Sonography for diagnosis of rotator cuff tear

Comparison with observations at surgery in 58 shoulders

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To investigate the correlation between ultrasonographic and anatomic changes of the rotator cuff of the shoulder, we studied the findings in 58 surgical cases. Fifteen cases had a full thickness tear, 10 of which had a positive and 5 a negative ultrasonogram. Nine cases had partial tears of the cuff on the bursal side. Ultrasonographically, 3 of these were normal. Among the 34 cases that proved to be normal at surgery, 9 had positive ultrasonograms.

The predictive value of a negative examination was 0.8, whereas the predictive value of a positive examination was 0.6. A cautious attitude towards ultrasonography for evaluation of the rotator cuff seems appropriate.

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Ultrasonography of the shoulder has been recommended to replace arthrography because of its high sensitivity in detecting lesions of the rotator cuff (Crass et al. 1984, 1985, Middleton et al. 1985, 1986a). However, the different ultrasonographic criteria are ambiguous. Ahovuo et al. (1989) have stated that alterations in echogenicity are nonspecific and uncertain. Crass et al. (1988) showed that changes in echogenicity and thickness can also reflect degenerative changes of varying degree.

Mack et al. (1985, 1988) have described focal defects or general thinning of the cuff at ultrasonography to be a sign of a tear, whereas Crass et al. (1988) suggested that this sign represents a thin cuff, and is not necessarily associated with a tear.

We have evaluated the correlation between ultrasonographic and anatomic changes in a group of patients undergoing anterior acromioplasty.

Material and methods

From November 1986 to June 1990, 58 patients with chronic subacromial pain were selected for surgery. There were 31 women and 27 men with a mean age of 46 (24–67) years. The decision to perform anterior acromioplasty was based on clinical examination, conventional radiography, and diagnostic subacromial injection of local anesthetics. Thus, arthrography was not done, and the ultrasonographic findings were not considered by the surgeon prior to the decision to operate.

Ultrasonography was performed with a Toshiba SSA-90A equipped with a 7.5 MHz linear array transducer. The initial 5 patients were studied with a MK 300 I from Advanced Technology Laboratories and a 7.5 MHz mechanical sector scanner. The static and dynamic examinations were performed as described by Middleton et al. (1984) and Crass et al. (1984). Comparisons were made with the contralateral shoulder. The biceps tendon was separately identified to avoid misinterpretation.

Both focal and general reduction in thickness were recorded. Increased, as well as decreased, echogenicity was noted.

We considered the ultrasonogram pathologic if (1) there was a focal or generalized change in echogenicity, (2) thinning of the cuff, or (3) no cuff substance.

Partial anterior acromioplasty was performed according to Neer (1972). Abnormalities were classified into partial thickness tears and full thickness tears.

Results

At surgery, 24 cases had tears of the rotator cuff, 15 of which had full thickness tears and 9 partial tears. Considering a thin cuff as pathologic, 14 out of 24 cases with tears had negative ultrasonograms; 34 cases were normal at surgery, but 4 of these had positive ultrasonograms (Table 1).

Based on changes in echogenicity, 11 cases of the 24 cases with tears were negative by ultrasonography,

Table 1. Results when only thinning of the rotator cuff is considered positive

	Surgical finding		
Ultrasonography	Tear[a]	No tear	Total
Positive	10	4	14
Negative	14	30	44
Total	24	34	

Sensitivity: 42 percent
Specificity: 88 percent
Predictive value of a negative examination: 68 percent
Predictive value of a positive examination: 71 percent
Accuracy: 69 percent
[a] Partial or complete tear.

Table 2. Results when only changes in echogenicity of the rotator cuff are considered positive

	Surgical finding		
Ultrasonography	Tear[a]	No tear	Total
Positive	13[b]	6	19
Negative	11	28	39
Total	24	34	

Sensitivity: 54 percent
Specificity: 82 percent
Predictive value of a negative examination: 72 percent
Predictive value of a positive examination: 68 percent
Accuracy: 71 percent
[a] Partial or complete tear.
[b] One case with complete retraction.

Table 3. Results when finding of either alterations in echogenicity or local thinning or the combination is considered a positive ultrasonogram

	Surgical finding		
Ultrasonography	Tear[a]	No tear	Total
Positive	16	9	25
Negative	8	25	33
Total	24	34	

Sensitivity: 67 percent
Specificity: 74 percent
Predictive value of a negative examination: 76 percent
Predictive value of a positive examination: 64 percent
Accuracy: 71 percent
[a] Partial or complete tear.

whereas 6 of the 34 normal cases were positive (Table 2).

Combining these two ultrasonographic signs, we found 8 cases among the surgically proven tears to be negative by ultrasonography; 9 of the normal cases were positive (Table 3). The predictive value of ultrasonography was 0.6 when positive and 0.8 when negative (Table 3).

Discussion

Our study showed a poor correlation between ultrasonography and the anatomic changes found at surgery. The early reports by Crass et al. (1985), Mack et al. (1985), and Middleton et al. (1986b) on the use of ultrasound in evaluating the rotator cuff were very promising. Their sensitivity (91–100 percent) and specificity (91–94 percent) were as good as or better than those of arthrography.

Later reports (Miller et al. 1989, Brandt et al. 1989, Vick and Bell 1990) have questioned these results, and have discussed the difficulties with the method. Miller et al. (1989) have pointed out that "a tear represents the end of a continuum of progressive stages of degeneration. ... [and that] previous reports have ignored the potential effect of degeneration on the sonographic appearance." Brandt et al. (1989) reviewed the different criteria applied at ultrasonography of the rotator cuff and concluded that there was no agreement on the accuracy or reliability. In fact, they found some of the criteria to be "highly subjective."

From previous reports, it is not clear whether or not the ultrasonographic studies were allowed to influence the decision to operate. In our study not only positive ultrasonographic findings, but also negative ultrasonographic studies, were verified by surgery without bias. In the study by Mack et al. (1985), surgical correlation was used for part of their ultrasonographic findings. Out of their 34 negative ultrasonographic examinations, only 16 were surgically explored. Similarly, in the study by Crass et al. (1985), 61 percent of the patients with a positive ultrasonographic study were surgically explored as compared with only 38 percent of those with a negative examination. This could account for the low number of false-negative examinations in their studies.

The relevance of echogenic areas as a sign of a rotator cuff tear has been emphasized by Middleton et al. (1984) and Crass et al. (1985), whereas Mack et al. (1985) found the echo-poor area to be a more reliable sign. Despite this existing controversy, it is surprising that in the patients we examined we found no case with an echo-poor area. On the contrary, the echo-rich

area proved to be the single most specific sign, but with a low sensitivity (Table 2). An explanation could be that echo-poor areas are more difficult to detect, although we have found it in patients outside of this study.

The sensitivity of an ultrasonographic study can be increased by also considering a thin cuff as a pathologic sign (Table 3). Upon applying a thin cuff at ultrasonography as a criterion of a rotator cuff tear, we achieved a specificity of 0.9, but the sensitivity was as low as 0.4. The sensitivity could be increased to 0.7 by using the combination of a thin cuff and an echogenic cuff as a sign of a tear. However, this resulted in a drop in specificity to 0.7 and a predictive value of a positive examination of only 0.6.

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