Cranial Burr Holes in the Emergency Department - To drill or not to drill?

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Cranial Burr Holes in the Emergency Department – To drill or not to drill?

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Case 1

A thirty-two-year old male was involved in a high-speed collision. On arrival in our Emergency Department his Glasgow Coma Score (GCS) was 10/15. He suffered an epileptic seizure minutes after arrival and was intubated using a neuroprotective strategy. Bilateral intercostal chest drains were inserted. While in the CT-suite he developed anisocoria and was shown to have a large extradural haemorrhage overlying his left temporal lobe (Fig. 1). A burr hole was drilled by a Consultant in Emergency Medicine using an Acracut® DGR-0 cranial perforator and guided by surface anatomy landmarks identified by the Consultant Radiologist. The haematoma was largely evacuated using irrigation and gentle suction and the wound was loosely occluded with a sterile dressing. It was noted that immediately upon evacuation of the haematoma pupils returned to normal size and reactivity. The patient was transferred to a neurosurgical unit where he underwent a craniectomy. En route he required further decompression of the extradural collection using irrigation and gentle suction. He made an uneventful recovery and achieved a Glasgow Outcome Score (GOS) of 5.

Case 2

A thirty-one year old man skidded and his vehicle struck a wall. He sustained isolated, significant head trauma. He was communicating coherently on scene. On arrival in our ED his GCS was 12/15 but rapidly deteriorated. He was intubated using a neuroprotective strategy. His CT-scan showed an extensive, compound, comminuted fracture of the right parietal and occipital bones with intrusion of fracture fragments into brain substance and fractures of the right temporal bone and mastoid. Intraventricular, petechial and subarachnoid haemorrhages with significant mass effect caused by a large 10cm x 4cm extradural haemorrhage in the right parieto-occipital region were demonstrated on CT (Fig. 2). Uncal herniation was already evident on CT, as was descent of the right cerebellar tonsil. On our patient’s return to the Resuscitation area, and in spite of administration of intravenous mannitol (1g/kg) and moderate hyperventilation, it was evident that herniation and death were imminent, heralded by profound systolic hypertension and bradycardia.

A burr hole was drilled by a Consultant in Emergency Medicine using an Acracut® DGR-0 cranial perforator over the right occiput, as per landmarks identified by the Consultant Radiologist. A large amount of haematoma and blood was evacuated and our patient’s blood pressure and pulse rate normalised immediately. He was transported to a neurosurgical unit and, as in Case 1, he required further irrigation and evacuation of blood from the craniotomy en route when coning was again considered imminent, evidenced by Cushing’s triad. Again this intervention normalised his haemodynamics.

An extensive craniectomy was performed on arrival at the neurosurgical unit. Our patient was weaned from the ventilator on day 7, communicating and sitting out in a chair on day 9 and moved out of the Intensive Care Unit on day 10.

Discussion

Closed head injuries do not evoke the same visceral response and call to action in the Emergency Department as a dying trauma patient with a tension pneumothorax or visible massive haemorrhage. A more clandestine killer, the extra-axial haemorrhage wreaks its havoc out of sight, doesn’t leak on the floor and claims its victims quietly and terribly effectively. Yet the mass effect of expanding extradural and subdural haemorrhages on the brainstem is akin to and equally as lethal as a tension pneumothorax compromising cardiac output and oxygenation. In the latter case, and on pain of being found guilty of professional misconduct (should we delay), we delve into the chest with large plastic tubes to save the day, an intervention far more invasive and potentially dangerous than drilling a burr hole.
In his study published in 2011,[1] James Nelson investigated the effect of non-neurosurgeon pre-transfer drainage of extradural haematomas on neurological outcomes in patients demonstrating signs of herniation. Notwithstanding methodological limitations and small sample sizes, Nelson concluded that: “Best available evidence suggests that herniating patients have improved outcomes with drainage procedures before transport.” Nelson identified two critical time frames in patients with proven extradural haematomas outside of which outcomes were dismal. Firstly, evacuation (even partially) of an extradural haematoma within two-hours of the onset of witnessed deterioration of GCS (often following a typical intervening ‘lucid period’) was associated with favourable outcome while the converse was equally telling. Secondly, evacuation of haematoma within seventy-minutes of witnessed anisocoria was associated with very favourable outcomes while the converse usually resulted in death.

Scotter et al investigated the prognosis of patients with bilateral fixed dilated pupils (BFDP) secondary to an extra-axial haemorrhage who underwent decompressive surgery and published their findings in 2015.[2] They concluded that a low threshold for decompression in patients with BFDP and extradural haemorrhages should be adopted noting that almost two-thirds of patients with extradural haematomas survived after decompression with over half having a good outcome. Notwithstanding the fact that the evidence for aggressive management of patients with BFDP and traumatic subdural haemorrhage is less convincing (due to a higher incidence of concurrent primary brain injury), they concluded that there were sufficient patients demonstrating good recoveries to justify an aggressive management strategy in this cohort in the first instance.

We keep a craniotomy pack in our Resuscitation area stocked with adult and paediatric Acracut® Cranial Perforators, which are driven by a drill that is compatible (using an adaptor) with the available 400kPa piped medical air supply. Self-retaining retractors, a periosteal elevator and dural hook are included. An algorithm was developed to guide decision making based on the critical timeframes identified by Nelson (Fig 3). Training of multidisciplinary Emergency Department colleagues is conducted regularly in the Emergency Department and includes a training video demonstrating the assembly and operation of the drill and perforators.

It is our firm belief that Consultants in Emergency Medicine in remote locations with CT-capability should acquire the straightforward skillset and equipment needed to perform pre-transfer emergency cranial burr holes. This life-saving intervention should move out of the ‘once in a lifetime heroic procedure’ category and become a reasonable standard of care.

References


Figure legends

**Figure 1:** CT-scans from ‘Case 1’ showing the large left temporal extradural haematoma and the position of the burr hole (marked) drilled in the Emergency Department.

**Figure 2:** CT-scans from ‘Case 2’ showing the large right parieto-occipital extradural haematoma and the position of the burr hole (marked) drilled in the Emergency Department.

**Figure 3:** An algorithm to guide decision-making in patients with extradural haemorrhage and delayed access to a neurosurgical facility.

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Figure 1: CT-scans from ‘Case 1’ showing the large left temporal extradural haematoma and the position of the burr hole (marked) drilled in the Emergency Department.
Figure 2: CT-scans from ‘Case 2’ showing the large right parieto-occipital extradural haematoma and the position of the burr hole (marked) drilled in the Emergency Department.

129x64mm (96 x 96 DPI)
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Acute Head Trauma

No

Yes (or suspected)

Polytrauma

Isolated Head Injury

Resuscitate according to ATLS®

CT Brain

Extradural Haemorrhage?

Yes

GCS = 3-8/15 or rapidly deteriorating

No

Anisocoria (not attributable to another cause)

No

Transfer

Yes

Time to definitive neurosurgical intervention >2hrs¹

No

Transfer

Yes

Time to definitive neurosurgical intervention >1hrs²

Yes

Cranial Burr Hole (see protocol)

Apply SIGN head injury Guidelines

No

Continue appropriate management

¹ Time from witnessed onset of coma (GCS 3-8/15) ie: 'talk-and-deteriorate' or from time of injury if comatose ab initio.

² Time elapsed since anisocoria first noted.