The Unsuspected Complications of Bacterial Endocarditis Imaged by Gallium-67 Scanning

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In this case report, we present a patient with bacterial endocarditis who was evaluated by 67Ga imaging for persistent fever despite treatment with multiple intravenous antibiotics. Although evidence of bacterial endocarditis was absent with 67Ga imaging, the study demonstrated findings that represent complications of bacterial endocarditis. The procedure demonstrated moderate pericardial uptake of isotope and thus provided the first evidence of pericarditis which was later confirmed at surgery. The study also demonstrated mildly increased activity in the vicinity of the aortic root and right atrium. A sinus of valsalva abscess, complicating the underlying diagnosis of bacterial endocarditis, was found and treated with surgery and antibiotics. At autopsy 4 wk later, a persistence of sinus of valsalva abscess was found which extended into the right atrium.

J Nucl Med 1993; 34:955–957

The early recognition of pericarditis can be difficult, particularly in postoperative patients and in those with other severe illnesses which may mask the clinical signs and symptoms. The effectiveness of 67Ga scanning has been demonstrated in many inflammatory and neoplastic lesions (1,2). In recent years, many cases of 67Ga uptake by the heart have been reported.

CASE REPORT

A 62-yr-old white female, who had a heart murmur known since 1986 and a history of extensive dental work in late 1989, was transferred to our institution in January of 1990 with a diagnosis of acute enterococcus endocarditis and accompanying septicemia. An admission echocardiogram was performed which revealed moderate aortic stenosis with large vegetations on a bicuspid aortic valve. The patient remained febrile with daily fever spikes despite intravenous administration of multiple antibiotics.

A gallium scan was performed for localization of any additional inflammatory sites approximately 1 wk after admission. The patient was injected with 10 mCi of 67Ga-citrate and whole body imaging was performed 48 hr postinjection. SPECT images of the chest were also obtained at that time. The study demonstrated moderately increased activity surrounding the heart in a distribution suggesting pericarditis. Also noted was mildly increased activity in the region of the aortic valve which extended into the right atrium (Fig. 1) but was better appreciated on an axial SPECT image (Fig. 2).

Cardiac catheterization confirmed a densely calcified bicuspid aortic valve with both stenosis and insufficiency as well as what was thought to be a very large right sinus of valsalva aneurysm. At surgery, there was evidence of epicarditis and pericarditis and a huge right sinus of valsalva abscess was found which was eroding into the aortic wall. The aortic valve annulus was debrided, the abscess cavity was drained and the patient's diseased aortic valve was replaced with a no. 25 St. Jude's prosthesis (St. Jude Medical Inc., St. Paul, MN). The immediate postoperative period was uneventful, but 2.5 wk after surgery, the patient began to develop complex arrhythmias with first degree atioventricular (AV) block and dissociation. One and a half weeks later, she suffered an episode of ventricular tachycardia which terminated in ventricular asystole. At autopsy, sections of the heart showed an abscess in the right atrium which involved both pericardial fat and atrial myocardium, as well as evidence of fibrinous pericarditis.

DISCUSSION

The ability of 67Ga to accumulate in inflammatory lesions of bacterial and nonbacterial origin have been known for many years (3–6) and its use in cardiomyopathies and endocarditis has been proposed by many authors (7–10). O'Connell (11) demonstrated an accumulation of 67Ga in four cases of pericarditis, three of them with an effusion. Multiple factors contribute to the accumulation and retention of 67Ga in inflammatory lesions (12). Gallium-67 has a high affinity for both transferrin and lactoferrin and is bound to circulating transferrin after intravenous injection. The affinity of 67Ga for lactoferrin explains its accumulation in abscesses because of high lactoferrin levels in neutrophils. In addition, bacteria normally produce siderophores, small molecules with a high affinity for iron. Gallium will form a complex with these siderophores in a manner similar to iron. The gallium-siderophore complex is then taken up by the bacteria by a specific iron-siderophore transport mechanism (13,14). These observations explain the finding that neutrophenic animals with abscesses will still accumulate 67Ga. Gallium-67 is also taken up by certain tumors which exhibit specific transferrin receptors on their cell surfaces. The 67Ga transferrin complex is taken up intact by these tumors and is deposited intracellularly. This latter mechanism of 67Ga uptake has not been demonstrated in inflammatory lesions. Cardiac uptake may be

Received Dec. 30, 1992; revision accepted Feb. 25, 1993.
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either focal or diffuse. Table 1 lists a number of conditions resulting in $^{67}$Ga uptake by the heart.

Pericarditis has been associated with uncomplicated bacterial endocarditis. The exact mechanism causing this association is unclear but mediation by circulating immune complexes has been mentioned as a possible cause (22). Pericarditis may also be seen in patients with a persistent bacterial infection (23) which was present in this case. Of more importance is the observation by Arnett et al. (24) that pericarditis is frequently associated with the development of a ring abscess in patients with bacterial endocarditis. In Arnett's series, 14 of 18 (78%) patients with pericarditis in the setting of bacterial endocarditis had a ring abscess. Furthermore, in 13 of 14 (93%) patients with a ring abscess and pericarditis, the pericarditis was due to involvement of the epicardium by extension of the abscess. Extension of the abscess to involve the septum was associated with AV block and AV dissociation. Both of these were also present in our patient.

The sensitivity of gallium scans for the diagnosis of bacterial endocarditis has been variable. Wiseman et al. (7) reported the results of $^{67}$Ga scanning in 11 patients with subacute bacterial endocarditis and found abnormal uptake in the region of the heart in 64% of the cases scanned 72 hr after an injection. In the series presented by Melvin et al. (25), only two gallium scans were positive for cardiac uptake out of a total of 28 (7%). Neither positive study identified the involved valve. The discrepancy between these two series may be due to differences in the site of involvement. In the series presented by Melvin et al., right-sided endocarditis predominated. The annulus and surrounding myocardium are known to have markedly less involvement in tricuspid endocarditis than in left-sided disease and less gallium uptake might be anticipated on this basis. In addition, early antibiotic therapy has been shown to decrease leukocyte migration to infected tissue. In all of the patients in Melvin's series, antibiotics were started before gallium scanning was carried out. Our case was similar in that a

TABLE 1

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<tr>
<th>Common</th>
<th>Uncommon</th>
<th>Rare</th>
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<tr>
<td>Pericarditis (11)</td>
<td>Acute myocardial</td>
<td>Kawasaki disease (20)</td>
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<tr>
<td>Myocarditis (19)</td>
<td>infarction (16,21)</td>
<td>Hypersensitivity angitis (15)</td>
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<tr>
<td>Inflammatory</td>
<td>Postpericardiotomy (15)</td>
<td></td>
</tr>
<tr>
<td>cardiomyopathy (11)</td>
<td>syndrome (10)</td>
<td></td>
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<tr>
<td>Bacterial</td>
<td>Myocardial abscess (8)</td>
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<td>endocarditis (7)</td>
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<tr>
<td>Pericardial and/or myocardial neoplastic involvement (16–18)</td>
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<td>Sarcoidosis (19)</td>
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The association between a ring abscess and bacterial endocarditis has been known for almost 140 yr (26) and the association between pericarditis and bacterial endocarditis for 120 yr (27). The frequency of a ring abscess in bacterial endocarditis may be as high as 28% (27/95) in patients without prosthetic valves, with the vast majority of cases involving the aortic valve annulus (24). In patients with bacterial endocarditis involving a prosthetic valve, the incidence of a ring abscess is much higher (63%) (28). The presence of an abscess may significantly alter the prognosis in these patients by affecting both the response to medical management and the success of surgical intervention. The use of 67Ga in pericarditis has been proposed by several authors, although figures for sensitivity and specificity have not been given. Gallium scans reportedly have a low incidence of positive scans in patients without localizing signs. Conventional 67Ga citrate imaging of the chest may also be used in identifying patients with intramural cardiac abscesses. In our case, mildly increased activity was noted in the region of the aortic root which was seen to extend into the right atrium on SPECT images. These observations correlated with subsequent surgical and autopsy findings. In the setting of pericarditis, however, distinguishing pericardial from aortic root and right atrial activity is difficult on planar images but is somewhat easier on SPECT images, particularly if the association between ring abscesses and pericarditis in patients with bacterial endocarditis is kept in mind.

SUMMARY

We present unusual findings on gallium scanning in a patient with bacterial endocarditis complicated by pericarditis and an aortic root abscess extending into the right atrium. Gallium-67 scanning demonstrated pericarditis and abscess of the aortic root in the absence of clinical findings which was subsequently proven at surgery and autopsy.

ACKNOWLEDGMENTS

The authors thank Dr. Spiegelhoff for reviewing the manuscript; Dr. Schmitt for reviewing autopsy findings with us; and Ms. Jean Lemanski and Ms. Pat Pfeffer for preparing the manuscript.

REFERENCES


