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Case Report

Two cases of acute anterolateral compartment syndrome following inversion ankle injuries

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ABSTRACT

Introduction: Compartment syndrome is a limb threatening, and sometimes life-threatening medical condition. It usually occurs in high energy lower extremity injuries, commonly in the younger patient with classic signs and symptoms. Pain out of proportion to exam is one of the key elements in diagnosis. A high vigilance for signs and symptoms of this condition should be present on most physicians' radars who treat emergency conditions, as this case report demonstrates, the mechanism and story are not always classic.

Presentation of cases: Two cases of young, healthy adults who underwent fasciotomy for compartment release for compartment syndrome isolated to the anterolateral compartment, but who did not sustain a high energy trauma, but rather a twisting ankle injury.

Conclusion: Compartment syndrome can occur in young, healthy, active patients with a lower energy twisting injury and without fracture. A high level of suspicion on the clinicians' part will prevent adverse outcomes to the patient.

Introduction

Compartment syndrome is a serious medical condition that must be dealt with emergently. Failure to identify and address acute compartment syndrome may lead to amputation or even death in some cases [1]. It commonly occurs due to high energy trauma that damages muscles and neurovascular structures within a fascial compartment, which subsequently leads to edema and increasing compartmental pressures that can compromise local blood supply [2]. Development of acute compartment syndrome is an unusual outcome following noncontact ankle sprains. There have only been a small number of case reports describing this uncommon consequence [3–9].

Hence, vigilance is required on behalf of the clinician in order to prevent the likelihood of developing limb and/or life-threatening conditions. This report describes two unique cases of acute compartment syndrome following inversion ankle injuries- a mechanism that one would not suspect to lead to this complication. These cases demonstrate that compartment syndrome, despite being a rare occurrence, can be a severe sequela following inversion ankle injuries.

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Case presentation

Case 1

A 37-year-old male presented to the emergency department with left lower extremity pain, swelling, and paresthesias 1 day after suffering an ankle inversion injury while playing soccer. He described the injury as his leg suddenly giving out but did not recall any specific popping or tearing sensations. He was able to ambulate with some discomfort afterwards. Later in the evening, he began to develop swelling along the lateral aspect of his lower extremity which did not improve with rest, ice, and elevation. Upon waking up the following day, the pain had worsened, and he developed paresthesias along the left lower extremity which prompted his visit to the emergency department.

On examination, the left lower extremity had intact skin. The anterolateral compartment was firm, but compressible. The remainder of the compartments was soft and compressible. The foot was warm and well perfused with a brisk capillary refill. There was decreased sensation in both the superficial and deep peroneal nerve distributions with the deep peroneal being more affected. Tibial nerve sensation was intact. The patient was able to fire his extensor hallucis longus, flexor hallucis longus, tibialis anterior, gastrocsoleus, and peroneal muscles. Muscle strength of the peroneal and tibialis anterior muscle groups on examination was graded to be 4/5, demonstrating reduced muscle strength against moderate resistance. Pain with passive inversion of the foot was elicited, but there was no pain with passive stretch of the great toe, tibialis anterior, or the gastrocsoleus muscles.

Radiographic imaging of the lower extremity revealed no fractures or dislocations. Anterior and lateral compartment pressures were recorded compartment pressures were obtained with a handheld Stryker compartment pressure monitor (Stryker, Kalamazoo, MI). Measurements obtained revealed two separate lateral compartment measurements of 80 mmHg each and an anterior compartment measure of 45 mmHg. Diastolic blood pressure was 74 mmHg at time of measurement.

The patient was emergently taken to the operating room for a single incision fasciotomy. A 20 cm longitudinal incision was made along the lateral leg. The subcutaneous tissue was dissected down to the fascial layer where a small, transverse incision was made through the fascia in order to identify the lateral intermuscular septum. The superficial peroneal nerve was identified and protected where it exits the deep fascia. Complete releases of the anterior and lateral compartments were performed both, proximally and distally.

There was substantial protrusion of muscle through the fasciotomy sites and hematoma formation in the distal third of the incision, primarily in the lateral compartment. There was a moderate amount of muscle in the lateral compartment that appeared nonviable by its dusky color, poor consistency, incapacity to bleed, and non-contractile with electrocautery. The muscle in the anterior compartment appeared to be viable following the same criteria. The nonviable muscle was sharply debrided and excised. The remaining musculature appeared to be completely viable following debridement and irrigation. Negative pressure wound therapy was applied. The patient was monitored for recurrent compartment syndrome in the anterior and lateral compartments as well as new onset compartment syndrome in the posterior compartment with compartment checks every 4 h for 48 h following surgery.

The patient was subsequently brought the operating room 48 h later for irrigation and excisional debridement with wound closure. Minimal hematoma and nonviable tissue were excised, and the wound was closed primarily.

At two-week follow-up, the patient had intact sensation to light touch, but had limited motor function throughout the ankle and foot for which he was referred to physical therapy. At three months post-operatively, the patient had made a full recovery in which he retained intact light touch sensation and regained 5/5 strength of the affected muscle groups. He was able to resume full activity with no limitations.

Case 2

A 21-year-old male presented to the emergency department for evaluation of right lower extremity pain, swelling, and paresthesias that occurred following an inversion ankle injury while playing lacrosse the evening prior. He was able to bear weight and ambulate following the injury. Throughout the evening, he developed progressively worsening pain and swelling in his anterolateral leg. He ultimately developed paresthesias over the dorsum of his foot with associated weakness in dorsiflexion which prompted his presentation to the emergency department.

On examination of the right lower extremity, his skin was intact. He had firm, but compressible anterior and lateral compartments. The posterior compartments were soft. The foot was warm and well perfused with brisk capillary refill. His sensory exam revealed decreased sensation in the superficial and deep peroneal nerve distributions with intact sensation to light touch over the tibial nerve distribution. He was able to appropriately fire his extensor hallucis longus, flexor hallucis longus, and gastrocsoleus. There was notably weak, 4/5, motor strength of the tibialis anterior and peroneal muscle groups. Furthermore, there was pain with passive plantar flexion, forefoot inversion, and passive stretch of the extensor hallucis longus.

Resting compartment measurements were not performed. Radiographic imaging of lower extremity revealed no fractures or dislocations. The patient was diagnosed with clinical concern for anterolateral compartment syndrome and was emergently taken to the operating room.

A single incision fasciotomy was performed along the lateral right lower extremity. Minimal debridement of necrotic subcutaneous tissue was performed. All four compartments were released. The muscles of the anterior, superficial and deep posterior compartment were noted to be viable. The peroneal muscle group of the lateral compartment were noted to be noncontractile on initial evaluation. Upon fascial release, perfusion of the peroneal muscle group improved. No debridement was performed as a result. Negative pressure wound therapy was applied. Postoperatively, the patient reported improved pain control, return of dorsiflexion, and improved

paresthesias of the foot. Eversion remained weak.

The patient was subsequently brought to the operating room 48 h later for irrigation and possible debridement with attempted wound closure. On evaluation, there were scant areas of muscle or tendon that appeared dark which did not warrant debridement. The remainder of the muscle appeared viable. Muscle contractility was evaluated with electrocautery which revealed that the anterior compartment was contractile. However, the lateral compartment containing the peroneal muscle group did not appear to contract despite having a viable appearance. It was elected to not perform a debridement due to the muscle appearing to be healthy. The proximal 25% of the wound and the distal 35% of the wound were closed. The remaining portion was under too great of tension to be closed and negative pressure wound therapy was applied. 48 h later the patient was brought to the operating room for complex closure of the remaining portion with retention sutures. At this time, the anterior compartment remained viable and contractile. The peroneal muscles of the lateral compartment remained viable in appearance but had now improved to be weakly contractile.

At two-week follow-up, the patient had improving sensation in the superficial and deep peroneal nerve distributions but continued to have weak dorsiflexion of his great toe. A referral to physical therapy was made at this time. At two-months post-operatively, the patient had regained function of his extensor hallucis longus. Furthermore, he was back to participating in lacrosse with no restrictions.

Discussion

The anatomy of the lower leg is made up of four fascial enclosed, nonelastic muscular compartments which include the anterior, lateral, and the superficial and deep posterior compartments [13]. The lower leg and its anterior compartment are most commonly affected by acute compartment syndrome given its relatively limited compartment compliance to accommodate expansion secondary to hematoma or swelling [11–13]. Normal muscle tissue pressure ranges below 10–12 mmHg and capillary blood flow within the compartment may be compromised at absolute intracompartmental pressures >30 mmHg which places muscle and nerve fibers are at risk for ischemic necrosis [15]. When the intracompartmental pressure is within 30 mmHg of the pre-operative diastolic blood pressure, surgical intervention becomes necessary in order to avoid ischemia and necrosis of the underlying structures [2,15].

The diagnosis of acute compartment syndrome of the lower leg is challenging and often requires high clinical suspicion in the treating physician as no gold standard exists in making the diagnosis [15]. Elements of the patient history and physical examination, with pain out proportion and pain on passive stretching or compression of the compartments being most common, should play a critical role in heightening suspicion [14,15]. Intracompartmental pressure measurement is not necessary to make the diagnosis of acute compartment syndrome but can facilitate a diagnosis when the clinical symptoms and signs are equivocal, in an unconscious or uncooperative patient, or in a young pediatric patient [14–16].

Atypical presentations may result in a delay in diagnosis or treatment, thereby increasing the likelihood of morbidity for the patient and medicolegal consequences [10–12]. In particular, it has been demonstrated that cases without a fracture result in a significantly greater delay in fasciotomy than those with a fracture [8]. Lower extremity compartment syndrome, isolated to the lateral and/or anterior compartment secondary to an ankle inversion injury, has been reported in literature [3–9]. More specifically, it has been evidenced in the literature that these ankle inversion injuries have commonly resulted in avulsion of the peroneus longus muscle which has led to the development of hematoma and anterior and/or lateral compartment syndrome [4,5,8,9]. In addition, avulsion of the anterior tibial artery and perforating branches of the deep peroneal artery have been implicated as the impetus for resultant anterior and/or lateral compartment syndrome following ankle inversion injuries [3,7].

Each of our patients suffered an ankle inversion injury while engaging in sports. The mechanism as to why the compartment syndrome developed is unclear from our cases. It is likely that the injury to the lateral compartment muscles was the result of a primary compressive injury due to interstitial edema or secondary to ischemic injury. Intraoperatively, there was no sign of muscle rupture or arterial disruption and/or avulsion. In case 2, there was hematoma noted intraoperatively so it is possible that there may have been avulsion of a small vein supplying the muscle. This could be unique to young, active adults that have a more vascularized compartment in which a small vein is at greater risk of avulsing during a high energy twisting injury and only after significant compression does the bleeding stop.

Rehman et al. presented a case of an individual that developed lateral compartment syndrome of the right lower extremity with no underlying muscle rupture or arterial disruption and without obvious history of trauma or even an indirect injury such as ankle inversion [6]. To the best of our knowledge, our cases are the first to be reported in the literature to present the development of anterior and/or lateral compartment syndrome following an inversion ankle injury with no obvious signs of muscle rupture or arterial involvement.

Fortunately, in our cases, extensive muscle debridement was not required. In other reported cases, however, the diagnosis was frequently delayed or missed altogether, which subsequently led to the development of prolonged ischemia and eventual muscle necrosis requiring significant debridement and/or limb amputation [11].

Conclusion

The cases presented in this report underscore the importance of considering compartment syndrome when individuals present with an inversion injury of the ankle, even without fracture despite it being infrequently reported in the literature. It is imperative for clinicians to maintain a high index of suspicion for acute compartment syndrome even when muscle rupture or arterial disruption is of low likelihood in patients who are presenting with severe pain or worsening neurovascular symptoms. Prompt diagnosis and fasciotomy can ultimately prevent devastating, irreversible patient morbidity such as muscle necrosis, foot drop, and/or limb amputation all while minimizing medicolegal consequences.

Consent

Written informed consent was obtained from the patients for publication of this case report.

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Declaration of competing interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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