Injury to the Superior Gluteal Artery During Intramedullary Fixation of an Atypical Subtrochanteric Stress Fracture
A Case Report

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Abstract
Iatrogenic vascular injury during hip fracture surgery is a rare complication, with infrequent reports of injury during the procedure of cephalo-medullary nailing. We describe a case report of injury to the superior gluteal artery which occurred during insertion of a nail for prophylactic fixation of an incomplete femur fracture secondary to alendronate use. We describe the anatomy of the arterial branches, the postoperative course, and the management strategy and hope this will increase awareness of these rare injuries.

Iatrogenic vascular injury during hip fracture surgery is a rare potential complication, reported to occur in 0.2% of intertrochanteric fractures managed with cephalomedullary fixation or a dynamic hip screw.1-3 Reported etiologies include suspected vessel penetration by a guidewire, drill, screw or retractor tip, and infrequently, injury secondary to fracture fragment displacement.3,4 In the majority of described cases of hip fracture related vascular complication, the injured vessel is either a branch of the profunda femoris artery due to penetration by a drill bit or screw, or an intra-pelvic vessel damaged by over-penetration of the lag screw guidewire.3,5-9 Secondary to the significant morbidity associated with iatrogenic vascular injury about the proximal femur, acknowledgement of its potential and a low threshold for an appropriate diagnostic workup is of paramount importance.

We present a case in which an injury to a branch of the superior gluteal artery occurred during prophylactic intramedullary fixation of an atypical subtrochanteric stress fracture. Based on the location of the arterial injury, we suspect that the vessel was penetrated during the insertion of the initial threaded guidewire while attempting to locate the greater trochanteric starting point.

Case Description
The patient is a 57-year-old female admitted for a planned intramedullary nailing of an atypical right subtrochanteric stress fracture. The patient had been previously operated upon 4 months earlier for a completed atypical subtrochanteric stress fracture of her left femur. The procedure was carried out without apparent incident, and the patient was taken to the post-anesthesia care unit (PACU) extubated and in stable hemodynamic condition (Fig. 1). Total operative time was 75 minutes, and the estimated blood loss was 150 cc. Postoperatively, she was noted to have significant ecchymosis about the thigh, which was consistent with her gross appearance following her prior operation. She was weightbearing as tolerated starting on postoperative day 1. On postoperative day 2, the patient was transfused two units of packed red blood cells for a hematocrit of 20.0, which appropriately responded to a post-transfusion hematocrit of 28.0. The orthopaedic team was called on postoperative day 7 because the patient experienced increased pain in the operative thigh, but no evidence of increased swelling or ecchymosis was noted. The patient underwent a computed tomography (CT) scan of the right lower extremity, which demonstrated a hematoma in the region of the gluteus maximus measuring 13 cm by 9.7 cm and a second hematoma between the posterior and medial compartments of the right thigh measuring 3.6 cm by 3.0 cm. On the same day, the patient received two units packed red blood cells for a hematocrit of 18.8. On postoperative day 8, the patient’s hematocrit was found to be at a nadir of 13.6. The patient was transfused with three additional units of packed red blood cells for a hematocrit of 22.1.

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units of packed red blood cells and was transferred to the medical intensive care unit for monitoring. The thigh was noted to be swollen but not tense. The patient underwent a CT scan of her right lower extremity with contrast, which showed interval increase in the hematoma in the region of her gluteus maximus to a diameter of 14 cm by 12 cm and an increase in the thigh hematoma to 4.2 cm by 4.0 cm. Also, seen were findings highly suspicious for active contrast extravasation in the gluteus maximus hematoma for which angiography was recommended. This occurred on postoperative day 9. An arterial bleed from a distal branch of the right superior gluteal artery was found and subsequently coiled and embolized (Fig. 2). No other sources of bleeding were demonstrated. The patient was brought back to the intensive care unit for continued monitoring. During the remainder of her hospital course, she did not require further transfusions and remained hemodynamically stable. She resumed her progress with physical therapy and was transferred back to an acute rehabilitation floor on postoperative day 12, post-angiography day 3. At the most recent follow up, the patient was ambulating well without an assistive device and had no symptoms or long-term sequelae related to her right lower extremity. The follow-up hematocrit stabilized at 30.6 on postoperative day 25.

At last follow-up at 3 weeks postoperatively, the patient had no sequelae from the low hematocrit. During this postoperative period, no neurological deficit was noted.

**Discussion**

In the case presented, we believe that the injury to the distal branch of the superior gluteal artery occurred during placement of the initial threaded guidewire while locating the greater trochanteric start point for cephalomedullary nail insertion. It is possible that bleeding from the injured vessel slowed or ceased secondary to clot formation shortly after the initial insult, only to resume with probable clot dislodgement upon patient mobilization on postoperative days 2 through 7. The decline in the patient’s hematocrit and the presence of ecchymosis about her thigh were the only early signs of her vascular injury. She had remained ambulatory and did not have appreciable thigh swelling until postoperative day 7 when the diagnostic workup was started.

Vascular injuries associated with hip fractures and hip fracture surgery are rare complications with few reports in the literature. In the majority of these case reports, branches of the femoral artery were injured, likely secondary to over-penetration of drill bits, excessively long screws, or retractor placement. At 5 to 7 cm distal to the lesser trochanter, the superficial and deep femoral arteries lie in close proximity to the femur, placing them at risk for injury, especially during placement of screws in the distal holes of a sliding hip screw side plate or during placement of the interlocking screw of a short intramedullary nail. Yang and coworkers examined the position of the superficial femoral artery relative to the femur during hip fracture fixation on a fracture table. The
investigators found that while the mean distance between the artery and the femur was 20.3 mm in the neutral position, positioning the injured lower extremity in 20° of adduction and 20° of internal rotation, the common position of fracture reduction, decreased this distance to 9.5 mm.\(^9\)

In a recent case report, Ryzewicz and associates described an injury to a branch of the profunda femoral artery during fixation of a displaced intertrochanteric hip fracture managed with a percutaneously placed compression plate.\(^7\) Ten hours postoperatively, the patient was found to be hypotensive and tachycardic with significant lower extremity swelling and a hematocrit of 19. She was taken for angiography with coil embolization of the injured vascular branch. Interestingly, in this case, the injured vessel as documented on angiography was 2.5 cm distal to the end of their side plate, leading the investigators to surmise that the vascular injury occurred secondary to traction during a difficult reduction or during clamping of the side plate to the femur in the face of significant atherosclerosis. Bansal and Laing reported a similar mechanism of traction on an atherosclerotic vessel during hip fracture reduction and fixation leading to intimal damage and rupture.

Penetration of the acetabulum by the lag screw guidewire or late intrapelvic migration of the lag screw are other potential sources of vascular injury during or after hip fracture fixation. Moreyra and colleagues reported a case in which the lag screw from a sliding hip screw eroded through the acetabulum precipitating the development of a retroperitoneal and extraperitoneal hematoma 4 months postoperatively.\(^8\)

Surgical exploration identified a laceration of the left external iliac artery, which was repaired. Despite the vascular repair, the patient’s condition worsened, and he expired on postoperative day 2. Autopsy identified a concomitant injury to the internal iliac artery, which was not identified during the exploratory laparotomy.

Arterial injury arising secondary to displaced hip fracture fragments has been described. Ritchie and coworkers reported a case of patient who complained of persistent proximal thigh pain following operative fixation of a hip fracture.\(^9\) Evaluation with a CT scan identified a false aneurysm of the profunda femoral artery occurring in proximity to a displaced lesser trochanteric fragment.

Despite the low incidence of vascular injuries during hip fracture surgery, the treating surgeon must have a high level of suspicion and a low threshold for diagnostic workup when their patient has a drop in their postoperative hematocrit in the presence of increased thigh pain and swelling. Hard signs of arterial injury, such as loss of distal pulses, the presence of an expanding hematoma, or an auscultated thrill or bruit require immediate action; however, in the reported cases of vascular injury associated with hip fracture, these signs were typically not present. Patients presenting with softer signs of vascular injury may be worked up initially with noninvasive studies such as ultrasonography, CT scanning with contrast, or CT angiography. In the presented case, the initial CT scan identified two hematomas about the proximal femur, both of which increased in size on a follow-up scan. Based on the information obtained from the noninvasive studies, an appropriate treatment plan can be formulated. In addition to identifying the presence, location, and extent of vascular injury, conventional angiography allows for treatment of the injury with embolization.

The current case is the first we are aware of describing injury to a branch of the superior gluteal artery during cephalomedullary fixation of a hip fracture. We believe that the injury occurred during placement of the initial guidewire while attempting to locate the greater trochanteric starting point for nail insertion. There is potential for injury to the superior gluteal artery during this step of the operation and the operating surgeon should be vigilant postoperatively so that appropriate diagnostic studies and treatment can be undertaken expeditiously.

**Conclusions**

Routine surgery can be complicated by both known and previously unknown problems prompting a surgeon to be vigilant at all times. While rare, when faced with a thigh hematoma that appears to increase in size at follow-up, a CT with contrast should be recommended. A follow-up angiography maybe necessary, if the CT shows any extravasation allowing for the identification and treatment of injured vasculature.

**Disclosure Statement**

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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