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Clinical Picture

Role of Computed Tomography in Head Injury

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Abstract: The aim of CT imaging is to detect treatable lesions before secondary neurological damage occurs. CT plays a primary role in the setting of head trauma, allowing accurate detection of lesions requiring immediate neurosurgical treatment. CT is also accurate in detecting secondary injuries and is therefore essential in follow-up. This review discusses the main characteristics of primary and secondary brain injuries.

Keywords: Computed tomography, Trauma, Traumatic brain injury (TBI), Brain, Haemorrhage, Subdural, Imaging, Haematoma, Bleed, Subarachnoid.

INTRODUCTION

A 55 year old male presented with a history of head injury from a road traffic accident. After consulting in the casualty, he was brought to the radiology department to take CT of head.

METHODS

On physical examination his scalp was lacerated. He had bleeding from left ear and epistaxis. He had one episode of vomiting and was in loss of consciousness. He had an episode of seizure. He had eye opening to pain, extension response to pain and made incomprehensible sounds. His GCS was 6/15. CT of head was done to evaluate further and plan the line of management.

Fig 1

Fig 2

Multiple well defined hyperdensities in right frontal lobe, bilateral temporal lobes and left parietal lobe. Bilateral frontal subdural hyperdense hemorrhages (Fig 1). Left subdural collection of mixed density in keeping with acute on subacute subdural hemorrhag. Subarachnoid blood also present (Fig 2).

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Fig 3

Effacement of right lateral ventricle (adjacent to largest intraparenchymal bleed). Impression of frontal subfalcine displacement but other midline structures in normal position. Basal cisterns normal.

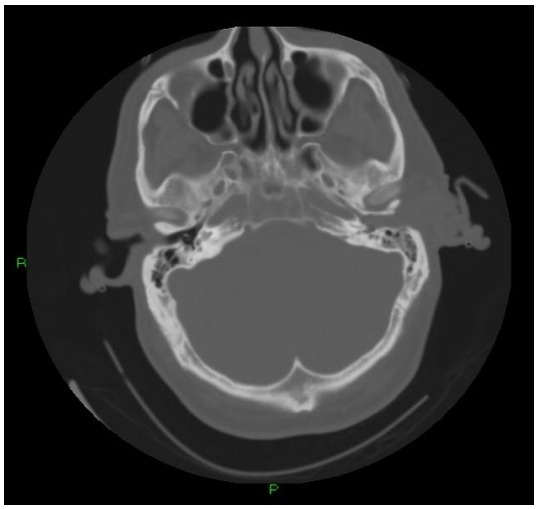

Fig 4

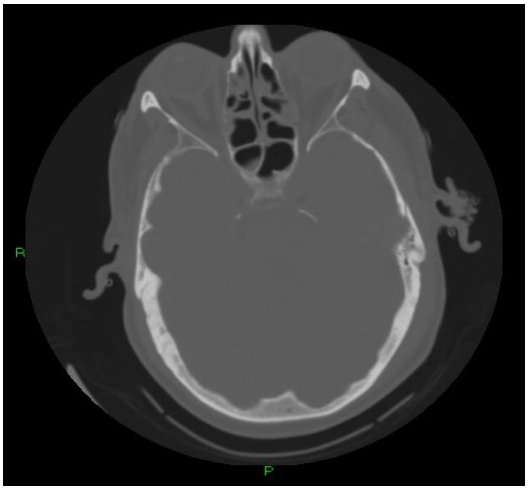

Fig 5

Mixed transverse and longitudinal left temporal bone fracture involving mastoid and external auditory canal. Hyperdense fluid in mastoid air spaces, middle ear and external ear canal in keeping with blood. No involvement of venous sinuses or jugular system (Fig 4 and Fig 5).

DISCUSSION

Traumatic brain injury is defined as damage to the brain resulting from external mechanical force, such as rapid acceleration or deceleration impact, blast waves, or penetration by a projectile, leading to temporary or permanent impairment of brain function. Traumatic brain injury (TBI) has a dramatic impact on the health of the nation: it accounts for 15–20% of deaths in people aged 5–35 yr old, and is responsible for 1% of all adult deaths. TBI is a major cause of death and disability worldwide, especially in children and young adults. Males sustain traumatic brain injuries more frequently than do females. The overall mortality in severe TBI, defined as a post-resuscitation Glasgow Coma Score (GCS) ≤8, is 23%. In addition to the high mortality, approximately 60% of survivors have significant ongoing deficits including cognitive competency, major activity, and leisure and recreation. This has a severe financial, emotional, and social impact on survivors left with lifelong disability and on their families. It is well established that the major determinant of outcome from TBI is the severity of the primary injury, which is irreversible. However, secondary injury, primarily cerebral ischaemia, occurring in the post-injury phase, may be due to intracranial hypertension, systemic hypotension, hypoxia, hyperpyrexia, hypocapnia and hypoglycaemia, all of which have been shown to independently worsen survival after TBI. One type of focal injury, cerebral laceration, occurs when the tissue is cut or torn. Such tearing is common in orbito frontal cortex in particular, because of bony protrusions on the interior skull ridge above the eyes. In a similar injury, cerebral contusion, blood is mixed among tissue. In contrast, intracranial hemorrhage involves bleeding that is not mixed with tissue. Hematomas, also focal lesions, are collections of blood in or around the brain that can result from hemorrhage. Intra cerebral hemorrhage, with bleeding in the brain tissue itself, is an intra-axial lesion. Extra-axial lesions include epidural hematoma, subdural hematoma, subarachnoid hemorrhage, and intra - ventricular hemorrhage. Epidural hematoma involves bleeding into the area between the skull and the dura mater, the outermost of the three membranes surrounding the brain. In subdural hematoma, bleeding occurs between the dura and the arachnoid mater. Subarachnoid hemorrhage involves bleeding into the space between the arachnoid membrane and the pia mater. Intraventricular hemorrhage occurs when there is bleeding in the ventricles. Some of the current imaging techniques used for diagnosis and treatment include CT scans and MRIs. Besides the diagnostic tools clinical examination and use of Glasgow coma scale help to diagnose and grade the severity of the injury. The preferred radiologic test in the emergency setting is computed tomography (CT): it is quick, accurate, and

widely available. Follow up CT scans may be performed later to determine whether the injury has progressed. Magnetic resonance imaging (MRI) can show more detail than CT, and can add information about expected outcome in the long term. It is more useful than CT for detecting injury characteristics such as diffuse axonal injury in the longer term. However, MRI is not used in the emergency setting for reasons including its relative inefficacy in detecting bleeds and fractures, its lengthy acquisition of images, the inaccessibility of the patient in the machine, and its incompatibility with metal items used in emergency care. A variant of MRI since 2012 is High definition fiber tracking (HDFT). Other techniques may be used to confirm a particular diagnosis. X-rays are still used for head trauma, but evidence suggests they are not useful; head injuries are either so mild that they do not need imaging or severe enough to merit the more accurate CT. Angiography may be used to detect blood vessel pathology when risk factors such as penetrating head trauma are involved. Functional imaging can measure cerebral blood flow or metabolism, inferring neuronal activity in specific regions and potentially helping to predict outcome. Electroencephalography and transcranial doppler may also be used. The most sensitive physical measure to date is the quantitative EEG which has documented an 80% to 100% ability in discriminating between normals and traumatic brain injured subjects.

CONCLUSION

Imaging plays a primary role in the management of patients with TBI. CT is the imaging technique of choice in the setting of acute head trauma, allowing accurate detection, and thereby treatment of extra- and intra-axial haemorrhage, hydrocephalus, mass effect and vascular injuries. CT is also accurate in detecting secondary injuries and is therefore essential in follow-up. In the acute setting, MRI is reserved to patients with severe neurological impairment despite the absence of structural brain damage on CT. MRI is the imaging modality of choice in subacute and chronic TBI and appears to be more reliable in CT in predicting outcome.

Compliance with ethical standards

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Ethical approval (animals): This article does not contain any studies with animals performed by any of the author(s).

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent: Informed consent was obtained from individual participant included in the study.

Authors' contributions

1. **Aravind (AR)**
2. **Prabakaran(PK)**

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work – (AR, PK)
- Drafting the work or revising it critically for important intellectual content (AR, PK)
- Final approval of the version to be published - (AR, PK)
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - (AR, PK)

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