Leukocyte Scintigraphy in the Diagnosis of Mycotic Aneurysm

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Early diagnosis of a mycotic aneurysm is critical, but often unsuspected, due to the insidious onset of symptoms related to occult infection. This study was undertaken to assess the role of leukocyte scintigraphy in establishing the diagnosis of mycotic aneurysm. The records of all patients with possible mycotic aneurysm between 1985 and 1991 were reviewed. Seven patients had leukocyte scintigraphy and computed tomography (CT), three also had magnetic resonance imaging (MRI) and three had angiography as part of the diagnostic workup. CT and MRI detected aneurysms in five of the seven patients, but CT scans were misinterpreted in two patients as indicative of abscess only. In six patients, infection could not be differentiated from thrombosis, seroma or hemorrhage by CT or MRI. Leukocyte scintigraphy was positive in all four patients with infected aneurysms; it was negative in two of the three noninfected aneurysms and equivocal in the third. Leukocyte scintigraphy provided a useful early survey that demonstrated evidence of infected aneurysms in four patients and identified other sites of infection in two patients. Leukocyte uptake complemented CT, MRI and angiographic findings distinguishing between seroma/hematoma and adjacent infection to establish a preoperative diagnosis of infected aneurysms.

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Mycotic aneurysms are uncommon but frequently fatal vascular lesions. Early diagnosis and aggressive therapy are essential to a successful outcome (*1–5*). There are, however, few early signs or symptoms other than those of occult infection. Leukocyte scintigraphy is the imaging procedure of choice for patients with nonlocalizing signs of infection (*6–11*) and has shown utility for detection of indolent vascular graft infections (*12–16*). Other imaging techniques that can facilitate detection of a mycotic aneurysm include: ^{67}Ga scintigraphy, sonography, computed tomography (CT), magnetic resonance imaging (MRI) and angiography (*5,17–25*).

Sonography, CT and MRI are noninvasive imaging techniques that can detect aneurysms, but they often fail to show findings that are specific for an infected aneurysm (*5*). Leukocyte imaging has been reported to add specificity for the presence of infection in a patient with an aneurysm that was detected by other imaging modalities (*26*). Seven patients who underwent multi-imaging evaluation for a possible mycotic aneurysm are presented, and the contributions of the various imaging modalities are discussed.

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MATERIALS AND METHODS

A retrospective analysis was performed of the diagnostic imaging studies obtained in seven patients who underwent multi-imaging evaluation for a suspected mycotic aneurysm between 1985 and 1991. All seven patients underwent leukocyte (WBC) scintigraphy and CT, three also had MRI and three had aortography; all imaging studies were performed within 1 wk of each other. Five patients had surgically proved cases, and two patients, without clinical or imaging evidence of an infected aneurysm, were followed for 8 and 10 mo after discharge from the hospital.

Scintigraphy

Leukocyte labeling with ^{111}In-oxine was accomplished using a modification (*27*) of the technique reported by Thakur et al. (*28*). Ten-minute anterior and posterior images of the abdomen/pelvis and, in some patients, oblique images were obtained at 4 and 24 hr (with the addition of chest images) after the injection of 400–500 μci (14.8–18.5 MBq) of ^{111}In-labeled WBCs. A large field of view gamma camera equipped with a medium-energy collimator, utilizing 15% windows centered on the 173- and 247-kev ^{111}In photopeaks, was used for image acquisition.

In this retrospective analysis, the original scan interpretations were used for all patients. The scintigraphic images were interpreted by a nuclear medicine staff physician and a resident physician with knowledge of the patient's history and/or clinical course. Images were called positive for infection if a focus of radiotracer localization was equal to or greater than liver uptake (*8*); indeterminate, if focal uptake was less than that of liver and if it varied in size and configuration over time; and negative, if no site of focal uptake was identified.

CT Scans

CT images were obtained in all seven patients using a Picker 1200 or Siemens Somatom DRH. Oral and rectal contrast material was given. Most patients received an intravenous bolus of 60 ml of Conray 60 or Omnipaque 300 plus an infusion of contrast material at a rate of 1 ml/sec for a total of 150 ml. In two patients (Patient 3 and the first CT of Patient 4), CT was done without contrast material, because of renal insufficiency at the time of CT imaging. Imaging was begun 40 sec after the start of the injection, and 8-mm axial cuts were obtained for every 10

mm of couch movement. The original interpretations used in the analysis of the results were rendered by a staff physician with knowledge of the patient's clinical history and clinical course. CT scans were classified as negative for aneurysm when the arteries were of normal caliber with no adjacent mass. When an aneurysm was present, a mycotic aneurysm would be suggested if there was gas in the wall, rapid progression or a saccular aneurysm with a contiguous soft-tissue mass in a septic patient. Demonstrated aneurysms with none of these findings in a septic patient were classified as indeterminate.

MRI Studies

All MRI studies were done using a 0.5-T superconductive unit (Picker Magnascanner). At least one axial T1-weighted (TR = 450–600 msec, TE = 20 msec) sequence with a corresponding T2-weighted (TR = 2000 msec, TE = 80–120 msec) sequence was obtained in each MRI examination. Additional sequences in coronal or sagittal planes were done based on the findings of the axial images. Again, the original scan interpretations were used.

RESULTS

Six of the seven patients had abdominal aneurysms, and one had a thoracic aneurysm (Table 1). Patients 1–4 had surgically proved infected aneurysms: three were culture-positive and the fourth, although culture-negative, had histologic evidence of infection (Table 2). WBC scintigraphy gave true-positive results for infection in all four patients (Fig. 1A). In Patient 4, WBC imaging also detected an infected gallbladder and an infected amputation stump of the left thigh. In Patients 5 and 7, WBC imaging correctly ruled out infection at the site of the aneurysm (true-negatives). Patient 5 had two WBC scans 3 wk apart. The first scan showed evidence of osteomyelitis of the sternum. In the second postoperative week, after debridement and closure of the sternal wound, the patient noted back pain. At this time, a second WBC scan was performed to survey for possible additional sites of infection. WBC images showed evidence of osteomyelitis in the T-spine, but no evidence of an infection at the site of an aneurysmal dilatation of the ascending aorta detected by CT and MRI. In Patient 6, WBC scintigraphy (Fig. 2) was interpreted as indeterminate.

CT scans revealed findings suggestive of paravascular bleeding or inflammation (Fig. 3A) in two of the four patients with surgically proved mycotic aneurysms (Patients 1 and 2). In Patient 3 (Fig. 3B), a left common iliac aneurysm was interpreted as being an abscess, perhaps because no intravenous contrast material was used due to poor renal function. In Patient 4, an infected left iliac pseudoaneurysm was not visualized on the initial CT scan and missed on two subsequent CT scans done at 1-wk intervals. The fourth CT scan was interpreted as a left psoas abscess (Fig. 4D), but, in retrospect, a left common iliac artery aneurysm with an adjacent fluid collection was apparent on a scan done 1 wk earlier (Fig. 4C). The initial

TABLE 1
Summary of Patient Data

Patient no.	Age (yr)/Sex	Location of aneurysm	Associated conditions	Signs and symptoms
1	66/M	Aorta: infrarenal	CAD, HTN, angina	Fever, night sweats, anorexia, weight loss, low back pain, ↑WBC and positive blood cultures
2	67/M	Aorta: infrarenal	CAD, HTN, pneumonia	Fever, chills, anorexia, weight loss, pelvic and ↑low back pain, testicular pain, ↑WBC and positive blood cultures
3	72/M	L. common iliac artery	PVD, pneumonia, sacral decubitus, lupus, steroids	Fever, anorexia, dyspnea, pleuritic chest pain, ↑WBC and positive blood cultures
4	48/M	L. common iliac artery	SBE, septic embolic events, perforated necrotic gallbladder	Fever, hypotension, delirium, ↑WBC and positive blood cultures
5	62/M	Aorta: ascending	Sternal wound infection after coronary artery bypass	Fever, back pain, ↑WBC and positive blood cultures
6	73/M	Aorta: infrarenal	HTN, CAD, diabetes mellitus, repair of aortic aneurysm	Pulsating abdominal mass and ↑WBC
7	79/M	Aorta: infrarenal and L. common iliac artery	CHF, PVD, infected sacral decubiti	Preoperative work-up for leg ulcers and ↑WBC

CAD = coronary artery disease; HTN = hypertension; L. = left; PVD = peripheral vascular disease; SBE = subacute bacterial endocarditis; and ↑ = increased; and CHF = congestive heart failure.

TABLE 2
Imaging Results and Outcome

Patient no.	Imaging Studies			Culture results	Outcome
		Results*	Final assessment		
1	CT:	infrarenal calcified 3.5-cm aortic aneurysm, 4-cm adjacent periaortic soft-tissue mass and inflammatory changes	Indet.	*Bacteroides fragilis*	Resection and bypass graft for infected aortic aneurysm; ×5 yr
	In-WBC:	focal uptake L. mid-abdomen	TP		
2	CT:	3.5-cm infrarenal aneurysm, adjacent soft-tissue mass	Indet.	*Pseudomonas aeruginosa* (blood and aneurysm)	Emergency resection and bypass graft for dissecting infected aortic aneurysm; alive without complications ×4 yr
	MRI:	aneurysm with periaortic signal changes and signal void in wall	Indet.		
	Aortogram:	enlarging saccular aneurysm	TP		
	In-WBC:	focal uptake, mid-upper abdomen	TP		
3	CT:	(without i.v. contrast) 8 x 13-cm soft-tissue mass L. iliac region, calcified distal aorta and iliac arteries	Indet.	*Pseudomonas aeruginosa* (blood and aneurysm)	Infected L. common iliac aneurysm ruptured intraoperatively and patient died
	In-WBC:	large focus in mid and L. pelvis	TP		
4	CT-1:	(without i.v. contrast), renal and splenic infarcts, with abdominal ascites	FN	Beta-hemolytic streptococcus group B (blood cultures); aneurysm cultures negative but histology showed acute inflammation	1. Resection of infected gallbladder; 2. Emergent resection and bypass graft for infected L. common iliac pseudoaneurysm; transferred to local hospital for convalescent care
	CT-2:	marked ↑ in loculated fluid and air, plus air in bile ducts; no iliac mass	FN		
	CT-3:	residual inflammatory changes diffusely in abdomen; decreased ascites; no focal abnormalities	FN		
	CT-4:	mixed-density mass L. psoas region	TP‡		
	In-WBC:	focal uptake L. mid-pelvis, gallbladder fossa, L. thigh, and some bowel activity; done on the same day as CT-1	TP		
5	CT:	4.5-cm pseudoaneurysm of ascending aorta, with a mural thrombus or soft-tissue mass, enlarged lymph nodes	Indet.	*Staphylococcus aureus* (blood cultures only)	16 wk of i.v. antibiotics for osteomyelitis; no complications on clinical follow-up, and repeat CT showed a stable aneurysm 1 yr later
	MRI:	inflammatory process T3 and T4, and mass anterior to aneurysmal ascending aorta	Indet.†		
	In-WBC-1:	focal uptake in sternum and photopenic T3-T4 vertebrae	TN§		
	In-WBC-2:	photopenic T3-T4 vertebrae	TN§		
6	CT:	5-cm infrarenal aortic aneurysm with periaortic fluid collection	Indet.	Negative blood and operative cultures	Severe intraoperative myocardial ischemia precluded resection of a noninfected aortic aneurysm; no complications during 10 mo of clinical follow-up
	MRI:	aneurysm and periaortic mass with low signal intensity on T1 and T2	TN		

TABLE 2 *continued*

Patient no.	Imaging Studies			Culture results	Outcome
		Results*	Final assessment		
	Aortogram:	saccular aneurysm L. renal artery to margin of aorto-bifemoral graft	Indet.		
	In-WBC:	small focus L. mid-abdomen, intensity less than liver	Indet.		
7	CT:	5-cm infrarenal aortic aneurysm with partial thrombosis vs. adjacent fluid	Indet.	Negative (blood cultures only)	Femoral to peroneal artery bypass graft; patient refused repair of aneurysms; no complications during 8 mo of clinical follow-up
	In-WBC:	negative	TN		
	Aortogram:	aneurysmal dilatation of L. common iliac artery	Indet.		

* During hospitalization.
† TP for abscess, but iliac artery involvement was not identified.
‡ Positive for osteomyelitis.
§ Positive for wound infection; suspicious for osteomyelitis.
TP = true-positive; TN = true-negative; FN = false-negative; Indet. = indeterminate; L. = left; ↑ = increased.

WBC images (Figs. 4A-B) had shown abnormal focal localization in this same region 4 wk earlier. In the remaining three noninfected aneurysms, CT detected evidence of a mural thrombus or soft-tissue mass in Patient 6 and adjacent fluid density collection, suggestive of a recent hemorrhage or infection, in Patients 6 and 7.

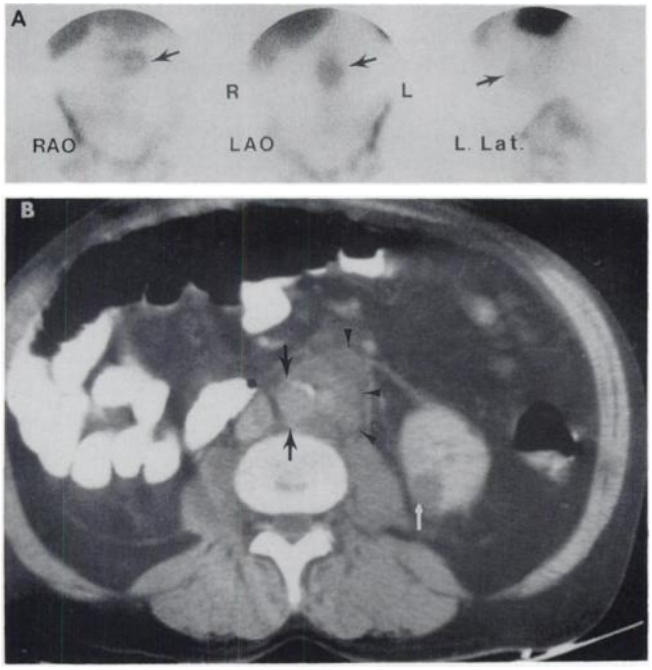

FIGURE 1. A 66-yr-old man (Patient 1) with coronary artery disease, fever, night sweats, low back pain and positive blood cultures. (A) Right anterior oblique (RAO), left anterior oblique (LAO) and left lateral (L. Lat.) WBC images reveal focal uptake in the left mid-abdomen (arrow). (B) CT scan shows a calcified aortic aneurysm (arrows) with an adjacent periaortic soft-tissue mass (arrowheads). Note simple cyst in adjacent left kidney (white arrow). A dissecting mycotic aneurysm with an adjacent infected hematoma was found at surgery.

MRI showed perianeurysmal signal abnormality in Patients 2 and 5 and wall signal abnormality in Patient 2. In Patient 5, MRI showed an inflammatory process of T3-T4 and evidence of a mass (infection, hemorrhage or thrombus) in or anterior to an aneurysm of the ascending aorta. In Patient 6 (Figs. 2C-D), the signal characteristics of the para-aortic mass were more suggestive of a recent hemorrhage than infection.

Angiography showed evidence of an enlarging saccular aneurysm in Patient 2 and noncalcified saccular aneurysms in Patients 6 and 7.

DISCUSSION

The term "mycotic aneurysm" was coined in 1885 to describe a nonsyphilitic infected dilatation of the arterial wall caused by septic emboli from endocarditis (*29*). Mycotic aneurysms are relatively uncommon; in one series, only 9 of 338 aortic aneurysms (2.6%) were true mycotic aneurysms (*1*). Most patients are more than 50 yr of age and have a history of occlusive vascular disease. Presenting symptoms are often related to low-grade infection, and the patient may experience back pain and weight loss. Pain also can be referred to the hip or testicles, and occasionally a pulsatile mass may be palpated (*1–5*). Back pain, often a clinical indication of dissection, was present in four of our patients. Three of the four patients had active dissection at the time of the diagnostic work-up.

Predisposing factors include prior vascular trauma or intravenous drug abuse (29%) and depressed host immunity (24%) from a variety of conditions, such as diabetes mellitus, cirrhosis, collagen vascular disease, corticosteroid

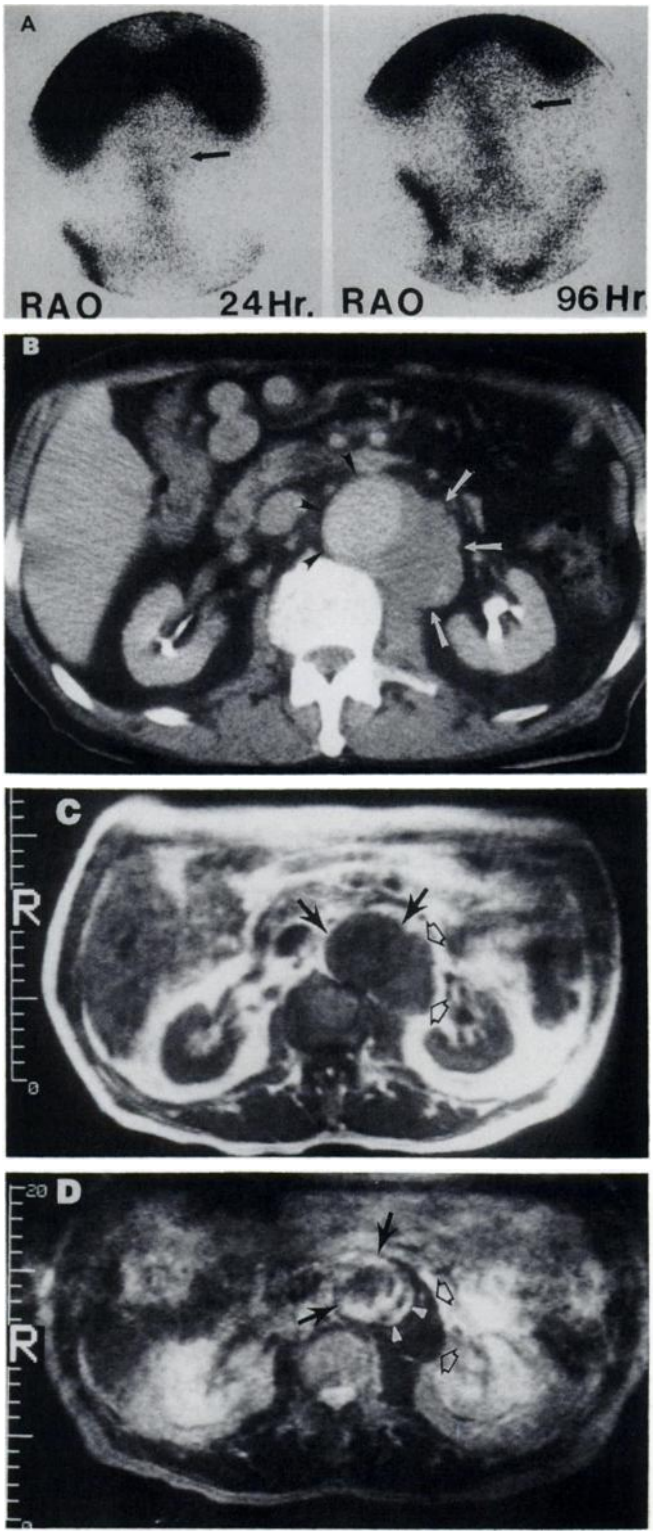

FIGURE 2. A 73-yr-old diabetic man (Patient 6) with coronary artery disease was found to have a pulsatile abdominal mass 4 yr after repair of an abdominal aortic aneurysm. (A) 24- and 96-hr equivocal WBC scans show a small focus of localization in the left mid-abdomen (arrow), which changes over time. (B) CT scan shows an aortic aneurysm (arrowheads) with adjacent periaortic soft-tissue mass (arrows). (C) Transaxial T1-weighted MRI and (D) T2-weighted MRI show an aortic aneurysm (arrows) with a low signal intensity periaortic fluid collection (open arrows) plus high signal intensity on T2 images (white arrowheads) along the posterolateral aspect, very suggestive of recent hemorrhage. A noninfected dissecting aneurysm with an adjacent hematoma was found at surgery.

or chemotherapy treatment and malignant neoplasms. Preexisting or concurrent sepsis is present in 17% of cases, either contiguous or distant, and cardiovascular defects with bacterial endocarditis are present in about 10% of cases (*3,5,21,23*). Many patients have an existing aneurysm before the development of infection (*21*). In view of the growing population of intravenous drug abusers and immunosuppressed patients, the incidence of mycotic aneurysms may increase.

Several mechanisms are included in the pathogenesis of mycotic aneurysms: inoculation of bacteria at the time of arterial trauma; septic embolization by direct disruption and invasion of the arterial wall or by dissemination of microemboli into the vasa vasorum; deposition of bacteria at an intimal defect (existing plaque and/or aneurysm) during an episode of bacteremia; and spread from an adjacent infection directly or via the lymphatics (*4,5,30*). Nontyphoidal salmonella is the associated organism in 20%–35% of all abdominal mycotic aneurysms (*4,30*). *Staphylococcus aureus* is associated with a high percentage of extra-abdominal mycotic aneurysms (*19,20*).

Mycotic aneurysms carry an extremely poor prognosis, especially if there is a delay in surgical intervention or adequate antibiotic therapy (*1,3–5*). Successful treatment is highly dependent on early diagnosis (*16,20–22*). However, only about 50% of patients with mycotic aneurysms have positive blood cultures, and the source of the infection is identified in only about one-half of all cases (*4*). In our series, all four patients with infected aneurysms and two of three without infected aneurysms had positive blood cultures. Even with the initiation of therapy, however, about 75% of mycotic aneurysms rupture, and up to 67% of patients with mycotic aneurysms die (*4*).

Noninvasive anatomic imaging techniques have helped to establish an earlier diagnosis of infected aneurysm. The main CT findings associated with mycotic aneurysm are the presence of a noncalcified saccular aneurysm with a contiguous perivascular mass or progressive enlargement of an aneurysm in a septic patient (*7,18–21*). A mycotic aneurysm is strongly suggested when gas is seen in the aneurysmal wall (*22*). Other findings associated with mycotic aneurysms are: an unusual location of an aneurysm, perianeurysmal fluid collection, perivascular hematoma, psoas or paravertebral abscess, adjacent vertebral osteomyelitis and nearby reactive lymph node enlargement (*5, 10,21*). However, in Patient 5, adjacent osteomyelitis, enlarged lymph nodes and a soft-tissue mass were present with a noninfected aneurysm. In Patient 4, an infected aneurysm was not detected on four CT scans, done at weekly intervals, despite an abnormal focus of WBC localization in this same region. The extent and multitude of findings in this patient, including gallbladder infection,

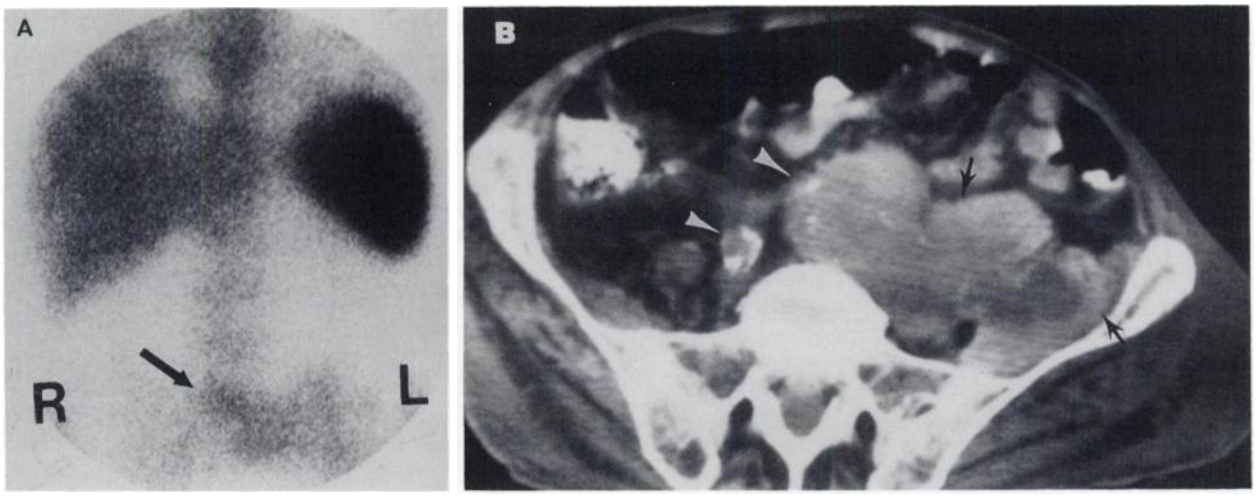

FIGURE 3. A 72-yr-old man (Patient 3) with peripheral vascular disease, fever, positive blood cultures and a sacral decubitus ulcer. (A) WBC scan shows a large focus in the mid and left pelvis (arrow). (B) CT scan (without intravenously administered contrast material) shows a calcified aorta, iliac arteries (arrowheads) and a 8 × 13-cm soft-tissue mass in the left iliac region (arrows). A mycotic aneurysm of the left common iliac artery surrounded by a large abscess was found at surgery.

ascites, peritonitis, adynamic ileus, renal insufficiency and multiple potential sites of infection, all were factors in obscuring early detection of the mycotic aneurysm.

A mycotic aneurysm also can be missed by CT if intravenous contrast material is not used (Patient 3 and the first CT of Patient 4). Furthermore, in Patient 6, a mycotic aneurysm was not found at surgery, despite CT evidence of periaortic fluid collection. In six of the seven patients, adjacent infection could not be differentiated from thrombosis, seroma or hematoma by CT findings alone.

MRI may be useful when there is a contraindication to the use of intravenously administered contrast material (*24*). Aneurysms and flowing blood are usually well visualized, and the multiplanar capability of MRI is helpful. MRI also may suggest the presence of infection adjacent to or in the wall of the aneurysm. These findings are nonspecific, however, since a hematoma or unrelated adjacent inflammation may have a similar appearance. MRI demonstrated evidence of osteomyelitis in adjacent thoracic vertebrae, lymphadenopathy and a soft-tissue mass anterior to the aneurysmal dilatation of the ascending aorta in Patient 5, who had a noninfected aneurysm. In Patient 6, the signal characteristics of the periaortic mass favored hemorrhage rather than infection, and since the patient has not subsequently shown signs of infection, a recent bleed was the probable cause. However, in the appropriate clinical setting, mycotic aneurysm also should be considered in the differential diagnosis.

Aortography is considered by many to be the most diagnostic imaging study for aortic aneurysms, and it is often obtained for preoperative evaluation to determine the extent of vascular involvement (*5*). Evidence of an enlarging aneurysm was seen in one of the three patients who underwent angiography in our series. The findings considered most diagnostic of mycotic aneurysm are: saccular configuration, smooth-walled localized vascular changes and atypical site for the usual atherosclerotic aneurysm (*5*). Nevertheless, none of these findings is specific for the presence of infection.

If the patient is septic, WBC scintigraphy can help identify multiple sites of infection and increase the diagnostic certainty of an infected aneurysm. In Patient 4, WBC scintigraphy gave a true-positive result for infection in the gallbladder fossa and the left amputation stump, as well as at the site of the infected left iliac pseudoaneurysm. In cases of infection, if WBC scintigraphy shows abnormal focal localization, sonography, CT or MRI is needed to help distinguish between an abscess and a mycotic aneurysm (*7,26*). In Patients 1 and 2, these modalities correctly identified the aneurysm and demonstrated evidence of infection or hemorrhage extending beyond the aneurysm. However, an aneurysm was missed in Patient 3 and on the initial CT scan in Patient 4, whose renal insufficiency precluded the use of contrast material.

False-positive WBC images have been reported due to thrombus formation in noninfected aneurysms as well as noninfected postsurgical pseudoaneurysms (*31*). However, noninfected aneurysms usually will only show WBC localization if there is active thrombus propagation or active bleeding (*32*). Also, if the patient is experiencing pain at the time of a positive scintigram, active hemorrhage or dissection of an aneurysm should be considered.

Leukocyte scintigraphy provides a useful early survey for localization of clinically occult sites of infection and may also detect additional unsuspected sites of infection. CT with contrast enhancement affords a good survey for detection of aneurysm and/or abscess. MRI, which shows similar findings and is more costly, should be reserved for patients with contraindication for contrast material. CT and/or MRI findings strongly suggested recent hemorrhage in only one patient, but failed to differentiate clearly between hemorrhage and infection in six of the seven

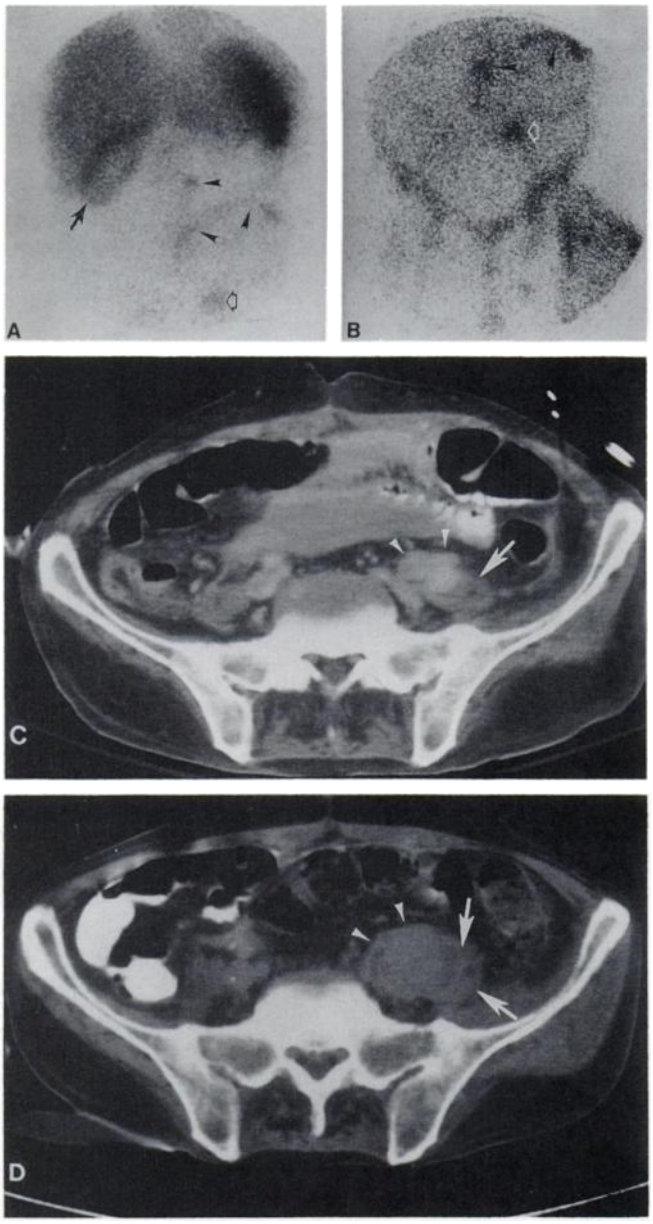

FIGURE 4. A 48-yr-old man (Patient 4) with subacute bacterial endocarditis, positive blood cultures and recent embolic events. (A and B) WBC scan shows focal uptake in gallbladder fossa (arrow) and bowel activity (arrowheads), focal uptake in the left midpelvis (open arrow), and diffuse uptake in the left upper thigh. Initial CT and a second CT scan 1 wk later did not show focal pelvic abnormality due to ileus and ascites. (C) Third CT scan 1 wk later showed a soft-tissue mass (arrow) adjacent to a left common iliac artery aneurysm (arrowheads). (D) Fourth CT scan 4 wk after the WBC scan showed a mixed-density mass in the left psoas region (arrow), involving the left common iliac aneurysm (arrowheads). An infected pseudoaneurysm of the left common iliac artery was found at surgery. The patient had also undergone prior operations for empyema of the gallbladder and debridement of an infected left thigh after a recent above the knee amputation.

patients. On the other hand, WBC imaging correctly predicted the presence or absence of infection in six patients and was indeterminate in one. The combined results of all imaging studies, however, revealed the correct diagnosis in all but one patient. Technetium-99m-HMPAO-labeled leukocytes should allow earlier scintigraphic results to be obtained in these patients (*15*).

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EDITORIAL

Detection of Cardiovascular Infections with Radiolabeled Leukocytes

Cardiovascular infections usually localize to damaged areas of the endothelial wall, areas of thrombosis or prosthetic materials, such as heart valves or grafts. These infections may also spread to form perivascular abscesses. Vascular infections and perivascular abscesses are associated with a high morbidity and mortality if definitive antibiotic and surgical treatment are not instituted immediately. Since clinical symptoms and physical findings are frequently not diagnostic for the presence of infection, nor do they always localize the site, invasive and noninvasive imaging methods are necessary for accurate evaluation. There are two distinct and usually complementary imaging approaches to diagnosis: anatomic and physiologic. The anatomic methods, computerized tomography (CT), magnetic resonance imaging (MRI), ultrasound and contrast arteriography have high spatial resolution that provide exquisite detail of the vascular and perivascular space. If the only step necessary for diagnosis was anatomic definition, physiologic methods would be unnecessary. However, hematomas and seromas next to a vascular graft or native vessel have the same anatomic appearance as an abscess, and noninfected intravascular thrombi, atherosclerotic plaques or prosthetic valves may have the same anatomic appearance as those that are infected. Thus, anatomic methods accurately define cardiovascular structures, but are not specific for diagnosis of cardiovascular infections. In addition, CT and arteriography require intravascular contrast injections for best results, and these cannot be used safely in all patients. Contrast agents are not available for MRI, and cardiac and whole-body ultrasound cannot provide good quality technical studies on all patients, especially those with prosthetic valves. For these reasons, techniques utilizing a physiologic approach are needed for accurate, safe and specific diagnosis of cardiovascular infections.

Radionuclide approaches to identification of cardiovascular infection use radiolabeled, physiologic tracers to detect and localize sites of infection (*1*). Spatial resolution is inferior to anatomic imaging methods due to lower information density, higher background activity and the inherent limitations of radioactive decay. The basic approach involves the identification of a specific target present in high concentrations in the area of infection or that accumulates over time. Traditional targets have included leukocytes, components of the infecting organism or the various protein components present with inflammation. Radiolabeled monoclonal antibodies directed to leukocyte antigens allow in-vivo labeling and have potential for cardiovascular detection of infection. The ideal agent would accumulate rapidly in high concentration at an infected site following intravenous injection and be rapidly cleared from the blood to lower background activity. Detection of vascular or perivascular infections are ideally suited for this approach. There is easy access of the radiolabeled probe to the site of infection and renal, splenic, bone marrow or hepatic clearance, in combination with a large volume of distribution, result in a low background activity in a short time period.

Successful use of radiolabeled leukocytes have been reported for prosthetic valve endocarditis (*2*), detection of large valvular vegetations (*3*) and identification of vascular graft infections (*4,5*). Leukocyte scintigraphy has a useful role only in certain types of endocarditis. That is, only in the presence of increased numbers of leukocytes in association with large vegetations and extensive areas of tissue destruction or abscess formation will there be sufficient uptake to allow imaging. Thus, the sensitivity of this technique will be low in those cases of subacute endocarditis associated with small surface vegetations and minimal tissue destruction. Leukocyte scintigraphy will not be useful for endocarditis screening in patients with underlying cardiac abnormalities who experience episodes of transient bacteremia. Radiolabeled leukocytes are clinically useful in the identifica-

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