Journal of Radiology Nursing 38 (2019) 11–12

Contents lists available at ScienceDirect

Journal of Radiology Nursing

journal homepage: www.sciencedirect.com/journal/journal-of-radiology-nursing

Just Pediatrics

Heads-up: Concussion in the Pediatric Patient

Lori P. Halaby, MSN, APRN (Guest Columnist) *

Nurse Practitioner, Division of Rehabilitation Medicine, Nemours AI DuPont Hospital for Children, Wilmington, DE

Concussion is the most common sports injury in children and adolescents and is the leading cause of emergency department visits for pediatric patients, with an estimated 640,000 visits in 2013 alone (Lumba-Brown et al., 2018a,b). When children are diagnosed with a concussion, many parents ask, "Isn't a concussion a brain injury? Why wasn't any imaging of my child's head performed?" The answer to the first question is—yes, a concussion is a mild traumatic brain injury (mTBI). It may also be referred to as a minor head injury or minor head trauma. Although these terms are often used interchangeably, the perceived significance can vary between patients, families, and health-care providers, leading to potential misunderstanding. In fact, the Centers for Disease Control and Prevention recently released a guideline for the diagnosis and treatment of mTBI and recommended that the term "mild traumatic brain injury" replace the term concussion (Lumba-Brown et al., 2018a,b).

In answering the latter question—"Why wasn't any imaging of my child's head performed?"—concussion or mTBI is not an imaging-based diagnosis; as such, neuroimaging is not routinely needed. The role of imaging in the acute setting is to evaluate for the presence of an intracranial injury (ICI) requiring stricter monitoring or neurosurgical intervention. Neuroimaging studies including computed tomography (CT) and magnetic resonance imaging (MRI) are not recommended after mTBI as they typically reveal normal findings (Guenette, Shenton, & Koerte, 2018). The decision whether or not to image should be based on validated clinical decision rules established to assess for likelihood of a structural ICI, such as those from the Pediatric Emergency Care Applied Research Network (PECARN) or the American Academy of Neurology. These tools assess a combination of risk factors for ICIs, including age younger than 2 years, severe or worsening headache, loss of consciousness, vomiting, severe mechanism of injury, clinical suspicion for skull fracture, Glasgow Coma Scale less than 15, amnesia, and nonfrontal scalp hematoma (Lumba-Brown et al., 2018a,b). Neuroimaging is not without risk. The risks of higher radiation exposure from CT imaging, as well as the risks of potential sedation, should be discussed in relation to the risks for ICIs. When clinically indicated, the recommended diagnostic tool of choice is CT due to its increased sensitivity for hemorrhage and higher spatial resolution than MRI (Guenette, Shenton, & Koerte, 2018).

So, how do we diagnose a concussion or an mTBI? The diagnosis of mTBI is based on a reported head injury that causes an alteration in physical, emotional, behavioral, and/or cognitive functioning. The injury to the head can be from direct trauma or a force transmitted to the brain, as in a whiplash type injury. The force can cause immediate onset and/or delayed (hours to days) onset of symptoms. Although 80-90% of children recover from an mTBI within 3 months, the remaining 10-20% report ongoing symptoms for several months (Schmidt et al., 2018). As of present, there is no single tool that can be used in isolation to diagnose injury and assess for recovery. Age-appropriate validated symptom scales, such as the Post-Concussion Symptom Inventory or the Acute Concussion Evaluation tool, should be used. Patient evaluation should also include assessment for premorbid conditions/risk factors for prolonged recovery: (1) history of an mTBI, (2) lower cognitive ability, (3) neurological or psychological disorder, (4) learning difficulties, (5) Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder, (6) headaches/migraines, (7) family and social stressors, (8) lower socioeconomic status, (9) Hispanic ethnicity, (10) older child/adolescent, and (11) severe symptom burden (Lumba-Brown et al., 2018a,b). Physical examination should include a complete neurologic examination, vestibular/ocular motor screening, and balance assessment. Neuropsychological assessment, an important component of the concussion examination, should include an objective cognitive screening and screening for mood-related symptoms. Recovery from injury is based on symptoms, examination findings, and function returning to the preinjury baseline.

Based on the current data available, there is no biomarker or neuroimaging tool that clearly identifies concussion or mTBI or injury recovery. In a systematic review by Schmidt et al. (2018), the authors described multiple studies using advanced neuroimaging for identifying potential brain biomarkers, including diffusion tensor imaging (DTI), functional MRI (fMRI), susceptibility-weighted imaging, electroencephalogram (EEG), anatomic MRI, resting-state fMRI, and magnetic resonance spectroscopy. DTI, a form of MRI that measures diffusion of water molecules, has been the most frequently used imaging technique and appears to hold promise having a significant correlation with symptom report, emotional issues, arithmetic problem solving, and concussion outcome scores (Schmidt et al., 2018). In addition to neuroimaging techniques, other biological biomarkers, such as blood, serum, and genetics, are also being

* Corresponding author: Lori P. Halaby, Nemours AI DuPont Hospital for Children, Division of Rehabilitation Medicine, Wilmington, DE, USA.
E-mail address: Lori.halaby@nemours.org.

https://doi.org/10.1016/j.jradnu.2018.12.004
1546-0843/$36.00/

studied. In the future, the combination of these modalities may be used for timely diagnosis, as well as targeted management and more accurate prognostication of pediatric mTBI.

References

Guenette, J.P., Shenton, M.E., & Koerte, I.K. (2018). Imaging of Concussion in Young Athletes. *Neuroimaging Clin North Am, 28*, 43-53.

Lumba-Brown, A., Yeates, K.O., Sarmiento, K., Breiding, M.J., Haegerich, T.M., Gioia, G.A., Turner, M., et al. (2018a). Centers for disease control and prevention guideline on the diagnosis and management of mild traumatic brain injury among children. *JAMA Pediatr, 172*, e182853.

Lumba-Brown, A., Yeates, K.O., Sarmiento, K., Breiding, M.J., Haegerich, T.M., Gioia, G.A., Turner, M., et al. (2018b). Diagnosis and management of mild traumatic brain injury in children: a systematic review. *JAMA Pediatr, 172*, e182847.

Schmidt, J., Hayward, K.S., Brown, K.E., Zwicker, J.G., Ponsford, J., van Donkelaar, P., et al. (2018). Imaging in pediatric concussion: a systematic review. *Pediatrics, 141*.