

Incidental Finding of Particulate Debris in Cell Salvage Bag: A Case Report

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Citation

T G Island. *Incidental Finding of Particulate Debris in Cell Salvage Bag: A Case Report*. The Internet Journal of Advanced Nursing Practice. 2014 Volume 14 Number 1.

DOI: [10.5580/IJANP.22419](https://doi.org/10.5580/IJANP.22419)

Abstract

During spine fusions, significant intraoperative blood loss is expected due to size of incision and proximity of blood vessels. Several blood preservation strategies can be incorporated in anesthetic management and may include hemodilution, deliberate hypotension, antifibrinolytics, autologous blood transfusions, and intraoperative blood cell salvage. The case report involves a case in which the intraoperative cell salvage infusion contained particulate matter and what appeared to be coagulated blood cells at the base of the bag. The infusion was stopped immediately, and the remaining cell salvage blood component was discarded. No adverse effects were observed in the patient during post-anesthesia care or immediate recovery.

INTRODUCTION

Approximately 410,000 spinal fusions occur each year, with increasing utilization, higher frequency of operations, older average age of patients, and more costly hospital charges, in a longitudinal data study of 1998 to 2008¹. Spinal fusions often result in significant surgical blood loss with the potential for deleterious effects on hemodynamic stability, wound healing, and end-organ perfusion.^{2,3} Several factors confound the risks associated with blood loss in spine surgery. These factors include size of incision, arterial blood pressure, and baseline blood cell counts.² Other factors that complicate the anesthetic management of spinal fusions include ongoing blood loss due to venous bleeding, intraoperative heat loss, perioperative fluid management, as well as prone positioning and attendant risks.² Significant blood loss can lead to deleterious physiological effects such as fluid shifting, delayed wound healing, increased hospital length of stay, delayed recovery, and edema.² A variety of therapeutic interventions and strategies have been incorporated to mitigate surgical blood loss associated with spinal fusions which include deliberate intraoperative hypotension, autologous blood donation, hemodilution, administration of antifibrinolytics, and intraoperative cell salvage.² Although spine fusions are performed routinely, the risks are present and must be considered when preparing for and managing these cases.

Traditional fluid management strategies include replacement

of surgical blood loss with crystalloids, colloids, or cross-matched donor blood. Risks of allogenic blood administration include infectious disease transmission, lung injury, inflammatory response, edema, and consumption of a scarce resource.² To mitigate the risks associated with transfusion of allogenic blood, several treatment and fluid management alternatives have been described.

One treatment option is the administration of antifibrinolytics. Three primary medications used for antifibrinolytic therapy include aminocaproic acid, tranexamic acid, and valproic acid, *in vitro*.^{3,4} Antifibrinolytics interrupt the coagulation cascade through competitive inhibition of plasmin and plasminogen. Ultimately, these medications act by encouraging fibrin deposition and clot formation. In a study of 64 spine surgery patients, Elwatidy and researchers⁵ found that patients who received a 2-gram loading dose of tranexamic acid plus 100 milligrams (mg)/hour infusion during surgery experienced statistically significant reductions in blood loss during surgery and a decrease in allogenic blood transfusion requirements postoperatively. In a study of 180 cardiac bypass surgery patients, Diprose et al. administered 5grams (gm) tranexamic acid (in 200 milliliters [ml] saline diluent) before cardiac bypass and concluded that allogenic transfusion rate was reduced by more than half.⁶ All subjects in the Diprose study group also received intraoperative cell salvage in conjunction with antifibrinolytics.⁶ No adverse

effects related to concomitant administration of tranexamic acid with intraoperative cell salvage were noted by the researchers.⁶ The administration of antifibrinolytics along with other blood loss reduction strategies act synergistically to reduce intraoperative surgical blood loss.

Another intervention used to minimize surgical blood loss is the collection of autologous whole blood before scheduled surgery with subsequent infusion intraoperatively or postoperatively.² The volume deficit may be replaced with crystalloid infusions which results in a relative hemodilution effect. Replacement of blood volume with crystalloid fluids may lead to altered coagulation pathways and a dilutional anemia.⁶ However, the benefits of minimizing transfusion risks must be weighed with the relative perioperative anemia, which also has subsequent effects on hemodynamics.

A third technique used to mitigate the harms associated with significant surgical blood loss is the use of intraoperative cell salvage.^{3,4,7} Intraoperative blood cell salvage has traditionally been used to recoup the blood loss from surgical suction canisters. Rather than discard the blood that is irrigated and suctioned from the wound, the cell salvage machine is able to recover, wash, heparinize, filter and return the red blood cell component back to the patient. The benefits of not having foreign blood donation, coupled with the return of the patient's own blood is preeminent, and is considered a highly favorable option for intraoperative blood replacement.^{2,3,4} Contraindications to intraoperative cell salvage include patient refusal, malignancy in and around the operative site, or overwhelming presence of contaminants that cannot be removed during the filtration and washing process.⁸

CASE REPORT

A healthy 61-year old female (165 centimeters [cm], 95 kilogram [kg]) with chronic lumbar back pain presented to the preoperative holding area for a planned multi-level spine fusion from L3 to S1 using an anterior and posterior surgical approach.

The preoperative vital signs were as follows: temperature 97.6° Fahrenheit – pulse 82 beats per minute – respirations 18 breaths per minute – blood pressure 149/81 mmHg – room air oxygen saturation 96%, and pain score 3/10. The preoperative hemoglobin and hematocrit were 12.1 grams (g)/deciliter (dL) and 36.4% respectively, which were within normal limits. The metabolic panel was reviewed and was also within normal limits. Comorbid conditions included

chronic lumbar back pain, lumbar radiculopathy, hypothyroidism, hypertension, gout, and obesity (body mass index 34.9). Home medications included the following: carisoprodol, hydrocodone-acetaminophen, tramadol, gabapentin, lisinopril, allopurinol, levothyroxine, atenolol, prednisone, alendronate sodium, and citalopram hydrobromide. The patient received midazolam for anxiolysis immediately prior to transport to the operating room (OR).

Upon arrival to the OR all standard monitors were placed, and pre-oxygenation was initiated. The patient underwent conventional anesthetic induction, consisting of fentanyl, lidocaine, propofol, rocuronium, and succinylcholine, with an atraumatic intubation using a 7.0 millimeter (mm) endotracheal tube. Anesthesia was maintained in a 50/50 air-oxygen mixture with desflurane inhalational anesthetic. Prophylactic medications for prevention of postoperative nausea and vomiting were administered intravenously, to include dexamethasone and ondansetron.

The patient received intravenous acetaminophen, was positioned in the prone position with face, torso and extremities checked, and received 10 ml/kg intravenous tranexamic acid diluted in 250 ml 0.9% saline fluid prior to incision. The Wilson frame was used, and positioning was checked by the nurse anesthetist, the circulator, and the surgeon prior to surgical draping. Forced air warming was initiated, and the nasopharyngeal temperature remained within expected values throughout the case. Brain activity monitoring indicated adequate anesthetic depth throughout the case with values between 40 and 60.

Throughout the operation, neurophysiologic monitoring was utilized to detect changes in electromyography (EMG), electroencephalography (EEG), motor evoked potentials (MEP), and somatosensory evoked potentials (SSEP) in an effort to reduce the risk of damage to muscles, nerves, and the spinal cord during surgery, as well as monitor the transmission of nerve impulses from the brain to the extremities. During periods of surgical traction and distraction, the neurophysiologic monitoring results were reported aloud to the surgeon and OR personnel. The patient's hemodynamic status, urine output, and neurologic monitoring all remained within normal, expected ranges of values throughout the procedure.

As the blood loss continued throughout the first hour and into the second hour of the procedure, totaling 400 ml, the surgeon requested initiation of intraoperative cell salvage.

Once the technician arrived and equipment was appropriately prepared, the salvaged blood was immediately filtered, washed, and heparinized. Near the end of the operation, the technician did a final wash and centrifuged the blood to separate the red blood cells (RBCs).

Total estimated blood loss was 700 ml, which included both the cell salvage volume and the blood loss suctioned prior to initiation of cell salvage. Once the fluid was collected and prepared to be administered back to the patient, the bag only contained 120 ml of RBCs. The relatively low volume of RBCs was explained as being related to the high particulate matter, possibly bone fragments, bone cement, and foreign material from the surgical field.

SIGNIFICANT FINDINGS

When the washed cell salvage component was prepared for infusion, the bag appeared to contain viable RBCs. The cell salvage bag was connected to the blood transfusion tubing that had been previously used to administer colloids. The cell salvage infusion was initiated within minutes of completing the spin cycle from the cell salvage machine.

Once cell salvage transfusion was initiated, the nurse anesthetist noted that the infusion of filtered RBCs was not dripping when observing the drip chamber of the infusion bag. The line and tubing were both checked for patency. The line was flushed with 5 ml of 0.9% saline. The intravenous line appeared to be functional and without occlusion. The nurse anesthetist then looked at the cell salvage bag and noticed faint white debris present in the bottom of the cell salvage bag (see Image 1, 2). The infusion was stopped, and the bag was removed for further inspection. The surgical fluid collection chamber of the cell salvage machine was also noted to have white film and debris along the sidewalls (see Image 3). The cell salvage machine utilized for the spinal fusion is shown in Image 4.

The infusion line was inspected for any occlusions, and none were observed. The 0.9% saline was restarted to flush the line. Further inspection and examination of the cell salvage bag identified a substantial amount of foreign material present in the bottom of the cell salvage bag. After discussion with the surgeon, the perfusion technician, and the anesthesiologist, the incident was considered unusual and unique. Surgery continued uneventfully, and the patient was positioned in the supine position after surgical closure of the posterior surgical wound. The patient emerged from anesthesia without incident and was transported to the post-anesthesia care unit in stable condition for further

monitoring and observation. She was later discharged to a skilled nursing facility on postoperative day 3 to assist with ambulation and rehabilitation. The patient was in stable condition and no evidence of adverse effect related to the attempted cell salvage component transfusion was observed.

Tranexamic acid has been utilized in conjunction with intraoperative cell salvage in a variety of surgical procedures. No prior incidents of this description has been described in the peer-review, scholarly literature, nor reported in informal peer-to-peer anesthesia discussions. A search for similar cases was completed in the PubMed and Google Scholar databases using the following terms: cell salvage, intraoperative blood loss, spine fusion, tranexamic acid, and Cell Saver®. No similar cases were found.

The perfusion technician later reported that a regional supervisor had observed a similar phenomenon during cardiopulmonary bypass for coronary artery bypass graft surgery. In that case, the tubing of the cell salvage machine had occluded, and the entire tubing apparatus was discarded due to the overwhelming presence of fibrous white material found throughout the infusion bag and cell salvage tubing.

Figure 1

White debris noted in cell salvage bag.



Figure 2

Close up of white debris noted in cell salvage bag.



Figure 3

Cell salvage blood collection chamber. Note white debris present on walls of chamber.



Figure 4

Intraoperative cell salvage machine with blood tubing connected.



CONCLUSION

The presence of foreign material in what is considered a closed autologous RBC salvage apparatus is concerning and raises several unanswered questions. Potential causes for the observed phenomenon include coagulopathies, unreported interactions between tranexamic acid and intraoperative cell salvage, hypercoagulability, inadequate filtration of surgical field contaminants, and fluid shifting. In order to distinguish abnormalities related to patient-specific conditions or medication interactions, further investigation should be conducted. Analysis of the fluid bag by pathologists may have clarified the contents to aid in differential diagnosis. This course of action was not considered at the time of the incident.

Future considerations for researchers may include genetic screening to determine potential coagulation abnormalities in selected high-risk patients. Future research considerations should direct attention and investigation towards the interaction between the multiple therapeutic options available for reducing intraoperative blood loss. In order to minimize risk of adverse events and optimize therapeutic goals, further examination into the short-term and intermediate-range effects of anti-fibrinolytics should be evaluated, in light of this observed phenomenon.

Clinician nurse anesthetists should, as always, remain vigilant for presence of foreign debris in all blood transfusion products and closely inspect all blood products prior to administration to patients. For blood products prepared outside of the blood bank, the clinician index of suspicion should be raised even higher, due to the inevitable

reduction in process safeguards.

References

1. Rajaei S, Bae H, Kanim LE, Delamarter RB. Spinal fusion in the United States: analysis of trends from 1998 to 2008. *Spine*. 2012;37(1):67-76. doi: 10.1097/BRS.0b013e31820cccfb.
2. Badeaux J, Hawley D. Effectiveness of intravenous Tranexamic Acid (TXA) administration in managing perioperative blood loss in patients undergoing spine surgery: a systematic review protocol. *JB I Database Syst Rev Implementation Rep*. 2013;11(5):123-131.
3. Elgafy H, Bransford RJ, McGuire RA, Dettori JR, Fischer D. Blood loss in major spine surgery: are there effective measures to decrease massive hemorrhage in major spine fusion surgery? *Spine*. 2010;35(9S):S47-S56.
4. Endres S, Heinz M, Wilke A. Efficacy of tranexamic acid in reducing blood loss in posterior lumbar spine surgery for degenerative spinal stenosis with instability: a retrospective case control study. *BMC Surg*. 2011;11(29):1-5.
5. Elwatidy S, Jamjoom Z, Elgamal E, Zakaria A, Turkistani A, El-Dawlatly A. Efficacy and safety of prophylactic large dose of tranexamic acid in spine surgery: a prospective, randomized, double-blind, placebo-controlled study. *Spine*. 2008;33(24):2577-2580.
6. Diprose P, Herbertson MJ, O'Shaughnessy D, Deakin CD, Gill RS. Reducing allogenic transfusion in cardiac surgery: a randomized double-blind placebo-controlled trial of antifibrinolytic therapies used in addition to intra-operative cell salvage. *Brit J Anesth*. 2005;94(3):271-8. doi: 10.1093/bja/aei044.
7. Wong J, Beheiry YR, Lewis S, Ahn H, et al. Tranexamic acid reduces perioperative blood loss in adult patients having spinal fusion surgery. *Anesth & Analgesia*. 2008;107:11479-86.
8. Esper S, Waters JH. Intra-operative cell salvage: a fresh look at the indications and contraindications. *Blood Transfus*. 2011;9:139-47. doi: 10.2450/2011.0081-10.

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