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Case Report

Ultrasound Findings of Teres Minor Denervation in Suspected Quadrilateral Space Syndrome

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ABSTRACT: Isolated teres minor denervation is an uncommon finding on sonographic examination. We present a case of a 64-year-old man with increased echogenity of the teres minor muscle and a slight reduction in muscle bulk. Investigation of a suspected axillary nerve lesion included a detailed sonographic examination of the posterior shoulder and the axillary space, followed by MR imaging and electrophysiologic testing. This case demonstrates the potential importance of examining rotator cuff muscles when performing sonographic examination of the shoulder in patients with persistent symptoms, no history of trauma, and absence of tendon tears. © 2006 Wiley Periodicals, Inc. *J Clin Ultrasound* **34**:343–347, 2006; Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/jcu.20239

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Isolated diffuse increased muscle echogenity of the teres minor muscle is an uncommon finding on sonographic examination. If there is no evidence of a tendon tear, trauma, or history of inflammatory myositis, this sign strongly suggests the existence of an axillary nerve lesion. The quadrilateral space is the most common site of isolated axillary nerve compressive neuropathy. Compression of the axillary nerve (or 1 of its major branches) and the posterior humeral circumflex artery (PHCA) with some movement of the shoulder has been termed quadrilateral space syndrome (QSS).[1]

Little has been published on the sonographic examination of the rotator cuff muscles and the potential role of sonography in the investigation of diffuse increased muscle echogenity.[2,3] The present report describes a case of isolated teres minor denervation that was detected during a routine shoulder examination.

CASE REPORT

A 64-year-old man with no history of recent or past trauma presented with a 3-month history of mild pain over the anterior aspect of the shoulder and slight weakness of the right arm on exertion. The patient underwent sonographic examination of the right shoulder with a Philips iU22 scanner and a broadband 17–5-MHz linear-array transducer (Philips Ultrasound, Bothell, WA). The examination did not demonstrate any tears of the rotator cuff, but it revealed a diffuse increase in echogenity of the teres minor muscle with a slight reduction in muscle bulk (Figure 1A). Examination of the opposite shoulder confirmed the change in muscle size (Figure 1B). The appearances of the other shoulder muscles were normal. The posterolateral surface of the humeral head, the posterior glenoid labrum, and the anteroinferior rim of the glenoid labrum had a normal sonographic appearance without identification of indirect sonographic signs of anterior shoulder dislocation, such as small Hill-Sachs deformities or

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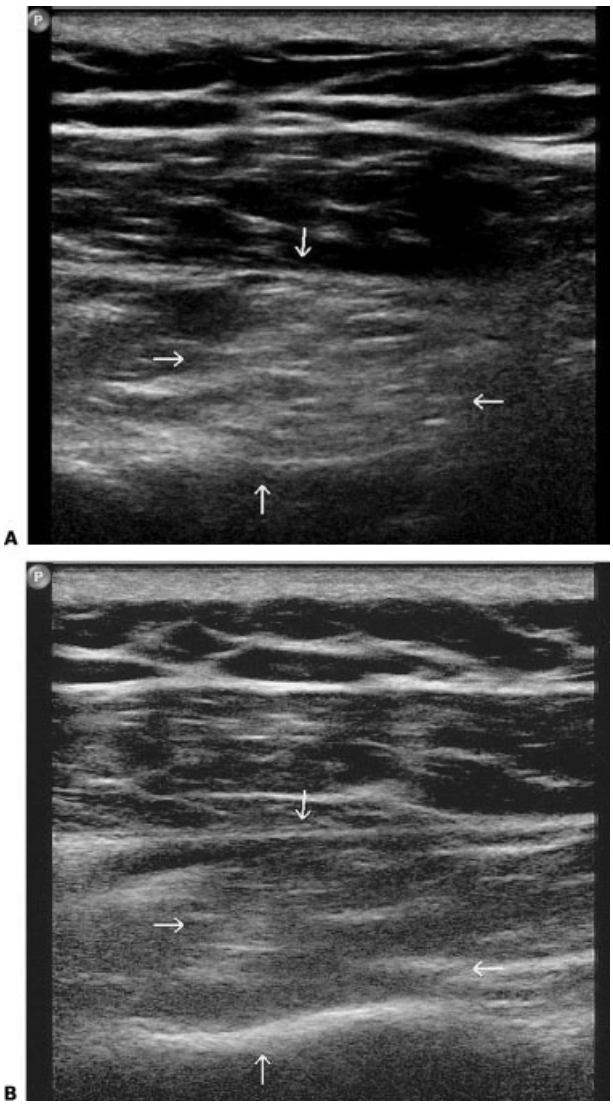

FIGURE 1. (**A**) Transverse sonogram of right teres minor muscle (arrows) shows increased muscle echogenicity with slight loss of muscle bulk. The overlying deltoid muscle has a normal sonographic appearance. (**B**) Transverse sonogram of the normal left teres minor muscle (arrows) is shown for comparison.

Bankart lesions.[4,5] The examination of the axillary space was performed with the patient in the supine position and the arm abducted 90° with the elbow flexed.[6]

An attempt was made to visualize the PHCA using color Doppler sonography. Initially this study was performed in the position described above, and was then repeated with the arm raised to the head with hyperabduction and external rotation.[7,8] In the first arm position, flow signals in the PHCA were seen near its origin, whereas in the maximum stress position no flow signal was identified (Figure 2). Examination of the opposite healthy side revealed flow signals in both stress positions. The axillary nerve showed no evidence of nerve swelling, other intrinsic neural lesion, or signs of an extrinsic space-occupying lesion. Similarly, sonographic examination of the brachial plexus did not reveal the presence of edema or other neural lesions.[9,10]

Electromyography revealed the denervational pattern of the teres minor muscle. Nerve conduction velocity studies showed axillary nerve latencies near the upper limits of normal in the early stage of the condition, probably due to the intermittent nature of the nerve compression.[11,12] The combination of electromyography with the abnormal appearances of the muscle suggested axillary nerve injury.

MR imaging confirmed the sonographic findings of selective teres minor denervation, best seen on STIR and T2 FSE sequences as a moderate increase in signal intensity with a slight decrease in size, suggesting a stage between acute and chronic denervation (Figure 3). In the absence of an identifiable mass lesion, initial management was conservative. Surgical investigation was performed 5 months later in response to a gradual deterioration of the patient's symptoms. Fibrous bands within the quadrilateral space were identified and excised.

DISCUSSION

The majority of cases of denervation syndromes of the shoulder girdle—and especially of axillary nerve injury—that have been reported in the literature were examined with MR imaging.[13–15] In a recent study employing sonography, the prevalence of muscle atrophy around the shoulder was described for the first time.[3] However, the authors did not investigate potential causes such as entrapment neuropathies. Teres minor atrophy was seen in 36% of cases of atrophy around the shoulder, and 28% of these cases were seen in isolation with no concomitant rotator cuff tear.

Selective teres minor atrophy can result from selective compression of the corresponding axillary nerve branch or PHCA. Axillary nerve compressive neuropathy most often occurs in association with fibrous bands in the quadrilateral space or other space-occupying lesions, such as inferior (from 9-o'clock to 7-o'clock positions) paralabral cysts, lipomas, or dilated veins.[16] Other situations that can present with the symptom complex of QSS on physical examination include[1,12] (1) anterior shoulder dislocation, (2) humeral neck fracture, (3) brachial plexus stretch injury, and (4) thoracic outlet and inlet syndrome.

The sonographic assessment of the size and echogenity of the teres minor muscle is of value, because clinical diagnosis may be difficult. This is

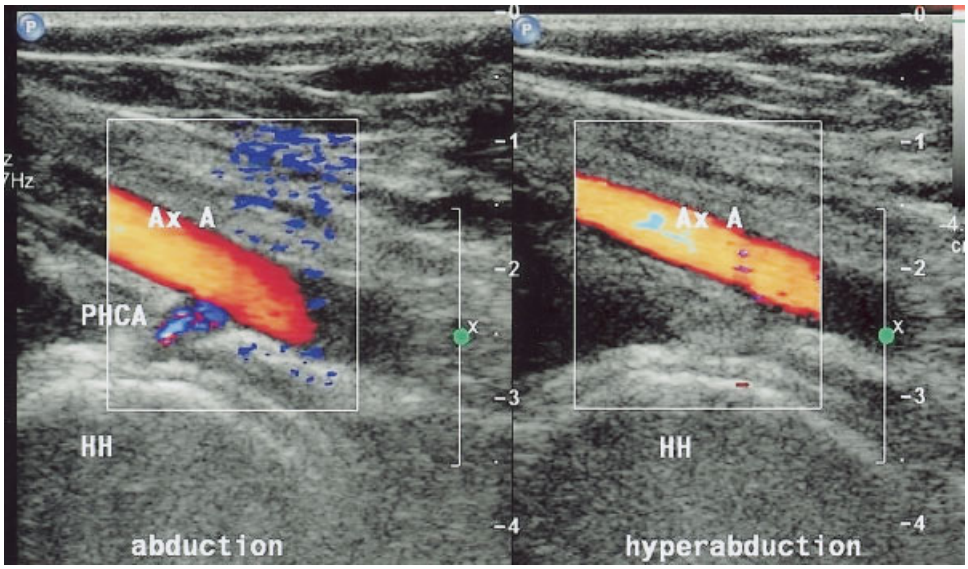

FIGURE 2. Dynamic examination of the axillary space. Left: Longitudinal view of right axillary artery (Ax A) at the level of the origin of posterior humeral circumflex artery (PHCA) adjacent to the humeral head (HH) during 90° abduction and external rotation of the arm. Right: No flow signals in the PHCA were identified during hyperabduction (>120°) and external rotation of the arm.

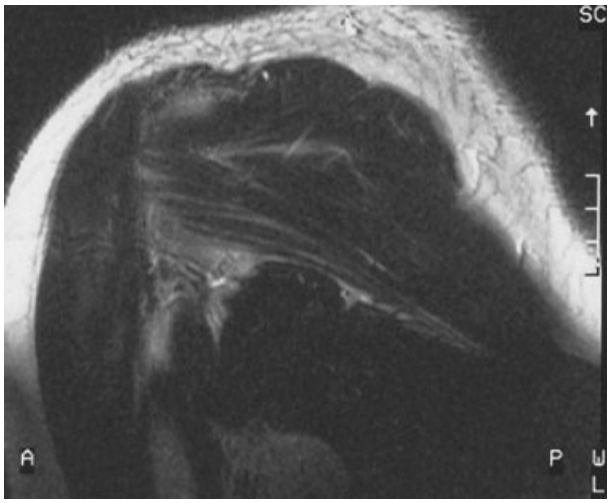

FIGURE 3. T2-weighted TSE coronal MR image at the level of teres minor shows the increase of signal intensity with a slight decrease in size of the muscle.

because the relative contributions of the teres minor and infraspinatus muscles cannot be determined with clinical certainty.[12] In our case, the degree of teres minor atrophy was not proportional to the muscle fatty infiltration seen with sonography. This may be explained by the duration of symptoms that corresponds to a teres minor denervation between the subacute and chronic stages.[11,14]

MR imaging seems to be superior to sonography in the identification of early neurogenic atrophy. Soon after neural injury, muscle changes are mainly related to extracellular edema and result in increased signal intensity on T2-weighted sequences and normal intensity on T1-weighted sequences. MR imaging may be important in the differentiation between acute and chronic appearances of the affected muscles. In chronic denervation, the affected muscles show increased intensity on standard spin-echo MR sequences.[11,14] Moreover, although acute and subacute changes are nonspecific and can be seen in any process that produces muscle edema, the distribution of the signal changes helps differentiate neural injury from direct muscle injury. Direct trauma usually affects superficial structures more than those that are deeper. This means that direct injury of the teres minor muscle would probably be seen in combination with an injury of the more superficial deltoid muscle, which was intact in our patient. The differences in distribution of muscle changes can be identified with sonography and can also help distinguish Parsonage-Turner syndrome from QSS. In particular, sonography can demonstrate involvement of the suprascapular nerve in Parsonage-Turner syndrome with denervation of the supraspinatus and/or infraspinatus, whereas QSS involves the teres minor muscle and/or deltoid muscle.[14]

The sonographic study of the axillary space has a potential role in localizing the axillary nerve, which can be achieved by first identifying the PHCA.[17] It may be detected adjacent to the PHCA, but it is not always depicted if the patient is not slender or young. Sometimes the axillary neurovascular bundle can be imaged with the patient's arm elevated in the posterior axillary

fold as it enters the deltoid muscle; it then can be followed across the posterior shoulder with the patient's arm maintained in the neutral position.[18]

Color Doppler sonography may help to identify the PHCA and confirm reduced blood flow in stress positions (abduction and external rotation of various degrees of the arm). A mechanism of intermittent compression of the nerve and artery as a result of shearing and closing down of the space by the teres major and teres minor muscles has been proposed.[12] Localization of the midsection of the PHCA in the neutral position has been described above. Comparison with the opposite side is necessary. The finding of occlusion in the stress position has until now been described in the radiology literature only in association with MR angiography.[4,7,8] It is not specific, because the same signs may be found in asymptomatic volunteers.[8] Nevertheless, its presence preoperatively and its absence postoperatively might be useful, because some authors emphasize that decompression of the quadrilateral space is effective if the pulse of the PHCA remains palpable when the arm is abducted and rotated externally during the operation.[1,19,20] The value of a reduced flow in the PHCA during stress maneuver is not entirely clear, and the potential usefulness of sonography needs to be evaluated in future studies.

Because the small size of the axillary nerve makes it difficult to obtain reliable morphologic information, the main reason to sonographically examine the quadrilateral space is to rule out any space-occupying mass as a possible cause of entrapment. If there is no evidence of a space-occupying lesion, as in our case, the patient should be reassured that the symptoms could potentially resolve with nonoperative treatment. If imaging does not reveal a cause of teres minor atrophy, fibrous bands may be causing the compression.[12] The inability of sonography to detect fibrous bands makes it a diagnosis of exclusion that is usually made via surgical investigation, as in this case.

Our case demonstrates the potential importance of examining rotator cuff muscles when performing sonographic examination of the shoulder. A quick look at the muscles also makes localization and thorough examination of the corresponding tendons easier, without substantially increasing the diagnostic time. The practical message to musculoskeletal radiologists or other skilled physicians performing sonographic examination of the shoulder (eg, orthopedic surgeons, physical therapists) is that muscle atrophy, though usually associated with rotator cuff tendon tears, may occasionally be the only indirect imaging finding of a latent entrapment neuropathy and should be interpreted in the appropriate clinical and electrophysiologic setting.

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