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Case Report

Concussion and Chronic Migraine in a Female Pediatric Patient with Chiari Malformation Type I and Syringohydromyelia

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Abstract

Concussion in contact sports is a common occurrence, diagnosed at an increased frequency given new awareness regarding post-concussive injury. Both the decision to utilize neuroimaging in diagnosis and treatment, as well as the determination of return to play to contact sport, can be challenging and controversial. This case report discusses a 13-year-old female who sustained a concussion and experienced atypical neurologic symptoms. Chiari Malformation and syringohydromyelia were found incidentally and believed to have prolonged the recovery.

Keywords: Concussion; Headache; Chiari malformation; Contact sports

Abbreviations

CM: Chiari Malformation; CMI: Chiari Malformation Type I; PCP: Primary Care Physician; MRI: Magnetic Resonance Imaging

Introduction

There has been an increased awareness of the dangers of concussion in pediatric patients as a result of participation in contact sports [1–3]. Adolescent participation in soccer is known to be associated with increased risk of mild traumatic brain injury due to the high frequency of direct contact with the ball to the head [4]. Caring for patients with concussion can be challenging given the various mechanisms of injury, their past medical history, as well as the possibility of other, previously undiscovered, preexisting medical conditions which can extend recovery times. The literature in sports-related injuries shows 80-90% of concussion patients recover within 7-10 days [1,5,6]. The remaining 10-15% sub-population of more chronic concussion patients experience atypical symptoms and/or prolonged recovery. These patients are often treated in an outpatient setting with a more complex evaluation and treatment plan because of their chronicity and possible presence of underlying, co-occurring health conditions [7].

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Case Presentation

A 13 year-old female athlete playing in a competitive soccer tournament suffered a concussion with no loss of consciousness. While playing defense, she was hit in the back of the head with a soccer ball by her own goalie. Directly after the event, she experienced headaches, poor sleep, and nausea. She did not experience imbalance or dizziness, attention and concentration deficits, or mood disturbance. The athlete continued to play until she visited her primary care physician (PCP) 2 weeks after the injury. The PCP recommended removal from play and a full neurologic evaluation.

One month after injury, she was seen at the Dent Neurologic Institute's concussion center in Amherst, New York. She presented with worsening symptoms including dull, daily headaches at 5-6/10 on the pain scale, with intermittent spikes in pain at 9/10. Her pain typically occurred behind and around her eyes and was exacerbated with physical activity. However, the patient experienced increased pain in the back of her neck and occipital region when bending over, coughing, and physical exertion. The patient was diagnosed with concussion.

She had a preexisting history of mild, dull headaches, with photophobia and phonophobia, occurring on average 2 times a week. These headaches had no significant impact on her day-to-day functioning or school attendance and did not require medication. There was a family history of migraines in her mom and maternal aunts. It was suspected the patient had a past history of migraines that were previously undiagnosed.

Initially after the concussion, the athlete tried ibuprofen as needed but did not experience relief. At the concussion center, treatment included amitriptyline, Relpax, Nasprosyn, and magnesium oxide, as well as physical therapy and massage therapy. The patient was non-responsive to treatment after a 3 month period.

Subsequently, brain and cervical spine MRI scans on a 3 Tesla magnet were ordered due to reports of focal numbness and tingling down into her hands with increased pain when

moving her neck. The brain MRI, shown in Figure 1, revealed low-lying peg-shaped cerebellar tonsils extending 1.4 cm below the foramen magnum, which is consistent with a diagnosis of Chiari malformation type I (CMI) [8–10]. There was also straightening of the normal lordotic curvature of the cervical spine indicative of a paraspinal muscle spasm. The cervical MRI revealed a widening of the central spinal canal from C6-C7 to C7-T1 consistent with a diagnosis of syringohydromyelia. The syrinx measured 2.1 cm rostral caudal [Figure 2] with a maximum diameter of 0.28 cm [Figure 3]. Massimi et al., noted a high frequency temporal association between CMI symptom onset and minor head injury [11] which is consistent with the present case report.

CMI can be managed using medical and surgical intervention. McVige and Leonardo provide a step-wise flowchart for clinical management of CMI and argue, "As headaches are the most common presenting symptom of CMI, they are typically treated according to presenting phenotype. The decision for surgical intervention is based on a combination of the clinical presentation, neuroimaging and/or physiologic studies such as somatosensory evoked potentials, swallow evaluations and sleep studies [12]." The patient was referred to pediatric neurosurgery to explore surgical options. After full evaluation and collaboration with neurosurgery, a decision was made to aggressively treat her headaches without surgery given that they were not typical of Chiari-type headache [12,13]. The headache presentation was atypical, as the patient consistently experienced pressure behind her eyes especially with physical exertion, however, posterior occipital and neck pain improved temporally with physical therapy. Other notable atypical neurological symptoms included numbness and tingling down her arms and occipital region pain. The patient felt the postconcussive fogginess and concussion headaches had resolved.

At this point, her presentation seemed more consistent with migraine, which was believed to be a preexisting condition. She eventually tried several treatments for migrainous headaches including, Frova, Migranal, Propranolol, Butterbur, Topamax, Cambia, and Sprix, as well as, occipital and supraorbital nerve blocks, trigger point injections, and a series of sphenopalatine blocks. The patient experienced minimal to no short-lived relief from all previously referred migraine treatment options. The patient was also physically examined for scoliosis as this is a common comorbidity with CMI and syringohydromyelia [12], but was not found to have this diagnosis. Her headaches were daily and averaged 6-8/10 in the bifrontal/bitemporal with posterior radiation. These headaches were described as "nagging" and often negatively impacted her sleep. Due to her level of disability and the fact that patient met criteria for chronic migraine with failed pharmacotherapy, physical therapy and therapeutic injection treatments, Botox injections were initiated [14].

At the beginning of Botox injection treatment, she reported daily headaches with pain averaging 6/10 and some days of increased intensity "spikes" at 8/10. Over the past five years, she has received a total 19 Botox injection treatments and at last visit reported an average of 3 or fewer headaches days a month with pain averaging 1/10 which she rates as a 90% improvement overall. Figures 4, 5 illustrate the improvement in her headache

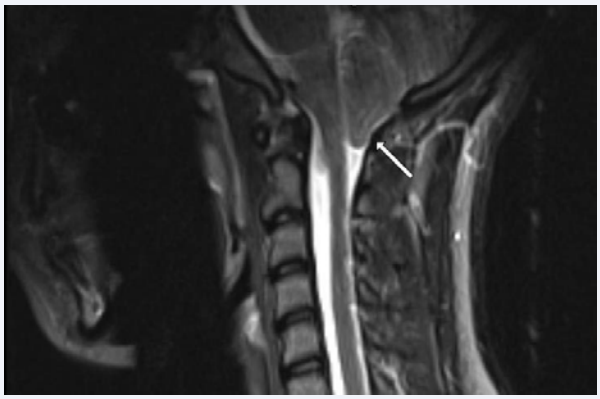

Figure 1 T2 weighted sagittal image showing low lying peg-shaped cerebellar tonsils, measuring at 1.4 cm below the foramen magnum.

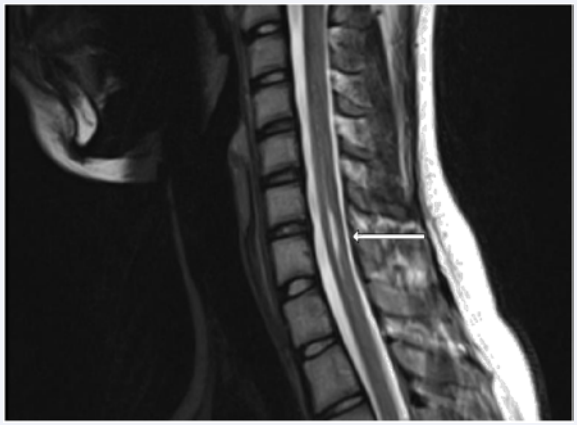

Figure 2 T2 weighted sagittal image showing widening of the central spinal canal from C6-C7 to C7-T1. The syrinx measured 2.1 cm rostral caudal.

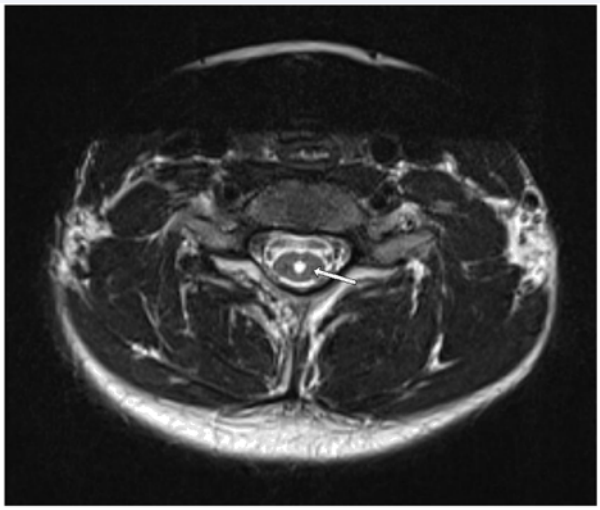

Figure 3 T2 weighted transverse image showing the syrinx at the maximum diameter of 0.28 cm.

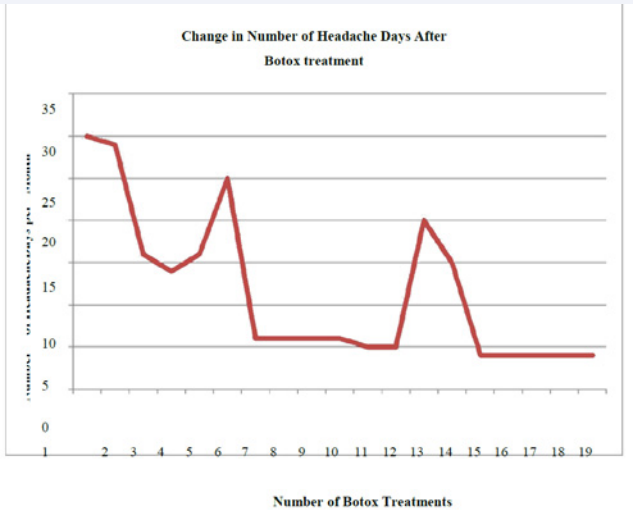

Figure 4 A longitudinal graph of the number of headache days on average per month after the patient began Botox treatment. Note: The spikes at treatments #6 and #13 are the result of extended delays between Botox treatments.

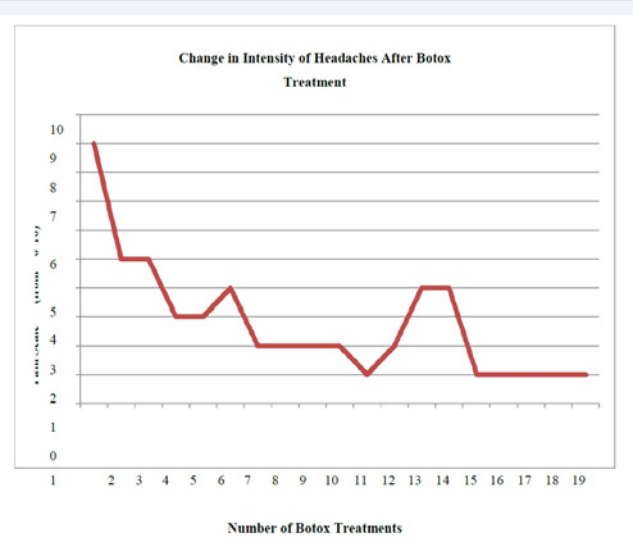

Figure 5 A longitudinal graph of headache intensity on average per month after the patient began Botox treatment. Pain scale represents 0 as no pain and 10 as severe pain. Note: The spikes at treatments #6 and #13 are the result of extended delays between Botox treatments.

frequency and intensity over the course of her Botox injection treatment.

Currently she participates in non-contact soccer training and other non-contact sports such as swimming, running, and golf due to the CMI diagnosis. She regularly comes in for her Botox injections and re-evaluations every 3 months to keep her headache frequency and intensity minimal. The athlete graduated high school and is currently planning on attending college away from home.

Discussion

The pathophysiology of CM is multifaceted and often cannot be attributed to one theory or cause. While some research asserts genetic predisposition other literature proposes a de novo presentation. In fact, some patients with CM might have no family history of CM or syringohydromyelia [8,10,12] as was the case for this present patient. Furthermore, in the field of sports medicine, there is generally an agreement regarding the dangers of CM. Many researchers recommend that athletes with CM should not return to contact sports [15,16]. In pediatric patients, most doctors recommend that CM athletes, either with or without syringohydromyelia, do not seek surgery before exhausting other therapeutic options [12,17].

The present case shows a pediatric athlete who presented with concussion and postconcussive headaches, as well as an incidental finding of CMI with syringohydromyelia, and a preexisting medical history of undiagnosed migraine headache without aura. The patient's migraine symptoms were well managed until she sustained a concussion during soccer which exacerbated her headaches. Her diagnosis of CMI was unknown until the headaches continued beyond an expected time period and presented in a fashion atypical for migraines. When the patient began to experience focal neurologic signs and atypical headache, neuroimaging revealed the underlying cause of her prolonged recovery. With the proper physical restrictions, due to the CMI diagnosis, and treatment for chronic intractable migraine headache, the patient was able to improve her headache symptoms and quality of life.

This patient was not considered to be a good candidate for neurosurgical intervention to treat CMI. Therefore, the neurological treatment approach was targeted at decreasing headache frequency and intensity by using a variety of medications, injections, and physical therapies. After exhausting several abortive and preventative therapeutic options, Botox injections were chosen for treatment of her chronic migraines [14,18]. While Botox treatment did not cure her pain completely, it has significantly decreased her level of pain and headache frequency, ultimately reducing the burden of her disabling chronic migraines and pain.

In conclusion, this case suggests that advanced neuroimaging should be considered for individuals with focal atypical neurologic presentations, such as post- ocular pressure, numbness and tingling in the upper extremities, and posterior occipital pain, as well as prolonged recovery [12,19]. In addition, alternative therapies should be entertained for post-concussive headache treatment if the patient does not respond to traditional treatment. In this case, a patient with no family history of neurological deficits or complications had an underlying history of undiagnosed migraine coupled with congenital anomalies, CMI and syringohydromyelia, which exacerbated the patient's headache presentation and required additional therapies. Given the increasing popularity of participation in contact sports and related concussion injuries, patients with prolonged recovery and atypical presentation require an individually tailored treatment plan.

Acknowledgements

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