

CASE REPORT**Bilateral Divergent Fracture Dislocations in a COVID-19 Patient Following a Hyponatremia-Induced Seizure**

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*Research performed at Rothman Orthopedic Institute, Philadelphia, PA, USA**Received: 30 October 2022**Accepted: 17 January 2023***Abstract**

Bilateral divergent fracture dislocations of the shoulder are very rare. Caution with regards to seizure development in COVID-19 patients must be taken to avoid such injuries. This is the case of a male COVID-19 patient who sustained hyponatremia-induced seizure that resulted in bilateral divergent shoulder fracture dislocations. The patient suffered a lesser tuberosity fracture on his left shoulder which was posteriorly dislocated, and a greater tuberosity fracture on his right, which was anteriorly dislocated. The patient underwent bilateral open reduction and internal fixation, with suture anchor fixation for the lesser tuberosity fracture on the left side, and a proximal humerus locking plate for the greater tuberosity fracture on the right side. Education on postoperative complications and expectations were provided to the patient.

Level of evidence: IV**Keywords:** Greater tuberosity, Lesser tuberosity, Locking plate, Suture anchor fixation**Introduction**

Bilateral glenohumeral fracture dislocations constitute a rare clinical entity in orthopedics that accounts for a small number of shoulder dislocations.¹ These dislocations are often attributed to significant trauma, electrocution or epileptic seizures.^{1,2} These dislocations can occur anteriorly or posteriorly, and are often associated with proximal humeral fractures, Bankart lesions, or other soft tissue injury.¹⁻³ It is very rare to dislocate with an asymmetric or divergent presentation, i.e. an anterior fracture dislocation in one shoulder and a posterior fracture dislocation in the other following the causative event. Such cases are important to report in order to guide physicians and surgeons on the appropriate diagnosis and management of future patients and provide insight into prognostic outcomes.

COVID-19 has been associated with the generation of electrolyte disturbances in its patients, with hyponatremia being one of the most common.⁴ These electrolyte disturbances can cause neurological symptoms that can vary from mild drowsiness to epileptic seizures.⁵ In our report, we present the case of a COVID-19 patient who sustained bilateral divergent fracture-dislocations of the shoulder following a hyponatremia-induced seizure.

Case Presentation

This is the case of a 30 year old right-hand dominant male who presented, while maintained in bilateral slings, for the evaluation of both his shoulders. The patient was previously healthy, takes no medications, and works as a fireman. Two weeks prior to his presentation, the patient was incidentally found to have an asymptomatic COVID-19 infection. A few days later, he suffered a seizure, and upon hospitalization, he was found to be hyponatremic with a sodium level of 122. During his seizure, he sustained bilateral shoulder fracture dislocations. Patient denied any numbness or tingling in any of his arms. He also denied any previous pain, debilitation or injury to any of his shoulders.

On his left side, it was found that the patient had suffered a posterior dislocation which was reduced under conscious sedation [Figure 1a]. On the right side, it was found that the patient had suffered an anterior dislocation [Figure 1b], for which he also underwent a closed reduction under conscious sedation. Computed Tomography (CT) imaging on the left side revealed a comminuted displaced lesser tuberosity fracture with extension towards the greater tuberosity [Figure 2]. An associated fracture line was also noticed through the anatomic neck. On the right side, CT and X-ray imaging revealed a comminuted displaced greater

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tuberosity fracture, which was inferiorly and posteriorly positioned with several millimeters of extension into the articular surface [Figure 3]. A decision of bilateral proximal humerus open reduction and internal fixation procedures was taken due to the fact that this was a polytrauma, to facilitate recovery, and to maximize anatomic restoration.



Figure 1. Figure 1: X-ray imaging of the patient at presentation confirming a posterior dislocation of the left shoulder (a) and an anterior dislocation on his right side (b)

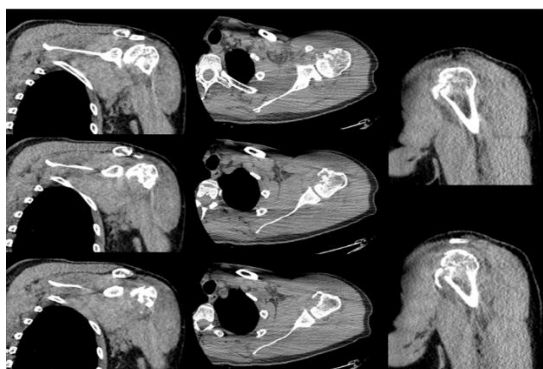


Figure 2. CT imaging of the left shoulder showing a comminuted displaced lesser tuberosity fracture. There is extension of the fracture line towards the greater tuberosity and into the anatomic neck

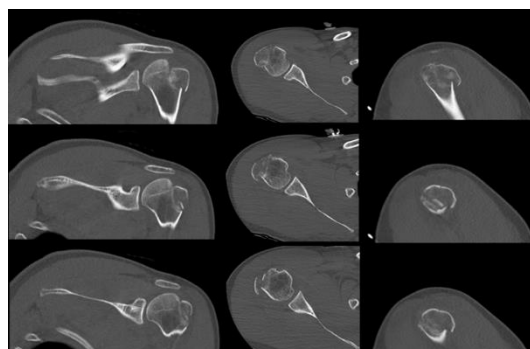


Figure 3. CT imaging of the right shoulder showing a comminuted displaced greater tuberosity fracture. The fracture showed inferior and posterior positioning, with mild extension into articular surface

For the left side, a deltopectoral approach was performed in order to repair the lesser tuberosity fracture. After

performing a subscapularis split, the area of bony displacement was identified and the decision to repair this with suture anchor fixation was made. Upon completion of fixation, fluoroscopic imaging confirmed appropriate fixation, and range of motion testing showed great stability without any compromised motion [Figure 4a]. On the right side, a deltopectoral approach with an accessory focal deltoid split was performed in order to gain adequate exposure into the site of injury and optimize tuberosity reduction. A proximal humerus locking plate was used to fixate the greater tuberosity fracture [Figure 4b]. Fluoroscopy following the procedure showed good reduction and fixation of the fractures on both sides.

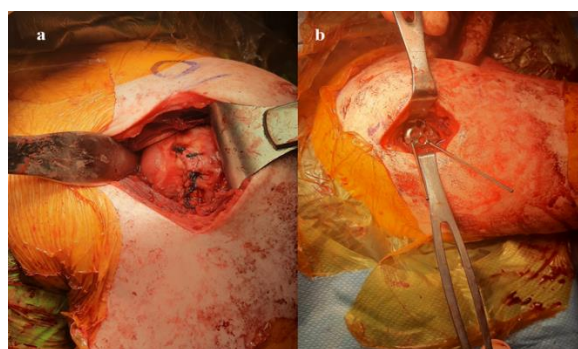


Figure 4. Intraoperative images of repair of lesser tuberosity fracture on the left side using suture anchor fixation through a limited subscapularis split (a), and repair of greater tuberosity fracture on the right side using proximal humerus locking plate (b)

The patient was started on aspirin prior to the surgery as a prophylactic measure to prevent blood clots following bilateral immobilization of his arms. X-ray imaging at 10 days following procedure showed appropriate reduction and fixation of both sides. On 3 months post-op, imaging revealed evidence of bone healing and union for both fractures [Figure 5]. During that visit, the patient had retained his full range of motion and had started strengthening protocols for both arms. The left side was monitored carefully throughout the recovery process to continuously check for signs of avascular necrosis and generation of arthritis, given the fracture lines evident at the anatomic neck, which was displaced at his initial presentation.

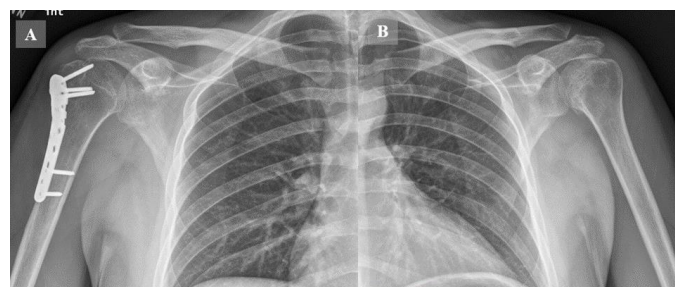


Figure 5. X-ray imaging at 3 months post-surgery showing appropriate fixation and reduction of the greater tuberosity on the right shoulder (A), and the lesser tuberosity fracture in the left shoulder (B)

Discussion

Given its high mobility and range of motion, the shoulder is often considered one of the most unstable joints in the human body, with around 50% of all dislocations attributed to it.⁶ The vast majority of shoulder dislocations- around 97% are anteriorly oriented - while the remaining are posteriorly oriented.⁷ That being said, bilateral glenohumeral dislocations are very rare entities in orthopedics, and in this small subset, the shoulders are often posteriorly dislocated, with the etiology typically being associated with trauma, sports, seizures, electric shock, or electroconvulsive therapy.⁶ It is even rarer to sustain a bilateral divergent shoulder dislocation with each shoulder dislocating in a different direction, such as the case in our patient.⁸ As a matter of fact, a literature search by Kambhampati et al in 2019 yielded only 8 reports of asymmetric or divergent shoulder dislocation cases.⁸ Moreover, fractures are a very uncommon complication of seizures, especially in the absence of trauma, with reported incidence as low as 0.3%.⁹ When considering the background of hyponatremia and COVID-19, we believe this case provides a unique diagnostic and therapeutic insight into a very rare medical and surgical presentation.

COVID-19 became considered a pandemic in 2020, with its widespread prevalence, various complications and unpredictable prognostic outcomes.¹⁰ Neurological complications following COVID-19 infection have been discussed in the literature, with reported associated complications like encephalopathy, encephalitis, stroke and epileptic seizures, among others.¹¹ In addition, there have been many reports of electrolyte disturbances among COVID-19 patients, with hyponatremia being one of the most prevalent.⁴ In our case, the patient had a sodium level of 122 while being COVID-19 positive; it is thus highly likely that electrolyte disturbances associated with COVID-19 caused the seizure exhibited by the patient. It is important to shed light on the relationship between electrolyte disturbances and seizures in COVID-19 patients, especially given that patients may present with an asymptomatic course, making prophylactic measures very challenging.

The mechanisms of dislocation in asymmetric seizures have been discussed in the literature. These usually happen during the seizure episode when one arm is adducted and internally rotated, while the other is abducted and externally rotated.^{6, 12, 13} Axial loading with the glenohumeral joint in adduction, flexion and internal rotation is often the cause of posterior dislocation during seizures, with fractures often occurring due to the stress of the humerus on the glenoid.¹⁴ With regards to anterior dislocation, the mechanism can involve the contraction of the pectoralis and latissimus against an unyielding arm, or due to a fall with a flail upper extremity in abduction, extension and external rotation.^{6, 14} Greater tuberosity fractures are often reported to be due to either impaction or avulsion.¹⁵ Avulsion is usually associated with anterior shoulder dislocations, whereas impactions involve trauma against the acromion or superior glenoid.¹⁵ Moreover, lesser tuberosity injuries are considered a relatively common sequelae of posterior

shoulder dislocation, with a reported frequency of 14.3%.¹⁶ Given the absence of impactful traumatic incidents in our case, it is likely that dislocation-associated avulsion injuries caused the fractures exhibited in this presentation.

Operative management consisting of bilateral proximal humeral open reduction and internal fixation was indicated and opted for our patient. The lesser tuberosity fracture on the left side was repaired using suture anchor fixation. It is often advisable to use this technique in cases that involve small bone fragments or comminuted fractures, where screw fixation would not be advantageous.⁸ Another advantage to this technique is that it does not involve metal implants, which may require future removal in any subsequent surgical interventions such as arthroplasty.⁸ The greater tuberosity fracture on the right side was fixated using a proximal humeral locking plate. This technique has been supported by the literature as a reliable method for achieving satisfactory and functional results in similar cases.^{17, 18} In light of the surgical procedures performed in this case, it is very important that proper education be given to the patient on some prophylactic preoperative measures and postoperative expectations. The prolonged immobility prior to the surgery and after the injury necessitated the initiation of antiplatelet medication perioperatively, to prevent blood clotting incidents. In addition, the involvement of the anatomic neck in the left-sided fracture entailed meticulous monitoring for any signs of subsequent avascular necrosis or arthritic changes in that joint. It is pivotal to educate the patient on all aspects of postoperative course, including the lengthy recovery periods and monitoring for deleterious complications.

Conclusion

In summary, bilateral divergent shoulder, fracture dislocations are highly uncommon injuries in orthopedics. This case presents the first report of such an injury after a hyponatremia-induced seizure in a COVID-19 patient. Treatment options for such cases often include operative management with extended periods of recovery and watchful postoperative course. Educating patient on prognostic expectations is key to achieve satisfactory therapeutic outcomes.

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