Role of Ultrasonography in Assessment of Knee Joint in Patients with Rheumatoid Arthritis

MAGED A. HAWANA, M.Sc.; HATEM M. E-AZIZY, M.D. and NAGUI M. ABD EL-WAHAB, M.D.

The Department of Radiology, Musculoskeletal Imaging Unit, Faculty of Medicine, Cairo University

Abstract

Background: Rheumatoid Arthritis (RA) is a chronic systemic disease affecting approximately 0.5-1% of the adult population. Early diagnosis and early treatment of RA are mandatory for the prevention of irreversible joint damage and disability. The knee is commonly affected in RA, and the diagnosis of synovial inflammation and joint effusion are usually done by clinical examination; however, clinical examination only may lead to delayed diagnosis and treatment. Since the early changes generally begin in soft tissues, Ultrasound (US) seems to be superior to clinical examination and conventional radiography in early detection, quantification and follow-up of several synovial pathologic changes affecting the knee joint.

Aim of the Work: The purpose of this study is to emphasize the role of ultrasonography in the assessment of patients with rheumatoid arthritis involving the knee joint giving special emphasis on the synovial inflammatory process as a useful adjunct influencing the therapeutic strategy.

Patients and Methods: Thirty cases; 23 females and 7 males with 60 symptomatic knee joints were included in this study at the period from November 2011 till January 2014, age range 22 to 54 years old (average 38 years). Patients were referred to the Radiology Department at Kasr Al-Aini Hospital after full clinical examination and laboratory investigations to evaluate their knee joints affection by RA using US and MRI.

Results: The high correlation rate between the results of US and MRI have shown that in rheumatoid arthritis patients with knee joint involvement, US is an easily accessible and effective alternative/complimentary method of examination in detection of knee joint early signs of synovitis, effusion and bony erosions in patient with rheumatoid arthritis.

Key Words: Ultrasonography – Knee joint – Rheumatoid arthritis.

Introduction

RHEUMATOID Arthritis (RA) is a chronic systemic autoimmune disorder of unknown etiology characterized by symmetrical joint synovitis and pain. RA has a wide clinical spectrum and may vary from mild, non-erosive disease to severe inflammation and joint damage with extra-articular manifestations. The knee is commonly affected in RA, and the diagnosis of synovial inflammation and joint effusion are usually done by clinical examination; however, clinical examination only may lead to delayed diagnosis and treatment [1].

Ultrasound findings in rheumatoid arthritis affection of the knee joint include synovial hyper trophy; joint effusion and marginal erosions are crucial findings in rheumatoid arthritis [2].

Synovitis is defined as non compressible intra articular tissue, within synovial recesses. It may occur in the joint capsules, bursae, and tendons sheaths. The thickened synovium tend to appears as hypoechoic vegetations protruding inside the synovial fluid or completely filling the articular space [3].

Synovial proliferation is one of the early manifestations of rheumatoid arthritis and its detection has practical importance because it can indicate early aggressive treatment to try to limit extensive erosive changes [4].

However, grayscale imaging for synovial hypertrophy can not accurately differentiate between chronically and acutely inflamed synovial membranes, as the synovial membrane retains its thickened state over time [5]. Power Doppler ultrasound imaging allows for detection of vascularity and have been proved to be useful in distinguishing active (hypervascular) from fibrous (hypovascular) pannus. Demonstration of a hypervascular pannus has therapeutic implications as it correlates with disease activity [6].
Effusion is defined as hypoechoic or anechoic compressible intra articular material within synovial recesses, simple effusion should be completely transonic with no increase in Doppler signal [7].

Erosions are seen as cortical bone defects in longitudinal and transverse planes. US examination appears to be superior to radiography in erosions detection [8].

Bone erosions represent a pathologic hallmark of RA, and the monitoring of both erosion presence and progression is a key feature of RA management [9].

Acute erosions generally have an irregular margin and a poorly defined base, which allows through transmission of sound and are associated with active synovitis. Bone defects that do not have synovitis adjacent to them should be regarded with suspicion, though some may turn out to be true chronic erosions [10].

Aim of the work:

The purpose of this study is to emphasis the role of ultrasonography as an initial imaging method in the assessment of patients with rheumatoid arthritis involving the knee joint giving special emphasis on the synovial inflammatory process as a useful adjunct influencing the therapeutic strategy.

Patients and Methods

Thirty cases; 23 females and 7 males with 60 symptomatic knee joints were included in this study at the period from November 2011, till January 2014, age range 22 to 54 years old (average 38 years). Patients were referred to the Radiology Department at Kasr Al-Aini Hospital after full clinical examination and laboratory investigations to evaluate their knee joints affection by RA using US.

Ultrasonography of their both knee joints were performed using GE LOGIQ P6 pro ultrasound machines using a near focused linear array transducer with a centre frequency of 7.5-12MHz.

MRI was performed using Philips scanners achieva or intera (1.5 T) by knee coil in all cases.

All 30 patients were already known to be cases of rheumatoid arthritis by laboratory investigations.

They were presented at the time of the study by acute worsening symptoms of the disease involving the knee joints (stiffness, pain or swelling or combination of symptoms).

All of them were under therapy by corticosteroids for periods ranging from one month to 10 years.

Inclusion criteria:

Known cases of rheumatoid arthritis by laboratory investigations and clinical examination.

Data assessment and interpretation:

The joint effusion, synovial proliferation and bony erosions were assessed by US and Magnetic Resonance Imaging (MRI). The results of both examinations were interpreted blindly and compared by two experienced radiologists considering MRI as a gold standard study.

Results

This study involved 30 cases with rheumatoid arthritis (23 females and 7 males) with age range 22 to 54 years old (average 38 years).

Regarding joint effusion: Both MRI and Ultrasound detected and agreed in diagnosis of 41 joints with effusion out of the 60 knee joints.

Regarding synovial proliferation: Both MRI and Ultrasound detected and agreed in diagnosis of 29 joints with synovial proliferation out of the 60 knee joints.

Regarding bony erosions: Both MRI and Ultrasound detected and agreed in diagnosis of 20 joints with bony erosions out of the 60 knee joints.

In the comparison of both examination modalities (US and MRI), the results were concordant (Tables 1-3). This makes the sensitivity, specificity, positive/negative predictive values and overall accuracy values of US regarding joint effusion, synovial proliferation and bone erosions all equal 100%.

Table (1): Concordance and discordance rates between magnetic resonance imaging and ultrasound in detection of synovial hypertrophy.

<table>
<thead>
<tr>
<th>Synovial hypertrophy by ultrasound</th>
<th>Synovial hypertrophy by MRI</th>
<th>Total</th>
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<tbody>
<tr>
<td>Absent</td>
<td>Absent</td>
<td>31</td>
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<tr>
<td>Present</td>
<td>Present</td>
<td>0</td>
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Total 31 29 60
Case (1): Female patient 37 years old with rheumatoid arthritis. (A,B) Longitudinal US image over the infra patellar and posterior knee regions showing multiple bony erosions along the anterior and posterior aspects of the medial tibial condyle. (C,D) Sagittal STIR and PD images showing multiple bony erosions along the anterior and posterior aspects of the medial tibial condyle.

Case (2): Female patient 23 years old with rheumatoid arthritis. (A,B) Longitudinal US images over the supra patellar region showing mild Joint effusion, mild hypo echoic synovial thickening with minimal increased vascularity by Doppler study indicating mild activity. (C,D) Sagittal and axial post contrast T1 Wted images shows mild Joint effusion with mild enhancing synovial thickening.
Case (3): Female patient 31 years old with rheumatoid arthritis. (A,B) Longitudinal US images over the supra patellar region showing mild joint effusion, mild hypo echoic synovial thickening with increased vascularity by Doppler study indicating activity (C,D) Sagittal T2 and T1 images shows supra patellar region showing mild joint effusion and mild synovial thickening with distal femoral bone infarcts (not detected by US).

Case (4): Female patient 27 years old with rheumatoid arthritis. (A) Longitudinal US images over the supra patellar region showing mild Joint effusion, mild hypo echoic synovial thickening with increased vascularity by Doppler study indicating activity. (B) Sagittal T2 Wted images shows supra patellar region showing mild Joint effusion and synovial thickening.

Table (2): Concordance and discordance rates between magnetic resonance imaging and ultrasound in detection of joint effusion.

<table>
<thead>
<tr>
<th>Joint effusion by MRI</th>
<th>Joint effusion by ultrasound</th>
<th>Total</th>
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<tbody>
<tr>
<td>Absent</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Present</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>41</td>
</tr>
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</table>

Table (3): Concordance and discordance rates between magnetic resonance imaging and ultrasound in detection of bone erosions.

<table>
<thead>
<tr>
<th>Bone erosions by MRI</th>
<th>Bone erosions by ultrasound</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Present</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
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Discussion

Rheumatoid Arthritis (RA) is a chronic systemic autoimmune disorder of unknown etiology characterized by symmetrical joint synovitis and pain. RA has a wide clinical spectrum and may vary from mild, non-erosive disease to severe inflammation and joint damage with extra-articular manifestations. The knee is commonly affected in RA, and the diagnosis of synovial inflammation and joint effusion are usually done by clinical examination; however, clinical examination only may lead to delayed diagnosis and treatment [1].

The use of Ultrasonography (US) in patients with inflammatory arthritides has increased over the last decade and has been demonstrated to be more sensitive than clinical assessment in detecting joint swelling, thus helping identify patients with subclinical synovitis [10].

This study was performed to compare value of high resolution dynamic ultrasonography to MR imaging as a diagnostic tool in the evaluation and assessment of patients with rheumatoid arthritis involving the knee joint giving special emphasis on the synovial inflammatory process as a useful adjunct influencing the therapeutic strategy.

It included thirty cases; 23 females and 7 males with 60 symptomatic knee joints were included in this study with their ages ranged between 22 to 54 years old.

Regarding joint effusion and synovial thickening detection, D'Agostino and his colleagues [5] studied 600 patients with painful knee and found that inflammation evident by synovitis and joint effusion seen by US correlated statistically with advanced radiographic disease.

Abraham and his colleagues [1], studied reliability and validity of ultrasound imaging of features of knee osteoarthritis in the community and substantial to excellent agreement between ultrasound observers for the presence of joint effusion size.

Ostergaard and his colleagues [11] compared ultrasound and MRI showing that ultrasound detected 100% of effusions and Baker's cysts as well as 57% of the suprapatellar recess synovial membrane thickening seen on MRI.

Scheel and his colleagues [12] demonstrated excellent agreement of Ultrasound with MRI. There was 100% agreement for effusion and 79% for synovial hypertrophy, when compared to MR imaging of the knees with inflammatory arthritis.

Karim and his colleagues [8] stated that with the use of arthroscopy as the gold standard, US had 98% sensitivity, 88% specificity, 97% accuracy as a toll of detecting synovitis in the knee joint.

This matches with our results, we found US 100% sensitive, specific and accurate in detection of the joint effusion and synovial thickening in comparison with MRI.

Szkudlarek and his colleagues [13] stated that the sensitivity of ultrasonography, with signs of inflammation on MRI sequences as the reference, was 70%, the specificity was 78% and the overall accuracy 76%.

The variation between the results of most of the studies and the results of Szkudlarek [13] as regarding joint effusion and synovial thickening, in which ultrasound missed some of the cases, may be related to the relatively small sample size of our study (30 cases with 60 knee joints), the new US machine generations and the fact that musculoskeletal ultrasound is an operator dependant which needs experience.

Regarding bone erosions detection, Szkudlarek and his coworkers, [13] compared US to MRI examination in detection of bony erosions with MRI as the reference method, the overall accuracy and specificity of ultrasonography in detecting bone erosions were 95% and 98%. They concluded that US enables detection and grading of joint destructive changes.

Another study conducted by Magnani and his coworkers, [9] compared the ultrasonography and MRI in their capability to detect bone erosions in RA patients, they examined thirteen patients with advanced RA and found no significant difference between both modalities in detecting erosions in joints.

These results were concordant with our results in which we concluded that the US is 100% sensitive, specific and accurate in detection of bony erosions.

Yet this is not consistent with the results concluded by Malattia and his colleagues [10] whom stated that MRI was the best method for the identification of erosions, revealing more than twice as many erosions as radiography and ultrasonography.

This can be explained that Malattia and his colleagues [10] studied bone erosions in juvenile idiopathic arthritis at the wrist joints with small acoustic window adding to their pediatric age.
Conclusion:
We concluded that ultrasonography has an important alternative and complementary role to MRI examination in the evaluation of the knee pain of patients with rheumatoid arthritis yet it is operator dependent and needs experience.

References