

Effectiveness of Cell Salvage for Minimising Intra Operative and Postoperative Allogenic Blood Transfusion in Patients undergoing Aortic Aneurysmal Surgeries

Iqra Nazir Naqash¹, Zaid Tariq², Misbah Jabeen³, Showkat Ahmad Gurcoo⁴, Farooq Ahmed Ganaie⁵, Firdous Ahmad Bhat⁶, Aijaz Rasool⁷

¹Associate Professor, Department of Anesthesia SKIMS SOURA Srinagar J&K

²Msc. of Technology, Department of Anesthesia, SKIMS SOURA Srinagar J&K

³Senior Resident, Department of Anesthesia, SKIMS SOURA Srinagar J&K

⁴Professor and HOD, Department of Anesthesia SKIMS SOURA Srinagar J&K

⁵Associate professor CVTS, SKIMS SOURA Srinagar J&K

⁶Perfusionist, Technical officer SKIMS SOURA Srinagar J&K

⁷Associate professor Department of Anesthesia, SKIMS SOURA Srinagar J&K

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Corresponding Author: Dr. Misbah Jabeen

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Abstract:

Background: The need for blood transfusion is indispensable to any major surgical procedures. Patients undergoing open surgical repair of aortic aneurysm and dissection have high bleeding risk. There has been a great concern due to increasing awareness of adverse effects of allogenic blood transfusion. Cell Salvage and Acute normovolemic hemodilution (ANH) has been proposed as an alternative to allogenic blood transfusion.

Objectives: To investigate the effectiveness of cell salvage for minimizing intraoperative and postoperative allogenic blood transfusion in patients undergoing aortic aneurysmal surgeries.

Study Design: A prospective retrospective observational study.

Participants: 54 patients undergoing aortic aneurysmal surgeries.

Methods: Patients were divided into two groups.

Group 1: Cell saver group (CS group) included all the patients, prospective as well as retrospective, undergoing/ has undergone aortic aneurysmal surgery in whom cell saver was used. **Group 2:** Control group (group C) included those patients who have undergone aortic aneurysmal surgery in whom cell saver was not used. Allogenic blood transfusion was given if Hb was <7gm% during intra operative and post-operative period. Patients were followed in post-operative period for 24 hours and requirement of blood transfusion was recorded in each patient and same data was collected from retrospective subjects.

Results: We observed that there was significantly decreased need for allogenic blood transfusion in cell saver group both intraoperatively as well as in immediate postoperative period. It was also observed that the total number of blood units transfused were significantly higher in control group in comparison to cell saver group.

Conclusion: It was concluded that the use of cell saver in repair of aortic aneurysm surgeries was beneficial for patients and decreased the need for allogenic blood transfusion and hence should be incorporated in these surgeries wherever feasible.

Keywords: Aortic Aneurysm; Autologous Blood Transfusion; Cell Saver; Dissecting Aortic Aneurysm; Open Surgical Repair.

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Introduction

The need for blood transfusion is indispensable to any major surgical procedures. Patients undergoing open surgical repair of aortic aneurysm and dissection have high bleeding risk. There has been a great concern due to increasing awareness of adverse effects of allogenic blood transfusion. Cell Salvage and Acute normovolemic hemodilution (ANH) has been proposed as an alternative to allogenic blood transfusion [1]. Cell salvage, also

known as autologous blood transfusion or intraoperative blood salvage, is a medical procedure that involves collecting and reinfusing a patient's own blood that is lost during surgery [2]. This technique helps to reduce the need for allogenic (donor) blood transfusions and can have several benefits for the patient. Allogenic blood transfusions come with certain risks, such as the potential for transfusion reactions, infections, and

other complications. Cell salvage offers an alternative approach by allowing the patient's own blood to be collected, processed, and reinfused back into their body. The desired red blood cells are separated and washed to ensure their quality before being reinfused back into the patient [3]. There are many advantages of intraoperative cell saver, some of major advantages includes decreased risk of transmission of diseases, reduced risk of alloimmunization, maintains a normal potassium concentration, eliminates the risk of transfusing wrong type of blood and does not have the risk of side effects from antifibrinolytic agents or coagulating factors but autologous blood transfusion with cell saver techniques can lead to dilutional coagulopathy as only normal saline is mixed with RBCs [4]. Extracted blood cannot be used for transfusion in case it gets mixed with amniotic fluid urine, bowel contents etc [7].

The purpose of this study was to evaluate the benefits of intra-operative usage of cell saver in terms of requirement of allogeneic blood transfusion in patient undergoing aortic aneurysm surgery, in intra-operative as well as post-operative period.

Aims and Objectives: The aim of our study was to measure the percentage of patients undergoing aneurysmal surgeries, requiring allogeneic blood transfusion during intra operative and immediate postoperative period in cell saver group and control group. We also aimed to measure the total number of blood units transfused in each group.

Material & Methods

After obtaining approval from institutional ethical committee, this observational retrospective, prospective study was conducted on the patients undergoing aortic aneurysmal surgeries, in Sher-I-Kashmir Institute of Medical Sciences Soura, Srinagar. Informed written consent was obtained from all participants.

Prospectively the data was collected from all the patients who underwent aortic aneurysmal surgeries, from MAY- 2022 to NOV- 2023 with intra operative usage of cell saver (cases). Retrospectively the data was collected from MRD section regarding the patients who have undergone aortic aneurysmal surgeries using cell saver over past 2 years (cases) and those patients who have undergone same surgery before 2020 when cell saver was not available (control).

A pre-operative assessment was done in all patients and base line investigations were collected. On arrival in operation theatre, patient was connected to multi-channel monitor. Pre-induction ABG was taken as 0 hour; Standard anesthesia technique was used in all patients.

During surgery blood from surgical field was

collected and let go through cell saver system if blood loss exceeds 500 ml. In case blood loss was <500ml, collected surgical blood was not processed through cell saver apparatus. When cell saver was used all recovered blood volume was re-transfused. Salvaged blood volume was converted into units by dividing by 300. Intra operative ABG was recorded hourly. Patients were divided into two groups.

Group 1: Cell saver group (CS group) included all the patients, prospective as well as retrospective, undergoing/ have undergone aortic aneurysmal surgery in whom cell saver was used.

Group 2: Control group (group C) included those patients who have undergone aortic aneurysmal surgery in whom cell saver was not used.

Allogeneic blood transfusion was given if hb <7gm% during intra operative and post-operative period. Patients were followed in post-operative period for 24 hours and requirement of blood transfusion was recorded in each patient and same data was collected from retrospective subjects.

Observations & Results

54 patients scheduled for aortic aneurysmal surgeries were included in this study. The patients were divided into two groups CS and C group. The two groups were found comparable with regards to the age .In both the groups we observed more males as compared to females which is suggestive of the fact that aortic aneurysm in more common in males as compared to females. Our findings are concordant with the literature.

Intraoperatively we made following observations; we found no difference with regards to the baseline characteristics like HR, CVP, And ETCO₂ between the two groups ($p > 0.05$). Also PH value, Po₂ value and bicarbonate value were found comparable between two groups ($p > .05$). Also the hemoglobin values were found to be comparable between the two groups at various intervals with only difference observed at 5 hour interval (higher hemoglobin levels being observed in cs group in comparison to c group). The Hct value between two groups was comparable at various intervals with higher hct values in cell saver at 3hrs and 5 hrs.

Postoperatively following observations were made:

Ph value was found to be comparable between two groups. The po₂ value was observed to be significantly better in cell saver group at 1 hours, 2 hours, 3 hours, 4 hours and 5 hours.

Bicarbonate value was found to be higher (more towards normal range) in CS groups at 0 hours, 1 hours, 2 hours and 3 hours.

There were significantly higher hemoglobin values in cell saver group at 2 hours, 3 hours, 4 hours and

5 hours. Similarly hematocrit values of CS group were observed to be higher in comparison to C group. There was statistically significant difference in allogenic blood transfused, cell saver group having less percentage of patients receiving allogenic blood transfusion. The difference was observed both intraoperatively (44 % in comparison to nil) and postoperatively (51% vs

3%). Furthermore we found in our study that Intra operatively no allogenic blood transfusion was given in cell saver group in comparison to total 20 units in control group and postoperatively one unit of allogenic blood transfusion was given in cell saver group whereas 48 units were infused in control group.

Demographic details

Table 1: Comparison of age (in years) of patients in two groups

Group	Mean	Age	SD	Range	P value
CS- group	29.7	45	3.175	40-70	0.437
C- group	30.23	48	1.96	40-65	

Table 2: Comparison of gender in between two groups.

Group	Total	Male	Female	% Male	% Female
CS- group	27	15	12	55.5	44.4
C- group	27	16	11	59.2	40.7

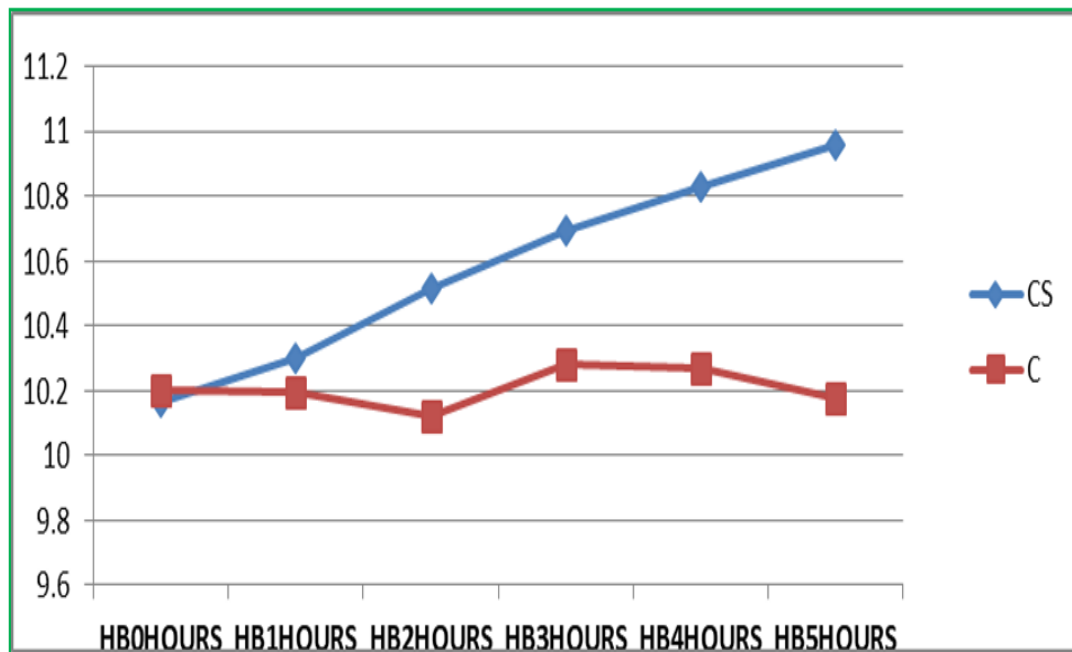


Figure 1: Comparison of post-operative Hb between two groups

Table 3: Comparison of percentage of patients receiving allogenic blood transfusion between two groups

Group Statistics				
	Group	Total no of patients	No of patients receiving allogenic blood transfusion	Std. Deviation
Intraoperative allogenic blood transfused	CS	27	0	Nil
	C	27	12	44%
Postop allogenic blood transfusion	CS	27	1	3%
	C	27	14	51%

Table 4: Comparison of total units of allogenic blood transfused between two groups.

Intra OP Allogenic Blood Transfusion	N	Total Units
CS	27	0
C	27	20 units
Post Allogenic Blood Transfusion		
CS	27	01 unit
C	27	48 units

Discussion

Repair of aortic aneurysms and dissections are surgical procedures involving high morbidity and mortality risk with a large volume of blood loss in the surgical field. High intraoperative blood loss and consecutive allogenic RBC transfusion are associated with severe pathological complications, such as immunomodulation, infectious and allergic complications, transfusion-associated lung injury, and circulatory overload. These complications result in an increased risk of respiratory failure, prolonged intubation, acute respiratory distress syndrome, wound infection, sepsis, cardiac events, increased length of hospital stay, and death [6].

Blood salvage strategies in individual patients, such as preoperative correction of underlying coagulopathy and anemia, have been proposed to reduce allogenic blood donation. Moreover, the use of intraoperative cell salvage demonstrated a significantly positive effect on reducing blood transfusion [7]. The cell saver device was developed, in order to regain the lost blood and to reduce the volume of transfused allogenic blood products. Autologous blood is normothermic, cheap, and has better oxygen carrying capacity compared to banked blood. Additionally, the complications associated with the transfusion of banked blood can be avoided. However, auto transfusion requires adequate equipment and trained personnel and involves disadvantages, such as coagulopathies, hemolysis, embolism and bacterial contamination [8].

The blood aspirated from the surgical field is mixed with anticoagulants (heparin), washed using an isotonic solution, filtered, concentrated and returned to the patient. Hence, the toxic products in the aspirated blood and procoagulants in the surgical field are removed. Nevertheless, the process also involves the loss of platelets, plasma proteins and coagulation factors. The hematocrit value of the blood obtained by means of a cell saver device is approximately 55%–70% and is similar to that of banked blood (55%–80%). However, the quality of the blood obtained through the cell saver device is better, on account of the fact that in the banked blood, 95% of the 2,3-Diphosphoglycerate (DPG) levels are exhausted after 2 weeks and are almost completely depleted after 3 weeks. Moreover, in the banked blood, the shift of the oxyhemoglobin dissociation curve to the left makes the release of oxygen from haemoglobin into the tissues difficult. Consequently, the oxygen-carrying capacity of the fresh blood obtained using the cell saver device is better [9]. Additionally, the blood obtained using a cell saver device has better deformability with reference to the passage through small capillaries, compared to the banked blood [10]. Blood obtained

via cell saver device has a lower rate of hemolysis and a lower risk of citrate-related deep hypotension, decreased contractility and vasoplegia in situations involving the transfusion of excessive erythrocyte suspension, as the blood obtained using the cell saver device does not contain citrate [11]. Repeated centrifugation of the blood causes depletion of platelets and coagulation factors. Processing a large amount of blood with cell saver may lead to depletion coagulopathy and massive bleeding.

In the present study, the use of cell saver did not provoke thrombocytopenia. Mean 300mL of thrombocyte suspension was given to the patients in both the groups [12]. In our study we aimed to investigate the effectiveness of cell salvage for minimizing intraoperative and postoperative allogenic blood transfusion in patients undergoing aortic aneurysmal surgeries. In this study during the **intraoperative period** we found no difference with regards to the baseline characteristics like HR, CVP, And ETCO₂ between the two groups. Also PH value, Po₂ value and bicarbonate value were found comparable between two groups. Also the hemoglobin values were found comparable between the two groups at various intervals with only difference observed at 5 hour interval (higher hemoglobin levels being observed in cs group in comparison to c group). The Hct value between two groups was comparable at various intervals with higher hct values in cell saver at 3hrs and 5 hrs.

Postoperatively following observations were made:

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Our study is in concordance with Amanvermez Senarlan et al. 2021[8] who in their study found that there was a significant association between the use of cell savers and the decreased need for red blood cell and total blood product transfusions. Our study is in concordance with Cataldi et al 1997[13] who in their study found that Autologous blood transfusions were demonstrated to be safe in patients undergoing intracranial surgery and to be more cost-effective than allogenic blood transfusions.

Our study is also in concordance with Mandhari et al 2015[14] who in their study titled suggest that intraoperative cell salvage with a cell saver in patients undergoing primary elective coronary artery bypass decreases the proportion of patients exposed to allogenic red cell transfusions and the number of units of red blood cells transfused.

Conclusion

We observed that there was significantly decreased need for allogenic blood transfusion in cell saver group both intraoperatively as well as in immediate post-operative period. It was also observed that total number of blood units transfused was significantly higher in control group in comparison to cell saver group. Therefore, we concluded that use of cell saver in repair of aortic aneurysm surgeries was beneficial for patients and decreased the need for allogenic blood transfusion and hence should be incorporated in these surgeries wherever feasible.

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