

Rare popliteal mass following retrograde nailing of ballistic femur fracture: a case report

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Abstract

Introduction: Civilian ballistic injuries are commonly associated with fracture, vascular injury, and soft tissue trauma. Posttraumatic pseudoaneurysms represent an extremely rare subset of vascular injuries following ballistic fractures.

Case: We present the rare case of a posttraumatic pseudoaneurysm that occurred after retrograde femoral nailing of a ballistic distal femur fracture. The patient presented in clinic postoperatively with a pulsatile popliteal mass. Distal pulses were intact but subsequent ultrasound and angiography revealed a pseudoaneurysm of the distal superficial femoral artery. The pseudoaneurysm was subsequently treated with a covered stent and the patient's recovery was uncomplicated.

Conclusion: Due to the potential life and limb-threatening complications from pseudoaneurysm rupture, this case report emphasizes the early recognition and expeditious management of vascular complications following ballistic fractures in the civilian population.

Keywords: ballistic injury, civilian, femur fracture, pseudoaneurysm, retrograde femoral nail, traumatic

1. Introduction

Civilian ballistic fractures most often involve the lower extremities and are associated with lower velocity firearms, lesser degree of soft tissue injury and contamination, and a higher rate of immediate fixation and limb salvage than those encountered in the war theater.^[1] A significant rate of vascular injuries have been reported in civilian ballistic injuries, particularly those involving the distal third of the femur and associated with a femur fracture.^[2]

Posttraumatic pseudoaneurysms, or false aneurysms, represent a rare subset of vascular injuries following a ballistic fracture. Unlike a "true" aneurysm, pseudoaneurysm vessel walls lack an intimal layer and most often result from penetrating trauma. Pseudoaneurysms in the lower extremity have been described

following femoral artery catheterization, stab or gunshot wounds, and rarely, aberrant drill path, guide pin or screw placement during intertrochanteric nailing, femoral plate, and screw fixation or dynamic hip screw fixation for femur fractures.^[3–5]

While previous studies have reported femoral pseudoaneurysms following closed femur fractures in the pediatric population and following hip fracture fixation, no studies to date have reported delayed presentation of pseudoaneurysm following retrograde femoral nailing of a ballistic femur fracture.^[3–9] Because of the life and limb-threatening consequences that can result from mis- or delayed diagnosis of pseudoaneurysms, we present our experience with this rare posttraumatic phenomenon.

2. Case report

A 34-year-old male presented to our Trauma Bay following an isolated gunshot wound to the left anterior distal thigh, just superior to the patella. The bullet entered anteriorly and exited laterally to the knee. Distal pulses were palpable and ankle-brachial index (ABI) was normal on arrival. Radiographs as well as CT scan of the left femur revealed a comminuted, displaced, extra-articular supracondylar femur fracture (AO/OTA 33A3.2H) with numerous metallic bullet fragments (Fig. 1). The patient was resuscitated and subsequently underwent surgical fixation the following day with retrograde femoral nailing through an anterior knee approach (Fig. 2). Postoperatively he was admitted to the floor and required 3 units of blood during his hospital course. After working with physical therapy, he was discharged on postoperative day 5 with 2 weeks of enoxaparin venous thromboembolism prophylaxis and scheduled to return to clinic in 2 weeks.

At his subsequent postoperative visits, the patient reports increased knee pain and stiffness. His x-rays showed stable hardware position and physical exam remained neurovascularly intact with palpable distal pulses. However, at his 6-week postoperative appointment, increased leg edema was noted as well as persistent knee pain and stiffness. In addition, a posterolateral knee mass was present. Duplex ultrasonography demonstrated a fluid collection consistent with an aneurysm,

Source of funding: Nil.

Work Performed in Institution: Froedtert Hospital.

Authorship has been granted only to those individuals who have contributed substantially to the research or manuscript.

All authors have read and complied with the ethical approval/informed consent requirements. Oral informed consent was approved by the patient for publication of this case report. Statement for consent is reflected in the final sentence of the "Case Report" section.

The authors have no conflicts of interest to disclose.

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OTA (2021) e094

Received: 7 July 2020 / Received in final form: 9 September 2020 / Accepted: 7 October 2020

Published online 11 February 2021

<http://dx.doi.org/10.1097/OI9.000000000000094>

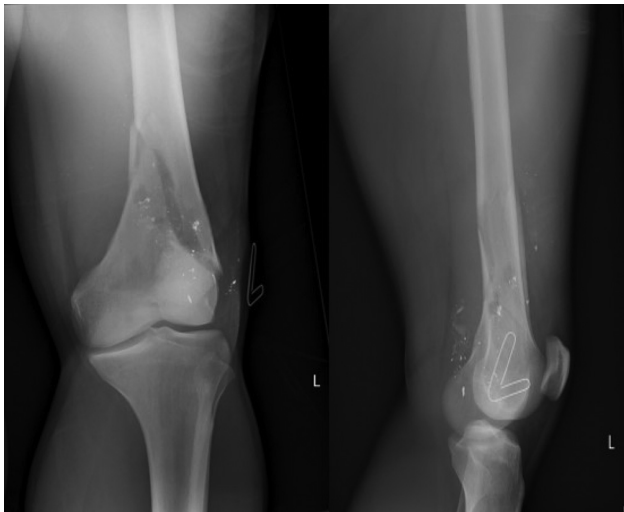


Figure 1. Comminuted left distal femur status post gunshot wound.



Figure 2. Two weeks status post retrograde nailing of ballistic distal femur fracture.

which was confirmed with CT angiography showing a 12 cm × 10 cm × 9 cm, patent, distal superficial femoral artery pseudoaneurysm resulting in severe compression and medial displacement of the artery (Fig. 3).

Vascular surgery was consulted and the patient underwent endovascular repair of the left distal superficial femoral artery. Access was obtained via the right femoral artery under ultrasound guidance, and the pseudoaneurysm was repaired using a 7 mm × 5 cm covered stent (Viabahn Endoprosthesis; Gore, Flagstaff, AZ) with angioplasty 6 mm distal to the superficial femoral artery segment (Fig. 4). The femoral artery access site was closed using an 8-French vascular closure device

(Angio-Seal VIP Vascular Closure Device; Terumo, Somerset, NJ). The patient had an uneventful postoperative course and was discharged on day 3 with aspirin 81 mg QD and clopidogrel 75 mg QD for stent patency. ABI on postoperative follow-up were 1.03 on the left and 1.12 on the right, with no identifiable stent stenosis. The patient’s pain subsequently improved and he has since gone on to heal his fracture uneventfully. The patient provided informed consent for publication of this material and understood that the course of clinical care and imaging may be used for educational purposes within a medical journal. The study was deemed exempt from Institutional Review Board and Animal Use Committee Review.

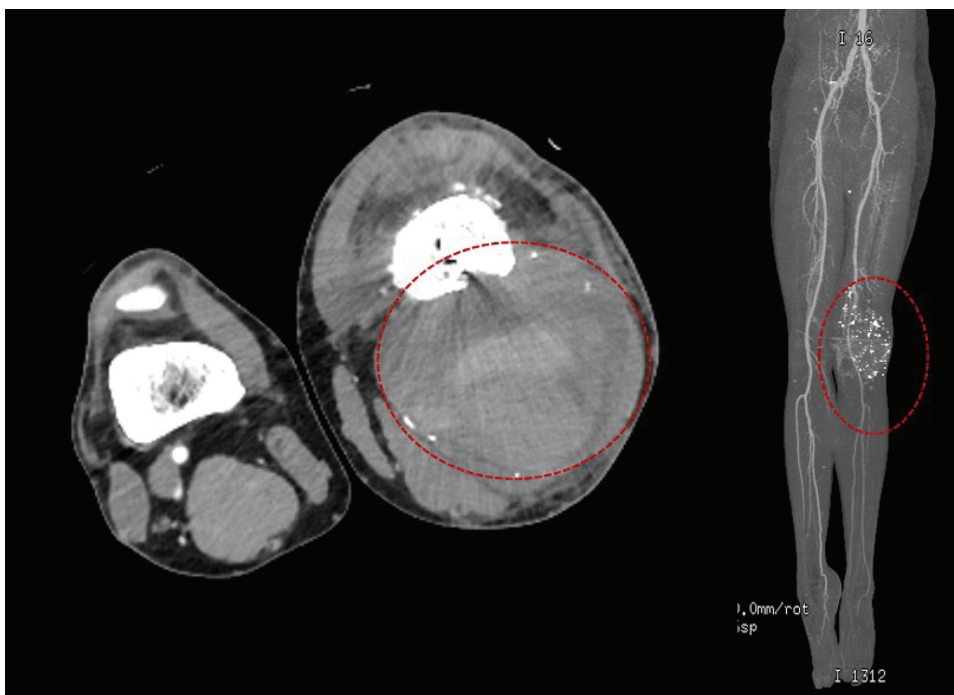


Figure 3. CT angiogram 2 months postop showing large pseudoaneurysm (left, red circle) and significant shrapnel (right, red circle).

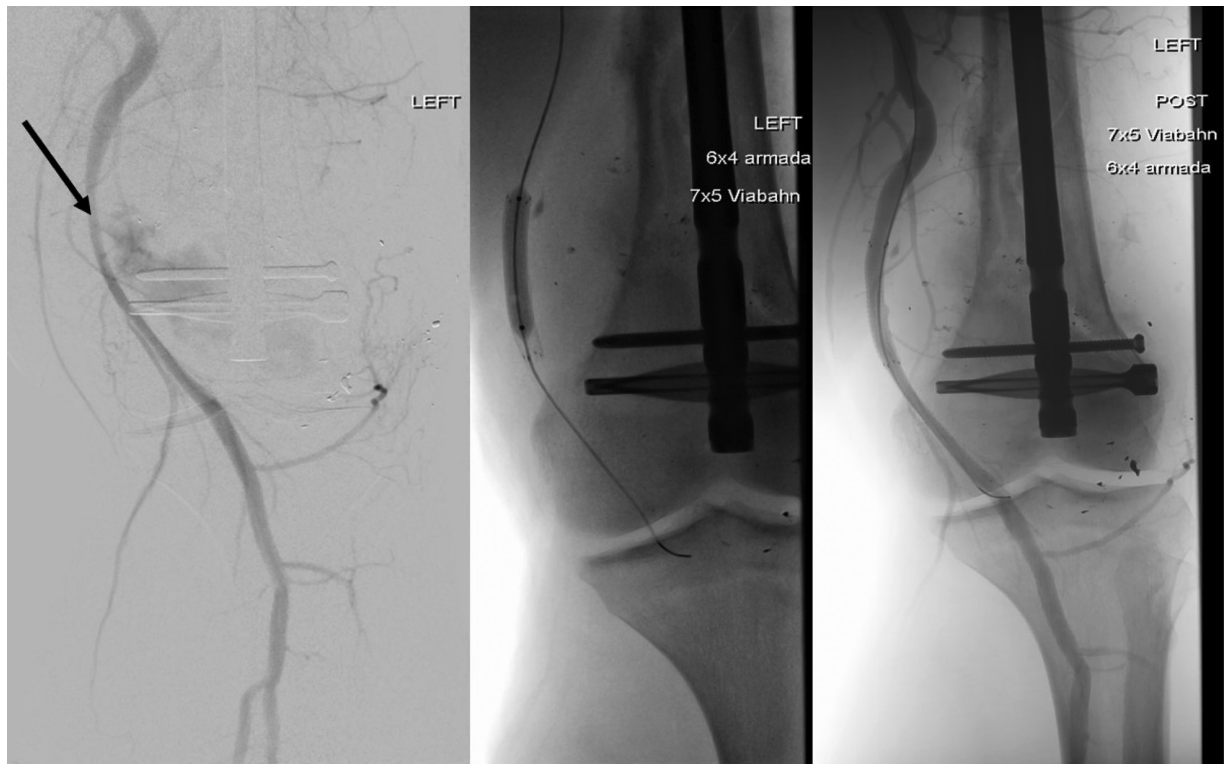


Figure 4. Intraoperative angiogram demonstrates pseudoaneurysm from superficial femoral artery (SFA) (arrow, left). A coated stent is deployed (middle) with successful restoration SFA flow (right).

3. Discussion

Pseudoaneurysm formation following penetrating trauma, whether from ballistic missile or following fracture fixation, represents a rare but potentially devastating complication of a femur fracture. In the case of this patient, the origin of pseudoaneurysm is unclear, but the sharp fracture or bullet fragments are most likely responsible. Intraoperatively, the helical blade drilling and insertion was performed from the lateral to medial direction and the course of the guidewire remained intramedullary. Due to this, iatrogenic causes seem less likely, but are still possible. Complications of pseudoaneurysms include acute thrombosis leading to limb ischemia, embolization to distant locations, and/or rupture leading to hemorrhagic shock.^[10] Early detection and treatment are important but can be complicated by nonspecific patient symptoms including limb edema, ecchymosis, pain, and restricted range of motion which is often present after trauma in the absence of vascular injury.^[3] Pseudoaneurysms can take months to

develop which is why surgeons must pay attention to the “soft” and “hard” signs of vascular injury in follow-up long after the fracture heals. Table 1 shows the “hard” and “soft” signs of arterial injury as described by DeSourza et al.^[11] We routinely follow our ballistic femur fracture patients for a minimum of 6 months postoperatively to ensure fracture union, return to function and no other less common complications, such as pseudoaneurysms, have occurred.

Secondary prevention of traumatic pseudoaneurysms is centered upon the understanding of who is most at risk for this rare complication. Previous studies, looking at vascular injuries following ballistic femur fractures, have shown that the location of the fracture is important, particularly in the patient population with intact pulses and no other “hard” signs of vascular injury. Shayne et al^[12] have previously reported that a wound track involving the anteromedial thigh was 92% sensitive and 50% specific for vascular injury. Additionally, Gitajn et al^[2] reviewed 114 consecutive ballistic femur fractures and found that distal location was 6-fold more likely to be associated with vascular injury. However, pseudoaneurysms following penetrating trauma often lack these obvious “hard signs” associated with vascular injury at initial presentation. This is due to the lack of circumferential dilation of the intimal layer in pseudoaneurysms, in contrast to true aneurysms. This enables laminar arterial flow to continue in the affected extremity and subsequent normal ABI measurements to be obtained (1–1.4) such as in our case.^[11] In addition, pain secondary to the associated femur fracture can serve as a distracting injury. However, knowledge of the proximity of the wounds to the underlying vascular structures as well as the course of the missile should raise one’s index of suspicion for potential vascular injury, including potential for pseudoaneurysm formation. In addition, while high-energy

Table 1
Combined EAST and WTA guidelines of hard and soft signs of vascular injury.

Hard signs	Soft signs
Bruit	
Diminished pulse	
Expanding hematoma	
Pain	History of arterial bleeding
Pallor	Neurologic deficit
Paralysis	Nonexpanding hematoma
Paresthesia	Proximity of wound to artery
Pulsatile bleeding	Small, nonpulsatile hematoma
Thrill	

ballistic injuries from a military or hunting rifle commonly cause intimal injury to an artery from the sonic and cavitation effects passing through the tissue, a lower energy ballistic missile from a handgun, like our patient, usually needs to make very close contact or create a secondary projectile from a fracture fragment to cause arterial injury.^[13] Attention to the “soft” signs of vascular injury that may develop over time is paramount, as delays in diagnosis can be limb threatening, particularly in the setting of embolus, thrombosis, or rupture.

The work up for arterial injury after ballistic femur fractures is controversial. There is no consensus definition between West Trauma Association (WTA) and Eastern Association for the Surgery of Trauma (EAST) of “hard” and “soft” signs of vascular injury, let alone a unified algorithm for imaging and treatment.^[11] Options for diagnosis include physical exam, ABIs, ultrasound (US), computer tomography angiography (CTA), catheter angiography, magnetic resonance imaging, and surgical exploration. In our practice, all patients are examined and ABIs are obtained. In the presence of pulsatile bleeding, hemodynamic instability and a pulseless foot, emergent surgical exploration is performed. In the setting of other “hard” signs of vascular injury or ABI <0.9, a CTA is obtained to identify and localize any potential vascular injury. For patients with “soft” signs of vascular injury and normal ABIs we routinely observe these patients clinically. While following patients clinically, US can be a helpful point-of-care test in the outpatient setting to screen for pseudoaneurysm as well as venous thromboembolism. However, US is not as sensitive as CTA and is more operator dependent, so we commonly use CTA as the confirmatory diagnostic study and for Vascular Surgery preoperative planning.^[11] As stated, catheter angiography can also be used to diagnose vascular injuries. However, this modality takes longer to obtain at our institution than CTA and has a small, but significant, complication risk of arterial injury in itself (as high as 9% in some studies), making it a second line option.^[11] Additionally, the routine use of angiography following lower extremity gunshot wounds is controversial. It adds cost and has previously been shown to not alter management despite its ability to detect occult vascular injuries not identified by pulse examination, ABI measurement, and Doppler ultrasonography. Norman et al^[14] previously performed arteriography on 75 consecutive patients who had long bone fractures following gunshot wounds to the extremities. Despite a normal examination, 28% of patients were subsequently found to have occult vascular injury identified on arteriogram. However, the majority (83%) of these were minor, and surgical intervention was only required in 1 patient (1.6%).^[14] Finally, as another alternative diagnostic method, MRA can be used which obviates the radiation exposure associated with CTA. However, its higher cost and prolonged time to obtain limits its application in the acute trauma setting and makes it less commonly used within our practice. Regardless of imaging modality, recognition of the subtle signs of vascular

injury early in the postoperative course, which can mimic normal postoperative pain and edema or more common complications such as venous thromboembolism, can potentially be life- and/or limb-saving.

4. Conclusion

This case presents the rare complication of superficial femoral artery pseudoaneurysm following retrograde nailing of a ballistic femur fracture. While it is not clear whether the vessel injury occurred as a result of the fracture or bullet fragments, the early recognition of this rare complication using clinical signs and symptoms of a pseudoaneurysm led to prompt vascular intervention and satisfactory functional results without additional complications.

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