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Diagnosis of a Chiari Malformation After a Concussion in a Junior College Football Player With a History of Chronic Headaches: A Case Report

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Diagnosis of a Chiari Malformation after a Concussion in a Junior College Football Player with a history of Chronic Headaches: A Case Report

Key Points:

- Junior college football player who was diagnosed post-concussion with a Chiari malformation.
- Chiari malformations are frequently missed on images which can complicate treatments.
- Treatment protocols for those with a concussion with a Chiari malformation are debatable.

Key Words: brain, return to play, head injury, sport-related, collision sport

ABSTRACT

The purpose of this report is to present the case of a National Junior Collegiate Athletic Association football player diagnosed with Chiari malformation post-concussion. A Chiari malformation is characterized by the cerebellum presenting below the level of the foramen. The uniqueness of this case stems from the patients' health history, length of symptoms and diagnosis. The effectiveness of treatment options, and the primary means to reduce the risk of catastrophic head injury in those with Chiari Malformations are debatable. Clinicians should be familiar with the potential for the presence of a Chiari malformation with persistent symptoms post-concussion.

INTRODUCTION

Concussions are a significant issue in athletics with an estimated 1.6-3.8 million individuals suffering from concussion while performing physical activities each year in the United States.[1,2] Abnormal brain anatomical structures, while uncommon, may play a significant role in concussion management.[3-5]

Chiari malformation, also known as Arnold-Chiari malformation, is a rare anatomical irregularity in which the cerebellum may be depressed 3-5mm below the level of the foramen magnum.[6] Onset of Chiari malformation may be congenital or acquired through infection or trauma and is only diagnosed between 0.1-3.6% of all people, possibly because of its asymptomatic nature.[6-11] Chiari malformations are normally diagnosed through magnetic resonance imaging (MRI), and a radiological measurement of the amount of cerebellar depression.[6,7] There are four types of this deformity, however, a Type I is the most common variant and involves downward displacement of the cerebellar tonsils emanating from the inferior opening of the skull and into the spinal cord without displacing the other structures of the central nervous system.

The symptoms of Chiari malformations are similar to post-concussion syndrome, and include headache, dizziness, muscle weakness, chronic fatigue, tinnitus and impaired ability to coordinate movement. Those symptoms can be aggravated by a Valsalva maneuver, cough, or postural changes, and may derive from disturbing cerebrospinal fluid or cerebellum compression through trauma.[6,8,9,11] However, no studies have clearly demonstrated a specific age of onset of Chiari malformation in acquired cases.[6,8,9,11] It is generally believed that surgery is a superior treatment option compared to conservative treatments, but is dependent on the physicians'

impression of the severity and associated symptoms.[6,7,8,12,13]

Due to its' asymptomatic presentation, athletes may have a Chiari malformation, but not be diagnosed until an MRI is performed post-concussion with severe or unresolving symptoms.[6,8-11,14,15] Therefore, the purpose of this case report is to present the unique case of a National Junior Collegiate Athletic Association football player who was diagnosed with a Type I Chiari malformation after a concussion.

CASE PRESENTATION

Patient

The patient was a male Junior college student and football linebacker (Caucasian, 18 years, 182cm, 104.3kg). He had no outstanding previous injuries related, but reported headaches almost daily for approximately three years and noticed a steady increase in headache frequency. The headaches were mainly posterior and radiated forward to the superior portion his head and forehead, and he also reported pressure behind his eyes during these episodes. He tolerated most of the headaches, but indicated several were severe. A severe headache for the patient was characterized as global with pressure behind his eyes, photophobia, phonophobia and occasional nausea. There were no other neurologic features or consistent length of symptoms. At the age of 16, his headaches worsened and an MRI of the brain was read as normal by a neurologist.

During a football practice on Aug 13th 2012, he tackled and hit heads with an opposing player. He was evaluated immediately by the certified athletic trainer (AT). The athlete did not remember how he got hit and could not answer questions about the incident correctly. The player was asked his name, but he answered with a different teammate's name. His symptoms included headache, vomiting, dizziness, visual problems, fatigue, photophobia, sensitivity to noise,

retrograde amnesia, emotional problems, forgetfulness, positive Romberg test, and difficulty walking. The athlete was referred to the local emergency room where he was diagnosed with a grade II concussion. Moreover, cranial CT scans revealed no acute findings but showed a possible instance of Type I Chiari malformation.

During the week following the injury, the AT checked on his status and symptoms daily. His symptoms slowly improved, however he performed an ImPACT (ImPACT Applications, Inc. Version 2.1, Pittsburgh, PA, USA) test which showed each score worse than his baseline (Table 1). Approximately one week later, he was seen by a 1st neurologist. The 1st neurologist diagnosed him with post-concussive syndrome due to his persistent headaches and occasional nausea. Upon evaluation by the 1st neurologist he demonstrated errors in serial-7 subtractions and occasional delays in information retrieval. Language and speech, eye movement, facial sensation, muscle strength assessments, and coordination tests were normal. An ImPACT test one week later, while improved still demonstrated worse than baseline scores.

He was seen again by the 1st neurologist approximately three weeks later. The patient displayed improvements in cognitive memory function, but noticed the headaches had not ceased. In addition, he reported the headaches were so severe, he had very little appetite. The 2nd neurologist reviewed his previous MRI as well as a CT scan of his head, and diagnosed him with Type I Chiari malformation with chronic headaches. The 2nd neurologist found a 3-mm herniation on his MRI (Figure 1a). Although the 2nd neurologist diagnosed him with a Chiari malformation, they believed that the headaches were not related to this disorder because this was a congenital malformation that had not altered over time. Since the patient's headaches had not improved with medication, they recommended that he see a 3rd neurologist for a second opinion

on his headaches. He saw the 3rd neurologist approximately a week later, but he could not determine the exact factors which led to his symptoms.

Intervention

The primary treatment was rest to lessen the symptoms and neurological issues. The 1st neurologist recommended that prior to return to play the patient would need to be asymptomatic both at rest and during activity. In addition, the 1st and 2nd neurologist suggested no clearance for physical activity until his ImPACT score was closer to his baseline. He was also prescribed Midrin (Isometheptene, dichloralphenazone, and acetaminophen, 1-2 capsules, TID-QID, prn) as a trial therapy for his headaches, which is a typical pharmacological agent for severe migraines.

After three-weeks from the visit to the 1st neurologist, he was still not cleared to return to playing football and continued to report his progress to the AT. The Midrin was discontinued after the fourth visit because it appeared to provide no benefit and Nortriptyline (25mg-50mg at bedtime), a tricyclic antidepressant and typically used for severe chronic migraines was prescribed. The neurologist recommended continuing with conservative care and suggested the patient seek a second opinion.

He sought the second opinion and was seen by a 3rd neurologist just over one month from the initial injury due to no significant improvements in headaches or symptoms. The 3rd neurologist believed there was a low likelihood that the headaches were related to the Chiari malformation. The neurologist started him on Topamax as a preventative measure, and he was instructed to take nortriptyline for sleep as needed. He also continued the previously prescribed medications. After this consultation, he saw a different neurosurgeon one month later. This 3rd neurologist also recommended no sports or physical activities until his symptoms and headaches

were resolved.

The student decided to end his participation on the football team in three months after the initial injury because his symptoms, especially the headaches, had not improved, and the neurologists' opinion had not changed.

He was recommended to a 4th neurosurgeon. This neurosurgeon believed his Chiari malformation was symptomatic with 14-mm herniation from the previous MRI. This 4th neurosurgeon felt he was a candidate for surgery because of a loss of the gag reflex, a sign of a cranial nerve X problem. He had a surgical intervention 6 months later, with no improvement in the preceding months. The 4th neurosurgeon performed a posterior fossa decompression with external durotomy. Post-surgery, he was prescribed Bacolfen to prevent muscle spasms and Dilaudid for pain control.

Comparative Outcome

Symptoms began improving in the three months post-surgery (Figure 2). He saw the neurosurgeon three times at six month intervals. His symptoms, including the severe headaches began returning, and at the final follow-up appointment of 18 months post-surgery the neurosurgeon told him there was nothing else which could be done. The case remains unresolved.

Discussion

The purpose of this case study was to present a unique report of an athlete that had a concussion, which resulted in a Type I Chiari Malformation diagnosis. The uniqueness of this case extends from the health history and length of symptoms of the patient. Moreover, several MRI's were performed on the patient in which initial imaging was read as normal.

This case has several implications on clinical practice. First, Chiari malformations are rare and typically diagnosed in infancy, so it is possible that previously undiagnosed conditions in older patients may be overlooked by physicians. Chiari malformations are typically diagnosed by an MRI by measuring the depression of the cerebellum.[6-11] The initial missed diagnosis likely resulted from the rarity of Chiari malformations and the expertise required to identify them.[6,8,9] Therefore, patients at the high school and collegiate levels may be diagnosed during post-concussion imaging investigations.[13,14,15] Clinicians should also take this into consideration, when the patient's symptoms do not improve for lengthy periods.[6,10,16]

There are several symptoms which can overlap in patients with concussion and/or Chiari malformation. Typical symptoms which could be due to both conditions include severe headache, dizziness, fatigue, tinnitus, nausea and an impaired ability to coordinate movement.[6,8,9,11] Differential symptoms for patients with solely a Chiari malformation may include vagus nerve dysfunction (i.e. difficulty swallowing) as well as numbness and abnormal sensations in the extremities due to the compression on the cerebellum.[6,8,9,11] However without the imaging in this particular case, it was exceedingly difficult to differentiate among the diagnoses of post-concussion symptoms, chronic headaches, and Chiari malformation due to the similarity in clinical presentation.

Conservative treatments are typically recommended for Chiari Malformations prior to surgical interventions. For this particular case, physical rest and various medications were ineffective for treating the headaches and symptoms. Therefore, this case ultimately turned to a surgical intervention, which some studies have demonstrated better outcomes compared to conservative treatments.[7,8,12,13,16,17] Surgical interventions appear to decrease the risk of

reoccurrence and improve symptoms including headaches.[7,8,12,13,16,17] However, the severity of the condition and the patient and neurosurgeon preference influence the course of treatment and further research is still necessary to identify the ideal protocol.

Similar cases have been reported in the literature including a female volleyball player[4] and male football players.[10,14,15] However, each of these athletes were asymptomatic prior to the concussive episode. In each case, symptoms worsened post-concussion and the neurologists diagnosed them with a Type I Chiari malformation from their MRI. Each did not receive surgery, underwent conservative protocols, recovered, and were able to return to sports without incident. In a surgical case, Callaway et al[16] reported a football player suffering from tingling, radiating into both anterior thighs as well as shortness of breath after a contact injury. A follow-up MRI of the patient revealed a Type I Chiari malformation and his post-surgical recovery was uneventful. However, due to the mechanism of injury, several orthopedic and neurosurgical spine specialists advised the patient not to return to contact sports. Based on these published case studies there appears to be no consensus on the best treatment or return to activity path for athletes with Chiari malformations and depends on the individual patient.[6-8,10,12-14,16-18] However unlike the previous cases, both conservative management and surgical interventions failed, which suggests a need for further options for patients.

Criteria for returning to competition requires the patient to be asymptomatic and receive physician clearance. It was no different in this particular case and in addition to those requirements the neurologists wanted the patients ImPACT test scores to be similar to baseline prior to any return to play decision. Albeit the current patient was still experiencing symptoms, one study suggests the risk for athletes with asymptomatic Chiari malformation is low while

playing various kinds of sports including contact sports.[9] Clinicians may take this into consideration when deciding whether to allow an athlete to return to play, however a cautious approach is warranted.

CLINICAL BOTTOM LINE

It is difficult to clinically differentiate between the source of symptoms when both a concussion and Chiari malformation are present as there is a potential for an overlap in symptoms. Clinicians should be familiar with the possibility of a Chiari malformation when patients are suffering from long-term, unrelenting headaches or other symptoms post-concussion. Additionally, with persistent symptoms in individuals diagnosed with a concussion, an MRI may be necessary to rule-out structural abnormalities. Creating imaging guidelines may be helpful for patients following head injuries with persistent or unusual symptoms, so future studies should work to develop specific guidelines for these cases. The effectiveness of treatment options whether surgical or non-surgical, and the best ways to lessen the risk of catastrophic head injuries in those with Chiari Malformations are still largely unknown. Further studies are needed to clarify these issues, and should lead to creating guidelines for athletes with Chiari malformation intended to allow them to participate in sports safely.

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