Acute compartment syndrome of the thigh after joint replacement with anticoagulation

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We describe three patients with a compartment syndrome of the thigh, two after total hip replacement and one after total knee replacement. Two of the patients were fully anticoagulated.

A compartment syndrome of the thigh is a rare, but important complication of joint replacement surgery if patients are receiving anticoagulants. Close observation is needed and when indicated monitoring of the intracompartmental pressure should be done. Early recognition of the signs and symptoms of an acute compartment syndrome and knowledge of the anatomy of the compartments of the thigh will help in the diagnosis and treatment of this potentially devastating complication.

A compartment syndrome is a well-recognised complication of injuries of the shin and forearm, but its occurrence in the thigh is uncommon. Previous reports associate the syndrome with femoral fractures, closed intramedullary nailing for fracture of the femur, application of antishock trousers, compression after drug abuse, contusion produced by exercise, prolonged tourniquet application and extensive deep-venous thrombosis (DVT).

We report three patients with acute compartment syndrome of the thigh, in two after revision total hip replacement (THR) and in one after primary total knee replacement (TKR).

Case reports

Case 1. A 70-year-old woman who had previously had a Girdlestone arthroplasty of the left hip after failure of revision of THR had a reconversion to a THR. She was on long-term anticoagulation with warfarin because of recurrent DVT and pulmonary embolism. This was stopped before the surgery and she was fully heparinised on the first postoperative day. She complained of pain and swelling at the lower end of the thigh wound on the third postoperative day. Her haemoglobin fell from 13 g/dl to 10 g/dl, the activated partial thromboplastin time (APTT) ratio was 2.8 and the international normalised ratio was 1.4. The following day, the swelling became worse and she complained of numbness of the left leg. The peripheral pulses were present but she had complete loss of sensation to light touch in the leg and a foot drop. Her haemoglobin had fallen to 8.0 g/dl. A clinical diagnosis of a compartment syndrome was made. Decompression of the left thigh was carried out by extending the lateral wound distally. On incision of the deep fascia there was marked bulging of the muscle. A large haematoma was found and evacuated. The wound was left open and subsequently she had a delayed primary closure. Two years later her Harris hip score was 73, but she still had decreased sensation on the sole of the foot with a partial foot drop for which she was wearing an ankle-foot orthosis.

Case 2. A 77-year-old man had revision of a right THR for aseptic loosening using a Kent hip implant and was started on routine deep-venous thromboprophylaxis with daily subcutaneous injection of low-molecular-weight heparin (Fragmin, 2500 IU; Upjohn Ltd, Crawley, UK). In the early postoperative period he complained of pain and swelling of his right thigh. He had persisting anaemia despite more blood transfusions. On the sixth postoperative day, he developed loss of sensation in the right leg and a foot drop. Monitoring of the anterior and posterior compartments of the thigh using the slit-catheter technique revealed an intracompartmental pressure (ICP) of 105 mmHg with a diastolic pressure of...
60 mmHg. Decompression of his right thigh was carried out through the previous posterior approach, which was extended into the thigh. There was a large tense haematoma in the posterior compartment with an extensive area of necrotic hamstring muscle. The clot was evacuated. Fresh bleeding was noted but the source was difficult to identify. It was finally controlled with the assistance of a vascular surgeon who ligated the profunda femoris artery by an anterior approach. The wound was packed with antiseptic dressings and left open. Several further debridements of the wound were carried out to remove necrotic muscle and once the wound was clean, it was closed.

During the postoperative period Klebsiella and Pseudomonas were cultured from the necrotic tissue and cefazidine and gentamicin were required. The wound eventually healed and he recovered sensation on the dorsum of his foot. Three years later his Harris hip score was 60. He had marked weakness of both knee flexion and ankle dorsiflexion.

**Case 3.** A 71-year-old man had a TKR for osteoarthritis. Immediately after the operation he was given 5000 units of heparin twice daily. On the third postoperative day he had a suspected pulmonary embolus and a DVT of the left calf was demonstrated by ultrasound. He was fully anticoagulated with heparin and then warfarin. He subsequently developed increasing pain and swelling of the left thigh with decreased sensation of the leg and foot. The peripheral pulses were present. His haemoglobin dropped to 6.8 g/dl with an APPT ratio of 3.0. Pressure monitoring of the anterior and posterior compartments of the thigh using the slit-catheter technique showed an ICP of 110 mmHg and a diastolic pressure of 63 mmHg. The thigh was decompressed through a lateral approach and a large intramuscular haematoma was evacuated. The wound was left open and closed two days later. He made a good recovery and was free from symptoms six months after the TKR.

**Discussion**

A compartment syndrome, as defined by Mubarak et al., is due to increased pressure in a closed fascial space compromising the circulation to the nerves and muscles within the involved compartment. It may be caused by a decrease in the compartmental volume, an increase in the contents, or externally applied pressure. Compartment syndromes, although uncommon, complicate a variety of conditions and the devastating effects of an unrecognised compartment syndrome are well-documented. Prompt recognition and decompression are imperative to prevent irreversible ischaemic changes.

The thigh has three compartments, anterior, medial and posterior, which are separated by fascial septa as shown in Figure 1. The lateral intermuscular septum is strong and the least compliant whereas the medial and posterior intermuscular septa are much thinner. The thigh has a large potential space to allow for swelling and an increase in the interstitial pressure before the circulation is endangered. Treatment, by fasciotomies of the anterior and posterior compartments, involves a single lateral incision. A separate medial incision is used to decompress the medial compartment.

In our patients with revision THR the increase in intracompartamental pressure was probably caused by bleeding due to extensive soft-tissue dissection. These patients also had an iatrogenic coagulopathy due to anticoagulant therapy which may have increased the likelihood of a compartment syndrome from intracompartamental haemorrhage. This was probably the sole cause in our patient who had a standard TKR without extensive dissection (case 3).

Our cases show the progression of events in a compartment syndrome. Each patient developed severe pain and swelling in the thigh which could not be relieved by narcotic analgesics. Unfortunately, the diagnosis was made after the paraesthesia had developed. Each patient had an emergency fasciotomy but, because of the delay in diagnosis, two have a permanent neurological deficit.

Two patients had an ICP of more than 100 mmHg and a differential pressure of less than 30 mmHg. Measurement of the ICP is important but should not replace clinical judgement. It is also useful in identifying which of the compartments are involved. In our patients measurement of each individual compartment was not necessary since the clinical signs localised the compartments involved, and both the anterior and posterior compartments were opened through the lateral approach. The neurological deficit clearly indicated the need for urgent fasciotomy. The classical early sign of compartment syndrome, disproportionate pain, is difficult to judge after such major elective surgery in which opiates are routinely required, although the longer the time from surgery for which this persists, the higher must be the index of suspicion.

![Diagram of a cross-section of the thigh, showing the three fascial compartments, and the relative thickness of the intermuscular septa.](image-url)
In two patients, the muscles appeared viable and remained contractile at fasciotomy. They had resolution of signs and symptoms after decompression. In case 2, however, the hamstring muscles were necrotic and needed many debridements. This man was left with a permanent disability of weakness of knee flexion and of ankle dorsiflexion. The delay in diagnosis of compartment syndrome of the thigh was due to confusion with a possible DVT, which may also present with thigh swelling and firmness on palpation. This should be excluded before considering the diagnosis of compartment syndrome.12 This patient also had a subsequent local infection with *Pseudomonas* and *Klebsiella*, despite decompression and excision of necrotic muscle. A local infection rate of 66% was reported by Schwartz et al10 in their series and most of the wounds were infected with *Pseudomonas*. It is recommended that formal anterior and posterior fasciotomies be carried out through a lateral approach to ensure adequate decompression of the thigh.19,10 If there is any doubt regarding the medial compartment, intraoperative measurement of the pressure should be obtained as a guide.9

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References