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Noninvasive Detection of Active Microcalcification in an Occlusive Peripheral Vascular Aneurysm Using ^{18}F -NaF PET/CT Imaging

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Abstract: A 65-year-old man with an occluded popliteal artery aneurysm and calf claudication underwent PET/CT imaging with ^{18}F -NaF to assess the status of active microcalcification in the aneurysm site and additional lower extremity arteries. CT imaging revealed macrocalcification of the aneurysm that colocalized with elevated retention of ^{18}F -NaF on PET images. PET/CT detected additional distal arterial sites with focal uptake of ^{18}F -NaF that did not coincide with CT-detectable macrocalcification. This report highlights a case of active microcalcification in an occlusive peripheral aneurysm using PET/CT. PET/CT may provide molecular insight into the remodeling of lower extremity aneurysms and atherosclerotic lesions.

Key Words: PET, CT, molecular imaging, peripheral arterial disease, aneurysm

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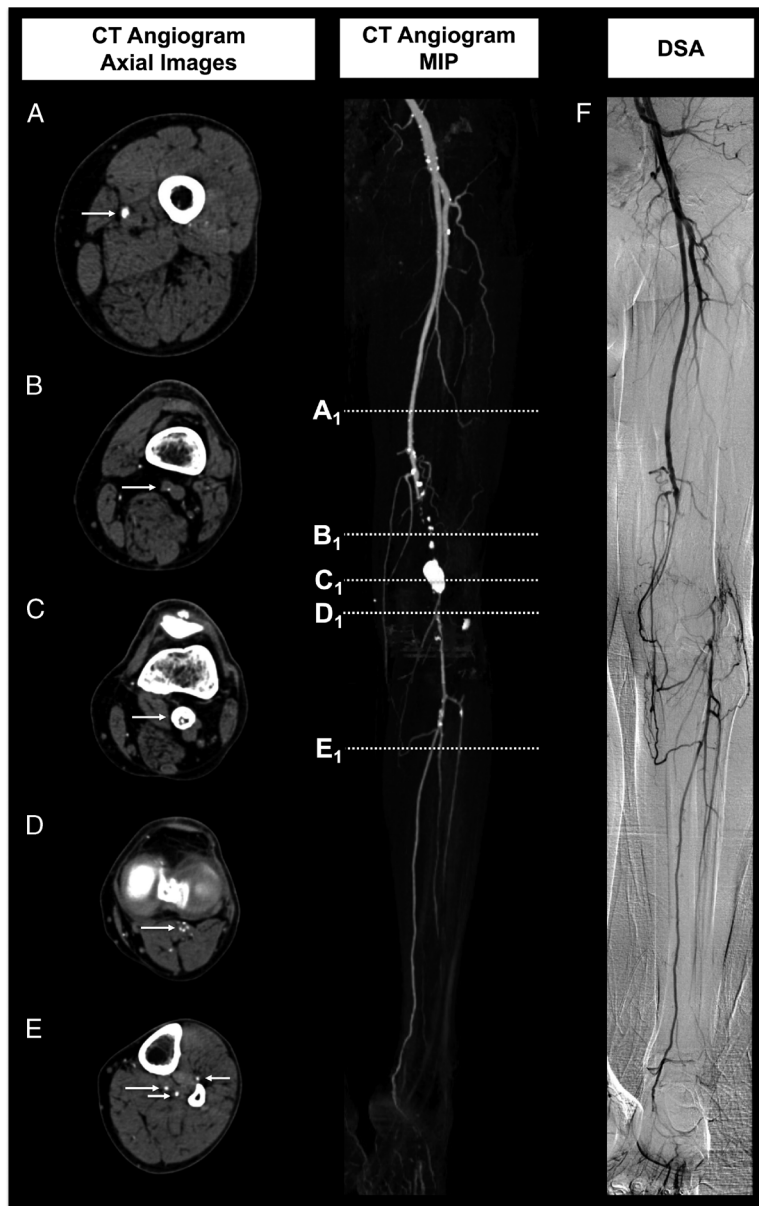


FIGURE 1. CT and digital subtraction angiography (DSA) in a 65-year-old man with peripheral arterial disease (PAD), calf claudication, and an occluded popliteal aneurysm. Four years ago, the patient developed moderate claudication, which resulted in evaluation by CT angiography (A–E) that revealed occlusion of the popliteal artery proximal to the knee (B) and at the site of an extensively calcified aneurysm at the level of the knee (C). CT angiography also demonstrated that the popliteal artery was reopacified distally by collateral vessels (D). The trifurcation distal to the popliteal remained unremarkable with 3-vessel runoff (E). One month after CT angiography, there was worsening of claudication symptoms that led to an abdominal aortogram with runoff using DSA (F). DSA demonstrated popliteal artery occlusion above and at the level of the knee, with reconstitution slightly below the knee and 3-vessel runoff. No intervention was performed, and medical management with aspirin and acetaminophen as well as recommendations for smoking cessation and walking therapy were pursued. Cilostazol was prescribed, which resulted in marked improvement of symptoms, thereby enabling conservative management over subsequent years.

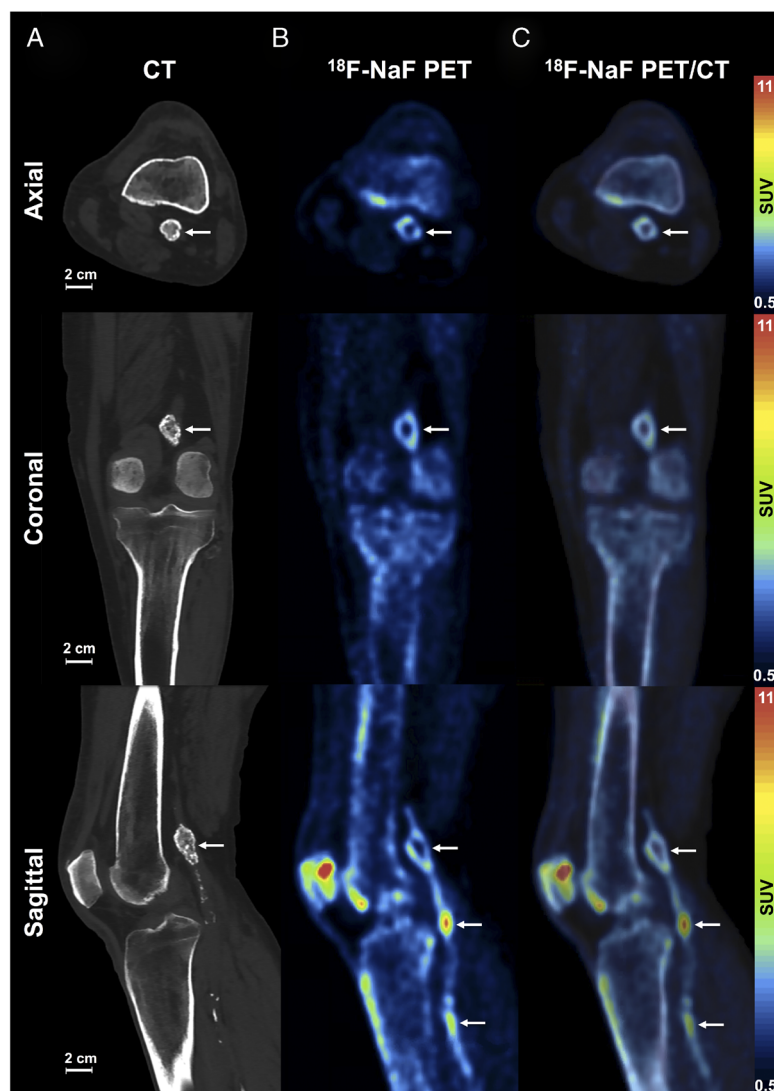


FIGURE 2. ^{18}F -NaF PET/CT imaging of peripheral atherosclerosis. Four years after angiography imaging, the man continued to have mild claudication symptoms and had an ankle-brachial index of 0.62 and a toe-brachial index of 0.47. At this time, he was prospectively enrolled into an ongoing study evaluating the prognostic value of radiotracer-based imaging in PAD patients (<https://clinicaltrials.gov>, NCT03622359). As an additional component of this study, PET/CT imaging was performed 75 minutes after IV injection of ^{18}F -NaF (370 MBq) to assess the status of active microcalcification in lower extremity arteries. CT imaging detected the extensive macrocalcification of the popliteal aneurysm (A, arrows) that colocalized with the elevated retention of ^{18}F -NaF around the calcified aneurysm on PET (B, arrows) and PET/CT images (C, arrows), suggesting ongoing remodeling of the aneurysm. PET/CT also demonstrated increased focal uptake of ^{18}F -NaF in 2 distal vascular sites (B and C, arrows) that did not coincide with prominent macrocalcification on CT images, thereby indicating potential early stages of microcalcification in additional atherosclerotic plaques. ^{18}F -NaF PET/CT imaging has emerged as a tool that offers dual assessment of macrocalcifications (via CT) and the process of active microcalcification associated with atherosclerosis (via ^{18}F -NaF PET),¹ with ^{18}F -NaF uptake being shown to localize to arterial segments that are undergoing active microcalcification.^{2,3} Although ^{18}F -NaF PET/CT imaging investigations have traditionally evaluated coronary artery plaque remodeling,¹ recent work has also begun to assess the utility of PET/CT for evaluating abdominal aortic aneurysms,⁴⁻⁷ carotid arteries,^{8,9} and femoral arteries.^{10,11} This report documents a case of active microcalcification in a lower extremity aneurysm and in below-the-knee arteries using ^{18}F -NaF PET/CT. Further application of PET/CT imaging in PAD patients could provide novel insight into the calcification of peripheral arteries and aneurysms, thereby potentially providing guidance for therapeutic strategies and lifestyle modifying behaviors focused on preventing and/or inhibiting the development of life-limiting and limb-threatening peripheral atherosclerosis.