

## Intraoperative Cell Salvage in Obstetrics

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### **Abstract:**

Cell salvage is beneficial in surgeries that are high risk of anticipated blood loss or where patient factors limit the use of allogeneic blood transfusion. However, the use of cell salvage was limited in obstetric settings due to its early theoretical concerns and ignorance of harmful effects of allogenic transfusions. With the increasing use of intraoperative cell salvage (ICS) in different surgeries including obstetric surgeries across the world, the aim of this review was to describe the current trends and importance of cell salvage in obstetrics.

**Key Word:** cell salvage; obstetrics; blood transfusion; obstetric hemorrhage

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### **I. Introduction**

Globally, obstetric hemorrhage is the leading cause of maternal mortality.<sup>1,2</sup> In a WHO systematic analysis of global causes of maternal death, about 73% of all maternal deaths between 2003 and 2009 were due to direct obstetric causes; particularly for obstetric haemorrhage, while the rates were 16.3% and 27.1% in developed and developing regions, respectively.<sup>3</sup> Uterine atony is most common cause of postpartum hemorrhage (PPH) and approximately 10% of them require blood transfusions. Due to the concerns of safety of allogeneic transfusions, shortage of blood and refusal of certain patients to blood products has lead to increase in strategies to avoid allogeneic transfusions.<sup>4,5</sup>

Intraoperative cell salvage (ICS) is most effective method of autologous transfusion.<sup>6</sup> The use of ICS in Obstetrics has been endorsed and recommended by various associations such as Association of Anaesthetists of Greater Britain and Ireland (AAGBI)<sup>5</sup>, Obstetric Anaesthetist's Association (OAA)<sup>7</sup> and National Institute of Health and Clinical Excellence (NICE)<sup>8</sup>.

### **II. Basic principle of Cell Salvage:**

ICS is the process whereby blood loss during an operation is collected, filtered and washed to re-infuse to the patient.<sup>6</sup> The blood is collected from surgical field using a dedicated double lumen suction catheter using vacuum of 150 mm of Hg while the amniotic fluid or the peritoneal fluid are evacuated through separate suction. The double lumen suction catheter has one lumen to perform suctioning of blood from the operative field and the other lumen adds a predetermined volume of heparinized saline to the salvaged blood. This anticoagulated-salvaged blood is then passed through filter and collected in a reservoir. The machine will automatically centrifuge (spin, wash & package) red blood cells for re-infusion when enough fluid is present in the reservoir. Cell Salvage blood is superior in quality than allogeneic blood with higher viability and oxygen carrying capacity.<sup>9</sup>

### **III. Risks of ICS unique to Obstetrics**

Potentially, the risks of cell salvage in obstetrics population parallels with that of general population.<sup>4</sup> Traditionally, cell salvage has been avoided in the obstetric population because of the perceived risk of amniotic fluid embolism (AFE) or induction of maternal alloimmunization.

#### **AFE:**

AFE is a peri-partum syndrome of rapid-onset dyspnea, hypoxemia, and cardiac collapse, with a mortality rate as high as 60% in developed nations.<sup>4</sup> The salvaged blood may get contaminated with amniotic fluid and hence may elicit the AFE when transfused into maternal circulation.<sup>9</sup> It has been shown that amniotic fluid in maternal circulation can trigger unpredictable complex series of physiological reactions mimicking those seen in anaphylaxis and sepsis. However, no case of AFE has been reported associated with the use of obstetric cell salvage.<sup>10</sup> Systematic reviews have also concluded that the re-infusion of RBCs salvaged during

Caesarean section is not associated with an increase in the incidence of AFE.<sup>7</sup> It is now widely accepted that the risk of AFE has been overestimated.<sup>11</sup> Cell salvage using modern leucocyte depletion filters (LDF) has been shown in vitro to remove all particulate components to a level equivalent to maternal blood at time of delivery.<sup>8</sup> NICE (2005) has accepted the safety of use of ICS in obstetrics if used in combination with an LDF.<sup>8</sup> CEMACH<sup>12</sup> the AABGI<sup>5</sup>, and OAA have also endorsed cell salvage.

#### **Maternal Alloimmunization:**

The cell saver is unable to distinguish between maternal and foetal red cells where later encompasses to 1.5% of recovered red blood cells.<sup>4</sup> This may lead to maternal sensitisation to foetal red cell antigens. Incompatibility with Rhesus D is relatively common after delivery but the sensitisation can be prevented with adequate administration of anti-D in the post-partum period. It has been depicted that cell saver with a LDF can significantly reduce the levels of amniotic fluid but not fetal RBCs in salvaged blood.<sup>11</sup> However, the risk of allo-immunization is unlikely to be greater than that incurred in a normal vaginal delivery.<sup>11</sup> Salvo trial also emphasized the strict use of Anti-D immunization in caesarean sections using ICS.<sup>10</sup>

#### **Other risks of ICS**

- 1) Bacterial contamination of cell salvage units- Bacterial contamination has been found to be common in reinfusion of salvaged blood but there is no report of septicaemia or infection due to autologous transfusion.<sup>4</sup>
- 2) Hypotension: Some of the reports have shown episodes of hypotension when transfusing salvaged blood using leukocyte depletion filters.<sup>4</sup>
- 3) Non-immune haemolysis
- 4) Air embolus
- 5) Other transfusion reactions- febrile non-haemolytic transfusion reactions, mis-transfusion, and coagulopathy
- 6) Impurities like drugs, cleansing solutions, infectious agents, and incomplete washing leading to contamination with activated leucocytes, cytokines, and other micro aggregates.

NICE<sup>8</sup> reviewed the evidence in 2005 and supported its use in Obstetrics subject to:

- Data collection
- Reporting of complications to the Medicine and Healthcare products Regulatory Agency
- Patients should be well informed 'whenever possible' about the potential complications
- Intraoperative cell saver should be handled and Performed by the teams who are regularly trained and are experienced in using it.

### **IV. Benefits of ICS**

ICS has been reported in Cochrane meta-analysis to reduce the requirement of allogenic transfusions by 40% without causing any systemic complications.<sup>6</sup> There is clear evidence that there is no risk of allogenic transfusion reactions or blood borne infections and is cheap; the disposables for a cell saver run cost less than a single unit of red cells.<sup>13</sup> However, it also avoids immune-modulating effects of allogenic transfusion and associated nosocomial infection.<sup>13</sup> Not only cell-salvaged blood is immediately available to transfuse but also avoids the problems caused by cross-matched blood especially in the presence of antibodies. Cell salvage does not carry the risk of side effects from other measures of control of bleeding like antifibrinolytic agents, lysine analogues, and coagulation factor concentrates.<sup>6</sup> It's also accepted by some Jehovah's Witnesses. It can be safely transfused along with administering medications (such as uterotonics and tranexamic acid). Moreover, salvaged blood is better physiologically compared to the stored blood as temperature, 2,3-DPG, pH and potassium are more closer to maternal values.<sup>4,13</sup>

### **V. Indications and Contraindications for ICS<sup>4,7,11</sup>**

#### **INDICATIONS:**

According to the guidelines by AAGBI and NICE, indications for ICS may be liberal or restrictive but should be considered for women at risk of PPH during Caesarean section (CS). The 2009 AAGBI guidelines describes the need for the use of intra-operative cell salvage when the anticipated blood loss is 1000 ml or 20% of the estimated blood volume along with other associated indications for transfusion.

ICS is more cost effective in when there is high probability of blood transfusion such as invasive placentation, repeat CS in known placenta praevia, preoperative anemia.<sup>14</sup>

<b>OBSTETRIC INDICATIONS</b>	<b>MEDICAL INDICATIONS</b>
Placental causes: - Invasive placentation (accreta, increta, percreta) - Placenta praevia/low-lying placenta	Severe preoperative anaemia
Previous PPH - atony - incisional bleeding - retained placenta or genetic factors)	Laparotomy for PPH or haemoperitoneum
Surgical risks - Fibroids >8 cm - hysterotomy site - Previous uterine rupture	Maternal coagulopathy - Acquired causes - Inherited causes Thrombocytopenia (<80 x10 <sup>9</sup> /L)
Caesarian Sections (CS) - Emergency CS - Previous CS - Classical CS	Declined allogenic transfusion (i.e. Jehova Witness patients)
Multiple gestation	Difficulties with cross-match/ antibodies

### **CONTRINDICATIONS<sup>5,7,11</sup>**

The only absolute contraindication for cell salvage is Patient refusal.

Other relative contraindications are:

- Biological contaminants faeces (Note: urine and amniotic fluid are safe)
- Medical contaminants
- Haemostatic agents (Gelfoam™, Avitene™, Surgicel™, Floseal™ etc.)
- Medication not appropriate for intravenous administration
- History of heparin induced thrombocytopenia
- Malignancy
- Homozygous sickle cell anaemia

## **VI. Considerations for Cell Salvage in Obstetrics**

### **1. Patient Selection and Consenting**

Wherever possible, the advantages and risks of ICS and allogenic blood transfusion should be discussed with the woman prior to undergoing an obstetric surgical procedure. In a pre-planned case this can be done during pregnancy. The NICE<sup>8</sup> guidance “Intraoperative blood cell salvage in obstetrics” recommends, “Whenever possible, the woman understands what is involved and the theoretical risks, and agrees (consents) to have the procedure”. When patient selection for ICS is at the discretion of the surgeon and anaesthetist caring for the patient and must be considered on a case-by-case basis.

When obtaining formal consent for a caesarean section, the obstetrician or anaesthetist should discuss the advantages and risks of ICS with the woman and document clearly her agreement to undergo the procedure. Such detailed consent may not be practicable in an emergency, in which case the use of ICS should be fully discussed with the mother following the procedure.

### **2. Organisation of service and Training**

Considering the recent trends and safety of the ICS, cell salvage should be made integral part of peri-operative practice and trained staff should be available to deliver this service 24 hours the day where hemorrhage risk is evident.<sup>5</sup> The training and accessibility should be conducted regularly with a named supervisor or clinical lead, which is responsible for overall cell salvage services in hospital. The hospital policy/guideline with standard operating procedure should be available to standardize the practice.

### **3. Safety and Cost Efficacy**

SALVO TRIAL (cell SALVage in Obstetrics) is one of the largest trials (n=3054) conducted to determine the safety of cell salvage and cost effectiveness in women undergoing caesarian section and at risk of hemorrhage. They did not find the significant difference in donor transfusion rate or cost benefit for routinely setting up of cell salvage with complete cycle of collection and reinfusion.<sup>10</sup> The cost of cell salvage can be reduced through the use of a standby system, which collects blood in a specifically designed reservoir. Anti-coagulant (usually heparin) is added to the collected blood, which is only processed if a sufficient volume is recovered.<sup>11</sup>

## VII. Conclusion

Cell salvage is a safe and effective method for the management of significant intraoperative blood loss in obstetric surgeries. It is advantageous and cost effective for pregnant women who are at risk of postpartum haemorrhage. There have been no serious adverse events reported due to ICS use in pregnant women. In fact, it avoids the adverse risks associated with donor blood transfusion and helps preserve the allogenic blood products.

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