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Case Report

Taking the bull by the horns: Patient trampled by bull requiring surgical fixation of multiple rib fractures including rib 11☆,☆☆

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ABSTRACT

Rib fractures are a serious problem in thoracic trauma resulting in high morbidity and mortality. Surgical stabilization in the management of rib fractures is gaining more popularity and recognition as outcomes continue to show positive results, however, there is still hesitancy among the trauma community to recommend this intervention. Although there still remains questions as to which patients to provide surgical stabilization to in the non-flail rib fracture patient population, surgical stabilization of rib fractures have been shown to be extremely beneficial in those patients with flail chest and should be strongly considered in this patient population, especially if they require ventilatory support. Here we present a 62-year-old female with severe chest wall deformity from 21 rib fractures after being trampled by a bull. This included a flail segment and a severely angulated 11th rib fracture piercing through the lung into the retroperitoneum. Furthermore, we also introduce a new technique for stabilization of rib fractures that are more posterior. Given the fact we surgically intervened early in our patient with severe chest wall trauma, she had a very favorable outcome, allowing her to be discharged from the hospital in a timely fashion with minimal overall morbidity.

Introduction

Rib fractures are among the most common injuries following blunt trauma [1]. They occur in approximately 10% of all traumatically injured patients and are associated with significant pulmonary-related morbidity and mortality [1–3]. Although vast improvements have been made in the care of rib fracture patients, including surgical stabilization of rib fractures (SSRF), outcomes for this population still remain poor with limited change over the past decade [1,3].

Despite an increased appreciation and utilization of SSRF, there still is hesitancy to recommend patients presenting with rib fractures undergo this operation [1,3]. In fact, data from the National Trauma Data Bank(NTDB) indicates that less than 1% of patients with flail chest receive SSRF [1,3], an indication clearly evident in recent literature [4–6]. Furthermore, there is uncertainty about which patients without a flail segment would benefit from SSRF, likely due to a lack of evidence-based research surrounding this patient population [1,2,7].

In an effort to better guide SSRF among the trauma community, various consensus statements and guidelines have been proposed based on current research [1,2]. One of the current guidelines from the Rib Fracture Colloquium 2016 states “repair of ribs 1,2, 11

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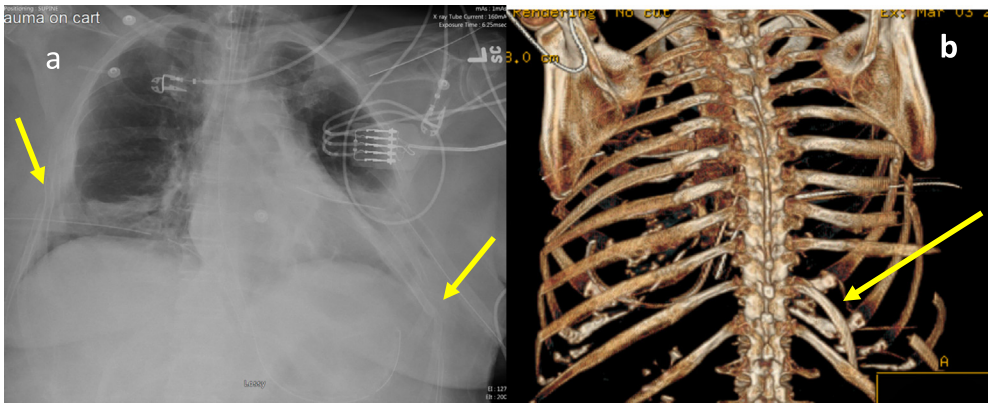

Fig. 1. a Chest X-ray demonstrating severe chest wall deforming (Arrows) and early pulmonary contusions. b 3D reconstruction of chest showing severe deformity on the right with significant angulation of rib 11 (Arrow) and flail segment on the left.

and 12 does not confer additional benefit in terms of either chest wall stability or pain control. In highly select circumstances…repair of these ribs may be considered" [1]. Below, we present one of these rare circumstances where surgical stabilization of rib 11 was necessary.

Case presentation

A 62-year-old female was rammed in the chest and trampled by a bull after falling to the ground. She was initially unconscious and subsequently intubated in the field. Upon arrival to our institution, she was found to have a small subarachnoid hematoma(SAH). She was also noted to have ligamentous injury of her cervical spine, a grade 2 liver laceration and right adrenal hemorrhage. Furthermore, she was found to have a displaced left scapular fracture. Most significantly, she was diagnosed with severely displaced right-sided fractures of ribs 4–12 and left-sided fractures of ribs 3–11 fractures with a flail segment of left-sided ribs 5–7, causing significant chest wall deformity (Fig. 1). Bilateral pulmonary contusions and hemopneumothoraces, for which chest tubes were placed, further complicated this injury. Lastly, the patient's right-sided 11th rib fracture was sharply angulated, piercing through the lung into the retroperitoneum (Fig. 2).

She was subsequently admitted to the intensive care unit(ICU). No surgery was required for either the SAH or cervical ligamentous injury per neurosurgical consultation. Orthopedic surgery was consulted and recommend an arm sling only for the scapular fracture. Given the severity of the patient's rib fractures, including the flail segment and persistent air leak from the right lung, the decision was made to perform bilateral SSRF including rib 11 on the right given its severe deformity.

On hospital day 4, the patient was taken to the operating room(OR) to undergo right-sided SSRF. After placing her in the left lateral decubitus position, a muscle-sparing SSRF was performed preserving the latissimus dorsi and serratus anterior muscles. Upon

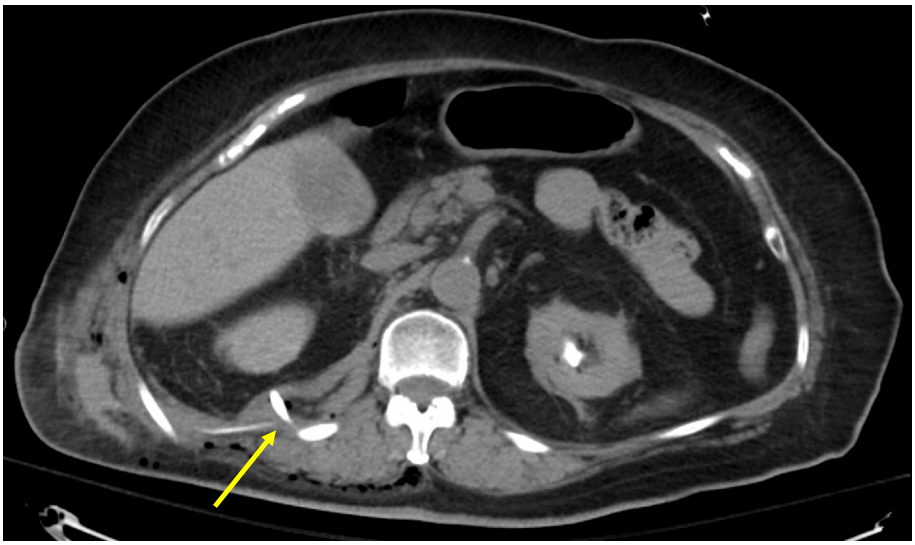

Fig. 2. Axial CT scan of the chest showing severe angulation of rib 11 piercing through the right lower lung lobe into the retroperitoneum (Arrow).

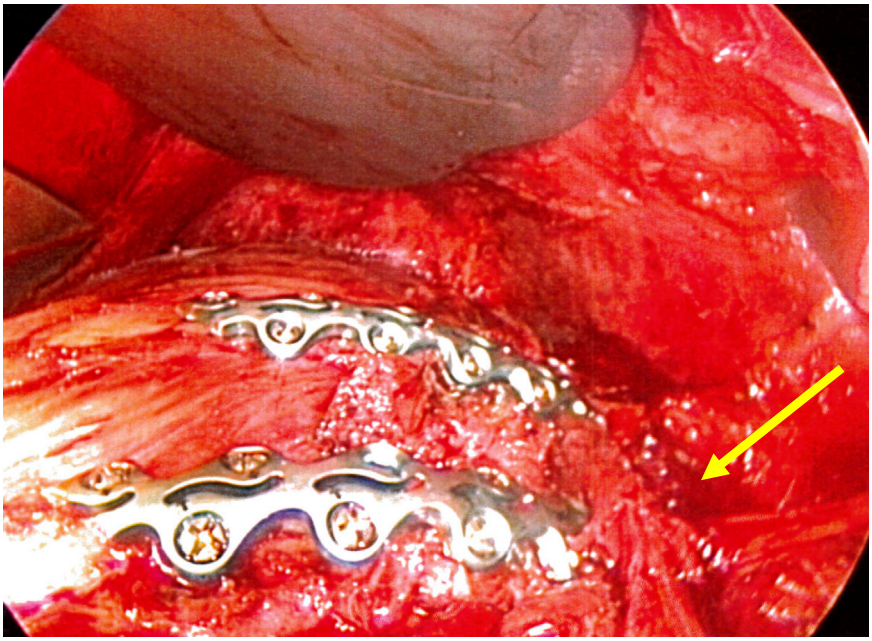

Fig. 3. Intra-operative picture demonstrating the great visualization of the posterior portion of ribs 3 and 4 on the left utilizing the 10 mm, 30-degree thoracoscope. With the use of the thoracoscope, we were able to appropriately secure the plates to the ribs without making a secondary incision. The yellow arrow is pointing to the spine.

revealing the ribs, there was significant destruction of the intercostal muscles, such that a thoracotomy had essentially been performed for us. We visualized the right lung injury from rib 11, which was only a small puncture not requiring repair. We began the SSRF by reducing rib 11 and placing a 10-hole plate across it. Because it is a "free-floating" rib, it was challenging to stabilize, however, utilizing a series of right-angle clamps and counter-traction we were able to successfully re-establish continuity and stability. We were then able to plate right-sided ribs 4–10. Due to the amount of chest wall injury, we elected to place a 36-French chest tube followed by subcutaneous drainage of our dissected chest wall plane. The patient also underwent a bronchoscopy because of significant secretions. She tolerated this procedure well and was returned to the ICU in a stable condition.

Two days later, the patient returned to the OR for SSRF of the left-sided rib fractures. The patient was placed in the right lateral decubitus position and a muscle-sparing SSRF of left-sided ribs 3–9 was completed. This was much more challenging as the fractures were more posterior, many of them beyond the angle of the rib. (Rib 10 was too posterior to plate). Instead of creating a second incision to place screws in the posterior location, only adding to the surgical pain, we utilized a 10 mm, 30-degree thoracoscope to help us visualize the posterior ribs, allowing us to successfully secure the plates (Fig. 3). Once the posterior fractures were stabilized, we addressed the flail segment of ribs 5–7 performing SSRF of these anterior fractures using a separate plate. A thoracosopy was performed, evacuating all retained hemothorax. A 14-French pigtail catheter was placed in the pleural space followed again by subcutaneous drainage given the significant tissue damage. She returned to the ICU in a stable condition.

After restoration of the patient's chest wall (Fig. 4), her breathing mechanics were greatly improved. Three days later, the patient was meeting all criteria for extubation, so the endotracheal tube was removed. She did experience a minor right cerebrovascular accident and was started on aspirin and atorvastatin. She continued to progress and was liberated from all chest drains. On hospital day 20, she was discharged to acute rehab and has since made a full recovery, returning to "working cattle" with her husband.

Discussion

Rib fractures are a serious problem, resulting in significant mortality. A recent study examining the NTDB demonstrated patients with a single rib fracture have a mortality of 5.8% where those patients with ≥8 fractures have a mortality of up to 34.4% [7, 8]. Increased number of rib fractures is associated with increased risk of pneumonia, acute respiratory distress syndrome, empyema, ICU length of stay(LOS) and hospital LOS [7,8]. Another study showed patients with ≥3 rib fractures have an odds ratio of 2.02 for mortality [9]. Furthermore, flail chest alone is associated with a mortality of 16–17% which increases to 42% in the presence of pulmonary contusions [3,7].

While there remains a lack of studies regarding SSRF indications for non-flail rib fracture patients [4], multiple studies have confirmed the benefits of SSRF in patients with flail chest showing a decrease in ventilator days, ICU and hospital LOS, pneumonia, septicemia, tracheostomy and chest deformity [5,7]. Given these findings, SSRF should strongly be considered in patients with flail chest, especially those requiring ventilatory support. Our patient, who had 21 rib fractures and a flail segment, was able to avoid pneumonia, tracheostomy and prolonged ventilation due to timely SSRF.

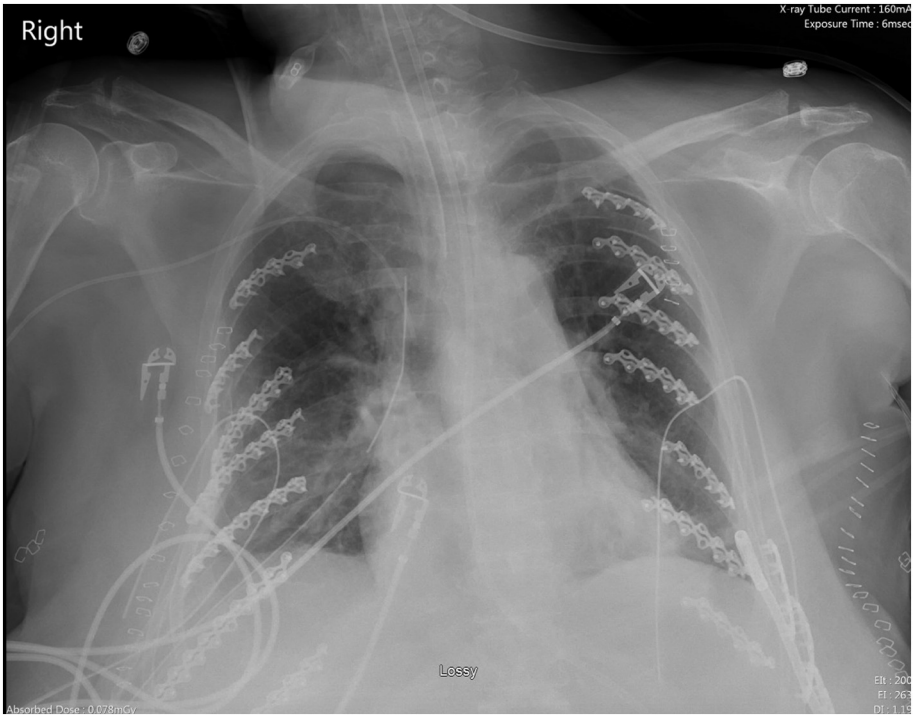

Fig. 4. Chest X-ray after completion of SSRF of both sides. The patient's chest wall deformity is much improved after fixation. She received a total of 18 new titanium rib plates.

Although current published guidelines suggest no need to plate rib 11 except under special circumstances [1], here we present one of those special circumstances. With right rib 11 significantly displaced and actually piercing through the right lower lobe of the lung into the retroperitoneum, this would be an indication to reduce and plate this rib. We also introduce a new rib fixation technique. The use of a 10 mm, 30-degree thoracoscope can safely help visualize and access the difficult, posterior portion of the ribs in order to reduce the fracture and secure the plates to that portion of the rib decreasing the need for a secondary incision and accessory port. Because of the good outcomes we presented, we highly recommend early SSRF for patients with flail chest and fixation of rib 11 in special circumstances such as the one presented above.

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Drs. Zachary M. Bauman, DO, Samuel Cemaj, MD and Lisa L. Schlitzkus, MD had full access to all the information in the case report and take responsibility for the integrity of the information and the accuracy of the information analysis.Author contributions and conflicts of interest

All authors contributed substantially to this project. There are no conflicts of interest or financial interests to disclose for any of the contributing authors. All authors involved in this project collectively reviewed and agreed upon the information as presented. Furthermore, all authors reviewed and approved the decision to submit this manuscript for publication.

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