

Acute Compartment Syndrome After Rupture of the Medial Head of Gastrocnemius in a Child

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Rupture of the gastrocnemius muscle is an uncommon injury, with most cases occurring in athletes and, typically, presenting with the acute onset of focal calf pain and ecchymosis after injury. Although gastrocnemius ruptures are usually treated symptomatically with good results, we present an unusual case of a medial head of gastrocnemius muscle tear complicated by acute compartment syndrome in a 7-year-old boy whose right calf was crushed in a fall. After confirmation of the diagnosis of compartment syndrome, the patient underwent emergency fasciotomy with evacuation of hematoma, and, thereafter, he recovered unremarkably. Clinicians and surgeons need to maintain a high index of suspicion for compartment syndrome associated with gastrocnemius muscle injury, so that timely surgical decompression can be undertaken and complications related to delayed diagnosis and treatment can be avoided. (The Journal of Foot & Ankle Surgery 46(4):288–290, 2007)

Key words: compartment syndrome, gastrocnemius rupture, fasciotomy

Compartment syndrome is a well-recognized and serious complication of fractures localized to the extremities, especially those affecting the leg and forearm (1). It has also been reported as a complication of soft tissue injury (2); however, compartment syndrome due to muscle rupture in the leg has rarely been reported (3–5).

An uncomplicated muscle rupture of the leg musculature occurs most frequently at the musculotendinous junction in athletically active individuals, and the most common presenting symptoms observed in the emergency department or outpatient medical office include acute pain, swelling, and ecchymosis localized to the injured muscle. With supportive therapy, most of these symptoms usually resolve.

We report the case of a young patient who presented with rupture of the medial head of gastrocnemius associated with an acute compartment syndrome affecting the superficial, posterior compartment of the leg. To our knowledge, this is the first published report of a case involving an acute compartment syndrome associated with an avulsion injury of the medial head of gastrocnemius.

Case Report

A 7-year-old boy was playing with friends when he accidentally fell from a height of approximately 6 ft onto a bush located near a solid wall. Upon falling, his right leg was caught between a wire located in the bush and the adjacent wall, effectively crushing the child's right calf. He presented to his general practitioner immediately after the injury, complaining of severe pain and swelling involving his right leg. The general practitioner was concerned about the severity of the injury and immediately referred the patient to our hospital for further evaluation and management.

Upon presentation to our clinic, physical examination revealed a very tense and swollen right calf with ecchymosis localized to the skin overlying the medial head of gastrocnemius. There was a visible and palpable defect of the medial head of the gastrocnemius near its proximal attachment to the femur. An oblique, linear bruise was evident inferior to the tibial tuberosity, indicative of the contusion inflicted on the skin by the metallic wire. The knee was antalgically held in approximately 120° of flexion, and any attempt to straighten the knee caused severe pain (Fig 1). Furthermore, the patient held his right foot in approximately 30° of plantarflexion, and any dorsiflexion movement caused severe pain proximally in the calf. With the exception of the origin of the medial head of gastrocnemius, there was no evidence of any other knee joint involvement, although complete examination of the knee was not possible because of the antalgic, fixed flexion attitude and inhibition

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FIGURE 1 Flexion deformity at the knee while the patient is under anesthesia.

of movement. There was no pain or limitation of the range of motion of the toes on passive and active movements in the right foot, indicative of the presence of intact anterior and deep posterior compartment musculature. Sensation in the distribution of the posterior tibial and common peroneal nerves was normal. The dorsalis pedis and posterior tibial arterial pulses were palpably present in the injured lower extremity. Only a lateral radiograph of the right knee and proximal aspect of the leg was obtained because of the extreme, antalgic flexion deformity of the knee; this examination did not show any osseous abnormality. A diagnosis of traumatic rupture of the medial head of the gastrocnemius muscle was made. Moreover, on the basis of the presence of severe pain, dense and taut musculature, and exacerbation of pain on stretch, despite the absence of any overt cutaneous sensory dysfunction, acute compartment syndrome of the superficial posterior compartment of the leg was suspected.

Initial management consisted of rest, ice, stabilization of the injured lower extremity, pain relief with morphine, and hourly neurovascular assessments. Despite these efforts, it was not long before the child complained of rapidly and progressively worsening pain without overt progression of the abnormalities of the cutaneous sensory function or the deep posterior compartment muscle function. An urgent computerized axial tomography scan was performed, and preparations were made for surgical decompression of the superficial posterior medial compartment of the right leg. The computerized axial tomography scan revealed a nearly complete rupture of the medial head of the gastrocnemius (80%) near its femoral origin, along with the presence of hematoma located between the disrupted head of gastrocnemius and underlying, intact soleus.

Within 3 hours of presentation to our clinic, the patient was taken to the operating room for surgical decompression of the superficial posterior leg muscle compartment. With the patient under general anesthesia and before commencement of the surgical dissection, intracompartmental pressure measurements were made with the Stryker pressure monitor (Stryker Corporation, Kalamazoo, MI). This was done in an



FIGURE 2 Showing tense medial gastrocnemius.



FIGURE 3 After decompression, showing viable muscle.

effort to accurately determine whether excessively high intracompartmental pressure was actually present in the superficial posterior compartment of the right leg. The patient's blood pressure was 110/60 mm Hg at the time that the intracompartmental pressures were measured. Pressure measurements revealed intracompartmental pressures of 50 mm Hg in the superficial posterior compartment in the area of the disrupted medial head of gastrocnemius, 28 mm Hg in the deep posterior compartment, 35 mm Hg in both the anterior and lateral (peroneal) compartments, and 12 mm Hg in the anterior thigh (quadriceps) compartment.

After measurement of the intracompartmental pressures, a 20-cm incision was made on the posterior aspect of the calf, centered over the medial head of the gastrocnemius (Fig 2). Dissection revealed the deep fascia to be intact and very taut, and the underlying intramuscular compartment was palpably indurated without fluctuation or crepitus. After sectioning the deep fascia, a dense hematoma was observed in the cleft between the proximal and distal segments of the medial head of the gastrocnemius muscle (Fig 3). The hematoma consisted of approximately 100 mL of partially coagulated blood; this was drained and the compartment was debrided by means of sharp and blunt dissection. Afterward, the injured muscle belly appeared normal with respect to color and consistency, and visible twitching was noted on mechanical stimulation with a forceps and on stimulation with the monopolar electrocoagulator. At this point, all of the compartments of the leg appeared to be

grossly lax and of normal texture, and repeat intracompartmental pressure measurements revealed normal pressures (12-14 mm Hg) in all 4 of the compartments. The partial tear of the gastrocnemius belly was not repaired. The fascia was not reapproximated, and the skin was loosely closed with 3 nonabsorbable, interrupted sutures without excessive tension. A posterior splint was applied, with the knee extended and the ankle maintained in the right angle relationship to the leg. This position was maintained for the first 2 weeks after the operation, followed by an additional 2 weeks of nonweightbearing with gentle ankle and knee motion, after which gradual resumption of weightbearing and increased motion took place. Overall, the postoperative recovery was unremarkable. One year after the operation, the patient remained asymptomatic and displayed full ranges of motion in the knee and ankle, without any evidence of gastrosoleus muscle weakness or dysfunction.

Discussion

The leg musculature is contained within 4 deep fascial compartments: anterior, lateral, superficial posterior, and deep posterior. Although acute compartment syndrome involving the superficial posterior compartment is rare (1), it can become limb threatening and warrants emergency surgical decompression. Acute compartment syndrome of the leg, specifically due to muscular tears, has been reported in association with gastrocnemius, peroneal, and tibialis anterior ruptures (6-8). It has also been reported in association with external soft tissue injuries without muscle sectioning (9) and, rarely, without antecedent soft tissue injury in anticoagulated patients (10, 11).

The diagnosis of a compartment syndrome is not always easy to make on the basis of the history and clinical examination alone, and confirmation may require measurement of the intracompartmental pressure deep to the deep fascia. Acute compartment syndrome is usually characterized by the "4 S's": severe pain, stretch pain, sensory abnormality, and swelling (9, 12). It is generally accepted that severe "breakthrough" pain resistant to analgesics is usually the earliest symptom of acute compartment syndrome. Although various techniques of measuring intracompartmental pressures have been developed, controversy exists over the exact definition of acute compartment syndrome. All of the intracompartmental pressures in the leg must be measured to determine whether the condition exists. Most authors (2, 9, 13, 14) agree that an absolute value greater than 30 to 45 mm Hg, or a value within 20 mm Hg of the diastolic blood pressure, requires fasciotomy to avoid the development of myonecrosis and permanent neuromuscular injury such as Volkmann's ischemic contracture (15).

It is important to make an accurate diagnosis of compartment syndrome in a timely fashion. Pulselessness is rarely

observed in association with acute compartment syndrome because the critical pressure to cause compartment syndrome is usually considerably less than the systolic blood pressure. Because there are no named anatomic nerves in the superficial posterior compartment of the leg, decreased sensation in the distribution of posterior tibial nerve is not a sign of this condition.

It should also be noted that tear of the medial head of gastrocnemius can cause anterior, in addition to posterior, compartment syndrome as in the case presented by Straehley and Jones (16). In this situation, decompressing the posterior compartment alone may decrease pressure in the anterior and lateral compartment and may avoid unnecessary fasciotomy of the anterior compartment, although intraoperative assessment, both before and after fasciotomy, will guide the surgeon's degree of intervention.

References

1. Rorabeck CH. Compartment syndromes. In *Skeletal Trauma*, pp 385-309, edited by BD, Browner JB, Jupiter AM, Levine Philadelphia, WB Saunders Co, 1992.
2. Mubarak SJ, Owen CA. Compartment syndrome and its relation to the crush syndrome. *Clin Orthop* 113:81-89, 1975.
3. Anouchi YS, Parker RD, Seitz WH. Posterior compartment syndrome of the calf resulting from misdiagnosis of a rupture of the medial head of the gastrocnemius. *J Trauma* 27:678-680, 1987.
4. Egan TD, Joyce SM. Acute compartment syndrome following a minor athletic injury. *J Emerg Med* 7:353-357, 1989.
5. Patton GW, Parker RJ. Rupture of the lateral head of the gastrocnemius muscle at the musculotendinous junction mimicking a compartment syndrome. *J Foot Surg* 28:433-437, 1989.
6. Arciero RA, Shishido NS, Parr TJ. Acute anterolateral compartment syndrome secondary to rupture of the peroneus longus muscle. *Am J Sports Med* 12:366-367, 1984.
7. Freundlich BD, Dashiff JE. Avulsion of tibialis anticus and peronei muscles resulting in acute anterior and lateral compartment syndrome. *J Trauma* 27:453-454, 1987.
8. Shields CS, Redix L, Brewster CE. Acute tears of the medial head of the gastrocnemius. *Foot Ankle* 5:186-190, 1985.
9. Matsen F, Winquist R, Krugmire R. Diagnosis and management of compartmental syndromes. *J Bone Joint Surg Am* 62:286-291, 1980.
10. Griffiths D, Jones DH. Spontaneous compartment syndrome in a patient on long-term anticoagulation. *J Hand Surg Br* 18:4142-4146, 1993.
11. Nadeem RD, Cliff BA, Martindale JP, Hadden WA, Ritchie IK. Acute compartment syndrome of the thigh after joint replacement with anticoagulation. *J Bone Joint Surg Br* 80:866-868, 1998.
12. Pai VS. Compartment syndrome of the thigh following total hip replacement. *Arthroplasty* 11:609-610, 1996.
13. Boume RB, Rorabeck CH. Compartment syndromes of the lower leg. *Clin Orthop* 240:97-104, 1984.
14. Whitesides TE, Haney TC, Morimoto R, Harada H. Tissue pressure measurements as a determinant for the need of fasciotomy. *Clin Orthop* 113:43-51, 1975.
15. Fletcher MD, Spicer D, Warren P. Delayed presentation of compartment syndrome following gastrocnemius tear. *Acta Orthopaedica Belgica* 67:190-192, 2001.
16. Straehley D, Jones WW. Acute compartment syndrome (anterior, lateral and superficial posterior compartment) following tear of gastrocnemius muscle. A case report *Am J Sports Med* 14:96-99, 1986.