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Original article

Bedside ultrasonography for verification of shoulder reduction: A long way to go

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ABSTRACT

Purpose: Shoulder dislocation is a common joint dislocation managed by the emergency physicians in the emergency departments. Pre- and post-reduction radiographic examinations have long been the standard practice to confirm the presence of dislocation and the successful reduction. However, shoulder ultrasonography has recently been proposed as an alternative to the radiographic examination. This study aimed to assess the accuracy of ultrasonography in evaluating proper reduction of the dislocated joint.

Methods: This was a prospective observational study. All patients with confirmed anterior shoulder dislocation were examined by both ultrasonography and radiography after the attempt for reduction of the dislocated joint. The examiners were blinded to the result of the other imaging modality. Results of the two methods were then compared.

Results: Overall, 108 patients with confirmed anterior shoulder dislocation were enrolled in the study. Ninety-one (84.3%) of the patients were males. Mean age of the participants was (30.11 ± 11.41) years. The majority of the patients had a recurrent dislocation. Bedside ultrasonography showed a sensitivity of 53.8% (95% CI: 29.1%–76.8%) and a specificity of 100% (95% CI: 96.1%–100%) in detecting inadequate reductions. The results of ultrasonography had a statistically significant agreement with the results of radiography (Kappa = 0.672, $p < 0.001$).

Conclusion: The results suggest that the sensitivity of post-reduction ultrasound is not sufficient for it to serve as a substitute for radiography.

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Introduction

Emergency physicians frequently encounter patients with a shoulder joint dislocation. The shoulder is the most frequently dislocated major joint.¹ Anterior glenohumeral dislocations account for more than 50% of all joint dislocations.² Reduction is

attempted in the emergency department (ED), often under conscious sedation. As a common practice, pre- and post-reduction radiographic examinations are performed to ensure the presence of dislocation, to exclude fractures, and to confirm a successful reduction. However, the necessity of routinely obtaining these radiographs from all patients with dislocation has been challenged.^{2–4}

Ultrasonography is being increasingly used in the EDs as a diagnostic tool. It has been proposed as an alternative to the radiography in evaluating shoulder joint dislocation^{1,5,6} considering its benefits in detecting shoulder pathologies.^{7,8} In the evaluation of proper reduction of a dislocated shoulder joint after performing the reduction maneuvers, bedside ultrasonography has the advantages of timely usage and can preclude the need for re-sedation in cases

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of an inadequate reduction. This in turn can result in a decrease in the cost and the length of patient's stay in the ED. Therefore, bedside ultrasonography can be a good choice as long as it is accurate.

To our knowledge, very few papers that chiefly comprise case reports and small case series have addressed the use of bedside ultrasonography in evaluating the adequacy of the reduction.^{1,5,6,9} There is an obvious gap in the literature for larger validation studies. We performed a prospective observational study to evaluate the accuracy of the bedside ultrasonography in detecting unsuccessful reductions and to examine whether this diagnostic modality can be safely recommended as a reliable indicator of the post-reduction persistent dislocation.

Materials and methods

This prospective observational study was performed between March 2012 and March 2014 at a university-affiliated trauma center ED where the two principal investigators were on duty as attending emergency physicians. We enrolled all patients with suspected shoulder dislocation presented to the ED in the two-year study interval.

Patients whose anterior shoulder dislocation was further confirmed by the standard radiologic examination were included in the study. A true anteroposterior (true AP) shoulder radiograph was taken as the standard criterion to confirm the anterior shoulder dislocation. In order to have a more homogenous sample, patients with a body mass index (BMI) of 35 or higher were excluded from our study. Other exclusion criteria were: time interval of more than 12 h since the occurrence of the dislocation, multiple trauma or concomitant fractures. Posterior glenohumeral dislocations were also excluded because standard radiography is not accurate enough to show this type of dislocation,¹⁰ and according to our hospital's protocol, the suspected posterior dislocations should be managed by an orthopedic surgeon and reduced in the operation room not the emergency department.

An experienced attending emergency physician interpreted the initial radiographs and confirmed the dislocations. Subsequently, either of the two principal investigators tried to reduce the joint by performing scapula manipulation or traction-counter-traction maneuvers while procedural sedation was applied and cardiovascular monitoring was being performed in all cases. Then, the two principal investigators who had several years of experience in bedside emergency sonography and had received training courses of shoulder ultrasonography in the radiology department performed the ultrasonography of the shoulder. Presence of humeral head in the glenoid fossa was examined to confirm the proper

reduction. We used an ultrasound system (Honda Electronics Co., Ltd., Japan, 2100) with a 7-MHz linear probe. Both anterior and lateral approaches were used while the patient was laid in the supine position. A persistent dislocation was assigned as a positive finding.

After the result of the ultrasonography was documented, a post-reduction radiograph was obtained and interpreted by the independent attending physician who had confirmed the dislocations at the first stage. He was blinded to the results of the bedside ultrasonography performed by the principal investigator. Therefore, the interpretation of the radiographs and the sonographic examinations were performed independently and in a double-blind manner. At the end, the two sets of results were collected and then entered into a spreadsheet for later analysis. [Figs. 1 and 2](#) demonstrate the radiographic and ultrasonographic views of the shoulder joint before and after the reduction.

Statistical analysis was performed using SPSS for Windows (version 14.0, SPSS, Inc. Chicago, IL). Data was presented using descriptive statistics. Student's *t* and Chi-square tests were used to compare the results of ultrasonography and radiography, and sensitivity and specificity were calculated according to the standard formulas. Kappa agreement coefficient for the two diagnostic modalities was also calculated. Non-parametric tests were considered in case the variables did not obey the normal distribution. *p* values of 0.05 or less were regarded as statistically significant.

The study was approved by the ethics committee of the corresponding medical university. Written informed consent was obtained from all participants.

Results

Overall, 108 patients with confirmed anterior shoulder dislocation were enrolled in the study. Ninety-one (84.3%) of the patients were males. Mean age of the participants was (30.11 ± 11.41) years with a minimum age of 18 and a maximum of 75 years. The majority (80.6%) had a prior dislocation. Patients who were suffering the first episode of the shoulder dislocation were significantly younger. There was no significant difference between males and females in terms of dislocation recurrence ([Table 1](#)).

Cross tabulation was used in order to compare the findings of ultrasonography with the results of radiography ([Table 2](#)). Ultrasonography had a sensitivity of 53.8% (95% CI: 29.1%–76.8%) in detecting persistent dislocations. All cases that were assigned by the ultrasonography as positive were further confirmed by the radiography to be an unsuccessful reduction. Thus, ultrasonography was 100% specific (95% CI: 96.1%–100%) in detecting persistent dislocations.

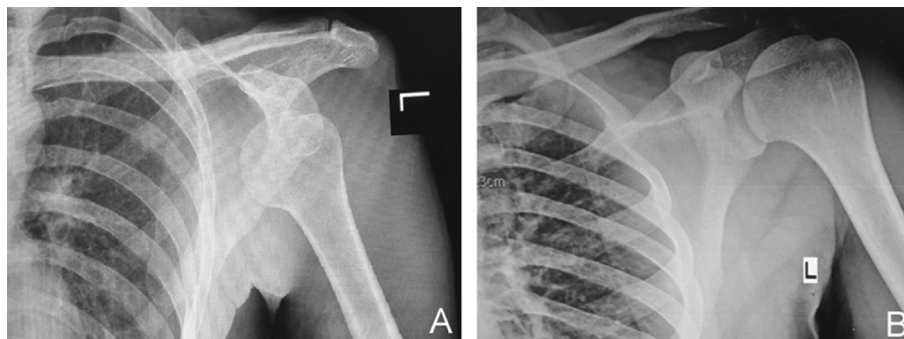


Fig. 1. Radiographic evaluation of the dislocated shoulder joint, anteroposterior view (A). Post-reduction radiograph shows the head of humerus relocated into the glenoid fossa (B).

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