

A case of extensive fracture bullae: A multidisciplinary approach for acute management

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INTRODUCTION

Fracture bullae occur in 2.9% to 6.6% of acute fractures that require hospitalization.^{1,2} The shear forces at the time of injury can lead to separation of the epidermis from the underlying dermal layer with subsequent vascular edema formation.³⁻⁵ However, these dermatologic manifestations associated with fractures are largely underreported in the dermatology and orthopedic surgery literature. Development of posttraumatic fracture bullae are associated with an increased risk of infection and a delay in surgical treatment that can lead to prolonged hospital stays and potentially increased health care spending.¹ Skin breakdown at the base of the fracture bullae is particularly prone to infection, which can compromise wound healing and delay surgical repair, thus, prolonging hospital stays.^{1,3,4}

Therefore, early recognition and a multidisciplinary approach with both dermatologists and orthopedic surgeons are critical to improve outcomes in these select patients. Despite their prevalence, there is no consensus on the treatment of fracture bullae. We describe an impressive case of diffuse upper extremity fracture bullae after a low-energy fall, along with our management of these lesions in a unique clinical scenario.

CASE REPORT

An 87-year-old man with hypertension and atrial fibrillation managed with apixiban presented to the emergency room with left upper extremity pain and swelling after a mechanical fall. On physical examination, a midshaft deformity of the left humerus was noted along with moderate swelling and

ecchymosis at the level of the injury. Neurovascular examination found decreased sensation in the radial nerve distribution along with inability to actively extend the wrist and digits of the injured extremity. Initial plain radiographs depicted a spiral fracture of the distal third of the humerus (Fig 1), consistent with a Holstein-Lewis fracture pattern.⁶ Acute management consisted of fracture immobilization with application of a coaptation splint and admission for observation.

Approximately 48 hours after injury, numerous tense hemorrhagic and serous bullae with superficial erosions developed. These varied bullae were present with ecchymoses directly overlying the fracture site, along with extension distally over the elbow and to the forearm (Fig 2). Wound cultures obtained from the bullae showed no growth of bacteria or fungus. The tense bullae were cleansed with isopropyl alcohol and drained with a 25-gauge needle to prevent traumatic rupture and erosion. These bullae were then covered with Xeroform petroleum gauze and dry gauze dressings. The extremity was again immobilized, and the upper extremity elevated to reduce swelling. Improvement of the affected dermis was noted within 72 hours without new bullae formation.

After discussion of treatment options, the patient opted for surgical management of his left humeral shaft fracture. Five days after sustaining the fracture, he underwent open reduction and internal fixation of the left humerus with exploration and neurolysis of the radial nerve. A modified posterior approach as described by Gerwin et al⁶ was used. There were no perioperative complications, and the patient was discharged home uneventfully on postoperative day 2 with a dry gauze dressing over

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Fig 1. Plain radiographs of the patient's left oblique humeral shaft fracture. **A**, Anteroposterior view. **B**, Lateral view.

the incision. At most recent follow-up, 1 year postoperatively, there are no reported wound complications with return of radial nerve function and no gross scarring.

DISCUSSION

Fracture bullae are tense vesicles or bullae that arise on edematous skin directly overlying a fracture.¹ These bullae typically appear within 24 to 48 hours of injury, although development of bullae up to 3 weeks after the initial fracture injury has been reported.^{1,7} Less commonly, these bullae can extend beyond the area overlying the fracture site with extension across an adjacent joint, as seen in this case report. The presence and extent of fracture bullae may not correlate with severity of the fracture, with necessary modification of fracture treatment until soft tissue permits.

Although multifactorial, torsional and shearing forces that lead to fracture can cause separation of the epidermis from dermis.³⁻⁵ Comparatively, fracture bullae rarely occur with open fractures because the open wounds decompress the forces in the soft tissue and prevent blister formation.⁷ Anatomic areas with superficial bony prominences and minimal soft tissue covering, such as ankles, elbows, feet, and distal tibias have the highest incidence of fracture bullae.¹ The ankle is

particularly vulnerable to trauma because of flat dermal papillae, minimal subcutaneous tissue, and extensive arborizing veins.⁷

Two subtypes of fracture bullae have been identified: serous and serosanguinous (hemorrhagic). These differ in the level of epidermal separation after injury, with serous bullae associated with a subcorneal blister compared with hemorrhagic bullae that can represent a subepidermal blister. Giordano et al⁸ performed a histologic study of the 2 bullae subtypes, finding that clear serous bullae retained epithelial cells with no damage to the dermis, whereas hemorrhagic bullae were devoid of epithelial attachments. A potential mechanism could also be related to energy of the trauma, with disruption of underlying papillary vessels allowing subsequent leakage into the bullae. Clinically, hemorrhagic bullae can also be slower to heal and lead to increased complications.⁹ In a similar clinical scenario to our case, this could present further considerations in timing operative intervention for fracture bullae. The goal of treatment would still be to promote epithelialization, while avoiding potential infection. Fluid from aspirated bullae is sterile¹; however, skin cultures from ruptured bullae have grown *Staphylococcus epidermidis* and *Staphylococcus aureus*.¹⁰



Fig 2. Clinical photographs of the bullae formation after injury. **A**, Left upper extremity after injury. **B**, Close up of the affected area highlighting tense serous bullae (*black arrowhead*) and tense hemorrhagic bullae (*white arrowhead*).

Table I. Evaluation of fracture bullae and treatment recommendations

Evaluation

Obtain radiologic imaging of the area underlying all tense serous or hemorrhagic bullae to rule out underlying fracture if history of trauma.

Early orthopedic consultation is warranted in the presence of an underlying fracture.

Consider Doppler ultrasound scan of the edematous limb to rule out deep vein thrombosis if history is concerning.

Culture bullae if infection is suspected and treat empirically with antibiotics until cultures show growth/speciation.

Treatment

Drain bullae >1 cm to prevent traumatic rupture and erosion. Clean intact bullae at site of drainage with isopropyl alcohol. Puncture a small window of the blister roof with a sterile needle or scalpel to drain bullae.

Apply Xeroform petroleum gauze to maintain moist environment after puncture; consider silver sulfadiazine cream twice daily to prevent secondary infection if treatment delay exists.

Elevation of limb to reduce swelling/edema.

Avoid excess heat.

Avoid topical antibiotics commonly associated with allergic contact dermatitis (ie, neomycin or bacitracin).

Avoid excessive use of povidone iodine, hydrogen peroxide, or isopropyl alcohol, as this can interfere with re-epithelization of the epidermis.

There is no consensus on the treatment of fracture bullae, but few studies have proposed treatment regimens with local wound care.^{1,3,4,9} Our patient

was able to safely undergo operative fixation of the left humerus within 5 days of the index injury after our clinical approach (Table 1).

McCann et al⁴ recommend applying a dry dressing to intact blisters and a hydrocolloid dressing to previously ruptured blisters to maintain a moist environment. Alternatively, Strauss et al³ recommend unroofing the bullae, providing treatment with a topical antibiotic such as silver sulfadiazine and applying a dry, clean dressing. In the scenario in which the blister spontaneously ruptures, the blister roof should be left intact to allow the overlying epidermis to act as a biologic dressing.¹

Healing depends on the size of the bullae and retention of the epidermal cells on the dermis. Fracture bullae typically resolve spontaneously within 10 to 14 days; however, aggressive debridement may produce resolution in 5 to 10 days⁷ and may allow for earlier surgical intervention if indicated. Routinely implemented, elevation can prevent blister formation along with early surgical fracture fixation.^{1,10}

We report on a patient with extensive fracture bullae with an upper extremity fracture requiring urgent operative management. Early targeted treatment and a combined multidisciplinary approach enabled the patient to be treated

effectively for fracture bullae enabling timely surgical care.

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