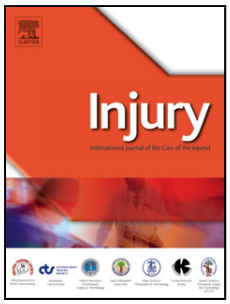

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Temporising Extradural Haematoma by Craniostomy Using an Intraosseous Needle

Running title: IO needle craniostomy for extradural

Harry Bulstrode PhD[1], Silvester Kabwama BM[2], Andrew Durnford MSc[3], Jonathan Hempenstall BSc[3], Aabir Chakraborty PhD[3]

1. Department of Clinical Neurosciences, Addenbrookes Hospital, Cambridge CB2 0QQ
2. Leeds General Infirmary, Leeds LS1 3EX
3. Wessex Neurological Centre, Southampton General Hospital SO16 6YD

Harry Bulstrode: harry.bulstrode@addenbrookes.nhs.uk

Silvester Kabwama: silvester.kabwama@uhs.nhs.uk

Andrew Durnford: andrew.durnford@uhs.nhs.uk

Jonathan Hempenstall: jonathan.hempenstall@uhs.nhs.uk

Aabir Chakraborty: aabir.chakraborty@uhs.nhs.uk

Abstract

We report a novel application of intraosseous needle drainage, alleviating raised intracranial pressure due to extradural haematoma. The potential application of this technique in preventing secondary brain injury and herniation during transfer to a neurosurgical unit is discussed.

Keywords: extradural; head injury; intraosseous needle

Introduction

Extradural haematoma is a neurosurgical emergency, for which craniotomy and evacuation is the mainstay of management. Outcomes are significantly better when the evacuation is performed by neurosurgeons [1], but significantly worse with time to evacuation from onset of anisocoria [2] or coma [3]. The Monro-Kellie Doctrine {Monro, 1783; Kellie 1824} establishes the critical dependence of intracranial pressure on small changes in the volume of the cranial contents. Drainage of even a small quantity of extradural haematoma may therefore improve cerebral perfusion and prevent secondary brain injury during the critical period of transfer to a neurosurgical centre.

In obtunded patients with CT-confirmed extradural haematoma, we propose temporising by craniostomy and partial drainage of the collection using an intraosseous needle, while preparations are made for transfer. We describe an example of the application of this technique, in an Anaesthetic Room, whilst a patient was stabilised for emergency craniotomy.

Methods

Craniostomy was performed using an EZ-IO drill and a Vidacare 25mm 15ga IO needle (unlabelled use). Consent was obtained on a best interests basis in the first instance, and publication of the report was discussed and approved by the patient and relatives following recovery. No conflicts of interest are declared.

Results

A 43 year old pedestrian was struck by a car travelling at approximately 30 mph, as she crossed the road. She arrived by ambulance at her local Emergency department at 2100, where her admission GCS was E4V4M6. CT head showed small frontal contusions and an occipital extradural collection related to the transverse sinus, without significant mass effect (Figure 1). A repeat CT scan was advised, and at 2200 she vomited in the scanner, and her conscious level deteriorated to E1V2M5. The left pupil was fixed and dilated. The repeat CT demonstrated a large left parieto-occipital extradural haematoma and frontal contusion / ICH with a midline shift of approximately 11mm. She was intubated and airlifted to the Wessex Neurological Centre for emergency craniotomy.

The patient arrived at the Wessex Neurological Centre at 0230 and proceeded directly to the Anaesthetic Room. During the Anaesthetic handover, an occipital site was shaved, prepared and incised, an IO needle track was drilled using a standard EZ-IO drill, and a 25mm 15ga intra-osseous needle was inserted (Figure 2). 30ml of blood was aspirated immediately, and the procedure was completed within 8 minutes.

The left pupil was noted to be smaller but remained unreactive. The patient was transferred onto the operating table, and a craniotomy performed. The intraosseous needle track was evident on opening (Figure 3), and residual clot was demonstrated on removal of the bone flap (Figure 4).

Following surgery, the patient was transferred to the neurointensive care unit, where she was extubated with satisfactory post-op CT appearances (Figure 5), and made an excellent recovery without residual neurological deficit.

Discussion

We believe this to be the first reported application of IO needles, universally available in Emergency departments, for the partial drainage of extradural haematoma. A potential complication of inserting a needle into the extradural space is injury to brain vessels, resulting in further haemorrhage. Infection is a further theoretical complication. The closest parallel in routine practice is probably to intracranial pressure monitor insertion for which the reported rates of clinically significant haemorrhage and infection in large case series are 1-3% and <5% respectively [4-6]. The needle must also be of sufficient depth to penetrate both the scalp and the cranium. Whilst a 25mm needle was used in this case, the presence of significant scalp swelling might necessitate the use of a longer needle. In this case the procedure took 8 minutes and did not delay craniotomy as the patient was stabilised and prepared for craniotomy simultaneously. However, we envisage that emergency practioners doctors could perform this procedure in district units directed by telephone on needle placement with respect to key landmarks by the receiving neurosurgeon who has reviewed the CT imaging remotely. This might be especially

helpful in cases where transport or other delays are encountered- IO needles are characterised by their ease of use and universal availability in hospital emergency depratments. We propose the site of insertion should be the point of maximal clot depth and therefore localisation of the insertion point would be on a case by case basis. Most extradural haematomas requiring emergency craniotomy are of sufficient size that we postulate that failure to place the needle into the haematoma is unlikely but a potential complication. We also note most extradural haematoma is of solid consistency: the aim of the procedure is to drain enough fluid to temporarily alleviate raised intracranial pressure prior to definitive craniotomy. This technique could also be applied by appropriately trained retrieval teams during the transfer of a patient from a peripheral unit. The duration and extent of raised intracranial pressure in the minutes and hours prior to definitive evacuation of these collections is a major determinant of survival and functional outcome, and this technique has the potential to improve outcomes in the set of patients who are comatose prior to transfer to a neurosurgical centre. The proportion of patients who might benefit is unknown. We note the Australian Neurotrauma guidelines that state local burrholes should be placed in the deteriorating patient when transfer will take longer than two hours[7]. IO needle placement in this scenario might temporise a deteriorating patient without the delay of a local burrhole placed by an practioner unfamiliar with the technique.

The authors declare no conflicts of interest associated with the manuscript 'Temporising Extradural Haematoma by Intraosseous Needle Craniostomy'

Author contributions

HB and SK wrote the paper, AD provided critical revision, JH and AC conceived the technique, HB and AC performed the operation in the case presented.

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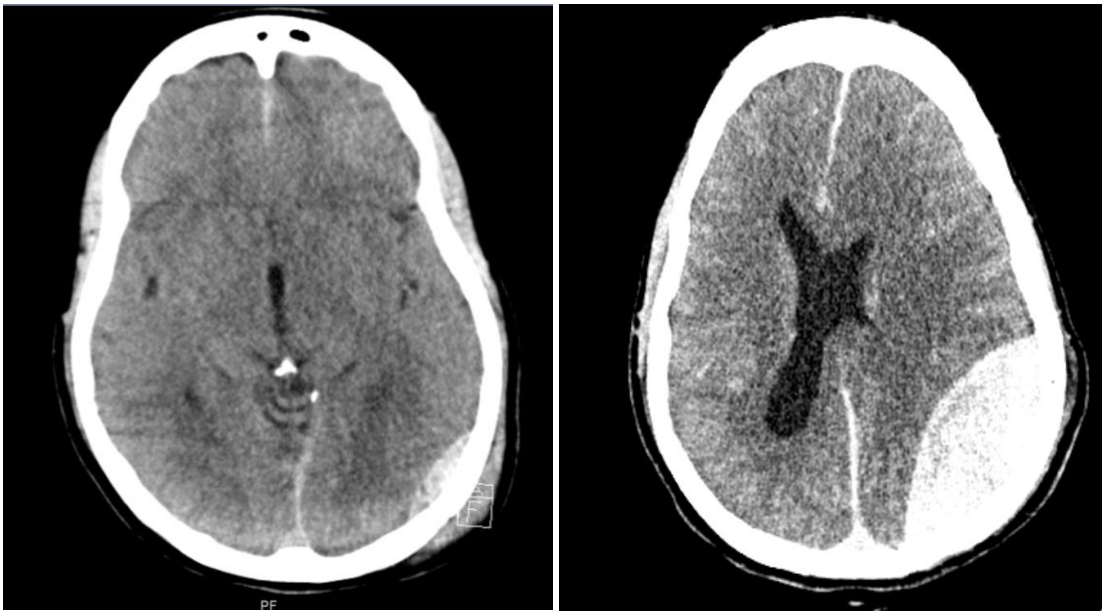
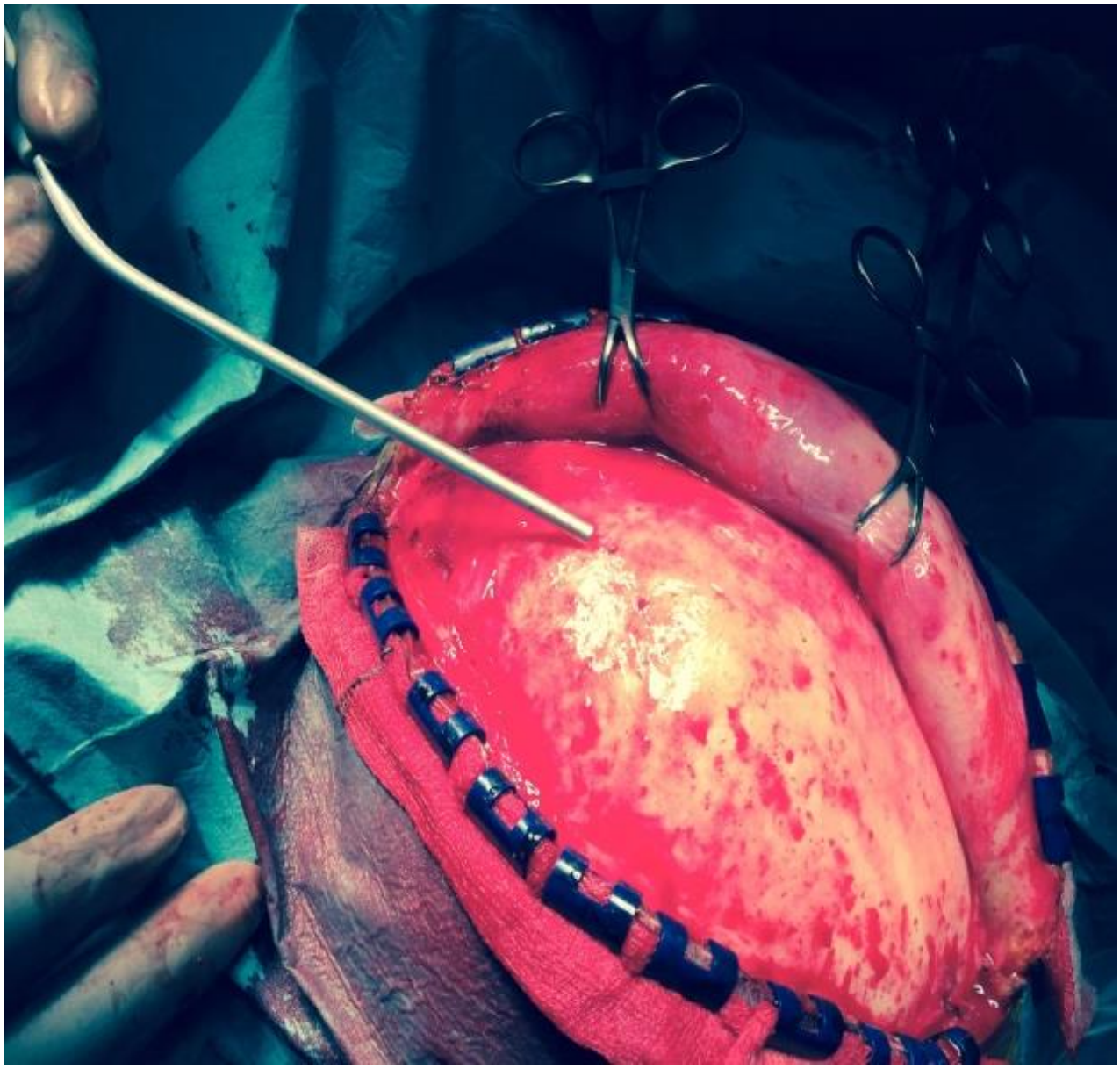


Figure 1 Plain CT head example axial sections at admission (left) and one hour post admission, coincident with clinical deterioration (right).

Figure 2 Aspiration of extradural blood using intraosseous needle

Figure 3 IO craniostomy needle track, evident during the subsequent definitive craniotomy.



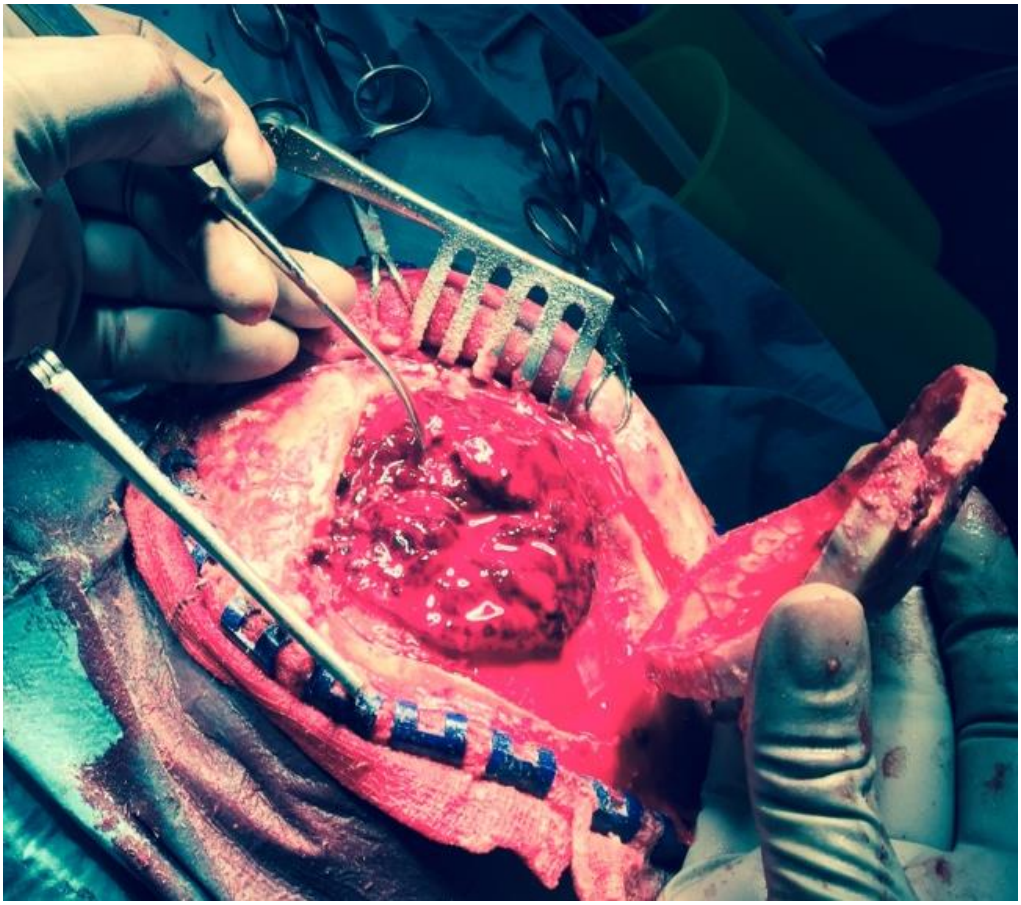


Figure 4 Residual extradural haematoma evident on removal of the bone flap

Figure 5 Post-operative CT appearances