Minimising blood loss and transfusion in contemporary hip and knee arthroplasty

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Despite advances in contemporary hip and knee arthroplasty, blood loss continues to be an issue. Though blood transfusion has long been used to treat post-operative anemia, the associated risks are well established. The objective of this article is to present two practical and effective approaches to minimising blood loss and transfusion rates in hip and knee arthroplasty: the use of antifibrinolytic medications such as tranexamic acid and the adoption of more conservative transfusion indications.

Surgical blood loss continues to be an issue in contemporary hip and knee arthroplasty. A blood loss of 1000 ml predictably leads to a hemoglobin drop of 3 g/dl, and peri-operative loss is commonly between 1000 ml and 1500 ml with these procedures.1 Ultimately, such blood loss is associated with a significant number of patients going on to develop symptoms requiring intervention. Though transfusions have long been used to treat post-operative anemia, the general risks are well established including immunological reactions, immune suppression, intravascular hemolysis, disease transmission, lung injury, and transfusion-induced coagulopathy. Furthermore, in arthroplasty patients receiving transfusions, hospital admission cost and duration are increased by 10% to 20% and 20% to 25%, respectively,2 and outcome data suggests increased long-term morbidity and mortality.3 While such relationships should not be misconstrued as causal, the potentially deleterious effects of blood loss and transfusion on these patients should not be discounted and are worthy of consideration.

Methods such as bipolar saline cautery devices, topical sprays, and autologous pre-donation have historically been implemented to minimise peri-operative blood loss and anemia, but have generally fallen out of favor. An alternative modality that is relatively under-utilised in orthopedics is the use of antifibrinolytic medications such as tranexamic acid (TXA), aprotinin, and aminocaproic acid. These medications have a long history of use in other fields such as trauma, cardiac, and dental surgery because of their ability to minimise peri-operative blood loss. Of these medications, TXA is the most widely studied. There are currently 50 peer-reviewed studies published that evaluate the effectiveness of TXA in total hip and knee arthroplasty. Meta-analyses of this literature have convincingly demonstrated that the use of TXA leads to significant reductions in both peri-operative blood loss and the proportion of patients requiring post-operative transfusion.4-6

TXA is a synthetic derivative of the amino acid lysine which primarily inhibits plasminogen activation, ultimately leading to reduced fibrinolysis of existing thrombi5 (Fig. 1). Though this might instinctively suggest an increased risk of thrombotic and embolic events, such concerns have not born out in the literature. While no individual study has sufficient statistical power to prove safety, the accumulation of current data shows no evidence to suggest an increased incidence of symptomatic deep venous thrombosis or pulmonary embolism associated with the use of TXA in hip and knee arthroplasty. This may be supported by the findings that TXA inhibits fibrinolysis in the wound bed to a significantly greater extent than in the general circulation,7 and has no effect on vein walls.8

At our institution, the use of TXA has evolved over the past decade to become part of the typical protocol for more than 3000 elective hip and knee replacement procedures each year. Our experience provides fairly compelling evidence for the efficacy of its use in decreasing transfusion. Data from 2010 shows 2% and 7% prevalence of transfusion in patients treated with TXA versus 18% and 33% prevalence in those knee and hip replacement patients, respectively, who were not treated with it.
Even in critical care patients, data has shown that a transfusion threshold based on a hemoglobin level as low as 7 g/dL was at least as effective as, or superior to, a threshold of 10 g/dL.12 With this growing body of literature supporting conservative transfusion protocols, the American Association of Blood Banks issued new guidelines in March 2012, which are consistent with such findings13 (Table I).

Table I. The updated transfusion guidelines issued by the American Association of Blood Banks on March 27, 2012.13

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<th>American Association of Blood Banks Transfusion Guidelines</th>
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<td>Adhere to a restrictive transfusion strategy (7 to 8 g/dL) in hospitalised, stable patients.</td>
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Much as this has been shown to be more effective than a single bolus dose.9 Its use has also been shown to be cost effective when the savings from transfusion are taken into account.6 The cost of TXA in the United States is roughly $60 per gram, and only about $6 per gram in Canada and Europe. The cost effectiveness and practicality of TXA administration makes it an intriguing option for minimising blood loss and transfusion.

Aside from minimising blood loss through adjuvants such as tranexamic acid, transfusion rates can be further decreased by adopting a more conservative mentality concerning transfusion indications. While historic practice has typically mandated blood transfusion for hemoglobin values as high as 10 g/dL, recent research has led to a changing paradigm concerning indications for blood transfusion. Two recent controlled trials have supported the claim that transfusing patients with hemoglobin values greater than 8 g/dL has no benefit, regardless of pre-existing cardiovascular disease.10,11 Even in critical care patients, data has shown that a transfusion threshold based on a hemoglobin level as low as 7 g/dL was at least as effective as, or superior to, a threshold of 10 g/dL.12 With this growing body of literature supporting conservative transfusion protocols,


