

## Case Report

# Suture fixation of traumatic rib fracture flail segment with *Klebsiella* osteomyelitis

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## ABSTRACT

We report the case of a 71-year-old male who initially presented with urosepsis and was found to have a rib fracture of his right 6th rib with a flail segment and an associated abscess. Given the concern for infection, surgical rib fixation with titanium plating was not pursued during the washout of his abscess and instead, he successfully underwent rib fracture stabilization with bilateral suture transfixation. He was continued on a prolonged course of antibiotics for *Klebsiella pneumoniae* osteomyelitis and was discharged uneventfully with optimal pain control and adequate respiratory effort.

## Introduction

Osteomyelitis involves the ribs in <1 % of cases in children and young adults and typically occurs following the contiguous spread of bacterial, mycobacterial, and fungal organisms [1]. Despite the known benefits of surgical stabilization of rib fractures (SSRF), there is no consensus on the management of rib fractures in patients with traumatic wound contamination or an ongoing but separate infection [2]. Although infrequent (0.5–4 %), plate infection following SSRF is extremely morbid and all efforts should be undertaken to minimize its occurrence [3,4]. Various methods have been described to avoid the placement of permanent hardware in trauma patients with high risks for infections, including the utilization of bioprosthetic plates, closed-incision negative pressure therapy (ciNPT), or non-operative management [5–8]. Suture trans-fixation of rib fractures has demonstrated success in both animal models and patients following chest trauma in a non-contaminated setting [9,10]. This case report demonstrates the successful suture transfixation of a post-traumatic flail rib fracture segment in a known infected field to avoid the placement of a metal implant following the unavailability of a bioprosthetic plate.

## Case presentation

A 71-year-old male with a history of depression, tobacco abuse, hypertension, hyperlipidemia, complete heart block with pacemaker placement, remote partial gastrectomy for a bleeding ulcer presented with 5 days of right upper abdominal pain, poor appetite, and dyspnea.

Vitals on presentation included a blood pressure (BP) of approximately 90/50s mmHg, heart rate (HR) 100–110 beats per minute, and respiratory rate (RR) of 20–26 breaths per minute. Blood work was notable for WBC 30 K, creatinine 2.2 (baseline ~0.8), AST 61, ALT 52, ALP 268, and urinalysis demonstrated multiple bacteria, WBC 54, large leukocyte esterase, negative nitrite, and <1 epithelial

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squamous cells per high-power field. Initial imaging of CTA pulmonary artery and abdomen/pelvis and abdominal ultrasound (US) demonstrated diminished enhancement of the left kidney with concern for pyelonephritis and non-obstructive left renal stone. The patient was promptly resuscitated with crystalloid boluses and started on vancomycin and piperacillin/tazobactam after the collection of urine and blood cultures, both of which speciated into pan-susceptible *Klebsiella pneumoniae*. Antibiotics were de-escalated to ceftriaxone and the patient's hemodynamics, leukocytosis, and creatinine improved. Given continued right-sided abdominal pain, a repeat US and CT was ordered by the medical team on hospital day 8 which was concerning for a complex gas and fluid collection anterior to the left hepatic lobe (~8 cm) with an associated 2.5 cm displaced fracture of the right 6th rib (Fig. 1). Trauma surgery was subsequently consulted.

Upon further review and discussion with radiology, this peri-hepatic fluid collection was also present on the admission CT scan though slightly smaller in the earlier scan (Fig. 2). On additional questioning, the patient revealed that he suffered a mechanical fall 4 months prior to this admission onto his right chest and flank. The patient was taken for perihepatic abscess washout and drainage on hospital day 11. After obtaining bone/cartilage biopsy and purulent fluid for culture, the flail cartilaginous rib fracture was fixed with two simple-interrupted stitches with 0-Vicryl sutures at each fracture site (Fig. 3). Given the presence of infection, surgical fixation with permanent hardware was not pursued. No injury to the diaphragm or entry into the thoracic cavity was noted on exploration. After copious irrigation, a 15-French Blake drain was placed and the fascia, subcutaneous tissue, and skin were closed in layered closure. The bone tissue culture grew *Klebsiella pneumoniae* as well suggestive of osteomyelitis and the infectious disease team was consulted who recommended a 6-week course of IV ceftriaxone. The drain remained serosanguinous and an interval CT scan on post-operative day 4 demonstrated appropriate alignment of the fracture (Fig. 4). The patient was discharged on hospital day 16 and post-operative day 5.

## Discussion

Osteomyelitis has an overall incidence of 21.8 cases per 100,000 person-years [11]. The pathogenesis of the disease is heterogeneous and can occur via hematogenous seeding, contiguous spread from nearby structures, or direct inoculation following trauma or surgery [1]. Most bone infections only involve one location and predominantly occur at the tarsal/metatarsal bones, long bones of the lower extremity, spine, pelvis, or sternum though infrequent involvement of the ribs has been described [1,11]. The majority of hematogenous osteomyelitis are monomicrobial while those secondary to contiguous spread or inoculation can be either monomicrobial or polymicrobial. Causative organisms are typically *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Enterococcus*, *Pseudomonas*, *Escherichia coli*, anaerobes, and *Mycobacterium tuberculosis* [11,12]. Rib osteomyelitis secondary to *Klebsiella pneumoniae* is extremely rare and has only been reported in the pediatric or immunocompromised population [13–15].

The clinical presentation of osteomyelitis is typically non-specific and involves fevers, chest or abdominal pain, elevated inflammatory markers, localized chest wall swelling or a draining sinus [16,17]. Although not utilized in our patient, MRI is the most sensitive and specific diagnostic modality for rib osteomyelitis [16]. The management of rib osteomyelitis is multifaceted and involves a multidisciplinary approach. Treatment typically involves a prolonged duration of antibiotic or anti-fungal therapy tailored to the causative organism, drainage of associated abscesses, and in some cases surgical debridement of affected bone [1,16].

SSRF of multiple rib fractures, severely displaced ribs, flail chest, or refractory pain has demonstrated a significant reduction in the length of intensive care unit and overall hospital stay, ventilator use as well as decreased rates of pneumonia, pain medication dependence, and tracheostomy [18,19]. Unfortunately, there is no consensus on strategies to reduce implant infections in patients with concurrent infections at a different anatomic location or SSRF in a contaminated field [2]. Implant infections following SSRF are relatively rare but can be extremely morbid and involve multiple rounds of wound debridement, antibiotic bead placement, negative-pressure wound therapy, and implant removal [3,4]. Methods to avoid the placement of a prosthetic plate in patients with a risk for



**Fig. 1.** Interval CT scan on hospital day 8 demonstrates a significantly displaced (2.5 cm) fracture of the right 6th rib with an associated 8 cm complex gas and fluid collection anterior to the left hepatic lobe.



Fig. 2. Admission CT demonstrating previously smaller peri-hepatic fluid collection.

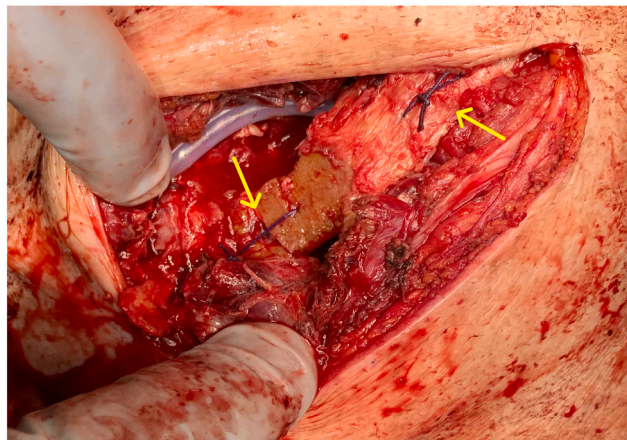


Fig. 3. Suture transfixation technique of flail rib with two simple-interrupted 0-Vicryl stitches at each fracture site.



Fig. 4. An interval CT scan on post-operative day 4 demonstrates appropriate alignment of the flail segment at the fracture site.

infection have been described and vary from non-operative management, bioprosthetic brace implantation, and suture transfixation of rib fractures [5,6,8,10].

A newborn foal with fractures of left ribs 2–9 underwent suture rib fixation in a figure-of-eight fashion and demonstrated successful

stabilization without post-operative complications [9]. In 10 human patients following posterior chest trauma, a prosthetic-free suture fixation of rib fractures demonstrated no post-operative chest wall deformity or need for an additional stabilization procedure [10]. Several studies comparing solitary suture repair versus prosthesis utilization (rigid or non-rigid) in the reconstruction of complex chest wall defects following oncologic resection demonstrate no difference in respiratory complications or mortality although the group with prosthetic reconstruction has a higher rate of reoperation for infection [20,21]. Our patient demonstrated successful stabilization of his flail rib fracture with double simple-interrupted transfixing sutures at each of the two fracture sites with no post-operative complications. He was discharged on post-operative day 5 to a skilled nursing facility with plans to remain on a 6-week course of IV ceftriaxone.

## Conclusion

Traumatic rib fractures complicated by osteomyelitis pose a challenging clinical scenario. A high index of suspicion and a multidisciplinary approach are essential to achieve favorable outcomes. Fracture transfixation of the rib with suture can allow for successful stabilization and reduces the risk of implant infections. This technique is fast, easy to perform, and inexpensive and thus is a good surgical option especially if bioprosthetic devices are unavailable.

## Declaration of competing interest

The authors declare no competing interest.

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