Arteriovenous Fistula Formation After Intra-articular Injection Following Total Joint Arthroplasty

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abstract

Intra-articular joint capsule injection is a common method used to control postoperative pain as a result of primary total knee arthroplasty (TKA). It is generally considered a safe practice and is highly effective in reducing the need for postoperative opioid administration as well as decreasing recovery time through early mobilization. However, any injection into the posterior knee space has the potential to injure the vascular structures surrounding the knee. Iatrogenic formation of an arteriovenous fistula is a rare complication after TKA, and there are no reported cases of arteriovenous fistula formation as a direct result of intra-articular injection. This case report describes this complication that occurred several days after TKA. The patient had acute pain and swelling in the treated leg. An arteriovenous fistula of the popliteal artery and vein was identified with bilateral Doppler ultrasound and confirmed by angiogram. The most likely inciting event for the formation of the arteriovenous fistula was intra-articular injection of bupivacaine, which likely pierced the popliteal artery and vein, allowing the formation of the patent channel. The patient was treated successfully with stent placement through interventional radiology. Orthopedic surgeons performing intra-articular injections of the knee should refamiliarize themselves with the anatomy and location of the popliteal artery, use smaller-gauge needles, and aspirate the syringe before the injection to decrease the risk of iatrogenic damage to the vasculature or fistula formation. [Orthopedics. 2016; 39(5):e976-e979.]

Intra-articular joint capsule injection is a common method used to control postoperative pain after primary total knee arthroplasty (TKA). These injections are widely considered to be safe and effective for reducing postoperative opioid requirements and decreasing time to recovery through early mobilization. As with any injection, there exists the potential for injury to the local vascular structures. Among the potential complications is the possibility of forming an arteriovenous fistula as a result of puncture of an artery and vein in close proximity. Iatrogenic formation of an arteriovenous fistula is a rare complication after TKA, and there are no reported cases of arteriovenous fistula formation as a direct result of intra-articular injection or clearly identified inciting factors for fistulas produced by TKA. The authors report this complication in a patient several days after TKA and outline the diagnostic workup and necessary interventions. Identification of this potential cause of arteriovenous fistula formation offers a potential explanation for some of the reported cases after TKA.

Case Report

A 79-year-old woman with severe degenerative arthritis of the left knee had progressive pain and difficulty walking...
for several years. The patient had a history of hypertension, hyperlipidemia, thrombocytosis, anemia, hypothyroidism, hydrenephrosis, and end-stage renal disease. Previous surgeries included cataract removal, hysterectomy, and oophorectomy. Medications included aspirin, oxycodone, furosemide, levothyroxine, cholecalciferol, anagrelide, simvastatin, and metoprolol. Range of motion in the left knee was 5° to 110°,

with crepitus and pain and greater than 5° opening with varus and valgus stress. Conservative management with injections of cortisone, triamcinolone, and hyaluronan resulted in only mild improvement. After failure of conservative management, the patient underwent total joint arthroplasty (Figure 1). During the procedure, injection into the posterior knee capsule of 35 mL of 0.50% bupivacaine was given to control pain postoperatively. The patient tolerated the procedure well, and the only complication in the immediate postoperative period was anemia requiring transfusion of 2 units packed red blood cells. After a short inpatient stay, the patient was discharged to a Level 2 rehabilitation facility to continue physical therapy. On postoperative day 9, the patient had acute pain and swelling of the left leg and was transferred to the emergency department by ambulance. Bilateral Doppler ultrasound showed pseudoaneurysm of the left popliteal artery. A subsequent angiogram showed an arteriovenous fistula involving the popliteal artery (Figure 2). The patient was admitted to the hospital and underwent stent placement to close off the arteriovenous fistula (Figure 3). The patient tolerated the procedure well, and her recovery was unremarkable. She was subsequently discharged to the rehabilitation facility to continue physical therapy before returning home. At 3 months postoperatively, the patient had no further complications. Range of motion of the left knee was 0° to 100°, without instability on varus or valgus stress. The patient was satisfied with the outcome of treatment.

Figure 1: Preoperative anteroposterior (A) and lateral (B) radiographs of the left knee of a 79-year-old woman with severe degenerative joint disease. Immediate postoperative lateral radiograph of the same leg after total joint arthroplasty (C).

Figure 2: Doppler ultrasound showing an arteriovenous fistula of the left popliteal artery and vein. The popliteal artery was originally identified as a pseudoaneurysm (PSEUDO) (top arrow). A fistula is seen between the popliteal artery and vein (middle arrow). The popliteal vein was originally identified as the common femoral artery (CFA) (bottom arrow) (A). Flow through the arteriovenous fistula (arrow) (B, C).
DISCUSSION

The most likely explanation for the formation of the arteriovenous fistula in this patient was intra-articular injection of bupivacaine. The needle likely pierced the popliteal artery and vein when it was injected, allowing formation of a patent channel. To the authors’ knowledge, this is the first report in the literature of formation of an arteriovenous fistula after an intra-articular injection during TKA. There are 2 other case reports in the literature of popliteal arteriovenous fistula formation after TKA. In both cases, there was no indication of the source of the arteriovenous fistula and it was noted only that the arteriovenous fistula occurred after TKA.

Damage to the popliteal artery is a rare complication of TKA. Two surveys of the United States National Inpatient Sample found that 0.003% to 0.057% of TKA procedures were complicated by injury to the popliteal artery that resulted in increased cost, length of stay, and mortality. Rapid identification and treatment of iatrogenic popliteal artery injury has been shown to lead to better outcomes compared with delayed identification or definitive repair, and more effective methods are needed to detect and treat these injuries. Knee positioning was believed to be an effective method to avoid accidental injury to the popliteal artery. However, studies that used magnetic resonance imaging and ultrasound to determine the position of the popliteal artery during TKA found no reliable safe position of the knee (extension or flexion) during the procedure.

In this report, the initial ultrasound was interpreted to show a pseudoaneurysm of the popliteal artery. Pseudoaneurysms of the popliteal artery are reported in 0.03% to 0.17% of TKA procedures and are the result of trauma to the vessel from any intraoperative source, such as retractors, oscillating saws, heat from bone cement, and surgical pins. The most common presentation is a painful, pulsatile mass that develops postoperatively. However, pseudoaneurysms may lack this pathognomonic feature. Treatment of these pseudoaneurysms included percutaneous embolization, endovascular stent graft, and open vascular repair.

Intra-articular injection of regional anesthesia during TKA has been a common practice among orthopedic surgeons for decades, but this practice has become much more popular and widespread in recent years. These injections have been effective in reducing pain and speeding recovery. A study comparing intra-articular injections of 0.25% to 0.50% bupivacaine with periarticular injections of ropivacaine, ketorolac, epinephrine, and clonidine found a significant decrease in hospital length of stay and postoperative nausea and vomiting compared with intra-articular injections.

CONCLUSION

The occurrence of an arteriovenous fistula in this case illustrates the potential risks associated with performing blind intra-articular injection. Modern TKA and its nearly ubiquitous use of periarticular injections may lead to many more cases of arteriovenous fistula complicating otherwise routine TKA. It is important for knee surgeons to refamiliarize themselves with the anatomy of the popliteal artery and its location during injection to avoid arterial puncture. Intra-articular injections should be given medially within the capsule to avoid the vasculature (midline) and prevent injury of the peroneal nerves (lateral), which could result in vascular injury or foot drop. The authors recommend less invasive means of performing periarticular injections, including the use of smaller-gauge needles (22 vs 18) and aspiration of the syringe before injection to decrease the risk of arterial damage with inadvertent puncture. In addition, more vigilant surveillance for postoperative arteriovenous fistulas is warranted in patients with excessive swelling or pain after TKA.

Figure 3: Anteroposterior (A) and lateral (B) radiographs of the left knee after stent placement and closure of the arteriovenous fistula.
References


