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Dima Khalil

Natasha Kuklis

Sarah A. Jones Sapienza MD

Shadi Shojaei MD

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Pediatric Blunt Cerebrovascular Injury: A Review of Literature and Case Study

Dima Khalil¹; Natasha Kuklis¹; Shadi Shojaei, MD²; Sarah Jones Sapienza, MD, FACS, FAAP³
 1: LVHN Summer Research Scholar, 2: LVHN General Surgery Residency Program, 3: LVHN Division of Pediatric Surgery, Medical Director of Pediatric Trauma

Lehigh Valley Health Network, Allentown, Pennsylvania

Introduction and Objectives

- Blunt cerebrovascular injury (BCVI) is a rare but serious non-penetrating injury to the carotid or vertebral arteries
- Primarily caused by high impact mechanism of injury with hyperextension and/or rotation of the neck
- Adults have higher incidence of BCVI, with 0.18-2.7% of all blunt trauma admissions¹, while children have an incidence of 0.03%²
 - Likely missed BCVI in children due to lower index of suspicion, lower rate of screening, and discrepant symptoms
- Computed tomography (CT) is the standard imaging modality for BCVI
 - Imaging often not obtained for pediatric patients due to concern for radiation sequelae³
- Objective:** Review relevant literature on pediatric BCVI as well as analyze specific case from LVHN pediatric trauma cohort

Methods

- Literature Review**
 - Systematic review of articles through ClinicalKey journal database
 - Literature was relevant to pediatric BCVI
 - 19 articles reviewed, 3 key articles presented
- Database Query**
 - Common BCVI ICD codes compiled from literature
 - Excluded penetrating trauma findings
 - Queried LVHN pediatric trauma database yielding 1,675 relevant patients; one was chosen for case study
- Analysis**
 - Papers were analyzed for relevant findings
 - Case study was evaluated and compared to literature

Results

Figure 1: Considerable Pediatric BCVI Literature Findings

Study Title	Unique BCVI Presentations	Imaging Decisions	Radiographic Findings	Treatment
1. Blunt cerebrovascular injury in children: underreported or underrecognized? : A multicenter ATOMAC study ⁴	<ul style="list-style-type: none"> 13% of patients with BCVI did not meet any adult criteria Clavicular fractures Combined head & chest trauma 	<ul style="list-style-type: none"> Adult guidelines (Memphis Criteria) were used to decide who should receive imaging 	<ul style="list-style-type: none"> Clavicular fracture had highest association with BCVI BCVI rate of 0.4% 1 patient with frontal bone fracture near eye with frontal lobe contusion 1 patient with pulmonary contusion 	<ul style="list-style-type: none"> Antithrombotic treatment is effective: 0 patients with BCVI developed stroke after antithrombotic therapy, all 6 BCVI patients with stroke were untreated
2. Risk factors for blunt cerebrovascular injury in children: do they mimic those seen in adults? ⁵	<ul style="list-style-type: none"> Concerning neurological exam helped predict BCVI 100% of patients with carotid artery injury had poor neurological exam 3 patients did not become symptomatic until 18 hours after initial presentation 	<ul style="list-style-type: none"> Adult guidelines were used (Denver Criteria) 	<ul style="list-style-type: none"> 100% of patients with vertebral artery injuries had cervical spine fractures BCVI rate of 0.9% Majority of injuries were intimal flaps or dissections 	<ul style="list-style-type: none"> Stroke rate for patients treated with antithrombotic therapy was 0% versus 38% in those untreated
3. Screening for Pediatric Blunt Cerebrovascular Injury: Review of Literature and a Cost-Effectiveness Analysis ³	<ul style="list-style-type: none"> Displaced midface or complex mandibular fracture with severe neck hyperextension Closed head injury 	<ul style="list-style-type: none"> Selective CTA was found to be the most cost-effective, optimal imaging strategy 	<ul style="list-style-type: none"> CTA chosen over magnetic resonance angiography (MRA) because MRA has long scan times, need for sedation in children, lower sensitivity with MRA 	<ul style="list-style-type: none"> Selective anticoagulation is the most cost-effective treatment for high risk BCVI patients

Figure 2: BCVI Patient Case Study

Mechanism of Injury and Initial Presentation
<ul style="list-style-type: none"> Healthy 4-year-old male Two seat utility vehicle roll-over, patient in passenger seat with older sibling driving Vehicle pinned patient's left chest and neck, crush injury No loss of consciousness Hoarse voice Abrasion on right neck and across chest (shoulder to shoulder) Neurologically intact Right shoulder swelling and pain
Hospital Course and Imaging Results
<ul style="list-style-type: none"> Scans obtained due to mechanism of injury and exam: CTA neck, CT chest, CT head, X-ray (XR) chest, XR right humerus, XR abdomen Upper mediastinal hematoma with tracheal deviation; otolaryngology (ENT) performed laryngoscopy with no significant findings Questionable left common carotid artery (L CCA) intimal flap on CTA, MRA neck was recommended for following day due to poor CTA visualization Sedated for MRA, found with L CCA intramural hematoma, 50% luminal narrowing, 3 cm extending superiorly from aortic arch Small infarction in left occipital cortex (11 mm), causing impaired strength, impaired balance, decreased activity tolerance, impaired gait
Outcome
<ul style="list-style-type: none"> Sent to outside facility for pediatric cardiothoracic (CT) surgery consult Immediately started on acetylsalicylic acid (ASA) antiplatelet therapy, to continue for 1 month CT team did not recommend surgery Proceed to follow up with neurology and further imaging in 3 months to check for any vascular changes Seen by physical therapy for rehabilitation

Conclusions

- Adjunctive MRA proved valuable in case presented, but feasibility is still not widely accepted as standard of care in the literature
- Case highlights importance of pediatric-specific guidelines due to:
 - Smaller body size and different anatomy
 - Impact sustained from mechanism of injury
 - Implications for medical treatment and intervention
- Head and chest trauma correlated with pediatric BCVI in both literature and case study
 - No neurological deficits in patient upon first examination, contrasting with some literature findings that suggest carotid artery injuries are paired with poor initial neurological exams
- Anticoagulation therapy was indicated in literature, and used for patient without complication

Future Directions

- We plan to use available literature and LVHN pediatric trauma cohort to create a quality improvement initiative
 - Find common pediatric presentations of BCVI in our own patients
 - Create guidelines at LVHN for screening blunt cerebrovascular injury in children



Figure 3: Patient's MRA Neck Showing L CCA Injury

References

- Bromberg W.J., Collier B.C., Diebel L.N., et. al.: Blunt Cerebrovascular Injury Practice Management Guidelines: The Eastern Association for the Surgery of Trauma. J Trauma Acute Care Surg 2010; 68: pp. 471-477. [410.1097/TA.1090b1013e3181cb1043da]
- Jones T.S., Burlew C.C., Kornblith L.Z., et. al.: Blunt cerebrovascular injuries in the child. Am J Surg 2012; 204: pp. 7-10
- Malhotra, Ajay, Wu, Xiao, Kalra, et. al. (2015): Screening for Pediatric Blunt Cerebrovascular Injury: Review of Literature and a Cost-Effectiveness Analysis Journal of Pediatric Surgery, 2015-10-01, Volume 50, Issue 10, Pages 1751-1757
- Azaraksh N., Grimes S., Notrica D.M., et. al.: Blunt cerebrovascular injury in children: underreported or underrecognized?: A multicenter ATOMAC study. J Trauma Acute Care Surg 2013; 75: pp. 1006-1011. [discussion 1011-1002]
- Kopelman T.R., Berardoni N.E., O'Neill P.J., et. al.: Risk factors for blunt cerebrovascular injury in children: do they mimic those seen in adults?. J Trauma 2011; 71: pp. 559-564. [discussion 564]