JSES Open Access 2 (2018) 28–33

Contents lists available at ScienceDirect

JSES Open Access

journal homepage: www.elsevier.com/locate/jses

Tranexamic acid administration for anatomic and reverse total shoulder arthroplasty: a systematic review and meta-analysis

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ARTICLE INFO

Keywords:
Anatomic total shoulder arthroplasty
Reverse total shoulder arthroplasty
Tranexamic acid
Transfusion
Meta-analysis
Total blood loss

Level of evidence: Level III, Systematic Review

Background: Tranexamic acid (TXA) has been shown to reduce perioperative blood loss and risk of blood transfusion. Evidence establishing its efficacy in total shoulder arthroplasty (TSA) is limited. The current study evaluated the effect of TXA on perioperative blood loss and transfusion risk after TSA.

Methods: A systematic review and meta-analysis of TXA administration for TSA was performed, and 6 studies with a total of 680 patients were found. Data on change in hemoglobin, drain output, total blood loss, and transfusion were extracted. Meta-analysis was performed with stratification into reverse and anatomic TSA subgroups.

Results: TXA administration was associated with decreased change in hemoglobin (–0.63 g/dL; 95% CI, –0.87 to –0.39 g/dL; $P < .00001$), drain output (–112.05 mL; 95% CI, –182.29 to –41.81 mL; $P < .0001$), and total blood loss (–231.87 mL; 95% CI, –334.23 to –129.48 mL; $P < .00001$) after reverse TSA. There was a trend toward reduction in transfusion rate after reverse TSA (–4%; 95% CI, –8% to 0%; $P = .06$). TXA administration was associated with reduced drain output after anatomic TSA (–123.07 mL; 95% CI, –163.93 to –82.20 mL; $P < 0.00001$). TXA administration was not associated with decreased transfusion rate after anatomic TSA. Data to evaluate the effect of TXA on change in hemoglobin and total blood loss after anatomic TSA were insufficient.

Conclusions: Routine administration of TXA reduces perioperative blood loss and may reduce the risk of transfusion after reverse TSA. Future studies are needed to further characterize its effect on the risk of transfusion after reverse TSA and efficacy in anatomic TSA.

The risk of allogeneic blood transfusion after total shoulder arthroplasty (TSA) ranged from 4.2% to 7.7% from 1998 to 2011.[10] Blood transfusion after arthroplasty surgery results in increased health care utilization costs, longer hospital stays, and an increased risk of surgical site infection.[10,19] The most widely supported risk factors for blood transfusion after TSA include increasing age[6,10,17,18] and preoperative anemia.[3,6,7,10,13,14,17,18,20] Other potential risk factors include, female gender,[6,10,17,20] number of medical comorbidities,[10,17,18] low hospital caseload,[1] proximal humeral malunion,[8] and reverse vs. anatomic TSA.[6,9]

Tranexamic acid (TXA) is a competitive inhibitor for plasminogen by reversibly blocking the plasminogen lysine-binding site.[1,2,4,5,11,19-21] This mechanism results in stabilization of blood clots from prevention of fibrin degradation.[1,2,4,5,11,19-21] This antifibrinolytic agent has become widely used across multiple subspecialties to decrease blood loss and to reduce the need for intraoperative and postoperative transfusions.

TXA has been shown to reduce perioperative blood loss and allogeneic blood transfusion rates after total hip (THA) and knee (TKA) arthroplasty.[2,21] Few studies, however, have evaluated its efficacy for TSA. The purpose of the study was to determine whether the current literature supports the use of TXA to reduce perioperative blood loss and transfusion rates after anatomic and reverse TSA. We hypothesize that use of TXA during shoulder arthroplasty will demonstrate similar results to those that have been reported with use during THA and TKA.

Materials and methods

Systematic review and meta-analysis

To obtain articles relating to TXA use in shoulder arthroplasty, the PubMed, Ovid MEDLINE, and CINAHL databases were queried with the terms “shoulder arthroplasty” and “tranexamic acid.” The final analysis included 6 articles[1,4,5,12,15,22] with a total of 680 patients. This search was performed by 2 independent reviewers in January 2017, and after review of the limited number of titles as well as abstracts, we arrived at our final manuscripts evaluated for further analysis. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram is shown in Fig. 1.

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https://doi.org/10.1016/j.jses.2017.12.004

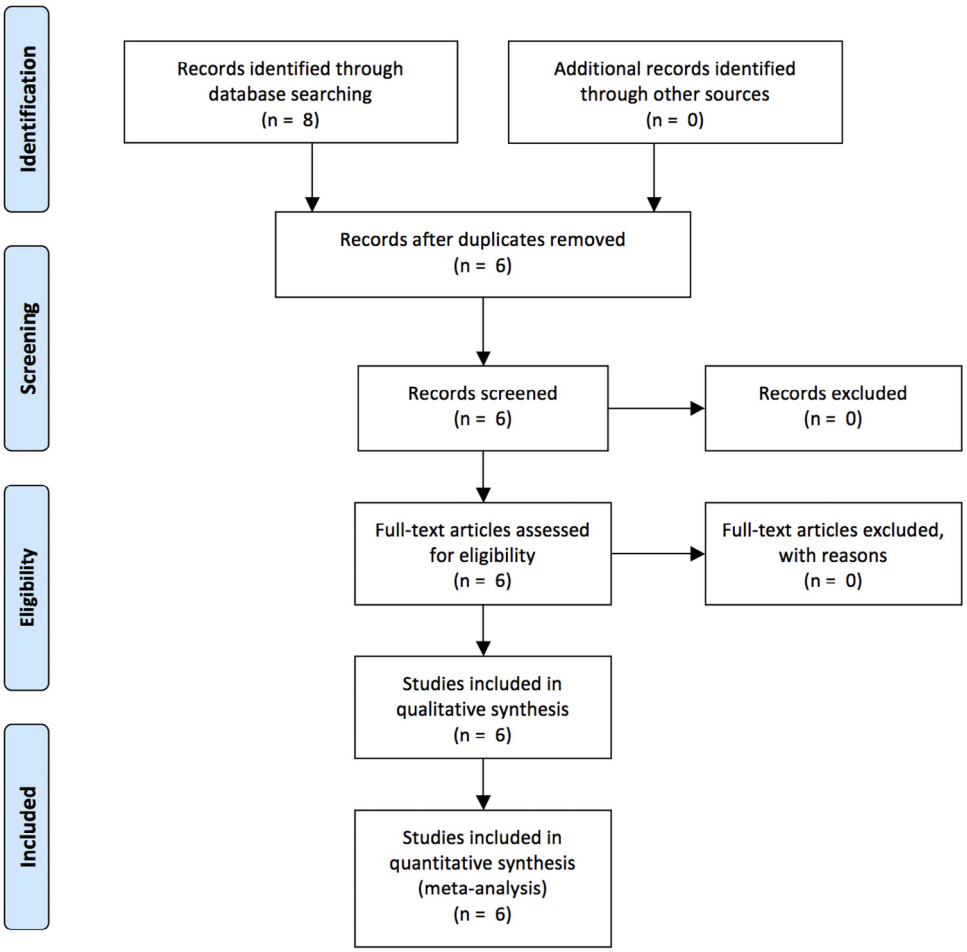

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

The inclusion criteria were studies of patients undergoing anatomic or reverse TSA, administration of topical or intavenous TXA, and studies assessing outcomes measures, including blood loss, need for transfusion, drain output, postoperative change in hemoglobin or hematocrit, or both, and rate of complications. Studies were excluded if they were not clinical trials, or if the topic focused on basic science laboratory investigations, cadeveric or biomechanical models, or did not include patients who underwent shoulder arthroplasty.

A meta-analysis was performed using RevMan 5.3 software (Cochrane Collaboration, Copenhagen, Denmark).[16] Changes in hemoglobin concentration, drain output, total blood loss, and transfusion rate were evaluated. Mean differences of continuous variables were assessed. When reported, means and standard deviations were extracted from included studies. When these statistics were not available, the median was used as an approximation for the mean and the range divided by four was used as an approximation of the standard deviation as recommended by Hozo et al.[8] For transfusion events, risk differences were tested. A fixed effects model was used when heterogeneity was statistically insignificant. A random effects model was used when effect size heterogeneity was statistically significant. Two-sided statistical significance of 0.05 was used.

Results

Systematic review

Descriptions of the studies included in the systematic review and meta-analysis are given in Table I. Of the 6 studies, 3 were retrospective analyses of a practice change from no TXA use to routine TXA administration.[1,4,12] In an analysis of 168 patients undergoing reverse and anatomic TSA, Abildgaard et al[1] (level of evidence [LOE] 3) found that 1 routine preoperative 1 g intravenous infusion of TXA was associated with a reduction in total blood loss, hemoglobin drop, hematocrit drop, and drain output. In an analysis of 194 and 48 patients respectively, Friedman et al[4] and Kim et al[12] (LOE 3) found similar results with 20 mg/kg infusions and 2 g TXA dosing regimens, respectively. Both studies were underpowered to detect a change in the transfusion rate.

The remaining studies included in the current systematic review and meta-analysis were randomized, placebo controlled trials (LOE 1).[5,15,22] In a study consisting of 111 patients, Gillespie et al[5] found that 2 g topical TXA reduced the hemoglobin drop after reverse TSA but not anatomic TSA. No patient in the placebo or intervention arm required a transfusion. In a study including only reverse TSAs (102 subjects), Vara et al[22] demonstrated the efficacy of two 10 mg/kg intravenous TXA infusions in reducing the postoperative hemoglobin drop, drain output, and total blood loss.[22] The transfusion rate in the placebo group was 14.3% compared with 5.7% in the TXA group. Although fewer patients in the TXA arm required a transfusion, the effect was not statistically significant. Pauzenberger et al[15] found that TXA reduced drain output and total blood loss in mixed groups of 54 patients undergoing anatomic and reverse TSA. No patient in either arm required a transfusion.

Meta-analysis

A meta-analysis of the studies listed in Table I was performed for change in hemoglobin, drain output, total blood loss, and risk