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Pediatric acquired brain injury

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Abstract

BACKGROUND: Although pediatric patients are sometimes included in studies about visual problems in patients with acquired brain injury (ABI), few studies deal solely with children. Unlike studies dealing with adult patients, in which mechanisms of brain injury are divided into cerebral vascular accident (CVA) and traumatic brain injury (TBI), studies on pediatric patients deal almost exclusively with traumatic brain injury, specifically caused by accidents.

CASE REPORT: Here we report on the vision problems of 4 pediatric patients, ages 3 to 18 years, who were examined in the ophthalmology/optometry clinic at a children's hospital. All patients had an internally caused brain injury and after the initial insult manifested problems in at least one of the following areas: acuity, binocularity, motility (tracking or saccades), accommodation, visual fields, and visual perceptual skills.

CONCLUSION: Pediatric patients can suffer from a variety of oculo-visual problems after the onset of head injury. These patients may or may not be symptomatic and can benefit from optometric intervention.

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There are various methods of classifying types of acquired brain injury (ABI).[1,2] The first method classifies injuries as to whether the insult is internal or external.[1] External insults to the brain, also known as *traumatic brain injury* (TBI), can result from motor vehicle accidents, falls, sports injuries, assaults, and blunt or penetrating trauma. Internal insults to the brain can result from cerebral vascular accidents (CVA), brain surgery, or arterio-venous malformations (AVMs). The second method of classification uses the mechanism of injury to the brain, either a mechanical force or the interruption of the oxygen supply.[2] Mechanical force injuries can result from blows to the head, motor vehicle accidents, assaults, and penetrating trauma. However, they can also result from internal forces such as a spontaneous hemorrhage. Interruptions of the oxygen supply can result from mechanical force injuries, as well as from ischemic or embolic stroke, strangulation, smoke inhalation, and near drowning. In some cases there can be a "vicious cycle" of mechanical force injuries leading to interruption of the oxygen supply and vice versa.[2]

As with adults, pediatric patients can suffer a brain injury from any of the above mechanisms. Studies on patients with ABI have found that refractive, binocular, accommodative, or ocular motility problems develop in many patients.[3-8] Other studies have found that ABI patients demonstrate visual field defects and visual processing difficulties.[4,5,7,9,10] Although pediatric patients were included in some studies on ABI, few studies dealt solely with patients younger than age 19.[3]

According to the Centers for Disease Control and Prevention, approximately 475,000 children younger than age of 14 suffer from a TBI each year.[11] Approximately 37,000 to 50,658 of these children are hospitalized.[11,12] An overall incidence of approximately 70 to 80 patients

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per 100,000 has been reported for pediatric TBI hospitalizations.[11-13] Some of the variability in rates can be attributed to varying definitions of TBI as well as the age range included as pediatric. Studies agree that boys are more likely to suffer from a TBI than girls.[11-15] Motor vehicle accidents (including motor vehicle–pedestrian accidents) and falls are the 2 most common causes of pediatric brain injury.[3,11,13-15] With teenagers, sports injuries, especially from football, become increasingly common.[14,16]

In younger children, abuse is a frequent cause of brain injury. The incidence of inflicted TBI during the first year of life compared with that in the second year of life has been reported as 29.7 per 100,000 compared with 3.8 per 100,000.[15] Similarly, Reece and Sege[17] found that children with brain injuries secondary to abuse were younger than children with brain injuries from accidents (0.7 years of age compared with 2.5 years). If the etiology of brain trauma in an infant is suspect, the presence of subdural hematomas and/or retinal hemorrhages may be helpful. Reece and Sege[17] found subdural hematomas in 54% of abuse cases and in only 10% of accidental brain injury cases. Retinal hemorrhages were also more common in abuse cases than in accidental cases (33% vs. 2%).

In addition to classification by etiology, cases of ABI can be classified by severity. The Glasgow Coma Scale was developed in the 1970s to assess impaired consciousness.[18] The scale grades a patient's verbal response, motor response, and eye-opening ability. A modified Glasgow Coma Scale for pediatrics exists for preverbal children.[14] The total score for all 3 areas ranges from 3 to 15. Severe brain injury is a score of 3 to 8, moderate is 9 to 12 and mild is a score of 14 to 15. There is some disagreement as to whether a score of 13 is mild or moderate.[14]

Although the Glasgow Coma Scale assists in grading impairment of consciousness, the American Congress of Rehabilitative Medicine has developed more specific definitions of what constitutes mild, moderate, and severe traumatic brain injury for everyone. For example, a mild TBI can include a loss of consciousness, a loss of memory for events immediately preceding or after the accident, an alteration of mental state during the accident, and focal neurologic defects.[19] Studies have found that the majority of cases (81% to 90%) of pediatric TBI are mild, 8% are moderate, 6% severe, and 5% fatal.[4,20]

Vision problems after ABI

Patients who experience a brain injury may complain of numerous visual symptoms. Sabates et al.[4] found the most common presenting complaints of TBI patients, ages 5 to 74 (average age, 31), presenting to a neuro-ophthalmological clinic, were blurred vision (46%), followed by diplopia (30%) and headaches (13%). In spite of these complaints, they found 88% of patients' visual acuities were able to be corrected to 20/30 or better. Similarly, Poggi et al.[3] reported visual acuity decreases are the most common complaints in pediatric traumatic brain injury cases; however, this study included children with pathological causes for decreased acuity, including optic atrophy.

Suchoff et al.[5] also reported that blurred vision is a common presenting complaint of ABI patients. The authors noted that a change in refractive error may be the cause, but that damage to the oculomotor nerve (CN III) or medications, which can affect accommodation, can also result in blurred vision, especially at near. Patients may also report blurred vision in the presence of good acuity because of contrast sensitivity problems.

Reports on adults have shown that 90% of patients with a TBI and 87% of patients with a CVA manifest an oculomotor dysfunction after the injury.[6] Oculomotor dysfunction is a general term for a myriad of conditions including disorders of accommodation, version, vergence, strabismus, and cranial nerve palsies. Interestingly, Ciuffreda et al.[6] found that the most common anomaly varied depending on the type of brain injury. For patients with TBI, vergence disorders were the most common, affecting 56.3% of patients, whereas for patients with CVAs, version problems were most common, affecting 56.7%. Many studies have found that exo deviations, such as convergence insufficiency or intermittent exotropia, are the most common vergence problems affecting ABI patients.[3,7,8] Poggi et al.[3] found that the duration of coma correlated with the difficulties with convergence. Older children and children with cortical atrophy, subacute, subcortical, or diencephalic lesions were more likely to have convergence difficulties. He also found that visual acuity loss and ocular motility problems were more common than vergence problems in younger children.

Cranial nerve palsies have been reported to affect 7% to 43% of patients with ABI.[3,6,20] The percentages vary depending on the type of brain injury, patient age, and the clinic setting in which the patients were examined. One study looking specifically at cranial nerve palsies in patients with closed head trauma found that patients who had a cranial nerve palsy generally had lower Glasgow Coma Scores than patients without cranial nerve palsies and that patients with a third cranial nerve palsy had the lowest Glasgow Coma Scores.[21] Up to 75% of patients show a partial or complete resolution of the palsy without treatment.[20,22]

In a study on pediatric patients with cranial nerve palsies, the most commonly affected cranial nerve was sixth (55%), followed by third (22%), fourth (12%), and finally multiple nerves (11%).[22] In all groups, the most common etiology for the cranial nerve palsy was trauma (42%). Other etiologies were neoplasm (17%), postoperative (4%), and meningitis (3%).

Many ABI patients receive rehabilitative treatments such as speech, occupational, or physical therapy. Additionally, some patients are referred for psychological or educational testing. In many respects, the primary care optometrist can assist in the treatment of these patients by