Original Research Article

Role of computed tomography as a prime modality in evaluation of head injury

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Abstract

Background: Head injury causes more deaths and disability than any other neurologic condition before the age of 50 and occurs in >70% of accidents, which are the leading cause of death in adults <35 year old. Most of these cases are in their prime period of second and third decade of their life and therefore have a direct social and economic effect besides the emotional burden of suffering a lifelong debilitating loss of function. The aim of the present study was to evaluate and assess the role of computed tomography in patients with head injury and to study the various craniocerebral changes that occur in trauma to head with aid of computed tomography (CT). **Methodology:** The study comprised of one hundred and fifty patients with head injury. These patients were initially stabilised after assessing according to Glasgow Coma Scale" (GCS) and subjected to CT scanning of head using Hitachi W400 and the radiological findings were observed. Rates, ratios and percentages of different diagnosis and outcome made by computed tomography was computed and compiled. Chi square test was used for comparison of CT findings of different variables with "p" value less than 0.05 was considered as significant. **Results:** The study revealed that males were commonly affected (82.60%). Most of the patients were in age group of 21-30 years (33.33%). Road traffic accidents were found to be commonest mode of injury (65.34%). Linear fractures were found to be the common type of skull fractures (72.04%). Contusions were the most common intracranial - lesion observed (44%). Subdural haemorrhage was more common of all intracranial haemorrhages noted (3 8.6%). Intracerebral haemorrhage was the most common haemorrhage noted in patients who expired (58.0%). Patients with a Glasgow coma scale of<8 had the highest mortality (48.38%). **Conclusion:** CT aids in surgical planning, prognosticating outcome and recovery time. It can demonstrate significant primary traumatic injuries including extradural, subdural, intracerebral haematomas, subarachnoid and intraventricular haemorrhages, skull fractures, cerebral oedema, contusions and cerebral herniation. CT is one of the most comprehensive diagnostic modality for accurate localization of the site of injury in trauma to head.

Key Words: Road traffic accidents; Fractures; Extradural hematoma; Contusions

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INTRODUCTION

Head trauma causes a spectrum of brain injuries ranging from transient physiological dysfunction, manifested by short periods of confusion and amnesia to severe immediate irreversible neuronal damage and death. All the cases with severe head injury and as many as two- thirds of those with moderate head injury will be permanently disabled and will not return to their premorbid level of function. Immediate and instantaneous death following cranial trauma occurs due to unpreventable primary brain injuries. However, death occurring within 24hrs of head injury can be averted by timely institution of diagnostic and therapeutic measures that could prevent secondary brain insults.[1] Prompt recognition of treatable injuries is

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critical to reduce mortality and CT of the head is the cornerstone for rapid diagnosis. Follow up assessment using CT is frequently necessary to detect progression and stability of lesions and evidence of delayed complications and sequelae of cerebral injury, which can determine whether surgical intervention is necessary. Besides facilitating rapid implementation it can demonstrate significant primary traumatic injuries of various patterns and conditions. Contribution of CT is crucial to complete injury assessment and forms the basis of patient management.[2, 3] Computed Tomography is widely available, rapid, permits close monitoring of unstable patients, compatible with respirators and other mechanical support devices. It is very sensitive in detecting acute hematomas and depressed fractures that require emergency surgery. However Computed Tomography is less sensitive in detecting white matter injuries and posterior fossa lesions due to beam hardening artefacts, from the surrounding bones.[4] This study was planned to evaluate and assess the role of computed tomography in patients with head injury and compare the type of cerebral insult on CT imaging in patient with head injury with their clinical outcome.

METHODOLOGY

The present study was conducted in tertiary care centre northern part of Karnataka. The descriptive analytical study included 150 patients, it was purposive consecutive sampling. All age groups with head injury reporting within 24 hours of incident, GCS score less than 14 were included in the study. The cases excluded were cranial trauma during child birth and patients with non-traumatic intracranial haemorrhage. After obtaining initial history and physical examination, and suspected head injury cases were ruled out any evidence of cervical spine injury. The patients were examined with CT scanner in the supine position. The Gantry tilt was given in the range of ± 0-20 degrees, so as to parallel the scan plane to the orbito-meatal line. The patients were scanned using Hitachi W400, Matrix size-512, Slice thickness - 10 mm, 5mm and MAS-50 to270. Contiguous axial sections of slice thickness 5 mm were taken for the posterior fossa study and 10 mm in the supratentorial region respectively. Thinner sections were also obtained in the region of interest. Bone algorithms and wide window settings were studied to visualise the various craniocerebral changes.

Statistical methods:

Rates, ratios and percentages of different diagnosis and outcome made by computed tomography was computed and compiled. Chi square test was used for comparison of CT findings of different variables and p-value less than 0.05 was considered to be statistically significant using the software SPSS version 19.

RESULTS

Of the total 150 patients involved in study 124(82.6%) cases were male and 26 (17.3%) were female cases showing male predominance. The peak incidence of head injury in males occurred in the age group of 21-30 years i.e. 40 patients (32.26%). Incidence in other age groups being 14 patients (11.29%) in 0-10 years, 15 (12.09%) in 11-20 years, 28 (22.58%) in 31-40 years, 13 (10.48%) in 41-50years, 10(8.07%) in 51-60 years and 04 in (03.23%) patients aged above 61yers. In females also the peak incidence occurred in 21-30 years age group i.e. 10 patients (38.46%). The other age groups being 04 (15.39%) in 0-10 years, 02(7.69%) in 11-20 years,04 (15.39%) in 31-40 years, 02 (7.69%) in 41-50 and 4 in 51-60 years category.

Table 1: Incidence of Different Modes of Injury

Type of Injury	No. of Cases (%)
Road traffic accident	98 (65.3%)
Fall from height	40 (26.6%)
Assault	06 (4%)
Others	06 (4%)
Total	**150 (100%)**

According to our observation road traffic accident was found to be the commonest mode of head injury with an incidence of followed by other modes of injury such as falls, assaults and others as depicted in Table No.1. According to the study, commonest type of fractures associated with head injury were linear fractures accounting for 67(72.04%), followed by depressed fractures 18(19.35%) and skull base fractures 8(8.61%). Out of a total of 93 fractures detected on CT, 69 (74.19%) fractures were detected on plain radiographs modality, the remaining 24(25.80%) fractures were detected only on CT imaging.

Table-2: Grading of Head injury based on GCS Score

Type of head injury	No. of Cases (%)
Mild (13-14)	48 (32%)
Moderate (9-12)	40 (26.7%)
Severe (<8)	62 (41.3%)
Total	**150 (100%)**

As shown in Table no.3 contusions of brain were the commonest intracranial lesion noted in 66 patients (44%) and fractures were the commonest of all lesions accounting for 93 cases (61%). Out of 43 patients with extradural hemorrhage, 40 patients had an overlying fracture associated. Intracerebral hematoma (58%) was the most common lesion noted in patients who expired followed by subdural hemorrhage 46%. Extradural hemorrhage 7.50% was the least common lesion noted in these patients

Table 3: Incidence of various lesions as observed on CT imaging modality

Lesions	No. of Cases (%)
Contusions	66 (44%)
Cerebral edema	65 (43.3%)
Middle shift	59 (39.9%)
Subdural hematoma	58 (38.6%)
Extradural hematoma	43 (29%)
Intracerebral hematoma	28 (19.3%)
Subarachnoid hemorrhage	36 (24%)
Intraventricular hemorrhage	6 (4%)
Pneumocephalous	27 (18%)
Fractures	93 (61%)

Table 4: Mortality on basis of GCS

Glasgow coma scale	No. of cases	Death
<8	62	30 (48.38%)
9-12	40	9 (22.5%)
13-14	48	1(2%)

As shown in Table No.4 poor outcome was noted with a GCS score of <8.Patients with GCS score of <8 had a mortality of 48.38% followed by 22.5% in patients with GCS of 9-12 and 2.08% in patients with 13-14 GCS score. Outcome is therefore poor with low GCS score. x=25.49 and p<O.OO1, which shows that the relationship is significant

DISCUSSION

Males were found to be more predominant than females in the present study. Incidence reported in other studies were Kalsbeck *et al.*. [5] 59%, Zimmermann *et al*[6] 79%, James F Holmes *et al*[7] 65%, Masih Saboori *et al*[8] 78.2%. This male preponderance can be attributed to the increased outdoor activity and travel by males. In the present study patients in the age group of 21-30 years formed the bulk of the study. Study by Ogunseyinde AO *et al.* [9] also stated that head injury was common in patients younger than 35 yrs. Fary Khan *et al.* [10] in their study mentioned that peak incidence of traumatic brain injuries were between 15-35 years age group and Masih Saboori *et al*[8] reported a mean age of 29 years for patients of head injury. By the studies it is noted that head injury is seen commonly in socially and economically productive age group of the population and hence has an impact on the financial aspect of the family. Road traffic accidents were found to be the commonest mode of injury in the present study accounting for 65.34%. Zimmermann *et al*[6] also reported RTA as the major cause albeit at a lesser population (39%). Igun GO *et al.*[11] in his study reported vehicular accidents as the major mode of head injury with an incidence of 72% and Masih Saboori *et al.*[8] 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. Linear fractures were found to be commonest type of fracture with an incidence of 72.04% followed by depressed fractures accounting for 19.35%. Study by David *et al*[12] showed an incidence of linear fractures of 84% and that of depressed fractures to be 9%. In the present study, out of 93 fractures totally detected on CT, 24 (25.8%) were missed on plain radiograph. CT was a better imaging modality for detection of fractures including the detection of skull base fractures. In the present study, patients classified as severe head injury with a GCS score of <8 formed the bulk of the study accounting for 41.3 followed by 32% of patients with mild head injury with GCS score of 13-14. This increase in incidence of severe head injury seen is probably due to exclusion of patients with normal CT findings in the present study conducted. Many studies were conducted to predict the usefulness of CT scan in a patient with minor head injury. In this respect Proflan *et al.* [13] 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 mm 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. Dublin *et al.* [14] also reported similar observation of 40% in their study. Subdural hematoma was found to the commonest type of hemorrhage noted accounting for 38.6% in the present study. Incidence reported in other studies were Masih Saboori *et al*[8] (34.7%), Igun GO *et al.*[11] (60%), Ogunseyinde AO *et al.*[9] (28.7%). Intracerebral bleed accounted for 14.3% of lesions in the present study, whereas a slightly higher incidence of 26.3% was noted in the study conducted by Ogunseyinde AO *et al*[9]. Intraventricular hemorrhage (IVH) was the least common lesion noted with an incidence of 4% in the present study. Le Roux PD *et al*[15] and Lee J.P *et al*[16] in their studies had stated that IVH is noted in 1% to 5% of all patients with head injury. Traumatic IVH is thus relatively uncommon and usually reflects severe injury. Extradural hematoma was found to be associated with an overlying fracture in 93.02% of cases in the present study. Igun GO *et al.*[11] reported 100% association of EDH with an overlying fracture. A blow to the calvarium resulting in fracture of the adjacent bone causes displacement of dura away from the inner table of skull resulting in damage to underlying vessel thus causing extradural hematoma. The commonest hemorrhage found in patients who expired was intracranial hemorrhage with an incidence of 58%. This can be attributed to the more severe impact of trauma to cause the hemorrhage and also the significant midline shift noted in these patients leading to a grave prognosis. Subdural hematoma was seen in 46% of patients who expired. Bricolo A.P *et al*[17] 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. EDH was seen in only 7.5% of patients who expired. Bricolo A.P *et al* [17] and Smith HK *et al.* [18] 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 of 48.38% followed by 22.5% in patients with GCS of 9-12 and 2.08% in patients with 13-14 GCS score. Study conducted by Gordon Stuart *et al.*[19] reported 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. Preoperative decompression was carried out in 6 patients with extradural hematoma. All operated patients had good recovery. Traumatic extradural hematoma is a neurosurgical emergency and timely surgical intervention for significant extradural hematoma is gold standard as stated by Phoebe S.Y *et al.* [20] in their study. Liu JT *et al*[21] also mentioned in their study that burr hole evacuation followed by drainage under negative pressure is a safe and effective method or emergency management of a pure traumatic epidural hematoma.

CONCLUSION

Head injury causes more deaths and disability than any other neurologic condition before age 50 and occurs in >70% of accidents, which are the leading cause of death in men <35 year old. Neuroimaging techniques provide some of the most important diagnostic, prognostic, and pathophysiological information in the management of brain injury. Anatomical imaging modalities can help assess intracranial hemorrhage, fractures, and other structural lesions. Beside the correct diagnosis itself the time to establish a diagnosis above all has a crucial impact on successful management and good outcome of these patients. Computed tomography is a simple, inexpensive, highly effective and safe imaging modality and provides the ability to rapidly evaluate patients with acute head injuries. CT aids in surgical planning, prognosticating outcome and recovery time. It can demonstrate significant primary traumatic injuries including extradural, subdural, intracerebral hematomas, subarachnoid and intraventricular hemorrhages, skull fractures, cerebral edema, contusions and cerebral herniation. CT is one of the most comprehensive diagnostic modality for accurate localization of the site of injury in trauma to head. Thus it is justifiable to conclude that CT is and should be considered the first imaging of choice in acute head injury as it forms the cornerstone for rapid and effective diagnosis.

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