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Role of Computed Tomography in Traumatic Brain Injuries

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Introduction

- A traumatic brain injury (TBI) is a cranial injury caused by a forceful blow or jolt to the head
- Can also be caused by a foreign object piercing the skull and entering through the brain

(National Institute of Neurological Disorders and Stroke, 2024)

- CT is the imaging modality of choice when assessing for a TBI
- The use of CT in evaluating a TBI is essential for early intervention and higher survival outcomes (Kheirbek et al., 2021)

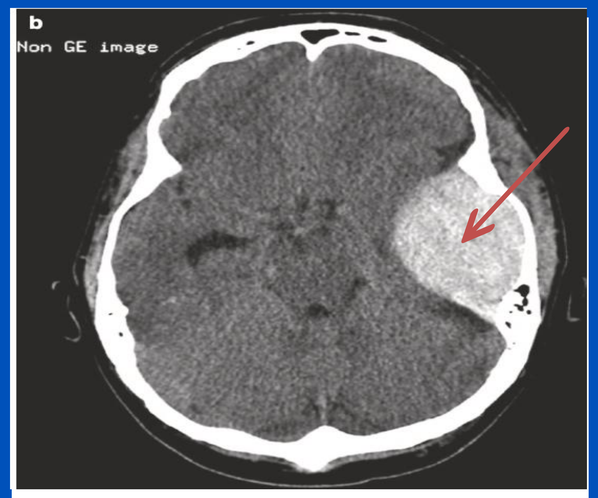
Why Choose CT for TBIs?

- CT allows physicians to quickly view images of the brain in high-resolution cross-sectional slices
- CT imaging of the brain allows for early identification and intervention of intracranial trauma
- Provides physicians with an exact representation of injury for operative decision-making

Different Intracranial Traumas

- **Scalp Lesions**
- Common in victims of head trauma, indicates where the point of impact occurred
- CT allows the radiologist to visualize blood, subcutaneous fatty tissue, and cerebrospinal fluid from scalp lesions
- **Skull Fractures**
- Classified by shape of fracture (linear, comminuted, stellate), fractures can be depressed, non-depressed, or open
- **Epidural Hematoma**
- Pooling of blood between the skull and the dura mater, often associated with skull fractures and lacerations of blood vessels, CT is used to visualize fractures as well as hemorrhages
- **Subdural Hematoma**
- Extracerebral pooling of blood between the dura mater and arachnoid membrane
- Can cross between multiple cranial sutures

(Parizel & Phillips, 2020)



Acute left arterial epidural hematoma

(Parizel & Phillips, 2020, p. 81)

Penetrating vs Non-penetrating TBI

- **Penetrating**
- Also referred to as an “open TBI”, occurs when a foreign object pierces the skull and enters through the brain tissue, causing intracranial trauma
- Examples of sources that can cause a penetrating TBI include bullets, shrapnel, and bone fragments
- **Non-penetrating**
- Also known as a “closed head injury” or “blunt TBI”, caused by a force great enough to make the brain shake against the skull
- A few examples of accidents that result in non-penetrating TBIs include falls, motor vehicle accidents, and sports injuries
- Some traumatic brain events can cause both penetrating and non-penetrating injuries

(National Institute of Neurological Disorders and Stroke, 2024)

Signs and Symptoms of TBI

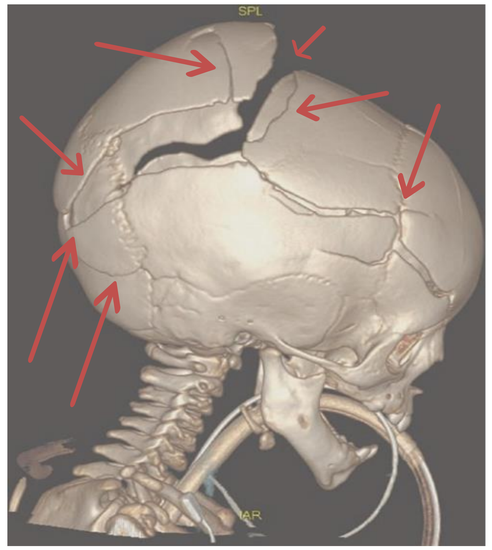
- **Neurobehavioral**
- Depression, anxiety, cognitive difficulties, irritability, and poor sleep (Lange et al., 2019)
- **Physical**
- Headache, seizures, blurred vision, unequal pupil size/dilation, fluid drainage from nose or ears, nausea, vomiting, sensitivity to light

(National Institute of Neurological Disorders and Stroke, 2024)

Grades of TBI

- **Mild TBI**
- First level of traumatic brain injuries, considered least severe
- Grade of TBI is often referred to as a concussion
- Mild TBIs can cause confusion in patients for roughly 24 hours, as well as attention and memory problems
- **Moderate TBI**
- Considered the second level of traumatic brain injuries, symptoms are mildly severe
- This grade of TBI can potentially result in loss of consciousness for up to 30 minutes
- Confusion lasts for roughly seven days
- **Severe TBI**
- Third level of traumatic brain injury, considered to be the most severe
- This grade of TBI can cause loss of consciousness for up to an entire day
- Severe TBIS have the potential to be a fatal or life-threatening condition

(Jha & Ghewade, 2022)



(arrows pointing to skull fractures)

Volume rendering technique (VRT), obtained from a 3D CT-scan data set, reveals multiple skull fractures and displaced bone fragments.(Parizel & Phillips, 2020, p. 78)

Treatment

- **Medications**
- Diuretics are often prescribed to to lessen the amount of fluid collected in the brain tissue
- Anticonvulsants are prescribed, if necessary, to prevent seizures as well as analgesics to manage pain
- **Surgery**
- Open and closed brain surgery are two options to remove damaged brain matter resulting from a traumatic brain injury
- Closed surgery is preferred because it prevents nerve damage as opposed to open brain surgery
- **Physical Therapy**
- Used for rehabilitation, improves the circulation of blood to the brain reducng inflammation
- Increases levels of oxygen delivered to brain
- **Acupuncture**
- Increases blood flow to the brain through muscle contractions
- Can help significantly reduce the amount of anxiety, depression, and insomnia a patient may suffer from due to injury

(Jha & Ghewade, 2022)

Conclusion

- Overall, CT's role in assessing traumatic brain injuries is essential for patient diagnosis as well as planning for interventional cranial procedures.
- CT allows radiologists to interpret cross-sectional images of both the brain and skull to determine the type of injury, where it is located anatomically, and the severity of the injury so physicians and surgeons can coordinate how to plan and achieve the best possible outcome for patient recovery.
- CT is the modality of choice because of its ability to produce images within seconds in a trauma unit as opposed to other modalities, such as MRI.
- CT ultimately plays a key role in saving a patient’s life after a traumatic brain injury has occurred.

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