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Case Report

Arteriovenous fistula of the deep femoral artery induced during PFNA fixation for intertrochanteric femoral fracture: a case report

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Abstract: We report the case of an 80-year-old woman who developed an arteriovenous fistula of the deep femoral arteries during proximal femoral nail antirotation (PFNA) fixation for an intertrochanteric femoral fracture. Six days after PFNA fixation, color Doppler ultrasonography and digital subtraction angiography revealed an arteriovenous fistula. The cause of vascular injury was believed to be misalignment of the guide pin. Embolization was successful. Five days later, the patient was discharged without complication. At the six-month follow-up, the wound and fracture had healed, and the patient was able to bear her full weight and had normal gait. Radiological imaging and a high index of clinical suspicion are necessary for diagnosing arteriovenous fistula associated with PFNA fixation, for which intervention is one of several treatment options.

Keywords: Arteriovenous fistula, PFNA, deep femoral artery, fixation, intertrochanteric femora, fracture

Introduction

An arteriovenous fistula is an abnormal connection between an artery and a vein that allows arterial blood to be shunted into the vein. Acquired arteriovenous fistulas may occur as a complication of invasive surgery or as a result of direct injury in association with trauma, such as a long bone fracture [1]. The clinical manifestations of arteriovenous fistula may not be immediately obvious, and diagnoses may be delayed for weeks or even years [2]. Arteriovenous fistulas are associated with complications such as rupture, distal limb ischemia, thrombosis, and heart failure. Open surgery is the gold standard treatment for arteriovenous fistula, however, other options include stent implantation and coil embolization [3].

Intertrochanteric fracture is a common osteoporotic fracture, accounting for 47% of hip fractures in the elderly [4]. The incidence of femoral intertrochanteric fracture caused by low-energy trauma is increasing in the context of the ageing population [5]. Conservative treatment for intertrochanteric fracture is associated with considerable mortality, as patients are bedridden. This can aggravate existing medical conditions and cause complications such as hypostatic pneumonia, pressure ulcers, and venous blood clots. Surgery using proximal femoral nail anti-rotation (PFNA) fixation is the preferred treatment method for intertrochanteric fracture in the elderly. PFNA is a minimally invasive fixation technique that avoids soft tissue damage around the fracture line, as well as periosteal stripping. PFNA fixation is safe and reliable and allows early out-of-bed activity and weight bearing [6]. Complications associated with PFNA fixation include infection, non-union, femoral head necrosis, and vascular and nerve injuries. Although the rate of vascular injury is fairly low, only 0.2% [7, 8], it should brought to our sufficient attention because of the huge number of femoral intertrochanteric fractures.

Formation of an arteriovenous fistula in deep femoral arteries is rare after PFNA fixation, and to our knowledge, has not been reported in the medical literature. A high index of clinical suspicion and radiological imaging are necessary for the diagnosis of arteriovenous fistula, for which

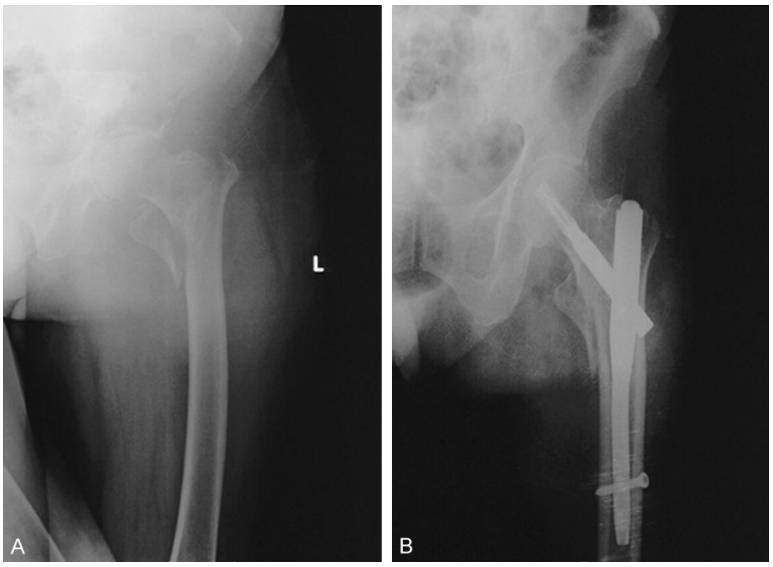

Figure 1. Preoperative (A) X-rays showing the intertrochanteric fracture of the left femur (AO 31-A2) and postoperative (B) X-rays showing good fracture reduction.

the main clinical symptoms are swelling of the limbs and progressive decline in hemoglobin. Color Doppler ultrasonography and digital subtraction angiography are important techniques for radiological imaging. Limb- and life-threatening injuries can occur if the condition is not promptly diagnosed, owing to blood loss from the arterial injury, distal limb ischemia, and compartment syndrome.

We report the case of an elderly woman who developed an arteriovenous fistula of the deep femoral arteries during PFNA fixation for an intertrochanteric femoral fracture.

Case report

In March 2015, an 80-year-old woman was hospitalized for left hip pain and the inability to walk one day after a fall. Prior to the injury, the patient had been able to walk unimpeded. The patient's medical history revealed hypertension and coronary heart disease. Clinical examination demonstrated swelling of the left hip, abduction and external rotation deformity in the left limb resulting in the left limb being approximately 2 cm shorter than the right limb, as well as palpable pedal pulses. Plain radiographs showed an intertrochanteric fracture of the left femur (**Figure 1**, AO 31-A2). The patients and/or their families were informed that data from the case would be submitted for publication, and gave their consent.

Three days after the injury the patient was treated with PFNA fixation under fluoroscopic control. After gentle traction with internal rotation and reduction, a 3 cm incision was made proximal to the greater trochanter. The guide pin was placed at the medial border of the femur adjacent to the fracture site and adjusted until it was visible in the center of the femoral cavity. The proximal femur was reamed and tapped, and the PFNA (Kang Hui, China, 130° 200 × 11 mm) implant was fixed in position. Duration of surgery was approximately 40 minutes, and intraoperative blood loss was 120 mL. A blood transfusion was not required. During the two days after surgery, the patient's hemoglobin and albumin levels were 104 g/L and 25 g/L, respectively; the patient was treated for hypoproteinemia. Forty-eight hours later, total drainage from the wound was 120 mL. The radiographs showed good fixation (**Figure 1B**).

Six days after surgery, the patient experienced mild swelling of the left leg. The patients' thigh circumference (20 cm suprapatellar) was 57 cm on the left and 42 cm on the right, with extensive subcutaneous ecchymosis from the left hip to the fossa. Left pedal pulses were palpable and weaker than the right pedal pulses. Hemoglobin and albumin levels were 75 g/L and 37 g/L, respectively. Active bleeding or deep vein thrombosis were considered. Duplex ultrasound scanning of the left leg showed the absence of deep vein thrombosis in the femoropopliteal venous system, but revealed a 4 × 6 cm hematoma with a blood pattern suggestive of a pseudoaneurysm (**Figure 2**).

Emergency digital subtraction angiography imaging showed contrast medium extravasation from the deep femoral artery into the femoral vein 3 cm below the nomadic lesser trochanter, and the formation of a deep femoral arteriovenous fistula (**Figure 3**). Following coil embolization of the deep femoral artery, contrast medium no longer spilled from the femoral artery, and the left deep femoral vein was

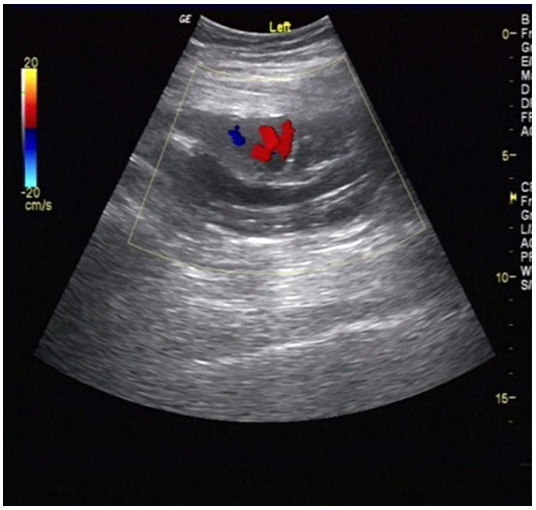

Figure 2. Vascular Doppler ultrasound showing a partial irregular cyst in the left thigh receiving a blood supply.

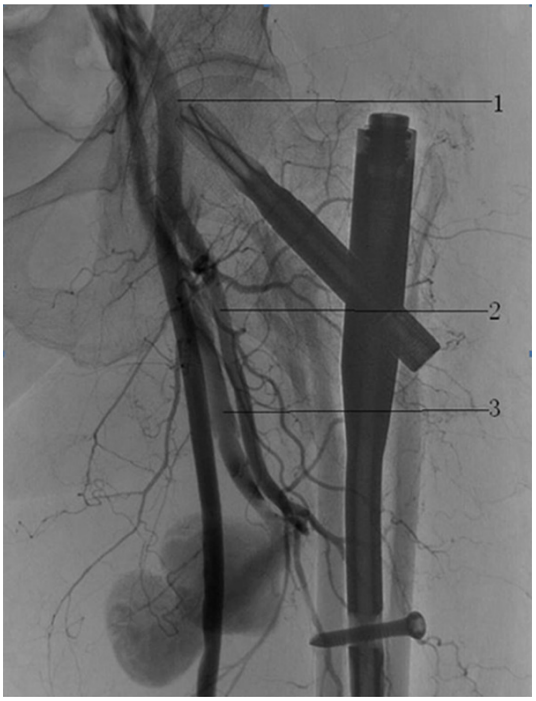

Figure 3. Digital subtraction angiography imaging showing the formation of a deep femoral arterio-venous fistula: 1, femoral artery; 2, deep femoral artery; 3, deep femoral vein.

not visible on digital subtraction angiography (**Figure 4**). The patient received a postoperative blood transfusion of two units of packed red blood cells. Upon review, the patient's hemoglobin level was 92 g/L and vital signs were stable. The patient was discharged five days later. Fracture union was observed at the three

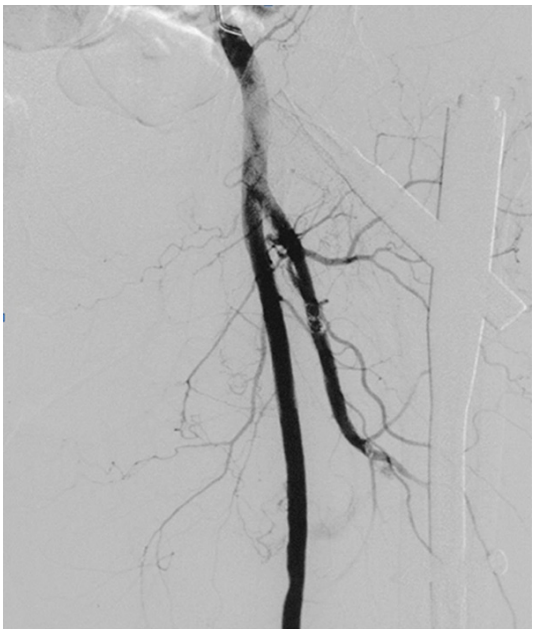

Figure 4. Digital subtraction angiography imaging after coil embolization of the deep femoral artery.

month follow-up, and the patient started weight-bearing functional exercises. At the six month follow-up, the patient was bearing her full weight and showed normal gait.

Discussion

The deep femoral artery originates from the posterolateral aspect of the femoral artery, which is 2.25 to 5.0 cm below the inguinal ligament. The deep femoral artery starts laterally, becomes positioned posterior to the femoral artery and medial to the proximal femoral shaft, and ends at the lower third of the thigh in a small branch that pierces the adductor magnus and is distributed on the back of the thigh to the hamstring muscles. The perforating arteries of the deep femoral artery are situated near the proximal femur unless traction, adduction, and rotation of the femur during surgery (e.g., dynamic hip screw, PFNA, total hip replacement) causes them to approach the cortex of the femur [9-13]. In this case, the deep femoral artery at the level of the proximal femoral shaft is vulnerable to intraoperative or postoperative injury [14]. Displacement of the lesser trochanter during intertrochanteric fracture may also cause injury to the deep femoral artery [15, 16].

Symptom onset varies according to the cause of arterial injury [17]. Symptom onset is acute when arterial injury is caused by fractured bone

or over-penetration by a drill bit, retractor, or screw. Symptom onset is delayed secondary to prolonged impingement or erosion of the artery by a protruding fixation screw [18]. This is mostly seen in arteries with atherosclerotic plaques, whereby constant friction causes arterial wall erosion.

In the patient in the current case report, injury to the deep femoral artery was located 33.2 mm inferior to the lesser trochanter, and 49.3 mm superior to the distal screw. As the deep femoral artery is close to the cortex of the femur, intraoperative rotation of the guide pin during insertion resulted in the formation of an arteriovenous fistula. Based on our clinical experience, we recommend that surgeons be aware of the risk of vascular injury during PFNA fixation, and take care when inserting the guide pin.

Diagnosis of injury to deep femoral arteries is difficult and frequently delayed. Injury is usually masked by trauma or other complications such as deep venous thrombosis. An arteriovenous fistula may present as swelling of the limbs, low hemoglobin, decreased blood pressure, weakened or absence of pulse, and pulsatile hematoma. As hematoma can be difficult to detect because of the deep location, the integrity of the distal vasculature of the lower limb, based on the color and temperature of the limb, should be investigated.

Diagnosis of arterial injury requires a high index of clinical suspicion and radiological imaging, including duplex ultrasonography and digital subtraction angiography [19]. Surgery should be considered if the patient is hemodynamically unstable and satisfactory outcomes cannot be achieved using intervention treatment, or if the hematoma is large and may cause compartment syndrome of the thigh. Interventional procedures allow diagnosis and treatment of a femoral arteriovenous fistula. Femoral artery angiography and percutaneous transarterial embolization with coils are preferred treatments, as they avoid reoperation. Most patients with intertrochanteric fractures are elderly with multiple comorbidities and are therefore poor surgical candidates [20].

In conclusion, we report the case of an 80-year-old woman who developed an arteriovenous fistula of the deep femoral arteries during PFNA fixation for an intertrochanteric femoral fracture. Based on our clinical experience, we recommend accurate diagnosis of vascular injuries associated with PFNA fixation and interventional therapy as a safe and effective treatment.

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Written informed consent was obtained from individual participants. All patients or guardians, after reading, filled in and signed the consent form and agreed to participate in the study.

Disclosure of conflict of interest

None.

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