury is injury to scalp, skull and the brain parenchyma. Scalp injury may be in the form of abrasion, contusion or laceration. Scalp lacerations bleed profusely if not controlled, because blood vessels in the dense fibrous layer, superficial to galea aponeurotica remain exposed once this layer is torn. Underlying the lacerations and scalp hematomas there can be skull fractures. Common types of skull fractures are simple linear fracture, depressed fracture, base of skull fracture and orbital blow out fracture. A sincere effort has been put in this study to understand the epidemiology and evaluation of head injury following RTA's. This study is intended to help the practicing radiology fraternity. **Methods:** The study was done in the Department of Radiodiagnosis at The Oxford Medical College Hospital And Research Centre, Bangalore. The study was done from October 2015 to December 2016. Forty three cases were taken up for the study and evaluated by plain CT scan (NCCT scan– Non-ContrastCT scan, i.e. CT scan without administration of intravenous contrast agent) of the head. Ten axial sections of the head from the base of skull were taken and evaluated. The information collected includes age, sex, occupation, alcohol consumption, type of vehicle involved, clinical presentation and CT findings. Thirty two cases out of the total had concurrent spinal injuries. **Results:** Male sex had the highest incidence of head injury which accounted for thirty four cases in comparison to females which accounted for only nine cases. Thirty two cases had concurrent spinal injuries. **Conclusion:** In this study it was noted that incidence of head injuries following RTA was more in the age group of twenty one to forty years. It was also noted that male sex out weighed the female sex for head injury following RTA.*

**Keywords:** NCCT scan, Head Injury, RTA's, Alcohol, Driving.

## 1. Introduction

Road safety is one of the biggest challenges in India and the frequency of road traffic accidents (RTA's) are among the highest in the world. The cause can be rash driving/disregard for speed limit, disregard for road rules, driving under the influence of alcohol, disregard for personal safety measures like helmets and seat belts, etc. Road traffic accidents not only cause monetary loss, but also mortality and morbidity. The victim may become disabled for life following RTA.

Head injury is one of the commonest causes of morbidity and mortality following RTA. Most serious head injuries and 65% of subsequent deaths are as a result of RTA<sup>1</sup>.

Head injury is injury to scalp, skull and the brain parenchyma. Scalp injury may be in the form of abrasion, contusion or laceration. Scalp lacerations bleed profusely if not controlled, because blood vessels in the dense fibrous layer, superficial to galea aponeurotica remain exposed once this layer is torn. Underlying the lacerations and scalp hematomas there can be skull fractures.

Common types of skull fractures are simple linear fracture, depressed fracture, base of skull fracture and orbital blow out fracture. Simple linear fractures occur as a result of head striking a broad surface. They may involve the entire thickness of the bone or either of the tables. The fracture usually starts at the point of impact and runs parallel to the direction of force.

Depressed fracture occurs as a result of focal impact. Both inner and outer tables of the skull can be involved; depth depends on the velocity of impact. The area of impact is

driven along the line of the force into the subjacent structures. The depressed fragment may tear the dura or lacerate the brain.

Base of skull fractures are of frequent occurrence and are occult radiologically. The base of skull is relatively weak because of presence of various foraminas. The anterior fossa fractures which usually result from direct impact may run through the cribriform plate, blood in these cases may spread along the tissue planes around the eye resulting in black eye or periorbital ecchymosis. Sometimes there can be CSF rhinorrhea. Direct impact behind the ear can lead to middle fossa fractures. In such cases there can be CSF otorrhoea. Mastoid hemorrhage may also be seen in such cases which is also called as Battle sign. Posterior fossa fractures result due to impact over the back of the head. There can be escape of blood and CSF to the tissues of the back of neck.

Orbital blow out fractures result from blunt trauma to the eye where force is transmitted via the globe to the bony orbit which leads to disruption of the orbital wall.

The injury to dura matter may be in the form of a tear. Brain injury can be primary brain injury or secondary brain injury. Types of primary brain injury are diffuse axonal injury, cerebral concussion, cerebral contusion and laceration. Types of secondary brain injuries are intracranial hematomas, cerebral swelling, cerebral ischemia and cerebral herniation.

Types of intracranial hematomas are intracerebral, extradural, subdural and subarachnoid.

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Subarachnoid hemorrhage is the most common intracranial hemorrhage resulting from blunt trauma to head. The location is between arachnoid matter and pia matter. Traumatic causes are the result of damage to the internal carotid, vertebral or basilar arteries. Blood may even leak from the vessels of the brain surface. The lesions may be space occupying if the source is arterial. The lesions can be focal, diffuse or bilateral involving both cerebral hemispheres.

Subdural hemorrhage can occur due to rupture of bridging veins or tears in dural venous sinuses following head trauma. Location is between dura matter and arachnoid matter. Acute subdural hemorrhage is almost always traumatic in origin. The lesion is often space occupying. It can be unilateral or bilateral.

Extradural hematoma mostly occurs due to rupture of middle meningeal artery or its branches following head trauma. It is usually accompanied by linear fracture of skull. The location is between skull and dura matter. It can be space occupying and distribution is usually on one side.

Traumatic intracerebral hemorrhages are usually seen in the central white matter of the frontal or temporo occipital regions<sup>2</sup>.

Plain CT scan (NCCT scan) has been the investigation of choice in head injury cases. Simple linear skull fractures require CT scanning for evaluation of the underlying brain parenchyma, base of skull fractures are visible in bone window axial CT scans. Cerebral contusions in CT scan appear as small areas of hemorrhage in the cerebral parenchyma. Intracerebral hematomas appear as hyperdense lesions on CT with associated mass effect and midline shift. Extradural hematomas appear convex in shape on CT and do not expand past suture lines. Subdural hematomas in CT classically appear crescent shaped. Acute bleeds are hyperdense whereas chronic bleeds can be isodense on CT.

The incidences of Head injuries are increasing because of industrial revolution and globalization<sup>3</sup>. The Injuries could be caused by blunt or penetrating trauma<sup>4</sup>. Any kind of cranio - cerebral injury is lethal<sup>5</sup>. Spinal Injury is also fairly common in these cases.

The common varieties of spinal injuries encountered are:

- **Flexion injury:** It is the commonest type of spinal injury, caused by fall from height on the heels or buttocks. It can result in compression fractures of C5 to C7 vertebral bodies, can lead to dislocation of one vertebra over

another (most commonly C5 over C6) and can result in wedge fractures involving the dorso-lumbar spine.

- **Flexion rotation injury:** It is the worst type of injury as it leaves the spine unstable with a high chance of neurological damage. Fall on the posterolateral part of head can result in this type of injury. It can result in dislocation of facet joints, fracture dislocation of cervical vertebra and fracture dislocation of dorso-lumbar spine.
- **Vertical compression injury:** Fall from height in an erect position may lead to this kind of injury. This can lead to burst fracture of the cervical or dorsolumbar spine.
- **Extension injury:** This injury is commonly seen in the cervical spine and usually occurs when the head hits the ground, extending the neck. This can result in a chip fracture of the anterior rim of a vertebra.
- **Direct injury:** It is because of direct impact. Generally a fracture of the spinous process can be seen.

A sincere effort has been put in this study to understand the epidemiology and evaluation of head injury following RTA's. This study is intended to help the practicing radiology fraternity.

### Aims and Objectives

To study the epidemiology and evaluation of head and spineinjuries by NCCTfollowing RTA's.

## 2. Materials and Methods

The study was done in the Department of Radiodiagnosis at The Oxford Medical College Hospital And Research Centre, Bangalore.

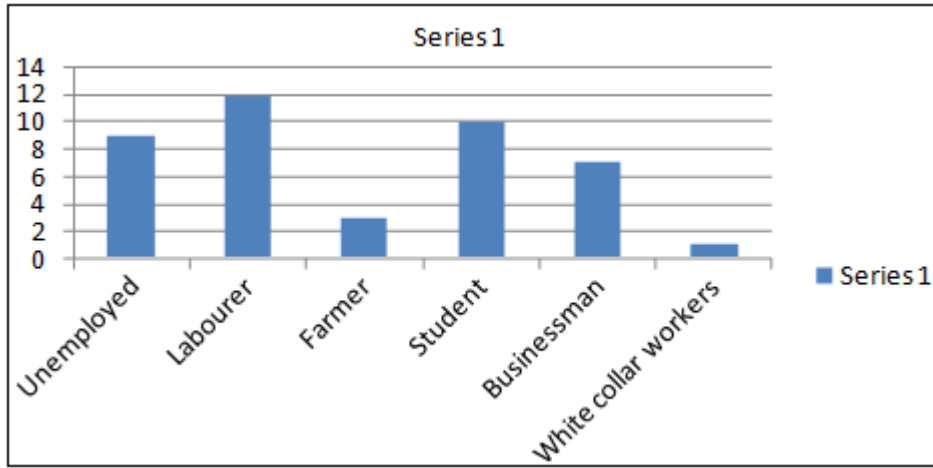
The study was done from October 2015 to December 2016.

Forty three cases were taken up for the study and evaluated by the plain CT scan (NCCT scan) of the head. Ten axial sections of the head from the base of skull were taken and evaluated. The information collected includes age, sex, occupation, alcohol consumption, type of vehicle involved, clinical presentation and plainCT findings.

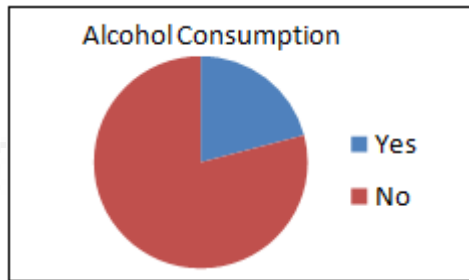
## 3. Results

**Table 1:** Showing incidence of age and sex:

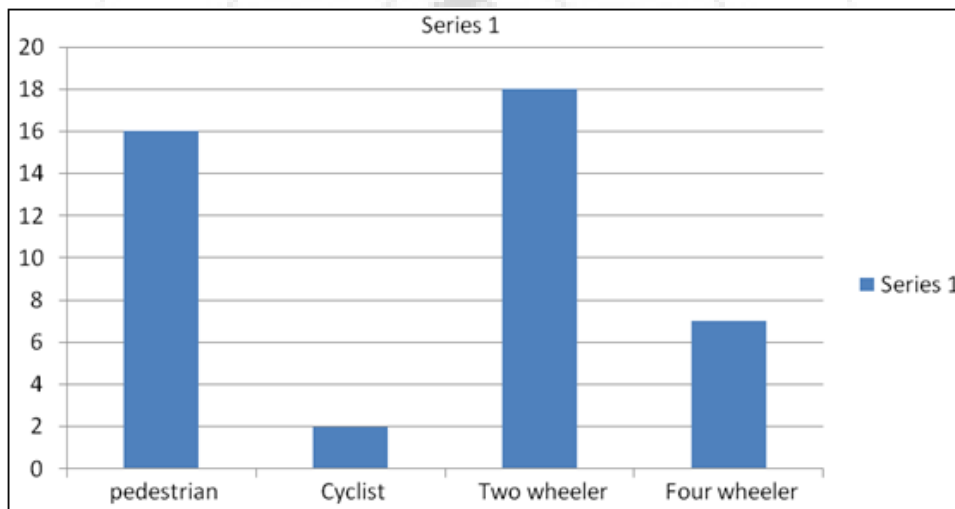
Age group	Male	Female	Total
0-20 years	6	2	8
21-40 years	18	6	24
41-60 years	8	1	9
>60 years	2	Nil	2



Graph 1: Occupation of the victim



Graph 2: Alcohol Consumption



Graph 3: Type of vehicle involved

Table 2: Clinical Presentation

No obvious clinical presentation	2
Headache	33
Vomiting	19
Loss of consciousness	11
Amnesia	7
Siezure	6

Table 3: CT findings in head injuries

Normal brain parenchyma	3
Skull fracture	19
Extradural hemorrhage	14
Subdural hemorrhage	11
Subarachnoid hemorrhage	12
Intracerebral hemorrhage	08
Cerebral contusions	17

Table 4: Showing types of spinal injury in CT

Injury	Frequency
Un-displaced spinal fractures	14
Displaced spinal fractures	18
Cord Injury	6

Table 5: Showing the level of spinal injury in CT

Cervical	1
Thoracic	11
Lumbar	26
Sacral	3

#### 4. Discussion

Male sex had the highest incidence of head injury which accounted for thirty four cases in comparison to females

which accounted for only nine cases. The age group of twenty one to forty years accounted for highest number of cases in this study which accounted to twenty four cases. Age group forty one to sixty years accounted to nine cases followed by age group of zero to twenty years which amounted to eight cases. Least number of cases were seen in age group of more than sixty years which accounted for two cases.

Based on the occupation of the victim the laborers suffered maximum number of head injuries in RTA's which accounted for twelve admissions followed by students which amounted to ten admissions. The unemployed victims accounted for nine admissions followed by businessmen who accounted to seven admissions followed by farmers which accounted to three admissions and white collar workers which accounted to one admission.

In this study twenty one percent of the victims had consumed alcohol which amounted to nine cases and thirty four cases had not consumed alcohol which amounted to seventy nine percent. Based on the type of vehicle involved two wheelers amounted to eighteen cases, followed by pedestrians which amounted to sixteen cases followed by four wheelers which amounted to seven cases followed by cyclists which amounted to two cases. Based on clinical presentation of the victim following RTA's thirty three cases presented with headache, nineteen cases presented with vomiting, eleven cases presented with loss of consciousness, seven cases presented with amnesia, six patients with seizures and two cases had no obvious clinical presentation. The CT findings of the cases studied showed skull fractures in nineteen cases, cerebral contusions in seventeen cases, extradural hemorrhage in fourteen cases, subarachnoid hemorrhage in twelve cases, subdural hemorrhage in eleven cases and intracerebral hemorrhage in eight cases. Three cases showed normal brain parenchyma.

According to a study conducted by Md. Ziya Ahmad<sup>6</sup> et al. Age twenty one to thirty years had maximum number of cases, male sex amounted to maximum number of cases, CT scan finding showed that skull fractures were the injuries which were noted maximum number of times followed by cerebral contusions. The CT scans in our study showed that eighteen cases had displaced spinal fractures followed by fourteen cases which had undisplaced spinal fractures. Cord injury was seen in six cases. Based on the level of spine injury twenty six cases had lumbar spine injury, eleven cases showed thoracic spine injury, three cases showed sacral spine injury and one case showed cervical spine injury.

According to a study conducted by Suraj Bajracharya et al<sup>7</sup>, fall from height was the most common mode of spinal injury. In this study the mean age in males was 41.74 years and in females it was observed to be 38.56 years. Thoracolumbar regional spine injury amounted to the maximum number of spine injuries.

## 5. Conclusion

In this study it was noted that incidence of head injuries following RTA's was more in the age group of twenty one to forty years. It was also noted that male sex outweighed

the female sex. Plain CT scan (NCCT scan) is the ideal tool to access any form of head injury. When in doubt it is advisable to refer for a plain CT scan so that any head injury if present can be diagnosed early. This helps in early treatment and decreased mortality.

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