Radial Wrist Pain: Spectrum of Normal and Pathologic Sonographic Findings-Pictorial Essay

Ferdinando Draghi*1, Chandra Bortolotto1, Elena Canepari1, and Francesco Alessandrino1

Received 7 December 2013; Published online 19 April 2014

© The author(s) 2014. Published with open access at www.uscip.us

Abstract

The purpose of this pictorial essay is to review the most important anatomic structures at the radial aspect of wrist and normal variations, with its clinical and sonographic findings. The conclusions of the review are that sonography is a valuable technique for diagnosing radial wrist pain.

Keywords: Radial wrist pain; Ultrasound; De Quervain disease; Wartenberg syndrome; Intersection syndrome

1. Introduction

Pain at wrist radial aspect can be caused by various pathologic conditions of several anatomical structures (fig. 1). Among them, de Quervain disease (figs. 2, 3, 4, 5) is probably the most frequently diagnosed. Other conditions, such as infectious tenosynovitis (fig. 6), impingement (fig. 7), intersection syndrome (figs. 8, 9) and Wartenberg syndrome (fig 10), can also provoke radial wrist pain. While de Quervain disease can be easily diagnosed with a thorough clinical examination, other rare pathologic entities can be correctly recognised and treated with the aid of ultrasound examination.

Anatomic variations, overuse of the thumb, trauma and postoperative complications can be co-involved in the pathogenesis of radial wrist pain.

1.1 Extensor retinaculum
The extensor retinaculum of the wrist is a thickening of the distal antebrachial fascia at the level of the dorsal distal radioulnar joint, preventing bowstringing of the extensor tendons (Massaki et al., 2013; Precerutti et al. 2010). It consists of two layers: the supratendinous and the infratendinous retinaculum. The infratendinous layer is limited to the three compartments of the ulnar.

*Corresponding e-mail: f.draghi@smatteo.pv.it
1* Foundation IRCCS, Policlinico San Matteo, Institute of Radiology, University of Pavia, Pavia, Italy
Six longitudinal vertical septa originate from the supratendinous retinaculum and insert into the radius, dividing the extensor tendons of the wrist into six compartments. Septum of the first compartment shows the largest radial surface area and the highest overall resistance to failure. Septum attachment is inserted into the radius styloid process, crosses over the abductor pollicis longus and extensor pollicis brevis tendons and attaches to the second septal attachment, a dorsoradial bony protuberance on the distal radius. Anatomic variations in the division of this compartment with no septation, complete septation or incomplete distal septations are reported. The first extensor compartment of the wrist, formed by the extensor retinaculum and the osseous groove over the lateral aspect of the radial styloid, contains two tendons, the abductor pollicis longus and the extensor pollicis brevis and their synovial sheaths (Preiser et al., 2010).

1.2 Abductor pollicis longus and extensor pollicis brevis
Abductor pollicis longus arises from the posterior surface of the radius and ulna and from the interosseous membrane. It descends along the ulnar surface of the radius with the extensor pollicis brevis (Preiser et al., 2010). Proximal to the dorsal carpal ligament, it travels laterally and superficially, then crosses over the extensor carpi radialis longus and brevis tendons, passing through the first osteofibrous tunnel and is inserted into the base of the first metacarpal bone. Extensor pollicis brevis arises from the posterior surface of the radius and from the interosseous membrane and travels with the abductor longus crossing over the second osteofibrous tunnel and inserts into the dorsal side of the base of the proximal phalanx of the thumb. There could be anatomic variations in the number of tendons involved: the number of extensor pollicis brevis tendon slips is generally one or sometimes two, while in about 25% of patients, the number of tendon slips of the abductor pollicis longus is one, but the rest of these patients shows two or more tendon slips.

1.3 Radial nerve
The radial nerve arises from the posterior cord of the brachial plexus. Anterior to the lateral epicondyle, the nerve subdivides into a deep motor branch and a superficial sensory branch (Knutsen and Calfee, 2013).

The superficial sensory branch follows the radial artery and crosses over the long abductor and short extensor of the thumb (proximal intersection) in the wrist, innervating the dorsal aspect of the thumb, the index finger and the middle finger.

2. De Quervain disease
De Quervain disease represents a particular entity of the first extensor compartment of the wrist caused by multiple factors, including local anatomy as well as mechanical and hormonal factors (De Maeseneer et al, 2009; Vuillemin et al. 2012). Overuse of the thumbs, involving repetitive movements (flexion, extension and rotation), and ulnar deviation of the carpal linked to occupational, leisure or sport-related activities are recognised as risk factors. Oestrogen stimulation and oestrogen deficits also have also been considered as possible risk factors. The pathogenesis of de Quervain disease includes thickening of the extensor retinaculum (fig. 2, 3, 4, 5), stenosis of the first osteofibrous tunnel, friction and tenosynovitis of the abductor longus and extensor brevis of the thumb tendons. The clinical feature is pain around the radial styloid process,
exacerbated by movements of the thumb and by ulnar deviation of the wrist. Diagnosis is based on the history and physical examination. Furthermore, clinical tests, such as Finkelstein's test, can give false positive results, thus ultrasound can be a useful diagnostic tool.

Sonography shows hyperechoic thickening of the retinaculum with enlarged tendons. Often tendons are difficult to differentiate, appearing rounder than usual on transverse scans. In the acute phase, fluid can be seen inside the sheath.

There could be anatomic variations in the number of tendons and in the division of the first compartment with the presence of complete (fig. 3) or distal incomplete (fig. 4) subcompartmentalisation (Rousse et al., 2010; Choi et al. 2011). The anatomic variations may be a causative factor of de Quervain disease, and an intracompartmental septum is a risk factor for the failure of treatment with corticosteroid injections.

There are operative and non-operative treatment options: operative treatment is more invasive and associated with higher costs and a higher risk of complications, whereas it is vital to inject the therapeutic agent into the tendon sheath while performing corticosteroid injections. Sonography, with dynamic studies, can be used to assess the postoperative stability of the tendons and to guide intrasynovial injections, ensuring that the drug is correctly placed in the sheath (Hajder et al., 2013).

3. Infectious tenosynovitis

Because of their superficial location, a variety of microorganisms may infect the extensor tendons of the radial side of the wrist. Infectious tenosynovitis may be related to a penetrating trauma, even relatively mild ones, with or without a foreign body, which lead to peritendinous soft tissue infections that spread to the tendon sheath, or rarely to haematogeneous seeding (Draghi, 2013). The most common pathogens are Staphylococcus aureus, Streptococcus spp., Pseudomonas, atypical Mycobacteria and Gonococcus spp.

Sonography shows effusions within the tendon sheath, of mixed echogenicity (fig. 6), associated with peritendinous oedema and hypervascularisation. Sonography examination can raise the suspicion of septic tenosynovitis, but the definitive diagnosis is based on analysis of fluid. If diagnosed within the first 48 hours, infectious tenosynovitis can be treated with immobilisation and antibiotics but, if a rapid clinical response does not occur, surgery is indicated.

4. Extensor tendons of the first compartment impingement

Fractures of the distal radius are the most common fractures in the upper extremity (Esenwein et al. 2013; Daenen et al., 2004) (fig. 7). In recent years, palmar plate fixation with fixed-angle implants has become the preferred treatment for unstable distal radius fractures. The close proximity of the extensors, especially the extensor pollicis longus to the radius, puts them at risk when there is a fracture of the radius or when palmar screws are placed. During movement of the wrist, the fractured bone impinges the sheath and the repeated microtraumas create a tenosynovitis; in these cases, tendon rupture may follow.
5. Intersection syndrome

Intersection syndrome is an overuse disorder of the dorsal distal forearm located 4-8 cm proximal to Lister's tubercle where the musculotendinous junctions of the first extensor compartment tendons intersects the second extensor compartment tendons (fig. 8, 9), or more rarely, where the third extensor compartment tendon intersects the second extensor compartment tendons (De Lima et al., 2004). Localised pain is the main symptom, although swelling may also be present. Sonography shows effusion within the sheath of the tendons of the second extensor compartment (fig. 8B) and sometimes smaller effusions within the sheath of the first osseofibrous tunnel or soft-tissue oedema between the two tendon groups or within a serous bursa. When each tendon of the second extensor compartment is contained in its own sheath, tenosynovitis can affect only one sheath, generally the extensor carpi radialis brevis sheath (fig 9B). Distal intersection syndrome manifests with tenosynovitis of the tendons of both the second and third extensor compartments. Treatment consists of anti-inflammatory medication, but surgical treatment also has been advocated by some authors.

6. Wartenberg Syndrome

The radial nerve turns superficial at about 9 cm proximal to the styloid process of the radius to provide sensation to the dorsoradial aspect of the hand (Knutsen and Calfee, 2013). Due to its anatomical location, the superficial branch of the radial nerve is vulnerable to trauma and compression (Colles fractures, penetrating trauma, cephalic vein cannulation, etc.) (De Maeseneer et al, 2009). Patients with Wartenberg syndrome typically present with paresthesias along the dorsal radial forearm, radiating to the thumb, and index and long fingers. However, they may also have pain with ulnar deviation (Finkelstein's test) similar to de Quervain disease, which is often associated. Sonographically the nerve and its three terminal branches may appear normal (absence of macroscopic damage), or increased in volume and hypoechoic (fig. 10). Spontaneous resolution of Wartenberg syndrome is common. Surgical decompression is required in the absence of spontaneous resolution or when non-operative management failed.

7. Conclusion

In this article we have reviewed the most important anatomic structures at the radial aspect of the wrist, as well as clinical and ultrasound features of various pathologic entities causing radial pain such as de Quervain disease, infectious tenosynovitis, impingement, intersection syndrome, and Wartenberg syndrome. Our conclusions are that sonography is a valuable technique in diagnosing radial wrist pain. Advantages include the ability to assess all the wrist structures quickly and perform dynamic examinations; ultrasound is also cheap, well tolerated by patients, has no contraindications respect to magnetic resonance.
References


Figures
Fig. 1. In the radial aspect of the wrist (A), the abductor pollicis longus (Abd pl) and extensor pollicis brevis (Ext pb) crosses over the extensor carpi radialis longus (Ext rlc) and brevis tendons (Ext rbc) (B) and are stabilised at the styloid process of the radius by a retinaculum (Ex ret) (C). The radial nerve (RN) crosses over the proximal intersection, becomes superficial and gives rise to its terminal sensory branches (D, E, F).
Fig. 2. De Quervain disease. De Quervain disease is a particular entity of the first extensor compartment that affects the retinaculum, the tendons of the abductor pollicis longus (Abd pl) and extensor pollicis brevis (Ext pb) and their synovial sheaths (A). Sonography shows hyperechoic thickening of the retinaculum (Ex ret) (B), with tendons that are difficult to distinguish, and are rounder than usual on transverse scans. Fluid can be seen inside the sheath (C).
Fig. 3. De Quervain disease with complete division of the first compartment (A). Sonography shows hyperechoic thickening of the retinaculum (Ex ret) (B) and fluid inside the sheath of the extensor pollicis brevis (Ext pb) (C).
Fig. 4. De Quervain disease. De Quervain disease with distal incomplete subcompartmentalisation of the first compartment (A). Sonography shows hyperechoic thickening of the retinaculum (Ex ret) (B) and fluid inside the two sheaths (C). The abductor pollicis longus tendon (Abd pl) has multiple terminal laminae.
**Fig. 5.** Chronic de Quervain disease. Sonography shows thickening of the retinaculum (Ex ret) but no fluid inside the sheath.

**Fig. 6.** Infectious tenosynovitis of the fist compartment. Sonography shows effusion within the tendon sheath of abductor pollicis longus tendon (Abd pl) and extensor pollicis brevis (Ext pb) of mixed echogenicity.
Fig. 7. Fracture of the radius with impingement of the first compartment sheath. Sonography shows absence of thickening of the retinaculum (Ex ret) (A) and effusion within the tendons sheath (B).
**Fig. 8.** Intersection syndrome. Intersection syndrome is located in the dorsal distal forearm located 4-8 cm proximal to Lister's tubercle (A). Sonography shows effusion within the sheath of the tendons of the second extensor compartment (B).
Fig. 9. Intersection syndrome. Each tendon of the second extensor compartment is contained in its own sheath (A) and tenosynovitis affect only the extensor carpi radialis brevis sheath (Ext rbc) (B, C).
Fig. 10. Wartenberg syndrome. Sonography shows a terminal branch of the radial nerve (RN) that appears increased in volume and hypoechoic (A, B).