INTRODUCTION

Compartment syndromes are orthopedic emergencies. Although extensively described in legs, their occurrence in the thigh has been rare. However, the past decade has seen a surge in thigh presentations being diagnosed and managed.\(^1,2\) Because there is usually an etiological basis for it in the patient’s history, it would be an unlikely diagnosis in a patient presenting without a suggestive history or mechanism of injury.\(^3\) Given this clinical suspicion, a prompt clinical decision can prove limb-saving.

Case Presentation

A 27-year-old man presented to the emergency department (ED) with severe pain in his left thigh. This ED is part of a Level I trauma center in the southwest of England that sees 68,000 patients annually.

The patient, who worked at a food retail shop, was normally fit and well and did not take any medication routinely. He used to run half-marathons, but had not run for at least four months. He had gone out with friends a week earlier, but could not recall any incidental trauma. He did not lie on his bed awkwardly that night, but woke up with a dull ache in his left thigh the next morning. This pain did not inhibit him from going to work over the next week and he was able to bear all his weight through both legs.

The pain worsened dramatically on the night of ED presentation, such that he was unable to weight-bear and required copious amounts of analgesics, with limited effect. He was examined by the on-call orthopedic resident at 11PM, nearly an hour after he presented to ED. He looked in distress and complained of a severe “bursting” pain, despite having had 10 mg of intravenous (IV) morphine, 1 gm of paracetamol and 50 mg of diclofenac in the preceding hour. He was afebrile, with a pulse rate of 90/min, blood pressure of 145/90 mmHg. He was tachypneic (respiratory rate 26/min), but a cardiovascular and pulmonary examination was otherwise unremarkable. His abdomen was soft and non-tender in all quadrants, with no palpable masses.

On local examination, there was no obvious wound or bruising over the left thigh. It was swollen, with a mid-thigh circumference 12 cm larger than on the right side. It was exquisitely tender as well, with an extremely tense anterior compartment. The swelling was non-pulsatile with no audible bruit. He displayed hyperesthesia in the thigh anterolaterally, with preserved sensorimotor function and pulses distally in the limb. Straight-leg raise was possible to 30 degrees, with no palpable gap in the quadriceps mechanism. Passive hip and knee movements were possible but limited by pain.

Routine blood test results revealed a low hemoglobin (10.1 g/dl, with lab range 13.0 – 17.5 g/dl), normal white cell...
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count 9.3 x 10^9/L, Prothrombin time 13 sec (with lab range 12-15 sec), and APTT 32 sec (with range 26-40 sec). Urinalysis and electrocardiogram were unremarkable. Biplanar radiographs showed a soft tissue swelling anterior to the femur but no fracture. An urgent ultrasound revealed a large heterogeneous mass between the intact femoral cortex and the quadriceps muscles, with minimal internal vascularity and normal color flow in the surrounding femoral vessels, thereby ruling out a true or false aneurysm (Figure). By now, the patient had been started on IV morphine via patient-controlled analgesia, but he reported no pain relief with it.

A clinical diagnosis of impending compartment syndrome due to an idiopathic hematoma was made. Worsening pain precluded any further imaging or confirmation by compartment manometry. Three hours after ED presentation, he was taken to surgery for an emergency fasciotomy and decompression of his thigh under a general anaesthetic. A lateral incision was made from the greater trochanter to the lateral femoral condyle. The fascia lata was cut in line with the skin incision, and the vastus muscles bulged out under tension.

Beneath the muscles, a large hematoma extended into the medial compartment as well. A separate medial incision was made and the medial compartment was decompressed further through it. The posterior compartment was decompressed by dissecting through the lateral intermuscular septum. The whole hematoma was promptly evacuated. Detailed inspection showed no discontinuity, hyperperfusion or necrosis in the muscle mass. No obvious bleeding vessels could be identified. The thigh was thoroughly lavaged and dressed.

When reviewed post-operatively in the recovery bay, the patient admitted significant pain relief and was satisfied with having been offered immediate surgical evacuation. The fasciotomy wounds were washed out and closed 48 hours later, without the need for plastics intervention. He was observed closely for redevelopment of compartment syndrome, but recovered uneventfully. He was able to ambulate unaided, bearing his full weight through both legs. His wounds healed nicely and there was no recurrence of the hematoma on a repeat ultrasound six weeks later. He returned to his normal duties after that, and was asymptomatic with excellent hip and knee function, when reviewed later.

**DISCUSSION**

Mubarak et al^3^ classically described compartment syndrome due to increased pressure within a closed fascial space compromising the circulation to the nerves and muscles within the involved compartment. Compartment syndrome in the thigh is associated with significant morbidity, with long-term functional deficits reported in the literature.4,5

Unlike leg compartment syndromes, there are no true figures for the presentations in the thigh. Suzuki et al^6^ encountered thigh compartment syndrome in eight out of 3,658 cases of blunt trauma over a period of eight years (incidence 0.027% per year). The past decade has seen a surge in the number of cases reported globally. Most of these have been in the setting of acute musculoskeletal trauma. Ojike et al^1^ review of nine case series found blunt trauma to be the etiological mechanism in 90% of cases, mostly in the setting of motor vehicle accidents (34% of all cases). Forty-four percent of cases had associated femoral fractures. Femoral fractures can bleed significantly and lead to increased compartment pressures. This has been observed in both closed and open fractures, and even post-operatively after intramedullary femoral nailing.5,7-9 Gee^10^ reported gluteal compartment syndrome due to superior gluteal artery bleed after pelvic fracture.

Trauma without any concomitant fractures can also cause sufficient muscular damage to cause intra-compartmental hemorrhage and resultant hypertension. Muscular disruption can involve the rectus femoris, vastus intermedius, quadriceps tendon, biceps femoris and hamstrings tendon.11-16

Suzuki et al^6^ performed arteriograms in five out of eight thighs with compartment syndromes due to blunt trauma, and found evidence of definite arterial injury in four. Blunt trauma without any intra-operatively identifiable vascular damage has been implicated in a few other case reports.17-21 Best et al^22^ and Gillooly et al^23^ reported thigh compartment syndrome after penetrating injury with vascular damage Non-traumatic causes of thigh compartment syndrome include post-operative side effects, tumor infiltration, exercise-induced, snakebite, drug-induced, anticoagulant use and coagulopathy due to systemic comorbidity. These are summarized in Table 1.

While the diagnosis of compartment syndrome has traditionally been clinical, there is evidence that relying solely on clinical signs can under-diagnose this condition. Ulmer^24^ showed that the classical clinical signs were at most only 19% sensitive, with a positive predictive value of only 15%. Continuous compartment pressure monitoring can reduce the “miss-rate” in compartment syndromes associated with tibial fractures; however, this practice is not yet routine in most

**Figure.** Ultrasonogram suggesting a hematoma between the quadriceps muscle and anterior femoral cortex.
### Table 1. A summary of all reported cases of compartment syndromes in the thigh.

| Etiology                              | Main factor in causation                      | Main compartment(s)                      | Author |
|---------------------------------------|-----------------------------------------------|-----------------------------------------|--------|
| **Skeletal trauma**                   |                                               |                                         |        |
| Pelvic fracture                       | Gluteal                                       | Gee 2007                                |        |
| Femoral fracture                      | Anterior +/- posterior                         | Mithoefer 2006, Choi 2007, Bor 2008     |        |
|                                        | Posterior                                     | Bates 2009                              |        |
| **Muscular trauma (identified at surgery)** |                                               |                                         |        |
| Rectus femoris tear                   | Anterior                                      | Burns 2004                              |        |
| Vastus intermedius rupture            | Anterior                                      | Inoue 2000                              |        |
| Quadriceps tendon rupture             | Anterior                                      | Kuri 2006                               |        |
| Hamstrung avulsion                    | Posterior                                     | Kwong 2006                              |        |
| Biceps femoris rupture                | Posterior                                     | Kampa 2005                              |        |
|                                        |                                               | Mallo 2009                              |        |
| **Blunt trauma (no muscle pathology seen at surgery)** | No vascular injury confirmed                   | Anterior                                | Mallik 2000, Lee 2005, Riede 2007, Joglekar 2009 |
|                                        | Vascular injury confirmed                      | Anterior + medial                       | Lindsay 2008 |
| **Penetrating trauma**                | Femoral vessel rupture                         | Anterior + posterior                     | Best 2002, Gilooly 2007 |
| **Post-procedure**                    | Primary total hip arthroplasty (THA)           | Anterior                                | Mai 2000 |
|                                        | Femoral intramedullary nail                   | Not documented                          | Uzel 2009 |
|                                        | Femoral vein catheterisation                  | Anterior + posterior                     | Asplund 2008 |
|                                        | Trans-oburator tape (TOT)                     | Adductor (medial)                        | Olah 2008 |
|                                        | Anterolateral thigh (ALT) flap                | Anterior                                | Addison 2008 |
|                                        | Lateral position for arm surgery              | Anterior                                | Kwon 2000 |
|                                        | Knee-chest position in spinal surgery         | Posterior                               | Sancineto 2004 |
| **Tumour infiltration**               | Chronic myeloilmonocytic leukaemia            | Anterior                                | Khalpey 2008 |
| **Drug-induced**                      | Low molecular weight heparin                  | Anterior + posterior                     | Nadeem 1998 |
|                                        | Warfarin                                      | Anterior                                | Limberg 2008 |
|                                        | Non-steroidal anti-inflammatory drugs (NSAIDs) | Anterior                                | Gaines 2008 |
|                                        | Ecstasy (Intravascular)                       | Posterior                               | Salemis 2009 |
| **Exercise-induced**                  | Squats                                        | Anterior + posterior                     | Kahan 1994 |
|                                        | Running                                       | Anterior + posterior                     | Kuklo 2000 |
|                                        | Cycling                                       | Anterior                                | Bertoldo 2003 |
|                                        | Sking                                         | Medial                                  | Leplahliti 2002 |
|                                        | Horse-riding                                  | Anterior                                | Doube 1995 |
|                                        | Basketball                                    | Anterior + posterior                     | Boland 2009 |
|                                        | Weight-training                               | Anterior + posterior                     | Presnal 1995, Bidwell 1996, Wise 1997 |
|                                        |                                               | Anterior                                | Nau 2000 |
|                                        |                                               | All three                               | Robinson 2000 |
| **Coagulopathy**                      | Cirrhosis                                     | Not documented                          | Navaneethan 2008 |
| **Snake bite**                        | Cytotoxic and hemorrhagic effects of envenomation (Vipera berus) | Not documented                          | Cawrse 2002 |

Trauma centers in the United Kingdom. A recent review has concluded that a combined clinical and invasive (manometry) monitoring of an impending compartment syndrome should be instituted in the early phase after injury.

Most of the published literature on compartment syndrome pertains to the leg (calf) only. The optimal diagnostic approach to a possible thigh compartment syndrome has not yet been determined. In Ojike’s review of thigh presentations in nine series, 26% were diagnosed exclusively on clinical signs, while 22% were diagnosed by compartment manometry only, and 52% by both modalities combined. The leg is more prone to developing compartment...
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Thigh compartment syndrome is an orthopedic emergency, in which diagnostic delay can be disastrous. It is most likely to happen when the patient presents without a fracture.28 This case report reinforces the need for a strong clinical suspicion of a compartment syndrome in the absence of an etiological history, but with indicative symptoms and signs.29

We acknowledge that we did not measure his thigh compartment pressures in the ED. However, the patient’s symptoms and signs betrayed severe distress, and we made the decision to explore and decompress once the large hematoma had been visualized on ultrasound. We believe that while compartment manometry has a role in aiding diagnosis, the decision to fasciotomize should not be delayed in the face of obvious clinical signs. If the signs are subtler, then compartment manometry could be employed swiftly to confirm a diagnosis of compartment syndrome.

Prompt surgical consultation is essential. The ED physicians referred this patient promptly for an orthopedic opinion, and an emergent surgical decompression was performed based on clinical diagnosis, with excellent recovery and functional outcomes.

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