

# Fracture Blisters After Primary Total Knee Arthroplasty

Mohamad J. Halawi, MD

## Abstract

Fracture blisters are tense vesicles that arise on markedly swollen skin overlying traumatized soft tissue. While this relatively uncommon complication has been well described in the trauma literature, this article reports for the first time a case of fracture blisters after primary total knee arthroplasty. The fracture blisters developed within 36 hours of surgery and were associated with profound swelling and erythema. There was no evidence of vascular injury, compartment syndrome, iatrogenic fracture, or

deep venous thrombosis. The patient was treated with leg elevation, loosely applied nonadhesive dressings, and a short course of oral antibiotics after skin desquamation. Blood-filled blisters required longer time to reepithelialization than fluid-filled blisters. Knee stiffness developed because of pain and fear of participation with physical therapy, but the patient was able to resume intensive rehabilitation after resolution of the blisters. Patient factors, surgical factors, and review of the literature are discussed.

Fracture blisters are a relatively uncommon complication of high-energy fractures, with an incidence of 2.9%.<sup>1</sup> In the lower extremity, fracture blisters almost always occur distal to the knee.<sup>1</sup> Histologically, the blisters represent an injury to the dermoepidermal junction.<sup>2</sup> On physical examination, there are tense blood- and/or clear fluid-filled bullae overlying markedly swollen and edematous soft tissue,<sup>1</sup> resembling a second-degree burn.<sup>3</sup> Infection may develop after fracture blisters,<sup>1</sup> and this is perhaps the most dreaded complication of total knee arthroplasty (TKA). The patient provided written informed consent for print and electronic publication of this case report.

## Case Report

A 71-year-old man with end-stage osteoarthritis of the right knee underwent an elective TKA with cemented components (Legion PS; Smith & Nephew). His medical history included venous insufficiency, type 2 diabetes mellitus, chronic obstructive sleep apnea, hypertension, morbid obesity (body mass index, 50), and a previous uneventful left TKA. Tourniquet time was 78 minutes and estimated blood loss was 100 mL. An intra-articular drain was used and was removed on the first postoperative day. After wound closure, a soft splint bandage consisting of 2 to 3 layers of cotton and bias wrap was applied. Deep vein thrombosis (DVT) prophylaxis with enoxaparin 40 mg once daily was started on the first postoperative day.

Upon removal of the surgical dressings on the second postoperative day, the anterior leg was found to have a combination of tense clear fluid- and blood-filled blisters on markedly

swollen and erythematous skin. The incision was minimally involved (Figure A). There was diffuse 2+ pitting edema with hyperesthesia in the affected skin distal to the knee. Prior to these findings, the patient had complained of increasing pain in his operative leg, but there was no escalation in analgesic requirements. There was no evidence of compartment syndrome on serial examinations. An ultrasound of the lower extremity was negative for DVT. Plain films did not show iatrogenic

**Figure.** (A) Photograph taken on the second postoperative day shows tense clear fluid-filled and blood-filled bullae overlying markedly swollen and erythematous skin on the anterior leg. The incision is minimally involved. (B) Photograph taken 24 days after surgery shows complete resolution of the blood-filled blisters and skin reepithelialization. Fluid-filled blisters required less time to skin reepithelialization (14 days).



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fractures. There was no intraoperative vascular injury, and the foot pulses remained unchanged between the time the patient was in the preoperative holding unit, the postanesthesia care unit, and the orthopedic ward. The operative leg was treated with elevation and loosely applied Kerlix roll gauze (Kendall, Covidien), but active blister formation continued for another 2 days. A 10-day prophylactic course of trimethoprim/sulfamethoxazole was initiated on the third postoperative day after the blisters started to rupture. The patient was allowed to bear weight as tolerated, but his physical therapy (PT) course was limited by pain and fear “of losing his leg.” He declined several PT sessions and was hesitant to use continuous passive motion. The patient was discharged to a short-term rehabilitation facility with weekly outpatient follow-up. On the second postoperative week, his fluid-filled blisters completely reepithelialized, but the blood-filled blisters required an additional week for reepithelialization (Figure B). While the patient’s knee was stiff because of limited PT participation, it was not until the second postoperative week when most of the fracture blisters had healed that he was able to resume an intensive knee exercise program, avoiding the need for manipulation under anesthesia.

## Discussion

Giordano and colleagues<sup>2</sup> identified 2 types of fracture blisters: clear fluid- and blood-filled. While both types involved disruption of the dermoepidermal junction, greater disruption and complete absence of dermal epithelial cells was observed in the hemorrhagic type. Clinical follow-up of the patients in the study by Giordano and colleagues<sup>2</sup> showed that the mean time for reepithelialization was 12 days for fluid-filled blisters and 16 days for blood-filled blisters. These findings are similar to what we observed in our case report. In particular, the fluid-filled blisters healed in 2 weeks, whereas the blood-filled blisters required 3 weeks to heal.

The etiology of the fracture blisters in this patient is likely multifactorial and related to age, obesity, venous insufficiency, and diabetes mellitus. Farage and colleagues<sup>4</sup> described a series of progressive degenerative changes in the aging skin, including vascular atrophy and degradation of dermal connective tissue, leading to compromised skin competence. The integrity of the dermis can be further reduced in patients with diabetes through glycosylation of collagen fibrils.<sup>5</sup> Compared with age-matched normal controls, patients with insulin-dependent diabetes have a reduced threshold to suction-induced blister formation.<sup>6</sup> Obesity is another potential contributing factor, with multiple studies showing significantly impaired venous flow in obese patients.<sup>7,8</sup> Taken together, soft-tissue swelling after surgery in the setting of chronic venous insufficiency and compromised skin due to advanced age and diabetes may lead to markedly elevated interstitial pressure. One mechanism to relieve such abnormally high pressure is the formation of fracture blisters.<sup>1</sup>

Surgical risk factors that could have contributed to the complication in this case include the surgical skin preparation solution (ChlorPrep; CareFusion), use of adhesive antimicrobial

drape (Ioban, 3M), tourniquet time, dressing choice, and DVT prophylaxis regimen. While the skin preparation solution is an unlikely culprit since the presentation is not consistent with contact dermatitis, inappropriate strapping or removal of the adhesive drape could result in stretch injury of the skin, shearing the dermoepidermal junction and causing tension blisters.<sup>9</sup> There were no intraoperative complications and the tourniquet time was appropriate (78 minutes). Postoperatively, no compressive or adhesive dressings were used. With regards to DVT prophylaxis, the patient received a single dose of enoxaparin on the first postoperative day. While heparin-induced hemorrhagic blisters have been reported,<sup>10</sup> I do not feel that the use of enoxaparin was a contributing factor. Heparin-induced blisters have been described as systemic blisters,<sup>10</sup> whereas the blisters in this case were confined to the operative extremity. The patient was not taking any nutritional supplements (eg, fish oil, vitamin E) that could have increased his risk of bleeding. Throughout his hospital stay, he was hemodynamically stable and did not require blood transfusion.

Management of fracture blisters is controversial, and there is no consensus on appropriate soft-tissue handling. In this patient, the blisters were left intact. Blister fluid has been shown to be sterile, containing growth factors, opsonins, and activated neutrophils that aid in healing and infection prevention.<sup>1</sup> Giordano and Koval<sup>11</sup> found no difference in the outcome of 3 soft-tissue treatment techniques: (1) aspiration of the blister, (2) deroofting of the blister followed by application of a topical antibiotic cream or coverage with nonadherent dressing, or (3) keeping the blister intact and covered with loose dressing or exposed to air. In contrast, Strauss and colleagues<sup>12</sup> found that deroofting the fracture blister to healthy tissue followed by twice-daily application of silver sulfadiazine antibiotic cream promoted reepithelialization and resulted in better cosmetic appearance and higher patient satisfaction.

The optimal dressing for fracture blisters remains elusive. Madden and colleagues<sup>13</sup> showed that the use of occlusive nonadherent dressing was associated with significantly faster healing and less pain compared with semioclusive, antibiotic-impregnated dressings. In another study, Varela and colleagues<sup>1</sup> found no differences in blister healing between patients treated with either (1) dry dressing and casting, (2) Silvadene dressing (King Pharmaceuticals), or (3) whirlpool débridement and Silvadene dressing.

Infection is perhaps the most dreaded complication of fracture blisters after TKA. Varela and colleagues<sup>1</sup> showed that, while the fluid in intact blisters was a sterile transudate, polymicrobial colonization with skin flora often occurred soon after blister rupture and persisted until reepithelialization. Our patient received a 10-day course of prophylactic antibiotics and no superficial or deep infection developed; however, the real contribution of antibiotic prophylaxis to the absence of infection cannot be established based solely on 1 case.

Pain is another concern associated with fracture blisters. Our patient had significant pain that limited his ability to participate in PT, resulting in limited knee range of motion and eventual discharge to a short-term rehabilitation facility.

Fortunately, after resolution of the fracture blisters, he was able to participate in an aggressive rehabilitation program. By 6 weeks after surgery, he had significant improvement in his knee motion, avoiding the need for manipulation under anesthesia.

### Conclusion

This case represents the first reported fracture blisters after primary TKA. The risk of deep surgical site infection, a devastating complication after TKA, is perhaps the most frightening concern of this rare complication. While the etiology and the management are controversial, there is evidence to recommend prophylactic antibiotics after blister rupture and skin desquamation. The decision to withhold DVT prophylaxis should be based on individual patient risk factors and blister type (blood-filled vs clear fluid-filled). Patients should be encouraged to continue knee exercises during reepithelialization to avoid stiffness.

Dr. Halawi is Chief Resident, Department of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina.

Address correspondence to: Mohamad J. Halawi, MD, Department of Orthopaedic Surgery, Duke University Medical Center, Box 3000, Durham, NC 27710 (email, mohamad.halawi@dm.duke.edu).

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*This paper will be judged for the Resident Writer's Award.*

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