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CLINICAL ARTICLE

Intraoperative red cell salvage during obstetric surgery in 50 Japanese women

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ABSTRACT

Objective: To determine the clinical usefulness of intraoperative cell salvage (ICS) in obstetrics. *Methods:* A retrospective analysis was performed using data for 50 patients who had received ICS blood during obstetric surgery at 13 Japanese facilities between January 1, 2007 and December 31, 2013. The frequencies of ICS-associated adverse events, allogeneic blood transfusion (ABT), and preoperative autologous donation (PAD) were assessed. *Results:* Placenta previa was the indication for ICS in 42 (84%) women. The ICS blood was reinfused in all women (median 366 mL; range 80 to at least 3715). No ICS-associated adverse events occurred. The median estimated blood loss (EBL) was 2171 mL (range 574–47 000); 27 (54%) women lost at least 2000 mL. ABT was not used in 33 (66%) women. Among 26 women who lost at least 2000 mL of blood and were included in analyses, 12 (44%) did not receive ABT. EBL was linearly correlated with the total volume of transfused blood ($P < 0.001$). *Conclusion:* ICS caused no adverse events among women at elevated risk of peripartum hemorrhage and might be safe for use in obstetrics.

1. Introduction

Most maternal deaths occur within 24 hours of delivery, often because of excessive bleeding [1], making severe bleeding the single most important cause of maternal death worldwide. In the event of a massive hemorrhage in non-obstetric surgery, intraoperative cell salvage (ICS) reduces the demand for allogeneic (donor) red blood cells [2] and can be lifesaving if the volume of blood involved has outstripped local supply. Therefore, ICS is common practice in many surgical specialties [3,4]. However, the safety of ICS in obstetric surgery has yet to be determined. Its routine use in obstetric patients at high risk of massive hemorrhage has been hampered by the concern that ICS could result in the transfusion of blood contaminated by amniotic fluid, which might in turn lead to amniotic fluid embolism (AFE).

Modern cell savers (the apparatus used for ICS) remove most particulate contaminants from the salvaged blood, and leukocyte depletion filtering before transfusion further adds to the safety of ICS [5]. Indeed, no occurrences of AFE were reported among more than 400 obstetric patients who were reinfused with ICS blood [5]. Some investigators

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[5,6] insist that the use of ICS in obstetric clinical practice should be considered if the patient is at high risk for hemorrhage or if allogeneic blood transfusion (ABT) is difficult or impossible.

The aim of the present study was to determine the clinical usefulness of ICS in obstetrics.

2. Materials and methods

The present retrospective study was conducted after approval was received from the Institutional Review Board of Hokkaido University Hospital (Sapporo, Japan). In January 2014, all 686 hospitals certified as training facilities for obstetricians and gynecologists by the Japan Society of Obstetrics and Gynecology were asked about their experience with the use of ICS in obstetrics between January 1, 2007, and December 31, 2013. Of the 293 facilities that responded, 284 had provided maternity care during the study period. Fourteen (4.9%) of the 284 facilities confirmed that they had used ICS during at least one obstetric surgery, and 13 (4.6%) provided relevant information on their experience in a total of 50 patients. The present study analyzed data on these 50 women. All 50 patients had given informed consent on admission to the hospital regarding the use of their data for academic research purposes.

Information collected included demographic characteristics, outcomes, adverse events that were considered to be associated with ICS, volume of reinfused ICS blood, ABT, estimated blood loss (EBL), and preoperative autologous donation (PAD).

Equipment used for ICS varied by facility: Cell Saver Elite (Haemonetics, Braintree, MA, USA) was used in four facilities, Cell Saver 5 + (Haemonetics, Braintree, MA, USA) was used in three facilities, Cell Saver 5 (Haemonetics, Braintree, MA, USA) was used in three facilities, and the cell saver Xtra (Sorin Group, Milan, Italy) was used in three facilities.

Statistical analyses were performed using SPSS version 19.0 (IBM, Amonk, NY, USA). Only patients for whom the volume of reinfused ICS blood was known were included in analyses. Continuous data are presented as median (range). The Fisher exact test was used to compare the frequencies among categorical data. Regression analysis was performed to determine the association between EBL and the total blood volume transfused. $P < 0.05$ was considered statistically significant.

3. Results

The ICS blood was reinfused in all 50 women. The median amount of ICS blood transfused was 366 mL (range 80 to at least 3715 [volume unknown in one patient]). No ICS-associated adverse events (e.g. hypotension) or AFE-like symptoms (e.g. abrupt cardiovascular collapse, inadequate oxygenation of the arterial blood, coagulopathy not associated with blood loss, and seizures [7]) were recorded. All 50 women survived. In 49 women, ICS was used during cesarean delivery; in one woman, it was used during hysterectomy performed 7 days after cesarean delivery for placenta previa accreta.

The median EBL was 2171 mL (range 574–47 000). EBL was at least 2000 mL in 27 (54%) women (Table 1). Additional treatments for excessive blood loss included PAD, ABT, fresh frozen plasma, and fibrinogen (Table 1).

One woman with an unknown volume of reinfused ICS blood was excluded from the analyses. The EBL was 47 000 mL, no PAD blood was available, and 26 000 mL of ABT blood was used during cesarean hysterectomy as a result of placenta previa accreta. No severe anemia developed after the operation; the hemoglobin concentration was 95 g/L before the operation and 90 g/L 1 day after surgery.

Among the 49 women for whom the reinfused ICS blood volume was known, the total blood volume transfused (comprising ICS, PAD, and ABT blood) was linearly correlated with the EBL (Fig. 1). Fourteen (29%) women were given ICS blood alone, receiving a median of 315 mL (range 80–939 mL) for an EBL of 1550 mL (range 650–5200 mL) (Fig. 2). Among the 49 patients, 19 (39%) were given ICS and PAD blood, receiving a median of 600 mL (range 300–1200 mL) of PAD blood and 300 mL (range 202–775 mL) of ICS blood for an EBL of 1730 mL (range, 574–4832 mL) (Fig. 2). Eight (16%) women were given ABT and ICS blood, receiving a median of 2400 mL (range 400–7200 mL) of ABT blood in addition to 285 mL (range 155–3472 mL) of ICS blood for an EBL of 4096 mL (range 1865–7750 mL) (Fig. 2). The remaining eight women were given a median of 730 mL (range 220–3715 mL) of ICS blood, 700 mL (range 300–1200 mL) of PAD blood, and 1800 mL (range 800–10 400 mL) of ABT blood for an EBL of 4686 mL (range 1189–15 825 mL) (Fig. 2).

ABT was avoided in 33 (67%) of the 49 patients, including 21 (91%) of the 23 women with an EBL of less than 2000 mL and 12 (46%) of the 26 women with an EBL of 2000 mL or more (Table 2). In the 12 women with an EBL of 2000 mL or more, the reinfused ICS blood

Table 1
Demographic and clinical characteristics of included patients.[a]

Characteristic	Patients (n = 50)
Age, y	35.0 (23.0–45.0)
Nulliparous	15 (30)
History of previous cesarean delivery	22 (44)
Pregnancy duration at delivery, wk	36.4 (25.1–41.4)
<37	26 (52)
Infant birth weight, g	2406 (694–3560)
<2500	27 (54)
Apgar score <8 at 1 min	22 (44)
Apgar score <8 at 5 min	13 (26)
Indication for ICS	
Placenta previa (with or without placenta accreta)	42 (84)
Uterine myoma	7 (14)
Splenic aneurysm	1 (2)
Estimated blood loss, mL	2171 (574–47 000)
≥1000	44 (88)
≥2000	27 (54)
≥3000	16 (32)
≥4000	13 (26)
≥5000	8 (16)
Additional treatment for blood loss	
Preoperative autologous donation	27 (54)
Allogeneic blood transfusion	17 (34)
Fresh frozen plasma	16 (32)
Fibrinogen	2 (4)
Maternal mortality	0
Adverse events associated with ICS	0

Abbreviation: ICS, intraoperative cell salvage.
[a] Values are given as median (range) or number (percentage).

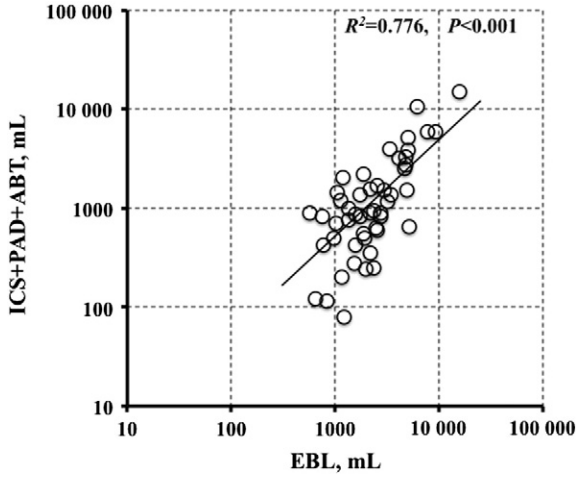

Fig. 1. Relationship between EBL and total volume of blood transfused among patients undergoing ICS (n = 49). Abbreviations: EBL, estimated blood loss; ICS, intraoperative cell salvage; PAD, preoperative autologous donation; ABT, allogeneic blood transfusion. One woman with an unknown volume of reinfused ICS blood was excluded from the analysis. Regression equation: total blood volume transfused (mL) = 0.908 × EBL (mL) – 740.