Gallium-SPECT in the Detection of Prosthetic Valve Endocarditis and Aortic Ring Abscess

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A 52-yr-old man who had a bioprosthetic aortic valve developed *Staphylococcus aureus* bacteremia. Despite antibiotic therapy he had persistent pyrexia and developed new conduction system disturbances. Echocardiography did not demonstrate vegetations on the valve or an abscess, but gallium scintigraphy using SPECT clearly identified a focus of intense activity in the region of the aortic valve. The presence of valvular vegetations and a septal abscess was confirmed at autopsy. Gallium scintigraphy, using SPECT, provided a useful noninvasive method for the demonstration of endocarditis and the associated valve ring abscess.

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The current incidence of prosthetic valve endocarditis (PVE) is 2%–4% (*1*). Aortic prostheses are most commonly affected and most major studies show an equal incidence of endocarditis regardless of prosthesis type (*2*). The development of a valve ring abscess is one of the most serious complications of bacterial endocarditis, occurring with an average incidence of 63% in mechanical valves and 16% in tissue valves (*3*). Major studies show an overall mortality of 61.4% in patients with this complication managed by antibiotic therapy alone compared to 38.5% for those treated with valve replacement (*2*). Early diagnosis of the abscess is necessary for appropriate operative intervention and reduction in mortality.

We report a case of an aortic root abscess complicating PVE, identified by gallium scintigraphy using single-photon emission computed tomography (SPECT).

CASE REPORT

A 52-yr-old man had a porcine prosthesis inserted for severe aortic stenosis in 1987. In March 1990, he was hospitalized for ureteroscopy, stone removal, and insertion of a ureteric stent. The procedure was performed without complication.

Three weeks later he was admitted to a local hospital with a 7-day history of abdominal pain, fever, and diarrhea. Physical examination revealed only a Grade II/VI systolic ejection murmur with radiation to both carotids. The WBC count was elevated at 16.4 × 10^9 cells/liter. He was treated for gastroenteritis and placed on penicillin and gentamycin. On Day 6, blood cultures grew *Staphylococcus aureus* and therapy was changed to cloxacillin and gentamycin. Two days later he developed atrial flutter and a left bundle branch block (LBBB).

Due to persistent fever and the development of conduction system disturbances requiring pacing, the patient was transferred to our hospital on Day 20 with a suspected diagnosis of prosthetic valve endocarditis.

The patient was afebrile on admission. Physical examination demonstrated no evidence of petechiae, Roth spots, Osler's nodes, Janeway lesions, new murmurs or other manifestations of endocarditis. The ESR was elevated at 143 mm/hr (normal 1–26 mm/hr) and the WBC count was 9.6 × 10^9 cells/l. An EKG showed first-degree heart block and LBBB.

One day following admission, the patient's temperature rose to 38.4°C. Blood cultures were negative. Two days later, examination revealed a Grade II/VI holosystolic murmur with radiation to left axilla. An echocardiogram confirmed the mitral insufficiency, mild to moderate aortic insufficiency, and a dilated left atrium. No valvular vegetations were seen.

On the fourth day after admission, a gallium scan was performed to look for an extracardiac cause of an intermittent low-grade fever.

Imaging Technique

Planar views of the head and neck, upper chest, as well as SPECT of the chest, abdomen, and pelvis were obtained 24 hr following the intravenous injection of 6 mCi (222 MBq) of ^{67}Ga-citrate. Early imaging was performed due to the severity of the patient's condition.

Imaging was performed with a large field of view gamma camera with a medium-energy collimator and a 20% window around the three photopeaks (93, 183, 296 keV). Acquisition with SPECT required 20 sec/stop, 64 stops; and 360° rotation. Image reconstruction was completed with a Hanning prefilter with a cutoff of 0.6 and a ramp backprojection filter.

Axial images were reconstructed 2 pixels thick for a slice thickness of 1.25 cm, reoriented into 2 pixel sagittal, and coronal views and photographed on transparent film.

Planar views of the chest demonstrated a focus of activity at the lower left sternal border (Fig. 1). Tomographic images showed an abnormal focus of radionuclide accumulation in the retrosternal area at the expected location of the aortic valve. The head, neck, abdomen and pelvis were negative.

Aortic angiography demonstrated a paravalvular fistula with extension into a septal abscess. Despite plans for immediate valve

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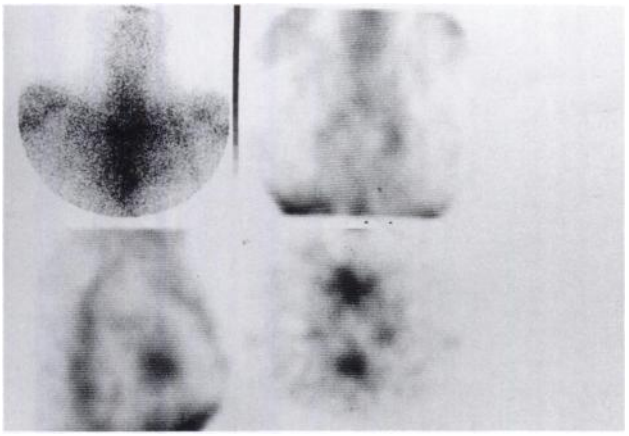

FIGURE 1. Planar view (top left) of the head and neck and upper chest shows a focus of gallium activity in the precordial region. SPECT of the chest in the coronal (top right), sagittal (bottom left) and axial (bottom right) planes confirm the presence of activity in the region of the aortic valve.

replacement and abscess drainage, the patient died following cardiopulmonary arrest.

Autopsy confirmed bioprosthetic valve endocarditis with valve ring dehiscence and a 3-cm abscess between the roots of great vessels (Fig. 2). Multiple vegetations had compromised the outflow tract. Death was attributed to conduction system disturbances induced by the abscess and to near total occlusion of the aortic valve by vegetations.

Postmortem gallium scintigraphy of the intact and sectioned heart performed 12 days after injection demonstrated a persistent focus of intense activity in the area of the aortic valve and surrounding root (Fig. 3).

DISCUSSION

A multitude of imaging modalities have been advocated in the evaluation of patients with endocarditis and its complications.

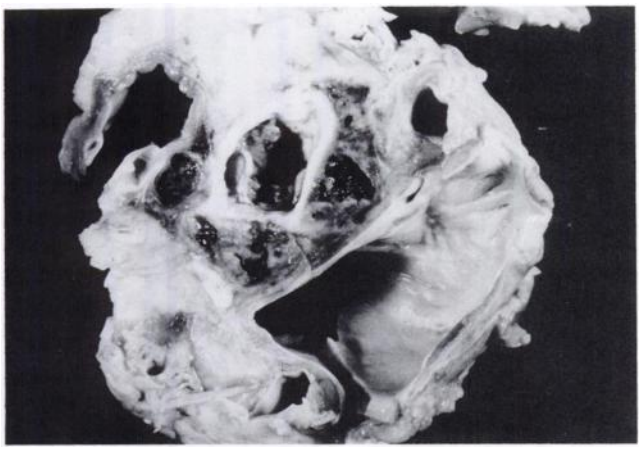

FIGURE 2. Photograph of the gross specimen at autopsy. Axial section through the heart at the level of the prosthetic aortic valve. Left atrium: lower right; aortic valve: center. Necrotic tissue surrounds the aortic root. Aortic abscess is left of the valve.

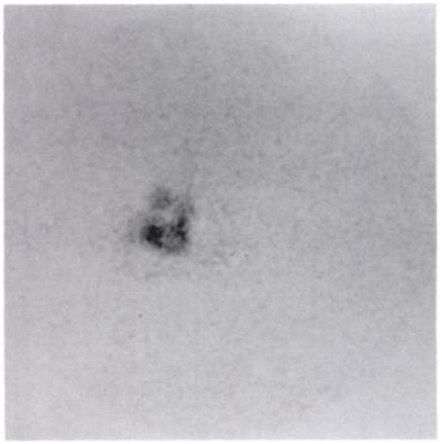

FIGURE 3. Postmortem gallium scintigraphy of the sectioned heart demonstrates persistent activity in the plane of section through the aortic valve and surrounding root.

Echocardiography may detect valvular vegetations in up to 80% of cases of native valve endocarditis (*4*). Recently, several authors have highlighted its use in the detection of complicating ring abscess in native valve endocarditis (*5*, *6*). However, multiple echoes generated by a valve prosthesis are often too intense for small vegetations and abscesses to be identified (*7*). Furthermore, in some patients a good quality examination cannot be obtained because of poor penetration of the ultrasound beam through interposed lung tissue or because of anatomical variations in the chest wall. These difficulties may explain the failure of echocardiography to identify the prosthetic valve vegetations and aortic ring abscess in the present case.

Radionuclide imaging techniques have been found to be useful in demonstrating acute bacterial endocarditis and its suppurative complications (*8*,*9*). Echocardiography in these cases was initially non-diagnostic. The demonstration of myocardial abscesses with ^{111}In-leukocytes is encouraging, but its role in the evaluation and monitoring of patients with acute endocarditis is not clearly established (*10*,*11*).

Gallium-67-citrate scintigraphy in the detection of native and prosthetic valve endocarditis has been described by several authors (*12–14*). Wiseman et al. (*12*) reported a detection rate of 64% in scanning eleven patients with endocarditis. Planar imaging, using a single photopeak (296 keV) and only 3 mCi (111 MBq) of ^{67}Ga-citrate was undertaken 2–7 days following intravenous gallium injection. All positive cases involved left sided valves and one identified a myocardial abscess. Four of seven cases were due to *Staphylococcus aureus*, which usually runs a more fulminant course.

In a review of 35 patients with clinically diagnosed native valve endocarditis, Melvin et al. (*4*) reported a much lower detection rate for gallium scintigraphy. Only 2 of 28 scans were positive; one due to *Staphylococcus* endocarditis. Shortened study times and the combined use

of a single lower energy photopeak (93 keV) with a high-energy collimator may have limited the detection of more subtle abnormalities. Fourteen of 31 cases involved the tricuspid valve, where it has been demonstrated that there is less involvement of the annulus and surrounding myocardium in the inflammatory process (*15*). Furthermore, there were no suppurative complications in this group unlike our case and others (*14,16*) where gallium has been positive.

The combined use of tomography, triple peak imaging and a higher dose of ^{67}Ga-citrate (6 mCi) may have improved the sensitivity of gallium in our case. Early imaging at 24 hr was necessary due to deterioration of the patient's condition. Delayed imaging at two or more days may improve the detection rate.

Although cardiac angiography made the definitive diagnosis, 24-hr gallium imaging supported the clinical suspicion of a septal abscess and led to more immediate intervention. This case suggests that imaging with gallium-SPECT may be a useful, noninvasive method for the detection of fulminant cases of PVE with complicating ring abscess.

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