Review on the MRI importance in the early diagnoses and follow up of Rheumatoid Arthritis

Poster No.: C-1738
Congress: ECR 2012
Type: Educational Exhibit
Authors: W. C. Tavares Junior, A. P. Amaro, A. M. Kakehasi, A. P. M. S. Santiago, R. Figueiredo, J. P. K. Matushita, J. N. M. Vieira; Belo Horizonte/BR
Keywords: Musculoskeletal joint, Bones, MR, Staging, Screening, Diagnostic procedure, Arthritides
DOI: 10.1594/ecr2012/C-1738

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys’ fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

The objective of this work is to review the data showing the importance of MRI in diagnosis, monitoring and for prognostic in rheumatoid arthritis.
Background

Rheumatoid arthritis (RA) is characterised by chronic joint inflammation that often leads to bone destruction. Inflammation in RA causes increased osteoclast-mediated bone turnover leading to erosions and bone loss. Early intervention with disease modifying antirheumatic drugs (DARMDs) is considered standard care for patients with RA in order to prevent joint damage and improve patient in outcome.

Regarding early diagnosis of RA, longitudinal studies have demonstrated that magnetic resonance imaging (MRI) is more sensitive than radiography in demonstrating progressive erosive joint damage, assessing synovitis as well as bone marrow oedema (osteitis), that show to be prognostic to erosive lesions in the follow up of the patients.

MRI is an important imaging technique that provides multiplanar images and is able to visualize a range of joint structures, including synovium, tendons, ligaments, bone, and cartilage. It does not use radiation, so it can be repeated as much as necessary, and allows longitudinal assessment. With the advances in sequence analysis software and lower costs, MRI is likely to become more accessible.

Erosions are visible on MRI on average two years before they are visible on radiographs and may become consistently visualized on radiographs of the metacarpophalangeal (MCP) joints only when 20%-30% of the bone is eroded on MRI.

To assess and quantify the disease manifestation in RA, the degree of synovial inflammation (synovitis), bone marrow edema, erosions, and tenosynovitis, several scoring systems have been suggested, and the Outcome Measures in Rheumatoid-Arthritis Clinical Trials (OMERACT) and Rheumatoid Arthritis Magnetic Resonance Image Scoring system (RAMRIS) are the most studied and used in clinical practice.
Imaging findings OR Procedure details

MRI TECHNIQUE

In early RA, wrist and hand involvement are usually bilateral. The study of the dominant or more painful wrist is routinely used, assuming that the joint involvement in this wrist will be higher than in the other wrist and hand. The use of MRI in a single hand reduces time, cost and discomfort for the patient.

The areas of interest are wrists, MCP joints, and proximal interphalangeal joints.

The OMERACT group recommends starting with a coronal STIR sequence or a Fat Saturated T2 sequence on the wrist and MCP joints for bone marrow edema detection, followed by a 3D isotropic T1-w gradient echo sequence; or a T1 sequence on the coronal and axial plane before and after gadolinium contrast for detection of bone erosions and synovitis.

Intravenous contrast estimates the degree of synovial inflammation and differentiates the synovial membrane enhancement from the surrounding tissues.

MRI FINDINGS

The finds in the literature with potential for diagnosis and accompanying in the patient with RA are:

- Synovitis
- Bone edema
- Erosion
- Tenosynovitis
- Synovitis

The thickening of synovial tissue caused by the rheumatoid inflammatory process may be identified on MRI.
Synovitis has an intermediate to low signal intensity on T1-weighted images and, due to the increased water content, high signal intensity on T2-weighted images (fig 1).

MRI signs of synovitis include increased synovial volume, increased water content and contrast enhancement (fig 2) (fig 3).

MRI is more sensitive than clinical examination in detecting synovitis in inflammatory arthritis and shows synovial inflammation in early RA.

Fibrotic pannus, which is usually present in end-stage of RA, appears relatively hypovascular after the intravenous administration of gadolinium. Moreover, with T2-weighted sequences, fibrous pannus with intermediate to low signal intensity can be distinguished from acute synovitis and joint fluid.

**Bone marrow edema**

Bone edema refers to a unique MRI-detected abnormality with high signal intensity on fat-suppressed MRI sequences and could enhance after contrast administration (fig 4).

Bone edema is defined by OMERACT as a lesion within the trabecular bone with ill-defined margins and signal characteristics of increased water content.

When present, it correlates with the severity of adjacent synovitis and both seem to be independent predictors of erosion development.

**Erosions**

MRI could provide an early diagnosis of RA by revealing erosions, whose presence constitutes one of the ACR 1987 diagnostic criteria.

The MRI definitions of erosions on T1-weighted images are loss of normal low signal intensity of cortical bone and loss of normal high signal intensity of the bone marrow cavity, with enhancement after the administration of gadolinium-based contrast material; and high signal intensity on T2-weighted and STIR images (fig 5) (fig 6).
Tenosynovitis

MRI signs of tenosynovitis include fluid in the tendon sheath, increased thickness and contrast enhancement of the tendon sheath synovium (fig 7) (fig 8).

When the diameter of the fluid in the tendon sheath is less than the diameter of the corresponding tendon, the fluid could be considered normal.

Dorsal tenosynovitis of the wrist is associated with tendon rupture, which has been described as the invasion of the tendon by the sheath synovitis and fraying of the tendon against eroded bone margins.

Predictors of imaging progression

Substantial efforts have been exerted to identify patients with poor prognosis at the time of diagnosis.

MRI erosion score and MRI bone marrow edema score were significantly and independently associated with radiographic progression after two years.

Bone marrow edema is considered an early marker of inflammation, given that its presence is correlated with increased levels of acute phase reactants (erythrocyte sedimentation rate and C-reactive protein).

Several studies have confirmed the relationship between MRI-detected inflammatory disease (synovitis and/or bone marrow edema) and subsequent damage. More recently, tenosynovitis proved to be a predictor of erosive progression in early rheumatoid arthritis.

In contrast to radiographic erosions, which reflect bone damage that has already occurred, bone marrow edema thus may represent an important part of the early immunopathological development in RA, and it could be reversed if recommended treatment is introduced.

Monitoring disease activity and damage
Several prospective follow-up imaging studies performed to compare radiography, US, and MRI findings demonstrate that US and MRI are more sensitive for visualization of inflammatory and destructive changes in joints.

Several scoring systems for MRI and US have been suggested over the years.

Synovitis, bone edema, and erosions on MRI have been defined by the Outcome Measures in Rheumatology (OMERACT) MRI Task Force and a scoring system, termed the RA MRI score (RAMRIS), and has been validated and evaluated for sensitivity to change in a longitudinal setting.

The OMERACT synovitis score is sensitive to change of inflamed synovium over weeks as well as months. MRI is being increasingly used when the treatment is associated with biological agents to measure changes in synovitis.

The score of each synovitis, bone erosions, and bone marrow edema is made from individual joints.
Fig. 1: Synovitis in a 35-year-old man with rheumatoid arthritis of the wrist, 4 years, in clinical remission. (a) Coronal and axial T1-weighted MR image shows medio carpal synovitis as low signal intensity (arrow) (B) Coronal and axial gadolinium-enhanced fat suppressed T1 weighted MR image shows intense enhancement synovia representing synovitis.

© W.C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
Fig. 2: Synovitis in a 35-year-old man with rheumatoid arthritis of the wrist, 4 years, in clinical remission. (a) Axial and coronal gadolinium-enhanced fat suppressed T1-weighted MR image shows intense enhancement synovia representing synovitis (*) and bone marrow edema represented by bone enhancement (arrow).

© W. C Tavares, Radilogia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
Fig. 3: Synovitis in a 38-year-old man with early rheumatoid arthritis. (a) Coronal T1-weighted MR image shows medio carpal synovitis as low signal intensity (arrow) (B) coronal T2 fat supressed weighted image show hypersignal in synovia in medio carpal bones (C) Coronal and axial gadolinium-enhanced fat suppressed T1 weighted MR image shows enhancement synovia representing synovitis (arrow).

© W. C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
**Fig. 4:** Bone marrow edema in a 37 year-old woman with early rheumatoid arthritis of the wrist. (a) Coronal T2-weighted MR image shows hamate, capitate and scaphoid bone edema represented by high signal intensity (arrows) (B) Coronal gadolinium-enhanced fat suppressed T1 weighted MR image shows intense enhancement representing edema/osteitis.

© W.C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Minas Gerais, Brazil

**Fig. 5:** Erosions in a 55 year-old woman with early rheumatoid arthritis of the wrist (12 months duration). (a) axial T1-weighted, (B) T1 fat suppressed MR gadolinium enhanced MR image (C) and axial multidetector CT image shows the rupture of the cortical bone.
compatible with erosion in the head of third metacarpal that's enhance after gadolinium (arrow in B). Synovitis is seen in metacarphophalangeal joint (*).

© W.C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil

Fig. 6: Erosions in a 55 year-old woman with early rheumatoid arthritis of the wrist (12 months duration) (same patient). (a) axial T1-weighted, (B) T1 fat suppressed MR gadolinium enhanced MR image (C) and axial multidetector CT image shows erosion in the capitate (arrow in B). Synovitis is seen in wrist (*).

© W.C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
Fig. 7: Tenosynovitis in a 47 year-old woman with early rheumatoid arthritis of the wrist and normal radiographic finding. (a) Axial T1-weighted MR (B) axial T2 fat supressed and (C) Coronal gadolinium-enhanced fat suppressed T1 MR image shows extensor of the fingers tenosynovitis with intense enhancement (arrow)

© © W. C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
Fig. 8: Tenosynovitis in a 50 year-old woman with rheumatoid arthritis. (a) Axial T1-weighted MR (B) Axial gadolinium-enhanced fat suppressed T1 MR image shows moderate tenosynovitis involving extensor tendons and flexor tendons of digits (arrows).

© W.C. Tavares, Radiologia, Ecoar Medicina Diagnóstica, Belo Horizonte, Brazil
Conclusion

MRI has the importance of detecting bone damage, particularly when radiographs are normal, contributing with this emerging tool for the diagnosis.

With the advent of more powerful treatment strategies, specially the development of biological agents that are disease-modifying antirheumatic drugs, the accurate and early diagnosis is the central topic related to the ability to select and initiate treatment programs, as is the ability to differentiate between responders and non-responders patients.

Surely, the MRI characteristics can provide support in many of these aspects of RA management.
Personal Information


email: line_amaro@yahoo.com.br
References