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DIAGNOSTIC METHODS: EDITORIAL

Demystifying shoulder pain with electrodiagnosis and musculoskeletal ultrasound imaging

Shoulder pain is one of the most common problems that physical therapists treat in clinical practice. Prevalence of one month of shoulder and arm pain was reported to be about 30% (Luime et al., 2004). Shoulder pain, as one of the most common complaints for patient's visit to general practitioner and physical therapy practice, is often managed conservatively in a similar manner without knowing the exact underlying pathology causing shoulder symptoms. Shoulder symptoms are broadly categorized into a single diagnosis of 'shoulder pain', without knowledge of specific structure(s) that may be causing the symptoms. This is because clinical tests and physical examination may not be enough to differentiate the wide range of possible pathologies, related to the shoulder-neck area, which can often be confusing because of their similar presentations (Karel et al., 2016). Structures causing shoulder symptoms can be broadly classified into two categories, neural and non-neural and possible causes divided into the two categories presented in Table 1, below.

Physical examination, history taking and special tests may not provide complete information as to the cause(s) of shoulder complaints. Appropriate use of Electrodiagnosis and Ultrasound imaging can provide usefl insights into specific pathology, and therefore should improve clinical decision making, and management of the patient. High levels of patient satisfaction, and patient perceived value, has been reported when clinic-based ultrasound imaging was used in an outpatient facility (Wheeler, 2010) since it helps patients to understand their problem, and improves their confidence in the provider.

1. Neural pathology

Differentiating cervical radiculopathy, thoracic outlet syndrome, or other neural pathology from primary shoulder disease, can be difficulty owing to the close proximity and overlap of symptomatology (Manifold and McCann, 1999). Appropriate use of EMG/NCS studies can tease out the neural component of the shoulder pain. EMG/NCS studies can distinguish possible neural pathologies (listed in Table 1) contributing to shoulder pain, weakness and abnormal dynamics. These abnormalities are seen as abnormal responses in nerve conduction studies and positive needle EMG findings, from the selected muscles of the affected myotome. EMG/NCS tests are an extension of the neurological examination and are tailored to examine the suspected neural structures. With the use of electrodiagnostic tests, it is possible to differentiate cervical radiculopathy that may be causing shoulder pain and weakness, from proximal nerve entrapment, such as axillary, long thoracic and suprascapular nerve entrapments. Electrodiagnostic tests are also helpful in ruling out less common neural pathologies of shoulder region such as Parsonage-Turner syndrome, or thoracic outlet syndrome. Abnormal findings present as delayed latency, slow conduction velocity, reduced amplitude, or abnormal long loop studies such as F waves in the distribution of the affected nerve, with abnormal needle EMG findings including fibrillations, positive sharp waves, abnormal recruitment or abnormal morphology of action potential, in the clinically affected muscles of the involved myotome.

2. Non- neural pathology

Adding ultrasound imaging to the physical examination can provide useful insights into localization of pathology, and also points towards the temporal component of the disease. For a full-thickness rotator cuff tear, ultrasound imaging has been reported to have sensitivity of 60%; specificity of 100%, positive predictive value of 100%, negative predictive value of 78% and accuracy of 84% - whereas for partial thickness tears, ultrasound findings of greater tubercle cortical irregularity have an accuracy of 72%, sensitivity of 69% and specificity of 100%, and positive predicted value of 100% (Jacobson et al., 2004). Ultrasound imaging is considered to be equally effective to, MRI in pathology related to the rotator cuff (Vlychou et al., 2009) and has an added advantage of real-time evaluation and use of dynamic imaging, which is not possible with MRI. In certain pathologies ultrasound is considered superior to MRI for example in identifying a mid-substance tear of supraspinatus, which may be missed with MRI or MR arthrogram, or evidence of neoangiogenesis in tendinopathy. Clinical history, physical

Table 1
Neural and non-neural causes of shoulder pain.

Neural causes of shoulder pain	Non-neural causes of shoulder pain
C5 C6 Radiculopathy	Rotator cuff tendinosis/tendinopathy
Suprascapular neuropathy	Subacromial impingement syndrome
Axillary neuropathy	Partial tear of rotator cuff tendons
Long thoracic neuropathy	Full thickness tears of rotator cuff tendons
Thoracic outlet syndrome	Tenosynovitis of long head of biceps
Parsonage-Turner Syndrome	Subacromial Subdeltoid bursitis
	Calcific tendinitis
	Joint effusion
	Arthritis with or without loose bodies
	Adhesive capsulitis
	Soft tissue mass/tumor (rare)

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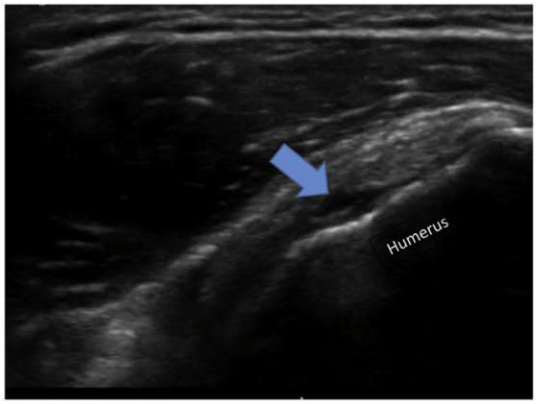

Fig. 1. Partial tear of Subscapularis tendon seen as a focal anechoic (black) defect (arrow).

examination, special tests and musculoskeletal ultrasound is usually sufficient to identify the pathology related to soft tissue of the shoulder region. In some cases, further MRI examination may be necessary, for example for identification of a soft tissue mass, bone pathology-like occult fractures, or suspicion of intra-articular pathologies, as evidenced during ultrasound evaluation of the region.

Some of the examples of shoulder pathologies are shown in Figs. 1–6.

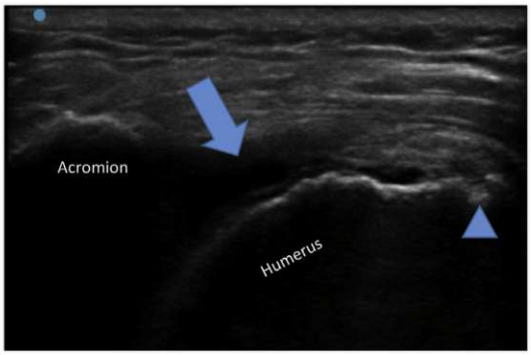

Fig. 2. Full thickness complete tear of supraspinatus tendon. Non-visualization of tendon with anechoic signal (arrow) and cortical irregularities noted at humerus and Greater tubercle (triangle).

Fig. 3. Subacromial bursitis seen as hypoechoic (dark) signal (arrow) over supraspinatus tendon causing impingement at subacromial space. GT- Greater Tubercle.

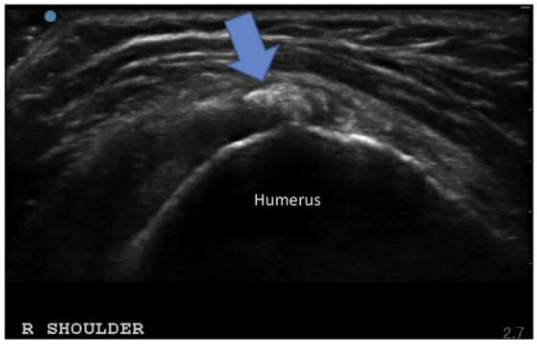

Fig. 4. Calcific tendinitis of supraspinatus. Calcific deposit is seen as hyperechoic signal (arrow).

Musculoskeletal ultrasound is not only helpful in identifying underlying pathology, it is also helpful in guided procedures if indicated. High levels of accuracy have been reported with guided injections of involving the acromioclavicular joint, gleno-humeral joint & subacromial region, when compared to blind injections. Furthermore, musculoskeletal ultrasound is most effective and efficient in post-operative rotator cuff repair evaluation, if the patient complains of pain or dysfunction post-surgery, where MRI may be limited due to altered signals from suture material, anchors etc.

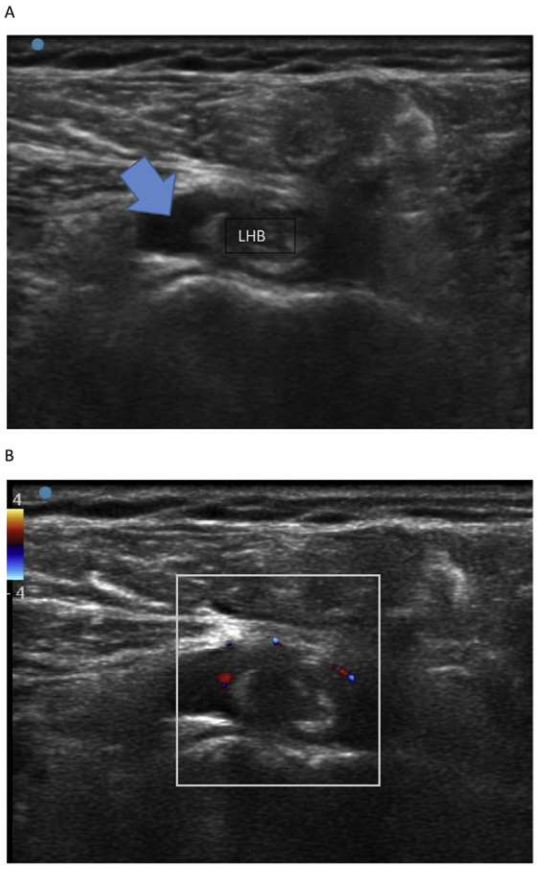

Fig. 5. A: Tenosynovitis of long head of Biceps tendon. Tenosynovitis seen as hypoechoic (dark) halo around the tendon (arrow) **B**: With color Doppler Ultrasound increased vascularity is noted (seen as color dots inside the box) around the Long head of biceps. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

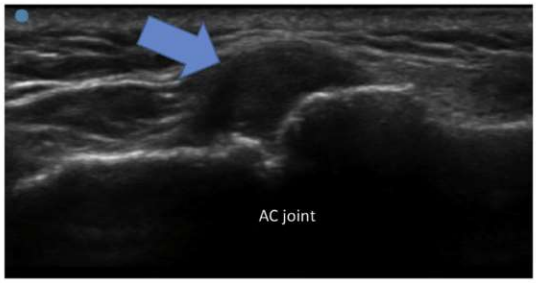

Fig. 6. AC joint effusion seen as hypoechoic (dark) signal (arrow) around the joint.

Electrodiagnostic tests and musculoskeletal ultrasound imaging together with the clinical history and physical examination, provide a detailed overview of the neural and non-neural soft tissue structures in the shoulder-neck region, and can help guide the proper management of the patient in a timely manner.

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