Avascular Necrosis of the Foot and Ankle in a Patient with Systemic Sclerosis: A Case Based Review

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This review describes a case of atraumatic avascular necrosis in the foot and ankle in a patient with systemic sclerosis who did not receive corticosteroid therapy. Both avascular necrosis and systemic sclerosis are uncommon disease entities. This case demonstrates that vasculitis and secondary vasconstriction in the pathogenesis of systemic sclerosis are important risk factors for the development of avascular necrosis of the foot and ankle. Therefore, if these patients develop chronic foot and ankle pain, avascular necrosis should be included in the differential diagnosis, even if they do not receive corticosteroids. For the diagnosis and follow-up of avascular necrosis MRI remains the gold standard. Thus, MRI should be used to diagnose avascular necrosis in an early stage.

Level of Clinical Evidence: 4.

Key words: Osteonecrosis; Scleroderma, Systemic; Tomography; Magnetic Resonance Imaging.

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For reference: Wastyn H, Leys M, Michels F, et al. Avascular Necrosis of the Foot and Ankle in a Patient with Systemic Sclerosis: A Case Based Review. Sovremennaya Revmatologiya=Modern Rheumatology Journal. 2021;15(1):94–97. DOI: 10.14412/1996-7012-2021-1-94-97

Introduction

Systemic sclerosis (SSc) is an autoimmune rheumatic disease characterized by fibrosis of the skin and internal organs due to excessive collagen production and vasculitis of small arteries. The prevalence of SSc is estimated between 3 and 24 cases per 100,000 people [1]. Female gender and African origin are risk factors for SSc [1].

Avascular necrosis (AVN) or osteonecrosis is bone death due to the disturbance of the vascular supply to the bone [2]. The incidence of AVN is approximately 3/100,000 [3], of which 3% involves the foot or ankle, whereas the hip is involved in 75.9% of cases [4]. AVN is often caused by a traumatic event but can also have an atraumatic cause such as the use of corticosteroids, alcoholism, hyperlipidemia, hemoglobinopathies/thrombophilia or diabetes mellitus.

As the treatment of systemic causes often includes corticosteroids, determining the exact cause can prove to be challenging. We present a case in which SSc can be identified as the causal factor in AVN since the patient did not receive any treatment with corticosteroids or had other concurrent pathology that may induce AVN.

Case Report

A 67-year-old woman complained of invalidating pain in the left foot that started spontaneously one year ago. She had a history of peripheral polyneuropathy, abdominal pain, acrosclerosis and pulmonary hypertension in the context of systemic sclerosis. She was treated with pulmonary vasodilators (macitentan, tadalafil), asaflo, bumetanide (Burinex), spironolactone, rosuvastatin and analgesics. She had not previously received any glucocorticoids.

On examination there was a pronounced swelling of both the ankle and the foot. The alignment was neutral, but weight bearing was not possible. There were inflammatory signs of dolor and calor, but no erythema. The functional assessment was limited due to pain. Palpation showed pronounced non-specific tenderness. The neurovascular examination showed limited hyporeflexia and mild deep sensory disturbance without clearly abnormal electromyogram.

Previous radiographs showed no other structural abnormalities but mild osteopenia and limited subchondral sclerosis (Fig. 1A). A Tc-99m HDP bone scintigraphy one month after the onset of the symptoms (one year before consultation) showed a hot spot in the talus, which was interpreted as a stress fracture (Fig. 2A). Supportive treatment with a walker boot provided initial symptom relief. However, due to ongoing discomfort 6 months later, a new bone scintigraphy was performed, which showed an active arthropathy mainly in the calcaneocuboid and subtalar joints (Fig. 2B). Finally, an additional MRI was performed seven months after the radiographs, which showed extensive AVN of different bones in the hind-, mid- and forefoot and of the tibia (Fig. 1B; Fig. 1C).

Maximum conservative treatment was opted for with limited weightbearing, a walking boot and pain medication. One year after the onset of the symptoms, the mobility and function of the joints is intact, and she has weaned off the walking boot.
Discussion

This case highlights the importance of considering AVN in the differential diagnosis in patients with chronic foot and ankle pain. AVN is caused by a disruption of the blood flow to the bone. This can be caused by a variety of processes including traumatic or compressive arterial inflow disruption, venous outflow obstruction or intraluminal vascular occlusion [2]. Trauma is a frequent cause of AVN in the femoral head, humeral head, scaphoid and talus. Besides trauma, AVN can also have an atraumatic cause such as the use of corticosteroids, alcoholism, hyperlipidemia, hemoglobinopathy/thrombophilia, diabetes mellitus or irradiation. If there is a systemic cause, such as systemic lupus erythematosus (SLE), multifocal infarctions of the foot and ankle can occur [2, 5, 6]. There are several case reports that describe an association between SSc and AVN, which is most commonly observed in the hip [7–9] and lunate bone [10–12]. However, only two cases of SSc with AVN of the foot are briefly mentioned in literature [13, 14]. In both cases, the talus was affected. In one of these cases multiple joints were affected, namely both hips and both taluses, and the patient never received any corticosteroids either [13]. In the second case, no specific information was given about concurrent AVN in other bones of the foot or other joints, on the use of corticosteroids or on the use of MRI for the diagnosis of AVN [14].

In systemic sclerosis (SSc), the characteristic changes in blood vessels are well known and are caused by three separate processes [15]. First, autoantibodies are produced, and cell-mediated autoimmunity is activated by abnormalities in the innate and adaptive immune system. Second, defective endothelial cells and fibroproliferative vasculopathy of small blood vessels develop. The damage to the endothelial cells leads to vasoconstriction (influenced by endothelin) and to obliteration of the micro- and macrovasculature. Finally, because of fibrogenic characteristics of endothelin and the abnormal fibroblast growth, qualitatively normal collagen is excessively produced. These three mechanisms affect all blood vessels in the body. For instance, vasculitis induced vasoconstriction can cause pulmonary hypertension and abdominal angina. Both the macro- and microvascular effects of vasculitis could be the cause of sporadic occurrence of AVN in SSc, similarly to the pathogenesis of acral osteolysis in SSc. Treatment with corticosteroids is also a known risk factor for developing AVN, but vasculitis itself and vasoconstriction are separate risk factors for AVN development and play an important role in its pathogenesis. Therefore, the

Fig. 1. Radiographic and MRI Images of the Left Foot and Ankle. (A) Lateral and Anteroposterior Radiographic Images of the Left Foot and Ankle: the arrows indicate areas of limited osteopenia and subchondral sclerosis, which corresponds to stage II of avascular necrosis. (B) Sagittal T2-Weighted MRI Images and (C) Sagittal T1-Weighted MRI Images of the Left Foot and Ankle with arrows indicating extensive avascular necrosis of the hind-, mid- and base of the forefoot and the tibia, corresponding to stage II/III of AVN.

Fig. 2. Three-phase HDP-99m bone scintigraphy. (A) One month after the onset of atraumatic pain in the left ankle, possibly corresponding to stage II/III of avascular necrosis. (1) Whole body scintigraphy showing increased bone turnover of the left ankle (black arrows). (2) Coronal and (3) sagittal SPECT/CT reconstructions of the feet in the same patient showing a hot spot (red arrows) in the base of the talus, and a relatively colder zone (blue arrows) in the cranial pole of the talus. (B) 18 months after the onset of atraumatic pain in the left ankle, possibly corresponding to a late phase of avascular necrosis. (1) Whole body scintigraphy no longer showing increased bone turnover of the left ankle (black arrows). (2) Transverse and (3) sagittal SPECT/CT reconstructions of the feet in the same patient showing active calcaneocuboid (2) and subtalar (3) arthropathy (white arrows), characterized by degenerative changes of the joints involved in the disease process.
Key points:
- Atraumatic avascular necrosis of the foot is a possible complication of systemic sclerosis.
- Avascular necrosis should be suspected in patients with systemic sclerosis who develop chronic joint pain.
- Literature suggests that vasculitis and vasoconstriction in systemic sclerosis play an important role in the pathogenesis of avascular necrosis.
- MRI is the gold standard for the radiographic diagnosis of AVN of the foot.
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Received/Reviewed/Accepted
14.12.2020/21.01.2021/23.01.2021

Declarations
Funding: No funding was received for this work from National Institutes of Health (NIH), Wellcome Trust, Howard Hughes Medical Institute (HHMI); or other institutions.
Conflict of interest: The authors declare no conflicts of interest.
Availability of data and material: Not applicable.
Code availability: Not applicable.
Acknowledgments: None.

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