Ultrasound of hands in rhumatoid arthritis and psoriatic arthritis

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Authors: R. Laroussi¹, S. Rekik², S. Behi², R. Ghariani², M. Elleuch², H. Mizouni²; ¹Bardo/TN, ²Tunis/TN
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Learning objectives

• To review the pathogenesis of rheumatoid arthritis (RA) and the peripheral disease in psoriatic arthritis (PsA).

• To describe the different ultrasound (US) features of the hand in RA and PsA.
Background

• Rhumatoid arthritis is the most common inflammatory arthritis. The synovium is the primary site of inflammation in RA. The development of a pannus leads to erosions at the osteochondral junction responsible of irreversible joint damage.

• The PsA is classified as aspondyloarthropathy where entheseseal involvement is the typical change.

• The wide availability and recent improvement in technology makes US the first choice imaging investigation for the evaluation of musculoskeletal diseases. It’s sensitive in identifying synovitis, tenosynovitis, erosions and enthesitis. It can be used as a tool to help distinguish RA from other inflammatory arthritis especially PsA.
Findings and procedure details

**Rhumatoid arthritis**

- RA is a chronic, inflammatory, autoimmune disease affecting approximately 1% of the world population. It is associated with progressive disability, systemic complications, early death, and socioeconomic costs.

- An interaction of environmental factors and genetic susceptibility leads to altered post-transcriptional regulation and self-protein citrullination and to autoantibody production (rheumatoid factor and anti-citrullinated protein antibody [ACPA]).

- Proliferative synovitis (rheumatoid pannus) is the earliest pathologic abnormality in RA, secondarily responsible for bone and cartilage damage (*Fig.1*). Initiated by cytokines such as interleukin-1 and tumor necrosis factor (TNF) alpha, synovitis can involve joints and tendon sheaths (tenosynovitis).

- Bone erosions represent the defining pathological feature of RA. Collagenase, produced at the interface of pannus and cartilage, is believed to be largely responsible for the bone lesions leading to irreversible joint destruction.

- Small peripheral joints are the first to be affected in RA: The wrist, metacarpophalangeal (MCP) and metatarsophalangeal (MTP) joints. RA is usually, but not exclusively, symmetric and bilateral.

- US is a sensitive imaging modality useful for early diagnosis to start an effective treatment to prevent joint destruction. Power Doppler sonography (PDS) affords visualization of small vessel flow, showing soft tissue inflammation and disease activity.

**US features in RA are:**

- **Synovitis:** defined as an abnormal thickened, hypoechoic, intra-articular tissue that is poorly compressible and can demonstrate increased Doppler signals (*Fig 2,3*). Associated joint effusion appears anechoic, displaceable by compression of the transducer, with no evidence of flow on Doppler imaging (*Fig.2*).

- **Erosions:** defined as a discontinuity of the smooth echogenic bone surface or cortex greater than 2 mm in diameter, visualized in two planes and having an irregular floor (*Fig.4*). On Doppler imaging, the presence of high signal within the bone erosions is due to proliferative, hypervascularized pannus tissue.

They are best detected in US at the ulnar styloid process, the radial aspect of the second metacarpal head, the ulnar aspect of the fifth metacarpal head.
• **Tenosynovitis:** defined as an abnormal hypoechoic or an echoic material with or without fluid inside the tendon sheath and with possible signs of Doppler signals in two perpendicular planes (Fig.5,6).

Tenosynovitis is a common finding in patients with early RA. The second and third flexor tendons are more frequently involved at the hands.

• **Bursitis:** appear more or less well-defined and homogeneous with significant peripheral hyperemia on Doppler. They are more common in the feet.

**Psoriatic arthritis**

• PsA belongs to the group of seronegative spondyloarthropathies. It is a multigenic autoimmune disease in which the CD8+ T cell plays a central role.

• It involves synovial tissue, enthesalsites, skin and nail. Synovial tissue in PsA is characterized by asublining infiltrate with T cells and B cells, vascular proliferation and a relatively thin lining layer of proliferating intimal synoviocytes.

• Extrasynovial abnormalities are common in the psoriatic finger. They are related to the selective vulnerability of tenoses to the "fibrous skeleton" (made up of ligaments, fibrous capsular bands, palmar fasciae, and fibrous sheaths that attach to the bone or dermis) to PsA.

• The fibrous skeleton is well-developed at the tip of the finger, where the flexor tendon, extensor tendon, and connective tissues septae that support the finger pad and nail attach to the distal phalanx and distal interphalangeal joint.

• PsA develops after the cutaneous disease in approximately 70% of patients, simultaneously in 10%-15%, and before psoriasis in 15%-20% of cases.

• Although PsA is commonly considered as a benign arthropathy, about 50% of patients go on to develop progressive arthritis, with joint function impairment or loss and even deformity.

• Extrasynovial inflammatory changes are characteristic findings of PsA including (Fig.7):

  - Abnormalities denoting enthesitis included juxtaarticular periosteal reaction, capsular enthesophytes (Fig.8), and enthesopathy at the attachment of the deep flexor tendon on the distal phalanx.

  **Enthesopathy** is defined as an abnormally hypoechoic and/or thickened tendon or ligament at its bony attachment seen in two
perpendicular planes that may exhibit power Doppler (PD) signal and/or bony changes (enthesophytes, erosions, and calcifications) (Fig.9).

- Thickening of the soft tissues, indicating inflammation, diffuse or confined to the finger pad: Dactylitis ("sausage digit") (Fig.10).

- Abnormalities related to cutaneous psoriasis. It consists in a Doppler signal from the base of the nail, which indicates periungual psoriatic involvement.

•US is the imaging method of choice for looking at the soft tissue components of the capsular, entheseal and bony changes in PsA.

•The application of US to PsA has improved the understanding of disease mechanisms and the difference between PsA and RA:

- Enthesal changes have been demonstrated in DIP joints in PsA.

- Bone erosions in PsA do not differ morphologically from those seen in RA but they may be associated with distinctive features such as bone proliferation and periostitis. They occur less frequently than in RA, and the rate of development of new erosions is much slower.

- Joint synovitis in PsA and RA appears to be indistinguishable. Joint involvement in PsA is frequently oligoarticular and asymmetrical.

- Predominant tenosynovial involvement in the hand and more frequent flexor tenosynovitis, compared with extensor tenosynovitis, are frequently reported in patients with PsA.

- Subcutaneous soft tissue edema and inflammation are also common findings in patients with PsA, frequently coexisting with tenosynovitis and to a lesser degree, with synovitis.

- Dactylitis does not occur in patients with RA, in which the inflammation is confined to the synovial membrane of the joints and tendon sheaths.
**Fig. 1:** A diagram of a rhumatoid arthritis pannus

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**Fig. 2:** Abnormal hypoechoic intra-articular tissue related to synovitis of a metacarpophalangeal joint with intra-articular effusion (arrow).
**Fig. 3:** Abnormal hypoechoic intra-articular tissue related to synovitis of the wrist with a signal PD.

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**Fig. 4:** Abnormal hypoechoic intra-articular tissue related to synovitis, associated to bone erosions (arrow) of a metacarpo-phalangeal joint.

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Fig. 5: Flexor tenosynovitis with fluid and thickening

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Fig. 6: Tenosynovitis with vascular spots detected in the flexor tendons.

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**Fig. 7:** Diagram showing the extrasynovial abnormalities seen in fingers with PsA.

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**Fig. 8:** Capsular calcification of a distal inter-phalangeal joint.

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Fig. 9: Abnormal hypoechoic and thickened extensor tendon with a calcification at its bony attachment related to an enthesitis.

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Fig. 10: Tenosynovitis of a flexor tendon with synovitis of proximal and distal interphalangeal joints and an infiltration of the subcutaneous fat related to a dactylitis suggesting PsA.

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Conclusion

• US should be used more often as a diagnostic tool in patients with inflammatory arthritis. It helps characterise undifferentiated arthritis so that early therapeutic decisions can be made.
References


