Rheumatoid Arthritis: MR Imaging of the Wrist (A Preliminary Report)

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Purpose: To evaluate the optimal pulse sequences in the detection of erosions and for the discrimination of the effusion from pannus.

Materials and Methods: MR studies were performed in thirteen patients with clinical diagnosis of rheumatoid arthritis. We used a 1.5T MR unit with single or dual 3 inch coil. We compared coronal images at the same location, obtained with pulse sequences of T2, T2 with fat saturation, and postcontrast T1 with fat suppression. Erosions were assessed by comparing the count of the numbers of erosions depending on each imaging method. A four point scoring systems was used for the comparison of conspicuity of lesion.

Results: T2WI with fat suppression and postcontrast T1WI with fat suppression were better than conventional T2WI in the detection of erosions. The pannus had a heterogeneous signal on T2WI, some of which were enhanced after the intravenous injection of MR contrast agents.

Conclusion: We suggest that the fat suppression T1WI with enhancement or the fat suppression T2WI were better than conventional T2WI for detecting both bone erosion and pannus. The postcontrast MR imaging may often be helpful in distinguishing pannus from the effusion.

Index Words: Arthritis, rheumatoid joints, MR wrist, MR wrist, arthritis

INTRODUCTION

Rheumatoid arthritis can occur in the middle age women and one of the common arthritides. The clinical diagnosis is often established by the criteria (1). Only one of seven of these criteria is relevant to the radiographic manifestation. However, the importance of the early detection of bony erosions on radiographs have been emphasized. Recognition of the radiographic findings may be helpful for the differential diagnosis of the arthropathy.

Although several investigators reported on the utility of the MR imaging in rheumatoid arthritis (2-10), the roles of MR imaging and the best pulse sequence have not been well established yet. Thus, authors report here to determine the best pulse sequence for the detection of erosions and to evaluate whether it is possible to discriminate the effusion from pannus in rheumatoid arthritis.

MATERIALS and METHODS

In thirteen patients rheumatoid arthritis was established according to the American Rheumatism Association Criteria (1). There were nine female and four male patients. Patients had the ages ranging from 22 to 60. All MR examinations were performed on a 1.5T imager (Signa, GE Medical Systems, Milwaukee, WI) with positioning the forearm in the neutral position beside the body. We used the following imaging parameters in this prospective study: the field of view was 8 cm; the matrix size was 256 × 192; the slice thickness and interslice gap were 3 mm and 1 mm respectively; the number of acquisition was one. We used a single or dual 3 inch coil. We obtained proton-weighted images.
(PWIs) and T2-weighted images (T2Wls) with repetition time (TR) of 2000 msec and an echo time (TE) of 20/70 msec, and also obtained PWIs and T2Wls with a chemical fat saturation using a same TR and TEs. Postcontrast T1Wls with a chemical fat suppression was obtained immediately after a bolus injection of gadopentetate dimeglumine with a dose of 0.1 mmol/kg body weight.

We tried to compare the three pulse sequences for the evaluation of erosions and pannus. For the evaluation of erosion of carpal bones, distal radius and ulna and proximal metacarpi, we used counting the numbers of erosions of each bone and we decided count two when the erosion was greater than 5 mm. For assessing the conspicuity of the pannus, we used scoring system as follows: 1 = none; 2 = poorly visualized; 3 = moderately visualized; patients. The number of erosions was also assessed using radiographs. Statistical analysis were performed to compare the difference in the detection capability of the erosive lesions and in the conspicuity of pannus detection according to the examination methods by utilizing a one-way analysis of variance (ANOVA) test.

**RESULTS**

For both the lesion detection (Fig. 1) and the evaluation of the conspicuity of lesions (Fig. 2) T2WI with a fat suppression and postcontrast T1WI were significantly better for the detection of lesion number at 95% confidence interval than conventional T2WI. There were no difference between T2WI with a fat suppression and postcontrast T1WI.

The signal intensity of intraarticular lesions were shown heterogeneously on the images, obtained with three pulse sequences. We could classify the five patterns of the signal characteristics which were shown in the Table 1. On T2WI some were shown as the intermediate signal lesions whereas others were as the high signal lesions. Of lesions with intermediate signal some appeared as enhanced lesions, in contrast to others did not (Fig. 3).

**DISCUSSION**

Rheumatoid arthritis is diagnosed on the basis of clinical manifestations rather than radiographic findings. The diagnostic criteria have been widely used (1), which was revised by the American Rheumatism Association. Radiographs play roles for determining which joints are involved as well as for evaluating the progression of disease. There has been reported on earlier radiographic changes in the feet than in the hands (11). Thus, there is a limitation of the revised criteria (11) which includes only radiographic changes in wrist and hand. It is hard to represent the disease

<table>
<thead>
<tr>
<th>Pulse sequence</th>
<th>T2WI</th>
<th>T2WI + FS</th>
<th>T2WI + FS + Gd</th>
<th>Number</th>
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<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low + High rim</td>
<td>2</td>
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<td>High</td>
<td>High</td>
<td>Intermediate</td>
<td>Low + High rim</td>
<td>3*</td>
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<td>Intermediate</td>
<td>Intermediate</td>
<td>Low + High rim</td>
<td>4*</td>
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<td>Intermediate</td>
<td>Intermediate</td>
<td>High</td>
<td>6</td>
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* means on of these were counted twice due to variable presentations which were included in the last group.

T2WI: a T2-weighted pulse sequence, FS: a chemical fat suppression, and Gd: a Gd-DTPA injection
status of the patients because the radiograph is an image of the true biologic endpoint demonstrating the result of inflammation and enzymatic degradation of cartilage and subchondral bone(12).

After a radiographic scoring system had been first proposed by Steinbrocker et al (13), many different methods developed(14 - 18).

However, most have their own problems for the evaluation of the rheumatoid hand and wrist(13 -15, 18, 19). More detailed scoring methods appeared to show better correlation between the score and the clinical status, and the duration of disease(16, 17, 20).

The roles of MRI may be for early detection of articular cartilage and the determination of the specific diagnosis, and the assessment of disease activity in the rheumatoid arthritis, as suggested by Kaye(21). Several authors have reported on MR imaging of rheumatoid knee(2 - 5) and wrist/hand(6, 7). There are general agreement that MR imaging is superior in the early detection of erosions, synovial lesions and cartilage changes compared to plain radiographs(7, 8). Most investigators mentioned about the abnormal synovia which showed the moderate or high signal intensity on T2WI and the enhancement on postcontrast T1WI. It was not difficult to distinguish from abnormal synovium from normal synovium by evaluating the postcontrast T1WI. That was because abnormal synovium was enhanced significantly in various synovitis as well as in rheumatoid arthritis, opposed to the normal synovium with no apparant enhancement following MR contrast injection(22). The signal intensity of joint effusion can be increased on the images obtained 15 -30 minutes after MR contrast injection(3, 5). A few authors have reported on the dynamic MR imaging by using the MR contrast agent. The synovial pannus showed the rapid and marked increase of signal intensity(9, 10).

The usefulness of the MR imaging of the rheumatoid arthritis have not been investigated for the hand or wrist but the knee, even though the hand and/or wrist joints are more frequentlyinvolved than the knee joint. Rominger and his colleague(6) suggested that a spoiled gradient-recalled acquisition in the steady state (SPGR) with fat suppression was the best pulse sequence for the evaluation of inflammation and erosions in rheumatoid hand and wrist. Their study had a limitation of spatial resolution, because they used a field of view of 16 cm. They did not described the difference of the pannus from the effusion and different enhancing pattern of pannus(6). From authors results, effusion differed from the pannus. We speculated that the enhan-

<table>
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<tr>
<td>Lesions</td>
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<td>Effusion</td>
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<td>Effusion</td>
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<td>Pannus</td>
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T2WI : T2-weighted pulse sequence, FS : a chemical fat suppression, and Gd : a Gd-DTPA injection
ced portion is hypervascular pannus, and non-enhanced pannus was fibrous pannus, as suggested by Koenig et al (10). However, we had also limitations that we could not undertake the comparison with MR findings with pathologic findings. Although we found the variable state of enhancement of the pannus, the problems have not been resolved which type of pannus (hypervascular or fibrous pannus) are enhanced or not, and whether these two types can be different histologically. One optimistic thing is that this study may provide the possibility to predict the inflammatory phase before the radiographic changes and to evaluate the progress of disease.

A small field of view was necessary for the detection of erosions of small joints such as wrist although high resolution MR imaging of wrist but hands may not always represent the clinical course of the patients. There have been no reports on the scoring method using MR imaging. For our scoring method the high resolution was necessary. The erosions were detected better on MR imaging than plain radiographs. Thus, we suggest that MR scoring method is a reliable method. We did not compared with our studying pulse sequence with SPGR which was suggested of the best MR sequence (6). Thus, further studies are needed in the future.

We suggest that the fat suppression T1WI with enhancement or the fat suppression T2WI were better than conventional T2WI images may be often, not always, helpful in distinguishing pannus from the effusion.

REFERENCES