FDG PET/CT Imaging for LVAD Associated Infections

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HEART FAILURE IS A MAJOR CAUSE OF MORBIDITY AND MORTALITY, particularly among patients with advanced disease and no access to cardiac transplantation. Owing to the constant shortage of donor hearts, the role of left ventricular assist device (LVAD) has been expanding in the management of these patients both as a bridge to transplantation and as a destination therapy (i.e., alternative to transplantation) (1). Although lifesaving, LVAD is often complicated with infections. In the REMATCH (Randomized Evaluation of Mechanical Assistance for the treatment of Congestive Heart Failure Trial), where LVAD was first evaluated as destination therapy, 42% and 52% of patients developed sepsis at 1 year and 2 years after implantation, respectively (2).

The percutaneous driveline, that exits the abdomen, can get disrupted by normal everyday activities such as showering, which introduces bacteria. Once bacteria infect the driveline and then the bloodstream, eradication of infection is difficult. Bacteria can infect all areas of the LVAD including driveline, pump, cannula, and tissues surrounding the pump. Treatment modalities include long-term antibiotics, LVAD replacement, debridement, and urgent transplant. LVAD infection portends poor prognosis, and treatment options are limited.

We present a negative (Fig. 1) and a series of LVAD infection cases (Figs. 2 to 5) demonstrating classic imaging manifestations on 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT). FDG PET/CT imaging of the LVAD is a potential tool to make an early and accurate diagnosis of LVAD infection. FDG PET/CT imaging may allow earlier detection of LVAD infection and its extent, as well as evaluation of response to therapy.
FIGURE 1 Negative FDG PET/CT Examination

An example of a 61-year-old male patient with ischemic cardiomyopathy status post-HeartMate II left ventricular assist device (LVAD) implantation with no evidence of LVAD infection. On the baseline study at 1 year and 2 months after implantation, computed tomography (CT) attenuation-corrected (AC) positron emission tomography (PET) (first row), localizing low-dose CT (second row), fused AC PET/CT (third row), and non-AC PET (fourth row) of axial (left column), coronal (middle column), and sagittal (right column) images show no evidence of abnormally increased fluoro-deoxyglucose (FDG) activity around the LVAD in the thorax and upper abdomen along the pump pocket (solid arrow) or outflow cannula exterior (open arrow) (A). There is no abnormal metabolic uptake along the driveline (open arrowhead) from the left upper abdomen downward into the right lower abdominal exit (solid arrowhead) in the coronal images (B). The patient has been event-free during the 1-year follow-up period.

FIGURE 2 Percutaneous Exit LVAD Infection

An example of a 51-year-old male patient with ischemic cardiomyopathy status post-HeartMate II LVAD implantation, which was complicated by pump thrombosis requiring pump replacement. At 1 year after implantation, the patient reported pain at the driveline exit site, purulent discharge, swelling, erythema, and fevers. The driveline and blood culture revealed methicillin-resistant staphylococcus aureus and propionibacterium, respectively. PET/CT images show a focal area of increased metabolic activity confined to the percutaneous exit of the drive line (solid arrowhead) in the right lower abdominal wall, compatible with percutaneous exit LVAD infection. The patient underwent immediate debridement of the driveline and subsequent urgent heart transplantation due to failed response to antibiotic treatment. Abbreviations as in Figure 1.
An example of a 45-year-old male patient with familial nonischemic dilated cardiomyopathy status post-HeartWare LVAD implantation. At 6 months after implantation, the patient reported pain, purulent discharge, and nonhealing at the driveline exit site. The driveline culture revealed coagulase-negative staphylococcus aureus and yeast. PET/CT images show intense linear FDG uptake along the driveline (open arrowhead) and percutaneous exit (solid arrowhead) that is compatible with driveline LVAD infection. The patient underwent revision of the driveline and subsequent urgent heart transplantation due to failed response to antibiotic treatment. Abbreviations as in Figure 1.

An example of a 68-year-old male patient with ischemic cardiomyopathy status post-HeartMate II LVAD implantation. At 1.5 years after implantation, the patient developed leukocytosis and hypotension requiring intravenous pressors. Both wound and catheter tip cultures revealed pseudomonas with klebsiella and pseudomonas from the sputum. PET/CT images show intense linear metabolic activity along the outflow cannula exterior (open arrow) attached to the ascending aorta, more prominent in the distal portion than the proximal metallic portion near the pump, which is consistent with cannula exterior LVAD infection. The patient died of septic shock and multiorgan failure despite device explantation and comprehensive antibacterial and antifungal antibiotic coverage. Abbreviations as in Figure 1.
An example of a 58-year-old male patient with nonischemic cardiomyopathy status post-HeartMate II LVAD implantation. At 3.5 years after implantation, the patient developed hypotension following chronic purulent discharge from the driveline exit site under coverage of antibiotic therapy. Both driveline and blood culture revealed pseudomonas in addition to proteus from the driveline. PET/CT images show increased FDG uptake corresponding to the LVAD pump pocket (solid arrow) and cannula exterior (open arrow) connecting to ascending aorta, which is confirmed on non-AC PET (fourth row) as a focal uptake at the pump pocket (curved arrow), compatible with pump pocket LVAD infection. In addition, there is abnormal FDG uptake within the subcutaneous soft tissues along the course of the LVAD driveline (open arrowhead) in the mid-abdomen. The patient died of septic shock despite debridement of the driveline along with aggressive antibiotic treatment. Abbreviations as in Figure 1.