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Diagnosis and management of rheumatoid arthritis; What is the current role of established and new imaging techniques in clinical practice?



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Ultrasound and magnetic resonance imaging (MRI) have become established imaging techniques for the management of rheumatoid arthritis. Several publications have pointed out the advantages of these techniques for a more complete evaluation of the inflammation and structural damage at joint level. Recently new imaging techniques as the positron emission tomography (PET) associated with computed tomography (CT) or MRI scan, and the optical imaging have been introduced in the panorama. This article presents the advantages and limitations of each imaging techniques in light with the recent publications.

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General introduction

Over the last few years, the clinical management of rheumatoid arthritis (RA) has changed dramatically, because of the introduction of new imaging techniques such as ultrasound and magnetic resonance imaging (MRI), which can visualize both inflammation and structural damage. More recently, new imaging techniques such as nuclear medicine and optical imaging have been proposed

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with results that can envisage a potential impact in the clinical management of RA. The respective roles of established (ultrasound and MRI) and new (nuclear medicine and optical imaging) imaging techniques are extensively discussed in the following sections of this chapter.

Ultrasound imaging

Technical background

Ultrasound imaging is safe and noninvasive based on the mechanical transmission and reflection of ultrasound waves through the body [1]. As the ultrasonic pulse passes through a medium, molecules within the body are reversibly perturbed from their equilibrium positions. Images are formed by sensitively detecting echoes of the pulse returned from interfaces or from scattering structures within the tissue. Ultrasonic transducers used to initiate and to detect ultrasonic pulses, and the electronics that accompany them are relatively low cost compared with the equipment necessary for most other imaging techniques.

The relative intensity of a returned echo is represented in terms of relative pixel brightness (from white to black) in the so-called “B mode” or “grey-scale”. The sound path's orientation and the echo time-of-flight are used to map each echo intensity to a position in a reconstructed image of the structure under evaluation. Echo-based imaging speed is limited by the pulse's travel time to and back from the deepest part of the imaged zone (in the order of 0.1 ms for an 8-cm depth).

The ultrasound evaluation provides real-time visualization. Movements within the structures can be observed as they occur, including the movement of blood flow (both velocity and direction) using the Doppler mode.

Management of RA by ultrasound

Because of safety and real-time evaluation, ultrasound has gained importance in the evaluation of musculoskeletal pathologies, including inflammatory arthritis, especially rheumatoid arthritis (RA). Over the last 20 years, an increasing number of studies have explored the value of ultrasound for the management of RA. All these published data support the importance of using ultrasound in addition to more established techniques such as conventional radiography (CR) or clinical and laboratory evaluation [2,3].

Detection of synovitis by ultrasound has shown to be an important outcome in both early and established RA [4–12].

Both Doppler and gray-scale (GS) ultrasound findings have shown to be predictive of later structural damage on CR. The potential use of ultrasound in the clinical management of RA has been outlined in a recent expert consensus-based publication [13].

In the following sections, recent data on the role of ultrasound for the diagnostic workup of RA, the monitoring of disease activity, and the added value for defining/monitoring remission are presented. The chapter focuses on the capability of ultrasound to detect inflammation at the synovial joint level (i.e., synovitis) with potential and established clinical implications, without focusing on the capability of ultrasound to detect inflammation at the tendon level (i.e., tenosynovitis) or to detect structural damage (i.e., bone erosions).

Ultrasound for the diagnostic workup of RA

Early diagnosis of RA and early initiation of disease-modifying anti-rheumatic drugs (DMARDs) have demonstrated to reduce inflammation and therefore limit disease progression and functional loss [14–16].

The American College of Rheumatology (ACR)/EULAR classification criteria have been developed for helping rheumatologists to classify earlier patients with potential RA on the basis of the presence of a minimal number of clinically inflamed joints (i.e., synovitis) or if bone erosions are detected on CR [17].

However, both clinical examination and CR can lack sensitivity and accuracy to detect early signs of joint inflammation and structural damage [18–21].

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