Blood salvage after total hip and total knee arthroplasty

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We performed a prospective study to determine the effect of postoperative collection and reinfusion of unwashed, filtered, salvaged blood alone and in combination with preoperative predeposited blood on the transfusion requirements of 375 patients treated with a total hip or total knee replacement. 208 patients were managed with postoperative blood salvage with use of the CBC ConstaVac autotransfusion system and closed suction drainage. Another 50 patients predeposited 1–4 units of autologous blood, before the operation, in addition to postoperative blood salvage. The remaining 117 patients were used as controls and were transfused with homologous blood from the blood bank. Postoperative reinfusion of salvaged blood decreased the need for homologous transfusion after hip and knee arthroplasty (mean 2.7 units) compared to controls (mean 4.2 units). The combination of postoperative reinfusion of salvaged blood and predeposited autologous blood was associated with the lowest requirements for homologous blood transfusions (mean 1.7 units).

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Orthopedic procedures, such as total hip and total knee arthroplasty, are usually associated with a need for a transfusion of red blood cells to replace blood loss that occurred intra- and postoperatively. However, homologous blood transfusion introduces a significant risk to various factors, including transmission of hepatitis, HIV, anaphylaxis, among others. As a result, a pronounced effort has been made towards diminishing, if not eliminating, the use of homologous blood transfusions for trauma and reconstructive procedures in orthopedics.

Since the 1980s, the effort to reduce the need for transfusion of homologous blood has led to the introduction of various methods of collecting and using autologous blood. Today, four different types of autologous blood procedures can be generally defined. The preoperative collection of autologous whole blood or plasma from the patient 42–44 days prior to the scheduled procedure has been reported to decrease the need for homologous transfusion following total hip replacement (Thomson et al. 1987, Woolson et al. 1987, Kay and Noble 1990, Birkmeyer et al. 1993, Biesman et al. 1994). Preoperative deposition of autologous blood can be used to collect 3 to 5 units or, in some cases, even up to 10 units for later use (Thomson et al. 1987, Woolson et al. 1987, Flecknoe et al. 1995). Another method for decreasing the need for homologous blood, is isovolemic hemodilution which involves the deposition of 1–2 blood units immediately before surgery with the concurrent replacement of the autologous blood along with colloids and crystal infusions in order to restore the blood volume (Stehling and Zauder 1994). Thirdly, there have reports of the successful use of intraoperative collection of blood with cell savers and retransfusion during the surgical procedure (Law and Wiedel 1989, McMurray et al. 1990, Elawad et al. 1991). Finally, postoperative collection of blood in closed systems with continuous suction from the trauma under absolute aseptic conditions has been effective in decreasing the prevalence of homologous transfusion (Ayers et al. 1995, Farris et al. 1991, Clements et al. 1992, Xenakis et al. 1995).

The present study was performed to determine prospectively, the effect of postoperative collection and reinfusion of unwashed, filtered, salvaged blood alone and in combination with preoperative predeposited blood on the transfusion requirements of 375 patients treated with a total hip or total knee replacement.

Patients and methods

From 1992 through 1996, 375 patients undergoing total hip or total knee arthroplasties were divided into three groups according to method of blood loss man-

agement. Group A (control) consisted of 117 patients who underwent total hip or total knee arthroplasties and who were given only homologous blood transfusions. Group B was comprised of 208 patients who were managed with autologous blood transfusion with postoperative blood salvage from the wound. Group C, 50 patients, donated autologous blood preoperatively, in addition to postoperative blood salvage from the wound for autologous transfusion. The patients donated 4 units of blood, from 4 to 42 days preoperatively with 1 unit (450 mL)/week.

All patients who were managed by autologous transfusions were previously evaluated by the blood bank to determine whether they met criteria for a volunteer blood donor, as established by the Greek National Blood Bank System. All patients were supported with iron supplement.

Prophylactic antibiotics were administered to all patients preoperatively. Specifically, second generation cephalosporin was initiated 12 hours before the surgical procedure and was continued for 48 hours postoperatively. Prophylactic anticoagulation therapy was also given and included either low dose heparin or low molecular weight heparin. Anticoagulation therapy was continued until the end of the third postoperative week.

Blood collection for postoperative blood salvage for patients in groups B and C was performed using the CBC Consta Vac (Stryker instruments Michigan USA) closed autotransfusion collection system with normal saline. Blood collection was performed during the first 6 postoperative hours without the administration of anticoagulants. Autologous blood was collected in a specially designed canister, and was then subsequently transfused through a blood transfusion sac. If less than 100 ml of autologous blood was collected, blood transfusion did not take place and the autologous blood was discarded. Segments of the silastic tubing from the autotransfusion device were sent for microbiologic analysis, including gram staining. Salvaged blood was stored in the blood bank and was transfused, only if the tests were negative.

Results

Group A (Control) was comprised of 117 patients, 101 women and 16 men, with a mean age of 62 (42–78) years. 79 patients underwent total hip arthroplasty, while 38 were treated with a total knee arthroplasty. Patients with total hip arthroplasty were transfused with mean 4.5 (1–8) blood units, while total knee arthroplasty was associated with the use of mean 3.5 (1–10) units of homologous blood.

Group B had 208 patients, 188 women and 20 men, with a mean age of 61 (23–81) years. In this group, 161 autotransfusion devices were used at a mean rate of 335 mL per apparatus. Autologous blood collected from 50 devices was not transfused, either because the quantity collected was less than 100 mL (n=41) or positive gram staining upon microbiologic evaluation (9). Patients of the latter group were transfused with additional homologous blood (mean 2.7 units), while in 11 patients no additional blood transfusion was needed.

Group C had 50 patients, 36 women and 14 men, with a mean age of 48 (20–68) years. An average of 325 mL were collected from each autotransfusion device, postoperatively. In addition, the patients of this group had donated between 1 and 4 units of blood preoperatively (mean 2.8 units). 11 patients of this group who had donated an average 1.2 (1–2) units required an additional homologous blood transfusion of 1.7 units per patients. In the remaining, 39 patients no additional blood was needed for transfusion, as the patient had previously donated 2.8 units of autologous blood and consumed on average, only 2.4 units. As a result, a total of 21 blood units were left to the blood bank for a donation.

From the 266 autotransfusion devices used in patients from Groups B and C, 52 units of autologous blood was not used for transfusion. In 42 units, the quantity of blood collected was less than 100 ml, 1 showed thrombus formation after blood filtration, and in the remaining showed positive gram staining. Of the 223 autotransfusion devices, 9 (4%) showed positive gram staining of the tubing section analyzed. Upon subsequent microbiologic analysis of the blood, however, the blood sample was found to be negative. On the other hand, of the remaining patients whose tubing was gram negative, 17 showed positive staining in the collected blood (Table 1).

Evaluation of the autologous blood samples collected by autotransfusion setups showed no abnormality in blood composition or blood factors. Sample

Table 1. Results of microbiological assessment of positive autologous blood samples

Staphylococcus coag. (–)	9
Staphylococcus cohnii	1
Staphylococcus simulans	1
Corynobacterium sp	1
Micrococcus spp	1
Aspergilus spp	2
Acinetobacter anitr.	1
Staphylococcus epid + Streptococcus viridans	1

Table 2. Blood salvage in patients with total hip arthroplasty (THA) and total knee arthroplasty (TKA)

Group	THA n	Blood shed, mL	Autologous collection (units)	Blood needed (units)	Blood gain	Homologous transfusions (n)	(units)
THA							
B	167	315	–	4	–	160	3
C	43	310	2.94	3.7	0.24	10	0.42
TKA							
B	44	455	–	3	–	40	2
C	12	445	2.44	2.55	0.89	1	0.08

hematocrit was 28% and patient hematocrit was 30.5%. From the group of patients in whom autologous blood with positive blood cultures was transfused, none developed infection with the exception of one patient with acinetobacter anitr. who presented with a high temperature until the 6 days postoperative. All patients, however, were covered with prophylactic antibiotics for 10 days. Blood reaction from the autotransfusion devices were noted in 4 patients, however, the autologous blood transfusion was discontinued in only one because of side-effects such as, nausea (Table 2).

Finally, overall, blood transfusion requirements were higher in patients undergoing total hip arthroplasty compared to those undergoing total knee arthroplasty. Approximately 1 unit per case more was required for total hip arthroplasty arthroplasty than for to total knee arthroplasty.

Discussion

Analysis of the data shows that a clear decrease in the need for homologous blood transfusion in those patients who are managed with an autotransfusion device. In this regard, control patients who received only homologous blood, required 4.2 homologous blood units on average per surgery, with no patients not undergoing transfusion. In contrast, patients in Group B where a autotransfusion device was used, only 2.7 units of homologous blood was required, with 11 patients needing no transfusion. This decrease was even more pronounced when the autotransfusion apparatus was used in combination with a predeposition of autologous blood by the patient. Thus, in Group C where predeposited autologous blood, as well as autotransfusion device was used, only 1.7 units of homologous blood was needed. This clearly shows a 41% decrease of the needs for transfusion compared to control patients. Even more important was that of those patients who predonated 3 or more units of autologous blood, none required transfusion with homologous blood. From the latter, 21 units were not needed and were returned to the blood bank.

The fact that reinfusion of unwashed, filtered, salvaged blood was well tolerated by the patients who had undergone either a total hip or total knee arthroplasty, with the exception of one case, is compatible with previous findings (Ayers et al. 1995, Faris et al. 1991). In the present series, autologous blood transfusion was terminated because of nausea in only one patient out of 258 patients managed with autologous transfusions. In turn, although other series have reported complications with the reinfusion of unwashed, filtered, salvaged blood after major orthopaedic procedures, such as total knee or total hip arthroplasties, no complications were encountered in the present study. Reported complications autologous blood transfusion include hypotension, febrile reaction, coagulopathy and cardiopulmonary compromise (Clements et al. 1992, Ayers et al. 1995).

The finding that none of the patients who predonated 3 or more units of autologous blood required transfusion with homologous blood, strongly suggests that patients scheduled for orthopaedic surgeries which are associated with significant blood loss, such total hip arthroplasty, should deposit at least 3 units of autologous blood preoperatively. Other authors have had similar findings, and as a result recommend that between 2 and 3 units of autologous blood should be deposited (Woolson et al. 1991).

In conclusion, the transfusion of homologous blood was minimized through transfusion of preoperatively deposited autologous blood, and postoperative salvage of unwashed, filtered blood with an autotransfusion device in patients treated with total hip or total knee arthroplasties.

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