Pain Control and Point-of-Care Ultrasound

An Approach to Rib Fractures for the Austere Provider

Reece Snyder, PA-C[1]; Dan Brillhart, MD[2]*

ABSTRACT

Rib fractures are common injuries that cause significant discomfort and can lead to severe pulmonary complications. Rib injury most often results from high-velocity traumatic mechanisms, while rarely representing underlying metastatic disease or secondary injury due to pulmonary illness. Because most rib fractures are caused by obvious trauma, algorithms are focused on treatment rather than investigating the exact mechanism of rib fractures. Chest radiographs are often the initial imaging performed but have proven to be unreliable in identification of rib fracture. Computed tomography (CT) is a diagnostic option as it is more sensitive and specific than simple radiographs. However, both modalities are generally unavailable to Special Operations Forces (SOF) medical personnel working in austere locations. These medical providers could potentially diagnose and treat rib fractures in any environment using a standardized approach that includes clarity of mechanism, pain relief, and point-of-care ultrasound (POCUS). This case demonstrates an approach to the diagnosis and treatment of a rib fracture in a 47-year-old male who presented to a military treatment facility with unlocalized flank and back pain, but the methods employed have applicability to the austere provider working far from the resources of a medical center.

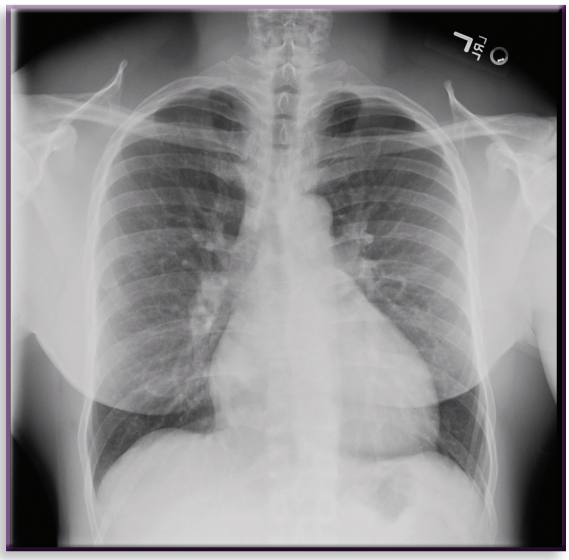
KEYWORDS: *pocus; rib fracture; perineural block; prolotherapy; musculoskeletal ultrasound*

Background

A 47-year-old male presented to the Emergency Department (ED) of an Army Medical Center with the initial complaint of back pain for 4 days. The patient described a 4-day history of right posterior lateral thoracic pain after completing a rigorous leg workout that included the use of a belt squat machine. This was the first time the patient had used this machine, and the patient stated he had recently increased the overall intensity of his lower body workouts. He decided to come to the ED because the previous night he had sneezed and felt a "pop" with increased pain. Physical exam showed full range of motion of the lumbar, thoracic, and cervical spine but moderate tenderness along the paraspinous muscles of the right side between T8 and T11 that radiated to the midaxillary line.

Initial evaluation included a complete blood count and complete metabolic count with chest radiography (Figure 1) to assess for potential infectious, oncologic, renal, or bony abnormalities. Creatinine was modestly elevated but was similar to bloodwork the patient had completed 2 months prior. After further chart evaluation, the patient had had an outpatient renal ultrasound (US) the day prior for routine evaluation of elevated creatinine. This ultrasound showed no abnormalities. The chest radiograph was normal.

FIGURE 1 *Chest radiograph demonstrating initially read as normal.*



Based on the above presentation, the patient was suspected to have an acute muscle strain secondary to his workout. Perineural injections were performed by first identifying relevant landmarks including T11, the 11th rib, and the point of maximal tenderness. Injections of 0.5mL of 1% lidocaine were then injected subcutaneously along the approximate courses of the cutaneous branch of the dorsal rami of T11 and the lateral cutaneous branch of the 11th intercostal nerve. These injections were spaced 3-cm apart except around the point of maximal tenderness where the injections were spaced 1.5-cm apart. Once analgesia was obtained, the area of maximal pain (around T11) was palpated eliciting crepitus that was not present on initial examination. POCUS was performed at bedside (Figure 2) showing a mildly displaced fracture of the 11th rib. A CT scan with contrast was performed (Figure 3) in order to investigate potential solid organ injury. That CT confirmed

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FIGURE 2 *Two longitudinal views along the 11th rib, indicating fracture.*

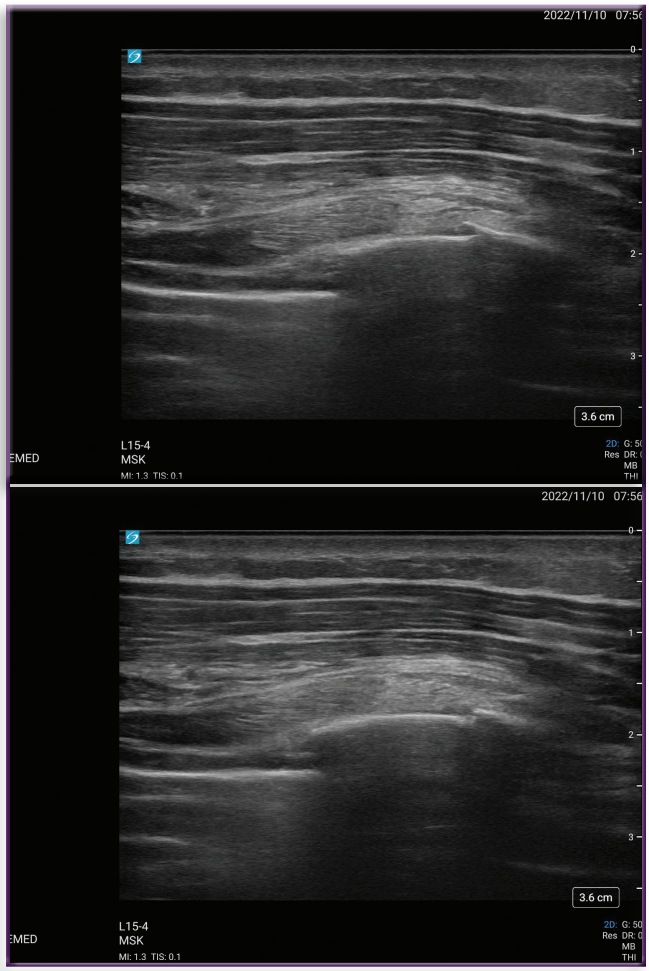
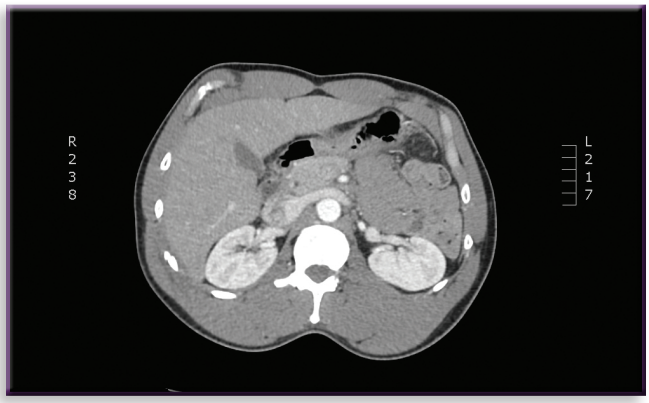


FIGURE 3 *CT confirming mildly displaced rib fracture with no underlying organ involvement.*



an isolated 11th rib fracture with no underlying pathology. The likely cause was the weight belt from the squat machine. The patient did not demonstrate any respiratory restrictions after pain was controlled and was educated regarding proper pulmonary hygiene to avoid secondary complications such as pneumonia. He was given incentive spirometry but declined additional pain medication outside of what was given during his ED visit.

Discussion

Mechanism Clarity

Rib fractures are markers of severe injury, as 30% of all rib fracture patients sustain multiple injuries.[1] Further, overall injury severity correlates with the number of ribs broken, as the baseline mortality for a patient with one rib fracture is 5.82% but increases with each additional rib fracture.[2] The Operator should keep this association in mind when evaluating potential rib fractures. A thorough history, review of systems, and physical exam must be completed on all patients with a rib fracture in order to determine if underlying injuries are present, especially in austere environments where imaging and evacuation are limited. Clarity of the exact force that the patient sustained to area is what led to the suspicion and eventual diagnosis of rib injury. In this case, although the pretest probability of organ injury was low, a CT was performed. In an austere environment, a clinician could forgo CT if the patient was stable, the mechanism was low-velocity, and the diagnosis of rib fracture was confirmed with POCUS. If the Operator was still concerned for solid-organ injury or bleeding after discovery of a rib fracture, serial extended focus assessment with sonography in trauma (EFAST) exams could be performed. While the direct sensitivity of US for detecting solid-organ injury is low, serial EFAST exams are a valuable screening tool for associated hemorrhage and can be substituted for CT in the case of stable trauma patients with or without rib fractures.[3]

Pain Control

In 2009, pain management was officially mandated for battlefield trauma casualties and is an imperative part of Soldier treatment and recovery on the battlefield and in remote locations.[4] Since then, approaches for battlefield analgesia have continued to expand with the addition of ketamine, battlefield acupuncture, and other unique strategies. Perineural blocks or perineural injection therapy is a time-tested adjunct that has applicability for battlefield analgesia. The technique involves several subcutaneous injections along cutaneous branches of regional nerves and most often contains dextrose but can contain analgesics, glucocorticoids, or any combination of the three.[5,6] Perineural injection therapy, while being an old therapeutic option, has a sparse research base but, due to renewed interest in regional pain management, some newer data are emerging. The immediate pain relief felt by the patient after the perineural injections is believed to have led directly to the muscular relaxation that allowed the care team to discover the crepitus over rib 11, focusing the diagnostic process. This case aligns with the current practice guidelines that state pain management is to increase patient comfort, promote pulmonary hygiene, and decrease intercostal muscle contraction around the fracture location.[7] For the Operator, perineural blocks can keep a Soldier on location longer as it requires very little overall medication, while also achieving analgesia and pulmonary protection. To perform these blocks in a patient with a rib fracture, the Operator can follow the steps outlined in this case. First, identify the appropriate anatomy around the point of maximum tenderness, specifically the cutaneous or superficial nerve paths around the injury itself. This can either be done by using anatomical landmarks or with US. Injections can be performed using dextrose, lidocaine, glucocorticoids, or a mixture along the nerve paths with a linear spacing of 2- to 3-cm and an option to decrease spacing where the patient is most tender. If the patient's pain is refractory to any chosen analgesia, it could be a potential indication of underlying injury beyond a rib fracture, and evacuation is indicated.[8]

Imaging

Initial imaging can miss injuries. Specifically, in determinations of rib fractures, 74.5% of fractures identifiable on CT are missed on initial chest xray.[9] It is understood that ultrasound is more sensitive than chest radiography in detection of rib fracture.[10,11] Chest ultrasonography has a 89.3% sensitivity and a 98.4% specificity in detection of confirmed rib fractures.[12] In this instance, the treatment team had extended training in bedside ultrasonography allowing for easy incorporation into their diagnostic process. If this extended training in POCUS was applied across a greater cross section of Operators, rib fracture detection and treatment could be simplified in austere environments. US is an established and still evolving imaging modality and diagnostic tool in modern medicine that is growing more deployable with advances such as smaller handheld devices and incorporation of artificial intelligence.

Conclusion

At the 30-day mark, the patient did not have any pain or other medical issues related to the rib fracture and did not require follow-up imaging. He did not seek any follow-up care, as all pain and discomfort was resolved after 2 weeks of light duty. If this patient had presented in an austere environment, it is possible that a 47-year-old male with chest pain that was reported as atraumatic on initial evaluation could have led to an unnecessary evacuation. As this case demonstrates, Soldiers with simple rib fractures that are managed by identifying the injury with POCUS and controlling their pain can be kept on location with a lighter workload until discomfort resolves with minimal care or the need for evacuation. In a time where the military faces limited evacuation resources in many theaters and is looking to future wars where medical evacuation may be unavailable, it is important to train skills that alleviate evacuation burden. A training regimen that prioritizes thorough history and physical exam, appropriate analgesia, and adjunctive US exams can pay dividends. A simple low-velocity mechanism rib fracture, like the one demonstrated in this case, can very easily be managed by an Operator in the field once the diagnosis is confirmed with POCUS, life-threatening injury is ruled out, and complications are prevented using the approach shown here.

Disclosure

The views presented are those of the authors and do not necessarily represent the views of the Department of Defense or its components.

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