



Case report and Literature Review

Intraoperative Blood Salvage and Re-transfusion For Ruptured Ectopic Gestation: A Case Report and Review of The Literature

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Abstract

Intra-peritoneal blood salvage following massive blood loss in surgical settings is not a very common event and may prove significant interest amongst clinicians in general. There is however a paucity of similar cases reports in the literature. Any blood salvage procedure perhaps may be a life-saving measure, especially in scenario where compatible homologous blood is not readily available. In view of the rarity of this occurrence and possible associated clinical curiosity the author is compelled to reporting of this unusual clinical event. We report the intra-operative blood collection and subsequent re-transfusion in a 22-year-old Cameroonian primigravida lady. She was hemodynamically unstable following massive intra-peritoneal hemorrhage from a ruptured ectopic gestation. Incidentally, the patient had early, prompt and was success resuscitation and intervention. She had an emergency open pelvic exploration and right salpingectomy with good post-operative outcome and recovery. The practice of intra-operative blood salvage techniques as an antidote to massive blood loss is far from being the reality in most clinical settings. With respect to cost benefit associated with using intra-operative blood salvage, this becomes relatively significant only when the blood loss and blood salvage rates are elevated. This case report elaborates the benefits inherent in simple intra-operative blood salvage program with an improvised Johnson's blood salvage kits used in the index patient; that proved practicable, cheap to operate and service in any busy surgical emergency department and especially those within resource constrained settings.

Keywords: Blood transfusion; Operative blood salvage; Autotransfusion; Cost benefit

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Introduction

Intraoperative blood salvage (IBS) is a conglomeration of many procedures involved in blood collection from the surgical field, thereafter, washing and filtering the biochemical elements or residues of the blood. Subsequently, following the filtering process, the patient's blood cells are re-infused back into the patient.^{1,2}

According to literature reports, the re-transfusion of autologous blood collected from body cavities may be a life-saving measure, especially when compatible homologous blood is not readily available.³ The benefits of IBS cannot be overemphasized for following reasons; first, it eliminates the possibility of transfusion hazards such as iso-immunization, mismatch, and transmission of diseases.³ Other benefits of IBS are the safety of not transmitting viral diseases, lesser risk of alloimmunization, absence of hyperkalemia, and no differential temperature of administration as the blood is given at room temperature.^[1,4] Other authors also see it as an antidote to rejection associated with patients who have an aversion for blood donations due to religious beliefs^[1, 5]. Spread of HIV and AIDS through the use of whole blood and blood products lends further credence to the use of autologous hemotransfusion^[6 - 8].

Interestingly, some authors have reported the use of blood collected from the peritoneal cavity in patients suffering from a ruptured ectopic gestation or splenic rupture as evidence-based common practice in the past.⁹ In addition, IBS has been successfully utilized in several spinal surgeries including deformity, tumor, and spondylitis. The bulk of existing evidence about the efficacy and safety of IBS remain controversial.^[10-14] Progress reports in the clinical application of IBS showed that it has enjoyed widely patronage and the use has significantly reduced the need for allogeneic transfusion for organ transplantation surgeries. Also, such advances in IBS have led to the production of hemonetics cell salvage machine which is being used in most sophisticated hospital settings in the western countries.^[14-19] The lack of such facility should not be an absolute limitation to such lifesaving IBS technique. We report a successful case of re-transfusion of intra-operative salvaged blood using a simple technique in resource-constrained mission hospital.

Case Report

The patient was a 22-year-old female Cameroonian of Kumbo origin, weighing 58 kg who had an operation for a ruptured ectopic gestation in St Elizabeth Catholic General Hospital, Northwest Cameroon. She was initially admitted with complaints of mild suprapubic pain of two days duration. She was a primigravida with a background history of amenorrhea lasting 6 weeks. There was no nausea or vomiting; and she was not constipated but had a low-grade fever (37.50C). On admission she had hemoglobin of 10 g/dL with a hematocrit of 30%. She had mild tachycardia (heart rate 90 per minute), tachypnea (respiratory rate of 22 cycles per minute), blood pressure (B/P) of 100/68 mm Hg, and pulse oximetry with SpO₂ at 99% in room air. Next morning (about 16 hours later) she was found to be grossly anemic with the hemoglobin level having dropped to 4.5 g/dL. A peritoneal tap was hemorrhagic. The abdominopelvic ultrasound scan essentially confirmed significant hemoperitoneum and raised a suspicion of a 'bleeding right tubal ectopic gestation.' Other preoperative investigations include routine blood biochemistry and a non-invasive 12-lead electrocardiograms were essentially normal as well as a positive pregnancy test.

There was no compatible blood available in the hospital as the patient was found to belong to the B Rh-negative blood group. In view of intra-abdominal bleeding an emergency laparotomy was performed. Before incising the peritoneum, arrangements had been made to collect the blood from the peritoneal cavity using improvised Johnson's Blood Salvage Kits- Figure 2. The process involved blood collection by direct scooping with an improvised long stented spoon into a sterile 1000ml receiver dish from where the blood is subsequently sieved into sterile blood bags containing acid-citrate-dextrose solution. Approximately 2.5 L of blood could be collected in about 10minutes using these improvised kits. This



Figure 1. Intra-Operative Cell Saver **Figure 2. Improvised Johnson's Blood Salvage Kits**

blood was sieved aseptically through two layers of sterile gauze moistened with isotonic saline (0.89% NaCl solution) into five 500 mL capacity sterile blood bags. On opening the abdomen, a ruptured ectopic gestation was found. It was managed by the attending Surgeon. Anesthetic management consisted of inducing anesthesia with diazepam (5 mg) and ketamine (75 mg), endotracheal intubation facilitated by use of suxamethonium (50 mg). Anesthesia was maintained using pancuronium (6 mg), morphine (6mg), nitrous oxide and oxygen (50:50). Intra-operatively, crystalloids (2.0 L) including 1500 mL of Ringer's lactate solution, and 500 mL of isotonic saline were used. Salvaged blood amounting to 2.5 L was given intravenously. All the resuscitation fluids were infused through two wide-bore intravenous cannulas. Auto-transfusion with the blood thus collected lasted two hours and thirty minutes extending into the postoperative period. At the end of the transfusion 10 mL of 10% calcium gluconate was given intravenously to neutralize any excess citrate. The patient's hemodynamic status remained stable intra-operatively and she was extubated after administration of reversal agents to counter the relaxant effect with standard doses of neostigmine and glycopyrrolate. Her post-extubation hemodynamic parameters were normal, and recovery from anesthesia was uneventful. She was transferred to the high dependency unit (HDU) for further observation. On the first postoperative day the parameters remain clinical stable with temperature of 37.40 Celsius; and the heart rates were 84 per minute. Her hemoglobin level had risen to 8.5 g/dL. She maintained good urinary output and was not icteric. Administration of mannitol was therefore not considered necessary. Serum bilirubin was found to be 0.85 mg/dL. She continued to maintain satisfactory post-operative status till the fifth postoperative day. Her blood and urine culture results were negative for any pathogenic organisms. Thereafter the patient regained her health, developed no complications in the immediate post-operative period and was discharged from the hospital on the 9th postoperative day in good health with the wound having healed by primary intention. The patient's clinical status remained satisfactory during the follow up clinic visits at the 2nd, 4th, and 8th week in the postoperative period.

Discussion

Blood Conservation Techniques during Major Surgeries

Many authors have reported massive peri-operative blood losses in major surgeries like total hip and knee arthroplasty, spinal, cardiac and vascular surgeries as well as organ transplantations have been reported.^{20,21} In these complex procedures because the attending surgeon envisages significant or potential for massive blood loss, therefore there is need for allogeneic blood transfusion.^[21-25] Significant peri-operative blood losses involving Caesarean Section have also been reported. For instance, in 1989, a French group described blood salvage in 15 patients undergoing Caesarean Section using the Hemonetics "Cell Saver 4".²⁶ The findings from the French group showed that there was a 20-fold increase in free Hemoglobin (Hb); cultures were positive for Epidermis staphylococcus; fetal red cells were present in 20% of cases; and fetal lanugo and scales were found in one case. The report equally showed that four patients who underwent caesarean operations received a total of 9 units of intra-operative salvaged blood without any records of amniotic embolism or other complications attributed to re-infusion, between 1989 and 1991 at Buon Samaritano Hospital, San Jose California - USA.^{26,27}

Furthermore, there are reports in literature of several complications accompanying allogeneic blood transfusion which include risks of disease transmission, hemolytic reactions, immunomodulation, hemodynamic overload, acute lung injury, and coagulopathy.^[28-31] We equally have evidence in support of patients who receive allogeneic blood with increased risk of postoperative infection, longer hospital stays, and mortality.^[29-31] Based on these facts therefore, there are rising concerns about blood conservation strategies to reduce intra-operative allogeneic blood transfusions and associated complications. There are many existing blood conservation techniques that include (i) Patients positioning to avoid abdominal compression, (ii) Hypotensive anesthesia, (iii) Normovolemic hemodilution, (iv) Application of topical hemostatic agents to decorticated bone, (v) Anti-fibrinolytic therapy, (vi) Preoperative autologous blood donation, and (vii) Intra-operative blood salvage system (IBS).^[32-35]

In a related development, other reports submitted that preoperative autologous blood donation may not be cheaper after all in clinical setting and most importantly many of donated blood in the pre-operative period may remain unused which can be counterproductive in the long run.^[36-38] Interestingly some authors have also argued against the effectiveness of acute normovolemic hemodilution in our surgical setting as relatively irrelevant and does not enjoy widespread practice amongst clinicians.^{20,39} Postoperative re-transfusion may result in transfusion reactions, as unwashed blood contains fibrin degradation products and other contaminants.^[20, 21, 40-44]

IBS has been widely adopted as a way of reducing the need for allogeneic transfusion at organ transplantation surgeries; also, have enjoyed patronage in various spinal surgeries including deformity, tumor, and spondylitis.^[11-14, 41-44]

Intraoperative Blood Salvage Technique

Historically, the first description of collecting one's own blood shed into body cavities for re-transfusion was dated back to 1818.^{7,45,46} IBS has been reported to be the most readily available source of blood, and the technique is free from certain hazards of homologous blood transfusion. Disadvantages include hemolysis, coagulopathies, micro-embolization, air embolism, sepsis, and metastasis of malignant cells.^{47,48} Sepsis and metastasis of malignant cells are still notorious for causing problems clinically despite improvements in technique and equipment. The last two decades have witnessed significant progress with respect to improved blood collection, anticoagulation, defoaming and filtration of the shed blood with equipment such as the Bentley auto-transfusion unit, which has helped minimize the complications associated with the procedure.^{3,45} Patients sustaining prolonged periods of hypovolemic shock may benefit with prophylactic enforced diuresis to protect the kidneys. Anticoagulation may be achieved by regional or systemic heparinization. In this index patient, acid-citrate-dextrose solution was used and any excess was neutralized with calcium gluconate administered at

the end of the transfusion.^{3,45} The advancement in equipment for IBS is demonstrated in figure 1 showing the intra-operative blood cell salvage system (Cell Saver®, Hemonetics®, Baltimore, MA, USA).^{3,45} The lack of such facility should not be an absolute limitation to such lifesaving IBS technique. This was demonstrated in our case presentation where improvised equipment (Johnson's Blood Salvage Kits- Figure 2) using a simple technique "came to the rescue" in resource-constrained mission hospital. The details of the intraoperative blood salvage and re-transfusion procedure is presented in the post-operative photographs labeled as Figures 2-5.

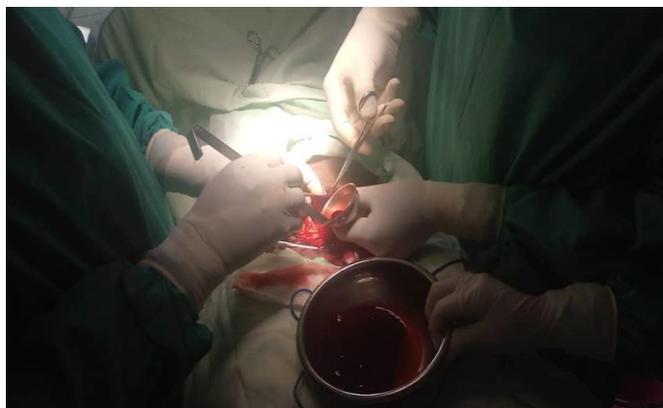


Figure 3. Intra-Operative Blood Salvage



Figure 4. Sterile Blood Bags (Acid-Citrate-Dextrose Solution)

Complications of Intraoperative Blood Salvage

Clinicians worldwide are concerned about the challenges relating to the use of IBS. Complications such as (i) Non-immune hemolysis, (ii) Hematuria, (iii) Coagulopathy, (iv) Micro-embolization, (vi) Contamination with drugs, such as cleansing solutions and infectious agents, and (vii) Incomplete washing; all have been reported.^{49,50} The risks of such complications have decreased with improving technical-know-how of users, training of service-staff, and growing experience with cell salvage usage.⁵¹ Some researchers have released a 5-year review of transfusion-related adverse events which showed that the rate of adverse events was substantially less in cell salvage, compared with allogeneic transfusion (0.027% vs. 0.14%, respectively).⁵² Other published literatures also submitted that there were no differences of transfusion related complications in IBS cohort.⁵³ Contrary to existing reports, in our index patient, transfusion related complications were not documented at any stage during the management of the patient. No record of administration of tranexamic acid to our in any form; this eliminated the effect of tranexamic acid as a confounder of intra-operative blood salvage.⁵⁴

Transfusion Related Coagulopathy in IBS

Transfusion related blood coagulopathy in IBS has been reported by many in recent past. The possible pathophysiology includes (a) the heparinized blood being transfused back to the patients,⁵⁵ (b) washing process discards all platelets and clotting factors,⁵⁶ and (c) activation of coagulation by damaged erythrocytes or mediators released by platelets or leukocytes.⁵⁷ Recent literatures suggested that heparin levels found in transfused blood were zero to insignificant level in modern cell salvage system^[58-60] and patient's coagulation remained normal if the blood loss is <3.5 Liters.⁵⁶ In the present study, an attempt to analyze the sequential coagulation profile monitoring showed no significant difference, and therefore disseminated coagulopathy was not evident in this patient using IBS.

Blood Cell Trauma in IBS

Various approaches have been described with respect blood collection during IBS. One popular approach is direct aspiration which causes mechanical trauma to red blood cell (RBC) with resultant lysis.^{46,61} In our case report, a different approach was adopted; that of direct scooping with scooping spoon but this did not seem to create any significant problem

in our index patient, as shown by only a mild rise of serum bilirubin level and a good output of normal colored urine post-operatively. The risk of micro emboli damaging lungs causing pneumonitis and even acute respiratory distress syndrome (ARDS) has been described. [46, 61-63] Damaged leucocytes may play a role in the pathogenesis of ARDS and techniques of rapid washing and concentrating RBC's have been recommended.^{3,6} Although collecting and re-transfusing the shed blood is fraught with many risks;^{3, 48, 64, 65} but our patient suffered only a mild febrile reaction in the immediate post-operative period which lasted two days. It can, therefore, be recommended as a life-saving procedure when adequate compatible blood is not available. Contra-indications to the procedure exist where blood has been contaminated with cancer cells or gastrointestinal contents.⁴⁷



Figure 5. Re-Bagging of The Salvaged Blood



Figure 6. Re-Transfusion of Salvaged Blood

Conclusion

Intra-operative blood salvage techniques are gradually gaining worldwide acceptance have become commonplace in many fields of surgery, especially those with potentials for massive blood loss. These IBS techniques tend to decrease the need for donor blood usage and the risks that accompany its re-infusion. It may practically also become life-saving measures, especially when compatible homologous blood is not readily available. Interestingly, it as an antidote to rejection experienced by patients especially those who have an aversion for blood donations due to religious beliefs. However, this practice of IBS techniques as an antidote to massive blood loss is far from being the reality in most clinical settings. With respect to cost savings associated with the use of IBS, this becomes relatively significant only when there is a high blood loss and a high blood salvage rate. This simple IBS program with an improvised Johnson's blood salvage kits used in the index patient proved practicable, cost-effective to implement in a busy surgical unit and in those within resource constrained settings.

Author contributions

BJA conceived of the study and participated in its design and coordination, helped to draft the manuscript, read and approved the final manuscript.

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Conflict of interest

All authors declare that they have no conflict of interest.

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