Radiology Case Reports

Volume 10, Issue 2, 2015

Acute exertional medial compartment syndrome of the foot in a teenager

Nathan R. Kelsey, MD; Lance D. Edmonds, MD; and David M. Biko, MD

Acute compartment syndrome is an emergent condition characterized by increased pressure in a non-compliant fascial compartment, resulting in ischemia of the muscles and nerves. It is most commonly caused by a traumatic etiology but rarely can be caused by an atraumatic etiology, resulting in a confusing clinical scenario. We present a case of a 15-year-old sedentary teenager diagnosed with acute exertional medial compartment syndrome of the foot, initially diagnosed with MRI, following two days of rugby practice.

Introduction

Acute compartment syndrome is an emergent condition caused by increased pressure in a relatively noncompliant fascial compartment, resulting in ischemia of muscles and nerves (1). Anatomic compartments in the upper and lower extremities can be affected (2). Symptoms include the "5 P's": pain out of proportion to exam, pallor, paralysis, paresthesia, and pulselessness (3). Etiologies include trauma, burns, rhabdomyolysis, prolonged compression, poor intraoperative positioning, and reperfusion injury (2). Acute compartment syndrome involving the medial foot occurs most often as a result of trauma such as a fracture or crush injury (4). Exertion is a rare atraumatic etiology that has been reported (4-6). Recognition of acute compartment syndrome is important because fasciotomy within 6 hours of diagnosis can prevent the late sequalae of debilitating contractures, loss of muscle function, and neuropathy (2-3).

Citation: Kelsey NR, Edmonds LD, Biko DM. Acute exertional medial compartment syndrome of the foot in a teenager. *Radiology Case Reports*. (Online) 2015;10(2);1092

Drs. Kesey and Edmonds, as well as Dr. Biko, are in the Department of Radiology at the David Gant Medical Center, Travis AFB, CA. Dr. Biko is also associated with the Department of Radiology at the Children's Hospital of Philadelphia, Philadelphia PA. Contact Dr. Kelsey at nathan.kelsey@us.af.mil.

Competing Interests: The authors have declared that no competing interests exist.

DOI: 10.2484/rcr.v10i2.1092

We report the case of acute exertional atraumatic medial compartment syndrome initially diagnosed with MRI in a sedentary teenager with a sharp increase in activity during rugby tryouts. Unlike other reports of acute medial compartment syndrome, this patient's symptoms improved with conservative therapy rather than surgical intervention.

Case report

A 15-year-old, predominately sedentary female presented to the emergency room with pain and swelling of the medial right foot and ankle. The pain initially occurred during the conclusion of 2 days of strenuous rugby practice. There was no trauma to the right ankle or foot during practice. The discomfort gradually worsened until she was unable to ambulate due to pain. She reported to the emergency room, had normal radiographs, and was discharged home. The patient followed up in the clinic four days following the initial symptoms. The patient now reported numbness in addition to pain. On physical examination, the patient had nonpitting edema over the right foot and ankle, firmness of the medial right plantar arch, pain with passive stretching, and diminished sensation in the ventral great toe. Pulses and capillary refill were normal.

Given the patient's discomfort, only a limited, noncontrast, enhanced MRI of the right foot was performed. The study demonstrated extensive edema and microhemorrhage within the enlarged abductor hallucis muscle, strongly suggesting medial compartment syndrome. Subcutaneous and deep fascial edema was seen adjacent to the enlarged muscle (Fig. 1).

Creatinine kinase (CK) was elevated at 1403 U/L (normal range 35 - 232 U/L). Additional laboratory values

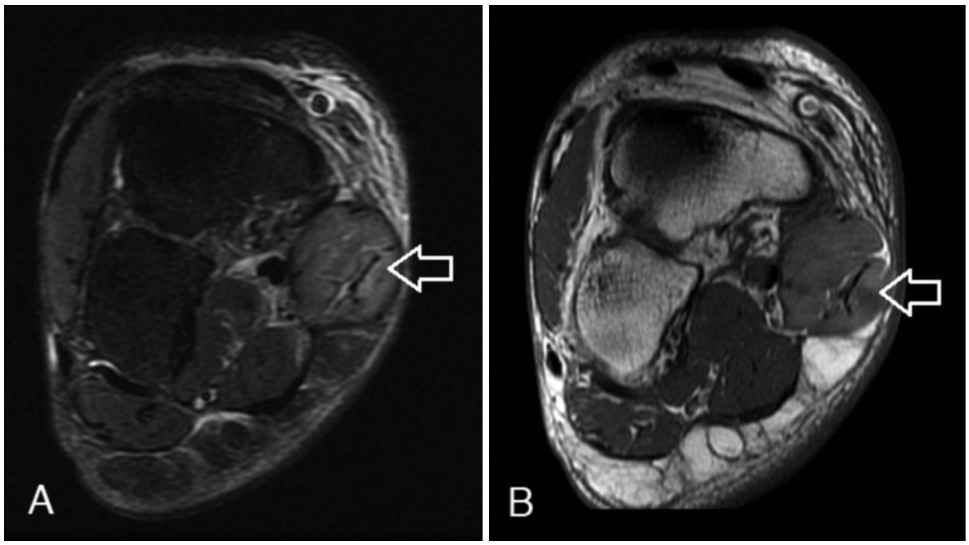

Fig. 1. 15-year-old with atraumatic right foot and ankle pain. A. Short-axis STIR of the right foot demonstrates enlargement and distention of the abductor hallucis muscle (arrow) with inhomogeneous hyperintensity consistent with edema. B. Short-axis T1 demonstrates relative hyperintensity of the abductor hallucis (arrow) muscle relative to the remaining musculature, suggesting microhemorrhage.

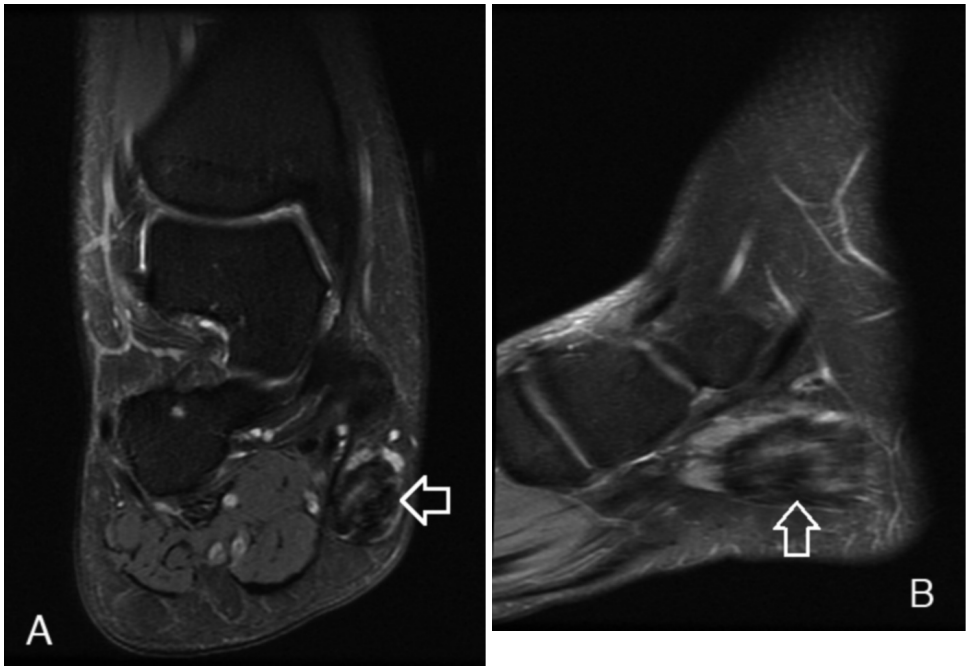

Fig. 2. MRI of a 15-year-old with atraumatic right foot and ankle pain presenting for 5-month follow-up examination. A. Coronal fat-saturated proton density demonstrates fatty replacement of the abductor hallucis muscle (arrow). B. Sagittal fat-saturated T2 demonstrates similar findings (arrow).

were normal. Compartment pressures were not obtained. The patient was sent home with a CAM boot and instructions for rest, ice, and elevation. No surgical intervention was performed.

On follow-up at 2 weeks, 6 weeks, and 5 months, the patient had improved physical examination findings with intact sensation. The patient continued to report achy pain in the medial arch of the right foot with physical activity. A follow-up MRI at 5 months revealed atrophic changes within the abductor hallucis (Fig. 2).

Discussion

Diagnosis of acute compartment syndrome can be difficult. In this case, paresthesia and numbness, and pain out of proportion to the exam and with passive stretching, were important clinical features (3). Most acute compartment syndromes occur secondary to trauma, with a fracture as the etiology in up to 70% of cases (7). Given that in this case the etiology was atraumatic, the diagnosis was not made clinically, and the MRI was an important tool to alert the clinicians of the diagnosis.

The diagnosis of acute compartment syndrome can be supported by intracompartmental pressure (ICP) measurements and elevated levels of CK (4). ICP measurements are obtained by inserting a needle in the fascial compartment of interest. ICP is normally 10mm Hg in muscle at rest. Values ranging from 30 to 50mm Hg have been suggested to diagnose compartment syndrome. Others advocate using the difference between diastolic blood pressure and ICP (2). ICP increases as the syndrome evolves, and values

should be monitored every 30 to 120 minutes to evaluate for progression (1). Unfortunately, it can be technically challenging to measure ICP, especially within small regions of the foot. CK is a marker for skeletal muscle damage and is therefore nonspecific. No absolute value has been established for the diagnosis of acute compartment syndrome. It is elevated in some, but not all, cases of compartment syndrome. Continued elevation of serum CK after fasciotomy suggests inadequate decompression (1).

Although there are nine compartments of the foot described in anatomic studies, the compartments are categorized into four main groups for surgical management (Fig. 3). The intrinsic compartment contains the dorsal interossei between the metatarsals. The central compartment contains the flexor digitorum brevis, quadratus plantae, and adductor halluces. The lateral compartment contains the flexor digiti minimi brevis and abductor digiti minimi. Finally, the medial compartment contains the abductor hallucis and sometimes the flexor hallucus brevis (5).

In the case presented, the edema on the MRI was solely within the abductor hallucis which occupies the medial compartment. The abductor hallucis was also enlarged in size distending the compartment. Follow-up MRI, demonstrated atrophic changes involving the abductor hallucis confirming the muscle damage. In a case series of lower leg compartment syndrome by Rominger et al., MRI demonstrated abnormal findings in all patients with "manifest" compartment syndrome, classified as neurological symptoms, loss of tissue function, and pathologic tissue pressures.There was loss of muscle architecture, inhomogeneous bright signal on T2 weighted imaging, and enhancement. Follow-up MRI of these cases demonstrated fatty degeneration of the muscle and decreased enhancement (7).

Conclusion

Acute exertional compartment syndrome of the foot is a rare disease but can be debilitating if undiagnosed. Although primarily a clinical diagnosis, the atraumatic etiology can be confusing. We present a case of acute exertional medial compartment syndrome in teenager where MRI was imperative in making this diagnosis. Anatomic knowledge of the compartments of the foot is essential to recognize this disorder.

Acknowledgment

The authors would like to thank Jessica Yim for providing Fig. 3.

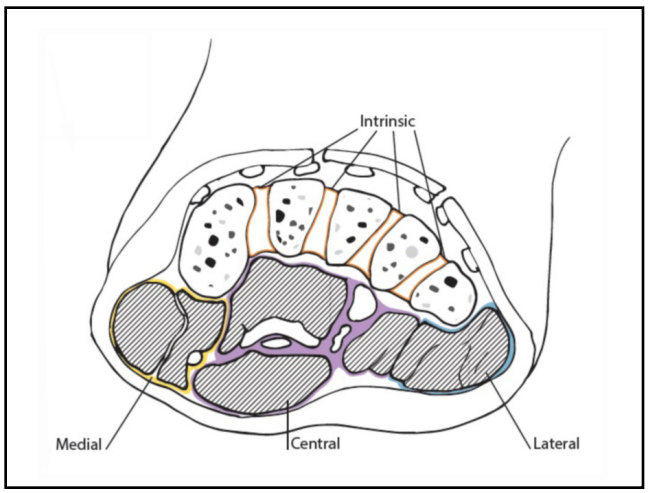

Fig. 3. Short-axis illustration through the forefoot demonstrates the four compartments of the foot.

References

1. Tzioupis C, Cox G, Giannoudis PV. Acute compartment syndrome of the lower extremity: an update. *Orthopaedics and Trauma* 2009;23:433-440. doi:10.1016/j.mporth.2009.09.003
2. Elliot KGB, Johnstone AJ. Diagnosing acute compartment syndrome. *J Bone Joint Surg Br* 2003 Jul;85(5):625-32. [PubMed]
3. Whitesides TE Jr. Heckman MM. Acute compartment syndrome: update on diagnosis and treatment. *J Am Acad Orthop Surg.* 1996 Jul;4(4):209-218. [PubMed]
4. Lam SK, McAlister J, Oliver N, et al. Bilateral medial foot compartment syndrome after an aerobic class: a case report. *J Foot Ankle Surg* 2012 Sep-Oct;51(5):652-5. [PubMed]
5. Chambers L, Hame SL, Levine B. Acute exertional medial compartment syndrome of the foot after playing basketball. *Skeletal Radiol* 2011 Jul;40(7):931-5. [PubMed]
6. Miozzari HH, Gerard R, Stern R et al. Acute, exertional medial compartment syndrome of the foot in a high-level athlete. *Am J Sports Med* 2008 May;36(5):983-6. [PubMed]
7. Rominger MB, Lukosch CJ, Bachmann GF. MR imaging of compartment syndrome of the lower leg: a case control study. *Eur Radiol* 2004 Aug;14(8):1432-9. [PubMed]