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Magnetic resonance imaging in individuals at risk of rheumatoid arthritis

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A B S T R A C T

Individuals with rheumatoid arthritis (RA) benefit from early diagnosis and initiation of therapy. There can be delays in both due to diagnostic uncertainties. Imaging modalities, including magnetic resonance imaging (MRI), can detect inflammation earlier than clinical examination alone in early RA patients. Furthermore, the predictive role of MRI for the future development of RA has recently been explored in 'at-risk' individuals. This review details the use of MRI in early and undifferentiated arthritis and summarises the studies to date in individuals at risk of RA.

Introduction

Early diagnosis of rheumatoid arthritis (RA) and initiation of therapy are essential in inhibiting the progression of structural joint damage and improving clinical outcomes and function. Early diagnosis can be challenging due to the non-specific signs and symptoms associated with many other articular conditions. Nevertheless, subclinical inflammation has been widely confirmed, even in the earliest phase of RA. Therefore, accurate, sensitive and non-invasive imaging techniques and outcome measures are required to assist clinicians in the diagnosis of early RA. Optimal imaging methods should be both sensitive and reproducible and offer the opportunity to monitor disease activity and assist prognostication [1]. For at-risk individuals, the role of imaging is principally in prognostication of progression to RA.

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Within this chapter, the principles of MRI for the diagnosis of early RA are discussed. Learning points from imaging in individuals with undifferentiated arthritis are considered with a particular focus on the prediction of future RA. Key studies that have explored the role of imaging in at-risk cohorts are reviewed, and practice points are highlighted.

Imaging techniques in rheumatology

In routine clinical practice, rheumatologists most frequently use four imaging techniques to explore bone and extra-articular involvement in RA: conventional radiography (CR), computed tomography (CT), ultrasonography (US) and magnetic resonance imaging (MRI). Other techniques such as nuclear medicine imaging, peripheral quantitative computed tomography (pQCT), digital X-ray radiogrammetry and dual X-ray absorptiometry have limited indications and whether they should be used in clinical practice is the subject of current research [2].

Conventional radiographs are commonly used to assess the presence and monitoring of periarticular change and erosions in RA. In early RA with high disease activity, it is possible to detect changes in joint damage within 3 months with plain radiographs [3]. However, for the assessment of earlier changes and the monitoring of early RA, more sensitive imaging is required. US and MRI provide a detailed evaluation of soft tissues and can evaluate the presence and degree of inflammation (See Chapter 7, Role of ultrasound imaging in individuals at risk of RA). The ability of MRI to assess the medullary bone for bone marrow edema (BME) is a significant advantage of this modality over US. EULAR recommendations for the use of imaging modalities in RA management have recently been published [4]. These recommendations acknowledge that MRI can improve the certainty of the diagnosis of RA and detect structural damage earlier than radiographs.

General principles of MRI

MRI is a sensitive imaging technique that has advantages over clinical examination and conventional radiographs for assessing joint damage (bone erosions and cartilage loss/joint space narrowing) and inflammation (synovitis, BME, and tenosynovitis), which are common features in the earliest stages of RA [5–11]. This method provides multiplanar images and can image a range of joint structures with a high degree of resolution and without ionizing radiation.

Arthroscopy and synovial biopsies have validated the use of MRI for the early detection of synovitis [12–14]. The imaging of synovitis remains problematic by using conventional unenhanced MRI sequences, as synovitis appears isointense with fluid and other adjacent structures. Outside the research environment, gadolinium-enhanced imaging with T1-weighted sequences remains the gold standard for assessing the synovium and evaluating its pathology with qualitative and quantitative techniques. In the absence of contrast-enhanced imaging, synovitis is commonly overestimated [15,16]. BME can be detected on fluid-sensitive sequences such as short-tau inversion recovery (STIR) or T2-weighted (fat suppressed) fast-spin echo sequences. For the detection of small bone erosions in the early erosive phase, T1-weighted MRI has demonstrated similar sensitivity to CT [17].

Outcome measures in MRI

The Outcome Measures in Rheumatology (OMERACT) Rheumatoid Arthritis Magnetic Resonance Imaging System (RAMRIS) scoring system is a standardised, reliable and validated scoring system for synovitis, erosion, BME and tenosynovitis [18,19]. This score has also been successfully used to demonstrate response to disease modifying antirheumatic drug (DMARD) treatment [20–24].

MRI findings in healthy individuals

For MRI to be used as a diagnostic tool for the early detection of RA, knowledge of the prevalence of MRI abnormalities in healthy individuals is essential. It is recognised that MRI changes are more frequent in older patients [25]; however, until recently, there were no published reference ranges for MRI abnormalities within the general population. The majority of data that informed a recent review

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