more than a two-fold comparison with the initial imaging. At that time, the fistula was continuously excreting pus and ESR also was increased, suggesting aggravation of the infection. One may suppose that platelet contamination could cause significant uptake in leukocyte imaging. Specimens of labeled cells were evaluated both by an automated hematologic analyzer and microscopy. Only minimal contamination of platelets was noted, indicating that ^{99m}Tc uptake was caused by labeled leukocytes.

Gallium-67 imaging was negative twice. This is an unexpected finding because ^{67}Ga scintigraphy has been shown to demonstrate graft infections quite well in earlier reports (*4–6*). Gallium-67 and ^{99m}Tc-WBC imaging gave almost equal results in a recent study (*4*). This case was clinically chronic infection. Gallium-67 has been better than ^{111}In-labeled leukocytes in detection of some chronic infections (*9,10*). Histology of the removed graft and nearby tissue revealed signs of chronic, subacute, and acute inflammation as well as foreign body reaction. Bacterial culture showed infection. Abdominal nonspecific background uptake was not the reason for the negative ^{67}Ga finding. Adequate blood supply is essential in ^{67}Ga accumulation in inflammatory lesions (*11*). The pus cavity around the graft may have decreased blood supply near the graft, thus preventing transferrin-bound ^{67}Ga from reaching the infection site. The transferrin level was not measured and it remains unclear whether a defect in the ^{67}Ga transport system could have been present.

Focal uptake of ^{99m}Tc-labeled platelets in the infected graft was seen 9 mo before the occlusion of the graft. This is in agreement with reports demonstrating that ^{111}In-labeled platelets can be used in the follow-up of prosthetic graft occlusion (*12*). Because of image quality and radiation dose, ^{99m}Tc-labeled platelets could be better in this respect.

Wound cultures after the first operation were negative perhaps due to antibiotic therapy. After fistulation about 1 yr postoperatively, the fistula drainage culture grew several different species of bacteria at different occasions as well as during antibiotic therapy. Although the samples were not taken from the perigraft region, it seems probable that the species of bacteria can be changed in chronic vascular graft infection.

In conclusion, ^{99m}Tc-WBC was the best method in diagnosing chronic vascular graft infection. Quantitative imaging may be helpful in the follow-up of disease. Negative results in ^{67}Ga imaging cannot exclude graft infection.

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EDITORIAL

Chronic Prosthetic Vascular Graft Infection Visualization with Gallium-67

Vorne et al. chronicle the 18-mo saga of a chronically infected femoral-femoral crossover graft that was periodically treated with antibiotics after numerous diagnostic ^{99m}Tc-leucocyte (WBC) and ^{67}Ga scans. It raises some issues regarding the evaluation and treatment of prosthetic vascular graft infections.

Although relatively rare, comprising approximately 2% of arterial reconstructions, graft infections remain a major cause of mortality and significant morbidity in this patient population. The nightmare of the vascular surgeon, this problem poses several dilemmas. The clinical presentation can be quite insidious, delaying the diagnosis and often life-saving treatment. This is particularly true of aortic or retroperitoneal grafts that reside a distance from the skin surface and therefore do not often present with distinct clinical findings unless a bowel fistula occurs. Most peripheral prosthetic graft infections, especially those that involve the groin, are more readily detected because of clinical

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findings such as cellulitis, anastomotic aneurysms, or fluid collections that can develop into a fistula as in this case report. Once the diagnosis is established, another dilemma is to determine the extent of the graft involvement in the infective process. This is important for developing a plan for the appropriate surgical resection and reconstruction, and it is especially true for aortic grafts that involve a bifurcation to either the iliac or femoral arteries. If only one limb of the graft is involved, the vascular surgical approach would resect only the affected portion of the graft and utilize the remainder for a crossover bypass to a more distal artery. If the whole graft is involved, total removal is usually required, necessitating oversewing the distal aorta with its potential acknowledged complication of stump disruption, and extra-anatomic bypass.

There are a number of diagnostic techniques that have been described for making the diagnosis of graft infections. Two were utilized in the article by Vorne et al.: ^{99}Tc-WBC and ^{67}Ga scans. Gallium-67 imaging is rarely used for diagnosing intra-abdominal or vascular graft infections. The ^{67}Ga scan is difficult to interpret in the abdomen where there is often a high background accumulation of tracer especially in the spleen, liver, and the gastrointestinal tract.

Other imaging techniques have been investigated to help better diagnose prosthetic graft infections, including ultrasonography, CT scan, sinography, and arteriography. Although some of these techniques can be very sensitive and reveal morphologic abnormalities such as anastomotic aneurysm or fluid collections indicative of a prosthetic graft problem, none of these tests are very specific. With the recent advent of magnetic resonance imaging (MRI), edema and collections can be very well visualized along bypass grafts in any location including the retroperitoneum. MRI scanning has not been extensively investigated for this problem and could be too nonspecific. However, with the continued improvement of MRI imaging, further study is warranted to determine its utility for the diagnosis of prosthetic graft infection.

A recent technique that has been under development is ^{111}In labeling of human immunoglobulin-G (IgG) for the detection of focal vascular graft infections. This nuclear medicine technique is very promising for the detection of inflammation with a very high specificity (100%) and sensitivity (91%) in the 25 patients who were studied. There were several important lessons in this study. First, repeated daily imaging to 48 or 72 hr was important in determining the presence of inflammation. The initial baseline scan would delineate the intravascular patent anatomy and provide a control for the subsequent scans. This is particularly helpful for this patient population because of previous surgery and variations in anatomy or size of the arteries. The follow-up studies have significantly diminished activity in the intravascular space, while the areas of inflammation, when present, would concentrate tracer. It is only in the instances of the increased accumulation of radiolabeled tracer in the area of the graft when the test is considered positive.

There are several other advantages to the ^{111}In-IgG scan. The test does not require the removal of leukocytes from the patient, and therefore there is no chance of cross-labeling of platelets. The IgG has a long shelf-life and can be readily labeled with radioactive tracer. A higher concentration of ^{111}In can be safely administered to the patient for these scans since the IgG is not sequestered in the spleen as are leukocytes, and there is therefore a higher signal to the background ratio. However, like the labeled ^{99}Tc-WBC scan, the labeled IgG scan has the shortcoming that if active inflammation is not present in the area of infection at the time of the scan, there will be a false-negative result. This is particularly common after a course of antibiotic therapy and they also require repeat imaging, resulting in a delay before results can be interpreted. Also, there is poor imaging in the hepatic and splenic area.

Although the labeled WBC and IgG scans are diagnostic techniques with a good specificity to screen patients for localized inflammatory processes, they can be inaccurate in delineating the extent of the prosthetic graft involvement. Therefore, in combination with MRI, these diagnostic techniques provide different and complementary information which together can best determine the presence and extent of prosthetic graft infections.

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