Aortofemoral Graft Infection: The Usefulness of 99mTc-HMPAO-labelled Leukocyte Scan

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Introduction

The infection of a prosthetic vascular graft is the most serious complication in reconstructive vascular surgery. This complication is rare, but is characterised by high mortality and morbidity rates.1,2

Poor surgical outcome is mostly dependent on the complications of the advanced graft infection such as retroperitoneal abscess or aortoenteric fistula, while low-grade infections seem to be responsible for lower mortality rate.3-9

The main clinical problem in prosthetic vascular graft infection is to establish instrumental diagnostic methods that can identify low-grade infection, permitting the early treatment of patients under optimal surgical conditions. Although the diagnostic value of conventional radiographic methods, such as computed tomography or ultrasound, has been proved in patients with advanced graft infection,10,11 the early diagnosis of prosthetic graft infection by these methods is often difficult. The aim of this work is to evaluate the clinical usefulness of the scintigraphic methods based on white blood cells labelled with 99m-technetium-hexametazime (99mTc-HMPAO) in the early diagnosis of prosthetic vascular graft infections.

Materials and Methods

Ninety-seven scans with 99mTc-HMPAO-labelled leukocytes were performed on 75 patients (54 males and three females) with suspected aortofemoral graft infection. The mean age of the patients was 62 years, range 36–77. All patients had undergone previous reconstructive surgery for aortoiliac obstructive diseases or aortic aneurysm. The separation and labelling technique used for the white cells was as described by Peters et al.12 The administered dose was 185 MBq. Two hours after the injection of the labelled leukocytes, 5 min static acquisitions of the abdomen were carried out in anterior, right anterior oblique (45 or 30 degree) and left anterior oblique (45 or 30 degree) views. Scintigraphic studies were performed on a large-field-of-view digital gamma-camera, equipped with a low-energy, all-purpose collimator. The type and the number of the studied grafts were as follows: aortobifemoral (63), aortoaoctic (16), aortofemoral (eight), aortobi-iliac (six), iliofemoral (four). The prosthetic material used was knitted Dacron in 82 scans and polytetrafluoroethylene (PTFE) in 15 scans.

According to the clinical findings at the time of scanning, patients were categorised into three groups. Group A included 17 scans, performed in 15 patients who had specific signs of graft infection: groin abscess, graft exposure and graft sinus tract, associated, in some cases, with prodromal gastrointestinal bleeding and persistent dull abdominal or back pain. Forty-six scintigraphic studies, carried out in 32 patients with non-specific signs and symptoms of graft infection, including vague abdominal pain, general malaise, low-grade fever, leukocytosis, anaemia and increased erythrocyte sedimentation rate were categorised in group B. In group C, 28 patients who had anastomotic aneurysm variably associated with abdominal pain, elevated erythrocyte sedimentation rate and low-grade fever, were submitted to 34 scans.

The scintigraphic images were separately reviewed.
Table 1. Results in relation to the type of prosthetic graft.

<table>
<thead>
<tr>
<th>Graft</th>
<th>True-positive</th>
<th>True-negative</th>
<th>False-positive</th>
<th>False-negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortobifemoral</td>
<td>19</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Aortoaortic</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Aortofemoral</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Aortoiliac</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Iliofemoral</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>33</td>
<td>3</td>
<td>0</td>
<td>97</td>
</tr>
</tbody>
</table>

Sensitivity = 100%; specificity = 91.6%; accuracy = 96.9%.

Table 2. Results in relation to the clinical signs of vascular graft infection.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. scans</th>
<th>True-positive</th>
<th>True-negative</th>
<th>False-positive</th>
<th>False-negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>B</td>
<td>46</td>
<td>21</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>C</td>
<td>34</td>
<td>24</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>97</td>
<td>61</td>
<td>33</td>
<td>3</td>
<td>0</td>
<td>97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groups A + B + C</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>91.6</td>
<td>96.9</td>
<td></td>
</tr>
<tr>
<td>Groups B + C</td>
<td>100</td>
<td>91.4</td>
<td>96.2</td>
</tr>
</tbody>
</table>

by two specialists who were unaware of the patient’s clinical symptoms. Only the scans judged as positive or negative by both specialists were accepted as really being positive or negative. In doubtful cases a third specialist was considered the final arbiter. The reliability of 66 scintigraphic results was assessed, in patients who underwent surgery, by intraoperative results of Gram staining, aiming to prove the presence of leukocytes, bacteria or both, and by graft culture results. In patients not undergoing surgery, the reliability of 31 scintigraphic results was assessed by an 18-month clinical follow-up, carried out to ascertain the presence of graft infection.

Results

The results of scintigraphic studies in relation to the type of the prosthetic graft and the overall accuracy of the procedure are shown in Table 1: one false-positive case was found in the aortobifemoral, aortobi-iliac and iliofemoral graft groups. Table 2 shows the scintigraphic results in relation to the clinical signs of vascular graft infection and the comparison between overall accuracy and accuracy calculated only on the patients of the groups B and C. The percentage of true positive cases is high in group A and seems to decrease in groups B and C according to the progressive decrease of the clinical suspicion of graft infection. On the other hand, the true negative rate increases from group A to group C for the same reason. No false-negative and three false-positive cases were found. As can be seen, no significant difference was found between the overall accuracy and the accuracy calculated for the patients of the groups B and C alone. The results of the study in relation to the prosthetic material are shown in Table 3: two false-positive cases in the group of knitted Dacron prosthesis and one false-positive case in the group of PTFE prosthesis were found.

Discussion

In the last 10 years the white blood cell scan has been proposed for the diagnosis of graft infections. Scintigraphy with 99mTc-HMPAO-labelled white blood cells seems to be the most widely used method. This is probably due to the greater availability of the 99m-Tc and to the possibility of reaching diagnostic conclusion within a few hours from the injection of the labelled cells. Moreover, the rapid physical decay of 99m-Tc allows a higher radioactivity dose administration and consequently a higher count-rate and better quality imaging.

Previous reports have shown sensitivity and specificity rates similar to our cumulative results. However, these studies were performed on patients not subdivided according to the severity of clinical findings at the time of scanning. In 1993 a prospective study carried out by our group demonstrated sensitivity and specificity rates of 100% and 94.4%, respectively, in 18 patients without specific signs of graft infection. However, this study referred to a relatively small number of patients in whom vascular graft infection was not clinically evident and needed a larger number of studied cases. The present experience confirms the above mentioned results on a larger number of cases, showing the ability of 99mTc-HMPAO-labelled leukocyte scan to detect graft infections in various stages of the disease and, more importantly, in its low-grade stages. In fact 46 scintigraphic studies were carried out in patients with non-specific signs and symptoms of graft infection, and only three false-positive cases were observed.
False-positive results of the leukocyte scan have been reported in different clinical conditions such as pseudoaneurysms, intraprosthetic thrombosis, haemato ma or lymphocele. In our series, three false-positive cases were found in three patients with anastomotic aneurysms, in which the absence of overt signs of infection was documented at surgery. Similar results have already been reported and related to the labelling of "contaminating" platelets and red cells. Nevertheless, this explanation is unsatisfactory because it has been reported that the HMPAO white blood cell labelling method produces low contamination of platelets, a possible solution could be to perform a dynamic study and images at 5 min from injection of labelled cells, as proposed by Prats et al., in order to detect pseudoaneurysms by comparison with delayed scans.

Conclusion

Because of the low false-positive rate and the absence of false-negative cases, we conclude that the 99mTc-HMPAO-labelled leukocyte scan is an accurate method in detecting prosthetic vascular graft infection, particularly in low-grade stages.

References