Outcome of Decompressive Craniectomy for Traumatic Brain Injury: Ways to Better Evaluate Functional Outcome

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The original article titled "Outcome of decompressive craniectomy for traumatic brain injury: an institutional-based analysis from Nepal" by Shah et al has spurred fruitful thoughts into further analysis of outcomes for TBI survivors.[1] Herein, we would like to give suggestions with regard to the evaluation of functional outcomes in this cohort. While the authors had done an excellent analysis to correlate clinical and computed tomographic (CT) variables with Glasgow Outcome Scale (GOS), we suggest that Extended GOS (GOS-E) would be a better scale to consider. GOS is open ended, simple to apply, and widely used; however, its limitations include ambiguity in describing upper categories where functions are multidimensional, with predominant emphasis on physical rather than cognitive or emotional issues, lack of sensitivity to clinical changes, and inadequate standardization when applying the scoring system.[1,2] The further subdivisions of eight functional categories in the extended GOS allowed a more sensitive, reproducible, and consistent way to evaluate TBI long-term functional outcomes.[3] We, therefore, advocate the use of GOS-E rather than GOS.

There were a few factors in the study that potentially influence the outcomes post decompressive craniectomy (DC). First, there was no mention on what encompassed the medical management. Consensus statement from the International Consensus Meeting on the Role of DC in the Management of Traumatic Brain Injury stated full escalation of treatment should be achieved before secondary DC, unless clinical deterioration warrants more urgent surgery.[4] As per the Brain Trauma Foundation TBI guidelines (4th edition) for severe TBI management, medical managements to reduce

intracranial pressure (ICP) include hyperventilation, hyperosmolar therapy, and use of anesthetics, analgesics and sedatives agent.[5] Specifically, hyperventilation is recommended as a temporizing measure for the reduction of raised ICP; however, clinician should recognize that prolonged hyperventilation is not recommended.[5] Mannitol is effective for the control of raised ICP at doses of 0.25 to 1 g/kg body weight. Existing guideline recommends restricting the use of mannitol before ICP monitoring in patients with signs of trans-tentorial herniation or progressive neurologic deterioration not attributable to extracranial causes, and to avoid its use in patients with hypotension.[5] High-dose barbiturate administration is recommended to control elevated ICP; however, hemodynamic stability is essential before and during barbiturate therapy.[5] Although propofol is recommended for the control of ICP, this drug is not recommended for improvement in mortality or 6-month outcomes.[5] Prophylactic hypothermia and the use of steroids are not recommended.[5] Bifrontal DC is not recommended to improve outcomes as measured by the GOS-E score at 6 months post-injury in severe TBI patients with diffuse injury without mass lesions. The committee of Brain Trauma Foundation TBI guidelines (4th edition) is aware of the results from RESCUEicp trial that were released soon after the completion of guidelines and intend to update these recommendations if needed.[5] The treatment protocol of RESCUEicp trial was organized in three hierarchical stages, with treatment intensity increasing at every stage. First and second stages include non-surgical management such as head elevation, ventilation, sedation, analgesia, paralysis,

mannitol, hypertonic saline, hypothermia, and loop diuretics. Surgical management in first two stages include ICP monitoring and ventriculostomy. Only refractory cases with persistent ICP elevation greater than 25 mmHg will be considered or DC. Results from RESCUEicp showed that DC in patients with TBI and refractory intracranial hypertension resulted in lower mortality and higher rates of vegetative state, lower severe disability, and upper severe disability than medical care. The rates of moderate disability and good recovery were similar in the two groups.[6]

Second, the timing of DC is very critical. In cases where patients already demonstrated signs of herniation before treatment, it may obfuscate the therapeutic benefit from a DC.[7] In adult TBI patients, early decompressive craniectomy within 24 hours may improve mortality and functional outcomes when compared with decompressive craniectomy performed beyond 24 hours.[7] Conversely, previous RCTs suggested late DC for TBI may result in worse functional outcomes than maximal medical therapy.[7]

Third, we noted decision for craniectomy was purely based on clinical judgment and radiological findings without intracranial pressure monitoring. Such decision could potentially lead to more DC done than needed. Notably, in this study by Shal et al, 39.1% of DC was done on patients with GCS score greater than 8 on admission, which falls under the category of mild-to-moderate TBI. If circumstances allow, ICP monitoring should be used in conjunction with CT findings and neurological exam to decide on secondary DC as it should be applied selectively as there is uncertainty as to which severe TBI subgroups will truly benefit.[7] DC may decrease mortality; however, it is not benign and is associated with significant risks of complications and potentially increased risks of disability.[7] Alternative surgical management include insertion of an extracranial ventricular drainage (EVD) system. An EVD system that zeroed at the midbrain with continuous drainage of cerebrospinal fluid (CSF) lower ICP burden more effectively than intermittent use.[7] Use of CSF drainage to lower ICP in patients with an initial GCS less than 6 during the first 12 hours after injury can be considered.[5]

The outcomes of post-DC would be better evaluated based on the severity of TBI. Younger age, higher GCS score at presentation, intact pupillary reflexes, and lower Marshall grade injuries were significantly associated with favorable outcome from previous studies. We suggest a comprehensive evaluation into these outcomes post-DC by dichotomizing patients into mild, moderate and severe TBI. Patients with

mild-to-moderate TBI might not benefit as much from DC as compared with their severe TBI counterpart in terms of long-term functional outcome and morbidity. DC itself, is not without risk and might necessitate cranioplasty as a second operation. In addition, delayed cranioplasty is well known to associate with an increased risk of post-traumatic hydrocephalus, syndrome of the trephined, and negative impact on self-esteem that would negatively affect the functional outcome.[8] Lastly, we advocate a longer duration of follow-up for TBI survivors. Given post-TBI rehabilitation plays an important role for functional optimization, surveillance of the type and intensity of brain injury rehabilitation during the course of follow-up is paramount.

Conflict of Interest
None declared.

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