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Common Ultramarathon Musculoskeletal Injuries

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Musculoskeletal (MSK) injuries are common among ultramarathon runners and particularly during ultramarathons. MSK injuries are most commonly seen as the result of overuse in lower extremities predominantly below the knee.[8,15,17,21] However, acute traumatic injuries such as sprains, strains, contusions, and fractures can occur. If a runner persists on completing the race in spite of the pain, cryotherapy (ice) and various taping techniques can be offered as possible alternatives for temporary pain relief.[4,17] Judicial use of acetaminophen (Tylenol) can also enable the runners to continue the race. Due to the potential risk of renal and gastrointestinal complications, use of oral non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and naproxen, during the race is not recommended.

Patellofemoral pain syndrome (PFPS)

PFPS, also known as "runner's knee," is the most common reported running injury with a higher prevalence among young and female runners.[9,35] Up to 25% of ultramarathon runners experience PFPS.[4,8,28] The prevalence of PFPS during ultramarathon races has been reported up to 16%.[4,21] Runners usually experience pain in the front of one or both knees. Sometimes pain is more localized behind the patella (kneecap). Pain usually subsides following the run. The cause of PFPS is multifactorial and includes overuse, poor alignment, and muscular imbalance. Management of PFPS should focus on multiple aspects which includes pain management (e.g. acetaminophen), strengthening programs (physical therapy), and shoe insoles or orthotics. Various taping techniques and patellar braces have been suggested for prevention of PFPS.[4,16] Although an increase of 5-10% in the running pace, with subsequent shorter steps, may decrease the pain in some runners, such changes in cadence may have an undesirable effect on the runners' performance.[2]

Iliotibial band friction syndrome (ITBFS)

As the most common cause of lateral knee pain in runners, the ITBFS has an incidence of about 10%.[34,35] It has a self-reported 1-year prevalence of 7% among participants of two 161-km ultramarathons.[14] The iliotibial band (ITB) is a lateral stabilizer of the knee joint.[7,34] There is a proposed impingement zone at 30° of knee flexion. Running uphill, downhill, and at slower paces, which is inherent in ultramarathons, may lead to a higher fraction of time in this zone.[34] The pain is usually elicited after a fixed distance, repetitive flexion and extension of the knee, or by holding the knee in 30° of knee flexion. It is relieved when the knee is held at full extension.[7,12,34] As the problem progresses, the onset of symptoms begins earlier during the course of running.[7,34] Acetaminophen, cryotherapy, myofascial release techniques, foam roller, and shortening the stride length may be helpful in alleviation of the symptoms during multistage races.[34] Long rest and immobility in aid stations should be discouraged to prevent worsening pain and tightness in ITB.

Shin splint (medial tibial stress syndrome)
Shin splints are a common running injury observed in about 5% of runners with a higher prevalence among men.[35] The prevalence of shin splints during ultramarathon races is about 10%.[4,21] Most runners with this condition will adapt to a slower running speed to decrease the pain during the race. The diagnosis of shin splints in the settings of new onset shin pain during the race should be a diagnosis of exclusion. In less severe cases, cryotherapy, stretching, and topical analgesics may be of some value during the race intervals.

Stress fractures
Stress fractures are common among ultramarathon runners. A survey study of the participants of two 161-km ultramarathons revealed a self-report of a 10% stress fracture rate in the previous year.[14] In this study foot, tibia, and femur were the most common stress fracture sites.[14] The repetitive stress of running without proper rest, may lead to a spectrum of pathologic bone responses from stress reactions (microfracture) to stress fractures (frank cortical disruption). The huge increase in running distance during the race compared to typical training programs puts ultramarathon runners at a much higher risk of developing stress fractures compare to the shorter distance running events. Diagnosis during the race is based on physical examination which may manifest focal tenderness and swelling.[23] Even if the access to a local clinical facility is available, plain radiography is not an appropriate modality for the diagnosis of stress fracture during or after the race. Cortical reactions may take up to 5 weeks to become evident in plain radiographs. High clinical suspicion of a stress fracture during a race warrants the termination of the race for the runner. Conservative on-site management includes immobilization, cryotherapy, and acetaminophen. A balanced diet to prevent weight loss, smoking cessation, daily intake of 1500-2000 milligrams of calcium and supplemental vitamin D, arch supports particularly if flat feet (pes planus) is present, and optimizing the training routines may prevent stress fractures.[23] A 10% reduction in stride length and an increase in the running cadence may decrease the risk of tibial stress fractures by decreasing the tibial strain forces.[6,13]

Sesamoid stress injuries
The sesamoid complex is located centrally at the plantar side (towards the sole) of the 1st metatarsal head, lying within the medial and lateral heads of flexor hallucis brevis tendon, while also receiving attachments from abductor and adductor hallucis tendons.[1] It normally transfers up to 50% of body weight, but this load can reach >300% during the run (push-off). The repetitive nature of running, and the large magnitude of these forces, can make the sesamoid complex prone to various pathologies (e.g., sesamoiditis, osteochondritis, acute stress fractures). Sesamoid disorders account for 1% of running injuries.[1] Prevalence of sesamoid stress injuries during ultramarathons is unknown. Sesamoiditis is a painful condition of the sesamoid complex due to repetitive stress with no radiographic findings. Crepitus, tenderness and pain on extension of the 1st metatarsophalangeal (MTP) joint are the main clinical findings. Sesamoid stress fracture is the most common pathology of the sesamoid complex which typically involves the tibial sesamoid.[1,18] Runners with clinically suspicious findings should be referred non-urgently to a physician for further work ups after the race.

Chronic exertional compartment syndrome (CECS)

The majority of diagnoses related to leg pain in runners can be attributed to overuse injuries. Following shin splints, CECS is the second most common cause of chronic leg pain in athletes.[10] Pain usually instantly disappears following cessation of the run and some rest with no permanent aftereffect in the leg. However, in rare cases if the exertion continues despite the pain, acute compartment syndrome may occur.[10] Physical examination during or post-race may reveal a tense or tender involved compartment. Any runners with continued pain in their lower leg despite rest should be transferred to the emergency department to rule out acute on chronic exertional compartment syndrome.[27] Other less common symptoms and signs of an acute compartment syndrome like numbness, tingling, pale skin color, paralysis, and inability to feel the pulse may be present. Delay in diagnosis and treatment may cause significant consequences. Surgery (compartment fasciotomy) may be warranted if the symptoms do not resolve with conservative management.[27,36]

Exercise-associated muscle cramping (EAMC)

EAMC is one of the most common conditions faced by an ultramarathon runner. It is reported to be the most common (57%) cause of premature race termination in a 250-km off-road ultramarathon.[19] In a survey study, 5% of 161-km ultramarathon runners reported muscle cramping as their main reason to drop out of the race.[14] It is characterized by painful involuntary spasms during, or immediately after exercise, which occurs mainly in the gastroc-soleus complex, hamstrings or quadriceps muscles. Despite the common belief among the athletes and coaches, there is limited evidence to support heat, dehydration, and electrolyte imbalance as the predisposing factors of EAMC.[11,30,31]Neuromuscular fatigue and increased excitatory activity of neuromuscular units have been proposed as the possible mechanisms.[11] In ultramarathon runners, increased relative exercise intensity, previous history of EAMC and pre-existing muscular damage are among risk factors for EAMC.[30,31] Acute EAMC can be managed by rest, various massage techniques, and passive stretching of the affected muscles. In cases of identified risk factors for other specific diagnoses, a targeted work-up is warranted. “Salty sweaters” (white, salt steaks on clothing or skin) often claim that salt or sodium supplements during a race may alleviate cramping. The potential mechanism could be due to an oropharyngeal reflex stimulated by oral sodium that causes muscle relaxation.[25]

Meniscal injuries

Five percent of running injuries presenting to a large sports medicine center were identified as meniscal tears.[35] With an increase in the average age of ultramarathon runners, the rate of meniscal injuries may be on the rise.[9] In one MRI study on 22 asymptomatic non-professional athletes, running a marathon race did not cause major changes to the menisci.[29] Whether running an ultramarathon increases the risk of an acute meniscal injury in runners over the age of 40 is controversial. The decision on dropping out or continuing an ultramarathon race in a runner with a suspected acute meniscal tear depends on the runner’s symptoms and desire to complete the race, but mechanical symptoms such as locking or catching may predispose runners to further injury and warrant withdrawal from the race.

Plantar fasciitis

Plantar fasciitis accounts for about 8% of all running injuries and is more common in male runners.[18,35] Self-reported 1-year prevalence of plantar fasciitis was 10% among

ultramarathon runners in one survey study.[14] Pain and tenderness over the medial plantar calcaneal tubercle is diagnostic in most cases, although differentiation from a calcaneal stress fracture can be difficult in some cases.[5] Cryotherapy, topical analgesic preparations, and acetaminophen may temporarily alleviate the pain. Plantar fascia rupture, presenting sometimes as a sudden increase in pain while running combined with a palpable defect, can end a race.

Lower extremity tendinopathies

Tendinopathy refers to a wide spectrum of disorders ranging from tendinitis (acute tendon inflammation) to tendinosis (chronic tendon degeneration) to tenosynovitis (tendon sheath inflammation) to partial and complete tendon ruptures.[38] Tendinopathies of the lower extremities are relatively common in runners. However, the exact prevalence of tendinopathies among ultramarathon runners is unknown. Achillies, patellar, peroneal, and anterior and posterior tibial tendinopathies are common among long distance runners.[32] Rupture or partial rupture presenting as a defect or significant increase in pain may prevent a runner from completing a race. Management of tendinopathies consists of biomechanical adjustment, physical therapy with focus on strengthening exercises (e.g. eccentric), and stretching. There is no good evidence that invasive modalities such as dry needling, PRP (platelet-rich plasma) injection, or prolotherapy have any therapeutic effects on tendinopathies.

Patellar tendinopathy. In one study 5% of patients presenting to a sports medicine clinic had patellar tendinopathy.[35] The exact prevalence of patellar tendinopathy among ultramarathon runners is unknown as most epidemiologic studies have knee pain as their self-reported diagnosis.[14,24,28,37] Diagnosis is usually made by history and physical examination (point tenderness).

Achilles tendinopathy. In one study the self-reported 1-year prevalence of Achilles tendinopathy among ultramarathoners was 12%.[14] It can have a drastic effect on runners' careers. The source of pain is not clear. Degenerative changes in the tendon start long before it becomes symptomatic and are possibly due to effects of repetitive microtrauma on the tendon.[5,38] Non-insertional, or midportion tendinopathy is the most common type, occurring in the avascular zone 2-6cm proximal to the insertion of the tendon into calcaneus (heel bone).[5,9,38] The patient has a gradual onset of pain which deteriorates after uphill running or sprinting (toe-running). Physical examination may reveal swelling, local tenderness, crepitus, decreased flexibility of the gastroc-soleus complex, and increased thickness of the tendon in case of chronicity.[9,32,38]

Posterior tibial tendinopathy. The posterior tibial tendon (PTT) stabilizes the medial longitudinal arch. In one retrospective study, 0.6% of patients presenting to a sports medicine clinic had a posterior tibial tendon injury.[35] PTT dysfunction can stress the ligaments of the hindfoot and midfoot, resulting in a painful acquired flatfooted deformity. In severe cases, medial ankle instability may occur due to deltoid ligament injury.[32,38] An acute increase in pain or drop in the medial arch warrants discontinuing the race.

Anterior tibial tendinopathy. The anterior tibial tendon (ATT) is the main foot dorsiflexor. ATT dysfunction or rupture is uncommon and results in foot drop and a slapping gait.[32] It is more common among long distance runner over the age of 45 years.[32] If gait or running form is affected in a way that further injury is a concern, the runner should be advised to withdraw from the race.

Peroneal tendinopathy. Peroneal tendon injuries (tendinopathy, subluxation, and ruptures) are uncommon. Only 0.7% of patients presenting to a sports medicine clinic had peroneal tendinopathy.[35] Persistent lateral ankle pain and chronic lateral ankle instability are usually linked to the peroneal tendinopathy. Running on uneven ground and muscle fatigue may lead to peroneal tendon problems in ultramarathon runners. New snapping symptoms or acute lateral pain posterior to the lateral malleolus may signal subluxation or longitudinal tendon tear, and may require a runner to withdraw from the race.

Exertional rhabdomyolysis (ER)

ER is the breakdown of skeletal muscle fibers resulting in the release of muscle proteins into the circulation. Exercise-related muscle pain, swelling, stiffness, and muscle weakness are the usual symptoms of ER. Muscle damage usually becomes evident by the elevation of creatine kinase (CK). Serum CK levels should be at least 5 to 10 times the upper normal limit to confirm the diagnosis of ER, but many athletes may experience high levels of CK without rhabdomyolysis.[20] The prevalence of symptomatic ER among ultramarathon runners is unknown, although significant exertion or exercise may increase CK levels without complications.[22] In a recent study of 39 asymptomatic runners of a 246-km continuous race, the mean CK level after completing the race was about 44,000 U/L.[33] Men tend to show higher serum CK level than women and African Americans tend to have higher serum CK level than Caucasians post-exercise.[20] This could be due to the larger average total muscle mass in men and in the African Americans compared to women and Caucasians, respectively. There is a well-established association between ER and heat injury, but the mechanism is poorly understood.[20] ER may results in myoglobinuria (cola-colored urine) which can cause acute kidney injury (AKI). ER is the most common cause of exercise-associated AKI in athletes. Use of NSAIDs during the race and underlying renal problems are risk factors for developing AKI among endurance runners.

Runners with dark urine (gross myoglobinuria) should be evaluated for renal function and serum CK level. It is ideal to have at least one fast laboratory analyzer at the finish line, though this is generally not feasible. Most analyzers can measure a basic metabolic panel and CK level if needed. Recovery generally results from oral rehydration without specific intervention, but intravenous (IV) rehydration may be appropriate in cases when oral fluids are not tolerated and there are clear signs of dehydration.[3,20] In these cases, close monitoring of urinary output, renal function, and serum CK levels is critical, and close follow-up is required. Significant cases of ER (stage II or III AKI)[26] should be transferred to the hospital for close monitoring and management.[3,20]

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