Ultrasound in rheumatology

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Abstract

Ultrasound has become an essential tool for rheumatologists to diagnose and treat musculoskeletal disorders. It can image bone erosions and osteophytes, tendons, entheses, synovium and cartilaginous structures in multiple joints in a cheap, convenient examination within the clinic; it can also assist in interventions such as joint and tendon sheath injection. This has altered clinical practice in several contexts. Evaluation of subclinical synovitis is valuable to define the extent of inflammatory disease. In early arthritis clinics, inflammatory changes and bone erosion can be used to identify patients who need early aggressive immunosuppressive therapy. In established inflammatory arthritis, the presence of inflammatory changes during clinical remission predicts longer term outcomes and may allow stratification of therapy changes. Ultrasound has also elucidated pathological processes, for example in the structures involved in dactylitis or the subtypes of lupus arthritis. In specific complex joints, such as the shoulder, ultrasound allows a dynamic evaluation of multiple structures and a more precise diagnosis of pathology than clinical examination alone or other imaging techniques. In this article, we review the structures and pathologies that are well imaged by ultrasound, and its principal applications in the rheumatology clinic.

Keywords Early arthritis; enthesitis; erosion; MRCP; power Doppler; synovitis

Key points

- Musculoskeletal ultrasound has become a core component of rheumatology practice
- Detection of subclinical synovitis may allow early diagnosis and guide treatment decisions in established inflammatory arthritis
- In specific joint areas such as the shoulder ultrasound allows a more precise diagnosis than clinical examination as well as guided injections

Introduction

Ultrasound has become a routine tool for investigating rheumatic diseases and is part of standard training for rheumatologists in some countries. This is because it can be performed in the clinic as an extension of clinical assessment, with no ionizing radiation, in real time and at a reasonable cost. Although ultrasound has applications for most of the organs affected by rheumatic diseases, we focus here on musculoskeletal ultrasonography.

Basic principles of ultrasound

Ultrasound images are frequently presented in black and white (B-mode, or brightness-modulated ultrasound). Power Doppler (PD) ultrasonography is frequently used in rheumatology to measure low-velocity flow in vascularized inflamed structures; in many contexts, it is considered more specific for true pathogenic inflammation.

Although beyond the scope of this article, it is important for trained sonographers to be aware of a variety of artefacts that can affect both grey-scale and PD images; considerable training and experience is required to reliably acquire and interpret diagnostic images.

Imaging of musculoskeletal pathology

Synovium: joint and tendon

The important anatomical sites of inflammation in inflammatory arthritides are the synovial joint, tendon sheath and enthesis. The synovium becomes thickened (hypertrophy) and inflamed, within both the joint and the synovial tendon sheath; this can be easily identified on ultrasound. The Outcome Measures in Rheumatology Clinical Trials (OMERACT) group have defined synovial hypertrophy as abnormal hypoechoic (relative to subdermal fat, but sometimes isoechoic or hyperechoic) intra-articular tissue that is non-displaceable and poorly compressible and may exhibit a Doppler signal.[1] In clinical trials, grey scale is given a semi-quantitative score from 0 to 3 (>1 is considered abnormal) and a PD signal score from 0 to 3 (>0 is considered abnormal) for each joint assessed.

Tenosynovitis is defined as hypoechoic or anechoic thickened tissue with or without fluid within the tendon sheath, which is seen in two perpendicular planes and may exhibit a Doppler signal (Figure 1).[1]

With persistent inflammation or mechanical stress, tendons may also exhibit signs of degenerative changes known as tendinopathy. In Figure 2, the Achilles tendon, shown in a longitudinal view, demonstrates fusiform mid-portion thickening with central fibre degeneration/tearing. Within the tendon itself, there is evidence of a positive PD signal, indicating inflammation within the tendon.

Enthesis

Enthesitis can affect synovial joints, fibrocartilaginous joints, syndesmoses and extra-articular entheses. It is a typical feature of spondyloarthropathy, which includes ankylosing spondylitis, psoriatic arthritis (PsA), reactive arthritis, inflammatory bowel

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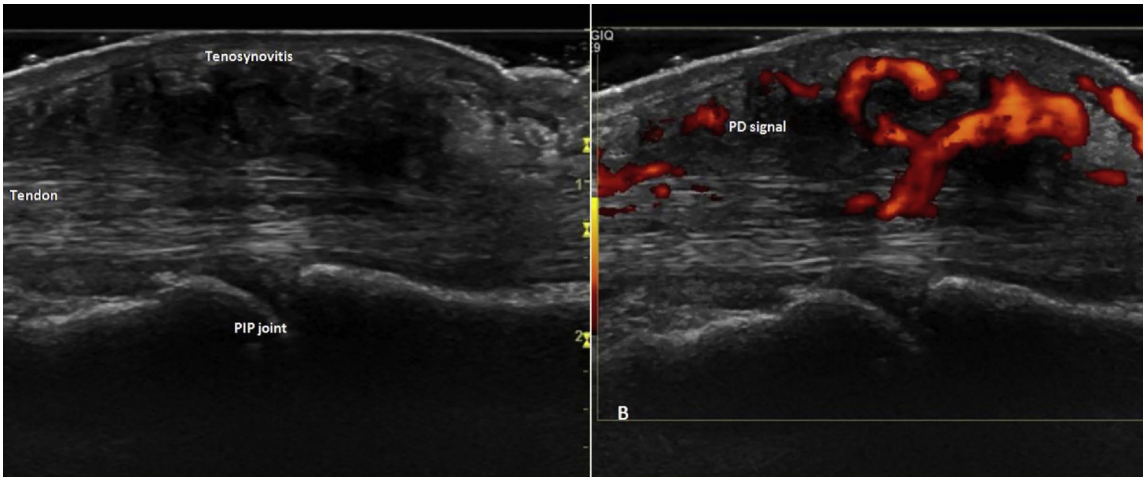

Figure 1 (**a**) Grey-scale image of a finger flexor tendon at level of the proximal interphalangeal (PIP) joint, showing marked thickening of the tendon sheath. (**b**) Image (**a**) with superimposed PD imaging, showing active inflammation within the tendon sheath.

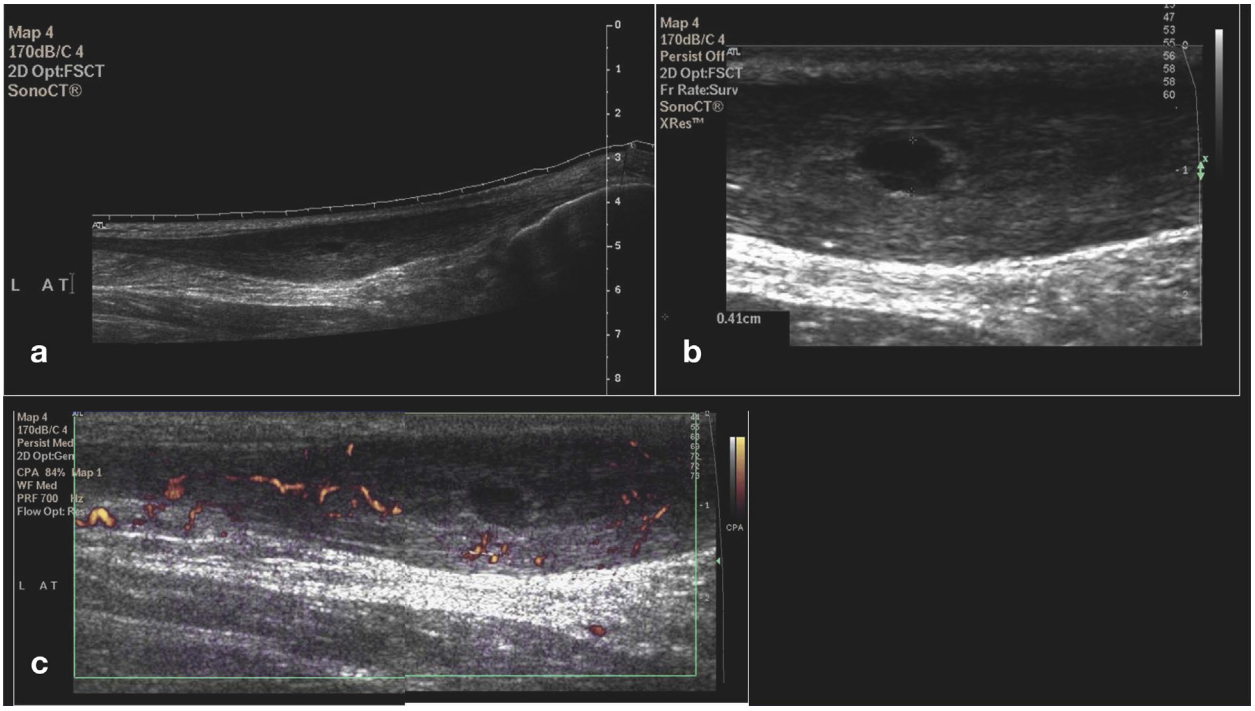

Figure 2 Longitudinal view of the Achilles tendon. Grey-scale and power Doppler images showing tendinopathy with associated inflammatory change within the tendon.

disease-associated arthritis and non-radiographic/undifferentiated spondyloarthritis.

The preliminary OMERACT definition of ultrasound enthesitis is as follows: an abnormally hypoechoic (loss of normal fibrillar architecture) and/or thickened tendon or ligament at its bony attachment, seen in two perpendicular planes, that may exhibit Doppler signal and/or bony changes including enthesophytes, erosions or irregularity.[1] An example of Achilles enthesitis is shown in Figure 3.

There are, however, potential pitfalls when scanning entheses. It can be difficult to differentiate inflammatory disease from mechanical or degenerative change, and both pathologies can also coexist in the same individual. For example, the presence of a large bony enthesophyte might also be labelled an osteophyte. There is currently a lack of standardization of image acquisition and scoring, although the OMERACT group are working on this. It is possible to see Doppler artefacts at an entheseal site because of reflective cortical bone. There are fewer vessels in inflamed entheses compared with synovium, so they can be harder to visualize.

It can be more helpful to think of entheseal changes in terms of ultrasound changes that are seen in active inflammation and those indicating damage; that is, past inflammation. This is summarized in Table 1 and described in detail by Filippucci et al.

