

# Improving Safety in Spine Surgery: Reducing Perioperative Blood Loss and Transfusion Requirements

## Abstract

Significant blood loss is associated with increased complications in spine surgery. Decreasing the rate of blood loss, salvaging lost blood, and decreasing the need for transfusion are three techniques to help minimize the hemodynamic complications associated with major spinal surgery. Herein, we present a concise overview of preoperative, intraoperative, and postoperative methods for decreasing blood loss and need for allogeneic transfusion.

**Keywords:** Blood loss; Blood salvage; Spine surgery; Antifibrinolytics; Cell saver

## Mini Review

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## Introduction

Blood loss in spine surgery has a significant impact on patient morbidity, length of surgery, and total cost. In addition to maintaining patients' hemodynamics, the control of blood loss is essential in attaining adequate visualization of the surgical field. Due to the proximity of tenuous neurovascular structures, the importance of a dry surgical field cannot be overemphasized. Realizing this goal requires collaboration between surgical and anesthetic teams. Although there is no standardized system for blood sparing, there are a number of techniques and approaches that can be employed to minimize blood loss perioperatively.

Decreasing the rate of blood loss, salvaging lost blood, and decreasing the need for transfusion are three potential areas for intervention. Acute normovolemic hemodilution is a technique employed to decrease the need for transfusion. Venous blood is collected after anesthetic induction until a target hematocrit of 30% and lost volume is replaced with colloids. As a result of decreased blood viscosity, tissue oxygenation is maintained through a compensatory increase in cardiac output and venous return.

Moreover, any surgical blood loss contains fewer blood cells per volumetric unit. The safety and efficacy of acute normovolemic hemodilution has been well documented in spinal fusion and scoliosis surgery [1,2]. In posterior instrumentation and fusion operations of the lumbar spine, Epstein et al. showed that 76% of patients avoided allogeneic transfusion with implementation of this technique [3].

Long before skin incision, patient positioning is the first step in the reduction of blood loss. Epidural veins are connected to the inferior vena cava (IVC) by a valve-less system. Positioning the patient on a Jackson frame table with the abdomen free of compression allows for decreased IVC pressure and subsequently, a decreased rate of epidural engorgement and bleeding [4].

Fast and efficient surgery is an often underestimated component in the reduction of blood loss. Surgeon comfort with the procedure and simultaneous operation on multiple areas of the spine allows for decreased surgical time and total blood loss. Use of bovie electrocautery on high setting (60/60) and meticulous subperiosteal dissection is paramount. Intraoperatively, the surgeon has various passive and active local agents in his armamentarium to achieve hemostasis. Collagen, cellulose, and gelatin-based products are passive agents that provide a scaffold for the promotion of platelet aggregation and formation of clot. On the other hand, active hemostatic agents have biologic activity allowing the de novo generation of a fibrin clot. These products are typically thrombin or combination products and have been shown to provide hemostasis within ten minutes of application [5].

In terms of high quality literature, intrathecal morphine may have the greatest effect on the reduction of perioperative bleeding. The mechanism of action is unclear, but the benefits are obvious. In a prospective randomized controlled trial (PRCT), Goodarzi et al. [6] showed that a 2µg/kg dose of intrathecal morphine led to a 50% reduction in estimated blood loss (EBL) [6]. In a later PRCT expanding on Goodarzi et al. [6] original work, Gall et al. [7] confirmed the efficacy of intrathecal morphine with a 65% reduction in EBL (5µg/kg dose) [7].

The usefulness of antifibrinolytic drugs on a systemic reduction in blood loss has been analyzed, as well. Tranexamic acid (TXA) is a synthetic lysine derivative that inhibits the conversion of plasminogen to plasmin, thus preventing clot breakdown. In PRCTs, standard dosing of TXA has been shown to decrease blood loss by 13% and 25% in posterior lumbar and cervical laminoplasty procedures, respectively [8,9]. High dose TXA (loading dose of 100mg/kg with a continuous infusion of 10mg/kg/hr) achieves even greater blood sparing. In posterior spinal deformity, Xie et al. [10] reported a 39.8% reduction in EBL, while

Sethna et al. [11] confirmed a 41% reduction in pediatric scoliosis surgery [10,11]. A recent meta-analysis of all PRCTs confirmed the efficacy of TXA with a 67% reduction in transfusions and an average 202mL decrease in total EBL [12].

When the resources used to minimize the rate of bleeding are exhausted, red blood cell salvage may remain effective in reducing transfusion. The exact role for autotransfusion remains highly debated in the literature, with some studies showing promise and others questioning the cost-benefit ratio [13,14]. However, in a Cochrane review of seventy-five PRCTs involving cardiac and orthopaedic cases, a 21% absolute risk reduction of allogeneic transfusion was achieved with the use of cell salvage systems [15].

Numerous techniques have been described to reduce perioperative blood loss and allogeneic blood transfusion during major spinal surgery. Unfortunately, the efficacy of the methods is still largely controversial and disputed in the literature. No standard protocol exists for the optimal management of blood loss in spinal surgery. However, judicious use of a combination of blood-sparing techniques may allow for a safer surgical experience and improved patient outcomes.

## Conclusion

Blood loss in major spinal surgery has a substantial influence on patient morbidity, outcome, and overall cost of care. Although there is no standardized system for blood sparing, there are a number of methods aimed at minimizing perioperative blood loss. Fast and efficient surgery with meticulous dissection and topical hemostasis cannot be over-emphasized. However, judicious use of a combination of blood-sparing techniques may decrease the need for allogeneic transfusion, decrease overall complications, and improve patient outcomes in spine surgery.

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