Ultrasound and operative evaluation of arthritic shoulder joints

E Alasaarela, J Leppilahti, M Hakala

Abstract

Objective—To assess the diagnostic value of ultrasonography (US) in the evaluation of arthritic shoulder joints.

Methods—Twenty shoulders of 20 inpatients with arthritis were evaluated by US one day before the shoulder operation. Changes in the subacromial-subdeltoid bursa, biceps tendon and tendon sheath, rotator cuff, and glenohumeral joint were recorded and compared with findings at operation.

Results—In the detection of effusion/hypertrophy in the subacromial-subdeltoid bursa, US had a sensitivity of 93% and a specificity of 83%. For a biceps tendon rupture US had a sensitivity of 70% and a specificity of 100%. US missed three intra-articular biceps tendon ruptures. For effusion/hypertrophy in the biceps tendon sheath US had a sensitivity of 100% and a specificity of 83%. For a rotator cuff tear US had a sensitivity of 83% and a specificity of 57%. US missed two small longitudinal rotator cuff tears. Three thin membranous, but intact, rotator cuff tendons were classified as full thickness tears by US. Synovial effusion/hypertrophy was detected by US and at operation in all of the 12 glenohumeral joints that were evaluable at surgery.

Conclusion—US is a reliable method in experienced hands for the evaluation of inflammatory changes of an arthritic shoulder. In advanced stages of rheumatoid shoulder joints, however, US is not useful, because destructive bone changes and tendon ruptures change the normal anatomy and restrict shoulder motions, limiting the visibility of US.

Table 1  US and operative findings, diagnoses, and types of surgery for the 20 patients

<table>
<thead>
<tr>
<th>Burial E/H</th>
<th>Biceps tendon</th>
<th>BTS E/H</th>
<th>Rotator cuff</th>
<th>GH joint E/H</th>
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Table 2  Percentage validity of diagnoses by US for the 20 patients

<table>
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<tr>
<th>Validity</th>
<th>Bursa E/H (n=20*)</th>
<th>BT rupture (n=19*)</th>
<th>BTS E/H (n=16*)</th>
<th>RC rupture (n=19*)</th>
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<tr>
<td>Sensitivity</td>
<td>93</td>
<td>70</td>
<td>100</td>
<td>83</td>
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<td>Specificity</td>
<td>83</td>
<td>100</td>
<td>83</td>
<td>57</td>
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<td>Accuracy</td>
<td>90</td>
<td>84</td>
<td>94</td>
<td>74</td>
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<td>PVPT</td>
<td>93</td>
<td>100</td>
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<td>77</td>
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<td>PVNT</td>
<td>83</td>
<td>75</td>
<td>100</td>
<td>67</td>
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</table>

Results

In the detection of effusion/hypertrophy in the SA-SD bursa, US had a sensitivity of 93%, a specificity of 83%, an accuracy of 90%, a predictive value of positive test of 93%, and a predictive value of negative test of 83%. In two cases, a mild synovial thickening of the SA-SD bursa classified as synovial hypertrophy without effusion detected by one method (US or surgery) was not confirmed by the other (table 1 and table 2). Table 2 shows the number of patients in whom the shoulder structure in question was evaluable at operation.

In the assessment of biceps tendon ruptures, US had a sensitivity of 70%, a specificity of 100%, an accuracy of 84%, a predictive value of positive test of 100%, and a predictive value of negative test of 75%. US missed three intra-articular biceps tendon ruptures. In the detection of effusion/hypertrophy in the biceps tendon sheath, US had a sensitivity of 100%, a specificity of 83%, an accuracy of 94%, a predictive value of positive test of 91%, and a predictive value of negative test of 100%.
In the assessment of RC tears, US had a sensitivity of 83%, a specificity of 57%, an accuracy of 74%, and a predictive value of positive test of 77%, and a predictive value of negative test of 67%. US missed one small longitudinal partial thickness tear and one small longitudinal full thickness tear. In three cases, thin membranous, but intact, RC tendons reported at surgery were classified as full thickness tears by US because of the loss of tendon substance. One RC tendon normal by US was classified as thinned at surgery, and one normal RC tendon at surgery was evaluated as thickened by US.

Synovial effusion/hypertrophy was detected by US and at surgery in all the 12 GH joints that were evaluable at surgery. Thus US had a sensitivity of 100%, but its specificity, accuracy, and predictive value of negative test were not assessable.

Discussion

This study shows that US had a high sensitivity in the detection of synovial effusion/hypertrophy in the SA-SD bursa, BTS, and GH joint, whereas in the assessment of biceps and RC tendons the sensitivity and accuracy of US were lower.

Although operation can be considered the “gold standard” of the investigation methods of the shoulder, it also has some limitations. Firstly, depending on the procedure, not all structures are visible, and blind palpation of the structures does not yield exact information. Secondly, the assessments of the quality and quantity of tissues are subjective without histological tissue samples or distinct measuring instruments.

In RA, the ruptured biceps tendon is usually adherent to the bicipital groove.15 In this study, we found that in advanced stages of RA, the intra-articular tendon area was not evaluable by US because of the upward subluxation of the humeral head. In three cases where US missed intra-articular biceps tendon ruptures, the tendons appeared to be in the groove in US.

Effusion in the BTS is non-specific finding and may reflect a pathological process elsewhere in the shoulder joint.1 As the BTS is merely an extension of the synovial membrane of the joint, generalised joint effusion in arthritis can lead to fluid in the sheath.16 Effusion caused by isolated biceps tendinitis is rare.19 The BTSs of 16 shoulders were evaluable at surgery; effusion/hypertrophy in the BTS was identified in 10 of these shoulders by both US and operation. Of these 10 shoulders nine had RC abnormalities and in nine shoulders concomitant effusion/hypertrophy in the GH joint was visualised by US. Some cases with a RC rupture had no effusion/hypertrophy either in the BTS or in the GH joint. In one shoulder US depicted distinct effusion around the biceps tendon, but at operation (resuturation of the RC) no effusion was seen after incision into the subacromial space, when synovial fluid had already poured out.

The diagnostic accuracy of US in detecting RC tears seems to be controversial.10-21 US has some limitations in the evaluation of the RC.

Sonograms can depict only the distal part of the RC, which is not obscured by the acromion.14 Some RC tears may not be of sufficient size or not have an appropriate configuration or differential echogenicity to be detected by US. Thus, a small longitudinal tear without any retraction of the torn edges or any focal alteration in RC echogenicity may not be revealed by US.22 In this study, we missed two such small longitudinal RC tears by US. Conversely, three US classified full thickness RC tears were intact at surgery, but very thin and membranous. The GH joints of these three shoulders were totally destroyed with the humeral head and a diminished subacromial space are a result of a rupture of the RC, although an intact but thinned RC has been seen in many instances.23 24 The above mentioned three cases represent Kelly’s group III. US failed to depict visible RC tendon substance, and these cases were thus classified as full thickness tears.

In the past 10 years, US and magnetic resonance imaging (MRI) have been introduced into the clinical practice of diagnosing shoulder problems. MRI is superior to US in depicting effusions,24-27 synovial thickening and pannus tissue formation, cartilage damage and intra-osseous abnormality,28 and RC pathology.29 However, in comparison with US, MRI is less available, more expensive and time consuming, and less convenient to the patients.

The operator dependency of US and the small number of patients in this series may somewhat limit the generalisability of our results. We, however, conclude that US is a reliable method in experienced hands for the evaluation of inflammatory changes of the arthritic shoulder. It is to be noted that in advanced stages of RA, the destructive bone changes and tendon ruptures cause upward and medial migration of the humeral head and restricted shoulder motions limiting the usefulness of US in the evaluation of the shoulder in these cases.

This work was supported by the Finnish Cultural Foundation, Helsinki, Finland.

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Ann Rheum Dis 1998 57: 357-360
doi: 10.1136/ard.57.6.357

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