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Biceps sheath fluid on shoulder ultrasound as a predictor of rotator cuff tear: analysis of a consecutive cohort

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Background: Ultrasound provides evaluation of rotator cuff disease with accuracy comparable to that of magnetic resonance imaging. Fluid in the sheath of the long head of the biceps tendon (LHB), identified on ultrasound scan, has been associated with disease of the rotator cuff, LHB, and glenohumeral joint. Prior literature has compared ultrasound findings only with arthrography, and results have been conflicting. Arthroscopy remains the reference standard in assessing accuracy of imaging modalities. We present the first study investigating the significance of fluid in the LHB on ultrasound in predicting subsequent rotator cuff disease identified on arthroscopy.

Methods: Records were reviewed of 175 patients undergoing ultrasound and subsequent arthroscopy under 1 shoulder surgeon. Experienced musculoskeletal radiologists and sonographers performed ultrasound. Ultrasound examination and operating records were collected and analyzed. Data were analyzed using descriptive statistics, correlation, and logistic regression modeling.

Results: Highly significant correlation ($P < .001$; $\rho = 0.354$) was found between fluid in the LHB sheath and rotator cuff tears on arthroscopy. Statistically significant but weak correlation ($P < .05$; rho = 0.187) was found between fluid in the LHB sheath and both biceps tendon disease and glenohumeral joint disease. Fluid around the LHB was shown to increase the likelihood of having rotator cuff tear (odds ratio, 2.641; 95% confidence interval, 1.229-5.674) and biceps tendon disease (odds ratio, 2.698; 95% confidence interval, 1.216-5.987).

Conclusion: This is the first report identifying significant correlation between fluid in the LHB sheath identified on ultrasound and subsequent rotator cuff disease identified at arthroscopy. We recommend routine reporting of fluid in the LHB sheath as it is likely to improve the accuracy of detecting rotator cuff and biceps tendon diseases.

Level of evidence: Level III; Diagnostic Study

Keywords: Long head of biceps; rotator cuff tear; ultrasound; shoulder pain; shoulder arthroscopy; biceps sheath fluid

Ultrasound scan of the shoulder is routinely used in the diagnosis of shoulder pain[1,19,21] and in particular for the evaluation of shoulder tendon disease. The accuracy of detection of full-thickness tears of the rotator cuff has been described

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as comparable to that of magnetic resonance imaging in some studies.[9,12,21] However, sensitivity and specificity in detecting rotator cuff and biceps tendon diseases can be variable,[3,8,11,15,17,19] in particular for the diagnosis of partial-thickness tears.

The long head of the biceps tendon (LHB) consists of extra-articular and intra-articular segments and is attached to the superior glenoid. It leaves the shoulder joint through the rotator interval to enter the bicipital groove. Fibers from both the supraspinatus and subscapularis tendons together with the coracohumeral and superior glenohumeral ligaments form pulleys that stabilize the LHB tendon. Whereas the exact function of the LHB tendon is a matter for debate, it remains anatomically closely linked with the rotator cuff. The incidence of LHB disease has been shown to be directly proportional to the extent of disease of the rotator cuff.[16] Tears of the anterior end of the supraspinatus or subscapularis may disrupt the supportive sling of the LHB tendon in the bicipital groove and cause mechanical instability.[22]

In our unit, ultrasound scan reports routinely comment on the presence or absence of fluid in the sheath of the LHB. It has been suggested that this fluid may be associated with pathologic changes of the rotator cuff, of the LHB, or within the glenohumeral joint.[5,13,14,18] The association between this fluid, rotator cuff tears, and LHB disease has been studied previously, but results have been conflicting. Middleton et al have shown a significant association between fluid in the LHB sheath and rotator cuff tears,[13,14] whereas other studies[5,18] were unable to show a clear correlation between the fluid and these specific pathologic processes. Those previous studies, though, compared ultrasound and arthrography findings. A recent Cochrane review,[12] however, highlighted that arthroscopy should be used as the reference standard for imaging modalities, and to our knowledge, no direct comparison between ultrasound and arthroscopic findings has so far been reported.

The aim of this study was therefore to determine if the presence of fluid around the LHB on ultrasound correlates with shoulder pathologic processes as identified during shoulder arthroscopy.

Materials and methods

Patients under the care of one specialist shoulder surgeon (A.R.) who underwent ultrasound examination of the shoulder and subsequent shoulder arthroscopy on the same side were eligible for inclusion in this analysis.

Between January 2005 and September 2010, after referral from the specialist shoulder clinic, 596 patients had an ultrasound examination of the shoulder. Of these patients, 175 then underwent shoulder arthroscopy at a mean of 5 months after the ultrasound examination.

Hospital notes of these patients were reviewed, and data from ultrasound reports (including reasons for referral) and operative notes on reported shoulder diseases were collected and compared following appropriate regulatory approvals from our institution's audit department. Complete case records were available for 154 of the 175 eligible patients.

Ultrasound examination

The ultrasound examinations were performed by 1 of 2 experienced ultrasound operators (a musculoskeletal radiographer and a musculoskeletal radiologist), each with more than 10 years' experience in shoulder ultrasound. The ultrasound technique used was similar to that of a study previously published by our department.[7]

All ultrasound examinations were carried out with a Philips HDI ultrasound machine (Philips Healthcare, Best, The Netherlands) using a high-frequency L12-5 MHz linear probe. The patient's arm was positioned in internal rotation and extension to evaluate the supraspinatus tendon in the transverse and longitudinal plane. The infraspinatus tendon was examined with the arm flexed and adducted, and the subscapularis tendon was examined with the arm externally rotated. The diagnosis of a full-thickness tear was made if a hypoechoic area was identified across the complete thickness of the tendon, a retracted tendon margin was seen, or the tendon was absent. The diagnosis of a partial-thickness tear was made when only a focal hypoechoic area was seen within the tendon on either the bursal or articular side. The LHB was located in the bicipital groove with the arm in neutral and the elbow flexed to 90° and demonstrated in the longitudinal and transverse plane (Figs. 1 and 2). To identify any subluxation of the tendon, the patient's arm was rotated externally.

Reporting of the ultrasound findings was standardized per local protocol to capture structural changes systematically, including the presence or absence of fluid in the LHB sheath. The amount of fluid, however, was not quantified.

Arthroscopy

The arthroscopies were performed by or under direct supervision of one specialist shoulder surgeon (A.R.). Intraoperative findings were documented on a standardized operation note, and presence or absence of pathologic change of each of the rotator cuff tendons, labrum, LHB, and glenohumeral joint was recorded. Rotator cuff tears were grouped into partial-thickness and full-thickness tears. The size of full-thickness rotator cuff tears was measured with a probe, and the tendon tear was described as small (<1 cm), medium

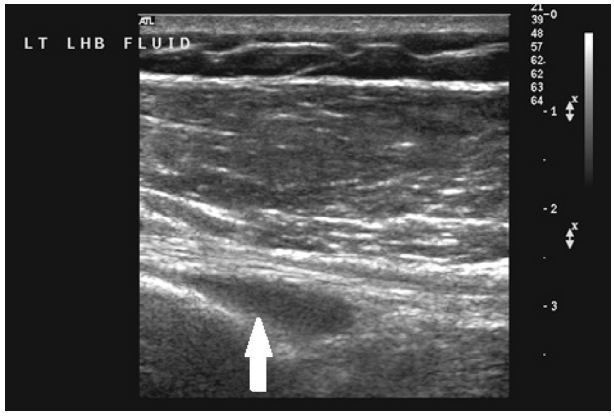

Figure 1 Ultrasound image visualizing long head of biceps (*LHB*) in longitudinal plane.