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The incidence and risk factors for blood transfusion in revision shoulder arthroplasty: our institution's experience and review of the literature

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Hypothesis: The purposes of this study were to determine the incidence of blood transfusion after revision shoulder arthroplasty and to assess risk factors associated with an increased risk of transfusion.

Materials and methods: Between 1994 and 2008, 566 consecutive revision shoulder procedures were performed at our institution, which formed the basis of this study. The patient's age, sex, body mass index, comorbidities, preoperative and postoperative hemoglobin level, details of the surgery, operative time, and transfusion details were documented retrospectively from medical records.

Results: Overall, 11.3% of patients (64 of 566) required a transfusion. An increased transfusion rate was associated with age (odds ratio [OR] per 10 years, 1.5 [95% confidence interval (CI), 1.2 to 2.0]; $P = .002$), operative time ($\leq$5 hours vs >5 hours) (OR, 3.3 [95% CI, 1.9 to 5.8]; $P < .001$), diabetes (OR, 2.3 [95% CI, 1.2 to 4.4]; $P = .01$), and cardiac disease (OR, 2.7 [95% CI, 1.5 to 5.0]; $P < .001$). There were significant associations between preoperative hemoglobin level (OR, 0.4 per 1 point [95% CI, 0.3 to 0.5]; $P < .001$) and a decreased odds of transfusion. The type of surgery (surgery on humeral component) also had an impact on the need for transfusion ($P < .001$).

Conclusions: Older age, low preoperative hemoglobin level, increased operative time, diabetes, presence of cardiac disease, and type of revision surgery are associated with higher postoperative transfusion rates. These factors should be taken into consideration to more accurately predict the need for transfusion and modify preoperative blood-ordering protocols.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Blood transfusion; revision shoulder arthroplasty; incidence and risk factors

Shoulder arthroplasty is associated with blood loss that may require intraoperative or postoperative blood transfusion. Allogeneic blood transfusion is not risk free and can be associated with allergic and immune-mediated reactions, hemodynamic overload, and risk of infection transmission.[5] There are a few reports concerning the

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incidence and risk factors for transfusion with shoulder arthroplasty.[1,2,6,7,9] Sperling et al[9] reported a transfusion rate of 8.1% in primary shoulder arthroplasty patients. Millett et al[6] reported a 25% transfusion rate for their study that included primary and revision shoulder arthroplasty. Gruson et al[2] included primary, revision, and reverse arthroplasty and reported an overall transfusion rate of 43%. Finally, Schumer et al[7] reported a 19.6% transfusion rate in a patient population undergoing primary and reverse shoulder arthroplasty. However, there is limited information detailing transfusion rates and risk factors in the specific setting of revision shoulder arthroplasty. Furthermore, revision shoulder arthroplasty constitutes a very wide range of surgical procedures, and consequently, the risks of blood loss may vary based on the extent of the procedure.

This study set out to identify the incidence and risk factors for transfusion in patients undergoing revision shoulder arthroplasty as a basis for determining preoperative blood-ordering protocols.

Materials and methods

Our joint registry database was accessed to identify all patients who underwent revision shoulder arthroplasty at our institution between January 1, 1994, and December 31, 2008. We identified 461 patients who underwent 581 consecutive revision shoulder arthroplasties. Fifteen cases were excluded from the study because there was insufficient information in the medical records. Adequate data were available for the remaining 566 procedures, which formed the basis of our study. We recorded the age, sex, body mass index (BMI), comorbidities, preoperative and postoperative hemoglobin level, decrease in hemoglobin level, type of operative procedure, operative time, number of units transfused, and time of transfusion relative to the time of surgery. The indications for transfusion included symptomatic anemia, characterized by persistent hypotension, tachycardia, dizziness, and shortness of breath, as well as asymptomatic anemia in high-risk patients. Multiple variables were considered for administration of a blood transfusion, and there was not a standard protocol during the study period.

On the basis of the type of procedure, we divided the patients into 3 groups for statistical analysis: Group 1 comprised patients who underwent any procedure on the glenoid side (removal, exchange, reaming, bone grafting) with or without humeral head prosthesis exchange; group 2 comprised patients who underwent any procedure on the humeral side (removal, exchange) with or without any procedure on the glenoid side; and group 3 comprised the remaining revision operations, which included exchange of the humeral head prosthesis, isolated soft-tissue procedures, and exchange of a cement spacer with another cement spacer or definitive implant.

Statistical methods

Descriptive statistics are reported as either number (percent) or mean (range) as appropriate. Univariate associations of patient factors with transfusion at revision total shoulder arthroplasty (yes vs no) were assessed by use of logistic regression. With a total of 64 transfusions in the study cohort, we also identified a multiple-variable logistic model using the backward-selection procedure (it should be noted that both the forward and stepwise procedures identified the same model). Results of the models are reported as the odds ratio (OR) and 95% confidence interval (CI). Sensitivity and specificity estimates for several cutpoints in preoperative hemoglobin level for the prediction of patient transfusion are reported by use of a receiver operating characteristic (ROC) curve. The α level was set at .05 for statistical significance.

Results

We included 448 patients who underwent 566 revision shoulder procedures (Table I). The overall transfusion rate was 11.3% (64 of 566). Regarding the number of surgeries, 272 (48%) were performed in female patients and 294 (52%) in male patients. All patients had stopped taking nonsteroidal anti-inflammatory drugs and receiving anticoagulation 5 to 7 days before surgery. No patients donated blood preoperatively. Only 1 patient received both intraoperative blood transfusion and cell saver. The mean age of the patients was 64 years (range, 23 to 89 years). The mean age was 69 years (range, 42 to 84 years) for transfused patients and 64 years (range, 23 to 89 years) for non-transfused patients.

The mean BMI of the patients was 30.4 (range, 16.4 to 63.7); it was 28.4 (range, 16.4 to 47.6) for transfused patients and 30.7 (range, 17.0 to 63.7) for non-transfused patients. The mean operative time was 3.8 hours (range, 0.1 to 14.7 hours); it was 4.3 hours (range, 0.1 to 14.7 hours) for transfused patients and 3.7 hours (range, 0.6 to 10.6 hours) for non-transfused patients.

The preoperative hemoglobin level was available in 92.6% of patients (524 of 566). The mean preoperative hemoglobin level of the patients was 13.5 g/dL (range, 9 to 17.7 g/dL); it was 12.0 g/dL (range, 9 to 14.6 g/dL) for transfused patients and 13.7 g/dL (range, 10.1 to 17.7 g/dL) for non-transfused patients. The postoperative hemoglobin level was available in 88.9% of patients (503 of 566). The mean postoperative hemoglobin level of the patients was 10.9 g/dL (range, 6.3 to 15.3 g/dL); it was 9.0 g/dL (range, 6.3 to 14.0 g/dL) for transfused patients and 11.1 g/dL (range, 7.4 to 15.3 g/dL) for non-transfused patients.

The mean change in hemoglobin level was 2.7 g/dL (range, −1.4 to 6.7 g/dL); it was 3.0 g/dL (range, −1.4 to 6.7 g/dL) for transfused patients and 2.6 g/dL (range, 0.2 to 5.7 g/dL) for non-transfused patients. Of the patients, 64 had heart disease and 64 had significant lung disease. Of those with heart disease, 48 were in the transfused group and 16 were in the non-transfused group. Of those with lung disease, 3 were in the transfused group and 61 were in the non-transfused group.

Among the 64 patients who received transfusions, the number of units of blood received was 1 U in 20 patients, 2 U in 35 patients, 3 U in 6 patients, and 4 U in 3 patients.