Traumatic intracranial bleeds

Traumatic brain injury (TBI) is a common and often devastating clinical condition. Prompt and appropriate management of TBI sequelae can significantly alter prognosis, especially in the first 48 hours following injury.[1] Neuroimaging is important in identifying cranial and cerebral damage, assessing the severity of injuries, and guiding surgical treatment.[2] In the first 24 hours following injury, CT is the imaging modality of choice. This is due to its availability, cost effectiveness, short imaging time and relative ease to perform on patients reliant on ventilatory support.[3] This article discusses intracranial bleeds and their appearance on CT scan.

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Images courtesy of St Vincent's Medical Center, New York.

Epidural haematomas

Epidural haematomas are collections of arterial blood between the dura and inner table of the skull.[4] The most common cause of an epidural haematoma is a fracture of the temporal bone in the area of the middle meningeal artery. The haemorrhage results from a tear of the artery, but less commonly may be due to disruption of the venous structures along the temporal bone, such as the peridural venous plexus. Initially, patients experience a lucid interval; however, these patients must be observed carefully as they may deteriorate and lose consciousness as intracranial pressure rises. On a CT scan, the acute haematoma classically appears as a high-density (white) extra-axial mass between the brain and calvarium, with a biconvex (lenticular) shape.[5] Epidural haematomas are limited by suture lines, but cross the midline. They are most common in the temporoparietal region. A CT scan is also used to diagnose a temporal bone fracture, which is usually adjacent to the site of the haematoma. Treatment of an epidural haematoma will largely depend on the size, and the presence or absence of midline shift or brain herniation. Treatment options include prompt transfer to a neurosurgical unit for clot evacuation, and may involve blood vessel ligation.

Subdural haematomas

Subdural haematomas are the most common type of traumatic intracranial bleed, and are located between the dura and the arachnoid. They are the result of shearing of bridging veins, and are therefore venous bleeds. In young patients, the most common cause of a subdural haematoma is a motor vehicle accident, whereas in the elderly they are usually due to a fall. Subdural haematomas progress slowly, and only one-third of patients present with fluctuations in their level of consciousness. Patients may also complain of intellectual slowness, tiredness, headaches, personality changes, and unsteadiness. An acute subdural haematoma will appear as a high-density concave (elliptical) extra-axial mass on CT scan. In contrast to epidural haematomas, subdural bleeds are not confined by suture lines, and do not cross the midline. With time, a subdural haematoma becomes isodense, and eventually hypodense (darker) to brain parenchyma (usually two to three weeks after the initial injury). Treatment options include evacuation via a burr hole, which generally results in full recovery.[6]

Haemorrhagic contusions

Haemorrhagic contusions are areas of primary neural and vascular brain injury, or 'brain bruises'. They are found on the surface of the brain and can extend into the white matter, subdural, and subarachnoid spaces. They occur by direct trauma, or acceleration and deceleration injuries. Contusions often demonstrate a 'contrecoup' pattern. A coup contusion is injury at the direct site of impact, whereas a contrecoup contusion occurs contralateral to the site of impact. Contusions evolve over a period of days, and may not be visible on immediate imaging. Such changes are especially seen in the first 24-48 hours following the initial injury, during which time the size and number of contusions progress. Initially, a CT scan may be normal or demonstrate areas of isointense contusions. Over the next few days, the contusions become more prominent, with areas of increased density, and surrounding oedema. There may be localised mass effect. Eventually the contusions resolve, but there may be residual neurological deficits secondary to cerebral volume loss.

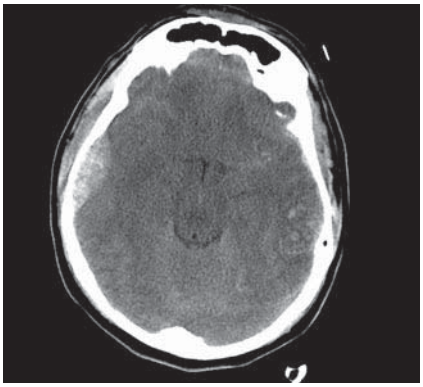

FIGURE 1: CT shows an acute right parietal epidural haematoma with a classic lens shape. Acute haemorrhage appears dense (white) on CT.

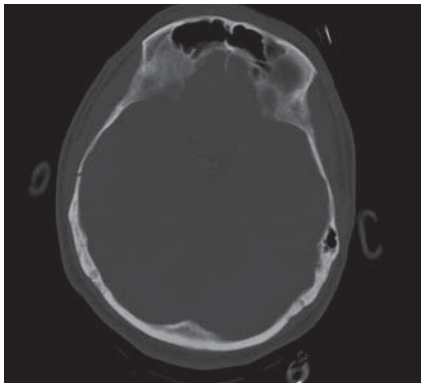

FIGURE 2: Different windowing reveals a non-displaced fracture of the right temporal bone adjacent to the epidural haematoma.

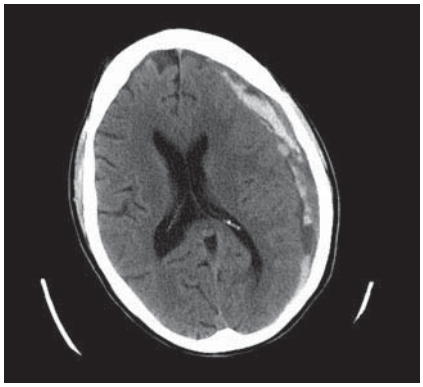

FIGURE 3: Acute subdural haemorrhage in the left lateral convexity with mass-effect and 4mm midline shift. Mixed densities within the bleed suggest an acute-on-chronic subdural haemorrhage.

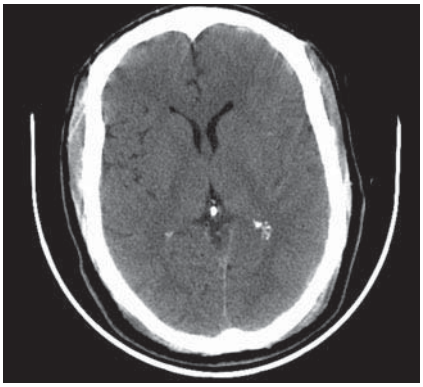

FIGURE 4: Initial CT scan of a young male patient after a motor vehicle accident. Early findings include sulcal effacement on the left but no obvious haemorrhage.

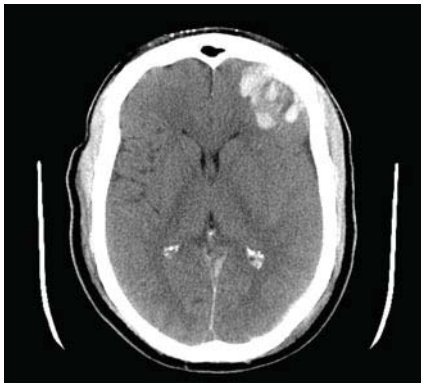

FIGURE 5: 24 hours after the initial injury, a left inferior frontal haemorrhagic contusion can be better appreciated.

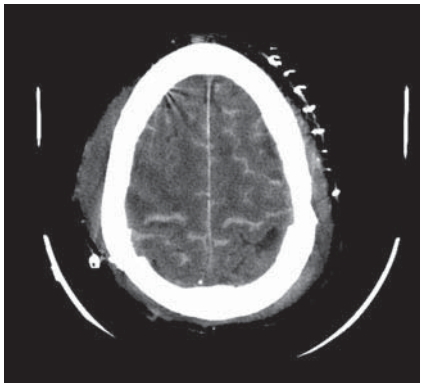

FIGURE 6: Extensive and diffuse subarachnoid haemorrhage in the sulci bilaterally with overlying skin staples.

Subarachnoid haemorrhages

The subarachnoid space is normally filled with cerebrospinal fluid. A subarachnoid haemorrhage (SAH) can occur secondary to traumatic or nontraumatic causes.[7] The most common nontraumatic cause is a ruptured aneurysm. A traumatic SAH occurs after severe head injury. Patients usually present with sudden onset of a severe headache – classically described as "the worst headache of my life". They may also show signs of increased intracranial pressure – nausea, vomiting, neck stiffness, and photophobia. Eventually their level of consciousness deteriorates. A CT scan is the most sensitive imaging modality and, acutely, will show blood in the subarachnoid space. The blood may layer within the dependent portions of the lateral ventricles or sit within the sulci. It can be seen anywhere in the subarachnoid space. Other imaging findings that may be present include hydrocephalus. Acute management includes resuscitation, bed rest, and a neurosurgical review. Surgical options include clipping or coiling of the aneurysm.

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