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### Post Concussion Syndrome

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# Post Concussion Syndrome

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## What is Post Concussion Syndrome ?

- Post concussion syndrome (PCS) is the prolonged occurrence of a variety of neurological symptoms that are sustained up to 1 month to years after a concussion (Guinto & Guinto-Nishimura, 2014).

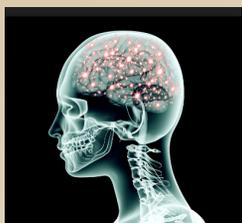


Figure 1: Illustration of brain activity during a concussion. Reprinted from neuroelevation.com. Retrieved from: <https://www.neuroelevation.com/services/2017/12/18/concussion-rehabilitation>

- Traumatic brain injuries and concussions was the diagnosis of 2.5 million patients admitted in U.S. emergency rooms in 2013. From 2007-2013, traumatic brain injury related emergency room visits increased by 47% (CDC, 2017).
- Guinto and Guinto-Nishimura (2014) estimate that ~15% of patients who sustain concussions experience PCS.
- This condition can cause a variety of symptoms ranging from a mild, persistent headache to depression, loss of balance, dizziness, etc.
- Due to its rising prevalence and the debilitating and long lasting potential of its symptoms, this author chose this subject in order to gain a better understanding of this syndrome and share these findings with others.

## Diagnosis

- Because post concussion syndrome is highly variable in its presentation, diagnosis can be somewhat challenging.
- Generally, diagnosis is made when symptoms persist for more than one month and at least three of the following symptoms are present: 1) fatigue 2) alterations in sleeping patterns 3) irritability that is out of proportion to stimulus 4) anxiety and depression 5) headache 6) vertigo 7) personality changes and 8) apathy (Guinto, G. & Guinto-Nishimura, Y., 2014).
- There is some evidence that certain biomarkers are present in the blood and other body fluids at the time of a concussion and during the recovery period. These biomarkers require further research, but they are a promising and more subjective method for the diagnosis of concussions and PCS (Battista, Rhind, Baker, Jetly, Debad, Richards, & Hutchinson, 2018).

## Signs and Symptoms

The presentation and length of the signs and symptoms of PCS are highly variable and may look different in each patient. According to Mullally (2017), patients with numerous symptoms in the immediate post concussion recovery period tend to have lingering symptoms (PCS). There is debate on whether the presence of preexisting conditions such as depression or mood disorders affect the possibility of a patient developing PCS. Additionally, despite the high variability of the symptoms of PCS, persistent headaches are the most commonly reported symptoms (Phillips & Reddy, 2016).

Other symptoms may include:

- Nausea
- Impaired balance
- Dizziness
- Blurred vision
- Confusion
- Memory impairment
- Brain fog
- Fatigue
- Cognitive, emotional, and/or behavioral changes
- Sleep disturbances

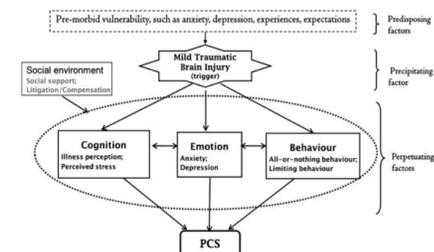


Figure 2: Diagram illustrating the complexity of symptoms of PCS. Reprinted from Hou, R., Moss-Morris, R., Peveler, R., Mogg, K., Bradley, B., and Belli, A., 2012.

## Underlying Pathophysiology

- Post concussion syndrome (PCS) begins with a concussion which is caused by direct force to the head. This usually occurs as the result of a coup contra-coup injury, falls, or blows sustained to the head. (Mullally, 2017).
- The force that is exerted on the brain causes the release of excitatory neurotransmitters.
- The main neurotransmitter that is released is glutamate. Glutamate binds to the N-methyl-d-aspartate (NMDA) receptors which causes an efflux of potassium out of the cell, while calcium rushes into the cell.
- The increase in intracellular calcium causes mitochondrial dysfunction, the release of free radicals, and apoptosis.
- As the cell attempts to restore homeostasis, the workload of the ATP powered Na/K pump is increased along with a higher demand for glucose to power these pumps.
- As the mitochondria continue to fail, lactate builds up as the cells resort to anaerobic glycolysis.
- This state of metabolic acidosis increases cellular permeability, worsening the ion imbalances and creating a cycle that is hard to break.
- There is evidence that PCS is caused by alterations in brain excitability including disorders of synaptic plasticity, axonal sprouting, as well as excitatory-inhibitory imbalances.
- Some of the cognitive deficits found in PCS could be due to the alterations in the hypothalamic-pituitary-adrenal-axis as many of the glucocorticoid receptors are found on the brain, particularly the hippocampus.
- Diffuse axonal damage, damage to axonal cytoskeleton from mechanical force of the injury, is another potential cause of some of the neurological deficits in PCS (Guinto & Guinto-Nishimura, 2014).
- Kamins and Giza (2016) note that most of this metabolic mismatch occurs in severe traumatic brain injuries (TBI). However, they state that both severe TBI and concussions seem to have an affect on cerebrovascular flow as a result of this abnormal metabolic activity.
- In most cases, this effect on cerebrovascular flow resolves in 1 to 7 days, but patients with symptoms persisting more than a month were more likely to have continuing decreased cerebrovascular blood flow (Kamins & Giza, 2016).

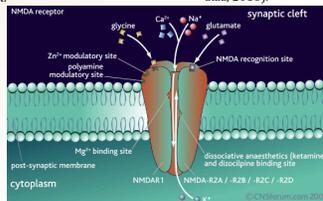


Figure 3: Illustration glutamate binding to NMDA receptor, leading to ion imbalance. Reprinted from jonlieffmd.com. Retrieved from: <http://jonlieffmd.com/blog/another-form-of-neuroplasticity-by-switching-glutamate-nmda-subunits>

## Significance of Pathophysiology

- There is some evidence that there is a genetic component to concussions. Research is beginning to suggest that those with the APOE promoter G-219T-TT genotype may be predisposed to concussions.
- Return to playing sports before concussion symptoms are resolved could result in second impact syndrome, which is when the recovering brain sustains another blow resulting in potentially fatal brain swelling (Phillips & Reddy, 2016).
- Levin and Diaz-Arrastia (2015) state that post concussion symptoms may take years to manifest as in the case of children who sustained concussions while they were younger and later experience developmental, mood, or conduct disorders.

## Implications for Nursing Care

- It is important to obtain a detailed history of conditions and symptoms prior to and after a concussion as PCS presents differently in each person and PCS symptoms can magnify preexisting psychiatric conditions.
- Prevention of additional head injuries and concussions is important as doing so can cause further complication in PCS recovery.
- Prevention and safety education such as the use of a helmet for appropriate activities and limiting or restricting participation in certain activities may be necessary.
- It is important to recognize that sleep disturbances, headaches, vestibular and emotional disturbances may occur in PCS in different severities and durations that vary from person to person.
- Because of the variability of symptoms, treatment for each patient could look different.
- Some interventions include the addition of various medications such as SSRIs or vision/physical/occupational therapy.
- Regardless of the treatment plan, the emotional needs of the patient need to be addressed as the loss in their ability to function 'normally' can produce frustration and depression.
- Patient and family education, as well as cognitive behavioral therapy and helping the patient to identify support systems can help address these emotional needs.
- Helping the patient establish an overall healthy and balanced lifestyle can significantly help the overall healing process (Phillips & Reddy, 2016).

## Conclusion

- Concussions, though rapid in onset, have the potential to cause symptoms that can have a significant and chronic effect on a person's ability to function in everyday life.
- Symptoms of PCS are vague, ranging in severity from mild to debilitating. Diagnosis is highly dependent on patient history and report of symptoms.
- It is important that PCS treatment is focused not only on symptom management, but on emotional support as loss of normal functioning can be distressing to PCS patients as well as worsens the symptoms that are already present.
- Increased awareness and a better understanding of the pathophysiology of this syndrome can aid in treating PCS as a condition and not as a set of symptoms.

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