

Emergency Out-of-Hospital Decompressive Neurosurgical Intervention = Last Source Measure

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Abstract: *The commentary explores the conditions under which Burr hole craniotomy or skull trephination could possibly be performed in prehospital emergency settings.*

Keywords: craniectomy, intracranial hypertension, emergency neurosurgery

1. Introduction

Even though there are some reports in the literature about emergency skull trephination or Burr hole in emergency departments¹⁻², in remote locations³ or in ambulance during inter-hospital transfer⁴; the available database remain limited⁵. Thus, while the first creates hopes about the wide implementation of such interventions in prehospital setting⁶, the latter creates skepticism about the conditions under we should go ahead with the techniques. The present article focuses on the reasons behind that skepticism.

2. The Certainty of Diagnosis

Decompressive surgery is mainly performed in order to reduce refractory intracranial pressure (ICP)⁷. Laboratory diagnosis of intracranial hypertension can be done either directly via ICP monitor catheters or indirectly, by confirming the pathology that caused a rise in ICP: computer tomography (CT) or angio-CT, magnetic resonance imaging (MRI), transcranial Doppler (TCD) or transcranial ultrasonography (US) (e.g. for epidural hematomas)⁸. Unfortunately, despite the fact that handheld digital pupillometry and pocket TCD/US are available, its use is still very limited in the pre-hospital setting⁹.

Clinical tools used are mainly Glasgow Coma Scale (GCS) and pupils' diameter, as cardiovascular and respiratory signs (Cushing's triad) usually indicate brain herniation and emerge late⁷.

However, both tools are subjective to bias. GCS was first designed for hospitalized neurosurgical patients and not for trauma brain injury (TBI) victims in the field. Moreover, it is designed as separate evaluation of distinct functions. The use of total score is basically wrong, and not validated. Thus same scores can reflect different status and different prognosis (e.g. GCS of 4 can be either E1/V1/M2 which corresponds to 48% mortality in TBI cases or E2/V1/M1 which corresponds to 19% mortality in the same patients)¹⁰. The scale can be challenging to non-trained personnel, especially when assessing motor response or when assessing children¹¹. Finally, it is not validated in toxicological cases- use of drugs or alcohol can affect assessment- and it does not incorporate brainstem reflexes.

Penlight pupils' examination is equally biased by different stimulus (light level, spectral composition, light accommodative state, spectral configuration: e.g. field size, monocular/binocular view, non-visual stimuli like pain or noise) or observer variables (age, day-to-day within observer differences, individual differences, biochemical factors- respirations, heart rate and cognitive factors like fear, arousal, attention, workload)⁹.

On the same time, more complicated scales such as less know Glasgow Liege Coma Scale or the FOUR score, are seldom used pre-hospitally¹²⁻¹³.

If we add to the aforementioned, the ICP cut-off value from intracranial hypertension treatment guidelines¹⁴, then we may encounter a problem: how certain are we in the field about the diagnosis of ICP>20 mmHg, refractory enough (>1h) to every other therapeutic measure, so that we can decide or not decompressive intervention? Results from the two available trials on the subject (DECRA and RescueICP) come from a full-monitored environment, and still have their limitations¹⁵.

3. The Technique

Emergency decompressive rescue intervention should not be confused with other neurosurgical procedures. Craniotomy is a broader term used to represent the means by which the surgeon enters the intracranial space, i.e. the surgical opening of the skull.

Decompressive craniectomy (DC) is a type of craniotomy used for intracranial ICP that consists in removing part of the skull and is often associated with removal of mass lesions such as subdural hematoma or traumatic intracerebral hematoma^{16,17}. Different methods of decompressive craniectomy have been developed. These include subtemporal decompression, circular decompression, fronto- or temporoparietal decompressive craniectomy, large fronto-temporoparietal decompressive craniectomy, hemisphere craniectomy, and bifrontal decompressive craniectomy^{16, 18}. DC indications do not include GCS<4 or fixated dilated pupils^{16, 18,19} and the whole procedure is not severe complications-free²⁰.

However, all the aforementioned refer to DC in the operation room performed by neurosurgeons.

Decompressive measure in pre-hospital setting could only be a Burr hole or skull trephination. Moreover, performing the technique without complications in an efficient way (e.g. probably more than one hole would be needed) by person how are not continuously trained for such interventions may seem like a very dangerous gamble.

4. The Timing

Finally, even if our diagnosis is certain and our training and conditions are such that allow performing an out-of-hospital DC-like procedure, the timing is another critical factor for the efficiency of our intervention. If the optimum time for in-hospital DC is not yet fully determined, then no definite answer can be given for an out-of hospital one.

5. Conclusion

Even those how performed an extreme DC procedure in out-of hospital setting noted it as a last resort measure²¹. As medicine evolves, we may reach a point in the future where ICP hypertension will be recognized and managed efficiently before hospital admittance. Yet, for the time being, we should focus on the management of TBI in accordance to the data we have in hand.

6. Conflict of Interest

The authors declare they have no competing interests.

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