Validity of Magnetic Resonance Imaging in Early Rheumatoid Arthritis

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Abstract

Aim of Study: To assess the diagnostic value of magnetic resonance (MR) imaging in patients with possible early-stage RA in whom the clinical diagnosis is equivocal and who present with polyarthralgia without radiographic evidence of RA.

Patients and Methods: This study comprised 81 patients (20 men and 61 women; mean age, 44 ± 12.7 years), who attended or were referred to the Rheumatology Clinic of Abha Private Hospital. Patients presented with persistent polyarthralgia with possible early-stage rheumatoid arthritis (RA) and without radiographic evidence of RA. Postero-anterior and oblique hand radiographs in all patients were obtained and interpreted. Participant patients underwent contrast-enhanced MR imaging as part of their diagnostic work-up. To confirm the final diagnosis, patients were instructed to do follow-up visits to the Rheumatology Clinic for at least one year after the MR imaging. A total of 11 patients were excluded from our study as they did not continue their one-year follow-up visits to the Rheumatology Clinic after having the MR imaging.

Results: The confirmed diagnoses of 70 patients were that 38 patients had RA, while 32 had non-RA diseases. By applying the MR imaging criterion, 38 patients were classified as having RA and 32 were classified as having a non-RA condition. The sensitivity of the MR imaging proved to be 97.4%, while its specificity was 90.6%. Positive predictive value was 92.5% while the negative predictive value was 96.7%. Its diagnostic accuracy was 94.3%.

Conclusions: The MR imaging criterion shows excellent validity with high sensitivity, specificity, predictive values and accuracy for the diagnosis of early-stage RA.

Recommendation: MR imaging be added as a useful tool for the evaluation of patients suspected of having early-stage RA.

Key Words: Rheumatoid arthritis – Magnetic resonance – Validity.

Introduction

RHEUMATOID arthritis (RA) is a common inflammatory arthritis, characterized by clinical manifestations associated with synovial inflammation of joints. The diagnosis of RA is based primarily on patients' clinical findings. It is sometimes difficult even for the trained rheumatologist to differentiate cases of early-stage RA from those of other diseases with joint manifestations. Joint erosions have been reported to begin within the first 2 years after disease onset [1]. Traditionally, the therapeutic approach or RA was based on non steroidal anti-inflammatory drugs (NSAIDs), which usually provide symptomatic relief but do not suppress the radiographic changes. Earlier control of the disease can be done by more aggressive therapy with drugs referred to as "disease-modifying anti-rheumatic drugs". Hence, the great importance of early diagnosis of RA [2,3].

Classifying patients as having RA or a non-RA condition was described in the 1987 ARA revised criteria [4]. The traditional format includes combinations of variables that are most sensitive and specific to the classification of RA. These variables are: (a) morning stiffness in and around the joints that lasts at least 1 hour before maximal improvement; (b) soft-tissue swelling (arthritis) of three or more joint areas observed by a physician; (c) swelling (arthritis) of the proximal interphalangeal (PIP), metacarpophalangeal (MCP), or wrist joints; (d) symmetric swelling (arthritis); (e) rheumatoid nodules; (f) the presence of rheumatoid factor; and (g) erosions and/or peri-articular osteopenia in hand and/or wrist joints on radiographs.

Magnetic resonance (MR) imaging has reportedly enabled clinicians to visually detect bone erosion and active synovitis long before the changes are visible on conventional radiographs. The detection of active synovitis can be done by means of post-contrast MR imaging with increased diagnostic accuracy [5,6].
Validity of MRI in Early Rheumatoid Arthritis

Aim of study:
The aim of our study is to assess the diagnostic value of MR imaging in patients with possible early-stage RA in whom the clinical diagnosis is equivocal and who present with polyarthritis without radiographic evidence of RA.

Material and Methods

Patients:
The present study comprised 81 patients (20 men and 61 women; mean age, 44±12.7 years; age range, 19-70 years), who attended or were referred to the Rheumatology Clinic of Abha Private Hospital during the period from January 2005 to January 2006. Patients presented with persistent polyarthritis (i.e., arthralgia of 3 or more joint areas) with possible early-stage RA and without radiographic evidence of RA. Postero-anterior and oblique hand radiographs in all patients were obtained and interpreted.

MR imaging:
Participant patients underwent contrast-enhanced MR imaging as part of their diagnostic work-up. To confirm the final diagnosis, patients were instructed to do follow-up visits to the Rheumatology Clinic for at least one year after the MR imaging. A total of 11 patients (out of the 81 patients) were excluded from our study as they did not continue their one-year follow-up visits to the Rheumatology Clinic after having the MR imaging.

MR imaging of the hand was performed with a 1.5-T superconducting magnet (Magnetom vision Siemens), equipped with a surface coil. The patient was placed in the prone position with the arm to be examined extended overhead toward the midline and the hand positioned in the center of the coil. The wrist was positioned palm downward and secured with restraining bands. Flexion contracture of the joint, if present, was corrected with relatively tight compression of the hand against the surface coil by means of a plastic board. This resulted in alignment of the metacarpal bones with the phalanges.

Multiple coronal MR images of the hand were obtained by using a fat-suppressed T1-weighted spin-echo sequence (repetition time msec/echo time msec=380/20, 4-mm section thickness with 1-mm intersection gap) before and after contrast enhancement. Contrast-enhanced images were obtained after bolus injection of 0.1mmol/kg (magnevist) into a vein in the contralateral arm. Then injection of magnevist was performed complete the examination. MR images are obtained including the distal radioulnar joint and the distal interphalangeal joints.

Working MR imaging criterion for RA:
No intense enhancement was observed in the wrists and hands of normal individuals. Patients with known RA demonstrate intense bilateral contrast enhancement in the wrists and/or MCP and/or PIP joints in both hands [7]. On this basis, we determined the criteria of diagnosis of early RA using MR imaging. When enhancement was seen bilaterally in the wrist, MCP and/or PIP joints of both hands in a patient with clinically possible early-stage RA who presented with polyarthritis but no radiographic evidence of RA and does not have any criteria of other non-RA disease, the patient was categorized as having RA. When the enhancement was seen only in the wrist, MCP and/or PIP joints of one hand or was not seen in either hand, the patient was not categorized as having RA (i.e., non-RA disease). Bilateral involvement of wrist, MCP, or PIP joints without absolute symmetry was an accepted finding. High post-contrast intensity indicates active synovitis. With this technique, the area of enhancement corresponds to the anatomic distribution of active synovitis [8].

Radiologic interpretation and follow-up assessment was based on the method of Larsen et al. [9]. Grading was as follows: Grade 0: Normal findings; grade 1: Slight abnormality; grade 2: Definite early abnormality; grade 3: Medium destructive abnormality; grade 4: Severe destructive abnormality and grade 5: Multilating abnormality.

Data analysis:
Only 70 patients out of the 81 were included in our study as 11 patients were lost to follow-up due to discontinued visits to our clinic. The RA or non-RA diagnosis was established after clinical follow-up for one year based on the MR diagnostic images. The diagnostic effectiveness of the MR imaging criterion was compared with that of the traditional format of the 1987 ARA revised criteria for RA [4].

Diagnostic validity of MR was calculated according to Spitalnic [10], as follows:

Sensitivity = True positive / True positive + False negative X 100
Specificity = True negative / True negative + False positive X 100
Positive predictive value = True positive / True positive + False positive X 100
Results

After completing the follow-up, the confirmed diagnoses of 70 patients were that 38 had RA, while 32 had non-RA diseases [osteoarthritis (n=12), reactive arthritis (n=2) and unclassified self-limited arthritis (n=18)], as shown in Table (1).

By applying the MR imaging criterion, 38 patients were classified as having RA and 32 were classified as having a non-RA condition. Among the patients who were MR criterion-positive for RA, 26 fulfilled the ARA criteria for RA at the time of entry and 11 eventually fulfilled the ARA criteria before the end of the study. Hence, the use of the MR imaging criterion resulted in correct diagnosis in 37 of 38 patients with true RA and in 3 false-positive diagnoses in 32 patients with a non-RA condition, as shown in Table (2). Consequently, the sensitivity of the MR imaging proved to be 97.4%, while its specificity was 90.6%. Positive predictive value was 92.5% while the negative predictive value was 96.7%. Its diagnostic accuracy was 94.3%.

The final diagnoses in the 3 false-positive cases were, osteoarthritis (n=2) and transient arthritis related to a viral infection (n=1). MR images in the patients with osteoarthritis showed incomplete fat suppression around the joints. This area of incomplete fat suppression may lead to erroneous interpretation as active synovitis. In the patient with a final diagnosis of transient arthritis related to a viral infection, MR images showed bilateral intense enhancement in the wrists, PIP joints and MCP joints (Figs. 1, 2). On the basis of the MR imaging criterion, follow-up of cases revealed one false-negative case. MR images in this patient showed monoarthritis in one hand.

Table (1): Confirmed diagnoses after one-year follow-up (n=70).

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheumatoid arthritis</td>
<td>38</td>
<td>54.3</td>
</tr>
<tr>
<td>Non-rheumatoid arthritis:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unclassified self-limiting arthritis</td>
<td>18</td>
<td>25.7</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>12</td>
<td>17.1</td>
</tr>
<tr>
<td>Reactive arthritis</td>
<td>2</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Table (2): Comparison of results of MR imaging criterion and ARA criteria.

<table>
<thead>
<tr>
<th>Diagnosis according to 1987 ARA revised criteria</th>
<th>RA</th>
<th>Non-RA disease</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA</td>
<td>37</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>Non-RA disease</td>
<td>1</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>32</td>
<td>70</td>
</tr>
</tbody>
</table>

Sensitivity: 37/38=97.4%  Diagnostic accuracy = 66/70=94.3%
Specificity: 29/32=90.6%  Positive predictive value: 37/40=92.5%
Negative predictive value: 29/30=96.7%

Discussion

The results of this prospective study showed the high validity of the MR imaging diagnostic criteria for early RA. The MR imaging criterion could be used to distinguish true RA with high sensitivity (97.4%), specificity (90.6%), positive
predictive value (92.5%), negative predictive value (96.7%) and diagnostic accuracy (94.3%).

In comparison with the 1987 ARA revised criteria for the classification of RA, the MR imaging criterion appears to be a useful tool for assistance in the diagnosis of early RA. Basically, the 1987 ARA criteria for RA were purposefully formulated to facilitate the classification of RA rather than for the clinical diagnosis of the disease [4]. Results of the present study confirmed that, depending on MR criteria, the diagnostic performance of early RA stage of disease can be enhanced.

In our patients’ series, we encountered one false-negative result determined on the basis of the MR imaging criterion. MR images in this patient showed monoarthritis in one hand. Patients with RA may have monoarthritis or oligoarthritis in one hand in the early stage [11]. This case emphasizes the importance of follow-up examination when the initial MR images reveal active synovitis, even if present in only one hand.

In conclusion, the MR imaging criterion shows excellent validity with high sensitivity, specificity, predictive values and accuracy for the diagnosis of early-stage RA. It is recommended that MR imaging be added as a useful tool for the evaluation of patients suspected of having early-stage RA.

Acknowledgments:

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References


