Comparative Evaluation Of Autologous Versus Allogenous Blood Transfusion Following Traumatic Hemothorax And Hemoperitoneum

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Citation

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Abstract

Context: Following the rising incidence of trauma leading to increased demand of homologous blood, cell saving machines are being used at trauma centers in developed countries for procuring autologous blood for transfusion. However, in developing countries like India with limited infra-structure facilities, a simple but safe and efficient technique of autotransfusion is required.

Aims: To assess the safety of autotransfusion using a low cost micro-fine filter and to compare the feasibility, complications and cost of autotransfusion vis-à-vis routinely performed allogenous transfusion in cases of trauma.

Settings and Design: A prospective randomised study conducted in a tertiary care centre.

Methods and Material: Forty cases of hemothorax and/or hemoperitoneum.
undergoing emergency surgery were randomly assigned to study and control groups based on whether they received autologous or allogenous blood respectively. In the study group, the shed blood was collected in a heparinised chest bag and then autotransfused using a low cost micro-fine filter. All cases in both groups were monitored for any transfusion reaction and post-transfusion complications.

Statistical analysis used: Fischer's exact test for ordinal variables and independent 't' test for nominal variables.

Results: On statistical analysis, pre-operative clinical and biochemical parameters were found to be comparable among the two groups. The incidence of deranged coagulation profile, post-operative clinical jaundice and wound complications was significantly lower in study group cases ($p<0.05$) whereas the costs of transfusion, manpower and time required were significantly higher in control group cases ($p<0.05$).

Conclusions: Autotransfusion in cases of hemothorax and hemoperitoneum using low cost micro-fine filter is safe and feasible. It is associated with significantly less post-transfusion complications in comparison to routinely performed allogenous transfusion.

INTRODUCTION

Trauma to the thorax and abdomen resulting in acute blood loss is a major cause of mortality among patients admitted in the emergency department. The major causes of injury to the chest and abdomen are motor vehicle accidents in more than 50% of cases.[1] As per our hospital records about 40 % of the trauma patients admitted in emergency have significant injuries to the chest, abdomen or both and about 50 % of these require blood transfusion which is mostly obtained from allogenous blood kept in the blood bank. Due to the recent automobile boom along with rapidly increasing population in third world countries like India, there is a significant increase in high velocity road traffic accidents. This has increased the number of trauma admissions in the emergency department leading to increased burden on the hospital blood bank for homologous blood.

With technological advances in the field of transfusion medicine autologous blood processed in cell saving machines has been used in cardiac and orthopedic surgery for many years. Apart from the distinct advantage of easy

availability of blood, the risk of transmitting dreaded infections like AIDS is ruled out in these cases. The properties of an ideal autotransfusion device include rapid assembly, relatively low cost, ease of operation, in line filtration, minimized air blood interface, simplified anticoagulation, and safety from air embolism and coagulopathies.[2] The importance of removing microemboli from autotransfused blood using microfilters is vital to prevent microemboli from clogging the microcirculation in all organs and tissues especially in the lungs.[3] Today, two systems for autotransfusion are available commercially operating on two different principles. In the first type, the anticoagulated blood processed with saline washes is centrifuged to reach an end product consisting of packed red cells suspended in saline (Hemonetics cell saver system, IBM cell washer, Dideco machine).[4] In the second type it consists of a collapsed plastic liner containing ACD solution, fitted with a filter within a rigid canister (Sorenson's receptaseal and Solocotrans autotransfusion systems).[5,6]

To meet the increasing demand of blood, the concept of autologous blood transfusion has also been introduced in the emergency department with the practice of transfusing the patient's own blood collected in the pleural and peritoneal cavities. Presently, in the developed countries cell saving machines are routinely in use in trauma centers.[7,8,9,10,11] In a country like India the concept of trauma center is relatively new and most of the existing trauma care facilities are part of the tertiary care hospitals. Even in these centers expensive modern equipment is not available due to lack of funds. Thus the concept of autotransfusion using cell savers in trauma patients can not be implemented in the present circumstances. Moreover autotransfusion during emergency surgery in countries like India is not established due to following reasons:

- Apprehensions regarding safety and efficacy of this procedure among anesthetists and surgeons.
- Risk of contamination during emergency surgery.
- The need to modify emergency laparotomy protocols to collect and transfuse autologous blood.

In this existing scenario, a simple, safe, affordable and efficient technique for autotransfusion is required that can be used even at peripheral centers having primitive infrastructure.

SUBJECTS AND METHODS

The present study was conducted as a prospective randomized controlled clinical trial in the emergency unit of the department of surgery in Pt. B.S. Sharma, PGIMS, Rohtak over a period of two years (2003 and 2004). This institute caters mostly to the poor patients with agriculture background from rural northern India. The study included 40 cases of traumatic hemothorax and hemoperitoneum, who underwent surgical intervention. Those cases presenting within 24 hours of injury and with estimated blood loss of more than 500 ml were included and those with gross fecal contamination, bacterial peritonitis and intra-abdominal abscesses were excluded from the study.

The patients were divided randomly into two groups of 20 each depending upon the type of transfusion they received. The two groups were matched as closely as possible for age, sex, and preoperative status. During the postoperative period, the same parameters were recorded and compared in the two groups.

AUTOTRANSFUSION GROUP (GROUP A)

In this group, autotransfusion was given to all the patients. Initial resuscitation at the time of admission was done with Ringer lactate solution and plasma expanders. In patients presenting with hemothorax, blood was collected in the chest bag after inserting the chest tube. For every 1000 ml of shed blood, 200 IU of heparin were added to the chest bag. In cases of hemoperitoneum, immediately after opening the abdomen, the blood from the peritoneal cavity was manually aspirated by the second assistant using Toomey's syringe and collected in a bowl to save collection time. During aspiration, the tip of the syringe was kept beneath the blood level so as to avoid red cell hemolysis. The collected blood was transferred to the heparinised chest bag using the same syringe. For transfusion a micro-fine filter was connected to the heparinised chest bag containing shed blood and after clearing the air column from the filter set, the transfusion was started (Fig. I, Fig. II).

ALLOGENOUS BLOOD TRANSFUSION (GROUP B)

In this group, twenty patients received allogenous blood transfusion only, as being done routinely.

Most of the blood transfusions were carried out in the emergency operation theatre either in the intra-operative or immediate postoperative period. Before transfusion, 10 ml of blood were taken from the transfusion bag in all the cases for

complete hematological evaluation and culture and sensitivity testing. During transfusion all the cases were carefully monitored for vital signs including pulse, blood pressure and respiration, chest auscultation for any bronchospasm and appearance of any skin rash. Symptoms and signs constituting minor transfusion reactions were defined as fever with rigor and chills, generalized cutaneous wheals, erythema and tachycardia but without any fall in blood pressure or chest spasm. Symptoms and signs constituting major transfusion reactions included alteration in level of consciousness, bronchospasm, fall in blood pressure and back pain leading to shock and oliguria. In the event of any anaphylactic reaction, transfusion was discontinued immediately and antihistaminics and steroid injections were given to the patient. In group B cases, the remaining blood was sent to the transfusion department to check for any mismatched transfusion.

All the patients were put on broad-spectrum antibiotic coverage. In the post-infusion period blood culture and sensitivity, prothrombin time and index, blood urea nitrogen, serum electrolytes, fibrin degradation products and liver function tests were done on the second post-infusion day. All the cases were clinically monitored for fever, jaundice and wound infection and appropriate investigations were done accordingly.

The pre-operative, intra-operative and post-operative clinical and biochemical data along with manpower requirement, time spent and cost incurred on transfusion in both of these groups were compared using Fischer's exact test for ordinal variables and independent ‘t' test for nominal variables.

RESULTS

The two groups were comparable in terms of age, sex ratio, etiology of trauma and preoperative general condition (shock at presentation, hematocrit, leukocyte count, platelet count and blood urea nitrogen) (Table-1). Most of the patients were males in age group 11 to 40 years.

Figure 1

Table 1: Comparison of preoperative and intraoperative variables of the two groups

Variable	GroupA (n=20)	Group B (n=20)
1. **Age**		
<10years	0	2
11-40 years	15	16
>40 years	5	2
2. **Sex**		
Male	15	18
Female	5	2
3. **Primary source of bleeding**		
a. Hemothorax	6	1
b. Hemoperitoneum	13	18
c. Both	1	1
4. **Mode of trauma**		
Blunt trauma	14	17
Penetrating trauma	6	3
5. **Hemodynamic status**		
Normal	4	5
Shock	16	15
6. **Time interval b/n injury and autotransfusion**		
<12 hours	13	14
>12 hours	7	6
7. **Volume of blood transfused**		
<2 L	15	13
>2 L	5	7
8. **Severity of injury**		
Severe	17	16
Moderate	3	4
9. **Amount of blood loss**		
<2L	6	10
>2L	14	10
10. **Duration of surgery**		
<2 hours	13	12
>2 hours	7	8

Clinical and operative assessment showed that there were 17 severe-grade organ-specific injury patients in the study group as opposed to 16 in the control group ($p>0.05$). The operating time was prolonged (> 2 hours) in seven patients in the study groups and in eight patients in the control group. However, the over all operating time was comparable in both the groups ($p>0.05$). The majority of the patients in the study group as well as in the control group underwent laparotomy for splenic and liver injuries. The type of surgical procedures performed in patients of the two groups was comparable (Table 2).

Figure 2

Table 2: Operative procedures

	Study Group.(n=20)	Control Group(n=20)
Splenectomy	4	9
Repair of liver tear	4	6
Chest tube placement	7	4
Salpingoophorectomy	4	0
Repair of stomach tear	1	2
Repair of bladder tear	0	1
Mesenteric repair	0	2
E.L. with primary closure of jejunal perforation	1	1
NB: E.L. = Exploratory laparotomy		

The amount of blood loss was calculated by measuring the volume of blood collected in the drainage bags, suction bottle and soaked abdominal sponges (80ml/sponge). Fifteen cases in the study group and seventeen in the control group had more than 1.5 liters of blood loss. The mean amount of blood loss in the study group was 2.385 ± 0.22 liters and in the control group it was 2.350 ± 0.23 liters which was comparable (p>0.05). Blood culture of the transfused blood was sterile in all the cases. The mean volume of transfused blood was 1.74 ± 0.28 liters in the study group and 1.83 ± 0.23 liters in the control group (p>0.05).

POST-TRANSFUSION REACTIONS

Except two patients, all the patients in the study group tolerated autologous transfusion remarkably well. One patient developed a minor transfusion reaction probably due to microscopic contamination of shed blood in the peritoneal cavity with the contents spilled from ruptured small gut. The second patient had systemic reactions on starting autologous blood. In this patient autologous blood was kept in the chest bag without refrigeration for 12 hours due to heavy emergency workload. This patient had febrile reaction with features of systemic anaphylaxis in the immediate post transfusion period. The blood culture was reported as sterile. The possible cause of such a reaction could be systemic anaphylaxis by polysaccharide antigens produced by bacterial overgrowth in the collected blood.

In the control group two patients had developed minor cross-match reactions in the immediate post operative period. Major cross-match reactions in the intra-operative period were seen in two patients who had an episode of hypotension and urticaria immediately after starting transfusion as reported by the anesthetist. The transfusion was stopped and injection pheniramine maleate and dexamethasone were given in all the cases. However there were no major transfusion reactions that could be attributed to ABO and Rh incompatibility due to clerical error. The difference in the incidence of major and minor cross match reactions between the study and the control group was found to be statistically insignificant (p>0.05).

HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS

The mean post-transfusion hemoglobin was 10.36 ± 3.8 gm% in the study group (compared to the mean preoperative hemoglobin of 8.7 ± 3.6 gm%) and 9.57 ± 2.72 gm% in the control group (compared to the preoperative hemoglobin of 8.36 ± 3.96 gm%). Although there was significant improvement in the hemoglobin after transfusion in both groups, the difference in the values of postoperative hemoglobin was not significant among the two groups (p>0.05).The majority of the patients in the study as well as control groups had total leukocyte count in the normal range after transfusion. However the majority of the patients had raised polymorphs in both groups possibly due to polytrauma or due to splenectomy. However, values of total and differential count were comparable in both groups (p>0.05). One patient in the study group and two patients in the control group had subnormal platelet counts (<1.5 lacs/cmm) possibly due to polytrauma requiring multiple transfusions. However, the values of the platelet count after transfusion were comparable among the two groups (P>0.05).

The majority of cases in both groups had normal values of renal function parameters after transfusion and were comparable (p>0.05). One patient each in the study and the control group had significantly raised blood urea nitrogen levels which responded to fluid resuscitation. Prothrombin index (PTI) was measured as patient/control ratio (control value being 11.5-13.5 sec) in percentage. Prothrombin index was considered deranged if this ratio was less than 75%. Twelve patients in the control group as compared to seven patients in the study group had deranged coagulation profile (PTI) after transfusion and this difference was statistically significant (p<0.05).

Patients were monitored for clinical jaundice in the postoperative period and postoperative estimation of the serum bilirubin and SGOP/SGPT estimation was done. On analyzing the reports, it was observed that out of five patients in the study group with jaundice, severe liver trauma

(grade IV and V) in three cases and huge abdominal wall hematoma (leading to hemolysis) in one case were responsible for jaundice. In the control group, out of six cases with jaundice only one had severe liver trauma (grade V). So in the remaining one case of the study group and five cases of the control group having jaundice, the possible cause of jaundice was transfusion induced hemolysis. This difference in the incidence of jaundice was found to be statistically significant ($p<0.05$). Raised SGOT/SGPT levels were seen in 4 cases of the study group (20%) and 5 cases of the control group (25%). The difference was not statistically significant ($p>0.05$).

Fibrin degradation products (FDPs) were found to be raised in four patients in the control group and none in the study group. However, the difference was not found to be statistically significant ($p>0.05$).

POST-OPERATIVE COMPLICATIONS

Prolonged bleeding was defined as persistent bleeding through the chest or abdominal drain measuring more than 200ml/24hrs for >3 days. Three patients each in the study and control group had prolonged bleeding in the postoperative period possibly due to polytrauma and unrelated to type of transfusion.

All the wounds (abdominal, thoracic, scalp, face, limbs etc.) were dressed daily and in case of excessive wound discharge and soakage dressing was done twice a day. The wound discharge was sent for culture and sensitivity. In case of sterile discharge, it was labeled as wound seroma. In case of purulent discharge with positive bacterial growth on culture, it was labeled as wound infection and antibiotics were changed according to the sensitivity report. If fresh bleeding with clots was observed in the wound, it was labeled as wound hematoma. The difference in the overall incidence of wound complications among the two groups was found to be statistically significant using Fischer's exact test ($p<0.05$) (Table 3).

Figure 3

Table 3: Wound complications

Wound complications	Study group (A)	Control group (B)
Seroma	1	5
Hematoma	0	2
Infection	0	1
Dehiscence	0	1

None of the patients in the study group and two patients in the control group developed urinary tract infection and the difference was not statistically significant ($p>0.05$). The average duration of hospital stay was 10.45 days in the study group and 11.35 days in the control group and was comparable ($p>0.05$). One patient in the study group and none in the control group died in the post-operative period. This patient had polytrauma including the chest and abdomen (grade V liver tear) and limb fractures. The cause of death was prolonged shock leading to multi-organ failure unrelated to autotransfusion.

MANPOWER, TIME AND COST

In the control group all the patients were transfused allogenous blood. The job of transfusing the blood after checking the labels was done by staff nurses in the emergency ward and by anesthetists in the operation theatre as being done routinely. It did not require any additional manpower. However, another aspect of allogenous blood transfusion is blood collection, testing for infections like viral hepatitis, HIV, storage and cross matching before transfusion. It requires transfusion technicians, medical officers and a blood bank that operates 24 hours a day. On calculation, it was observed that it required five persons at a time and 45 minutes in our setup for preparing allogenous blood for one patient.

In the study group, autotransfusion was done in patients of hemothorax after intercostal intubation. The resident surgeon was able to transfuse collected blood from the chest bottle with the help of a staff nurse. In patients with hemoperitoneum, autotransfusion was done after opening the abdomen and collecting the blood in a chest bag with Toomey's syringe . This required additional manpower in the form of a resident surgeon and a staff nurse. However, after the initial five patients, the attending anesthetist and a staff nurse were trained to perform the autotransfusion without help of the resident surgeon.

It took about 20 minutes on an average for opening a case of hemoperitoneum after diagnosis including the time it took to shift the patient to the emergency theatre. Then it took an additional 5 minutes for collecting the blood from the peritoneal cavity and to start autotransfusion making it a total of 25 minutes from diagnosis to start of autotransfusion in the study group. Whereas it took about 15 minutes for collecting blood sample and sending requisition to the blood bank, a minimum of 45minutes to cross match and issue the blood requested by a fully operational blood bank and an

additional 5 minutes to start the transfusion making it a total of 65 minutes from diagnosis to transfusion in the control group. It was observed that significantly more manpower and time were required in the cases of the control group as compared to study group cases ($p<0.05$).

The cost of blood transfusion in both the study and control groups was compared. The cost for allogenous blood transfusion was approximately 500 Rupees per unit (500ml) which included collection, cross matching and the transfusion set. In autotransfusion the cost includes the cost of chest bag (150 Rupees) and the microfine filter (150 Rupees).The Toomey's syringe cost was about 400 Rupees, but it could be reused several times after sterilization in glutaraldehyde solution. For the first liter of blood transfusion initial cost was 300 Rupees in the study group and 1000 Rupees in the control group. For every subsequent liter of blood transfusion, there was no extra cost for autotransfusion in the study group and an extra cost of 1000 Rupees for the control group. Thus the average cost of transfusion per patient in the study group was 300 Rupees (mean volume transfused 1.74 liters) and in the control group it was 1830 Rupees (mean volume transfused 1.83 liters) and the difference was statistically significant ($p<0.05$).

DISCUSSION

The present study was aimed at comparing the safety, feasibility, acceptability and cost effectiveness of autotransfusion vis-à-vis routinely performed allogenous transfusion. The shed blood was collected in a chest bag and a low cost micro-fine filter was used for autotransfusion in selected cases of hemothorax and hemoperitoneum.

The majority of the patients included in the study were young males. A similar pattern of injury involving young males was observed in another recently performed study on 423 subjects from central India.[12] However, most of the studies from the west show almost equal ratio of males and females with slight male preponderance[9,13,14] (Table 4a, 4b).

Figure 4

Table 4a: Age Distribution

Study by	Mean age (in years)
Mattox et al (1975)[14]	30.00
Horst et al (1992)[13]	30.00
Cavallieri et al.(1994)[11]	37.00
Smith R .S et al (1995)[9]	32.00
Zantut et al (1996)[10]	29.00
Present study (study group)(2005)	32.90
Present study (Control group)(2005)	27.30

Figure 5

Table 4b: Sex Distribution

Study by	Males	Females	Total
Mattox et al(1975)[14]	69	59	10
Horst et al (1992)[13]	154	135	19
Smith et al(1995)[9]	133	111	22
Ganveer et al (2005)[12]	363	60	423
Present study(2005) (Study group)	15	5	20
Present study (2005) (Control group)	18	2	20

This is possibly due to the fact that males in India are more prone to accidents since they are mostly bread winners of the family having outdoor activities while females stay at home. As evident from the observations, various parameters viz. etiology and severity of trauma, hemodynamic status, hematological values, renal functions, amount of blood lost, duration between injury and autotransfusion, volume of transfusion, culture of transfused blood, duration and type of surgery were comparable in the two groups and hence unlikely to alter the effects of transfusion and postoperative complications related to the type of transfusion.

On comparing the post-transfusion reactions, it was seen that 2 patients (10%) in the study group had post-transfusion fever while in the control group four patients (20%) had post-transfusion reactions ($p>0.05$). Two out of these four cases in the control group had minor cross-match reactions while the remaining two had systemic adverse reactions related to multiple blood transfusions. There was significant improvement in hemoglobin and hematocrit values after transfusion in both groups. However, the change in the values when compared between the two groups was not statistically significant. It indicates that the patients in the study group had equally good recovery of the lost blood volume when compared to the control group. However, a fall

in the levels of mean hematocrit value after autotransfusion has been observed in the past possibly due to use of cell saver machines which cause hemodilution from the priming solution.[11,15]The majority of the patients in both groups had total leukocyte counts in the normal range after transfusion. However, autotransfusion using semi-automated machines is known to decrease the leukocyte count both experimentally as well as clinically.[16,17,18] This is because leukocytes tend to clump during the salvage process using autotransfusors and are then filtered during transfusion. The possible reason for normal leukocyte count following autotransfusion in the present study was minimal processing of salvaged blood thus preventing leukocyte clumping.

In the present study the platelet count measured on the first postoperative day was normal in all except one patient in the study group and two patients in the control group and was comparable. The possible cause of subnormal platelet count in these cases was polytrauma requiring multiple transfusions. Large volume of autotransfusion in trauma patients is known to cause platelet dysfunction.[19] Various factors responsible for platelet dysfunction are high heparin dosage for anticoagulation and elevated levels of fibrin degradation products (FDP) leading to increased likelihood of bleeding diathesis.[15,19] In the present study the collected blood was heparinised with a low dose of heparin (100-200 units per litre) and none of the patients had elevated FDP in the postoperative period in the study group, which could explain the normal platelet function in most of the cases.

As assessed with the urine output, blood urea and serum creatinine estimation, postoperative renal function was normal in all except one patient each from the study and control group. In these two cases, renal function improved after fluid resuscitation suggesting hypovolemia and dehydration as a cause. Various studies have indicated that the chances of renal failure following transfusion of unwashed blood containing hemolysed cells are high especially in dehydrated patients.[4,20]But in most instances these values return to normal after the first postoperative day as happened in the patients of the present study.[14]

Twelve patients (60%) in the control group as compared to seven patients (35%) in the study group had deranged coagulation profile (PTI) and the difference was statistically significant ($p<0.05$). However in cases of polytrauma, coagulation profile can be deranged due to other factors also, viz, severe liver injury [21]and large volume of blood transfusion.[13] Analyzing these parameters in relation to subnormal PTI, it was observed that severe liver injury patients were comparable (four patients each in the two groups). The possible reason for the significantly higher number of cases with deranged coagulation profile in the control group was use of autologous stored blood.

Postoperative serum fibrin degradation products (FDP) were estimated on the second post operative day in all the cases of both groups. No patient in the study group and four patients (20%) in the control group had raised FDP levels in serum. Studies have demonstrated that patients with a raised FDP value following autologous blood transfusion were at risk of developing disseminated intra-vascular coagulation especially if the amount of blood autotransfused exceeds five litres.[22] Raised titres of FDP are also present in circulation in the setting of massive allogenous blood transfusion.[23,24] In the present study, four cases of the control group had raised FDP titre but none had features of DIC, possibly because these patients did not require massive transfusion (>5 litres).

Liver function tests (serum bilirubin, SGOT/SGPT) were done in all the patients. Four patients in the study group and one patient in the control group having jaundice and altered liver functions had severe liver injury. In the remaining one patient of the study group (5%) and five patients(25%) of the control group having jaundice and altered liver functions, the possible cause was transfusion induced hemolysis and the difference was statistically significant ($p<0.05$).

On comparing the wound infection no patient in the study group and one patient in the control group (5%) developed post operative wound infection, although the difference was not statistically significant ($p>0.05$). Immunosupression as a consequence of allogenous blood transfusion is known to be associated with increased frequency of postoperative bacterial infections.[25]A definite relationship has been seen between allogenous blood transfusion and postoperative bacterial infection in a meta-analysis of twenty peer received articles between 1986 and 2000.[25] The causative factor(s) for allogenous blood transfusion induced immunosupression remain(s) undefined. But some investigators have implicated leukocytes[26], whereas others have implicated plasma components of blood.[27] Regardless of the mechanism, this immunosuppressive effect of blood transfusion is not seen with autologous blood transfusion, and it is helpful in increasing the hemoglobin concentration without unwanted immunosuppressive effects.[28,29]

Many institutions in developed countries use semiautomated

systems to process autologous blood before reinfusion. A trained operator is needed to run the instrument. Even with the newer automated models, the operator should have no other responsibilities during surgery. Keeling et al. in their experience of 725 consecutive cases requiring autologous intraoperative transfusion employing Hemonetics cell saver observed that an expert medical technologist when used for this purpose is of great advantage and can free the surgeon, the anesthetist and the nurses from this job.[4] In the present study, two persons (one resident surgeon and one staff nurse) were able to manage the process of autotransfusion in the study group. On the other hand, allogenous transfusion, on an average required five persons including blood bank personnel for the whole process. As far as time required for the process of transfusion is concerned, average time in study group patients was 25 minutes, while in the control group it was 65 minutes ($p<0.05$). In the present study, on an average 5 minutes were spent in blood collection and starting autotransfusion.

The average duration of hospital stay was 10.45 days (range 5-20 days) in the study group and 11.35 days (range 6-20 days) in the control group and was comparable. Four cases in the study group and four cases in the control group had prolonged stay (>2 weeks) and all of them had severe injury requiring multiple transfusions. It has been observed that the hospital stay had a linear relationship with the severity of injury and the volume of blood transfused.[30]In another series of laparoscopically managed trauma cases with autotransfusion, the mean duration of stay was only 3.1 days obviously because of inherent advantage of minimal access surgery.[9]

On comparing the cost of transfusion it was observed that the cost of one litre of allogenous blood transfusion was more than three times that of the equal volume of autologous blood transfusion. The total cost of transfusion per patient in the study group and the control group was Rs1176 and Rs1810 respectively and the difference was statistically significant ($p<0.05$). In a study of autotransfusion using Haemonetics cell saver in 126 abdominal trauma patients the operational cost was $63,252.00 and the blood bank equivalent was $114,523.00 and the difference was $51,271.00. An average of $407.00 was saved using autologous blood transfusion.[7] As obvious from the results of the previous as well as the present study, autotransfusion significantly reduces the cost of transfusion when compared with allogenous blood transfusion.

In conclusion, autotransfusion using a low cost micro-fine filter has been demonstrated to be feasible, safe and practical in selected trauma patients in our set-up. While autologous blood transfusion using this technique was comparable with that of pure allogenous blood transfusion in replacing the hemoglobin concentration and hence the oxygen carrying capacity in trauma patients in shock, it was superior to allogenous blood as it caused a lower incidence of deranged coagulation profile, postoperative clinical jaundice and wound complications apart from avoiding the risk of deadly infections (HIV, Hepatitis B, C etc.). Moreover, the average cost of transfusion as well as requirement of manpower and time was significantly reduced following autotransfusion. After seeing the feasibility and advantages, routine use of autotransfusion in patients with hemothorax and hemoperitoneum (without gross gut contamination) following trauma can be recommended. However, further larger trials are needed to establish this procedure since the technique has been tried in a small number of cases.

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