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HOW TO TEST AND TREAT EXERTIONAL COMPARTMENT SYNDROME

When patients experience intense pain, a burning sensation, tightness and/or numbness in the lower extremities during exercise activity, and the pain usually resolves quickly once the patients stop the activity, you may be looking at exertional compartment syndrome (ECS). ECS is certainly one of the more confounding conditions as differentiating between the various leg pains can be difficult.

Parasthesia to the anterior leg, ankle or between the first and second metatarsal is indicative of anterior leg compartment involvement. In addition, weakness of ankle dorsiflexion or a drop foot also involves the anterior compartment. If you find parasthesia to the arch or plantar aspect of the foot, that is associated with deep posterior leg compartment involvement. Most of the time, however, numbness is not evident. Approximately 80 percent of ECS cases involve both legs.[1]

Other physical findings may include mild edema, muscle herniations over the involved compartment and muscle weakness in the specific compartment.

Several studies have been done to understand the pathophysiology of ECS. Mubarak studied acute compartment syndrome and concluded that the blood flow through the intracompartmental capillaries (capillary ischemia) is impeded, but blood flow continues to larger arteries and veins with palpable pulses distally.[2] The extent of capillary ischemia in ECS is unknown.

In a subsequent study performed with magnetic resonance imaging, researchers found that ECS is not related to ischemia, but is actually due to increased fluid content (water) within the muscle compartment.[3] This can compromise or impair function of the muscle or nerve within a tight and constricted fascial covering.

My personal observations through clinical and surgical intervention are that some individuals are genetically predisposed due to their anatomical muscle composition. Someone who is born with good muscle development/tone may actually wind up with hypertrophic muscle(s) as a result of repeated exercise activities. Muscle volume may expand 20 percent during exercise from both increased capillary infiltration and blood content. Ultimately, this intracompartment swelling increases the pressure within the enclosed compartment.

When testing the deep posterior compartment with the Stryker intra-compartmental pressure monitor system, insert the needle just medial and posterior, staying relatively superficial within the posterior tibial muscle belly.

I believe there's a similarity between this intracompartmental pressure problem of the leg and that which is present in tarsal tunnel syndrome cases. Here, there is an impingement of a nerve by surrounding hypertrophic muscle(s) or fluids within the medial ankle area. If the athlete persists in playing a sport with the pain, he or she may have the nerve impingement and symptomatic numbness or muscle weakness described above.

This is just one example. There are other differential diagnoses that you should consider when seeing symptoms of ECS (see "Why The ECS Diagnosis Is Often Missed" on page 24).

Essential Pointers On Testing For ECS

It has been fairly well established that the most reliable method for diagnosing ECS is by taking intramuscular compartmental pressures. Currently, I use the Stryker intracompartmental pressure monitor system.[4]

When the athlete/patient comes in, I test the one leg, prep it with povidine-iodine swabs and mark the areas for injection. The athlete should be in supine position on the exam table, with his or her knees bent so the sole of the foot is flat on the table. By having the lower leg upright, I have access to all the compartments.

For the anterior compartment, the injection site is midway up the leg, staying close to the lateral aspect of the tibia and directly over the anterior tibial muscle. Mark the area and anesthetize the skin superficially with 2% lidocaine plain.

Be sure to zero balance the pressure monitor system, holding the unit approximately perpendicular to the muscle and parallel to the exam table. Insert the side-ported needle into the anterior tibial muscle approximately one inch deep and inject the saline from the syringe into the muscle belly. (As far as the saline goes, I usually inject .3cc until the patient says the

injected site feels "full.") Then record the back pressure and read off the monitor once you've reached an equilibrium state, which occurs when the LCD readout stops or fluctuates back and forth a few degrees mmHg.

Reload the syringe with saline and repeat the procedure for the lateral compartment, which you would measure midway up the leg and just lateral to the surface of the palpated fibula bone. Here, you're gauging the pressure within the peroneal muscles. For the deep posterior compartment, measure it midway up the leg, staying close to the medial surface of the tibia. Insert the needle just medial and posterior, staying relatively superficial within the posterior tibial muscle belly.

Finally, measure the superficial posterior compartment, which is slightly further up on the leg. Insert the needle into the medial or lateral head of the gastrocnemius, depending on which side was more symptomatic.

The superficial posterior compartment is the least common of the compartment syndromes and testing is often not necessary. You'll find the anterior compartment is the most commonly involved and is often present with lateral compartment syndrome.

What Comparison Pressure Readings Will Tell You

Once you record the pressures, ask the patient to run either on a treadmill or outside until he or she feels the symptoms. Immediately repeat the testing. Do another test five minutes after the post-exercise test.

Normal baseline pressures pre-exercise should be approximately 15 to 20 mmHg. If the post-exercise pressures increase greater than 30 to 45 mmHg, this is considered pathologic. However, I have noted that most patients with ECS have elevated pressures above 45 mmHg during the immediate post-exercise testing. I should also point out that many patients have had a baseline compartment pressure reading greater than 30 mmHg, which is highly suggestive of ECS. Also keep in mind that if the immediate post-exercise measurements are significantly greater than 45 mmHg., you may not have to do the final five-minute post-exercise testing.

Performing The Corrective Fasciotomy For ECS

If you have established the ECS diagnosis and conservative care measures have failed, you should proceed to the corrective fasciotomy.

I prefer a single incisional approach for both the anterior and lateral compartments. Usually, you want to release both compartments, even when only one compartment is involved. Make a linear longitudinal incision approximately 15 cm. long midway up the leg between the tibia crest and fibular shaft. Sharply deepen the incision to the level of the subcutaneous tissues down to the layer of the overlying fascia. Proceed to incise the fascia. At this point, you should be able to identify the anterior intramuscular septum that divides the anterior and lateral compartments.

Make sure you identify and avoid the superficial peroneal nerve that lies in the lateral compartment, which usually runs alongside the intramuscular septum. Using a long Metzenbaum scissor, cut the ante-

rior fascia compartment in a linear longitudinal manner. Direct the scissors along the anterior tibial muscle down toward the anterior aspect of the lateral malleolus distally and proximally toward the patella.

Release the lateral compartment by cutting the fascia with the scissors along the lateral aspect of the fibular shaft. Direct the scissors distally toward the posterior aspect of the lateral malleolus and proximally toward the fibular head. It is important to visualize and cut with the tips of the scissors so you only release the fascia and avoid the superficial peroneal nerve.

When it comes to releasing the deep posterior compartment, I recommend making a linear longitudinal incision approximately 2 cm. posterior to the palpated medial posterior margin of the tibia. Then deepen the incision down to the level of the fascia. It is important to separate the fascia from the subcutaneous tissues in order to identify the saphenous nerve and vein, which should be just medial-posterior to the tibia.

Retract the neurovascular structures anteriorly and cut the deep posterior compartment fascia in a linear longitudinal manner, aiming the scissors distally towards the posterior aspect of the medial malleolus and proximally straight up. If you want to release the superficial posterior compartment as well, you should release the soleus bridge of soft tissues distally. Then perform the fasciotomy more posterior and along the soleus muscle, directing it proximally toward the medial head of the gastrocnemius.

(During these procedures, you should identify the nerves, including the superficial peroneal nerve and the saphenous nerve, in order to make sure they are not entrapped or appear abnormal.)

Proceed to irrigate the surgical sites with saline. Do not suture the fascia. Reunite the subcutaneous tissues and close with 2-0 absorbable suture in a simple interrupted technique. Then perform skin closure with a running subcuticular suture.

In Conclusion

Apply postoperative dressings along with a well padded posterior splint cast, which should be worn for three weeks to allow for soft tissue healing. After three weeks, the patient attends physical rehabilitation and usually progresses back to sports within five to six weeks after the surgery. Once you make the proper (albeit challenging) diagnosis for ECS, you'll find that surgical results are very gratifying. ■

Why The ECS Diagnosis Is Often Missed

Be especially vigilant for ECS when patients come in with a history of shin splints. Sometimes, in these cases, ECS is the more accurate diagnosis.

It has been well established that shin pain is often caused by excessive pronation with eccentric contraction of the soleus muscle or traction of the soleus muscle away from the periosteum of the bone. This may cause injury to the muscle or disruption of the periosteal lining or Sharpey's fibers where they insert into the bone. This may even eventually lead to micro- or stress fracture of the bone.

In my practice, I ask these patients if they have pain when walking. If their legs hurt while walking the day after the activity, then I look for a stress fracture with an X-ray and/or bone scan. Also keep in mind that the posterior tibial muscle tendon or other medial leg musculature are commonly involved with shin pain.

Patient may also have anterior muscle pains (possibly related to running uphill, sprinting, or overworking of the anterior tibial muscle against tight calf musculature) or are suffering from shock absorption issues. Shock absorption is particularly problematic for those who have rigid foot types (especially cavus feet). For these individuals, a change of playing surfaces or switching to more cushioned shoe gear is in order.

Yet you should also be on the lookout for more obscure causes of leg pain. For example, ECS and popliteal artery entrapment syndrome share very similar symptoms. For the latter condition, the pain is most prevalent during exercise activity, is severe and commonly occurs in the calf area. As with ECS, the intense pain subsides with rest.

Proceed with diagnostic testing, including arteriography and duplex scanning, to better evaluate the course and function of the popliteal artery. You may also want to perform non-invasive vascular testing to rule out claudication symptoms associated with the vascular pathology, especially in older athletes.

Another anomaly which causes ECS is an accessory soleus muscle or accessory peroneus quartus muscle. In my practice, I have seen many cases of recalcitrant posterior leg pain which mimics chronic Achilles tendonitis, but also mimics posterior compartment syndrome during activity.

I have identified several of these cases by looking at the overall contour of the distal calf and Achilles area. If you suspect hypertrophy or if the pains to the posterior leg are out of proportion to normal muscle soreness, order an MRI to determine if an accessory muscle is present. Obviously, an extra muscle within any compartment would cause increased pressures upon the adjacent soft tissues. When this is problematic, debulking or cutting of the surrounding fascia is often indicated.

References

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