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Review article

Exercise-induced leg pain

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Abstract

Exercise-induced leg pain is a common condition in athletes and in people involved in recreational sports. The diagnosis is not always straightforward: many conditions may cause exercise-induced leg pain. The aim of the present review is to provide a complete discussion of the most common pathologies related to this condition. Particular attention is dedicated to the history and the physical examination, which are fundamental for requesting the correct diagnostic tests or imaging techniques necessary for a precise diagnosis.

Keywords: chronic exertional compartment syndrome; exercise-induced leg pain; medial tibial stress syndrome; popliteal artery entrapment syndrome

Introduction

Exercise-induced leg pain includes a broad range of conditions that involve different tissues. The conditions include the following (Table 1): (1) *Bones:* stress fractures, medial tibial stress syndrome, and neoplasm; (2) *Muscles:* chronic exertional compartment syndrome, herniae, exercise-induced rhabdomyolysis, delayed onset muscle soreness, and neoplasm; (3) *Blood vessels:* popliteal artery entrapment syndrome, endofibrotic disease, popliteal artery aneurysm, cystic adventitial disease, and peripheral arterial dissection; (4) *Nerves:* entrapment syndromes (e.g., saphenous, peroneal, and tibial nerves) and lumbar radiculopathy; (5) *Tendons:* tibialis anterior, tibialis posterior, peroneals, and Achilles.

Chronic exertional compartment syndrome (CECS), medial tibial stress syndrome (MTSS), stress fractures, and popliteal artery entrapment syndrome (PAES) are more common than the other pathologies. However, the exact incidence of each condition is unknown. Studies show that MTSS accounts for 6–16% of all running injuries, and it can represent up to 50% of lower leg injuries in selected populations such as military personnel.[1] Chronic exertional compartment syndrome may be difficult to diagnose and is often underestimated, but it is very common in runners—mostly in the anterior and lateral compartments.[2] In a retrospective review of 150 athletes with exercise-induced leg pain, 33% of athletes were diagnosed as having CECS; 25% of athletes had stress fractures; 13% of athletes had MTSS; and 10% of athletes had nerve entrapment syndromes.[3] The aim of the present review is to provide a complete discussion of the most common pathologies related to exercise-induced leg pain. Particular attention is paid to the history and physical examination, which are fundamental for requesting the correct diagnostic tests or imaging techniques necessary for a precise diagnosis.

Chronic exertional compartment syndrome

Chronic exertional compartment syndrome is widely discussed, but its pathophysiology seems to be largely unknown. It has traditionally been described as occurring mostly in young individuals (median age, 20 years[4]), recreational and

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Table 1
Summary of the most common conditions causing exercise-induced leg pain.

Tissue	Condition	Special features	Symptoms & signs	Diagnosis	Treatment
Bone	Stress fracture (SF)	More common at the posteromedial tibia; less common at the anterior tibia, medial malleolus or fibula.	Gradual onset of localized pain. The pain is elicited by activity & decreases with rest. With the progression of a fracture, pain occurs with walking or at rest; there is localized pain on palpation; pain occurs with sustained one leg hop & with percussion at a distant site.	X-ray imaging. If X-ray imaging is negative but suspicion of a fracture is high, repeat X-ray imaging 2−3 wk later. Computed tomography (CT) scan or magnetic resonance imaging (MRI) can be obtained to expedite the diagnosis.	Conservative treatment for low-risk fractures (e.g., posteromedial tibia & fibula): rest (for 4−8 wk), ice, & pain killers. For failed conservative treatment of high-risk fractures (e.g., anterior tibia), surgery is required: intramedullary nailing for complete shaft fractures, drilling with bone grafting in incomplete fractures.
Bone	Medial tibial stress syndrome (MTSS)	Also called “shin splints”; the incidence ranges 4−35% in athletic & military populations.	Pain at posteromedial tibia. The pain is cumulative with activity & persists for a long time (sometimes days) before it improves with rest (this differs from CECS in which pain subsides after minutes of rest). On physical examination, the patient has diffuse tenderness along the posteromedial tibia (this differs from localized pain in SF).	History & physical examination are usually sufficient. X-ray imaging is usually negative; MRI usually shows medial & posteromedial periosteal oedema. The bone scan shows uptake along the posteromedial tibia on delayed-phase images; the uptake is longitudinally oriented, & one-third or more of the tibia is involved (this differs from localized uptake in SF)	Initially conservative treatment is attempted such as rest, ice, modification of the training schedule & shoes, stretching, & strengthening. For recalcitrant cases, surgery is indicated (e.g., fasciotomy of the deep posterior compartment & release of the periosteum).
Muscle	Chronic exertional compartment syndrome (CECS)	CECS can involve four compartments of the leg: anterior, lateral, posterior & deep posterior. The anterior & lateral compartments are involved in 95% of patients; muscle herniae are present in 40−60% of patients, mostly at the level of superficial peroneal nerve's exit from the lateral compartment.	History of leg pain & tightness at the same time, distance, or intensity of exercise; the pain increases with exercise & resolves after rest (in approximately 30 min). The patient can experience numbness or a “floppy foot”. Physical examination at rest is usually normal; after exercise; pain occurs with palpation of the involved muscles. Weakness of foot dorsiflexion, eversion, & plantarflexion are commonly associated with increased pressure at the level of anterior, lateral & posterior compartments, respectively.	Intracompartmental pressure (ICP) measurements, MRI, & near-infrared spectroscopy (NIRS) are used to diagnose the disorder. An MRI is more sensitive postexercise. The pre-exertional ICP measurement (normal values 5−12 mmHg) & immediate postexertion ICP measurement (normal values 9−20 mmHg) should be obtained for all compartments in both legs.	If the patient does not want to modify the activity level, fasciotomy is the only treatment. Open, subcutaneous, & endoscopic fasciotomies have been described.
Vessel	Popliteal artery entrapment syndrome (PAES)	There are six types of PAES that are based on anatomic variants; a 7th type is functional PAES.	Claudicatory symptoms in the anterior &/or posterior aspect of the leg; numbness & tingling of the foot may be present; the pain may be elicited by running (especially uphill) or by repetitive jumping. Functional PAES is often associated with paraesthesias in the tibial nerve distribution. In advanced PAES, the posterior tibial & dorsalis pedis pulses may be diminished or absent.	The resting ankle brachial index (ABI) is usually normal, but the 1-minute postexercise ABI is frequently decreased. The ABI can be decreased during PAES provocative manoeuvres (e.g., passive ankle dorsiflexion or active ankle plantarflexion). Other diagnostic techniques include duplex ultrasonography, conventional angiography, magnetic resonance	The treatment is usually surgical & depends on the PAES classification. The goal is to remove the compression & reconstruct the artery if it is chronically damaged.