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Article : The efficacy of lowering a traumatic brain injury patients' body temperature to combat increased intracranial pressure.

When a person experiences an initial traumatic brain injury, defined as an injury caused by an external force resulting in change of brain function, there is a significant chance that detrimental secondary damage to the brain will follow [3]. The initial primary injury triggers a sequence of pathophysiological processes, which when not acted upon, can cause a secondary injury to the brain [3]. Preventing such secondary injuries to the brain is a key strategy employed by intensivists and neurosurgeons to improve general outcome and survivability for the patient. A particular harmful process to the brain is the consistent elevation of the pressure within the skull (i.e., intracranial pressure) due to brain swelling and fluid accumulation. Prolonged increased intracranial pressure can disrupt the blood flow to the brain and in turn reduce drastically oxygen and nutrient delivery to the neurons causing cell death and irreversible secondary brain damage to the patient [3].

Initial treatment strategies of strong elevated intracranial pressure include drainage of ventricular fluids or the removal of space-occupying lesions so that pressure decreases [1]. Nevertheless, it is possible that even after the aforementioned measures elevated intracranial pressure is maintained and additional treatment strategies should be employed. A possible treatment option is therapeutic hypothermia, induced cooling of the patient's body temperature to 32 – 35 °C [2]. Therapeutic hypothermia is thought to counteract and slow down the processes involved in the formation of cerebral edema (i.e., excessive accumulation of fluid within the skull), and consequently lower intracranial pressure [2]. However, limited data exists to support the use of therapeutic hypothermia to lower intracranial pressures in traumatic brain injury patients. Recently, Andrews and colleagues (2015) published a study testing the efficacy of therapeutic hypothermia in a large randomized control trial (Eurotherm3235) in which they assigned 376 patients to either the control group (standard treatment protocols) or therapeutic hypothermia group (standard treatment protocols + hypothermia) and evaluated their outcome 6 months after injury using the extended Glasgow outcome scale (GOS-E) [1]. The authors found that inducing hypothermia on top of the standard care did reduce successfully intracranial pressure, however it did not result in improved functional neurological recovery after 6 months when compared to the control group, adding uncertainty to the existing body of evidence concerning the use of therapeutic hypothermia as treatment [1]. Insofar, research has thus shown variable effectiveness of therapeutic hypothermia following traumatic brain injury in improving patient outcome [2].

To better understand the body of evidence, systematic reviews of the existing literature were performed to identify differences and similarities between studies that give supporting or contradictive evidence. In general, therapeutic hypothermia was found to be effective at reducing intracranial pressure, however, there needs to be an individualized approach to therapeutic hypothermia, namely the extent and length to which it is induced [2]. For

example, if the clinicians observe an increase of intracranial pressure when rewarming a patient that had induced therapeutic hypothermia, recommencing the therapeutic hypothermia may be advisable [2]. Moreover, the type of initial primary traumatic brain injury also plays a role with regards to the efficacy of a treatment. For example, it was observed that patients experiencing cerebral hematoma, i.e. localized bleeding outside of the blood vessels due to the initial trauma, benefit from the therapeutic hypothermia while patients with cerebral contusion, a bruise of the brain tissue, did not [2]. Therefore, it is important that the treating clinicians are aware of the evidence that exists based on which they can make a tailored choice on a case by case basis. In general, therapeutic hypothermia may improve neurological outcome in patients that experienced a traumatic brain injury with relatively low risk of adding additional severe complications. Further high quality research is needed to determine the patient subpopulations that experience the most benefit –or harm from this treatment to clarify its efficacy in each patient subpopulation.

[1] Andrews PJD, Sinclair HL, Rodriguez A, et al. Hypothermia for Intracranial Hypertension after Traumatic Brain Injury. <http://dx.doi.org/10.1056/NEJMoa1507581>.
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[2] Dunkley S, McLeod A. Therapeutic hypothermia in patients following traumatic brain injury: a systematic review. *Nursing in Critical Care*. 2017;22(3):150-160.
doi:[10.1111/nicc.12242](https://doi.org/10.1111/nicc.12242)

[3] Kaur P, Sharma S. Recent Advances in Pathophysiology of Traumatic Brain Injury. *Curr Neuropharmacol*. 2018;16(8):1224-1238. doi:[10.2174/1871530318666180423121833](https://doi.org/10.2174/1871530318666180423121833)