Indium-111 Leukocyte Scintigraphic Detection of Myocardial Abscess Formation in Patients with Endocarditis

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Myocardial abscess formation in patients with bacterial endocarditis in most clinical settings, especially in patients with prosthetic valves, is a primary indicator for surgical valve replacement. We report the detection of myocardial abscesses using ^{111}In leukocyte scintigraphy in three patients with prosthetic or native valve endocarditis and nondiagnostic echocardiograms. Leukocyte scintigraphy may allow identification of myocardial abscess formation earlier than other imaging modalities.

J Nucl Med 30:703–706, 1989

Although bacterial endocarditis can usually be successfully treated with antibiotics, development of a myocardial abscess is often an indicator for prompt surgical intervention (*1,2*). Early diagnosis of a developing abscess is important for achieving the best surgical results, but the imaging techniques commonly utilized, echocardiography and chest computed tomography (CT), have low sensitivity, especially in patients with prosthetic valves. Although indium-111 (^{111}In) oxine-labeled leukocyte scintigraphy has identified purulent percarditis and abscess formation in a myocardial aneurysm, this method has not been used to detect endocarditis or myocardial abscess formation (*3–5*). We report on three patients with endocarditis, two with prosthetic valves, who had myocardial abscesses identified by ^{111}In leukocyte scintigraphy and confirmed at surgery or autopsy.

METHODS

Studies were performed on patients referred for clinical evaluation. White blood cell separation and labeling with [^{111}In]oxine were performed using previously described methods (*6,7*). In brief, 30 ml of whole blood in acid citrate dextrose solution were allowed to sediment for 1 hr following the addition of 6 ml of hetastarch. The leukocyte-rich plasma was centrifuged at 150 *g* for 5 min, followed by two washings with normal saline. The mixed leukocyte suspension was incubated with 300–555 μCi ^{111}In-8 hydroxyquinoline (Amersham, Arlington Heights, IL) for 15 min. Following resuspension in saline and platelet poor plasma, it was reinjected into the patient and imaging performed 16–24 hr later. Studies were performed using a large field-of-view gamma camera with a medium-energy collimator and dual energy windows (158–195 and 228–278 keV). Each image was acquired for 10 min or 200,000 counts.

CASE HISTORIES

Case 1

One year after insertion of a Starr-Edwards aortic valve for aortic regurgitation, a 61-yr-old male was hospitalized for cerebral embolic events resultant from inadequate anticoagulation. He subsequently developed staph. aureus bacteremia, and in spite of adequate antibiotic coverage, continued to spike fevers and have positive blood cultures. There were no signs of congestive heart failure or new murmurs and M-mode, two-dimensional, and Doppler echocardiography did not show vegetations or abnormal prosthetic valve function. An ^{111}In leukocyte scan, obtained to identify a possible noncardiac source of infection, showed a focal area of increased uptake to the left of the sternum (Fig. 1), as well as an area of absent activity in the spleen, probably representing a bland infarct in the spleen. At surgery, a sewing ring abscess that extended down the septum was found.

Case 2

The second patient was a 39-yr-old female i.v. drug user with a Bjork-Shiley aortic valve secondary to two previous episodes of bacterial endocarditis. The patient was admitted

Received Aug. 12, 1988; revision accepted Jan. 17, 1989.

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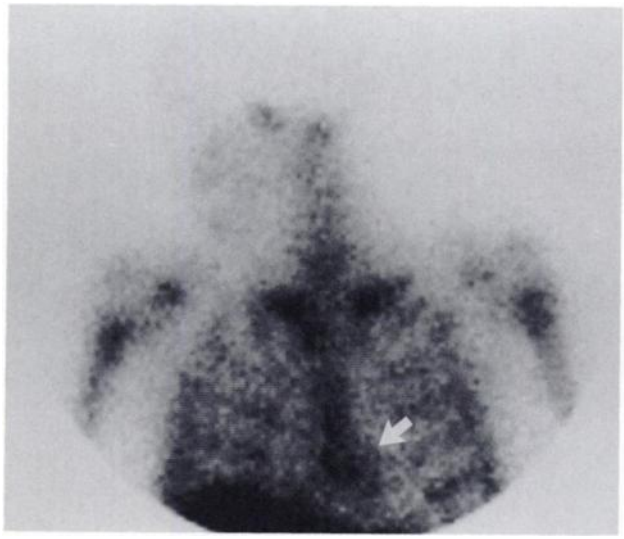

FIGURE 1
Patient 1. Anterior chest image showing a focal area of ^{111}In leukocyte uptake to the left of the sternum (arrow).

with *Staph. aureus bacteremia* and started on antibiotic therapy. M-mode and two-dimensional echocardiography showed no vegetations, abscess formation, or abnormal prosthetic valve motion. An ^{111}In leukocyte scan was obtained, selected images of which are shown in Figure 2. In the anterior chest image, focal increased leukocyte uptake cannot be discriminated from overlying normal bone marrow activity in the sternum. Uptake is best localized to the base of the heart on the three oblique images. Surgical exploration revealed that the underside of the prosthetic valve sewing ring was covered with purulent material and 2×3 centimeter subannular abscess cavity filled with pus and granulation tissue had eroded through the annulus.

Case 3

The third patient was a 56-yr-old male with polycystic kidney disease on hemodialysis for 8 yr who presented with an infected arteriovenous fistula and staph. aureus bacteremia. He was started on antibiotics and the fistula was excised. An M-mode and two-dimensional echocardiogram showed thickened aortic and mitral valve leaflets but no evidence of vegetations or abscess formation. The patient remained febrile and an ^{111}In leukocyte scan, ordered to exclude an infected renal cyst, demonstrated focal accumulation of activity in the base of the heart (Fig. 3). The patient subsequently died from an acute myocardial infarction, and at autopsy a myocardial abscess involving the mitral annulus was found.

DISCUSSION

In patients with prosthetic or native valve bacterial endocarditis receiving treatment with appropriate antibiotics, valve replacement is not recommended unless new signs of congestive heart failure develop, there is recurrent embolization, or there is evidence that further antibiotic therapy will not be successful (*1,2*). The identification of a myocardial abscess is usually sufficient evidence that antibiotic therapy alone will not be

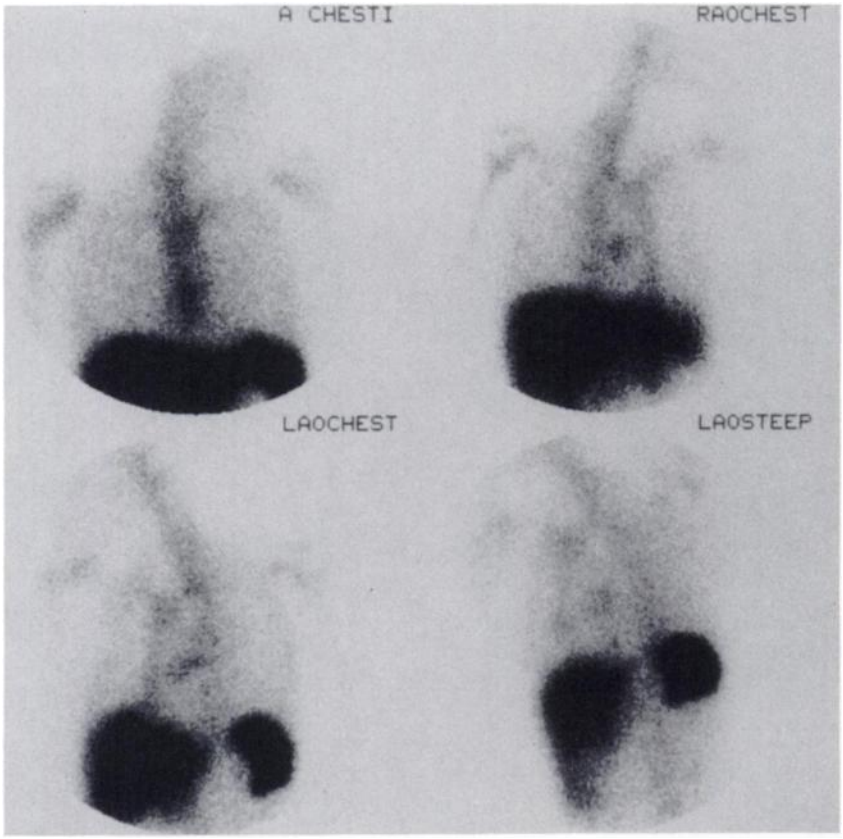

FIGURE 2
Four images of the chest of Patient 2: On the anterior image, the focal activity is beneath the sternum and not visualized, but the oblique images separate it from the overlapping sternum and allow excellent visualization.

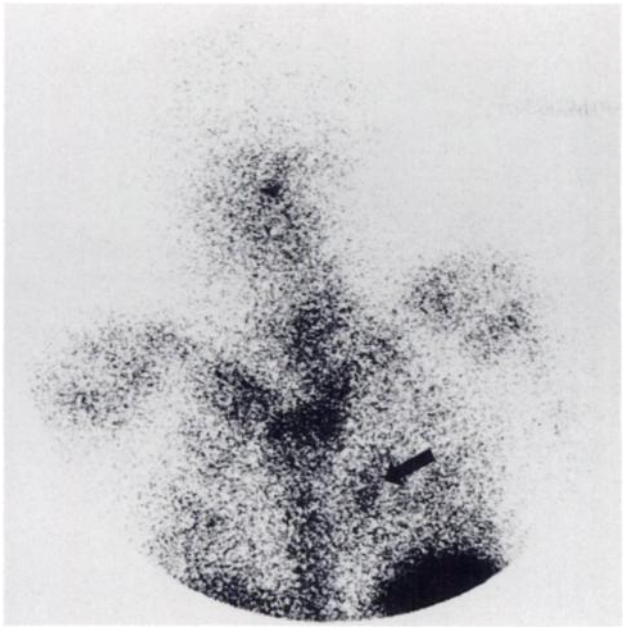

FIGURE 3
Anterior image of the chest of Patient 3 showing abnormal uptake to the left of the upper portion of the sternum (arrow).

adequate treatment. In addition, patients with myocardial abscess formation may develop hemodynamic compromise only after there has been severe destruction of the valvular annulus. In such patients, massive debridement is required at surgery and valve replacement is technically difficult. Early detection of the formation of a myocardial abscess is highly desirable, both to facilitate the decision to take a patient to surgery, and to increase the likelihood of a good surgical outcome. Persistence of fever and positive blood cultures are not specific findings for abscess formation and may be caused by noncardiac sites of septic emboli.

Methods which have been used to detect myocardial abscess formation include echocardiography, chest CT, gallium scans, and ^{111}In platelet scintigraphy. Although echocardiography and chest CT have been used to identify myocardial abscesses, they may be limited by poor sensitivity, especially in patients with prosthetic valves (*8–10*). All forms of echocardiography are operator dependent and frequently good quality studies cannot be obtained in all patients. Good quality studies can be readily obtained in all patients using ^{111}In leukocyte scintigraphy. Gallium-67 scintigraphy was reported to identify seven of 11 patients with clinically diagnosed bacterial endocarditis (*11*), but autopsy confirmation of abscess formation was made in only three cases. In spite of this promising early report, gallium imaging for endocarditis or abscess identification is not widely used. Indium-111-labeled platelets and leukocytes have also been reported to identify aortic valve endocarditis in a rabbit model (*12*). It was concluded that labeled platelets were more sensitive than leukocytes in detecting endocarditis. Although these results may have been influenced by ongoing thrombosis and platelet uptake in the area of denuded endothelium used to create endocarditis, active areas of thrombosis have been noted in clinical cases of endocarditis. Human reports of using ^{111}In-labeled platelets or leukocytes to detect endocarditis or abscess formation have not been published.

In using ^{111}In leukocyte scintigraphy in patients with endocarditis, we have noted that on the standard anterior chest images, normal bone marrow accumulation of ^{111}In leukocytes in the sternum may obscure abnormal uptake in an abscess (Fig. 2). We have found that both right and left anterior oblique views separate overlapping structures and improve abscess visualization. In patients with uptake in extreme posterior areas, image definition may be best on posterior projections. Single photon emission computed tomography can separate overlapping structures and improve contrast, but image quality may be limited by low count rates. Contrast for any projection may be improved by shielding the liver and the spleen with a lead sheet. This increases the information density in the area of the heart and markedly improves the target to background ratio in the area of the abscess.

Scintigraphy using ^{111}In-labeled leukocytes can detect abscesses in prosthetic and native valve endocarditis as demonstrated in the three patients presented here. Although this limited series of patients does not allow us to evaluate the sensitivity of this technique, our results do suggest that leukocyte scintigraphy can be a valuable noninvasive method for identifying patients in need of surgery earlier in the course of their infection, before there is hemodynamic failure and destruction of the valve annulus.

ACKNOWLEDGMENTS

The authors thank Steven Millmond, MD and the University of Washington Section of Nuclear Medicine for contributing one of the patients to this report. This work was supported by the Medical Research Service of the Veterans Administration.

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