Diagnostic Imaging Techniques in Vascular Graft Infection

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Introduction

The incidence of prosthetic vascular graft infection ranges from 0.5 to 2.5% and is still associated today with high morbidity (30%) and mortality (25-75%) rates.1,2 In at least half the cases, manifestation of infection occurs during the first month after the operation (early infection), while in the remaining half it may occur at any time up to 10 years after the graft implantation (late infection).3

The diagnosis of infection of the retroperitoneal portion of an aortic graft that often manifests with subtle and non-specific clinical signs is extremely difficult, and many diagnostic techniques have been used.4,5 At present, research is directed towards early diagnosis of infection in order to reduce complications linked to redo surgery. If an early diagnosis can be made, there is a significant reduction of the mortality rate from 43 to 19%. Table I lists the current diagnostic investigations for prosthetic graft infection, together with relative sensitivity and specificity.2

Table I. Sensitivity and specificity of diagnostic investigation in late prosthetic infection.

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computed tomography</td>
<td>57</td>
<td>100</td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>85</td>
<td>100</td>
</tr>
<tr>
<td>Indium 111-labelled leukocytes</td>
<td>96</td>
<td>85</td>
</tr>
<tr>
<td>Indium 111-labelled IgG</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td>99m-technetium labelled</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>Indium 111-labelled avidina/biotina</td>
<td>100</td>
<td>195</td>
</tr>
</tbody>
</table>

Fig. 1. CT scan of periprosthetic collection with presence of bubble gas.

Computed Tomography

The wide availability of computed tomography (CT) means that this method is an almost obligatory step towards detecting prosthetic infection. The use of CT scans in the diagnosis of retroperitoneal prosthetic infection was advocated by Haaga et al. in 1978, who suspected the diagnosis on the basis of the presence of perigraft gas bubbles. He defined the diagnostic criteria that includes the presence of a perigraft collection, the presence of gas bubbles and density alteration of soft tissue6 (Fig. 1). The main problem is that the absence of these signs does not exclude infection.

Moreover, as demonstrated by Brown et al. and others, in the immediate postoperative period the CT scan, as with other methodologies, has difficulty in distinguishing a retroperitoneal haematoma from a perigraft abscess within 7-12 weeks after the operation.7-9 The sensitivity can be improved by the use of CT-guided fine needle aspiration of the collection, as suggested by Cunat et al.10 This seems to be a safe, reliable method of confirming the diagnosis, even in the early stage.11
Scintigraphic Techniques

In comparison to morphological diagnostic exams, these seem to play a predominant role in the diagnosis of low grade infection, allowing for early detection of the infective process. Various techniques are used. The gallium-67 scan was introduced in 1980 by Causey et al. and is considered an outdated method due to its aspecific accumulation in the liver, spleen and the gastroenteric tract, which makes interpretation difficult. The indium 111-labelled leukocytes scan is more commonly used. False-positives may be linked to the incorporation of marked platelets, but it seems capable of excluding with certainty the presence of infection.

Further evolution is found in the use of marked IgGs introduced by LaMuraglia et al. in 1989. This has the advantage of not producing marked platelets and, therefore, of avoiding false-positives. The results are encouraging even if experience is still limited to only a few groups. More recently, technetium 99m-hexametizime was introduced. This combines reduced picture-taking time with a higher sensitivity (100%), but with a far from negligible number of false-negatives. The main limitation of scintigraphic techniques seems to be that of false-positives. A recent study conducted with avidine and biotine marked with indium 111 seems to overcome this limitation, even though the number of patients included in this study was limited.

Magnetic Resonance Imaging

In 1985 the first data regarding the use of magnetic resonance imaging (MRI) in prosthetic graft infection was reported by the radiology group of San Francisco. The Olofsson et al. study of 1988 is still the pilot study, with a diagnostic accuracy of between 88 and 94%. Thanks to its intrinsic characteristics of multiplanarity, this method permits differentiation and characterisation of the tissue, accurately evaluating the extension of the infective process. Moreover, with this method the main diagnostic cut-off is 6 months from the operation, a span during which modifications take place that are difficult to differentiate from the normal physiology of prosthetic incorporation.

The possibility of also emphasising the involvement of perigraft tissues (psoas muscles) and of using paramagnetic means of contrast (EDTA-gadolinium), which are electively picked up by infected tissues, makes this method particularly sensitive. A recent study conducted with STIR-MR seems to supply a better definition of the extension of the infective process, improving the contrast between normal fat and fluid collections.

The Authors' Experience

The diagnosis of early low grade infection calls for the identification of alterations to the normal process of prosthetic incorporation. With regards to this aspect, in a previous study we used MR to evaluate the normal process of incorporation of an aortic graft and today we can define physiological events with certainly. This will allow for early definition of anything that differs from this normal evolution. In all the patients studied, a periprosthetic collection was present which was reabsorbed (in relation to the type of pathology, anastomosis and the presence or absence of retroperitoneal drainage) from between 3 and 6 months after the operation, with a progressive reduction of signal intensity in T1 and T2 weighted sequences (Fig. 2).
perigraft collection at high intensity in T2 w.s. with involvement of the latter was identified during the initial phase in this way, should the patient later show dubious clinical signs, we can make a certain diagnosis. Out of 119 cases studied up until now, three cases of infection occurred, two of which were early and one late. The latter was identified during the initial phase thanks to this diagnostic comparison. However, it is too early for definitive results.

Conclusions

The problem of early diagnosis of a prosthetic infection has yet to be solved, although scintigraphic methods and MR are apparently beginning to give encouraging results. For a patient with a serious clinical suspicion of infection, there should be no fear of making a diagnosis, nor should precious time be wasted. A positive scintigraphic or magnetic resonance test in a patient with dubious clinical signs should be followed by an early operation, which will reduce the risk of septic complications.

References