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Prolonged recovery from minimal traumatic brain injury in patients suffering rapid repetitive head trauma due to syncope associated with postural orthostatic tachycardia syndrome

Abstract

Recurrent syncope due to autonomic instability is common in patients with postural orthostatic tachycardia syndrome (POTS) and often results in head trauma. These head traumas individually or combined may lead to concussion (MTBI) symptoms and therefore require medical intervention. Most MTBI recover in a short period of time however, a subset of patients including female adolescents and those with multiple head traumas in a short period of time before full brain recovery may be at risk for prolonged recovery. The combination of these factors could potentially lead to a significant risk of prolonged MTBI recovery. Three patients previously diagnosed with POTS related syncope who had multiple episodes of syncope with head trauma within a short period of time are described. Each of these patients had a prolonged recovery from their MTBI. The association of multiple MTBI within a short period of time in female adolescents with POTS associated syncope resulting in prolonged recovery illustrates the need for patient and family education, close observation, and possible head protection.

Keywords: concussion, brain, syncope, trauma, pediatric, adolescent, rehabilitation, neurology

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Abbreviations: POTS, postural orthostatic tachycardia syndrome; MTBI, minimal traumatic brain Injury; CT, computerized tomography; MRI, magnetic resonance imaging

Introduction

Minimal traumatic brain injury (MTBI) is defined as a functional disruption of cerebral neuronal function resulting from direct or impulsive force.[1,2] The clinical manifestations of MTBI may include physical symptoms such as headache or photosensitivity, cognitive symptoms such as foggy thinking as well as fatigue and syncope, emotional symptoms such as impulsiveness or irritability, and sleep disruption. The cause of MTBI syncope is uncertain but proposed to be a transient autonomic disruption. The recovery from MTBI typically follows a stepwise fashion and usually completes in 1-3 weeks although a subset of patients may take significantly longer. Risk factors for prolonged recovery are numerous and include female sex, pre-existing neurologic or psychiatric illness or disability, and repetitive MTBI especially before full recovery.[3]

Postural orthostatic tachycardia syndrome (POTS) is caused by an autonomic instability and results in a failure of peripheral vascular resistance to increase in orthostatic stress with decreased venous return to the heart despite a compensatory increased in heart rate and contractility.[4,5] The diagnosis of POTS requires an increase of heart rate by 30 beats per minute with 10 minutes of orthostatic stress. As a result, one of the most common symptoms of POTS syndrome is near or complete syncope and collapse. It could be postulated that female adolescent patients with POTS and recurrent head trauma are at risk for prolonged recovery and at the very least represent a high risk population.

Three adolescent patients with a previous history of POTS associated syncope suffering multiple head injuries in a short period of time and having a prolonged recovery are described to illustrate this high risk population. The patients described here are remarkable to the authors due to the frequency of pre-existing POTS associated syncope in the population of MTBI patients with prolonged recovery managed in the local adolescent concussion clinic. Of 426 MTBI patients seen between February 1. 2012 and December 31, 2012, 62 had recoveries longer than 3 months and 3 had pre-existing POTS associated syncope (5%).

Case 1

The patient was a 15-year-old female with no other cardiologic, neurologic or psychiatric diagnoses other than POTS. She was diagnosed after a history of recurrent near syncope with one complete syncope episode and a positive tachycardic response to orthostatic stress. She was maintained on mineralocorticoid spray and her symptoms became more infrequent. She had no previous MTBI. The patient suffered a complete syncope episode where she struck the back of her head. She awoke within 30 seconds and according to the parent was neurologically intact with no headache or neurologic findings. One hour later she had a similar complete syncope episode and struck the right parietal area. She awoke with confusion, dizziness, and altered mental status. During emergency department evaluation she continued to have headache, confusion, and dizziness. Brain imaging was normal. Her sensorium improved over the next 2 hours. She was discharged home with instructions for complete initial bed-rest and sensory withdrawal. She was evaluated at the local comprehensive concussion clinic the next day and found to have ongoing headache and photosensitivity associated with cognitive, physical exertion, and light exposure. A comprehensive recovery plan with clinical follow up was developed including rest, dietary management, gradual return to learn and play, as well as cognitive and ocular rehabilitation. All symptoms but her cognitive impairment of short term memory resolved over the next 3 weeks. Despite intensive cognitive rehabilitation therapy, she was notable to resume a full academic load for 9 months. She previously was an honor student in mathematics.

Case 2

Patient 2 was a 13 year old female previously diagnosed with POTS by a positive orthostatic stress test after a series of near syncope episodes and one previous complete syncope episode on a trampoline. She was maintained on mild salt replacement at home and had been symptom free for 11 months. She had no history of previous MTBI. The patient suffered a gastroenteritis episode with vomiting and diarrhea. During recovery 1 week later she had a complete episode upon standing and fell striking the right parietal area. She aroused quickly and had a normal sensorium. Approximately 10 minutes later she was sitting and had another syncope episode where she fell forward and struck her forehead. She aroused but was unable to stand due to weakness in her legs and had a severe headache, hearing loss on the right side, and photosensitivity. She was evaluated in the emergency department where she had normal imaging including CT and MRI. She was diagnosed with MTBI and discharged with standard appropriate concussion instructions.

In concussion clinic the next day she was found to have a severe centrally mediated gait disturbance with ataxia and oculomotor dysfunction. In addition to standard MTBI management, she was placed on appropriate vestibular and ocular rehabilitative plans and was compliant. Her headache and photosensitivity resolved in 2 weeks. Her balance required 7 months of vestibular rehabilitation. Her oculomotor dysfunction required 6 weeks of therapy, and her central hearing loss required 9 months for full recovery. She had previously been a competitive cheerleader but was never able to resume this sport.

Case 3

Patient 3 was a 16 year old female with a diagnosis of POTS by orthostatic stress test after recurrent near syncope episodes and 2 previous complete syncope episodes where she was caught by bystanders and suffered no head trauma. She was on no medication and behaviorally managed her near syncope feelings by avoiding high risk situations. She had no previous MTBI. She was an average student and worked a part time job after school prior to injury. At a basketball game she had a complete syncope episode in the stands with her parents and struck her left scalp. She immediately recovered and was taken home. On stepping out of the car she had another complete syncope episode and struck her forehead on the sidewalk. She had altered sensorium and was evaluated at the emergency department where she had normal imaging. She improved after observation overnight and was discharged with appropriate instructions the next day. In concussion clinic she was found to have a convergence deficit making it impossible to read. Oculomotor rehabilitation exercises were prescribed. Her headache and photosensitivity resolved in 3 weeks and her convergence deficit resolved only after 5 months of rehabilitation (Table 1).

Table 1 Possible factors associated with prolonged recovery in adolescent MTBI

Repetitive head trauma
Female sex
Pre-existing neurologic or learning dysfunction
Pre-existing behavioral or psychiatric diagnosis
Initial symptom severity
Previous MTBI with prolonged recovery

Discussion

Syncope may result from a number of conditions including vasovagal syncope, arrhythmias, POTS, and MTBI.[1,2,6] The complete loss of postural reflexes in patients with POTS places them at heightened risk of head trauma resulting in MTBI. The repetitive nature of syncope in these patients places them at risk for repetitive MTBI in a short period of time. In the patients described it is uncertain whether the initial head injuries resulted in an initial MTBI and subsequently contributed to the further syncope episodes independent of POTS associated syncope. The diagnosis of MTBI and subsequent recovery is clinically functional and the physiology is incompletely understood.[1,2]

MTBI is thought to result from neuron injury with subsequent cellular calcium influx and potassium efflux. This results in cellular inability to utilize glucose and neuron dysfunction. Clinical manifestations result from the global expression of this neuronal dysfunction. Recovery of neuron function after MTBI depends on many factors including severity and mechanism of injury, sex and developmental age of the patient, and previous MTBI history.[3,7] As a result, recovery is unpredictable especially in cases of repetitive injury within a short period of time. The typical recovery period for MTBI is 1-3 weeks. However, there remains a consistently described percentage of adolescent patients (10-30%) who have a prolonged recovery. Repetitive head trauma before full recovery from a prior MTBI increases the risk of a prolonged recovery and rarely results in catastrophic injury or death (second impact syndrome).

Conditions which may result in repetitive head trauma and potential MTBI such as POTS associated syncope place the patient at risk for prolonged recovery time. Patients and families should be counseled appropriately. In summary, three patients with pre-existing POTS who had rapid repeat head injuries due to syncope resulting in MTBI with a prolonged recovery time are described. Female adolescent POTS patients should be considered at high risk for repetitive head injuries which may result in multiple MTBI and prolonged recovery. Counseling by primary and specialty providers as well as appropriate behavioral precautions is recommended.

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Conflicts of interests

None.

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