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Role of computer tomography in evaluation and diagnosis in brain trauma

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Abstract
Background: Head injury is considered as a major health problem that is a frequent cause of death disability. CT scan remains essential for detecting lesions that require neurosurgical intervention as well as those that require in hospital observation and medical management.
Objectives: The aim of the study is to evaluate the computed tomography finding in patients sustaining traumatic brain injury and to emphasize the importance of computed tomography scan in head injury.
Methodology: The study was conducted for the period of four months. It comprised a total number of hundred patients resenting to the emergency room(ER) with head injury and were evaluated by CT scan of head using Philips Ingenuity 128 slice CT machine installed in NIMS Hospital.
Result: In this study patient with traumatic brain injury has investigated by CT scan head to rule out any head injury. The total number of 170 patients are investigated among them all underwent for CT brain. Patients are distributed according to age, gender, type of trauma and finding on CT scan. In age distribution between 1-15 yrs are 11%, 16-40 yrs are 51%, 41-60 yrs are 23% and above 61 years are 15%. Out of one hundred seventy patients 71% male and 29% female. Total number of cases are observed among them RTA are 76%, FALL are 14% and ASSAULT 10%. Which shows normal finding 56%, fracture 24%, haemorrhage 15%, and contusions 5%.

Keywords: head, brain, injury, Ct, trauma, radiology

Introduction

Traumatic brain injury (TBI) is a critical public health problem. It represents one of the most important medical surgical pathology worldwide. The occurrence indicate that this kind of injury cause a large number of deaths and impairments leading to permanent disabilities, that is why is necessary to triage the patient and identify the injury extension. Imaging has become a significant tool not only in the diagnosis of patients with TBI, but also as a patient outcome predictor. This review of literature provides evidence of the current states of TBI imaging as to what is considered to be the indications, benefits and limitations of computer tomography (CT). Traumatic brain injury (TBI) is defined as any structural skull traumatic injury with alterations of cerebral physiology as a result of an external force either in the form of mechanical energy, chemical, electrical or thermal heating. Head injury is a common feature of major trauma and patients with a moderate or severe head injury have a higher mortality as well as a higher morbidity, with victims often being left with a permanent neurological disability. The percentage of major trauma patients who have sustained a serious head injury has remained consistent since 2011-12, and accounted for 6.8% of hospitalized major trauma patients in 2015-16. The mechanism of injury, however, has changed for this group of patients. Motor vehicle crashes accounted for 27.6% of severe head injuries in 2015−16 compared with 20.9% in 2011-12.

The decrease in severe head injuries could be attributed to improvements in injury prevention including reduced speed limits, speed reduction campaigns and improved car design such as airbags and anti-lock braking systems. Pedestrians and pedal-cyclists comprised 17.6% % of severe head injury cases in 2015−16 compared with 19.1% % in 2011-12. In contrast the percentage of major trauma patients with a severe head injury sustained by elderly patients in a low-fall mechanism has increased from 17.3% in 2011−12 and to 15.8% in 2015−16. Services In patients with multi-system injuries, the head is the most frequently injured part of the body. Many incidents of traumatic brain injury (TBI) occur in rural areas where access to medical limited and a delay in definitive care may occur. It is important for health professionals working in these isolated areas to be aware of how to manage acute patients to prevent any secondary injury. Patients presenting with TBI can be a challenging group to deal with. They are often confused and combative, which can make assessments and even the most basic clinical tasks difficult and time consuming. TBI is generally classified according to the Glasgow Coma Scale (GCS). A GCS score of 13–15 is considered a mild injury; 9–12 is considered a moderate injury, and 8 or less as a 13 severe TBI. The GCS is universally accepted as a tool for TBI classification because of its simplicity, reproducibility and predictive value for overall prognosis. However, its use may be limited by confounding factors such as intoxication and ongoing medical treatment such as sedation and/or paralysis.

There are two types of brain injury: primary and secondary.

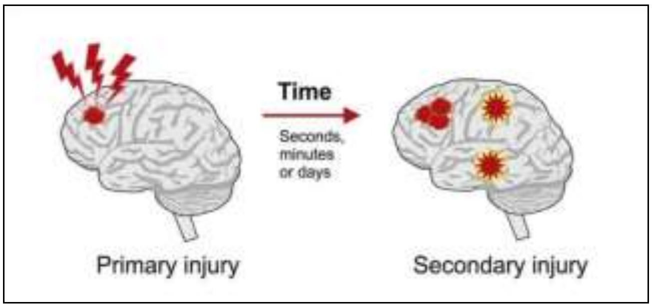

Fig 1

Primary injury: occurs at the moment of the traumatic incident and reflects the mechanical events in disruption of brain tissue that is not preventable. Common mechanisms include direct impact, rapid acceleration/deceleration, and penetrating injury and blast waves.

Secondary injury: can occur minutes, hours, days or even weeks after the initial injury and the damage can be averted or lessened by appropriate clinical management. Causes of secondary brain injury include hematoma, contusion; diffuse brain swelling, systemic shock and intracranial infection. Hypoxia and/or hypotension in a moderate to severely injured brain, even briefly, can have a harmful impact on outcome and survival. A single systolic blood pressure (SBP) of under 90 mmHg is associated with a 150% increase in mortality.4Action to prevent secondary brain injury must commence at the scene of the accident and continue through all stages of care.[4] It is important to remember that this is not about complex, specialist care but about applying basic principles in support of the injured brain. A patient who has suffered a severe head injury should be assessed and managed as a major trauma patient. Patients with TBI should be assumed to have a spinal fracture until proven otherwise and appropriate precautions taken to immobilize the spine until injury can be excluded. The aims of treatment are to prevent further brain injury, treat the underlying condition, minimize symptoms and optimize neurological and functional recovery.

Hematoma: A hematoma is a collection, or clotting, of blood outside the blood vessels.

Hemorrhage: A hemorrhage is uncontrolled bleeding.

Concussion: A concussion occurs when the impact on the head is severe enough to cause brain injury.

Edema: Any brain injury can lead to edema, or swelling. Many injuries cause swelling of the surrounding tissues, but it's more serious when it occurs in your brain.

Skull fracture: Unlike most bones in your body, your skull doesn't have bone marrow. This makes the skull very strong and difficult to break. A broken skull is unable to absorb the impact of a blow, making it more likely that there'll also be damage to your brain

Diffuse axonal injury: A diffuse axonal injury (sheer injury) is an injury to the brain that doesn't cause bleeding but does damage the brain cells. The damage to the brain cells results in them not being able to function. It can also result in swelling, causing more damage.

A traumatic brain injury (TBI) is defined as a blow to the head or a penetrating head injury that disrupts the normal function of the brain. TBI can result when the head suddenly and violently hits an object or when an object pierces the skull and enters brain tissue. Symptoms of a TBI can be mild, moderate or severe, depending on the extent of damage to the brain. Mild cases may result in a brief change in mental state or consciousness, while severe cases may result in extended periods of unconsciousness, coma or even death.

Epidural hematoma: It is when bleeding occurs between the tough outer membrane covering the brain (Dura mater), and the skull. Often there is loss of consciousness following a head injury, a brief regaining of consciousness, and then loss of consciousness again.

Intracerebral hemorrhage (ICH): It is caused by bleeding within the brain tissue itself — a life-threatening type of stroke. A stroke occurs when the brain is deprived of oxygen and blood supply. ICH is most commonly caused by hypertension, arteriovenous malformations, or head trauma.

Subdural hematoma: Is a collection of blood outside the brain. Subdural hematomas are usually caused by severe head injuries. The bleeding and increased pressure on the brain from subdural hematoma can be life-threatening. Some subdural hematomas stop and resolve spontaneously; others require surgical drainage.

Subarachnoid hemorrhage (SAH): Is bleeding into the subarachnoid space—the area between the arachnoids membrane and the pain mater surrounding the brain. Symptoms may include a severe headache of rapid onset, vomiting, decreased level of consciousness, fever, and sometimes seizures.

Stroke: Happens when blood flow to a part of your brain is cut off. Without the oxygen in blood, brain cells start dying within minutes.

The number of people with Traumatic Brain Injury (TBI) is difficult to assess accurately but is much larger than most people would expect. According to the CDC (United States Centers for Disease Control and Prevention), there are approximately 1.5 million people in the U.S. who suffer from a traumatic brain injury each year. 50,000 people die from TBI each year and 85,000 people suffer long term disabilities. In the U.S., more than 5.3 million people live with disabilities caused by TBI. Patients admitted to a hospital for TBI are included in this count, while those treated in an emergency room or doctor's office are not counted. The causes of TBI are diverse. The top three causes are: car accident, firearms and falls. Firearm injuries are often fatal: 9 out of 10 people die from their injuries. Young adults and the elderly are the age groups at highest risk for TBI. Along with a traumatic brain injury, persons are also susceptible to spinal cord injuries which are another type of traumatic injury that can result out of vehicle crashes, firearms and falls. Prevention of TBI is the best approach since there is no cure.

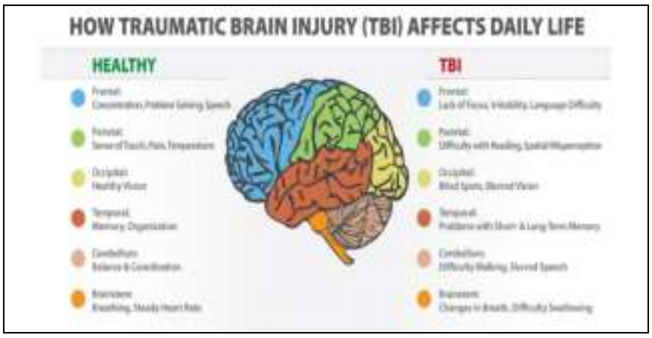

Fig 2

Aims and Objectives

The aim of the study of brain trauma is to evaluate the computer tomography findings the patient's traumatic brain injury and to emphasize the importance of computer tomography scan in head injury.

- To determine the sensitivity and specificity of computed tomography in Evaluation of brain trauma.
- To determine the discrete regions of trauma in a brain injury.
- To determine the various pathological finding in TBI.

Materials and Methods

CT is the workhorse of imaging in TBI, especially in the acute setting, and is able to identify the majority of injuries at the time of presentation. It is common for multiple injuries to be present simultaneously, such as the combination of cerebral contusions and traumatic subarachnoid, subdural and extradural hemorrhage as well as skull fractures and facial fractures these are discussed separately.

Research Methodology: A descriptive study which involves role of computer tomography in traumatic brain injury with proper patient preparation and positioning in radio-diagnosis department of the NIMS UNIVERSITY HOSPITAL, Jaipur, where the study was conducted.

Research Design: Research design is the way in which how the study is intended to be done. The design of this study was a retrospective, descriptive study. A retrospective cross-sectional design will be used.

Source of Data: A secondary source of data will use for the study. It will be obtained from the radiology record book of the CT unit, radiology department at NIMS Hospital

Study population: All records with requests for CT brain trauma scan with an indication of RTA. A population study will be conducted.

Inclusion criteria: Clinically suspected cases of brain trauma.

Instrument of data collection: 128 CT slice Philips genuity machine of the radiology Department.

Method of data collection

- A data capture sheet will be used.
- Data collected will be analyzed thus:
- Subjects were classified according to age group and sex -data will be presented in charts tables.
- Data will be analyzed using descriptive statistical tools; frequencies, mean and percentages.

Standard Imaging Protocol:

Brain perfusion Protocol

1. **Scout**: dual 275-300mm
2. **Breathe hold** – None

2. **Head w/o:**5mm x 5mm
3. Perfusion (injection) 5mm x 10mm x 30(4cm of coverage on 64 & 128 slice) 5mm X 10mm X 30(8cm of coverage on256 slice)
4. **IV access**: 18g to 20g
5. **Procedural preparation**: None
6. **Contrast:** 40ml omnipaque IV
7. **Contrast rate**: 5.0 cc per sec.

Routine Axial head protocol

1. Scout: lateral (length 350)
2. Breathe hold: none
3. Axial: 5mm x 5mm
4. Recon: 5mm x 5mm Bone
5. Fov :250
6. Scan length: angled to base of skull through top of skull.
7. Contrast : Omni 300/100ml
8. Rate: 1-2cc per sec scan after 5min.

Observation and Results

Result

In this study patient with traumatic brain injury has investigated by CT scan head to rule out any head injury. The total number of 170 patients are investigated among them all underwent for CT brain. Patients are distributed according to age, gender, type of trauma and finding on CT scan. In age distribution between 1-15 yrs are 11%, 16-40 yrs are 51%, 41-60 yrs are 23% and above 61 years are 15%. Out of one hundred seventy patients 71% male and 29% female. Total number of cases are observed among them RTA are 76%, FALL are 14% and ASSAULT 10% and it shows normal finding 56%, fracture 24%, haemorrhage 15%, and contusions 5%.

Table 1: Age Wise Distribution of Cases

Age group	No of cases	% of cases
1-15 YRS	19	11 %
16-40 YRS	86	51%
41-60 YRS	39	23 %
61 YRS & Above	26	15 %
Total	170	100 %

Table 2: Gender Wise Distribution of Cases

Sex	No of cases	% of cases
Male	120	71%
Female	50	29 %
Total	170	100 %

Table 3: Distribution Cases of TBI Total Cases in CT

Case	No. of case observation	% of cases
RTA	129	76 %
Fall	24	14 %
Assault	17	10 %
Total	170	100 %

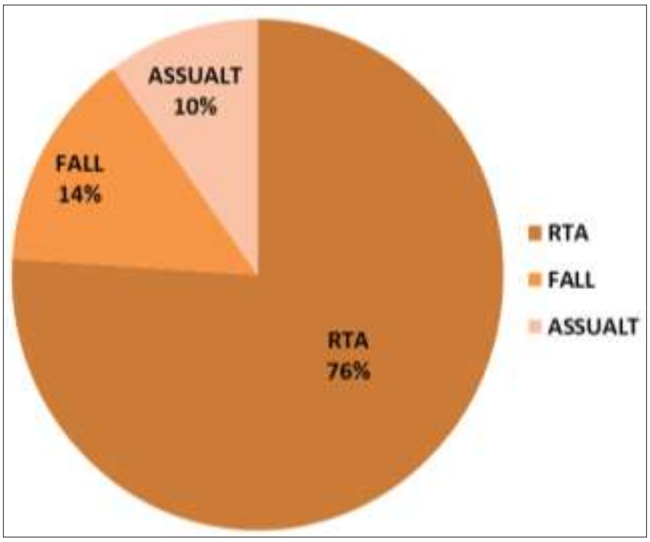

Fig 3

Table 4: Distribution of Cases & Corelation with CT Finding Total TBI Cases

Cases	No. Of case observevations	% of case
Fracture	41	24%
Haemorrhage	25	15%
Contusions	09	05%
Normal	95	56%
Total	150	100%

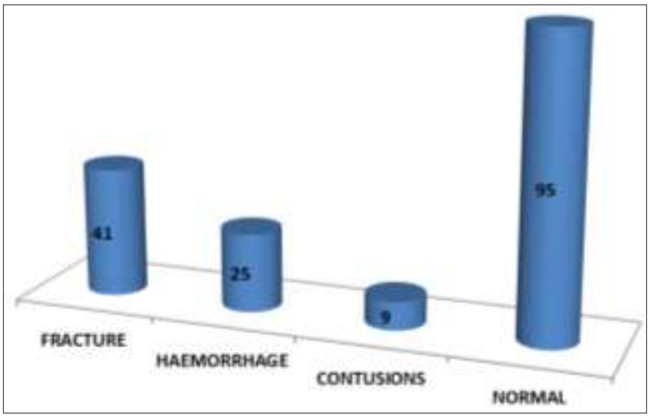

Fig 4

Discussion

The study was carried at radiology department of NIMS hospital, Shobha Nagar, Jaipur, and Rajasthan from Jan-2019 March 2019. The studies include role of computer Tomography TBI patient. Majority of the TBI patients were male as compare to female.

Distribution According to Number of Case Observe

In our study it is found 24% of fracture 15% followed by hemorrhage, contusion 05% and 56% normal.

Distribution of Age & Gender Wise

In our study conducted the age wise distribution of graph in age group, number of cases, and % of cases. Age wise 1-15yrs (19) cases and percentage of cases is (11%). In 16-40yrs (86) cases and percentage of cases (51%). In 41-60yrs (39) cases and percentage of cases (23%). In 61yrs and above (26) and (15%) percentage of cases. In gender wise study conducted (120) cases & (71%) percentage male and (50) cases & (29%) female.

Study Limitations

The major limitations of our study was carried at Radiology department of NIMS hospital, shobha Nagar,Jaipur, Rajasthan from Jan 2019-March 2019, significant results can be obtained by increasing the study population.

Conclusion

We conclude that the high prevalence of head trauma related CT findings justify the use of CT in head trauma. However, it should be performed only when clinically necessary which helps to reduce cost and avoids unnecessary exposure to radiation. However due to relatively small sample size and various post treatment follow up in this series, more experience shall be needed to establish the accuracy of various 52 imaging trauma patient correlating various fracture with alteration of configuration which may be used in monitoring treatment efficacy.

Summary

The topic includes a complete idea about technical aspects & role of CT in TBI and its protocols related to patient preparation and patient care. TBI patients always required a need full attention. Technicians are often responsible for the total care of TBI patient while performing diagnostic imaging procedure. 53 In TBI radiographer must be well versed in taking vital signs and knowing normal ranges and must be competent in cardiopulmonary resuscitation, administration of oxygen, and dealing with all type of medical emergencies. TBI patient require special attention to patient care. Careful precautions must be taken to ensure that performance of the imaging procedure. This paper is a collection of this entire topic which is useful in any time. It is arranged in comprehensive and order manner so that those who read will understand easily it and remember while doing "role of computer tomography in traumatic brain injury.

- **Identification of name and age must be present on or associated with all images.**
- **Proper patient positioning**
- **Selection of factor, protocol and techniques.**
- **Parameter selection.**
- **Image display.**
- **Standard precaution.**
- **Evaluation of requisition of medical record.**

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