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Acute compartment syndrome and delayed symptomatology after tibial intramedullary nail fixation: A case report

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Abstract
Introduction: Acute compartment syndrome is a limb-threatening orthopaedic emergency. Treatment of ACS consists of surgical management by way of decompressive fasciotomies, performed urgently. ACS occurs commonly in fractures of the tibia as well as iatrogenic postoperative tibial intramedullary nailing. To our knowledge, there is no published literature of delayed symptomatology of compartment syndrome related to a diaphyseal tibia fracture or tibial IM nail fixation.
Case: A 21-year-old male, otherwise healthy begins having symptoms of compartment syndrome more than 24 hours following uncomplicated tibial intramedullary nail fixation. Immediate assessment and urgent fasciotomies avoided permanent morbidity.
Conclusion: Delayed symptomatology of compartment syndrome related to tibial intramedullary nail fixation has not previously been reported. This case exemplifies the importance of identifying high risk patients, educating healthcare professionals and patients of signs and symptoms of compartment syndrome and integrating newer technology to accompany the clinical diagnosis of compartment syndrome.

Keywords: Acute compartment syndrome, tibial shaft fracture, tibial intramedullary nail fixation, delayed symptomatology

Introduction
Acute compartment syndrome (ACS) is a limb-threatening orthopaedic emergency [1], due to elevated pressures within a closed fascial compartment, causing local tissue hypoxia, and at the late stage, ischemia [2]. Treatment of ACS consists of surgical management by way of decompressive fasciotomies, performed as soon as possible and within an eight-hour window to avoid irreversible ischemic damage to the muscle [3]. ACS occurs in approximately 2 to 9% of tibia fractures [4] and account for 12-35% of ACS cases [5-6]. In skeletally mature patients with displaced tibial shaft fractures, the most common treatment is intramedullary (IM) nail fixation [7]. In addition to acute trauma, iatrogenic causes may additionally contribute to the development of compartment syndrome, namely tibial IM nailing, occurring in as high as 13.1% of patients [8-11] and typically presents acutely after insult [12]. To our knowledge, there is no published literature of delayed symptomatology of compartment syndrome related to a diaphyseal tibia fracture or tibial IM nail fixation. The purpose of this case report was to increase awareness of the possibility of delayed onset of symptomatology and to present a review of the literature surrounding ACS postoperative tibial IM nail fixation.

Case Report
A 21-year-old male presented with a closed right comminuted midshaft tibia fracture after part of a wall fell on him while at a construction site (Figure 1). He otherwise had no known medical conditions, he worked as a plumber and smoked approximately one third of a pack of cigarettes per day. He was assessed by the orthopaedic team where a padded long leg posterior splint was applied and was admitted for surgical management. At the initial time of consultation, his compartments were soft, with a normal neurovascular exam and pain was easily controlled. Given the mechanism of injury, he was carefully observed for any symptoms or signs of compartment syndrome.

He underwent surgical management by the means of suprapatellar tibial IM fixation, general anesthetic without any nerve blocks performed. Preoperative careful clinical examination revealed a comfortable patient who was able to move his toes well and without pain. A thigh tourniquet was inflated to 250 mm Hg for a total of 65 minutes, reduction was obtained in a closed manner, the canal was over-reamed by 1.5mm, blood loss was minimal, wounds were infiltrated with 40 mL of Marcaine 0.5% with epinephrine, total surgical time was 81 minutes. No external split or circumferential compressive dressing was applied. The lower extremity was nursed on a single pillow and not elevated above the level of the pelvis. Post-operative fluid resuscitation was minimal.

On the morning of postoperative day one, he was comfortable, compartments were soft, and he was able to plantar- and dorsiflex his foot without pain. More than 24 hours following surgery completion, physiotherapy assessment noted the patient experienced increased pain when leg was placed in the dependent position. Active toe and ankle motion was normal, and foot sensation remained intact. However, given the pain he was unable to ambulate independently and not cleared for discharge. The orthopaedic team was contacted later that evening due to increasing analgesic requirements, including the use of intramuscular morphine which he had not required at all throughout his admission thus far. He had new new paresthesias in the foot and worsening symptoms despite no compression dressing and elevation of the leg. Upon assessment, he was visibly uncomfortable, endorsed significant discomfort with palpation of the calf, decreased sensation of the tibial nerve distribution and excruciating pain with passive movement. He underwent emergent fasciotomies within three hours of assessment. A two-incision technique was used. Muscles in all compartments were noted to be pink, healthy looking and contractile, the incisions were left open. Following fasciotomies his pain was much improved. He returned to the operating room two days later for irrigation and debridement with primary skin closure. He was discharged from hospital three days after closure of his wounds. His total stay in hospital was 11 days. Postoperatively, he was permitted to bear weight as tolerated, and recovered uneventfully. He was followed postoperatively, with his incisions healed uneventfully. At 6 weeks postoperatively, he was ambulating pain free with normal ankle and knee range of motion. At final follow up around 1 year postoperatively, he was doing well without any physical impairment, and had fully returned to work in construction. His radiographs showed complete union (Figure 2).

Figures.

Fig 1: Preoperative radiographic showing midshaft tibia fracture

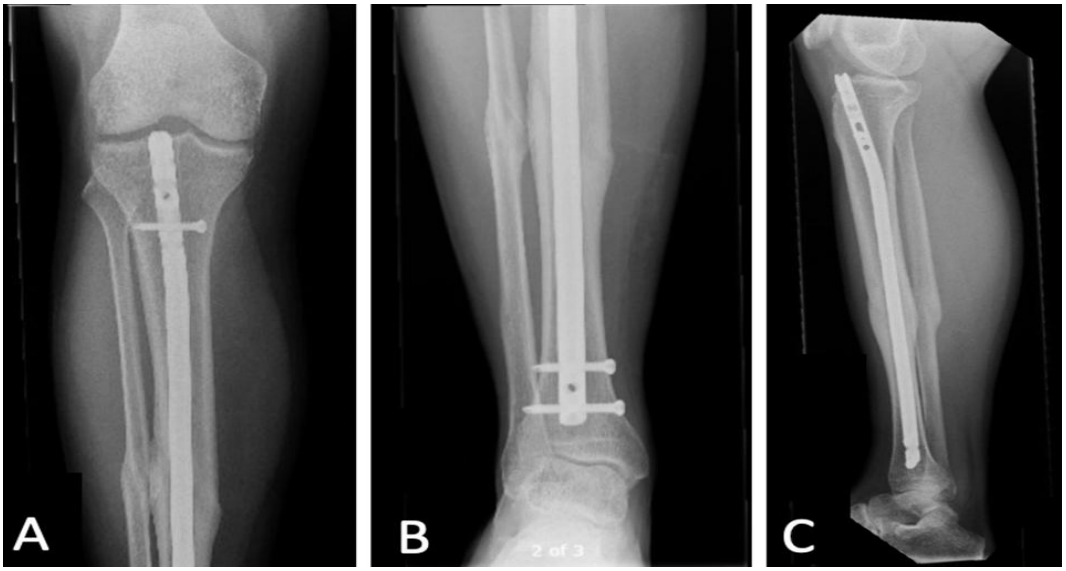

Fig 2: Proximal AP (A), distal AP (B) and lateral (C) radiographs one year postoperative tibial nail fixation

Discussion

Risk factors for ACS after tibia fractures include younger age, male gender, high-energy, blue-collar occupation, diaphyseal fracture; with young males being the strongest predictor of developing ACS [7,14]. The patient in the case we report had multiple risk factors and was at significant risk for ACS and monitored appropriately. ACS typically develops after severe trauma due to long bone fractures or crush injuries; however other etiologies exist such as vascular injuries, burns and iatrogenic causes [3]. ACS after tibial IM nailing has been reported in 0.07-13.1% of patients [8]. During tibial IM nailing, a combination of reducing compartment volume as well as increasing venous congestion both contribute to acutely increasing the pressure within fascial compartments, placing the patient at a greater risk of developing ACS postoperatively [14]. Although intraoperative pressure of greater than 30 mm Hg have been recorded during tibial IM reaming, there has been found to be no significant difference in compartment pressures postoperatively compared to unreamed tibial IM nails and no correlation with postoperative ACS [15]. Tibial IM reaming has been deemed safe, with no increased rates of compartment syndrome with the benefits of significantly reducing rates of nonunion and implant failure compared to unreamed nailing [16].

Other intraoperative factors examined in regard to tibial IM nailing and risk of ACS include the use of traction, surgical approach and anesthetic. Tibial IM nails have traditionally been inserted through an infrapatellar approach with the suprapatellar approach being introduced in the mid 2000s

and quickly becoming a familiar alternative [17]. The infrapatellar approach has been found to have much higher rates of ACS postoperatively with deep knee flexion preventing venous outflow being a postulated contributing factor [8]. This patient had a suprapatellar approach; from review of the literature, there is only one other published case of compartment syndrome postoperative IM nail fixation through a suprapatellar approach [9]. Regional anesthesia can be of great benefit to orthopaedic patients, however communication with anesthesiologists is paramount to ensure accurate assessment of pain and neurologic status. Overall, there is no evidence that perioperative regional anesthesia increases the incidence of missed ACS but does advice against it in patients who are unable to reliably comply with serial clinical examinations [1]. There are only rare case reports of delayed onset of symptoms of ACS, all of which involved soft tissue injury (muscle strain or contusion) without fracture [12, 18-19]. ACS typically develops acutely after insult [12], with once case report documenting returning to the operative room for fasciotomies within six hours after completion of IM nail for a closed tibia fracture [11]. It has been reported that fasciotomies performed within 12 hours from the initial procedure resulted in good outcomes [20] and in a case series, fasciotomies performed more than 24 hours postoperative tibial IM nail fixation were found to have ischemic muscle, requiring reconstruction and morbidity [21]. Interestingly, the patient in this case went more than 24 hours before developing any concerning features of ACS and had no ischemic changes at the time of fasciotomies or subsequent debridement. At our institution, patients who undergo tibial IM nail fixation are typically monitored for 24 hours. This case exemplifies the importance of educating patients and family members of signs and symptoms of ACS, and when to return to hospital. It also broaches the use of newer technology such as intracompartmental pressure monitoring [22] which has revealed high specificity and sensitivity, allowing early diagnosis of ACS [23] and may be helpful when combined with clinical assessment [24], These advances in technology have the potential to reduce patient morbidity from a missed ACS or from prophylactic fasciotomies and to decrease hospital costs and maximize patient outcomes, especially in patients with multiple risk factors for ACS similar to the one described in this report.

Conclusion

In conclusion, this is the first case report of delayed symptomatology of ACS related to fracture or tibial IM nail fixation. This case exemplifies the importance of identifying high risk patients, educating healthcare professionals and patients of both typical and atypical signs and symptoms of compartment syndrome and integrating newer technology to accompany the clinical diagnosis of compartment syndrome. Early recognition and intervention is critical in preventing devastating repercussions of compartment syndrome as illustrated in this case.

Statement of Informed Consent

The patient has provided informed consent to be included in this case report. They understand that their medical information will be used for educational and research purposes, while maintaining their confidentiality.

Conflict of Interest: Not available

Financial Support: Not available

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