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Clinical Study

The pattern of blood loss in adolescent idiopathic scoliosis

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Abstract

BACKGROUND CONTEXT: Previous studies have shown that modern intraoperative blood-saving techniques dramatically reduce the allogeneic transfusion requirements in surgery for adolescent idiopathic scoliosis (AIS). No studies have looked at the pattern of postoperative hemoglobin (Hb) in AIS patients undergoing corrective spinal surgery and correlated this with the timing of allogeneic transfusion.

PURPOSE: To describe the pattern of perioperative blood loss in instrumented surgery for AIS. We look at the recommendations regarding an ideal preoperative Hb, the need for preoperative cross-matching, and the timing of postoperative Hb analysis.

STUDY DESIGN: This was a retrospective case series. Surgeries were performed by one of four substantive pediatric spinal surgeons within a single regional center over a 3-year period.

PATIENT SAMPLE: A consecutive series of 86 patients who underwent posterior instrumented fusion for AIS were included: 10 males and 76 females. Mean age was 14 years (range 10–17 years). All patients had posterior instrumented fusion using various blood-saving techniques (eg, cell-saver). All patients were cross-matched preoperatively, and our transfusion trigger value (TTV) was 7 g/dL.

OUTCOME MEASURES: Hemoglobin level was the outcome measure. Hemoglobin readings were obtained preoperatively, within 2 hours of surgery, and daily up to 5 days after surgery. This physiologic measure was assessed using routine blood sampling techniques and standardized laboratory processing.

METHODS: Patient predictor variables (demographic and surgical) were assessed for association with Hb levels in a hierarchical model, with repeated Hb readings at the lower level being clustered within an individual patient at the upper level of the structure. The variation of Hb levels within individuals was compared with mean levels in different individuals via the variance partition coefficient of the model structure.

RESULTS: No patients required intraoperative allogeneic transfusion. Only four patients (4.65%) received allogeneic transfusion, all within 2 days of surgery. A clinically important drop in Hb occurred within the first 2 postoperative days, rising thereafter. The average postoperative drop in Hb was 4.1 g/dL. Young males had lower postoperative Hb values. Neither the preoperative curve magnitude (Cobb angle of major curve) nor the number of vertebrae/levels fused significantly affected the blood loss.

CONCLUSIONS: We recommend setting a minimum preoperative Hb value that is 5 g/dL higher than your TTV. Because no patients required an intraoperative transfusion when using modern blood-saving techniques, preoperative cross-matching is unnecessary and potentially wasteful of blood reserves. Hemoglobin analysis beyond the second postoperative day is unnecessary unless clinically indicated.

Keywords: Scoliosis; Adolescent; Hemoglobin; Blood loss; Transfusion

FDA device/drug status: Not applicable.

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Introduction

Corrective surgery for adolescent idiopathic scoliosis (AIS) puts the patient at a risk of allogeneic transfusion because of the extent of exposure, complexity of the surgery, and longer operative times [1–4]. Bowen et al. [3] found pediatric idiopathic scoliosis patients twice as likely to require transfusion, with a surgical time of more than 6 hours. Allogeneic transfusion carries the risks of sensitization, transfusion reactions, disease transmission, and surgical site infection [5,6]. The rate of hospital-acquired infection rose from 3% to 20% when patients received allogeneic blood [7].

Historically, a high percentage of patients received allogeneic blood to replace surgical blood loss [8]. With the use of modern blood conserving techniques, blood loss and the use of allogeneic blood for transfusion have reduced significantly [8–10]. Various blood conserving methods have been adopted in spinal surgery. Tranexamic acid (TXA) has shown a definite benefit in both arthroplasty and spinal surgery at reducing blood loss and the need for a transfusion [4,11–17]. A placebo-controlled study in pediatric patients undergoing scoliosis surgery found that TXA reduced blood loss by 41% [15]. Cell salvage has been shown to reduce allogeneic transfusion rates in spinal surgery [3,18,19], but recent review articles show little evidence to support its routine use [12,14]. A nonrandomized study has even showed increased blood loss in the cell-saver group [20]. Preoperative autologous blood donation has had mixed reports in the literature [21–25].

Corrective surgery for AIS is performed on a regular basis at our institution. Our blood-saving protocol uses a combination of techniques, such as TXA infusion, cell-salvage, meticulous hemostasis with electrocautery, controlled hypotension (mean blood pressure of 50–60 mmHg), and warmed fluids and warming blanket (avoiding hypothermia). Our institution has low allogeneic transfusion rates because of these techniques [9]. Despite our low allogeneic transfusion rate, all patients are preoperatively cross-matched for 1 to 2 adult units (1unit≈270 mL) of blood.

Our patients are managed postoperatively according to a documented protocol that dictates a minimum of 2 days high dependency care, standardized fluid supplementation to maintain mean blood pressure above 60 mmHg, and daily blood analysis. Our documented transfusion trigger value (TTV) is 7 g/dL. Low TTVs have been shown to safely lower allogeneic transfusion rates [8,9,26].

This study was aimed at answering a number of questions:

1. What is the pattern of postoperative blood loss in corrective surgery for AIS?
2. What is an acceptable preoperative hemoglobin (Hb) level in corrective surgery for AIS?
3. Is preoperative cross-matching necessary?
4. When should postoperative Hb analysis occur?
5. Is our view of the need for transfusion absolute, when perhaps it should be relative?

EVIDENCE & METHODS

Context
The use of blood saving techniques has reduced the need for allogeneic transfusion in all manner of spine surgery. This study seeks to evaluate trends in postoperative hemoglobin (Hb) and the need for allogeneic transfusion in a consecutive series of 86 patients treated for adolescent idiopathic scoliosis.

Contribution
Among the 86 surgical cases, there were no instances of intraoperative transfusion and only 4 postoperative allogeneic transfusions. Gender and preoperative Hb level were the two factors that most affected postoperative Hb.

Implications
The authors advocate that their findings can result in health care efficiencies if the use of intraoperative ''cell saving'' techniques translates into reductions in preoperative cross-matching. While the methodology behind this analysis is sound, the study was conducted using only a small number of cases derived from a single center with only four instances of the adverse outcome (postoperative allogeneic transfusion). Such considerations potentially impair broad translation of these results to other centers and surgical practices.

—*The Editors*

Methods

This was a retrospective review of consecutive children undergoing instrumented posterior spinal fusion for AIS at our institution. Theater records were used to identify 86 children between May 2008 and September 2011. Most children had a preoperative magnetic resonance imaging scan that confirmed idiopathic scoliosis.

Surgeries were performed by four substantive pediatric spinal surgeons. Segmental fixation was used in all cases. One wound drain was routinely placed superficial to the deep fascia during wound closure. Anesthesia was provided by four substantive pediatric anesthetists using a standardized technique. No child was excluded from the study or lost to follow-up. There has not been any conflict of interest.

For each case the following information was recorded: gender, curve type, blood-saving methods (ie, TXA, cell-saver, monopolar dissection, hypotensive anesthesia, and warming blanket), whether or not chemical prophylaxis (enoxaparin) was administered during the perioperative period, age at surgery, Cobb angle [27] before and after surgery, number of vertebrae included in fixation, reinfused blood cell-saver volume, crystalloid and colloid volume given during surgery, drain volume, and preoperative Hb