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RESEARCH ARTICLE

NCCT FINDINGS OF PATTERN OF HEAD INJURIES IN ROAD TRAFFIC ACCIDENTS

[1] Dr. Preeth Pany, T., [2,*] Col Dr. Sunita Dashottar and [3] Lt. Col Dr. Devendra Nema

[1]Junior Resident, Dept of Radiology and Imaging, Command Hospital, Lucknow, India
[2]Professor and Head, Dept of Radiology and Imaging, Command Hospital, Lucknow, India
[3]Assistant Professor, Dept of Radiology and Imaging, Command Hospital, Lucknow, India

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ABSTRACT

Background: Road traffic accidents (RTA) are a leading cause of mortality and morbidity. Non Contrast Computed Tomography (NCCT) has become the diagnostic tool of choice for head trauma due to its high sensitivity, rapidity, accuracy, reliability and wide availability. **Objective:** To establish the role of NCCT in assessing the pattern of head injuries in RTA victims in a small cohort of armed forces personnel and their dependents. **Material and methods:** A retrospective annual study was conducted on 136 RTA victims with a 16 slice spiral CT machine in the radiology department of a tertiary care armed forces hospital based in Lucknow. **Results:** Out of 136 RTA victims, 46 suffered only brain injuries, 42 sustained only osseous fractures and 16 of them had both brain injuries and osseous fractures. Surprisingly, 32 (23.5%) of the total number of patients included in the study had neither brain nor osseous injuries. Males in the age group of 21-30 years (27%) were the most common victims. In this study, SDH was the most common pattern of brain injury. Linear fractures were more common than comminuted fractures of both cranial vault and facial bones. Temporal bone was the most common fractured bone of cranial vault and nasal bone was the most common fractured facial bone. Most of the injuries either brain/osseous were right sided. Maximum incidence of RTA took place in the month of December. **Conclusion:** NCCT was found to be highly sensitive safe and reliable in assessing the patterns of brain as well as skull vault and facial bone injuries reiterating the fact that it the primary investigative modality of choice in RTA.

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INTRODUCTION

Road traffic accidents are accountable for over a million deaths and around 50 million sustaining non-fatal injuries every year (World Health Organisation Collaborating Centers for Neurotrauma, 1995; http://www.who.int/violence_ injury_ prevention/road_safety_status/2015/en/). In India, about a lakh are killed in road traffic accidents annually (World Health Organisation Collaborating Centers for Neurotrauma, 1995). It is a well known fact that head injury is the most common cause of mortality in RTA. As per global status report on road safety published by WHO (World Health Organization), 1.25 million road traffic deaths occur globally ever year. It is the primary cause of death among age group 15-29 years (http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/). 3 out of 4 road traffic deaths are among men (http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/).

Corresponding author: **Sunita Dashottar,**
Professor and Head, Dept of Radiology and Imaging, Command Hospital, Lucknow, India.
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Despite having only 50% of world's vehicles, the low- and middle-income countries contribute to 90% of the world's road traffic deaths (http://www.who.int/violence_ injury_ prevention/road_safety_status/2015/en/). The WHO predicts that road traffic injuries would become the seventh most common cause of death by the year 2030 (http://www.who.int/violence_ injury_ prevention/road_ safety_status/2015/en/). Wearing helmets alone can result in 40% reduction to risk of death and 70% reduction in death due to severe head injury (http://www.who.int/violence_ injury_ prevention/road_ safety_status/2015/en/). Scientific evidence from developed countries exists for the effectiveness of preventive measures such as usage of helmet, preventing drinking and driving, speed control, safety belts, trauma care, road engineering, use of sign boards and child safety seats (Krug *et al.,* 2016; Dinh-Zarr *et al.,* 2001). As per National crime record bureau statistics - 2015, state of Uttar Pradesh (23,219 deaths) accounted for 13.1% of total traffic accident related deaths in our country (Accidental Deaths & suicides in India 2015). There has been a 5.1 % increase in road accident related fatalities during 2015 as compared to 2014 (Accidental Deaths & suicides in India 2015).

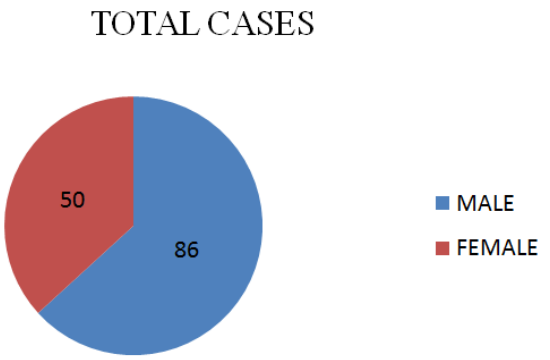

Fig. 1. Showing total cases with gender-wise break-up

Fig. 2. Arrow showing left parietal SDH

Fig. 3. Arrow showing fracture of left temporal bone

Fig 4. NCCT showing Contusion, SAH and SDH in left frontal lobe

Fig. 5. NCCT showing EDH in left fronto-parietal lobe

Road accidents usually have caused more injuries than deaths, but in the state of Uttar Pradesh road accidents caused more deaths in comparison to persons injured. Figures collected by national daily Times of India (TOI) (Times of India national newspaper dated 2017) reveal a startling fact that road accidents are responsible for the death of over 350 soldiers, sailors and airmen annually. Such huge number of well trained and disciplined armed forces personnel succumbing to RTA and thereby rendering themselves unfit for their primary duties both for their families and country is a grave cause for concern. Non Contrast Computed Tomography (NCCT) is helpful in characterizing the pattern of brain injuries such as contusions (hemorrhagic and non-hemorrhagic), extradural hemorrhage (EDH), sub- dural hemorrhage (SDH), subarachnoid hemorrhage (SAH) and intraventricular hemorrhage (IVH) apart from detecting even subtle skull fractures. Therefore, it

has become the diagnostic tool of choice for head trauma due to its high sensitivity, rapidity, accuracy, reliability and wide availability (Johnson, 1992; Brisman, 1997; Besenski, 2002; Zimmerman *et al.,* 1978). Most of the studies conducted in India to study the pattern of brain and osseous injuries were primarily autopsy based studies. So, in this era of imaging, this retrospective study is a sincere endeavor to study the imaging findings of head injuries in RTA victims.

MATERIALS AND METHODS

This is an annual retrospective study of road traffic accident victims who presented to the Accident and Emergency (A and E) department of a tertiary care armed forces hospital based at Lucknow in the year 2017. A total of 136 patients were included in the study. Information was collected from the requisition forms for NCCT head which were labeled as road traffic accidents irrespective of their Glasgow coma scale (GCS) and clinical symptoms. Only referrals from the A and E division of the hospital were included in the study. Deaths were excluded. 16 slice spiral CT scan machine (Philips Medical Systems) was used for the study. NCCT scans were performed with the patient in supine position; head at rest, from the base of skull to vertex. Cervical spine was also included in few cases, but the findings were not included in this study. 1.5-mm thick slices without interslice gap and with a 15-20 degree angle to the canthomeatal line were employed to reduce the beam hardening artifacts. The imaging findings were then evaluated under supervision of co-guide in the reporting room for both brain and osseous injuries. SPSS software was utilized for the data analysis.

RESULTS

The majority of RTA victims were two-wheeler borne drivers and pillion riders with a meager number of four wheeler drivers and pedestrians (as collateral victims). Most of the victims were males in the age group of 21 - 30 years (Table 1). 1-10 years was the least involved age group (Table 1).

The major victims of road traffic accidents were males (Figure 1). The maximum incidence of RTA occurred in the month of December (Figure 6), during which dense fog prevailed in this city. Out of 136 RTA victims, 46 suffered only brain injuries, 42 sustained only osseous fractures and 16 of them had both brain injuries and osseous fractures. So, brain injuries (62 cases) were more common than osseous fractures (58 cases). Surprisingly, 32 RTA victims had neither brain nor osseous injuries, an interesting finding which can be indirectly attributed to the strict enforcement of wearing helmets both by the drivers and pillion riders among the armed forces personnel and even their dependents.

SDH (Subdural hematoma) was the most common pattern of brain injury followed by contusions (Table 2) (Figures 2 and 4). Out of 62 cases with brain injuries SDH was seen in 33 cases (53 %) followed by contusions seen in 26 cases (42%). IVH (Intraventricular hemorrhage) was not seen in any RTA victim. Middle cranial fossa (MCF) injuries were most common followed by anterior cranial fossa (ACF) (Figure 7). Most of the patients presented with ear bleed which supplemented the fact that MCF was most commonly involved in this study. Linear fractures were more common than comminuted fractures (Table 3). Among the cranial vault fractures, temporal bone (23% linear and 12 % comminuted) was the most common fractured bone followed by frontal bone while sphenoid bone fractures were the least (Figures 3 and 5). Among the facial bone fractures, nasal bone (16% linear and 18 % comminuted) was the most common bone to be fractured followed by maxillary (16% linear and 12% comminuted) and least was that of mandible (06% linear and 02% comminuted). Most of the injuries either brain/osseous were right sided.

DISCUSSION

Males were the most common victims in RTA irrespective of age group as seen in other major NCCT based studies done in our country as well as abroad (Holmes *et al.,* 2006; Thiruppathy, 2004; Eze, 2011; https://www.researchgate.net/ publication/314119177; Bibek Khadka, 2016;

Table 1. Showing age-wise break-up with gender

AGE	1-10Y		11-20Y		21-30Y		31-40Y		41-50Y		51-60Y		61-70Y		71-80Y	
GENDER	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	1	2	13	7	25	12	15	5	9	8	13	7	5	8	5	1
TOTAL CASES	3		20		37		20		17		20		13		6	

Table 2. Incidence and pattern of brain injuries

PATTERN OF HEMORRHAGE	CASES
EDH (Extradural hemorrhage) only	08
SDH (Subdural hemorrhage) only	15
SAH (Subarachnoid hemorrhage) only	03
Contusion only	09
EDH+SAH	04
EDH+ Contusion	05
EDH+SDH+SAH	06
SDH+SAH+ Contusion	05
SDH+ Contusion	07

Table 3. Incidence and pattern of cranial vault fractures

SKULL VAULT	LINEAR FRACTURE (%)	COMMINUTED FRACTURE (%)
FRONTAL	20	10
TEMPORAL	23	12
PARIETAL	15	08
OCCIPITAL	10	02
SPHENOID	05	02

Table 4. Incidence and pattern of facial bone fractures

Facial bones	Linear fracture (%)	Comminuted fracture (%)
Nasal bone	16	18
Maxilla	16	12
Mandible	06	02
Zygoma	08	09
Lacrimal bones	10	08
Palate	07	04

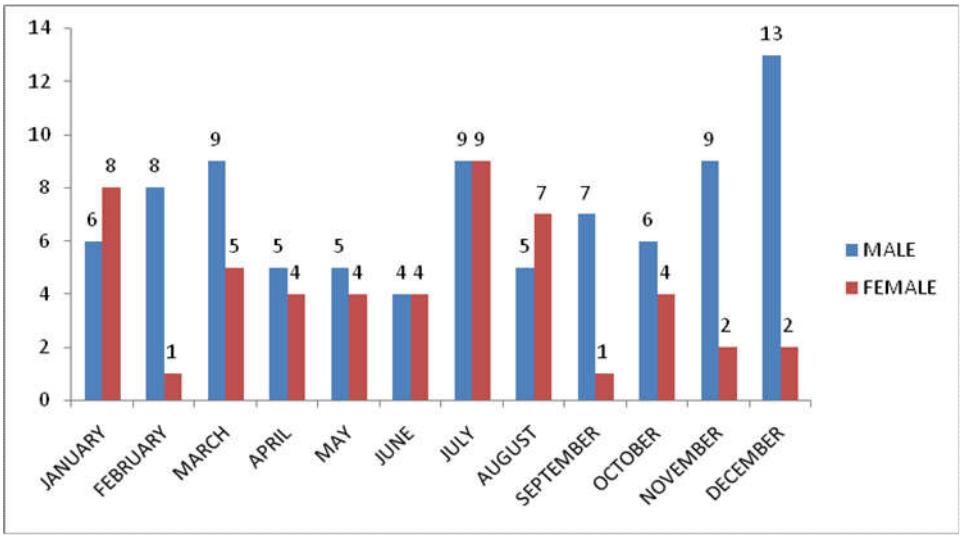

Fig. 6. Month-wise break-up of incidence of RTA

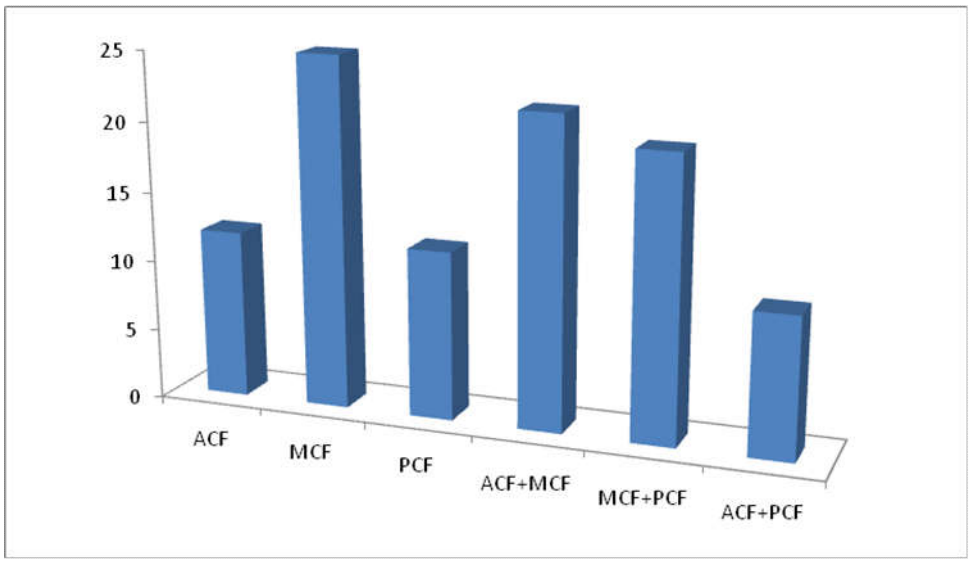

Fig. 7. Anatomical Location Fracture of Base of Skull (%)

https:// www.ncbi.nlm.nih.gov/ pmc/articles/PMC3263000/; Vikrant Kanagaraju *et al.,* 2016; Ogunseyinde *et al.,* 1999; Hans *et al.,* 2017).Most common age group of RTA victims were found to be 21 – 30 years which is in accordance with other studies (https://www.ncbi.nlm.nih.gov/ pmc/articles/ PMC3263000; Hans *et al.,* 2017). However, in the study conducted by Maharjan et al most common age group affected was below 15 years of age and in the study conducted by Bibek et al most common age group affected were 31-50 years. In this study, brain injuries were more common findings with or without fractures which was also the finding in other major studies (https:// www. researchgate.net/ publication 314119177; https://www. ncbi.nlm.nih.gov/ pmc/ articles/ PMC3263000/).

However, skull fractures were the most common finding seen in most of the other NCCT based studies (Eze, 2011; Bibek Khadka, 2016; Hans *et al.,* 2017; Gupta *et al.,* 2011). SDH, was the most common intracranial pattern of brain injury which is in concordance with study conducted by Samuel et al. (https://www.ncbi.nlm.nih.gov/ pmc/articles/PMC3263000/). Incidence of SDH in other studies were Ogunseyinde et al. (1999) (28.7%), Hans et al. (2017) (22%) and Gupta et al[21] (19%). In other major studies (Eze *et al.,* 2011; https://www.researchgate.net/publication/314119177; Dublin, 1977) contusions were the most common pattern of brain injury. EDH, was the most common brain injury seen in the study conducted by Bibek et al. (2016) SAH (77/85 cases) was the most common NCCT imaging finding in study conducted

by Vikrant et al. (2016) In this study, SDH was also the most common intracranial pattern of brain injury associated with skull fractures. In the studies conducted by Samudrala et al. (1997) EDH was more commonly associated with skull fractures. Linear pattern of fractures were commoner than comminuted fractures which was in accordance with other major studies (https://www.researchgate.net/ publication/ 314119177; https://www.nepjol.info/ index.php/JMMIHS/ article/view/15796; Hans *et al.,* 2017; Gupta *et al.,* 2011; Goyal *et al.,* 2010; Lloyd *et al.,* 1997; Adekanmi *et al.,* 2015). Temporal bone was the most common skull vault bone to be fractured and nasal bone was the most common facial bone to be fractured. In a 10 year long study conducted by Adekanmi et al. (2015) parietal bone was found to be the most common skull vault bone to be fractured. Middle cranial fossa (MCF) was most commonly involved followed by anterior cranial fossa (ACF). Most of the studies showed ACF to be most commonly involved owing to base of skull fractures which might be attributed to non-wearing of helmet or rash driving among other cohorts.

Conclusion

NCCT was found to be highly sensitive and safe in assessing the patterns of brain and osseous injuries and thereby the imaging modality of choice in RTA. It's easier availability and reliability in predicting the outcome of a road traffic accident victim can drastically reduce the mortality and morbidity rates among armed forces personnel as well as their dependents. Road accidents remain a cause for concern among the highly otherwise disciplined armed forces personnel. There are multiple directly and indirectly attributable causative factors associated with road traffic accidents. As every year passes by, despite having stringent road traffic rules; lack of their enforcement, poor road safety regulations and lack of civic sense directly contribute to the increasing number of RTA. It is thereby imperative to address these issues in a practical way and evaluate the results in a periodic basis. An incidental finding from this study is that the simple rule of compulsorily wearing helmet both by the drivers and pillion riders among armed forces personnel has significantly reduced the incidence of head injuries compared to their civilian counterparts. NCCT head studies should be prioritized based on the clinical symptoms associated with raised intracranial pressure like non-projectile vomiting, headache, seizures, blurring of vision, focal neurologic deficit as well as patients with low GCS. In this imaging era, prioritization based on these criteria would help in serving the needful and thereby eventually reducing the imaging abuse thrust upon the radiology department. A further value addition to this study would have been to follow-up these patients based on Marshall scoring system or Rotterdam criteria and ascertain the prognostic value of NCCT in traumatic brain injuries (TBI).

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