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Original Article

Spectrum of Computerized Tomography (CT) Findings in Craniocerebral Trauma- A Clinicoradiological Evaluation

Authors
Dr Shyna Narang[1], Dr Pradeep Bansal[2], Dr BB Thukral[3], Dr Mukta Mital[4]
[1]JR-III, Department of Radiodiagnosis, Subharti Medical College, Swami Vivekanand Subharti University, Meerut (U.P)
[2]Associate Professor, Department of Radiodiagnosis, Subharti Medical College, SwamiVivekanandSubharti University, Meerut (U.P)
[3]Professor and Head, Department of Radiodiagnosis, Subharti Medical College, Swami Vivekanand Subharti University, Meerut (U.P)
[4]Professor, Department of Radiodiagnosis, Subharti Medical College, Swami Vivekanand Subharti University, Meerut (U.P)
*Corresponding Author
Dr Pradeep Bansal
Associate Professor, Department of Radiodiagnosis, Subharti Medical College, Swami Vivekanand Subharti University, Meerut (U.P)

Abstract
Objective: *To assess the spectrum of computerized tomography (CT) findings in craniocerebral trauma by clinico-radiological evaluation.*
Methods: *This was a cross sectional study. After taking informed consent, the detailed clinical history was taken (including age, sex, date of injury, mode of injury and duration of LOC). General and systemic examination including detailed CNS examination (which included GCS score, higher mental function status, cranial nerve examination, motor and sensory function, meningeal signs) was done as per structured Performa. The patients presented with head injury referred for computed tomography of the head. After initial resuscitation, severity of the cranio-cerebral injury was graded with the help of "Glasgow Coma Scale" (GCS).*
Results: *About one third of patients were >50 years of age (33%). Majority of patients were males (76%). RTA was the most common mode of injury (56%). The commonest type of fractures associated with head injury were linear fractures (73%). Death was reported among 25 (25.0%) patients. Skull fracture were the commonest of all lesions accounting for 63.0% followed by contusions of brain (44.0%).Midline shift, contusion, Extradural Hematoma, Intra Cerebral Hematoma were significantly (p<0.05) associated with mortality.Patients with GCS score of <8 had a mortality of 54.5%. .There was significant (p<0.001) association of GCS with mortality.*
Conclusion: *Head injury higher among patients above 30 years of age. RTA was found to be most common cause of head injury in this study. Skull fracture was the commonest of all lesions accounting for 63.0% followed by contusions of brain (44.0%).*
Keywords: *Head injury, Road traffic accidents, Mortality, subdural hematoma, extradural hematoma, subarachnoid haemorrhage, intracerebral hematoma.*

Introduction

Head injury is defined as any trauma to the head, with or without injury to the brain. Traumatic brain injury (TBI) is a non-specific term describing blunt, penetrating, or blast injuries to the brain. TBI can be classified into primary and secondary injuries. Primary lesions are the direct result of trauma to the head, and secondary lesions arise as complications of primary lesions. Clinically, this classification is important because secondary injuries can be preventable, whereas primary injuries, by definition, have already occurred by the time the patient first presents for medical attention (Vadhanan S, Bhatoe, 2010).

Males are predominantly involved by 3:1 in all subgroups of TBI. More than half of the deaths or disabilities are as a result of head injuries due to road traffic accidents followed by falls on grounds, assaults and others. It most frequently occurs in very young children (age 0 to 4 years) and in adolescence and young adulthood (age 15 to 24 years), with a subsequent peak in incidence in older adults (over 65 years of age) (Butcher et al, 2007; Fearnside et al, 1993).

Traumatic brain injury (TBI) is a major health issue responsible for considerable mortality and long-term morbidity worldwide, especially among subjects under the age of 44 years (MacDorman et al, 2002). TBI can be further divided according to location (intra- or extra-axial), mechanism (penetrating/open or blunt/closed), and clinical severity (minor, mild, moderate, or severe) (Fearnside et al, 1993). The severity of head injury is usually based on the Glasgow Coma Scale (mild: GCS 13-15; moderate: GCS 9-12 ; severe: < 8) (Teasdale and Jennett, 1974).

Traumatic subarachnoid haemorrhage (SAH) is one of the most common CT findings in TBI, occurring in about 30% to 40% of patients with moderate to severe TBI, and 5% of patients with minor TBI (Farahvar et al, 2012; Roberts et al, 2004; Steyerberg et al, 2008). Subdural haematoma (SDH) are the most common type ofextraaxial mass lesion in TBI, seen in about 20% of patients with moderate to severe TBI, and in about 30% of fatal TBI. SDH occur in only 3% of patients with minor TBI. Epidural haematomas (EDH) are seen in about 10% of patients with moderate to severe TBI and about 1% of patients with minor TBI (Farahvar et al, 2012; Steyerberg et al, 2008).

Computed tomography perfusion (CTP) is an imaging technique that uses dynamics of injected contrast material and allows rapid qualitative and quantitative evaluation of cerebral perfusion by generating cerebral blood flow (CBF), cerebral blood volume (CBV), and mean transit time (MTT) maps providing clinically important information in patients with stroke, subarachnoid hemorrhage (SAH), and head injury (Stiell et al, 2005; Masson et al, 2001).

The present study was conducted to assess the spectrum of computerized tomography (CT) findings in craniocerebral trauma.

Material and Methods

This was a cross sectional study conducted in the Department of Radio-diagnosis, Imaging & Interventional Radiology, N.S.C.B Subharti Medical College, CSS Hospital, Meerut. The study was approved by the Ethical Committee of the Institute. The source of data for this study were patients of cranio-cerebral trauma referred to Department of Radio diagnosis, Imaging and interventional radiology from OPD/IPD/ Emergency of C.S.S hospital, N.S.C.B Subharti Medical College, Meerut for a period from September' 2017 to 31st May'2019. Patient referred to the department of Radio-diagnosis & Imaging for CT scan head with clinical h/o head injury, irrespective of cause of head injury were included in the study. Patients who presented earlier for CT scan head with h/o of head injury, with any h/o surgical intervention and refusal for CT scan were excluded from the study.

Methods

After taking informed consent, the detailed clinical history was taken (including age, sex, date of injury, mode of injury and duration of LOC). General and systemic examination including detailed CNS examination (which included GCS score, higher mental function status, cranial nerve examination, motor and sensory function, meningeal signs) was done as per structured Performa. The patients presented with head injury referred for computed tomography of the head.

After initial resuscitation, severity of the cranio-cerebral injury was graded with the help of "Glasgow Coma Scale" (GCS).

Statistical Analysis

The results are presented in frequencies, percentages and mean±SD. The Chi-square test was used to assess associations. The p-value<0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

Results

About one third of patients were >50 years of age (33%) followed by 31-40 (20%), ≤20 (17%), 21-30 (16%) and 41-50 (14%) years. The mean age of patients was 39.93±19.44 years. Majority of patients were males (76%). RTA was the most common mode of injury (56%) (Table-1).

The commonest type of fractures associated with head injury were linear fractures (73%) followed by depressed fractures (19%) and skull base fractures 7.9% (Fig.1).

Death was reported among 25 (25.0%) patients (Fig.2).

Skull fracture were the commonest of all lesions accounting for 63.0% followed by contusions of brain (44.0%). Other lesions which were seen on CT scan were Cerebral edema among 43.0%, Midline shift (36.0%), Subdural hematoma (41.0%), Extradural hematoma (32.0%), Intracerebral hematoma (22.0%), Subarachnoid hemorrhage (22.0%), Intraventricular hemorrhage (6.0%) and pneumocephalus among (19.0%) patients. Midline shift, contusion, Extradural Hematoma, Intra Cerebral Hematoma were significantly (p<0.05) associated with mortality (Table-2).

The cases with severe head injury with GCS score of <8 were the commonest accounting for 44.0% of all cases followed by mild head injury with GCS score of 13-14 accounting for 35.0% cases and with moderate head injury were least common accounting for 21.0%. The poor outcome was noted with a GCS score of <8. Patients with GCS score of <8 had a mortality of 54.5% followed by 4.8% in patients with GCS of 9-12 and 0.0% in patients with 13-14 GCS score. There was significant (p<0.001) association of GCS with mortality (Table-3).

Table-1: Distribution of basic profile of patients

Basic profile	No. (n=100)	%
Age in years		
≤20	17	17.0
21-30	16	16.0
31-40	20	20.0
41-50	14	14.0
>50	33	33.0
Mean±SD (Range)	39.93±19.44 (2-80)	
Gender		
Male	76	76.0
Female	24	24.0
Mode of injury		
RTA	56	56.0
Fall	32	32.0
Assault	8	8.0
Others	4	4.0

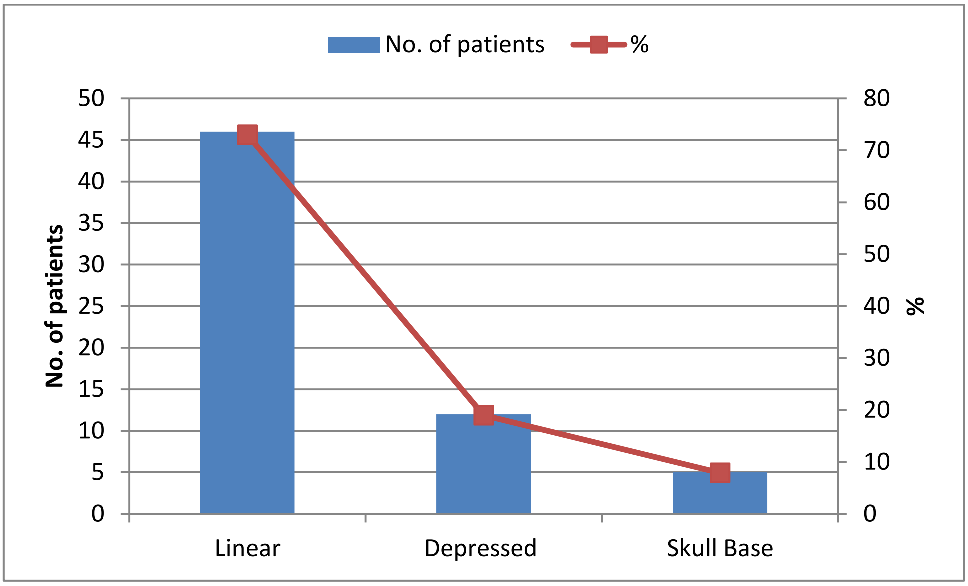


Fig.1: Incidence of types of Fractures as observed on CT Scan

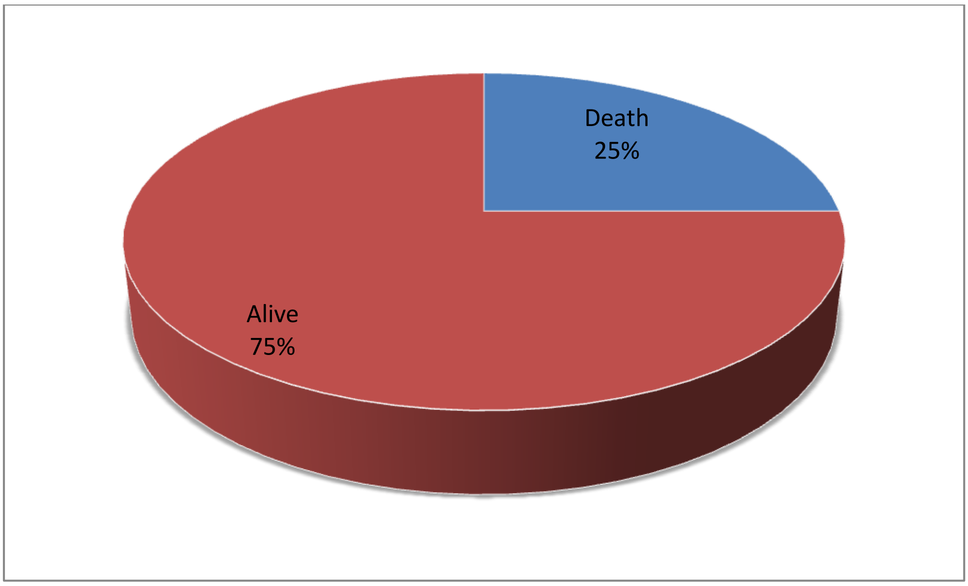


Fig. 2: Distribution of mortality

Table-2: Association of lesions on CT with mortality

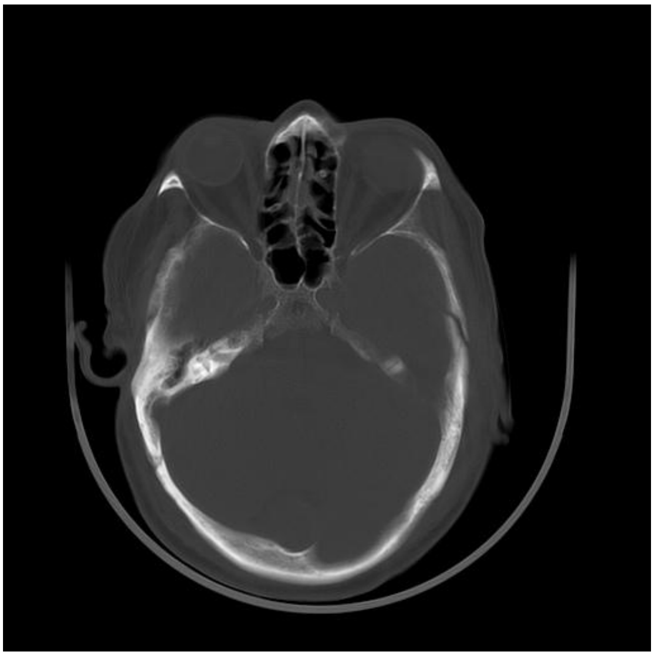
Lesions#	No. of patients		Death		Alive		p-value[1]
	No.	%	No.	%	No.	%	
Skull fracture	63	63.0	13	20.6	50	79.4	0.18
Cerebral edema	43	43.0	9	20.9	34	79.1	0.41
Midline shift	36	36.0	14	38.9	22	61.1	0.01*
Contusion	44	44.0	6	13.6	38	86.4	0.02*
Extradural Hematoma	32	32.0	4	12.5	28	87.5	0.04*
Subdural Hematoma	41	41.0	10	24.4	31	75.6	0.90
Subarachnoid Hemorrhage	22	22.0	4	18.2	18	81.8	0.40
Intra Cerebral Hematoma	22	22.0	14	63.6	8	36.4	0.001*
Intraventricular Hemorrhage	6	6.0	1	16.7	5	83.3	0.62
Pneumocephalus	19	19.0	6	31.6	13	68.4	0.46

[1]Chi-square test, #Multiple response, *Significant

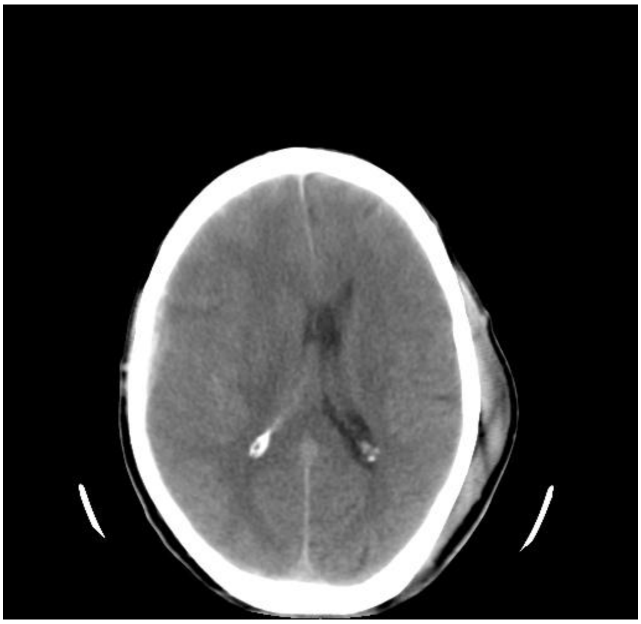
Table-3: Association of GCS with mortality

GCS	No. of patients		Death		Alive		p-value[1]
	No.	%	No.	%	No.	%	
Mild (13-14)	35	35.0	0	0.0	35	100.0	<0.001*
Moderate (9-12)	21	21.0	1	4.8	20	93.2	
Severe (< 8)	44	44.0	24	54.5	20	55.5	

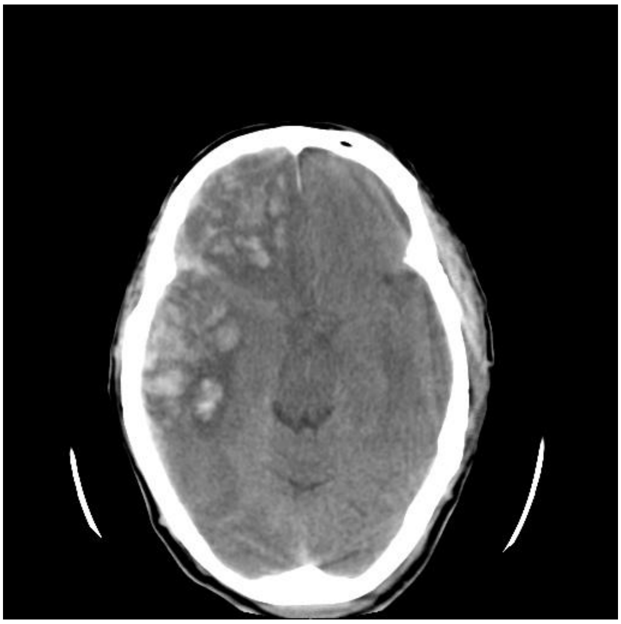
[1]Chi-square test, *Significant

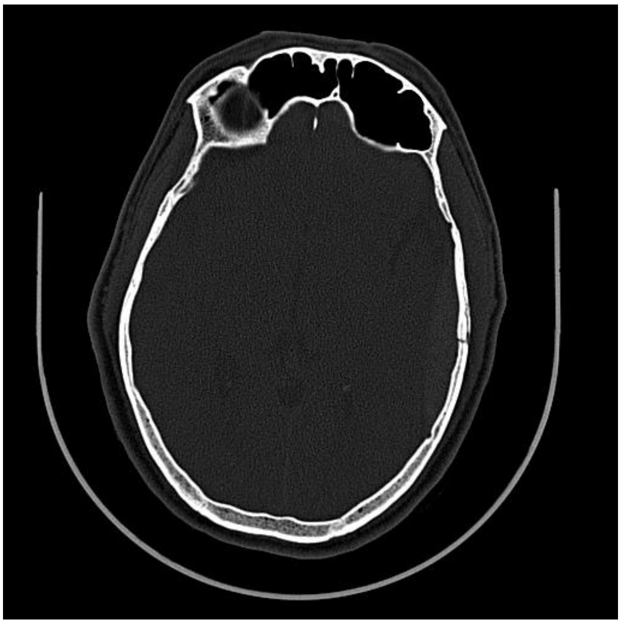


Case 1: Image shows multiple areas of hemorrhagic brain contusions involving right frontal and left temporal lobe. There is linear non displaced fracture of left temporal bone.



Case 2: Image shows multiple confluent areas of hyperdensities with adjacent vasogenic edema in right fronto-parieto and temporal region suggestive of hemorrhagic contusions. There is effacement of ipsilateral lateral ventricle and a midline shift towards left side .





Case 3: Image shows a lenticular shaped extra axial hyperdensity in left parietal region suggestive of Extradural hematoma (EDH). EDH is associated with linear non displaced fracture of left parietal bone.

Discussion

Traumatic brain injuries (TBI) are a worrying public health problem worldwide (Puvanachandra and Hyder, 2009). CT imaging is critical both in the diagnosis and management of TBI, particularly important is its role for triaging in the acute setups in determination of which patients require urgent neurosurgical attention (Mutch et al, 2016). This study was aimed at reporting CT findings of TBI in patients undergoing head CT examinations at the TTH due to histories of head traumas. Largely, head trauma occurred in patients of active age and in males than females. Unspecified source of trauma was found to be RTA being predominantly responsible for head traumas and TBI. Generally, males and youthful/productive age persons engage inconsiderable risk-related activities such as use of motor vehicle, predisposing them to increasing injuries (Rastogi et al, 2014).

In this study,the percentage of males was higher as compared to females. The other studies have also reported similar distribution of males and females. The studies by Kalsbeck[89] (59%), Zimmermann et al (1978) (79%), Holmes et al (2006) (65%), Saboori et al (2007)(78.2%) have reported almost similar finding as in this study.

In the present study, about one third of patients were >50 years of age (33%) followed by 31-40 (20%), ≤20 (17%), 21-30 (16%) and 41-50 (14%) years. The mean age of patients of this study was 39.93±19.44 years. Ogunseyinde et al (1999) also found that head injury was common in patients younger than 35 yrs. Khan et al (2003) in their study mentioned that peak incidence of traumatic brain injuries were between 15-35 years age group and Saboori et al (2007) reported a mean age of 29 years for patients of head injury.

In current study, road traffic accidents was found to be the commonest reason for injury among the subjects constituting 56.0%. Similar findings were reported by Bindu et al (2017) (RTA responsible for 68.0% of injuries) and Zimmermann et al (1978) reported RTA as the major cause albeit at a lesser population (39%). Igun et al (2000) in his study reported vehicular accidents as the major mode of head injury with an incidence of 72% and Saboori et al (2007) reported incidence of 88.2%. This increased incidence due to RTA can be attributed to the increased vehicular movement in cohesion with the population explosion.

In present study, commonest type of fractures associated with head injury were linear fractures (73%) followed by depressed fractures (19%) and skull base fractures (7.9%). Study by Lloyd et al (1997) showed an incidence of linear fractures of 84% and that of depressed fractures to be 9%. This was quite similar to the present study. In the study by Prasad et al (2017), linear fractures occurred more than the depressed fractures. This was quite similar to the present study.

Fractures can involve the vault, skull base, or facial skeleton and may be linear, depressed, or comminuted types. Dambatta and Sidi (2019) found an incidence of 28.6% of skull fractures in the abnormal patients, with few of these associated with intracranial lesions, particularly intracerebral hemorrhage (8%). These lesions were ipsilateral to the fracture sites. The fractures involved the cranium in 20 patients (82%) and the base in 2 patients (2.9%). The parietal bones (18.3%) and frontal bones (7.4%) were also involved. The explanation for this is probably because these are the most convex areas of the calvarium, and the more prone to impact.

In the present study, patients were classified as severe head injury with a GCS score of less than 8 formed the bulk of the study accounting for 44.0% followed by mild head injury with GCS score of 13-14 among 35.0% of the patients and least number of patients 21.0% having moderate head injury with a score of 9-12. This increase in incidence of severe head injury can be attributed to the location of our hospital on the highway with heavy traffic flow.

Steill et al (2001) came up with the Canadian CT head rule which consists of five high risk factors which are: (1) failure to reach GCS of 15 within 2 hours, (2) suspected open skull fracture,(3) any sign of basal skull fracture,(4) vomiting ≥ 2 episodes, (5) age ≥ 65 years) and two additional medium-risk factors (amnesia before impact >30 min and dangerous mechanism of injury). The high-risk factors were 100% sensitive and medium-risk factors were 98.4% sensitive for predicting clinically important brain injury.

Contusion was found to be the commonest intracranial lesion detected on CT accounting for 44% in the present study. Previous study by Dublin et al (1977) also reported similar observation (40%). The study by Prasad et al (2017) indicated that the commonest lesions encountered in cranio – cerebral trauma were contusions (39%) followed by oedema (34% including general as well as focal).

Similar results were observed by Tomar et al (2013) as they observed that the most common post traumatic consequences found in the study of adults are contusions, brain edema and intracerebral hematomas, while other sequelae such as subarachnoid hematomas, subdural hematomas and extradural hematomas are encountered less.

Subdural hematoma (41.0%) was found to the commonest type of extra – axial hemorrhage in the present study. Incidence of Subdural hemorrhage were most common extra –axial hemorrhage reported in other studies were Saboori et al (2007) (34.7%), Igun et al(2000) (60%), Ogunseyinde et al (1999) (28.7%).

Mortality rate in patients with intracranial hematoma was 63.6%. This can be attributed to the more severe impact of trauma to cause ICH and also the significant midline shift noted in these patients leading to a grave prognosis.

Mortality rate in patients with subdural hematoma was 24.4%. Cooper et al (1987) in his study stated that mortality due to subdural hematoma was between 35% to 50%. SDH is also associated with worse outcome because it generally is caused by high velocity injuries resulting in more primary brain injury.

Mortality rate in patients with EDH was 12.5%. Bricolo and Pasut (1984) and Smith & Miller (1991) in their studies stated that mortality with EDH is approximately 5%. Since EDH is usually associated with low velocity injury, it results in little primary injury to brain and causes poor outcome only if the expanding hematoma is allowed to compress the brain.

In the present study, poor outcome was noted with a GCS score of <8 with a mortality rate of 54.5% followed by 4.8% in patients with GCS of 9-12 and none in patients with 13-14 GCS score. Stuart et al (1998) in their study showed an incidence of 34.50% mortality with a GCS score of <8. This increased mortality in a patient with a reduced GCS score is probably due to more severe primary brain insult associated.

One of the limitations of this study was small sample size. The studies with larger sample with long duration of study period are required to have robust findings.

Conclusion

Head injury higher among patients above 30 years of age. RTA was found to be most common cause of head injury in this study.Skull fracture was the common of all lesions accounting for 63.0% followed by contusions of brain (44.0%).

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