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The Role of Magnetic Resonance Imaging in Diagnosis and Prognosis of Rheumatoid Arthritis

Thesis

Submitted for Partial Fulfillment of
Master Degree in ***Radiodiagnosis***

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List of Abbreviations

Abb.	Full term
ACPA	Anti–Citrullinated Protein Antibody
ACR	American College of Rheumatology
ACR	American College of Rheumatology
BME	Bone Marrow Edema
CMJ	Carpometacarpal joints
CRP	C–Reactive Protein
CT	Computed Tomography
DMARD	Disease-Modifying AntiRheumatic Drugs
DRUJ	The distal radioulnar joint
ESR	Erythrocyte Sedimentation Rate.
ET	Echo time
EULAR	The European League Against Rheumatism
Fa	Fast Spin
FOV	Field of View
IL	Interleukin
MCP	Metacarpophalangeal
MRI	Magnetic Resonance Imaging
OMERACT	The Outcome Measures in Rheumatoid-Arthritis Clinical Trials
PDW	Proton density-weighted
RA	Rheumatoid Arthritis
RAMRIS	Rheumatoid Arthritis Magnetic Resonance Image Scoring system
RF	Rheumatoid Factor
SNR	Signal-to-Noise Ratio
STIR	Short-tau inversion recovery
TFCC	Triangular Fibrocartilage Complex
TH	T helper cells
TNF	Tumor Necrosis Factor
TR	Repetition time
US	Ultrasound

ABSTRACT

Background: Rheumatoid arthritis (RA) is one of the most common forms of arthritis. A progressive joint damage occurs early in the disease course even before being detected in conventional imaging, and eventually leads to irreversible joint deformity and severe functional impairment. Routinely, clinical assessment and laboratory investigations as well as conventional radiology are used for diagnosis of RA, however; they are not fair enough to establish early diagnosis and can't provide information about the disease activity. Estimating the disease activity at onset is fundamental to identify the prognosis of RA.**Objectives:** The aim of this study was to demonstrate the importance of MRI in detecting early signs of arthritis helping in early diagnosis of rheumatoid arthritis, and its ability to assess the degree of inflammatory activity as a prognostic parameter for the development of subsequent bone destruction. **Patients and Methods:** The twenty-five patients included in this study (14 females, 56%, and 11 males, 44%), were diagnosed with rheumatoid arthritis according to the 2010 ACR/EULA classification criteria. The clinically dominant wrist and hand joints were examined by MRI study for detection of pathological signs of RA that include synovitis, BME, and erosions. Twenty (20) patients (80%) were found to have synovial thickening. Of which, 12 wrist joints (60%) were active, among them 5 joints (25%) had mild activity, 4 (20%) had moderate activity and 3 wrist joints had severe activity (15 %). 17 patients had bone marrow edema (68%), more frequently at the radius and the lunate. Erosions was seen in 8 joints (32 %). The total positive MRI inflammatory findings, as well as each one of them alone, were compared and correlated with the 2010 ACR/EULA scoring system. **Results:** We found significant correlation and agreement between the total MRI positive findings and the 2010 ACR/EULAR criteria used for diagnosing RA, and MRI was more sensitive in detecting synovitis and BME in patients who didn't meet the criteria. **Conclusion:** The high sensitivity of MRI in detecting inflammatory signs, and the significant correlation with clinical and laboratory findings, indicates the potential importance of MRI study in diagnosing RA early in its course, and the assessment of disease activity that helps in prediction of joint destruction

Keywords: Magnetic Resonance Imaging, Rheumatoid Arthritis

INTRODUCTION

Rheumatoid arthritis (RA) is one of the most common forms of arthritis. It is a chronic, autoimmune inflammatory joint disease, which primarily involves the small joints of the hands and feet, and affects 0.5–1.0% of the adult population. Erosive joint damage occurs early in the disease course and patients typically experience joint pain, swelling, tenderness, and stiffness, and they are at risk of developing progressive joint damage, which eventually leads to irreversible joint deformity and severe functional impairment ***(Møller-Bisgaard et al., 2015).***

Without adequate treatment, at 20 years after diagnosis, more than 60% of patients with RA may develop significant functional impairment, including the need of mobility aids, loss of ability for self-caring, and requirement of joint replacement, or experience loss of independence and require daily care ***(Venables, 2016).***

RA initially involves the synovium of the joints leading to synovial thickening, synovial hyperaemia, and pannus formation; later on, it will progress to bone erosions and destruction and deformity of the joints ***(Issar et al., 2016).***

According to the *American Society for Surgery of the Hand* ***(ASSH, 2017),*** RA affects the synovial tissue that line and normally lubricate the joints. The synovium becomes inflamed and swollen and erodes the cartilage and bone. The swollen tissue may also stretch the surrounding ligaments, resulting in deformity and instability. The inflammation may also spread to the tendons, result in fraying and eventual breaking of the tendons ***(https://www.assh.org, 2017).***

It is most likely to erode wrist, metacarpophalangeal, and interphalangeal joints. When synovial pannus is formed it may cause gradual erosion of the articular cartilage and bone cortex. So, it is possible to suppress the inflammatory reaction if the disease is recognized early and aggressive treatment is introduced through the first 3 months, known as a therapeutic window. Otherwise, the disease could take on a more chronic, aggressive form, with joint destruction ***(Xu et al., 2017).***

Over the last two decades, significant improvement has been achieved in its prognosis owing to new strategies for disease management, the emergence of new biologic therapies and better utilization of the conventional disease-modifying antirheumatic drugs. This raises the demand for a diagnosing method that can identify the early signs of the disease ***(Sudoł-Szopińska et al., 2017).***

Conventional radiography used as a standard tool for evaluation of RA patients in daily practice. However, the X-ray only shows late signs of disease activity when cartilage or bone is already destructed, while other medical imaging techniques such as ultrasonography (US) and Magnetic resonance imaging (MRI) have been used in RA in order to assess the earlier signs ***(Xu et al., 2017).***

MRI is increasingly being used in the assessment of rheumatoid arthritis due to its ability to directly visualize the bone and soft tissues in three dimensions and has the potential to measure inflammatory activity and joint destruction. It can detect synovitis, tenosynovitis, bone erosion, and joint effusion ***(Xu et al., 2017).*** MRI also allows the detection of bone marrow oedema, which is thought to be a precursor for the development of erosions in early RA as well as a marker of active inflammation and can be seen neither on radiographs, ultrasound nor computed tomography (CT). In addition, the multi-plane, multi-slice capability of MRI allows visualization of the area of interest in three orthogonal planes. Therefore, MRI has the advantage of providing details concerning both the bone and surrounding tissues of the joint, which is not shared by any other imaging modality, whilst avoiding ionizing radiation ***(Sudoł-Szopińska et al., 2017).***