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Case Report

Acute compartment syndrome after low-energy medial tibial plateau fracture in a young athlete: A case report and review of the literature

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Acute compartment syndrome (ACS) is a terrible complication that can occur in tibial fractures, especially following high energy trauma, and if it is misdiagnosed it could bring to severe consequences. In this report we present a case of a 19-year-old caucasian male rugby player with a medial tibial plateau fracture atypically occurred after a low energy non-contact injury during sports. The diagnosis is generally clinic, based on physical examination, characterized by classic symptoms like severe pain, pallor or pulselessness and on accurated patient history taking. Unfortunately, in rare cases, clinical details are not enough and even further investigations can not predict wether the chosen surgical treatment will be completely decisive or another procedure will be necessary.

Keyword: Acute Compartment Syndrome; tibial plateau fracture; fracture-dislocation; knee trauma.

INTRODUCTION

Tibial plateau fractures constitute 1% of all fractures. Peak age is generally between 16–40 years old in men and 50-70 in women. They may be divided into low or high energy fractures due to the traumatic mechanism. Low energy fractures are often related to osteoporosis so they are common in older females, instead high energy fractures are frequently observed in motor vehicle accidents, falls and sports injuries. These causes represent the majority of tibial plateau fractures in young.

Acute compartment syndrome (ACS) is a rare but very dangerous complication of tibial fractures, especially in high energy ones, due to elevated intracompartmental pressure that can reduce tissue perfusion until

compartmental ischemia and necrosis. Clinical diagnosis is aided by some classic features including pain, pallor and pulselessness; in cases where these features are unequivocal, emergency fasciotomy (Cohen et al., 1991) is indicated but in patients in whom the diagnosis is clinically difficult to reach there are several usefull types of diagnostic adjuncts, such as intracompartmental pressure measurement (McQueen and Court-Brown, 1996), Doppler Ultrasound (DU), Computed Tomography (CT) or Computed Tomography Angiography (CTA).

CASE PRESENTATION

A 19-year old rugby player was admitted to our emergency department, in the evening, with a knee distorsive trauma during sports.

After taking patient history, on physical examination we

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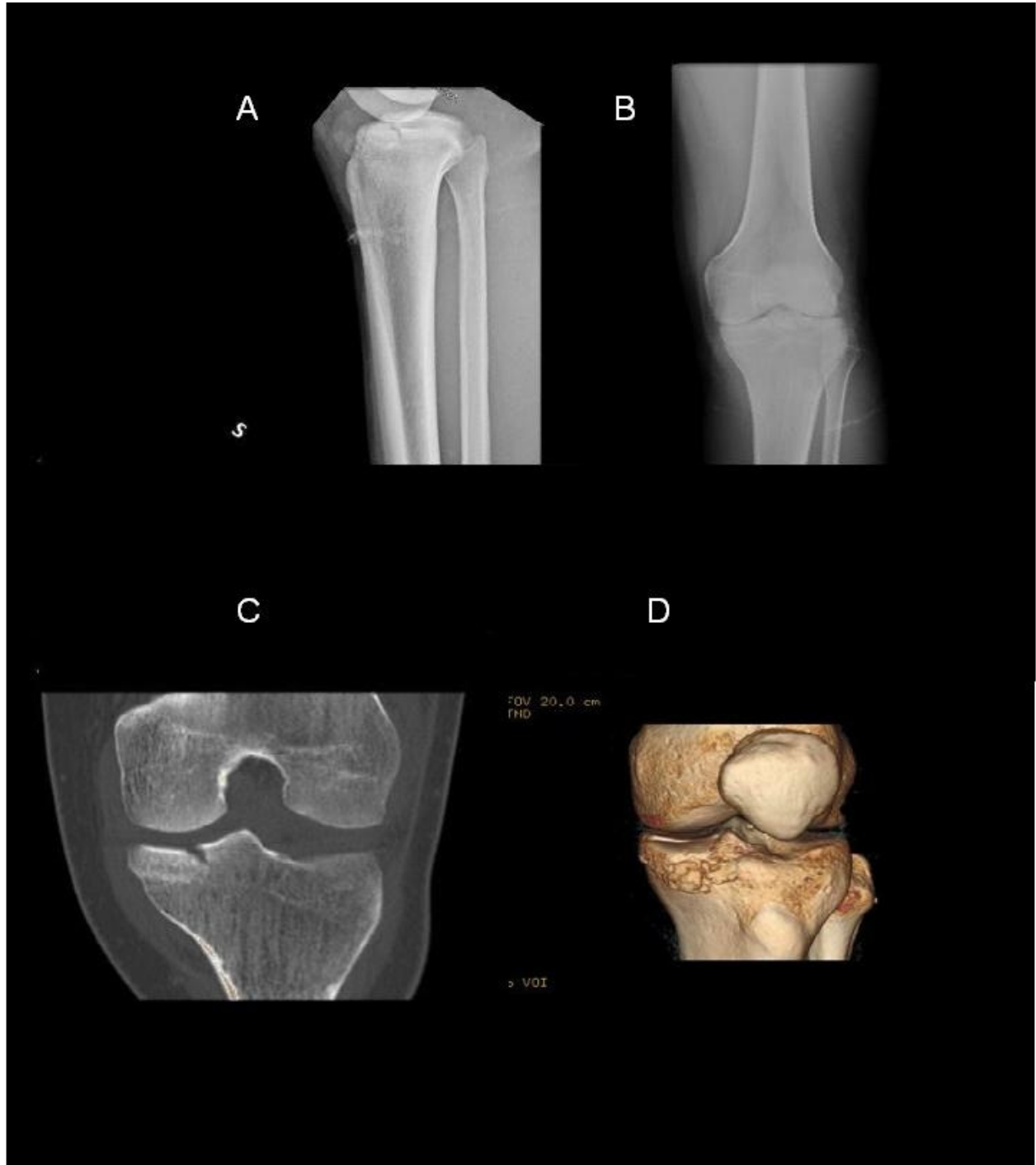


Figure 1. (A) Lateral and (B) Anterior to posterior Knee X-rays 1 hour after trauma show the fracture.
(C, D) Standard and 3D-CT Knee scan images

observed the knee quite swollen and tense; ligaments stability and knee range of movement (ROM) were difficult to be valued as any kind of movement was relatively permitted because of pain and swelling. There was peripheral cyanosis, non critical ischemia signs and peripheral pulses were present. Radiographs of the knee

showed that the medial tibial plateau was fractured and there was a suspect of knee subluxation (Figure 1 A, B). According to these findings and clinical evaluation a CT was performed (Figure 1 C, D). It showed a "fracture with slight decalage, involving anterior tibial spine with LCL suspect injury and suprapatellar articular spilling". During



Figure 2. After-surgery CTA images showing external fixator fiches. The tip of red arrows shows a vascular stop.

CT scanning the patient reported significant worsening of symptoms with painful swelling of the leg, resistant to Non-Steroidal Anti-Inflammatory Drugs (NSAID) and opioids. In a few minutes, by new clinical evaluation it was found the absence of the pedial and anterior tibial pulse and a DU was performed; unfortunately, because of pain and tissue swelling, the exam was difficult to interpret. On the Radiologist advice a CTA was quickly performed; it showed "absence of iodinated contrast agent at the level of the popliteal artery and venous supply of posterior and medial compartment". Finally, according to clinical examination and imaging, ACS was diagnosed. The patient was immediately conducted to the Surgery Room for a surgical decompression, using a double-incision technique and a stabilization of the fracture with external fixation. A post-surgery arteriography showed "the interruption of the popliteal artery, a caliber reduction of peroneal and posterior tibial arteries and the absence of anterior tibial artery" (Figure 2).

A few hours later, in the morning, the patient performed a bypass of the popliteal-anterior tibial-peroneal artery

with contralateral saphenous vein and an extension of the incisions from his previous surgery.

DISCUSSION

Acute compartment syndrome (ACS) of the lower limb is a low incidence severe complication of fractures, soft tissue trauma, and reperfusion injury after arterial obstruction.

Tibia fractures sustained during soccer and football had a statistically significant association with development of ACS (Wind et al., 2012).

It is either caused by bleeding or edema in a closed compartment or by a diminution of the intracompartmental space. The long term consequences of ACS were already described by Volkmann at the end of 19th century following application of casts (Volkmann, 1881) but only a few years later it was made the connection to elevated intracompartmental pressure.

Looking at literature, the most common cause of ACS

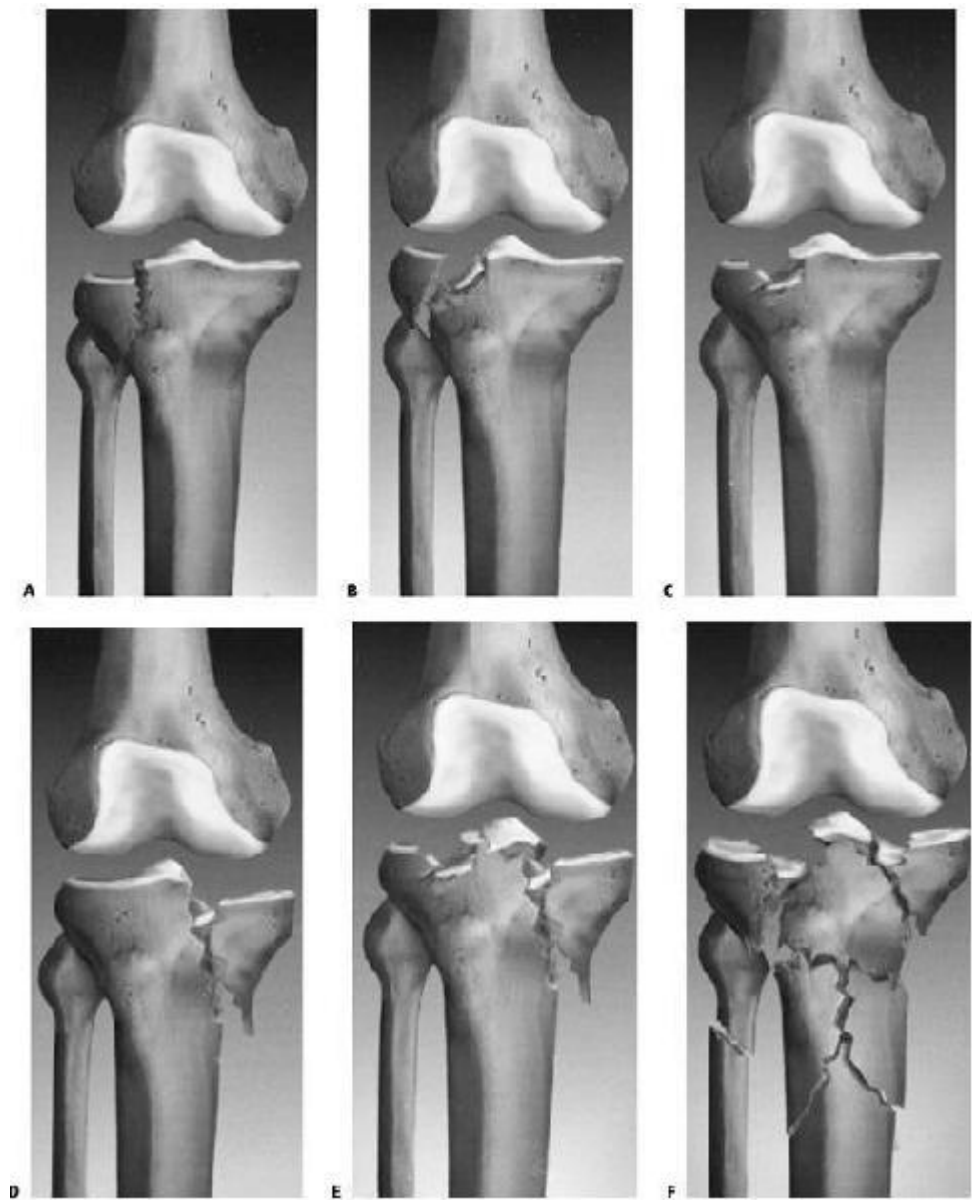


Table 1. Schatzker classification's groups

in the lower leg is closed tibial and/or peroneal diaphysis fracture but sometimes this complication can occur after tibial plateau fracture, especially in high energy ones (McQueen et al., 2000). Tibial plateau fractures are caused by a varus (inwardly angulating) or valgus (outwardly angulating) force combined with axial loading or weight bearing on knee. The tibial condyle is crushed or split by the opposing femoral condyle, which remains intact. 60% of plateau fractures involve the lateral plateau, 15% medial plateau, 25% bicondylar lesions. The knee anatomy provides insight into predicting why certain fracture patterns occur more often than others. The medial plateau is larger and stronger than the lateral, and there is a natural valgus or outward angulation

alignment to the limb which if associated with the force on impact could injure the lateral side. Although there are several classifications widely detailed, such as the AO's, the current classification system mostly used is the Schatzker classification, that is divided into six groups: S-I to S-VI (Table 1). According to literature and this classification, fractures involving the medial condyle, especially tipe IV fractures where the dislocated fragment is posterior, can be associated with increased risk for CS and neurovascular injury. Leg muscle compartments are tighter enclosed by the muscle fascia whose lower dilatability can promote the development of a CS. An increase of the perfusion barrier

can result in hypoxia and acidosis which increase by themselves vascular permeability and swelling, inducing ischemia in the nearest soft tissues. (Michael et al., 2010) It's possible that young patients, especially males, have an increased muscle mass within this fixed volume compartment when compared with older patients, who generally have relative muscles atrophy. In addition, although fractures that occur during sports generate significant local injury, the energy may not be sufficient to disrupt the boundaries of the compartments and during athletic competitions this may be a risk factor itself. (Wind et al., 2012) At the time of injury, the leg muscles of the athletes are in activity and at risk of inflammation, acidosis and swelling.

The diagnosis is generally clinic, characterized above all by severe pain and some other classic features including pallor and pulselessness; otherwise there are some cases in whom the diagnosis is difficult to reach without diagnostic adjuncts and surgical emergency treatment is not completely decisive.

In this presented case it's interesting to underline that this was a medial plateau fracture atypically related to a low-energy non-contact injury, complicated by ACS.

CONCLUSIONS

Tyler et al. in a series of 626 tibia fractures found 34 cases of ACS in whom ACS was associated with tibial plateau fractures just in 2 cases, both bycondilar with a

posterior fragment, which could more easily dislocate the popliteal artery and cause a vascular stop.

Instead our patient presented a medial plateau fracture where the dislocated fragment was anterior.

This tipe of fracture is uncommon to identify among all tibia fractures caused by low-energy injuries and an ACS as its complication is even more rare.

Anyway a timely diagnosis, based on patient history, physical examination and imaging exams, where necessary, and a careful follow-up in the first 24-48 hours after any kind of treatment are extremely important in order to avoid adverse outcomes for patients, even in cases where diagnosis and surgery treatment seem to have been simple and decisive.

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