Gallium-67 and Magnetic Resonance Imaging in Aortic Root Abscess

Stephen W. Miller, Edwin L. Palmer, Robert E. Dinsmore, and Thomas J. Brady

Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Fruit Street, Boston, Massachusetts

Perivascular abscess in the aortic root is a serious complication of infective endocarditis and is recognized infrequently with noninvasive techniques. This report describes a patient with sepsis who was imaged with 67Ga and magnetic resonance (MR) in order to locate a site of infection. The 67Ga image showed increased activity in the substernal region. Magnetic resonance correctly detected the multilocular aortic root abscess, which had extended into the interatrial septum. The combination of the sensitive 67Ga with the high-resolution MR image provided a useful method to locate aortic root abscesses and to identify contiguous spread.


Locating the site of the infection in patients with sepsis is frequently a difficult diagnostic problem that requires multiple types of medical imaging. For example, when the aortic valve is the site of infection, a problem frequently encountered on echocardiography is distinguishing a calcified aortic valve from a nidus of infection. This case report illustrates the value of combining gallium-67 (67Ga) imaging with magnetic resonance (MR) imaging to arrive at a specific site of infected endocarditis, namely an aortic root abscess adjacent to a scarred aortic valve.

CASE REPORT

A 66-yr-old firefighter developed fever and hypotension 10 days after an episode of urinary retention. Two years earlier he developed atrial fibrillation; a systolic heart murmur had been heard since childhood. An echocardiogram then revealed thickened aortic leaflets with probable calcification. He was otherwise well until 10 days before admission, when he had an episode of urinary retention, was catheterized, and given a short course of antibiotics. Urinary cultures subsequently grew Escherichia coli. On the day of admission, he developed a temperature of 106°F. Pertinent physical findings included a Grade 2 ejection murmur, distended neck veins, hepatomegaly, and an enlarged prostate. The initial cardiac examination apparently was unchanged from previous reports.

The initial clinical evaluation suggested that the genitourinary tract and, in particular, an enlarged prostate, was the source of the patient’s bacteremia. To further evaluate this possibility a [67Ga]citrate scan was performed with the intravenous injection of 5mCi (185 MBq) of 67Ga followed by whole-body images at 48 and 72 hr. The scan demonstrated no abnormality in the region of the prostate. Images of the chest showed a clearly defined zone of increased uptake to the right of the sternum in the retrosternal region (Fig. 1). Following these images, the patient had dynamic imaging with a bolus of 10 mCi (370 MBq) of technetium-99m-DTPA ([99mTc]DTPA) to locate the abnormal gallium activity. The gallium uptake was in the region of the right side of the heart.

In order to clarify the site of the gallium uptake, an MR study was performed using a spin-echo technique. Images gated to the cardiac cycle were obtained with a 0.6T superconducting magnet. Multislice imaging was performed in the transverse and sagittal planes with a section thickness of 15 mm. The picture matrix was 256 vertical (interpolated from 128) by 256 horizontal pixels using 256 shades of gray. Inplane resolution was 1.6 × 3.2 mm. A spin-echo pulse sequence employed a repetition time (TR) gated to the R-wave of the electrocardiogram and a time-to-echo (TE) of 32 msec with four excitations averaged.

The MR images showed several saccular cavities connected to the aortic root (Fig. 2). There was marked thickening of the periaortic tissue, suggesting that the inflammatory reaction extended into the adjacent mediastinum. The interatrial septum was abnormally wide, but appeared intact. The remainder of the heart including the mitral valve appeared normal.

From the combined gallium and MR data a preoperative diagnosis of multiple aortic root abscesses with extension into the periaortic tissue and interatrial septum was made. Following a 1-wk course of antibiotics, the patient underwent cardiac
catheterization and angiography. A supravalvular aortogram demonstrated two saccular aneurysms near the noncoronary sinus and mild aortic regurgitation. Surgery was undertaken and a multilocular abscess was found at the base of the aorta, extending into the interatrial septum. The aortic valve was bicuspid and calcified. The abscess had then ruptured into both right and left atria.

DISCUSSION

Aortic root abscess is a serious complication of infective endocarditis, particularly if it is not discovered prior to surgery. Because aortic valve ring abscesses develop in approximately 40% of patients with active infected endocarditis, its recognition is critical for proper medical and surgical management (7). In patients with fever of unknown origin, as in our patient, specific imaging techniques may locate not only the site of infection but also delineate serious complications.

Although the classic signs of endocarditis are still observed (fever, changing heart murmurs, splenomegaly, and peripheral embolization), a different constellation of clinical features was now recognized: congestive heart failure, myocardial infarct from vegetative embolization, and myocardial abscess (2,3). Our patient presented with sepsis, congestive heart failure, and myocardial abscess adjacent to a bicuspid aortic valve. In an earlier series of patients with aortic root abscesses, 83% had bicuspid aortic valves (4). This figure contrasts with the findings of Roberts and Buchbinder (5), who found bicuspid aortic valves in 20% of cases with left-sided endocarditis; rheumatic and degenerative valves were the major etiology. Perforations of the aortic cusps, annular abscesses, and perforations into adjacent structures are common complications of aortic valve endocarditis. In the angiographic series of 19 patients with infective endocarditis described by Miller and Dinsmore (4), aortic rupture into the right or left ventricles was seen in four patients, aortic regurgitation in all 19 patients, and extension into the mitral annulus producing mitral regurgitation in four patients. Our patient had right bundle branch block suggesting involvement of the interventricular septum by the aortic abscess.

Aortic root abscesses have been identified with a variety of imaging modalities. Two-dimensional echocardiography frequently is able to demonstrate a deformed aortic bicuspid or tricuspid valve and may show partial destruction of the cusps with coarse echoes projecting into the left ventricular outflow region during diastole (6-8). It may be possible to show extension of the abscess into the ventricular septum and adjacent aortic root echocardiographically, but visualization of the adjacent mediastinum is limited with this technique. Although supravalvular aortography is still required to quantitate aortic regurgitation, the new Doppler color mapping may diminish this presurgical requirement.

Of two patients described in the literature who have undergone x-ray computed tomography in the search for aortic root abscess, only one was successfully imaged, probably because of the large size of the mass posterior to the ascending aorta (9,10).

In our patient the MR image clearly showed the

FIGURE 1
Gallium-67 citrate images. Anterior (A) and right anterior oblique (B) images of the chest performed 48 hr after injection reveal an intense abnormality in the right mediastinum (arrow) posterior to the sternum.
FIGURE 2
Magnetic resonance images. A: Transverse section at the level of the aortic root demonstrates saccular posterior abscess (arrows) projecting into the left atrium. The periaortic tissue between the right atrium and aorta is abnormally thick. B, C: Sagittal sections through the right ventricle show the wide separation between aorta and left atrium adjacent to a posterior abscess (arrow). A = aorta, LA = left atrium, LV = left ventricle, RA = right atrium, RV = right ventricle.

mediastinal extension into the interatrial septum, the thickened posterior aortic wall, and the saccular aneurysms in the aortic sinuses of Valsalva. The relatively signal-free cavities contiguous with the aortic root are similar to those in previous reports (10,11). The thickened interatrial septum and the wide periaortic tissue with a signal intensity similar to myocardium are new findings and probably reflect a wider infection in our patient.

Gallium-67 citrate scanning has demonstrated utility
in detecting a variety of infective processes (12). Gallium uptake is not specific for infection, however, and may also be present in a number of inflammatory and neoplastic processes. An early report suggested that infective endocarditis could be identified with gallium scanning, particularly if delayed imaging at up to 1 wk was performed (13). Other investigators were not successful in detecting valve involvement (14). Subsequent clinical experience has demonstrated that endocarditis involving only the valve leaflet is typically not visualized. The inability to detect vegetations is probably related to the small volume of infected tissue and to the limited spatial resolution of gallium scanning. Because of these limitations, the presence of significant gallium uptake in a patient with suspected endocarditis suggests the presence of a more extensive abnormality such as myocardial abscess, valve ring abscess or mediastinal extension. Pericardial involvement can often be differentiated by the typical circumferential pattern of abnormal activity conforming to the pericardial space. Although noninfective processes such as myocarditis may cause abnormal cardiac gallium uptake, they are not likely to be confused on clinical grounds.

The ideal imaging technique for evaluating a patient with infective endocarditis would be noninvasive and both sensitive and specific for the cardiac infection. Unfortunately, no single test is currently available that meets these criteria. A $^{67}$Ga image that is sensitive for inflammatory processes combined with a high-resolution image, such as MRI, allowed the recognition of the complications of infected endocarditis.

NOTE

* Technicare Teslacan, Solon, OH.

ACKNOWLEDGMENT

This work was supported by a grant from National Cancer Institute Grant 5K04 CA00848-05.

REFERENCES