CASE REPORT

Chronic osteomyelitis of the tibia in a runner: catastrophic consequences of shin splints

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SUMMARY

Medial tibial stress syndrome and chronic osteomyelitis are conditions that are traditionally thought to affect very different patient groups. We present a case of shin splints in a recreational long-distance runner, complicated by chronic osteomyelitis of the tibia. This is a unique case in which the microtrauma resulting from shin splints was implicated as an entry point for bacterial infection into the bone. Clinical evaluation and bone biopsy culture results indicated haematogenous spread of bacteria originating from the oral cavity. The patient required surgical resection of the affected bone and a prolonged course of intravenous antibiotic treatment. We illustrate that when shin splints show signs of acute inflammation with delayed recovery, the possibility of osteomyelitis should be kept in mind.

BACKGROUND

Medial tibial stress syndrome (MTSS), commonly referred to as shin splints, describes the pain on the medial side of the shin bones experienced by many athletes as a result of microtrauma on the tibia. Relative overuse usually precedes the onset of MTSS: calf muscle fatigue following strenuous exercise or an underlying weakness, sudden increases in exercise frequency and intensity are, among others, factors contributing to the development of MTSS.¹

MTSS is a common condition; the incidence varies between 13.6% and 20% in recreational runners,² and up to 35% in military personnel.³ Largely benign and self-limiting, shin splints usually resolve following a period of rest.⁴⁻⁶ One well-recognised complication of MTSS when exercise is not reduced is the development of stress fractures in the distal third of the tibial bones.¹⁷

Osteomyelitis is a bacterial infection of bones. Before 6 weeks duration of bone infection, there is very little bone necrosis, allowing an excellent response to antibiotics alone.⁸ Most cases of acute osteomyelitis do not require surgery. After 6 weeks duration, parts of the bone begin to die and at that stage the condition is called chronic osteomyelitis.⁹ Chronic osteomyelitis always requires surgery to remove the dead bone and reconstruct the defect left after bone excision.¹⁰⁻¹¹ Ordinarily, bones are usually remarkably resistant to bacterial infection. However, trauma or reduced host immunity are risk factors for the development of chronic osteomyelitis.¹²

In a large proportion of cases of chronic osteomyelitis, pathogens reach the bone via haematogenous spread.⁹⁻¹² Once in the bone, bacteria are

able to survive through a number of mechanisms. These include adherence to bone matrix via expression of cell adhesion molecules and formation of biofilm. Some bacterial species are also able to survive within osteoblasts. Inflammatory cytokines lead to the induction of osteoclasts and osteolysis, and subsequently to sequestration within the bone. Chronicity further develops when these sequestra are sealed off by disruption of local vasculature, and with a deceleration of bacterial metabolism.⁹⁻¹³

All of these mechanisms are implicated in the resistance of chronic osteomyelitis to antibiotic therapy even in otherwise healthy bones.¹³ Treatment of chronic osteomyelitis is complex and expensive, often requiring prolonged courses of intravenous antibiotics and surgical intervention.

The two conditions, MTSS and chronic osteomyelitis, usually affect very different patient groups. MTSS as a sign of intense exercise tends to occur in young healthy athletes,¹ whereas chronic osteomyelitis is considered a disease of an immunocompromised and less healthy patient population.¹² Trauma is known to be a risk factor for the development of chronic osteomyelitis, but we present a case where the 'microtrauma' caused by MTSS resulted in a specific localised severe chronic osteomyelitis.

CASE PRESENTATION

We present the case of a 28-year-old woman who was referred to us with chronic osteomyelitis of the right tibia. She works as a nurse, and is otherwise healthy, with a body mass index of 20.86 (weight 66.1 kg; height 178 cm). The only medical history of note was a recurrent right lower wisdom tooth condition, which was treated with antibiotics 6 months earlier.

In April 2016, she awoke with pain in her right shin and hip, which she thought to be due to an increase in her exercise frequency and intensity. Running up to 60 km per week in her free time, in addition to aerobic and weight exercises, she initially attributed the pain to overtraining and subsequent simple shin splints. In the preceding months she was engaged in a weight-loss regimen.

When the pain worsened over the next few weeks, she attended the emergency department at her local hospital. The signs and symptoms were consistent with acute inflammation over the medial tibia. She was diagnosed with cellulitis and treated with a course of oral flucloxacillin. Over the next 3 months, she received three courses of oral flucloxacillin for persistent symptoms of inflammation resembling infection with little clinical improvement and persisting pain over

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Figure 1 X-ray of the patient's right tibia showing a well-defined linear lucency in the mid-tibia with a marked anterior tibial periosteal reaction.

the tibia. She remained systemically well with her inflammatory markers within normal limit over this period of time.

INVESTIGATIONS

An X-ray (figure 1) and MRI scan in June 2016 raised the suspicion of osteomyelitis in the middle third of the right tibia. A bone biopsy in July 2016 confirmed infection with *Aggregatibacter aphrophilus* and *Streptococcus milleri*. As HACEK-group organisms (*Haemophilus* and *Aggregatibacter* spp, *Cardiobacterium hominis*, *Eikenella corrodens* and *Kingella kingae*)¹⁴ were

identified in the bone biopsy, a transthoracic echocardiogram was performed, which showed no vegetations on the heart valves.

TREATMENT

In a joint case with the plastic surgery team, the focus of infection in the right tibia was debrided and filled with vancomycin-loaded hydroxyapatite and calcium sulfate bone substitute called 'Cerament' (Bone Support, UK). No bone-stabilising measures were required as it was a contained cortical defect. The wound was closed by means of a keystone flap. The patient then received a 6-week regimen of intravenous antibiotics: 2 weeks of piperacillin with tazobactam and vancomycin, followed by 4 weeks of ceftriaxone. This was self-administered via a peripherally inserted central catheter (PICC)-line, guided by the outpatient parenteral antibiotic therapy team. She attended follow-up appointments regularly with orthopaedics and infectious disease on completion of antibiotics in December 2016 and has remained symptom free thus far.

DISCUSSION

The diagnosis of osteomyelitis was made at a relatively late stage, when it had passed from the acute osteomyelitis stage to the chronic osteomyelitis stage requiring more complex and prolonged treatment. Initially, the associated skin changes were reasonably labelled as cellulitis and acute osteomyelitis was not considered as it has not been described with MTSS before. By the time an MRI scan was performed, which raised the question regarding osteomyelitis, the condition had progressed to the 'chronic' stage requiring more complex surgery and prolonged antibiotics.

We consider that a combination of several factors contributed to the development of chronic osteomyelitis in an otherwise healthy young adult. First, the increased levels of exercise lead to the development of shin splints as reportedly experienced by the patient. Through the microtrauma and associated periosteal reaction to the tibia, a connection to the systemic vasculature likely resulted, opening the bone to pathogens.¹⁵ The pathogens causing chronic osteomyelitis in this patient likely reached the tibia via haematogenous spread, given that there was no history of open trauma or wounds to the leg.

Both *A. aphrophilus* and *S. milleri* are considered to be part of the normal human microbiota and live as commensals in the oral cavity.^{14 16} *A. aphrophilus* is part of the HACEK group of organisms, they are rarely of clinical significance, accounting for a small proportion (5%–10%) of infective endocarditis on native heart valves.¹⁴ Given this patient's previous recurrent issues with the wisdom tooth and the bone biopsy culture results, we identified this as the likely origin of the infection in the tibia. Temporary bacteraemia originating from the oral cavity is an everyday occurrence, often triggered through trivial activities such as brushing teeth.¹⁷ This usually does not pose any concerns and pathogens are cleared within minutes by the host's immune system.¹⁸ However, the patient's immune system may have been compromised to a degree secondary to increased exercise levels and a weight-loss regimen; a phenomenon which has been observed in recreational athletes.¹⁹

To the best of our knowledge, there are no other case reports of chronic osteomyelitis complicating shin splints, and most patients with shin splints recover spontaneously with rest. It is, however, recognised that shin splints can take a chronic course, and often this is then considered as part of a spectrum with stress fractures.¹⁷ Taking into account the case of the patient presented in this report, this view of the natural history of shin

splints may be an oversimplification. Given the lack of similar cases reported, the incidence of chronic osteomyelitis complicating shin splints cannot be estimated.

We hope that this case report illustrates that when shin splints show signs of acute inflammation, the possibility of osteomyelitis should be considered. If identified before any bone necrosis has occurred (acute osteomyelitis), surgery is normally avoided, however, if identified late and chronic osteomyelitis has developed then treatment is more complex.

Learning points

- Shin splints with acute inflammatory changes may be complicated by bone osteomyelitis requiring urgent treatment and assessment.
- Recent dental infection or treatment in combination with shin splints may result in bone osteomyelitis due to haematogenous spread.
- Treating bone osteomyelitis early prevents it from progressing to chronic osteomyelitis that requires complex surgery, therefore early recognition is paramount.
- Non-resolving cellulitis should raise the suspicion of a deep-seated infection or an alternate diagnosis and prompt further investigation.

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