22 Cell Salvage (CS) n=20

Author: Sarah Haynes

Definition:

Any adverse events or reactions associated with cell salvage (autologous) transfusion methods, including intraoperative and postoperative cell salvage (washed or unwashed).

Abbreviations used in this chapter

AAA	Abdominal aortic aneurysm	**HTC**	Hospital Transfusion Committee
BCSH	British Committee for Standards in Haematology	**ICS**	Intraoperative cell salvage
		Ig	Immunoglobulin
cffDNA	Cell free fetal DNA	**IV**	Intravenous
FFP	Fresh frozen plasma	**LDF**	Leucocyte depletion filter
FMH	Feto-maternal haemorrhage	**WHO**	World Health Organisation

Key SHOT messages

- Cell salvage related incidents continue to be under-reported
- Preventable errors accounted for 10/16 adverse events
- Of the adverse reactions, hypotensive reactions were seen in 3/4 cases

Recommendations

- Where cell salvage has been planned, teams should ensure the availability of trained staff and adequate resources for the procedure. Review current training needs for all staff involved in the process and address any deskilling by update training

Action: Cell salvage leads, theatre leads, anaesthetic and surgical specialty leads

- Review suitability of cell salvage documentation (paper or electronic) and its appropriate use. Ensure the record of cell salvage is accessible and complete, particularly in relation to communicating pertinent details at handover

Action: Cell salvage leads, theatre teams, hospital transfusion teams

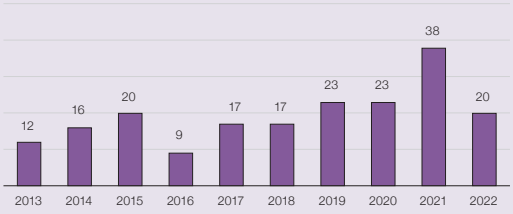
- Establish clear responsibilities and lines of reporting for cell salvage incidents. Review pathways and structure for governance and communicate these processes to all stakeholders

Action: Cell salvage leads, theatre leads, HTC, clinical governance leads

Headline data 2022

Number of reports n=20
Deaths n=0
Major morbidity n=0

CS reports by year



Demographic data

Male n=8
Female n=12
Adults n=19
Paediatric n=0
Unknown n=1

Blood component data

Red cells n=20
Platelets n=0
Plasma n=0
Multiple components n=0
Other n=0

Introduction

There were 20 cell salvage incidents analysed in 2022. All incidents related to the use of ICS. The reports were submitted from 15 different hospitals, with one hospital submitting 5 reports, one 2 reports, and the remaining 13 hospitals submitting a single incident each.

All reported incidents were in adult patients, with an age range of 26 to 89 years, with 12 females and 8 males.

Unlike previous years, reports were spread between surgical disciplines, with most surgeries being planned as opposed to emergencies (Table 22.1).

There were 16 adverse events, of which 10 were attributable to preventable error, and 4 adverse reactions comprising 3 episodes of hypotension and 1 allergic reaction. Hypotensive reactions on reinfusion of cell salvaged blood remain the most commonly reported reaction.

Table 22.1. Cell salvage cases by speciality

Specialty	Elective	Emergency	Total
Gynaecology	2	1	**3**
Hepatobiliary	1	0	**1**
Obstetrics	5	0	**5**
Orthopaedic	5	0	**5**
Spinal	1	0	**1**
Trauma	0	1	**1**
Urology	2	0	**2**
Vascular	1	1	**2**
Total	**17**	**3**	**20**

Deaths related to transfusion n=0

There were no deaths related to cell salvage in 2022.

Major morbidity n=0

There were no incidents that resulted in major morbidity in 2022.

Cell salvage adverse events n=16

There were 10 preventable incidents, 4 equipment failures and 2 other adverse events.

Procedural errors n=10

There were 3 cases where inappropriate substances were aspirated into the blood collection causing cell salvage to be abandoned. In a further case intermittent machine failures were found to have resulted from user error and resolved by installing a new consumable set correctly.

In 3 cases, reported from one hospital, inadequate documentation, and inability to access process records on the device called into question the quality of the salvaged red cells. In all 3 (2 orthopaedic, 1 gynaecology) there was no means of verifying at handover as to whether a partial bowl had been double washed. A contributory factor on 2 occasions was powering down the cell salvage device 'mid-processing' to move it from theatres to recovery to continue processing of the collected blood. Despite these concerns the processed red cells were reinfused in all cases.

Problems with reinfusion of cell salvaged blood were reported in 3 cases. In an orthopaedic case a fat reduction filter was not primed correctly (using reverse priming) causing it to fail and the infusion abandoned. In another incident a standard solute giving set, instead of a blood transfusion giving set, was used to reinfuse 461mL of salvaged red cells. Inadequate documentation was also noted in this case as the reinfusion start time had not been recorded. And in a third case, despite the blood bag not being labelled with the patient's details and no blood authorisation documentation being completed, a 473mL reinfusion went ahead regardless.

Learning points

- Procedure documentation must be contemporaneous, reliable, and complete
- Moving a device mid-procedure is not advisable. If power is lost to a device mid-procedure, staff should have sufficient training to be able to recall processing records on the cell salvage device

Equipment failure n=4

There were 4 incidents in which cell salvage devices or disposables failed or malfunctioned. In the first case, cell salvage was employed in an elective caesarean section. Ongoing failures of the on-board suction system persisted, despite attempts to troubleshoot, requiring a replacement machine to be introduced. Inevitably, some of the 2L intraoperative blood loss was not captured, reducing the efficiency of the process with only 391mL of red cells being reinfused.

In a 2nd case, cell salvage was set up for AAA surgery in a man in his 70s. Blood loss was rapid, and a large volume (over 3L) was quickly collected in the reservoir. Despite the best efforts of the theatre staff present, the device could not be initiated to process the blood. At this point cell salvage was abandoned and suction switched to a waste container. Ongoing massive blood loss and activation of the MHP resulted in transfusion of 11 units of red cells and four units of FFP. The patient died despite supportive measures. Failure of cell salvage was not deemed to be a contributory factor in the patient's death.

In the 3rd case, complete failure of the cell salvage device in an elective caesarean section meant that the 2.4L blood loss was not compensated and a two-unit allogeneic red cell transfusion was required. The reporter stated that the hospital's cell salvage machines were over 10 years old and in need of replacement.

The last incident related to quality concerns with black particles seen in the reinfusion bag after processing blood collected in an elective total hip replacement.

Other adverse events n=2

There were 2 further adverse incidents. In the 1st, which occurred outside core hours, a cardiac arrest call was put out for a postoperative gynaecology patient. The lady in her 60s, who was a Jehovah's Witness, was returned to theatre for an emergency laparotomy. Blood loss was collected, but there was no trained cell salvage operator available to process the blood. Additionally, the saline used as washout in the surgical field was not IV grade making the blood collected unusable. The patient was transferred to ICU and made a full recovery.

In the 2nd case, failures in communication resulted in a near miss but highlighted the need to discuss patient specific concerns and the use of cell salvage at team brief and at handover.

Case 22.1: Failure to communicate risks inadequate anti-D Ig prophylaxis

A woman in her 20s underwent an elective caesarean section in which cell salvage was to be used. Prior to surgery there was no discussion within the theatre team about the women's blood group, which was D-negative. The patient received a transfusion of 251mL of salvaged red cells whilst in theatre, something not communicated to the midwife at handover. This was later discovered when the patient herself told the midwife she had received her own blood back and the fact verified by review of the anaesthetic chart. No maternal sample had been taken for Kleihauer testing even though over 45 minutes had elapsed since the transfusion. A review of the cffDNA result however showed that the baby was also D-negative meaning that no anti-D Ig prophylaxis was required.

A failure in communication in this case risked a patient having inadequate anti-D Ig prophylaxis. BCSH guidelines (BCSH Qureshi et al. 2014) state that where ICS is used during caesarean section in D-negative, previously non-sensitised women, and where cord blood group is confirmed as D-positive (or unknown), a minimum dose of 1500IU anti-D Ig should be administered following the re-infusion of salvaged red cells, and a maternal sample should be taken for estimation of FMH 30–45 minutes after reinfusion in case more anti-D Ig is indicated. It is also recommended that clinicians inform the transfusion laboratory if ICS has been used to ensure that the correct dose of anti-D Ig is issued. It was fortunate in this case that a previous cffDNA test had shown the child to be D-negative, a result that was only reviewed in retrospect.

Learning point

- Communication around the use of cell salvage is key. The WHO Surgical Safety Checklist team brief allows patient specific concerns to be discussed prior to surgery. Any ICS infusions should be documented and notified at handover to recovery staff so that the patient is cared for appropriately. The transfusion laboratory should also be notified of cell salvage use in D-negative mothers

Cell salvage adverse reaction n=4

There were 3 hypotensive reactions reported. All were associated with the use of LDF to mitigate the risk of cancer dissemination, with citrate anticoagulation. All patients experienced transient symptoms which were corrected and made full recoveries.

A woman in her 50s underwent complex gynaecological surgery. On reinfusion of cell salvaged blood her BP dropped to 68/30mmHg. The transfusion was stopped, the patient was given fluids and vasoconstrictors and blood pressure normalised. On resumption of the reinfusion, a similar drop in blood pressure occurred and the cell salvage infusion abandoned. The patient received three units of allogeneic red cells intraoperatively but it was difficult to say if any of these could have been avoided if cell salvage had been successful.

Severe hypotension was also noted in a man in his 60s undergoing spinal surgery with malignancy.

A woman underwent a nephrectomy and experienced marked hypotension on infusion of salvaged red cells. The transfusion was stopped, the patient stabilised and the LDF removed and replaced with a 40-micron filter. In total 900mL of salvaged red cells were reinfused. The woman was a Jehovah's Witness, and the reinfusion was hence significant.

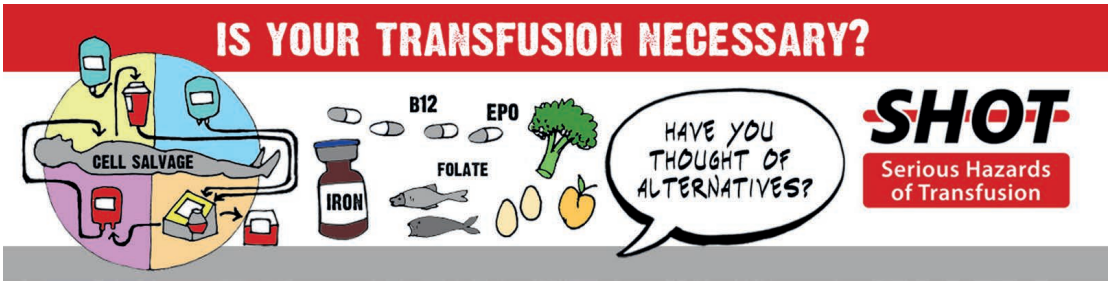
The 4th reaction was in a woman in her 30s undergoing an elective caesarean section. Following the reinfusion of 50mL of salvaged blood, the patient developed redness tracking along the vein and spreading across the forearm with white wheals. The infusion was stopped, the affected area on her arm delineated, and hydrocortisone administered. The reaction diminished over time with the patient being fine throughout apart from discomfort and itching at the reaction site.

Conclusion

It is concerning that most incidents reported this year were preventable. Staff were provided with refresher training in cases where procedural errors were identified. A number of new training resources related to blood transfusion, including a module on cell salvage, have been recently been released and are accessible to NHS staff through the e-learning for Healthcare website (see 'Recommended resources'). Appropriate staff training and competency-assessment are essential to ensure safe delivery of cell salvage.

Inaccurate documentation and labelling appear to be a theme this year, particularly in relation to communicating important information at handover. The appropriate management of patients receiving cell salvaged blood is vital as unexpected clinical reactions can and do happen. The 3 hypotensive reactions described here bring the total to 34 incidents reported to SHOT since 2010. It is anticipated that this under-represents the true picture.

In the recent UK Cell Salvage Action Group survey (in press), only 58% of organisations (53/90) reported cell salvage incidents to SHOT compared to 92% reporting through local incident reporting systems. Only 30% stated that they report machine and disposables failures to the MHRA Yellow Card Scheme or equivalent in devolved countries. Incidents were most commonly investigated through theatres, transfusion practitioners and ICS leads, with governance being provided by the Hospital Transfusion Committee/Team, Clinical Governance or Patient Safety Committee. Cell salvage contributes significantly to perioperative patient blood management. Hospitals should strive to achieve the same rigor in safety and governance as any other transfusion practice.



Recommended resources

E-learning for Healthcare
https://www.e-lfh.org.uk/programmes/blood-transfusion/

WHO Surgical Safety Checklist
https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

UK Cell Salvage Action Group
https://www.transfusionguidelines.org/transfusion-practice/uk-cell-salvage-action-group

References

BCSH Qureshi H, Massey E, Kirwan D, et al. BCSH guideline for the use of anti-D immunoglobulin for the prevention of haemolytic disease of the fetus and newborn. *Transfus Med*. 2014;**24(1)**:8-20. https://doi.org/10.1111/tme.12091 [accessed 30 April 2023].

The UK Cell Salvage Action Group. Intraoperative Cell Salvage: Survey of Equipment and Practice across the UK in 2019. (2023) (in press).