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Case Report Open Access

Diagnosis of Device-Related Infective Endocarditis with ^{99m}Technetium-Mononuclear Leukocytes SPECT/CT

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Abstract

Cardiovascular disease management has been substantially improved by the development of medical devices such as pacemakers and prosthetic valves. The diagnosis of infective endocarditis (IE) can be extremely challenging, especially in those patients with prosthetic valves and intracardiac devices. Early diagnosis is essential for adequate patient management and better prognosis, however clinical manifestations are often nonspecific and traditional diagnostic tools like the new modified Duke Criteria and transesophageal echocardiogram (TEE) have its limitations. Unfortunately, the diagnostic value of echocardiography is operator-dependent and its sensitivity can decrease in presence of intracardiac devices. Nuclear medicine imaging can contribute significantly on the evaluation process of prosthetic valve endocarditis (PVE), and it can be used in patients with suspected or confirmed infectious/inflammatory conditions. In this report, we illustrate the role of nuclear imaging for the diagnosis of device-related infective endocarditis.

Keywords: Cardiovascular disease; Artroplasty; Pacemaker

Case Presentation

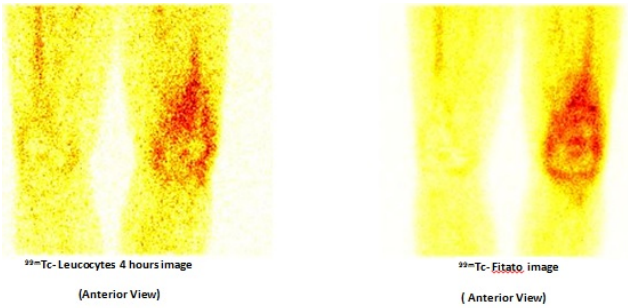

Figure 1: ^{99m}Tc-mononuclear leukocyte scintigraphy shows less intense tracer uptake on the left knee than sulfur colloid labeled with 99mTc in the same area, confirming negative result for osteomyelitis.

A 76 year-old man previously submitted to left knee artroplasty was admitted at the emergency department with fever and left knee pain. The initial blood work showed leukocytosis and elevated C-reactive protein (CRP). Blood cultures were drawn and a left knee aspiration was done. He was started on empirical broad-spectrum antibiotics (Ceftriaxone, Vancomycin and Rifampicyn) for septic arthritis and submitted surgical debridement. Meanwhile, the blood cultures revealed.

In the search of an infective source, ^{99m}Tc-mononuclear leukocyte scintigraphy with Computed Tomography did not show tracer uptake on the left knee (Figure 1), and sulfur colloid labeled with ^{99m}Tc had normal uptake in the bone marrow, leading to a mismatched image (Figure 2). Interestingly, we noted ^{99m}Tc-mononuclear leukocytes uptake on the permanent pacemaker cable (Figure 3). Later on, a TEE showedvegetation on the same topography, thereby confirming the diagnosis of bacterial endocarditis likely secondary to hematogenous dissemination of septic arthritis (Figure 4).

The pacemaker cable was removed and the patient was treated with long-term antibiotics. A follow-up TEE showed the migration of vegetation to the mitral valve (Figure 5), and a second nuclear study with ^{99m}Tc –mononuclear leukocytes scintigraphy did not show uptake in this location. Hence, we can demonstrate the role of ^{99m}Tc-mononuclear leukocytes scintigraphy to detect disease activity. Hybrid imaging with ^{99m}Tc-mononuclear leukocyte scintigraphy combined to computed tomography (CT) was essential to identify the site of infection and also to detect disease activity.

Discussion

Cardiovascular infections can appear in different sites e.g. myocardium, pericardium, valves, intracardiac devices; as well as the peripheral vascular system, such as native vessels and vascular grafts. These processes are usually associated with high morbidity and mortality. The yearly rate of infective endocarditis (IE) in patients with prosthetic valves is approximately 3 cases per 1,000 patients in the United States. Despite major advances in both diagnostic and therapeutic procedures for this condition, IE still remains associated with a poor prognosis, and its incidence and mortality rates have not decreased in the last 30 years [1].

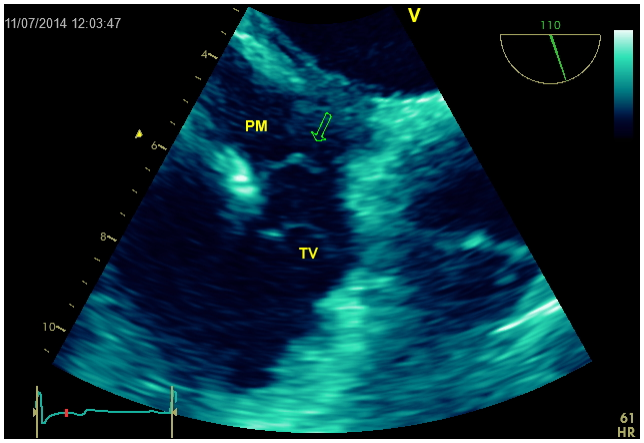

Figure 2: SPECT/CT ^{99m}Tc-mononuclear leukocytes uptake on the permanent pacemaker cable. PM=Pacemake; TV=tricuspide valve.

Staphylococcus aureus is the most common cause of device-realted IE, followed by coagulase-negative staphylococci, *Streptococcus viridans* group and *Enterococcus* spp. Yeasts can also cause IE, however they are related to a later onset (LO) PVE. Culture-negative endocarditis represents approximately 13% of PVE, with reported rates of up to 31% [2].

Echocardiography is the primary imaging modality for diagnosis of [IE] endocarditis. Transthoracic echocardiography (TTE) is less sensitive than the transesophageal approach, with a sensitivity of 70% and 90%, respectively [3]. However PVE diagnosis may still be problematic because its sensitivity decreases in the presence of intracardiac devices such as valvular prosthesis and pacemaker cable; and very small vegetation [4].

With the introduction of hybrid equipment for both conventional nuclear medicine [e.g. single-photon emission CT (SPECT)/CT] and PET (i.e. PET/CT), nuclear molecular techniques are evolving as an important supplementary method for patients with suspected IE and diagnostic difficulties. SPECT/CT imaging relies on the use of autologous radiolabelled leucocytes (111In-oxine or ^{99m}Tc-hexamethylpropyleneamine oxime) that accumulate in a time-dependent fashion in late images versus earlier images [5].

Radiolabelled WBC SPECT/CT is more specific for the detection of IE and infectious foci than 18F-FDG PET/CT and should be preferred in all situations that require enhanced specificity [6].

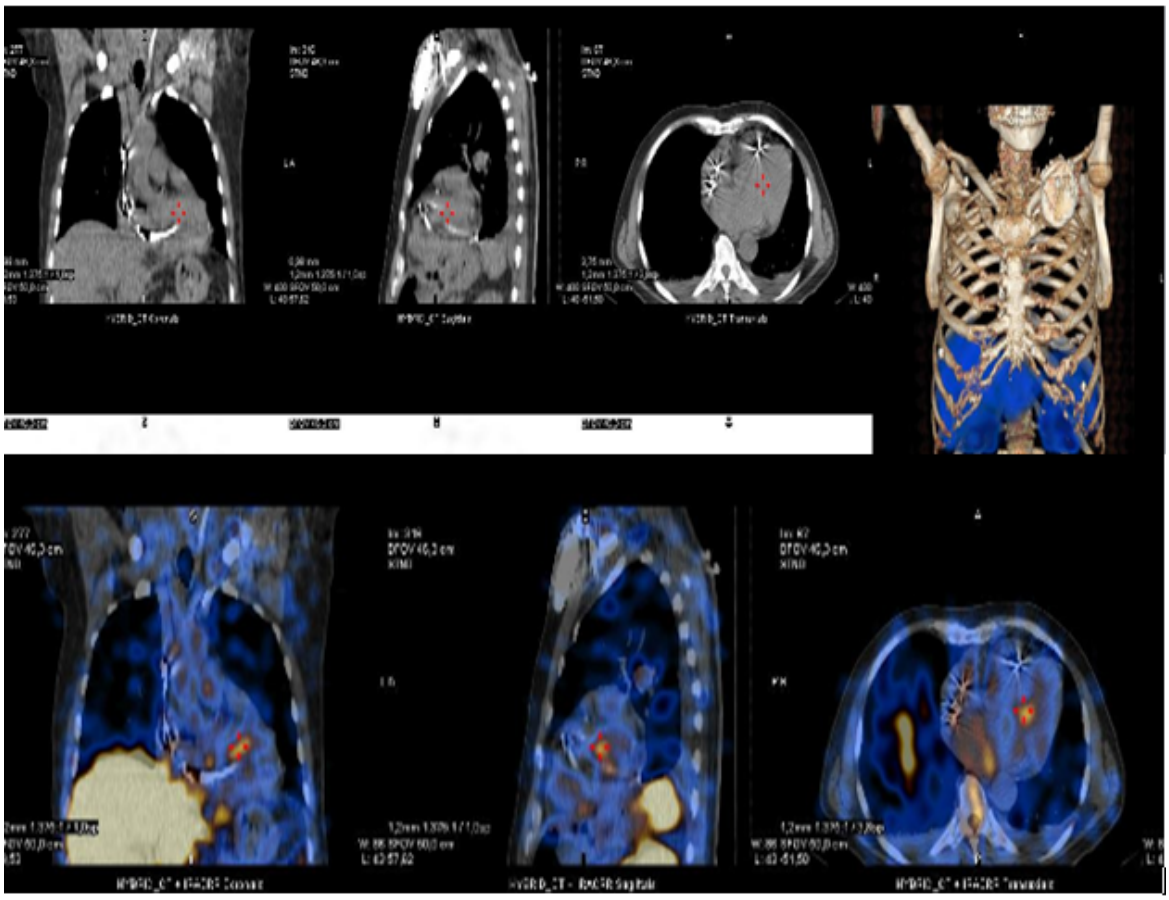

Figure 3: TEE shows vegetation on the permanent pacemaker cable, confirming the diagnosis of bacterial endocarditis.

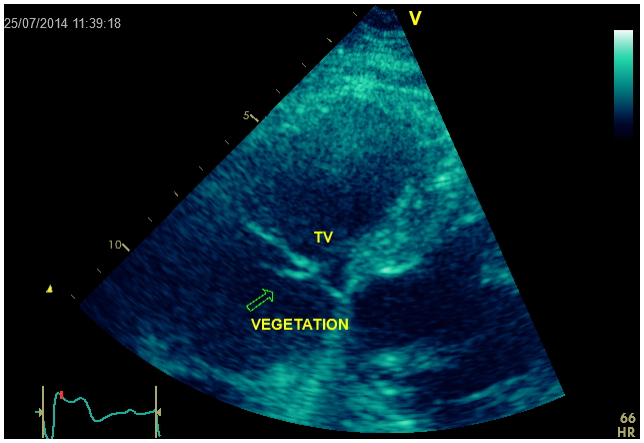

Figure 4: Follow-up TEE shows the migration of vegetation to the mitral valve. TV= tricuspide valve.

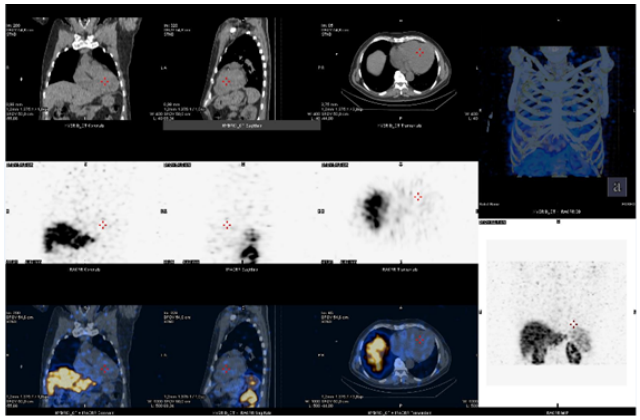

Figure 5: ^{99m}Tc –mononuclear leukocytes scintigraphy doesn´t show uptake in this location, indicating absence of infection.

Saby et al. [7] studied the role of 18F-FDG Positron Emission Tomography/Computed Tomography (PET/CT) in addition to new modified Duke Criteria for the diagnosis of PVE. In fact, the sensitivity of the new modified Duke criteria rises up to 97%, which would increase the rate of the so-called definitive endocarditis, mainly in those cases where the Duke criteria considered as possible endocarditis. This happens in cases of culture-negative endocarditis or in those cases in which both modalities of echocardiography, transthoracic and TEE are non-diagnostic or inconclusive.

We hereby report the use of multimodality imaging for the diagnosis of device-related infective endocarditis. ^{99m}Tc-mononuclear leukocytes scintigraphy in combination with CT and TEE was able to detect vegetation on the first scan. However the second scintigraphy 10 days after the first study did not show active infection despite the remaining vegetation on the mitral valve. Erba et al. reported that nuclear studies together with TEE had a sensitivity and specificity of 100% and 82%, respectively, for the detection of IE. SPECT combined to CT was more accurate than planar studies. Delayed imaging acquisition is preferred because it allows better clearance of the tracer from the blood pool [8].

Conclusion

Hybrid imaging with ^{99m}Tc-mononuclear leukocytes scintigraphy combined to computed tomography can be a valuable tool for the diagnosis, location and follow-up of cardiovascular inflammatory processes.

Further studies are necessary to define the situations in which leukocyte labeled ^{99m}Tc scintigraphy would provide the greatest diagnostic impact on device-related endocarditis.

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