

# Anemia and Surgery

Anemia Institute Review

## A LETTER FROM THE EDITOR:

This issue of the Anemia Institute Review is to update healthcare professionals and patients on the latest research on blood management before, during and after surgery. The importance of anemia and impeded postoperative rehabilitation is highlighted. The success of a bloodless surgery program requires collaborative teamwork amongst blood bank, pharmacy, administration, hematologist, surgeon and anesthesiologist. A clinical protocol or algorithm with multiple blood conservation modalities should be implemented with surgical patients: prevention or treatment of preoperative anemia, preoperative autologous donation, antifibrinolytic agent, normovolemic hemodilution, meticulous surgical technique, cell salvage, and lower transfusion triggers.

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## Anemia and postoperative rehabilitation

**Carson JL, Terrin ML, Jay M.**  
 Can J Anaesth. 2003 Jun-Jul;50(6 Suppl):S60-4.

Most of the published data relating anemia to function have come from clinical trials evaluating recombinant human erythropoietin in end stage renal failure, orthopedic surgery, and patients undergoing cancer-chemotherapy. While most studies were small and underpowered, the results are consistent in showing measurable improvement in fatigue, exercise capacity, muscle strength, and the performance of activities of daily living. Furthermore, studies are consistent in showing improvement

in cardiac and cognitive function as anemia is corrected. What is less clear is whether there is a level of hemoglobin below normal that does not compromise functional outcome. Aerobic exercise capacity improves when hemoglobin values are increased. In the published literature, the initial hemoglobin levels ranged from 6 to 7 g x dL(-1) and hemoglobin levels following treatment with erythropoietin ranged from 9 to 14 g x dL(-1). In two studies no further improvement in exercise performance was found when hemoglobin levels of 9 to 10 g x dL(-1) had been reached. In another study, physical performance was reported when hemoglobin levels of 14 g x dL(-1) were reached compared to 10 g x dL(-1). While it is likely

that normal levels of hemoglobin (12-14 g x dL(-1)) are optimal, there could be diminishing return as the hemoglobin concentration approaches normal. Thus, the risks and/or costs of blood transfusion or treatment with erythropoietin become important to consider. Patients undergoing surgery are often elderly and have co-morbidities. Anemia in these patients may impede their ability to recover from basic impairments and participate in postoperative rehabilitation. It is likely that higher blood counts will result in a more active participation in rehabilitation and greater functional independence. How high the hemoglobin levels need to be awaits further study.

## Blood saving protocol in elective total knee arthroplasty

**Kourtzis N, Pafilas D, Kasimatis G.**  
 Am J Surg. 2004 Feb;187(2):261-7.

**Background:** To eliminate the need for allogeneic blood transfusion in patients undergoing elective total knee arthroplasty, we established and tried a protocol of combined methods, which is characterized by effectiveness, ease in application, and safety. It is based on perioperative administration of human recombinant erythropoietin plus iron

and folic acid, mild acute normovolemic hemodilution, meticulous surgical technique, postoperative blood salvage through a closed-wound drainage system, and lower transfusion triggers.

**Data Sources:** Sixty-one patients entered the protocol, and the results were retrospectively compared with the ones obtained from 58 consecutive patients who were operated on in the past before the use of any blood saving technique.

**Conclusions:** Only 5 patients of those

who entered the protocol finally needed allogeneic blood transfusion, receiving a total number of 7 units, which is remarkable when compared with the 50 patients before the application of the protocol who required 111 units. Consequently, the utilization of allogeneic blood was reduced by 94%, a statistically quite significant result ( $P < 0.001$ ). We believe the protocol should be included in orthopedic surgeons' alternatives for blood saving in elective total knee arthroplasty.

## An algorithm to reduce allogenic red blood cell transfusions for major orthopedic surgery

**Slappendel R, Dirksen R, Weber EW, van der Schaaf DB.**

Acta Orthop Scand. 2003 Oct;74(5):569-75.

In a previous prospective study, we confirmed that transfusion-related immunosuppression predisposes to postoperative infections, impairs the postoperative healing of wound and thereby prolongs hospitalization. This increases the well-known risks, such as transmission of infection or transfusion reactions, and has obliged us to revise our transfusion guidelines. We used a relational database containing information about 28,861 orthopedic surgery patients was used to determine when and how to im-

prove these guidelines for transfusions. The survey showed the circumstances surrounding a high incidence of allogenic red cell infusions: failure to follow the guidelines, the preoperative use of nonselective NSAIDs, low preoperative Hb level, failure to retrieve blood, and high cut-off values for allogenic red cell transfusion. The first step was to determine the Hb level before giving red cell infusions and ensure compliance with predefined cut-off values. Subsequent measures included: use of COX 2-selective NSAIDs alone in the perioperative period; erythropoietin and iron therapy when the Hb level fell below 13 g/dL; use of cell salvage during and after

surgery; administration of aprotinin to patients expected to have a high blood loss. The type of anesthesia had no blood-sparing effect. Although these steps can not be regarded as a new approach, we show that by following a strict rules with appropriate steps and in a concerted fashion, the use of allogenic red blood cells was reduced by 80%. Moreover, the amount of blood saved had other effects--e.g., the incidence of deep wound infections was reduced by 40%. The outcome is described in an algorithm summarizing the steps in a comprehensive perioperative diagram for giving blood.

## Preoperative Autologous Donation Versus Cell Salvage in the Avoidance of Allogeneic Transfusion in Patients Undergoing Radical Retropubic Prostatectomy

**Jonathan H. Waters, MD\*, Julia ShinJung Lee, MPH MS, Eric Klein, MD, Jerome O'Hara, MD\*, Craig Zippe, MD, and Paul S. Potter, MD\***

Anesth Analg. 2004 Feb;98(2):537-42, table of contents.

There are many methods for preventing allogeneic blood administration during radical retropubic prostatectomy, and many of these methods have been compared with each other, but no studies have compared preoperative autologous donation (PAD)

and cell salvage (CS). In this study, we evaluated these two methods in patients undergoing radical retropubic prostatectomy. In a prospective cohort model, allogeneic exposure in patients from one surgeon who routinely had his patients donate blood before surgery was compared with that in patients from a different surgeon who predominantly used CS. Fifty patients were enrolled in the study: 26 in the PAD group and 24 in the CS group. No difference in allogeneic exposure was seen between the two groups. A significant difference was seen in the volume of red blood cells lost ( $891 \pm$

298 mL versus  $1134 \pm 358$  mL in the PAD and CS groups, respectively). We conclude that PAD and CS are equivalent in their ability to avoid allogeneic transfusion. Larger surgical blood loss in the CS group would suggest that in a more rigorously designed study, CS might provide better allogeneic avoidance than PAD. **IMPLICATIONS:** In this prospective cohort study, cell salvage and preoperative autologous donation were compared with respect to their ability to avoid allogeneic transfusion. There was a suggestion that cell salvage might offer better allogeneic transfusion avoidance.

## Blood Conservation in Elective Spinal Fusion Surgery: Case Examples

**Stephen J Lewis, MD Msc FRCS(C)**

Presented at: North American Spine Society, October 2002, Montreal Quebec.

Two case studies were presented to demonstrate the use of multiple methods of blood conservation to manage patients expected to experience significant blood loss while undergoing elective spinal fusion. Three blood conservation methods were used: preoperative autologous donation, pre-op erythropoietin, and intra-operative cell saver. Despite blood loss of 3000 mL and 9000 mL, neither patient received allogeneic RBCs intra- or post-operatively. *Case 1: Revision Fusion* A 42 year-old female (112 kg) underwent a second procedure to remove posterior instrument from previous posterior fusion for lytic spondylolisthesis. Patient donated two units of blood pre-op with a post-autologous Hb of 114 g/L. Patient

received 40,000 units erythropoietin weekly for three weeks and went into surgery with HB of 132 g/L. Patient underwent revision posterior decompression and instrumented fusion from L4 to S1 augmented with iliac wing fixation and an Lg-S1 posterior lumbar interbody fusion. Estimated blood loss was 3000 mL. Patient received 1000 mL of cell saver blood and one unit of autologous blood. Her post-op recovery room hemoglobin was 86 and patient received a second unit of autologous blood. Recorded HB on day 5 post-op was 97 g/L. *Case 2: Fusion with Osteotomy* Patient was a 24 year-old male (97 kg) diagnosed with lumbar kypho-scoliosis with significant degenerative changes. Posterior spinal fusion with corrective osteotomy was recommended. Patient pre-donated three units of autologous blood

with a post-donation Hb of 126 g/L. He received 40,000 units erythropoietin weekly for two weeks and had a pre-surgery hemoglobin of 138 g/L. Estimated intra-op blood loss was 9000 mL. Patient received 3000 mL of cell-saved blood, three units autologous RBCs, 2 units FFP, 2 units pentaspan, and 11 L crystalloid. Hemoglobin post-op was 127 and no further transfusions were given. Hemoglobin on day 4 post-op was 101 g/L. *Conclusion:* Patients undergoing elective spinal fusion surgery who are expected to experience significant blood loss can be successfully managed without allogeneic RBC transfusions using a combination of methods, including pre-autologous donation, erythropoietin, and intra-operative cell saver.

## Surgery without blood

**Shander A.**

Crit Care Med. 2003 Dec;31(12 Suppl):S708-14.

**Objective:** The principle aim of "bloodless surgery" is to minimize blood loss and to reduce or eliminate exposure to allogeneic blood transfusion. The risks associated with blood transfusions have been well documented, and it is the goal of bloodless surgery centers to avoid complications and unnecessary use of blood. Blood transfusion is a significant adjunct to perioperative resuscitation. However,

we aim to elucidate different approaches to minimizing blood loss and avoiding transfusion.

**Design:** In this document, we review the background and current status of bloodless surgery centers and then the different approaches to achieve the program goals.

**Findings:** There is no one single universal blood conservation strategy that is applicable to all patients and populations. Factors such as preexisting disease will alter the approach; however, it is the ability of any program to form a comprehensive strategy for blood con-

servation that is integral to the success of any such program.

**Conclusion:** The success of a bloodless surgery program requires both teamwork and careful cooperation between the blood bank, pharmacy, administration, hematologists, surgeon, and anesthesiologist to ensure that the goals of minimizing blood loss and avoiding transfusion are met.

## Tranexamic acid reduces blood loss and blood transfusions in primary total hip arthroplasty: a prospective randomized double-blind study in 40 patients

Husted H, Blond L, Sonne-Holm S, Holm G, Jacobsen TW, Gebuhr P. Acta Orthop Scand. 2003 Dec;74(6):665-9.

**Introduction:** We performed a prospective, randomized, double-blind study on 40 patients scheduled for primary total hip arthroplasty due to arthritis or osteonecrosis to determine the effect of tranexamic acid on per- and postoperative blood losses and on the number of blood transfusions needed.

**Patients and Methods:** 40 patients were randomized to tranexamic acid

(10 mg/kg given as a bolus intravenous injection, followed by a continuous infusion of 1 mg/kg/hour for 10 hours) or placebo (20 mL saline given intravenously) 15 minutes before the incision. We recorded the preoperative and postoperative blood losses at removal of the drain 24 hours after the operation and the number of blood transfusions.

**Results:** Patients receiving tranexamic acid had a mean preoperative blood loss of 480 mL versus 622 mL in patients receiving placebo ( $p = 0.3$ ), a postoperative blood loss of 334 mL

versus 609 mL ( $p = 0.001$ ), a total blood loss of 814 mL versus 1231 mL ( $p = 0.001$ ) and a total need for 4 blood transfusions versus 25 ( $p = 0.04$ ). No patient in either group had symptoms of deep venous thrombosis, pulmonary embolism or prolonged wound drainage.

**Interpretation:** Tranexamic acid is effective in reducing the postoperative blood loss, the total blood loss and the need for blood transfusion in primary total hip arthroplasty.

## A simple mathematical approach to calculate blood loss in radical prostatectomy

Hurle R, Poma R, Maffezzini M, Monetti A, Piccinelli A, Taverna G, Bellavita P, Graziotti P. Urol Int. 2004;72(2):135-9.

**Introduction:** The aim of this study was to apply a simple mathematical approach to calculate blood loss in 126 patients undergoing radical retropubic prostatectomy (RRP).

**Materials and Methods:** Perioperative red blood cell loss (RBCL) was estimated by adding the difference in circulating red blood cells from before to after surgery to the allogeneic

red blood cells transfused in the same period.

**Results:** Mean preoperative hematocrit was 45 +/- 4% and mean perioperative RBCL was 574 +/- 297 ml, corresponding to a mean equivalent whole blood loss (WBL) of 1,479 +/- 831 ml. Twenty of 126 patients (15.9%) received 42 units of allogeneic packed red blood cells (PRBC), for a mean of 2.1 +/- 1.2 U/patient. The transfusion rate was higher in patients with a preoperative hematocrit of 40% or less (45 vs. 13%,  $p = 0.014$ ).

**Conclusions:** Anatomical RRP is still associated with appreciable operative blood loss. Owing to the high preoperative hematocrit values, the allogeneic blood transfusion rate is low and the transfusion requirement of the majority of patients is limited to about 2 units of PRBC. Preoperative autologous blood augmentation strategies may not be routinely needed for patients with a basal hematocrit of >40%. Copyright 2004 S. Karger AG, Basel

*The Anemia Institute is a non-profit organization dedicated to generating and sharing knowledge about anemia as a serious condition - particularly amongst patients and health care professionals dealing with disease and/or treatment related risk factors for anemia.*

Treat anemia. Seriously.

