Ultrasonography after hip arthroplasty

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Abstract. Ultrasonography was performed in 55 patients who had total Charnley hip arthroplasties. Effusions were identified in 19 patients and confirmed in all but 3 by arthrocentesis or at surgery. Aspirations were performed in 5 and demonstrated infection in 2. It is concluded that ultrasound is a valuable noninvasive method for assessing painful hip arthroplasty. It can demonstrate the presence of effusion, which should be aspirated to exclude infection.

Key words: Hip joint arthroplasty – Ultrasonography

Infection and aseptic loosening are the two most common complications of total hip arthroplasty [2, 4, 6, 10–14, 16]. Early diagnosis is especially important. After physical examination, the following procedures may be ordered: plain radiography, radionuclide bone scan, arthrography, and aspiration [6, 14]. There is scant information on ultrasound as a means of investigating surgically treated hip joints [1, 7]. Loosening of hip prostheses may be the consequence of a synovitis [2, 4, 6]. In this study we have attempted to answer the following questions: (1) Can an effusion in a prosthetic hip joint be detected by ultrasound, independent of etiology? (2) What is the accuracy of ultrasound of the hip joint in patients with total hip replacement? (3) What are the causes of nonmechanical and aseptic loosening, and how can ultrasound help to identify them? (4) Can early diagnosis aid therapeutic intervention? and (5) What is the incidence of effusion detected by ultrasound in the contralateral, painless, untreated hip?

Materials and methods

Fifty-five patients (37 women and 18 men) who had Charnley hip arthroplasties carried out 6 months to 8 years previously were studied. The mean age was 65 years, with a range of 57–68 years. None of the patients had complications within 3 months of surgery.

Twenty-five patients complained of hip pain. All had undergone plain radiographs of the hip, and 10 had technetium-99m pertechnetate (99mTcO4) bone scans. Twenty of the patients subsequently had second operations. Fluid was obtained from 3 of 5 patients who had arthrocentesis. Arthrocentesis was performed with a 20 gauge needle using the freehand ultrasound-guided technique [3]. The needle was directed in the sagittal plane toward the neck of the prosthesis and was maintained caudal to the transducer head. The needle was then guided into the effusion under sonographic control [9]. The transducer was covered with a sterile glove, and sterile gel was used. Routine hematology, blood biochemistry, and cultures were obtained in all patients. Synovial fluid obtained in 3 of the 5 patients who underwent arthrocentesis was examined for total and differential cell counts and lactic dehydrogenase and glucose levels, and crystals, and was cultured.

Ultrasound was performed in 55 patients. Of the 25 patients who had pain following arthroplasty, 20 had second operations, and 5 had arthrocentesis. Control ultrasound was only performed in the latter group.

Ultrasound was also performed on the untreated contralateral hip of the 20 patients who had second operations. Radiographs of these painless hips showed only mild osteoarthritic changes.

Thirty patients who had successful Charnley hip arthroplasties were studied as controls. Five of these patients had bilateral arthroplasties.

Ultrasound examinations were performed with a Hitachi EUB 450 real-time scanner with a 5-MHz transducer. Scanning was done in the sagittal plane, parallel to the neck of the prosthesis. An effusion was defined as fluid within the capsule [1, 7] (Fig. 1).

Results

Table 1 summarizes the findings in 20 patients with hip pain due to loosening of the prosthesis; this group underwent second operations.

Of the patients who were considered to have aseptic loosening on clinical grounds, 4 had sonographic evidence of effusion. Effusion was surgically confirmed in 3, as well as in 1 of the remaining 6 patients who had negative ultrasound examinations. One of the 3 patients who had a positive ultrasound result and an effusion confirmed at the second operation was shown to have a Pseudomonas aeruginosa infection (Fig. 2). Infec-
Fig. 1. Ultrasonogram of hip joint showing large amount of effusion (effusio in Hungarian). The capsule is outlined by arrows. The horizontal lines below indicate echoes from the metallic neck of the prosthesis. The effusion was shown to be noninfective

Fig. 2. A further example on the right of effusion following Charnley arthroplasty. This was proven to be infected at operation. Note the small echoes in the effusion, which are more frequent in infected effusions. The operated hip on the left shows no evidence of effusion

Table 1. Results of radiographs, radionuclide bone scans, and ultrasonography in 20 patients who had second operations because of painful loosening of the prosthesis following Charnley arthroplasties

<table>
<thead>
<tr>
<th></th>
<th>X-radiography evidence of loosening</th>
<th>Radionuclide bone scan</th>
<th>Ultrasonography</th>
<th>Fluid present at surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noninfective*</td>
<td>Positive 7</td>
<td>Not done</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Negative 3</td>
<td>Not done</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Possibly infective*</td>
<td>Positive 10</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Negative 0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* As determined by clinical laboratory findings prior to second operation

Table 2. Data base for calculation of sensitivity and specificity of ultrasound

<table>
<thead>
<tr>
<th></th>
<th>True positive</th>
<th>False positive</th>
<th>True negative</th>
<th>False negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reoperated</td>
<td>20</td>
<td>13</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Arthrocentesis</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Sensitivity: 92.8%; specificity: 83%

and responded to antibiotic therapy. In the remaining 2 patients, it was not possible to aspirate any fluid from the affected hip joints.

Ultrasound demonstrated an effusion in only 1 of 30 painless hip joints which had been surgically treated. It was not considered ethical to attempt aspiration in an asymptomatic patient with an effusion demonstrated on ultrasound examination. However, it is of interest that the effusion could not be demonstrated 2 weeks after treatment with a nonsteroidal anti-inflammatory analgesic. In the group consisting of 20 subjects who had second operations and 5 who had painful hips after joint surgery, 2 were shown to have an effusion of the contralateral untreated hip. These effusions were confirmed by aspiration. Both patients had mild pain due to mild osteoarthritis. Data in the literature [8] suggest a high sensitivity and lower specificity for sonographic detection of effusions. The sensitivity calculated for our study in patients treated with second operations was 92.8%; the specificity was 83.3% (Table 2).

Discussion

The purpose of this study was to determine the value of ultrasound in assessing the failed hip arthroplasty. In many cases, the postoperative pain is due to mechanical loosening of the prosthesis. This may give rise to a secondary inflammation of the synovium, probably as a result of a foreign body reaction [2, 6, 15]. In addition to this aseptic process, infection may supervene. In both instances, effusions may develop. We hoped that ultrasound might prove a useful noninvasive procedure to confirm the presence of such an effusion.

In 13 of 14 patients, it was possible to obtain surgical confirmation of the presence of a hip joint effusion identified by ultrasound. Thus, the incidence of false posi-