

# Perioperative Concussion: Learning from Football and Improving Patient Safety

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**C**oncussion, or mild traumatic brain injury, results from a physical blow to the head, often synonymous with post-injury concussive symptoms such as headache, cognitive impairment, and sleep disturbance. Our understanding of this disease has grown rapidly over the last two decades. We know that sustained physiologic and metabolic alterations occur after concussion, even after symptoms have resolved (*Mayo Clin Proc* 2017;92:1042-52). Moreover, after our 2017 study, we now appreciate that patients with recent concussion may present to our ORs more commonly than we thought. This article will highlight recent knowledge, concussive pathophysiology, and perioperative patient safety considerations.

## Sociologic observation in concussion: Learning patient safety culture from outside medicine

In the short history of our evolving understanding of concussion, 17 years may be considered “ancient.” Just 17 years ago, in 2005, Dr. Bennet Omalu released the autopsy result of a former professional American football player, where he defined histologic postmortem changes in patients with sustained, repetitive head injury – a disease we now know as chronic traumatic encephalopathy, or CTE (*Neurosurgery* 2005;57:128-34). After this report, study after study provided evidence that repetitive secondary injury to a brain recovering from an initial traumatic injury can produce objective histologic, cognitive, and pathophysiologic neurologic changes.

Though we know this as fact now, return to play after concussion was taken more lightly, at least in professional football prior to 2005. The same year and in the same journal that Dr. Omalu’s landmark autopsy study was released, a consensus manuscript by the National Football League was published, stating that returning to play after recent concussion did not impose serious secondary injury (*Neurosurgery* 2005;56:79-90). While the OR environment is not equivalent to injuries on the football field, it is probably sufficient to assume that the perioperative environment is *not* comparative to rest and relaxation in a quiet home or bed for recovery after a concussion.



## What we can't see in recently concussed patients: Sustained pathophysiologic changes after head injury

Concussive injury after a blow to the head occurs as the brain moves suddenly within the cranial vault. Sudden jarring can cause shear forces. Blunt injury can cause a myriad of abnormal disruptions in normal neuronal physiology and activity. Dr. Pasternak and I recently reviewed these mechanisms in a “Focused Review” for the *Journal of Neurosurgical Anesthesiology* (*J Neurosurg Anesthesiol* 2022;34:277-81). Some of the main points of this review are:

- Hyper- and hypometabolic perturbations in normal cerebral function can cause an energy supply-demand mismatch state.
- Systemic hemodynamic changes may occur after concussion. Several studies suggest that patients with recent concussion can develop a pattern of diminished heart rate variability during stress and altered autonomic-dysregulation blood pressure responsiveness (*Curr Opin Anaesthesiol* 2020;33:639-64).
- Diminished cerebral autoregulatory processes and pathophysiologic changes in cerebral blood flow can occur after concussion.

## Persistence of physiologic aberrancies after concussion

Most clinical signs and symptoms of concussion resolve within seven days of injury. This depends on prior history of concussion and severity of injury or symptoms. However, despite resolution of symptoms, the subclinical alterations in physiology described above may persist for *weeks* and even months after injury (*Med Sci Sports Exerc* 2018;50:2192-9). Moreover,

in a study of young athletes, cerebral autoregulation was impaired despite a normal Glasgow Coma Scale score of 15 (*Brain Inj* 2018;32:269-75).

A study performing a multivariate analysis showed no difference in postoperative outcomes (headache, agitation, nausea, pain) (*J Neurosurg Anesthesiol* 2021;33:221-9). However, univariate analysis in patients within 30 days after concussion showed significantly higher rates in postoperative headaches and high pain scores after surgery. It is too early to make clinical decisions from these findings, but there are definite signals that should prompt future study.

## How can I impact perioperative safety in concussed patients?

Our medical knowledge of concussion is still in its infancy. While there are retrospective studies out there, there are no prospective studies looking at this population as of the date this article was written. Here are some general concepts regarding traumatic brain injury and the associated retrospective studies that have been published thus far.

- Know that patients with recent concussion may need anesthesia more commonly than we thought! In a large retrospective study at a single quaternary medical center, more than 1,000 patients with a recent (within one year) concussion underwent at least one anesthetic (general or monitored anesthesia care) over a 10-year period.
- Diagnosis of concussion and concussive symptoms can be easily done. Concussion is a clinical diagnosis. Many evaluation tests are available. For a quick assessment of concussive symptoms, consider the Sport Concussion Assessment Tool (SCAT5) used by sports medicine physicians to rule out concussive symptoms after head injury (*Br J Sports Med* 2017;51:848-50).
- In patients with ongoing concussive symptoms, *consider* delaying elective procedures under anesthesia. Any traumatic brain injury resulting in concussive symptoms requires, at the minimum, 24 hours of physical and cognitive rest.



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While giving any recommendation on timing of surgery/anesthesia after a concussion would be purely speculative at this time, we can appreciate that pathophysiologic changes after concussion can persist weeks after injury despite resolution of symptoms and that ongoing symptoms may reflect subclinical aberrations in brain physiology, metabolism, and function. At my institution, I have recommended multidisciplinary decision-making on delaying elective procedures in patients with recent concussion with ongoing symptoms.

- **There are practice recommendations outlined by the Brain Trauma Foundation for severe TBI. The hemodynamic parameters are worth reviewing.** Last updated in 2017, the guidelines for severe TBI are not specific to concussion and were made to support a neurophysiologic state for optimal brain recovery after injury. These guidelines recommend 1) avoiding unnecessary hyperventilation, 2) avoiding unnecessary corticosteroids, 3) maintaining normotension and avoiding hypoxia (*Neurosurgery* 2017;80:6-15).

## What's the take-home message?

As with all things, knowledge is key. We can learn from the awareness campaigns and evolution of safety practices that occurred in football and protecting our sports players – namely by spreading the word, becoming aware of concussion history, signs, and symptoms preoperatively, and knowing how to diagnose. We can expect further studies in this topic, with more power, prospectation, and better-defined outcomes. Hopefully, with deeper knowledge and a focus on patient safety, we can evolve our practices to optimize perioperative care for this patient population. ■

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