Pediatric Severe Traumatic Brain Injury

- Catalase Activity in the Brain Is Associated with Recovery from Brain Injury in a Piglet Model of Traumatic Brain Injury
- Timing of Magnetic Resonance Imaging (MRI) in Moderate and Severe TBI: A Systematic Review
- Severe Chronic Traumatic Encephalopathy in a US Naval Special Warfare Combatant Crewman
- Mortality after abusive head trauma: Relationship to brain injury severity, age, and co-occurring bodily injuries
- Special Pediatric Considerations in the Management of Severe Traumatic Brain Injury and Spinal Cord Injury
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Pediatric severe traumatic brain injury (TBI) is a condition where a child sustains significant damage to the brain as a result of a traumatic event. This can include falls, motor vehicle accidents, or other forms of blunt force trauma.

Diagnosis

The diagnosis of pediatric severe traumatic brain injury (TBI) involves a comprehensive evaluation based on various factors, including the history of the traumatic event, clinical presentation, and imaging studies. Here are some key aspects of the diagnosis:

History and Clinical Examination: The medical history typically involves gathering information about the circumstances of the traumatic event, such as falls, motor vehicle accidents, or physical abuse. A thorough clinical examination is performed to assess neurological status, including level of consciousness, pupil size and reactivity, motor function, and signs of increased intracranial pressure (ICP), such as vomiting or altered mental status.

Imaging Studies: Imaging studies are crucial for evaluating the extent and severity of brain injury. Common imaging modalities include:

Computed Tomography (CT) Scan: CT scans are often performed emergently to assess for acute traumatic intracranial injuries, such as hemorrhages, contusions, or fractures.

Magnetic Resonance Imaging (MRI): MRI may be used for further evaluation of brain injury, particularly for detecting diffuse axonal injury or subtle abnormalities not seen on CT scans. However, MRI may not be feasible in the acute setting due to time constraints and the need for patient stability.

Intracranial Pressure Monitoring: In cases of severe TBI, especially if there are signs of elevated ICP or neurological deterioration, invasive monitoring of intracranial pressure may be indicated to guide management and treatment decisions.

Laboratory Tests: Laboratory tests, such as blood tests, may be performed to assess for associated injuries, metabolic abnormalities, or signs of systemic compromise.

Scoring Systems: Various scoring systems, such as the Glasgow Coma Scale (GCS) and the Pediatric Glasgow Coma Scale (PGCS), are used to assess the level of consciousness and neurological status. These scoring systems help in prognostication and guiding treatment decisions.

Guidelines

see Guidelines for the Management of Pediatric Severe Traumatic Brain Injury, Third Edition.

New level II and level III evidence-based recommendations and an algorithm provide additional guidance for the development of local protocols to treat pediatric patients with severe traumatic brain injury. The intention is to identify and institute a sustainable process to update these Guidelines as new evidence becomes available [1)].

Greenan et al., used database research to evaluate admission clinical and CT scan characteristics for use as a decision tool to help clinicians caring for children with very severe traumatic brain injury. It may help clinicians identify children who can benefit the most from aggressive medical and surgical intervention [2)].

Management

Management typically involves a multidisciplinary approach, including neurosurgery, critical care, and rehabilitation.

Early and comprehensive management is essential for improving outcomes in pediatric severe TBI cases.

Anesthesiologists in the Nordic countries report restrictive perioperative RBC transfusion strategies for children that are mostly in agreement with the international TAXI recommendations. However, RBC transfusions strategies were modified to be guided by more liberal trigger levels when pediatric patients presented with severe comorbidity such as severe sepsis, septic shock, and non-life-threatening bleeding [3)]

Treatment

Treatment aims to stabilize the child, minimize secondary brain injury, and optimize neurological outcomes. Long-term prognosis can vary depending on the extent of the injury and the effectiveness of treatment interventions.

Complications

Severe TBIs in children can lead to various complications, including cerebral contusions, traumatic subarachnoid hemorrhage, and diffuse axonal injury.

Galbiati et al. performed a retrospective chart review on patients affected by severe subacute traumatic brain injury. Their levels of cortisol, ACTH, IGF-1, TSH, free T4, free T3, and prolactin were collected and compared with reference ranges; we then used regression models to highlight any correlation among them and with clinical variables; Lastly, we probed with regression models whether hormone levels could have any correlation with clinical and rehabilitation outcomes. We found eligible data from the records of 52 pediatric patients with markedly severe traumatic brain injury, as shown by an average GCS of 4.7; their age was 10.3 years, on average. The key results of our study are that 32% of patients had low IGF-1 levels and in multiple regression models, IGF-1 levels were correlated with neurological recovery, indicating a possible role as a biomarker. Moreover, 69% of patients had high prolactin levels, possibly due to physical pain and high stress levels. This study is limited by the variable timing of the IGF-1 sampling, between 1 and 2 months after injury. Further studies are required to confirm our exploratory findings [4)].

Outcome

Social determinants of health (SDH) are factors that may impact outcomes following pediatric traumatic brain injuries (TBI). The purpose of the study was to investigate the relationship between race and functional outcomes in a diverse pediatric population. They further explored how this association may be modified by SDH factors, including insurance status, social vulnerability, and child opportunity.

A cohort study (N = 401) of children aged 0-18 [median = 9.22 years (IQR: 3.56-13.59)] presenting to the Emergency Department at Level I and II Trauma Centers with mild to severe head injuries. Geocoded variables were used to evaluate SDH. The sample was described overall and by racial/ethnic group, which were adjusted for confounders using inverse propensity treatment weights (IPTW). Weighted and unweighted Firth logistic regression models (mortality) and generalized linear regression models (Extended Glasgow Outcome Scale) were reported without and then with potential effect modifiers.

The sample is majority male (65.84%); race/ethnicity are as follows: White (52.37%), Black/African American (35.91%), and Hispanic (11.72%). Black (31.25%) and Hispanic (27.66%) patients had higher rates of severe TBI. 35.89% of White patients were categorized as more socially vulnerable compared to 62.68% of Black and 70.21% of Hispanic patients. A total of 63.64% of White patients were from higher opportunity neighborhoods, compared to 25.87% of Black and 51.06% of Hispanic patients. A total of 50.95% of White patients, 25.87% of Black patients, and 17.02% of Hispanic patients were privately insured. There were no differences found between racial and ethnic groups on mortality or Extended Glasgow Outcome Scale scores.

Patients from minority backgrounds had more severe injuries, many resulting from pedestrian vs. motor vehicle accidents. Additionally, patients from minority backgrounds experience more social vulnerability and lower opportunity. Despite these discrepancies, they did not observe differences in rates of mortality or functional outcomes in either racial or ethnic groups. SDH was not found to impact outcomes. Further research is needed to determine how these complex social and environmental variables impact health outcomes [5)]

Sarnaik et al., failed to detect mortality differences across age strata in children with severe TBI. They discerned novel associations between age and various markers of injury-unrelated to AHT-that may lead to testable hypotheses in the future [6)].

Case reports from the HGUA

Q11374

Severe traumatic brain injury. Cerebral contusion. Traumatic subarachnoid hemorrhage. Diffuse axonal injury.

This is a two-year-old child who suffered polytrauma after falling from a fourth floor. Various computed tomography (CT) scans were performed to assess the injuries:

CT of the head and cervical spine: Multiple findings were observed, including subarachnoid hemorrhage, skull fractures, and lesions consistent with diffuse axonal injury.

CT of the chest: A small pericardial effusion and subcutaneous emphysema were identified.

After high intracranial pressure subsequently, decompressive surgery were performed, and post-surgical changes were observed in the CT images.

A magnetic resonance imaging (MRI) scan was conducted, confirming the presence of diffuse axonal injuries and areas of cerebral ischemia.

Finally, a postoperative follow-up CT scan showed postoperative changes without acute complications.

Later a cranioplasty was performed

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