Diabetic foot syndrome

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History

A 56-year-old male patient, suffering from an ulceration on the lateral side of his right foot for the past two weeks, came to the hospital. Physical examination revealed a wound, measuring 2 x 3 cm in size, with pus oozing and foul odor. His left leg had been amputated due to a severe injury 20 years ago, and he had been suffering from a poorly controlled diabetes over the past 10 years. He reported intermittent pain in his right lower limb, which had not been treated. A runoff CT angiography (CTA) of the right lower extremity was performed for vascular evaluation.

Diagnosis

CTA images showed moderate to severe stenoses, caused by calcified and non-calcified plaques, in multiple arterial segments including the distal superficial femoral artery, popliteal artery, proximal anterior tibial artery and the fibular artery. Ulceration on the lateral side of the fifth metatarsophalangeal joint with signs of free air in the soft tissue, as well as a hyperdensity in the distal epiphysis of the fifth metatarsal, were seen. These suggested serious infectious changes. The metatarsophalangeal joint was intact and no signs of bone erosion were visualized. A diagnosis of diabetic foot syndrome (DFS), grade 3 of Wagner-Meggitt Classification, was suggested. Subsequently, the patient underwent angiography, which confirmed the CT findings. An angioplasty was performed with drug eluting balloons during which all stenosed segments were successfully dilated. Surgical wound debridement was also performed. The patient was discharged from the hospital with good outcome after one week. Follow-ups plans were made in 1-3-6 months.

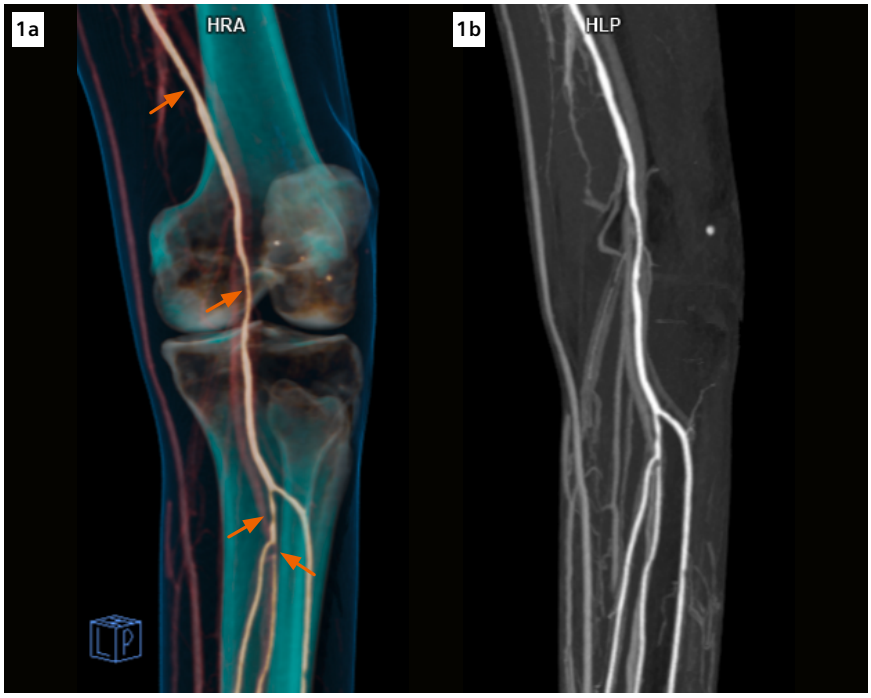
Comments

DFS is an ulceration of the foot associated with neuropathy and different grades of ischemia and infection in a patient with diabetes mellitus (DM). It is one of the most common and serious complications of DM, which occurs in up to a quarter of the patients over their lifetime. More than half of the cases are clinically infected at presentation. DFS is often associated with hospitalization, foot deformities and amputation, leading to substantial healthcare costs, loss of productivity and increased mortality. [1] Debridement has been regarded as an effective intervention to help accelerate ulcer healing and may help reduce the risk of complications. [2] However, without sufficient blood circulation, wound healing cannot be expected. As stipulated by all national/international guidelines, revascularization must be considered in case of arterial stenosis. [3] Runoff CTA is performed over a long scan range, imaging vascular detail of the lower extremities. The blood flow and, hence, the contrast bolus arrival, may slow down in cases of arterial stenoses. This needs to be taken into consideration when planning a scan together with a robust contrast injection protocol.

Examination Protocol

Scanner	**SOMATOM Force**
Scan area	Lower extremity
Scan mode	Runoff CTA, spiral mode
Scan length	1234.8 mm
Scan direction	Cranio-caudal
Scan time	17.8 s
Tube voltage	70 kV
Effective mAs	143 mAs
Dose modulation	CARE Dose4D
$CTDI_{vol}$	1.7 mGy
DLP	215.7 mGy*cm
Rotation time	0.5 s
Pitch	0.6
Slice collimation	192 x 0.6 mm
Slice width	1.0 mm
Reconstruction increment	0.7 mm
Reconstruction kernel	Br40, ADMIRE 3

Contrast	**400 mg/mL**
Volume	60 mL + 30 mL + 40 mL saline
Flow rate	5 mL/s + 2.5 mL/s + 4 mL/s
Start delay	Monitoring popliteal artery with manual start + 7 s



1 **A cVRT image (Fig. 1a) and a MIP image (Fig. 1b) show moderate to severe stenoses in the distal superficial femoral, popliteal, proximal anterior tibial and fibular arteries (arrows).**

2 **A cVRT image shows an ulceration on the lateral side of the right foot with detailed vascular structures.**

In this case, the rotation time and the pitch value were adjusted to extend the acquisition time to 18 seconds; a biphasic contrast injection protocol was applied with a decreased injection rate in the second phase in order to prolong the plateau of the time-density curve of the contrast bolus. The scanning was manually triggered at bolus arrival in the popliteal artery. A low kV setting of 70 kV was utilized to increase the iodine enhancement and to decrease the radiation dose (1.7 mGy) at the same time. Advanced Modeled Iterative Reconstruction (ADMIRE) was applied to reduce image noise. All these factors contribute to a significantly enhanced contrast-to-noise ratio which enables optimal contrast enhancement in the peripheral arteries. CT is also effective in visualizing abnormal bone, adding diagnostic value to the classification of DFS. The communication between physicians can be greatly facilitated by cinematic volume rendering technique (cVRT), demonstrating lifelike vascular details in three dimensions and prior to interventional revascularization. ●

Reference

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[2] Dayya D, O'Neill O, Habib N, et al. Debridement of diabetic foot ulcers: public health and clinical implications – a systematic review, meta-analysis, and meta-regression. BMJ Surg Interv Health Technologies 2022; 4:e000081. doi:10.1136/bmjsit-2021-000081.

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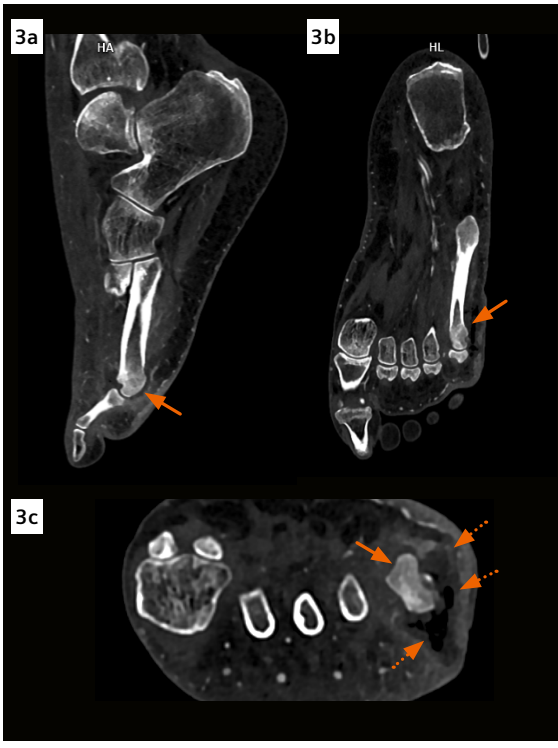

3 **MPR images show a hyperdensity in the distal epiphysis of the fifth metatarsal (arrows) suggesting infectious change. The metatarsophalangeal joint is intact. There are signs of free air in the soft tissue adjacent to the joint (dotted arrows).**