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The role of multidetector computed tomography in patients with cranio-cerebral trauma

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Abstract

Introduction: Cranio-cerebral trauma due to Road Traffic Accidents (RTA) have increased dramatically and taken an immense toll on lives and most of the affected individuals are in the prime of their lives and often suffer a lifelong disability or even death. Prior to the evolution of Computed Tomography, plain roentgenograms of skull and cerebral angiography were the mainstay for evaluation of cranio-cerebral trauma. A correct diagnosis is impractical only on physical examination. Quick assessment of reversible brain injuries is important to prevent mortality and CT of the head is the mainstay for correct diagnosis and treatment.3 For determination of neurointervention CT brain is of utmost importance.

Aim: This study is undertaken to evaluate the role of Multidetector Computed Tomography in patients with cranio-cerebral trauma.

Objective: To characterize cranio-cerebral trauma radiologically using MDCTN considering factors such as age, gender, mode of injury, type of injury.

Methods: The present study was carried out in patients with craniocerebral injury, referred to MGM hospital, kamothe. The study comprised of a total of one hundred patients with head injury admitted to MGM hospital, kamothe.

Results: Study showed that road traffic accident is the most common mode of trauma as we came across 63 case of head injury due to road traffic accidents which is 63% of the total case. Linear fractures were most common type of fracture we came across in the present study. It comprised of 53% of the patients who presented with fractures. After linear fractures, skull base fracture (26.6%) was found to be common. Contusion was seen as the most common type of injury making 49% of patients in this study. Subdural hematoma was found in 43%, extradural hematoma in 40%, intracerebral hemorrhage in 39% and subarachnoid hemorrhage in 33% of the patients. Intraventricular hemorrhage was uncommon seen in only 9% of the patients however the outcome of patients presenting with it was poor.

Conclusion: Imaging technique like computed tomography is essential in early diagnosis and proper management of the patient presenting with head trauma. Correct diagnosis is equally important in the outcome of patient with head trauma. Computed tomography has become a routine to rule out head injury in modern day as it is simple, highly effective, inexpensive and less time taking modality to evaluate patients with head injury.

Keywords: Multidetector Computed Tomography, Cranio-cerebral trauma.

Introduction

Industrialization and urbanization in a rapidly developing country like India has led to an exponential increase in road transportation. Due to this exponential increase, accidents have become a leading cause of death and disability. Road Traffic Accidents (RTA) have increased dramatically and taken an immense toll on lives and most of the affected individuals are in the prime of their lives and often suffer a lifelong disability or even death[1].

The human brain being a complex organ in function and design can suffer from a spectrum of injuries ranging from physiological dysfunction, amnesia to severe irreversible brain damage and sometimes even death. The effect of brain damage can often be misleading. Minor brain trauma can sometimes lead to permanent disability and death and patients with major injuries can survive with no serious neurological deficit. With the rapid advancement in the field of medicine, neuroimaging and intervention, head trauma is better evaluated in present times.

Death due to cranial trauma can lead to permanent and irreversible brain injuries. With timely diagnostic and therapeutic intervention death due to cranio-cerebral trauma can be identified, evaluated and often prevented.

Sir Godfrey Hounsfield described CT in 1973 and thereby spawned an imaging revolution.[2]

Prior to the evolution of Computed Tomography, plain roentgenograms of skull and cerebral angiography were the mainstay for evaluation of cranio-cerebral trauma. A correct diagnosis is impractical only on physical examination. Quick assessment of reversible brain injuries is important to prevent mortality and CT of the head is the mainstay for correct diagnosis and treatment.[3] For determination of neurointervention CT brain is of utmost importance[4]. Computed Tomography is the most informative diagnostic modality for evaluation of a head injury patient.

Aim

This study is undertaken to evaluate the role of Multidetector Computed Tomography in patients with cranio-cerebral trauma.

Objective

To characterize cranio-cerebral trauma radiologically using MDCTN considering factors such as age, gender, mode of injury, type of injury.

Methods

The present study was carried out in patients with craniocerebral injury, referred to MGM hospital, kamothe. The study comprised of a total of one hundred patients with head injury admitted to MGM hospital, kamothe.

Inclusion Criteria

All cases referred for CT scan with cranio-cerebral trauma amongst the admitted patients at MGM Hospital, Navi Mumbai.

Exclusion Criteria

1. Patients with known bleeding disorders and on anti-coagulant.
2. Pregnant women
3. Patients with history of previous or new cerebro-vascular accidents. As proved by history or present MDCT.
4. Patient not willing.

Equipment

The patients will be scanned using Toshiba Activion 16 Slice Spiral CT Machine.

This equipment may change to any similar MDCT machine as per hospital policy.

- This is a multidetector spiral helical CT scanner.
- Matrix size-512
- Slice thickness – 5 mm thick to 1 mm thin.
- K.V – 80 to 135.
- MAS – 10 to 500

Figure 1: Toshiba Activion 16 Slice Spiral CT Machine

CT Protocol

After the examination of the cervical spine for any evidence of injury, the patients were examined with CT scanner in the supine position. The Gantry tilt was parallel to the orbito-meatal line. 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 & wide window settings were studied to visualize the various craniocerebral changes.

Statistical Methods

Rates, ratios and percentages of different diagnosis and outcome made by Computed tomography will be computed and compiled. Chi square test will be used for comparison of CT findings of different variables and P value will be calculated.

Results

A total of one hundred patients of craniocerebral trauma with positive findings on CT were included in the present study.

Male population dominated the study with 71%of patients being male and 29%being female. (Table 1)

Table 1: Sex wise distribution in cranio-cerebral trauma.

Sex	No. of cases	Percentage
Male	71	71%
Female	29	29%
Total	100	100%

In the present study, the peak incidence of head injury in males occurred in the age group of 31- 40 in males which was 28.1% and in the age group of 21-30 in females which was 24.1%. The least no of head trauma were seen in the age group of above 61 in male which was only 4.2% and in the age group of 51-60 in female which was 6.8%. (Table 2)

Table 2: Sex and age wise distribution in cranio-cerebral trauma.

Age Group(years)	Male		Female		Total
	No.	Percentage	No.	Percentage	
0-10	5	7.04%	2	6.8%	7
11-20	9	12.6%	3	10.3%	12
21-30	10	14.08%	7	24.1%	17
31-40	20	28.1%	6	20.6%	26
41-50	18	25.3%	5	17.2%	23
51-60	6	8.4%	2	6.8%	8
Above 61	3	4.2%	4	13.7%	7
Total	71		29		100

According to the present study it was seen that road traffic accident is the most common mode of trauma as we came across 63 case of head injury due to road traffic accidents which is 63% of the total case. It was followed by fall which was about 27%. And the last was assault which was 10%.(Table 3)

Table 3: Incidence of different modes of injury

Type of Injury	No. of cases	Percentage
Road traffic accident	63	63%
Fall	27	27%
Assault	10	10%
Total	100	100%

Linear fractures were most common type of fracture we came across in the present study. It comprised of 53% of the patients who presented with fractures. After linear fractures, skull base fracture (26.6%) was found to be common. (Table 4)

Table 4: Incidence of the types of fractures as observed on CT scan.

Type of fracture	No of cases	Percentage
Linear	41	53%
Depressed	15	20%
Skull base	22	26.6%
Total	78	100%

Contusion was seen as the most common type of injury making 49% of patients in this study. Different types of hematoma also were pretty common as seen in this study. Subdural hematoma was found in 43%, extradural hematoma in 40%, intracerebral hemorrhage in 39% and subarachnoid hemorrhage in 33% of the patients. Intraventricular hemorrhage was uncommon seen in only 9% of the patients however the outcome of patients presenting with it was poor. Fractures were also very common type of injury seen with 78% of the patient presenting with some or the other type of fractures. Pneumocephalous was an additional finding in patients presenting with fracture. Cerebral edema was also quiet common occurring in 36% of the patients. Midline shift was the most common secondary effect due to pressure effect of various hematoma seen in around 37% of the patients.(Table 5)

Table 5 : Incidence of various lesions observed on CT scan

Lesions	Cases	Percentage
Contusions	49	49%
Cerebral edema	36	36%
Subdural hematoma(SDH)	43	43%
Extradural hematoma(EDH)	40	40%
Intracerebral hematoma	39	39%
Subarachanoid hemorrhage	33	33%
Intraventricular hemorrhage	9	9%
Midline shift	37	37%
Pneumocephalus	21	21%
Fracture	78	78%

According to the present study, intracerebral hematoma (53%) was the most common lesion noted in patients who expired followed by subdural hemorrhage. Extradural hemorrhage (6.3%) was the least common lesion noted in these patients.(Table 6)

Table 6: Incidence of various hemorrhages in patients who expired

Hematomas	Percentage
EDH	6.3%
SDH	42%
ICH	53%

Discussion

Road traffic accidents and assault over the past decades have increased exponentially and head trauma forms the major burden out of those cases.

In this study, 100 patients of head injury with positive computed tomography findings were included. In this study males with head injury were more prominent as compared to female that is 79 males and 21 females. Other studies reported an incidence of 59%in Kalsbeck et al[6], 79% in Zimmermann et al[5] and 65% in James F Holmes et al[7]. This male predominance is attributed to more outdoor activity and traveling by male. (Table 7)

Table 7: Comparative study of sex distribution

Authors	Male (%)	Female (%)
Kalsbeck et al	59	41
Zimmermann et al	79	21
James F Holmes et al	65	35
Present study	71	29

The commonest mode of injury was found to be road traffic accidents and it accounted for 63% of the 100 patients included in the this study. This may be due to increased vehicles on the road due to increasing population. Masih Saboori et al[8] and Igun G O[9] had also reported road traffic accidents to be the commonest mode of injury in their studies being 88.2% and 72% respectively. (Table 8)

Table 8: Comparative study of road traffic accidents

Author	Road traffic Accidents (%)
Masih Saboori et al	88.2
Igun GO	72
Present study	63

Contusions were found to be forming the bulk of this study as it was seen in 49% of the cases. Contusions are generally superficial and develop at the point or around the point of impact. It shows heterodense lesion of HU value 40-70 with irregular margins which are hypodense due to surrounding edema which extends across vascular territories and necrosis. This was accompanied with tiny hemorrhages in the surrounding area. Peripheral contusions are sometime difficult to differentiate from small extra cerebral collections. This can be differentiated as contusions are always accompanied by edema whereas collections are not.

Out of 49% of the cases presenting with contusion in this study, 8 cases (16.3%) where non hemorrhagic while the others (85.7%) presented with accompanying hemorrhage. Fractures were a common feature associated with 41 patients having fractures along with contusion in the present study.

Fractures are easy to detect on computed tomography by viewing it in bone window. There were 78 cases presenting with fractures in present study out of which we had 41 cases of linear, 15 cases of depressed and 22 cases of skull base fractures were observed.

Pneumocephalus was seen accompanying 21 of these cases with fractures which are about 26% of cases. It is easy to diagnose pneumocephalus as air is hypodense on CT scan and has a HU value of -100 and below. Skull radiograph has a little role to play in modern day imaging as fractures can be missed on it and CT scanogram reduces it need as well.

Cerebral edema is also seen in a no of cases of head trauma and is a common manifestation. In the present study we came across 36% of cases with cerebral edema. It is diagnosed by the effacement of the gyri and sulci on CT scan in axial sections with compression of lateral ventricles.

Subdural hematoma was the commonest hemorrhage seen in this study however intracerebral hemorrhage was more common amongst the people who expired due to cranio-cerebral trauma.

Subdural hematoma was diagnosed in 43 cases (43%) in the present study out of which 42% expired. In a previous study by Cooper et al[10], he stated that

mortality due to subdural hematoma was between 35% to 50%. As subdural hematoma is caused by high velocity injury, it was associated with worst outcomes. Intracerebral hematoma was seen in 39 case (39%) out of which 53% expired. More deaths in patients with intracerebral hemorrhage can be attributed to high velocity impact along with midline shift caused by pressure effect of collected hemorrhage. Intracerebral hemorrhage is seen as hyperdense lesion with an HU value ranging between 60-90HU.

Extradural hematoma was seen 40 cases (40%) with only 6.3% of those patients losing their life. In a previous study conducted by Bricolo A.P ET al[11] and Smith HK ET al[12], they stated that extradural hematoma leading to mortality was seen only in 5% of the cases and it was generally due to large extradural hematomas compressing the brain parenchyma. 90% of the cases with extradural hematoma were accompanied with fractures. Intraventricular hemorrhage was seen in the least no if cases in this study with only 9 cases (9%) presenting with it. Intraventricular hemorrhage is usually uncommon with trauma and if present reflects severe injury and grave prognosis.

Herniation and midline shift can occur as a secondary effect of head injury. Brain herniation is due to rise in intracranial pressure. The three type of herniations are subfalcine, transtentorial and uncal. In this study there were 6 patients who had herniation secondary to intracranial pressure after head injury. Midline shift was noted in 37 patients in this study .A midline shift of less than 5mm was seen with good recovery and no neurological deficit. However with a midline shift of more than 5mm had poor outcome with most patients requiring neurological intervention.

In this study, the age between 31 to 50 years formed the major bulk of the patients with 49 patients being from this age group. This signifies that head injury is seen more often in economically productive age group. Only 7 patients of age less than 10years were seen to have had head trauma in this study.

Conclusion

Cranio-cerebral injury is major cause of mortality and morbidity and it is more common than any other neurological condition. It is the most common cause of death in patients of age less than 35 and the cause of neurological disability in more than 60% below the age of 50.

Imaging technique like computed tomography is essential in early diagnosis and proper management of the patient presenting with head trauma. Correct diagnosis is equally important in the outcome of patient with head trauma. Computed tomography has become a routine to rule out head injury in modern day as it is simple, highly effective, inexpensive and less time taking modality to evaluate patients with head injury. Radiation is the only disadvantage that it imposes but the benefit out weights the disadvantages. the other advantages are that patient doesn't need any patient preparation and it is a non-invasive imaging technique.

Computed tomography helps in planning of surgery and can comment on prognosis of the patient with significant traumatic injuries which include extradural hematoma, intracerebral hemorrhage causing secondary effects like midline shift and herniation. It also helps in accurate localization of injury site in cases with trauma to the head.

Thus to conclude, computed tomography should be the first imaging investigation of choice in patients presenting with head trauma as it forms the cornerstone in rapid and effective diagnosis.

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