1 Overview of Traumatic Brain Injury and Need of Cisternostomy in TBI

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Introduction

Traumatic brain injury (TBI) presents a significant public health concern on a global scale, demonstrating a consistent epidemiological trend spanning the last three decades. TBI is a notable factor in both mortality and morbidity, particularly in younger individuals. The connection between TBI and both primary and secondary brain damage has been extensively documented. The former, influenced by the intensity of the injury, lacks definitive solutions. Following survival, the secondary damage plays a crucial role, as the absence of effective interventions could lead to complex cascades that worsen cerebral injury.

Despite progress in medical treatments, there is a lack of treatment options to reduce secondary or delayed harm following TBI. Many experimental and clinical studies have thoroughly investigated substances with neuroprotective qualities. However, thus far, all phase III trials have failed to

confirm the effectiveness of neuroprotective agents in TBI. Common surgical procedures currently include the placement of external ventricular drains and decompressive craniectomy. Studies suggest that both methods reduce intracranial pressure (ICP), though their impact on outcomes remains uncertain. In light of the challenges in validating neuroprotective agents for TBI, future research may need to explore alternative treatment strategies to effectively address ICP and enhance patient outcomes.

The DECRA study, also known as Decompressive Craniectomy (DC) in Patients with Severe Traumatic Brain Injury, represents the most comprehensive randomized trial dedicated to diffuse TBI.[1] Regrettably, the results of this investigation failed to illustrate the effectiveness of decompressive craniectomy in adult individuals afflicted by TBI. Despite the successful reduction of ICP to atmospheric levels achieved by decompressive hemicraniectomy, it does not address intracerebral pressure, consequently resulting in significant brain swelling and herniation. The exploration of novel approaches such as pharmacological interventions or advanced monitoring techniques could present promising pathways toward effectively managing intracerebral pressure and improving patient outcomes in cases of TBI.

Cisternostomy is an innovative procedure, which was proposed and started by Dr. Iype Cherian from India, that integrates expertise in skull base and microvascular surgery. It has been suggested that during the initial phases of a head trauma, there may be a transfer of cerebrospinal fluid (CSF) from the cerebral cisterns to the brain, resulting in significant brain swelling. By exposing the brain cistern to atmospheric pressure, cisternostomy has been proven to reduce ICP through the redistribution of CSF across the Virchow-Robin (VR) spaces.[2–4]

Nevertheless, it is important to acknowledge that accessing the cisterns in a swollen brain affected by TBI is a complex task that demands a comprehensive understanding of anatomy and substantial surgical expertise.

Its foundation lies in the theory of CSF shift edema, which associates brain injury with elevated pressure within the subarachnoid space resulting from hemorrhage and compromised glymphatic drainage. Initial findings suggest that cisternostomy has the potential to bring about notable enhancements in clinical results, manifesting as decreased mortality rates, shorter durations of stay in the intensive care unit (ICU), and improved scores on the Glasgow outcome scale (GOS). Despite the promise it holds, the integration of cisternostomy has been gradual, primarily due to the considerable learning curve involved and the necessity for proficient microsurgical abilities.[5,6] Research has indicated that cisternostomy, whether performed independently or as a supplementary procedure to DC, may prove more efficacious in managing ICP and minimizing complications when compared to the sole utilization of DC. Nonetheless, the available evidence remains restricted, with the majority of studies being confined to reports from single centers with limited sample sizes. Particularly in low- and middle-income countries (LMICs), where it was initially developed, this procedure has demonstrated potential by providing a cost-effective resolution to the substantial burden of TBI. Although suggestions have been made for cisternostomy to supplant DC due to its reduced morbidity and mortality rates, further investigation is imperative to definitively establish its efficacy and safety.[7] In essence, cisternostomy signifies a noteworthy progression in neurosurgical methodologies for TBI; nevertheless, its widespread acceptance hinges on the availability of more robust clinical data and training initiatives to surmount the technical obstacles.[8]

Conclusion

Cisternostomy represents an innovative surgical approach for severe TBI, although the concept of cisternal opening is a well-established principle in neurosurgical practice. Currently, the technique can be viewed as a supplementary surgical maneuver in conjunction with decompressive craniectomy. However, upon definitive confirmation of its efficacy, it possesses the potential to supplant decompressive craniectomy in the management of severe TBI. Innovative surgical techniques like cisternostomy hold promise for advancing the management of severe traumatic brain injuries beyond traditional practices. Exploring novel surgical methods such as cisternostomy could revolutionize the treatment of severe traumatic brain injuries by expanding beyond conventional approaches.

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