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Case Report

Compartment Syndrome and Popliteal Vascular Injury Complicating Unicompartmental Knee Arthroplasty

Nanne Pieter Kort, MD,* Jos JAM van Raay, PhD,† and Jim R van Horn, PhD‡

Abstract: Popliteal vascular injury and the compartment syndrome of the leg are rare but important complications of knee arthroplasties. Early diagnosis and treatment are of paramount importance in preventing the devastating complications of these conditions. To our knowledge, these complications have not been reported previously after unicompartmental knee arthroplasty in the literature. Low level of suspicion may delay the diagnosis, as popliteal vascular injury and compartment syndrome are not well recognized as possible complications of unicompartmental knee arthroplasty. **Key words:** unicompartmental knee arthroplasty, uni-knee, popliteal vascular injury, compartment syndrome, leg.
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Compartment syndrome of the leg is a serious and well-recognized complication of a tibial diaphyseal fracture and is well documented [1]. Compartment syndrome of the thigh after total knee arthroplasty has been reported [2], whereas compartment syndrome of the leg after total knee arthroplasty is a rarity [3].

Acute compartment syndrome is a condition in which the circulation and function of tissues within a closed space are compromised by increased pressure within that space. If untreated, it leads to ischemia of muscle and nerve and eventually to

disabling contractures, sensory changes, and muscle weakness [1]. The most commonly reported cause of acute compartment syndrome of the lower leg is tibial fracture [4]. The only reliable method of treating an established acute compartment syndrome of the lower leg is surgical decompression by fasciotomy of the 4 compartments. One of the most commonly used techniques in clinical practice is the double incision technique [5].

Injuries to the popliteal vessels during total knee arthroplasty are estimated to occur in 0.03% to 0.17% of all total knee arthroplasties performed [6,7]. A relatively small number of reported cases suggest a high morbidity, with tourniquet injury as a major contributor [8-12]. Arterial thrombosis is usually secondary to tourniquet application and arterial kinking during knee manipulation [8,12]. Direct, sharp injury to the artery is believed to occur less often [8,9]. If untreated, it leads to ischemia of the muscles and nerves, and can eventually result in amputation of the extremity [8-12].

With unicompartmental knee arthroplasty there is a low level of suspicion, as compartment syn-

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drome and popliteal vascular injury are not well recognized as possible complications. Because of their rarity, an orthopedic surgeon may not come across these complications in the course of his or her professional career.

Case Report

A 44-year-old obese woman was admitted for a left unicompartmental knee arthroplasty. Her body mass index was 39 (reference range, 20-25). There was no relevant medical history. Especially no vascular history was present so that the preoperative vascular status of the limb was not assessed. The operation was performed under spinal and epidural anesthesia introduced at the L2 through L3 level. An Oxford mobile bearing Phase III (Biomet, Bridgend, Glamorgan, United Kingdom) unicompartmental knee prosthesis was used with a minimally invasive approach without violating the suprapatellar pouch and the quadriceps tendon and without dislocating the patella. A tourniquet was applied for 115 minutes at a pressure of 300 mm Hg. Operating time was 130 minutes; it was prolonged on account of difficulties in the proper

placement of the femoral component (Fig. 1), due to the minimally invasive approach combined with the adiposity. The introduction of the intramedullary rod in the femur was standard; there was no indication of violation of the posterior cortex that may cause an iatrogenic vascular lesion. The positioning of the femoral drill guide was difficult, some extra manipulation of the knee was needed. For the vertical and horizontal cut of the tibia, an oscillating saw was used as for the horizontal cut of the femoral condyle. This technique was performed by the normal protocol and was uneventful.

The surgeon noticed a delayed recurrence of the circulation in the left leg after removing the tourniquet. The peripheral pulses (tibialis posterior and dorsalis pedis) were not palpable on the operated leg, but the capillary refill was normal after a few minutes. The patient was then transferred to the recovery room for monitoring. Continuous epidural anesthesia using 0.125% bupivacaine at a rate of 8 mL/h for postoperative pain control was administered. When the patient was transferred from the recovery room to the ward, the surgeon saw on examination a still normal capillary refill, and the peripheral pulses were still not palpable. At that time the surgeon took no further action.

About 12 hours postoperatively the patient complained of pain and swelling in the left leg. There were normal neurologic findings and the capillary refill was also normal. The epidural anesthesia was discontinued immediately. The vascular surgeon on duty reported no clinical indication of major vessel injury; the duplex scanning showed normal distal arterial and venous blood flow. Ankle-brachial indices were not obtained.

In the following hours the pain worsened; the patient complained of numbness in the left leg and she had a foot drop. The neurologist diagnosed anesthesia of the peroneal nerve. A clinical diagnosis of a compartment syndrome was made. There was numbness between the first 2 toes and there was disproportionate pain in relation to the operation. The pain was worsened by passive stretch of the involved muscles. There were no compartment pressure measurements done. Decompression of all 4 compartments of the lower leg was performed about 22 hours after the initial operation through a double-incision technique. On incision of the anterior compartment there was a modest bulging of the muscle, but in all the compartments the muscle was viable. The wounds were left open and subsequently there was delayed wound healing. The initial "pressure" pain subsided, although new neurologic pain appeared



Fig. 1. The anteroposterior (A) and lateral (B) x-ray of the unicompartmental knee arthroplasty showing on the anteroposterior view the excessive ($>10^\circ$) valgus angle of the femoral component.



Fig. 2. The arteriography shows the arterial thrombosis of the popliteal artery with obstruction of the artery approximately 12 cm above the knee joint.

which was treated with tryptisol. On the 10th postoperative day, extreme whiteness of the lower left leg was noticed when the patient began to mobilize. The arteriography made on that same day showed an arterial thrombosis of the popliteal artery approximately 12 cm above the knee joint (Fig. 2). Subsequently, on day 14, an arterial bypass with

autogenous vein was performed with good results. At the 6 weeks' follow-up the patient was still incapable of dorsiflexing the foot and the great toe. The wounds had healed, but there was still the neurologic impairment and pain. Long-term follow-up will show whether the neuromuscular impairment is reversible.

Discussion

Minimally invasive unicompartmental knee arthroplasty is an option for treating medial compartment osteoarthritis. As an initial arthroplasty procedure it relieves pain, restores limb alignment, and improves function with minimal morbidity, without interfering with future total knee arthroplasty [13]. As with all arthroplasties, complications are reported [14-16].

In this case the etiology for the increase in intracompartmental pressure was probably the venous tourniquet during the surgery and not increased blood flow secondary to a sympathetic blockade with epidural administered local anesthetics [17,18]. The prolonged operating time because of the adiposity and manipulation for the correct positioning of the femoral component made matters worse. The reperfusion phenomena after releasing the tourniquet (the tourniquet was at 300 mm Hg in an obese person) may have contributed to the rise in intracompartmental pressure. In our case, the epidural anesthesia did not mask the classic symptoms of compartment syndrome [19,20] and was discontinued immediately after the first symptoms of pain and swelling.

The arterial injury was probably caused by manipulation with extreme varus and valgus stress, rotation, and hyperflexion, which led to an intimal tear that subsequently clotted off as may be seen after a knee dislocation. Because the lesion was 12 cm above the knee we do not consider that the artery was traumatized directly. When performing minimally invasive unicompartmental knee arthroplasty in obese patients or patients with limited soft tissue mobility, particularly when significant difficulties are encountered, surgeons should expand the approach to prevent the need for excessive manipulation by providing better exposure.

The delay in diagnosing popliteal vascular injury in our situation was enhanced by the normal findings of the duplex scanning reported by the vascular surgeon. There are no records of this duplex scanning confirming the normal findings reported by the vascular surgeon. The duplex scanning may be operator-dependent and an ankle-brachial index would be an alternative. If there is a significant difference compared with the contra lateral limb, arteriography is indicated.

With the less invasive surgical procedures and approaches, careful evaluation of patients for vascular injury, neurological injury, and compartment syndrome is paramount. Early diagnosis and treatment may prevent the devastating complications of

compartment syndrome [1-3] and popliteal vascular injury [8-12].

There are no studies to date that have described these serious complications of unicompartmental knee arthroplasty. We consider that orthopedic surgeons should be aware of the possibility of popliteal vascular injury and compartment syndrome after unicompartmental knee arthroplasty to take preventive measures or enhance rapid recognition.

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