Selected Topics: Emergency Radiology

SELECTIVE PREREDUCTION RADIOGRAPHY IN ANTERIOR SHOULDER DISLOCATION: THE FRESNO-QUEBEC RULE

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☐ **Abstract—Background:** Shoulder dislocation is one of the most frequent dislocations encountered by emergency physicians. Typical emergency care usually includes performing both prereduction and postreduction radiography. However, selective radiography has the potential benefits of reducing emergency department (ED) time and radiation exposure. **Objectives:** To refine and combine two existing clinical decision rules for selective radiography in the ED management of anterior shoulder dislocation, thus creating the Fresno-Quebec rule (FQR). **Methods:** Patients presenting to the ED with an anterior shoulder dislocation were enrolled in a prospective cohort study in two university-affiliated EDs. Patients with a clinically important fracture-dislocation were compared with those with an uncomplicated dislocation. We refined our new decision rule to detect all fracture-dislocations while maximizing specificity. **Results:** A total of 207 patients were included in this study, of which 24 (11.8%) had a clinically important fracture-dislocation. The refined rule consisting of three criteria had a sensitivity of 100% (95% confidence interval [CI] 87.5–100%), specificity of 50% (95% CI 42.5–57.5%), negative predictive value of 100% (95% CI 96–100%), and a negative likelihood ratio of 0.21 (95% CI 0.14–0.30). No patient with an atraumatic, recurrent dislocation had a fracture. Patients over age 35 years had an increased risk of fracture-dislocation if they sustained blunt injury or had a first episode of dislocation. Using this rule could have reduced prereduction radiographs by 44%. **Conclusion:** The refined Fresno-Quebec shoulder dislocation rule detected all clinically important prereduction fracture-dislocations and could have reduced prereduction films by 44%. Prospective validation is warranted. © 2018 Elsevier Inc. All rights reserved.

☐ **Keywords**—anterior shoulder dislocation; prereduction radiography; emergency department; clinical decision rule

INTRODUCTION

Background

Shoulder dislocation is one of the most frequent dislocations encountered by emergency physicians (1–4). Typical emergency care usually includes performing both prereduction and postreduction radiography. This approach has long been recommended, but has also been challenged in many studies (1–10).

Most shoulder dislocations are clinically apparent, but associated fracture is often unsuspected (11). In one study, emergency physicians identified associated fractures with a sensitivity of only 77.3% when based on clinical gestalt (12).

The Fresno and Quebec shoulder dislocation rules are two separately derived clinical decision rules intended to help emergency physicians better identify which patients with an anterior shoulder dislocation should have

prereduction radiography (7,13). These rules include criteria such as age, mechanism of injury, recurrence of dislocation, or presence of an ecchymosis. Although the rules both reported a high sensitivity and specificity, they are not universally accepted. In 2011, Ong attempted to validate the Quebec shoulder dislocation rule, but reported low sensitivity and specificity (14).

Importance

Selective radiography has the potential benefits of reducing ED time, duration of pain, and radiation exposure. Furthermore, if the rate of successful reduction decreases as time passes, more judicious use of prereduction films could also improve success rates (15).

Goals of This Investigation

The primary objective of this study is to combine and refine the Fresno and the Quebec shoulder dislocation rules into a single, highly sensitive, clinical decision rule for selective use of prereduction films (7,11). Secondary objectives are to determine the actual rate of x-ray study utilization in the management of shoulder dislocation, and calculate the potential reduction for radiographs.

MATERIALS AND METHODS

Study Design and Setting

We performed a prospective, observational study in the ED at two Level I trauma centers. Both Institutional Research Ethics Boards approved the study with waiver of consent because management was not altered.

Selection of Participants

Patients were prospectively enrolled in each center if they met our inclusion criteria: 18 years or older, and presenting to the ED for a suspected acute anterior shoulder dislocation. Patients were enrolled from July 2009 to July 2011. Prisoners and patients unable to give the details of their injury were excluded.

Data Collection and Processing

Patients were enrolled by the treating physician or by a trained research assistant. Using a pragmatic approach, emergency physicians were free to order films at their discretion, and we collected data using a standardized data form. We recorded visit-related data during the ED encounter. Later, trained research assistants reviewed each medical record to collect demographic data, radiology reports, and any information on follow-up or additional ED visits. Predictor variables specific to each tested clinical decision rules and other potential predictor variables were selected by two of the investigators (ME, GH), based on prior work.

Outcome Measures

The primary outcome was detection of clinically important prereduction shoulder fracture-dislocations. Clinical importance was defined as a fracture that might influence management in the ED or at follow-up. Our definition included essentially any fracture noted in the radiology report, except a Hill-Sachs fracture. In cases where prereduction radiographs were not performed, results of postreduction radiographs were used. A secondary outcome was the potential decrease in radiographs. Assuming that the most conservative care would include pre- and postreduction radiographs for every shoulder dislocation, the "conservative approach" number of prereduction radiographs would be equal to the total number of study subjects. The number of radiographs recommended by the algorithm was compared with that of the "conservative approach" to calculate the potential reduction in film utilization.

Primary Data Analysis

Baseline analyses were done to compare our study subjects with eligible missed patients. Univariate analyses were conducted for each potential predictive factor using SAS software 9.0 (SAS Institute, Cary, NC). Statistical significance was set at $p < 0.05$. Subsequently, a CART (Classification and Regression Tree) recursive partitioning analysis was performed following Brieman's technique (16). A CART model was created using the different predictor variables, in relation to the main outcome. Answertree 3.1 (SPSS, Chicago, IL) was used. For all CART analyses, we used unweighted variables, 10-fold cross-validation, Gini splitting rules, a maximum tree depth of 5, and a minimum change in impurity > 0.001. Pruning was elaborated with a minimum risk analysis (16). To maximize sensitivity, a misclassification cost of 10 to 1 was attributed to false negative prediction. Predictor selection was performed to achieve maximum sensitivity and based on the two previous available rules. Investigators (ME, GH) reviewed each refined rule for clinical relevance. Nodes with small numbers of patients were aggregated and recursive partitioning was reinstituted to simplify the branch points. This modification, although not previously described, makes clinical sense and reduces the chance of selecting a suboptimal splitting variable when partitioning groups with smaller sample sizes were involved. The simplest, most specific prediction rule that met the sensitivity