Limit the Bleeding, Limit the Pain in Total Hip and Knee Arthroplasty

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Abstract

Patients undergoing total hip or knee arthroplasty often sustain significant decreases in hemoglobin and hematocrit, despite modern techniques and shorter operating times. Reasons for the blood loss include raw bony surfaces, vascular inflammatory tissue, and fragile vessels in elderly patients. Acute postoperative anemia has numerous deleterious effects on patients, including delayed rehabilitation, exposure to allogeneic blood transfusions, higher complication rates, and increased pain. The ability to limit the amount of postoperative bleeding may reduce the amount of postoperative pain that patients experience, ultimately resulting in greater patient satisfaction and smoother postoperative rehabilitation. This article focuses on intraoperative techniques available to limit bleeding, thereby minimizing pain and the need for postoperative transfusion.

Techniques to Manage Intraoperative Blood Loss

Fibrin Sealants

A direct approach to reducing intraoperative blood loss can be obtained through improved tissue hemostasis within the operative field. Topically applied agents such as thrombin, collagen, and fibrin glues have been studied. These agents, which can be applied to the tissue surface prior to closure, can be effective in reducing postoperative blood loss, minimizing pain, and reducing the risk of exposure to allogeneic blood transfusion.

In addition to the direct mechanism of action, fibrin seals contain various amounts of antifibrinolytics, which increase efficacy. Studies have shown that allogeneic transfusion rates can be decreased by up to 50% with their use. For example, in a study conducted by Levy et al, the mean apparent postoperative blood loss in the fibrin-tissue-adhesive group was 360 mL compared with 878 mL in the control group for a mean difference of 518 mL (P<.001). Transfusion was required in 55% of the control group compared with only 17% of the fibrin-treated patients. These data suggest the use of fibrin tissue adhesive is effective in reducing blood loss and blood transfusion requirements.

In a meta-analysis, Carless et al identified 18 trials of fibrin sealants (N=1406) that reported data on perioperative exposure to allogeneic red blood cell transfusion. Overall, 21.8% of patients in the control groups and 15.3% of patients in the fibrin sealant groups required allo...
geneic transfusion, corresponding to a reduction in the rate of exposure to transfusion of 37% (7% in absolute terms). In 14 trials (N=853) that provided data for postoperative blood loss, fibrin sealant treatment reduced average blood loss by approximately 161 mL per patient. In the orthopedic setting, fibrin sealant was associated with a reduction in postoperative blood loss of approximately 223 mL per patient and reduced the risk for transfusion by 32%.

Fibrin sealant treatment was not associated with increased risk for wound or any infection, hematoma formation, or death. Importantly, fibrin sealant use did not have a statistically significant impact on deep venous thrombosis (DVT) (relative risk, 3.0; 95% confidence interval [CI], 0.13 to 71.92) or pulmonary embolism (relative risk, 0.97; 95% CI, 0.11 to 8.88); however, the number of events for these outcomes in this meta-analysis (1 episode of DVT and 1 episode of pulmonary embolism) was far too small to draw firm conclusions. Fibrin sealant, despite reducing bleeding considerably, was not associated with a reduced length of hospital stay.

Although these data are positive, it should be noted that funnel plot assessment suggested there is some evidence of publication bias in the form of a missing population of small negative trials. Thus, the conclusions that can be drawn from this meta-analysis are inherently limited; large, rigorously designed studies of fibrin sealants are urgently needed.

Local Anesthetic

The use of intraoperative local anesthetic with epinephrine injections along the arthrotomy site has been shown to decrease postoperative blood loss in total knee arthroplasty (TKA). In 1 study of 37 sequential TKAs injected intraoperatively with bupivacaine and epinephrine (one-third peripercapsular, two-thirds peri-incisional) and 71 sequential control TKAs, the study group had 32% (or 195 mL) less drain output (P=.006). There were no statistically significant differences in the transfusion rate or bleeding indices. The 2 groups were comparable in terms of tourniquet times, intraoperative soft tissue releases, preoperative anticoagulant use, and overall postoperative complications. Overall, although these studies showed no difference in transfusion rates, blood loss into the knee joint was decreased. Reduced blood loss and swelling may result in a more comfortable knee for the patient and simplify postoperative physical therapy.

Electrocautery

The use of specialized electrocautery units, which enhance operative hemostasis, is an additional strategy for limiting intraoperative blood loss. These units improve hemostasis via collagen shrinking at cooler temperatures over broader fields, with reduced tissue destruction compared with a standard electrocautery device. Bipolar radiofrequency energy also can be combined with saline, resulting in coagulation of high-risk bleeding areas to obtain hemostasis with less tissue damage. The use of these techniques during the intraoperative procedure can help minimize blood loss and result in less postoperative wound drainage. By decreasing intraoperative blood loss, these specialized electrocautery units can also improve intraoperative visualization.

Pharmacologic Agents

Pharmacologic agents can be used intraoperatively in patients undergoing TKA to limit the amount of bleeding. Tranexamic acid and aminocaproic acid are 2 such antifibrinolytic agents. Both tranexamic acid and aminocaproic acid currently are being compared in orthopedic surgery. Fibrinolysis is stimulated by surgical trauma, and the antifibrinolytic agents act to increase hemostasis within the surgical site by enhancing the clotting mechanism. These agents have been shown to minimize perioperative blood loss and the need for postoperative allogeneic transfusion.

Tranexamic acid inhibits fibrinolysis by blocking the lysine binding sites of plasminogen to fibrin. Several studies have shown the efficacy of tranexamic acid in reducing postoperative blood loss and transfusion requirements in total hip arthroplasty (THA) and TKA. Reductions of 25% to 50% have been noted.

Kagoma et al published a review of studies involving tranexamic acid in total joint arthroplasty. They concluded that patients undergoing THA and TKA receiving tranexamic acid have a reduced need for postoperative allogeneic blood transfusion as well as reduced blood loss, with no increase in DVT. Together, these studies have demonstrated that with tranexamic acid, there is a significant decrease in early postoperative blood loss, total blood loss, and transfusion rates; no increase in DVT has been noted in studies in which patients have received tranexamic acid. Given the costs of transfusion and the low cost of tranexamic acid, it is likely that routine use of this agent would provide considerable cost savings; however, no studies to date have provided a direct estimate of cost savings with tranexamic acid.

Although the optimal dosage and timing for tranexamic acid have not been fully elucidated, a recent study suggests that a single dose of 20 mg/kg is as efficacious as multiple smaller doses but substantially more convenient. For THA, the dose is administered to patients during prepping and draping. For TKA, the dose is administered during wound closure prior to tourniquet deflation.

CONCLUSION

Although many strategies exist to help limit allogeneic blood transfusion during the preoperative and postoperative periods, limiting blood loss at the time of surgery also can help limit transfusion rates, minimize postoperative hematoma, and limit pain. A multimodal approach that in-
cludes both pharmacologic agents and topical techniques can be used to limit the amount of bleeding into the wound at the time of surgery. Meticulous intraoperative hemostasis can be obtained using specialized bipolar units and fibrin sprays, in addition to antifibrinolytics being given to patients. By limiting the amount of postoperative blood loss into the joint, patients will experience less pain, require fewer transfusions, and have a smoother postoperative recovery.

REFERENCES


