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A Comparison of Autologous and Homologous Transfusions in Spinal Fusion

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Autologous transfusion has been used to overcome adverse effects of homologous transfusion. Clinical studies evaluating general orthopaedic postoperative results have been designed to compare these transfusion methods. However, few studies have evaluated postoperative results in spinal fusion surgeries, which have larger blood loss volumes. The purpose of this study is to determine if there are differences in postoperative infection and clinical results of spinal fusion with autologous, as compared to homologous, blood transfusion. A total of 62 patients who underwent instrumented spinal fusion and received autologous (n = 30) or homologous (n = 32) transfusions were reviewed. Information on gender, age, preoperative and 3-day postoperative hematologic features, total transfused units, segmental estimated blood loss, transfused units, and surgery time were collected. In addition, postoperative infection data on wound infection, pneumonia, urinary tract infection, cellulitis, and viral disease, incidence and duration of fever, as well as clinical results, fusion rates, and patient feedback were collected. No differences in postoperative infection and clinical results were found between the two types of transfusions; however, homologous transfusion was associated with an increased number of total units transfused, longer duration of fever, and decreased patient satisfaction regarding the transfusion.

Key Words: Spinal fusion, autologous transfusion

INTRODUCTION

Major orthopedic surgical procedures, including hip arthroplasty, may result in significant blood loss.[1,2] Certain procedures, especially spinal fusions, require relatively large amounts of transfusion due to long operative duration, bleeding from the bone graft bed, and spinal instrumentation.[3,4]

In spite of developments in transfusion medicine, several complications are directly related to homologous blood transfusion. Although infectious contamination has declined substantially, the most common risk remains viral hepatitis, with a transmission rate of approximately 1 per 100,000 units transfused.[5]

Autologous transfusion (preoperative blood deposit and retransfusion) has been proposed to overcome adverse effects of homologous transfusion. Advantages include elimination of viral infection, transfusion-related lung injury, anaphylaxis, graft-versus-host disease, alloimmunization, and Rh sensitization.[6] Autologous transfusions have been used in major orthopaedic procedures, including hip and knee arthroplasties, and, since the introduction of spinal surgery in the 1970s, it continues to be used.[3,7-12,14-18]

Previous clinical studies have evaluated autologous transfusion combined with hypotensive anesthesia,[19] hemodilution,[20] replacement time,[21] and efficacy.[14,22] Several studies have also examined differences in postoperative results, compared to homologous transfusion, in hysterectomies,[23] general orthopedic surgeries,[24] and hip arthroplasties.[25] Surprisingly, few studies have evaluated postoperative infection and clinical results in spinal fusions, which tend to have the largest volumes of blood loss.

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The purpose of this study is to determine whether postoperative infection and clinical results differ between patients receiving autologous or homologous blood in instrumented spinal fusion.

MATERIALS AND METHODS

We reviewed medical records of patients who underwent transfusion and instrumented spinal fusion for spinal stenosis or spondylolisthesis between January 1, 1999, and December 31, 2000. Spinal stenosis without spondylolisthesis and spondylolisthesis alone occurred in 41 (66%) and 21 (34%) patients, respectively. Operations were performed by the same surgeons and anesthesiologist. All patients provided informed consent.

Autologous or homologous blood transfusion only, occurred in 30 and 32 procedures, respectively. Twenty five patients who received both autologous and homologous blood were excluded from the study. Patients with high infection risk, including steroid therapy, malnutrition, obesity, diabetes mellitus, and immunosuppression, were not included.

Criteria for autologous donation included a preparticipation screening hemoglobin value; at least 110 grams per liter. Phlebotomy was performed weekly and completed at least five days prior to surgery. Donation was delayed if hemoglobin was less than 110 grams per liter at any time during the blood-acquisition process. Oral iron administration was initiated prior to donation and continued for approximately two months.

In accordance with recently established red blood-cell transfusion guidelines,[26] absolute indication for transfusion included intra- or postoperative hemoglobin less than 70 grams per liter. However, most patients received transfusion for clinically based signs and laboratory findings consistent with symptomatic anemia; defined as hemoglobin less than 100 grams per liter, and associated with persistent tachycardia refractory to intravenous fluids, orthostatic hypotension, dyspnea on exertion, or profound fatigability that precluded physical therapy.

We collected information on gender, age, hemoglobin, hematocrit, preoperative and 3-day postoperative platelet count, segmental estimated

Table 1. Criteria for Measuring Improvement of Clinical Results

Excellent	Complete relief of pain in back and lower limbs
	No limitation of physical activity
	Analgesics not used
	Able to squat on the floor
Good	Relief of most pain in back and lower limbs
	Able to return to accustomed employment
	Physical activities slightly limited
	Analgesics used only infrequently
	Able to squat on the floor
Fair	Partial relief of pain in back and lower limbs
	Able to return to accustomed employment with limitation or return to lighter work
Poor	Physical activities definitely limited
	Mild analgesic medication used frequently
	Mild limitation to squat on the floor
	Little or no relief of pain in back and lower limbs
	Physical activities greatly limited
	Unable to return to accustomed employment
	Analgesics medication used frequently
	Unable to squat on the floor without support

blood loss, transfused units, surgery time, total transfused units, and duration of prophylactic systemic antibiotic therapy. Segmental estimated blood loss, time, and transfused units in surgery are defined as total blood loss, time, and transfused units divided by number of fused vertebrae, respectively.

Information on postoperative infections, such as wound infection, pneumonia, urinary tract infection, cellulitis, and viral transmitted disease, and incidence and duration of fever without identified infection, was collected. Additional collected information included postoperative clinical results, fusion rates, and satisfaction for the transfusion.

Criteria used for postoperative infection were those used by Tartter et al.[27,28] Purulent exudate and positive cultures were adequate evidence of postoperative wound infection. Urinary tract infection was diagnosed when more than 105 colonies grew from culture. Fever, leukocytosis, and chest infiltrate indicated pneumonia. Fever was defined by temperature more than 38.3℃ (101 ℉). Duration of fever was calculated in days.[25] Clinical results were analyzed by Kim's criteria, according to clinical improvement variables (Table 1).[29] Solid fusion is defined by continuous trabecular bridge traversing the grafted segment between the transverse processes by flexion and extension dynamogram.[30,31] Patient satisfaction was classified as "satisfied," "unsatisfied," and "not judged," by asking patient discomfort during and after transfusion, compared to before transfusion.

Statistical analysis was performed using SPSS 10. The independent-samples t test, chi-square test, and Pearson correlation analysis were used to compare variables. *P* value less than 0.05 was considered significant.

RESULTS

Autologous and homologous recipients were similar in gender, age, segmental time in surgery, estimated blood loss, number of transfused units, number of fused vertebrae, duration of antibiotic therapy, and mean hospital stay. Homologous transfusion was associated with an increased total number of units transfused (Table 2). Usually the recommended duration for prophylactic antibiotic administration upon spinal surgery is two days;[32] however, longer durations are common practice at our institution.

The autologous and homologous recipients were similar in hemoglobin, hematocrit, and platelet count preoperatively and at the 3rd postoperative day (Table 3).

No statistical differences were found in postoperative infections including wound infection,

Table 2. Clinical Features of Patients with Autologous and Homologous Transfusion

	Autologous	Homologous	*p* value
Number	30	32	
Sex (M/F)	13/17	16/16	
Age (yrs)	53.6 ± 12.7	56.9 ± 6.9	NS*
Seg. time in surgery (min)	142.6 ± 43.9	144.6 ± 67.0	NS
Seg. estimated blood loss (mL)	475.8 ± 216.9	561.7 ± 124.7	NS
Seg. transfused units	1.7 ± 0.8	2.2 ± 0.9	NS
Number of fused vertebrae	1.3 ± 0.2	1.5 ± 0.2	NS
Total transfused units	2.0 ± 0.7	3.5 ± 1.8	0.001
Days on IV antibiotics	7	7	
Mean hospital length of stay	10.2	9.7	NS

The values shown are mean ± SD unless otherwise noted.
The *p* values were determined by independent-samples t test, level 5%.
*Not significant.

Table 3. Laboratory Features of Patients with Autologous and Homologous Transfusion

	Autologous	Homologous	*p* value
Preop. Hb (gm/dL)	12.5 ± 1.3	13.3 ± 1.5	NS*
Preop. Hct (%)	37.1 ± 4.1	39.6 ± 4.2	NS
Preop. Platelet ($\times 10^3/\mu L$)	221.6 ± 73.4	271.7 ± 54.7	NS
PO. 3d Hb (gm/dL)	10.4 ± 1.3	11.0 ± 1.7	NS
PO. 3d Hct (%)	30.0 ± 3.8	31.5 ± 4.5	NS
PO. 3d Platelet ($\times 10^3/\mu L$)	225.9 ± 54.8	280.9 ± 103.7	NS

The values shown are mean ± SD.
The *p* values were determined by independent-samples t test, level 5%.
*Not significant.

Table 4. Postoperative Complications of Patients with Autologous and Homologous Transfusion

	Autologous (n = 30)	Homologous (n = 32)	*p* value
Postop. Infection	1	0	NS*
Wound infection	0	0	
UTI	0	0	
Pneumonia	0	0	
Cellulitis	0	0	
Viral infection	1	0	
Incidence of fever	19 (63.3%)	20 (62.5%)	NS*
Days of fever†	1.63 ± 0.68	3.00 ± 1.73	0.005‡

*Not significant.
† The values shown are mean ± SD.
‡ The *p* values were determined by independent-samples t test, level 5%.

pneumonia, urinary tract infection, or cellulites, although one patient in the autologous group developed postoperative wound infection, and one developed viral infection (the common cold) (Table 4).

No differences were found in incidence of fever without identified infection; however, homologous transfusion was associated with longer fever duration (Table 4), which, in turn, was associated with an increased total number of units transfused (Pearson correlation 0.448, *p*-value 0.015).

No differences were found in improvement of postoperative clinical results or fusion rates, but autologous transfusion was associated with increased satisfaction (Table 5, 6).

DISCUSSION

The purpose of this study is to determine whether differences in postoperative infection and clinical results occurred between those receiving autologous or homologous transfusion during spinal fusion.

Most large series evaluating postoperative wound infection in spinal surgery report an overall rate of less than 1%.[33-35] The incidence of postoperative wound infections depends on operative methods, times, and preoperative conditions; it decreases with simple procedures, good vascularity, and prophylactic systemic antibiotics, and increases with more fusions. Instrumented spinal fusion procedures involve more extensive

Table 5. Postoperative Clinical Results of Patients with Autologous and Homologous Transfusion

	Autologous (n = 30)	Homologous (n = 32)
Excellent	21 (70%)	26 (81.3%)
Good	6 (20%)	4 (12.4%)
Fair	3 (10%)	2 (6.3%)
Poor	0 (0%)	0 (0%)

Chi-Square test, p value = 0.710.

Table 6. Overall Satisfaction for Transfusion in the Autologous and Homologous Transfused Groups

	Autologous (n = 30)	Homologous (n = 32)
Satisfied	23 (76.7%)	4 (12.6%)
Unsatisfied	4 (13.3%)	26 (81.1%)
Not judged	3 (10.0%)	2 (6.3%)

Chi-square test, p value = 0.001.

soft tissue dissection, longer operative times, greater blood loss, greater dead space, and increased soft tissue damage from poor vascularity.[35] We targeted patients with instrumented procedures because of the greater possibility of postoperative infection.

Triulzi et al.[36] reported that patients who received both types of transfusions had a significantly greater rate of postoperative bacterial infection, compared to those with autologous blood only, 20.8% vs. 3.3%, respectively. Among patients with postoperative bacterial infections, surgery to address scoliosis was the most common surgical procedure (6/8) used in this study.[36] Usually, the scoliosis surgical procedure results in larger blood loss volumes than in spinal stenosis and spondylolisthesis surgical procedures. In these cases, autologous transfusion is usually not sufficient for replacement, and additional homologous blood is usually required.[37] Therefore, we targeted spinal fusion for spinal stenosis or spondylolisthesis, as homologous transfusion after autologous transfusion is usually not needed in such cases.

As postoperative wound infection in spinal surgery is less than 1%, we evaluated postoperative infection, including wound infection, pneumonia, urinary tract infection, cellulitis, and viral disease.

There has been reported increase risk of postoperative infection in patients receiving homologous blood, compared to those receiving autologous blood, in orthopaedic[24] and hip arthroplastic surgeries.[25] Triulzi et al.[36] reported an increased rate of postoperative bacterial infection in patients who received homologous blood, compared to those who received no blood (20.8 vs. 4.0%). Increased postoperative infection during homologous transfusion was correlated with a higher level of plasma immunosuppressive factor,[38] drop in natural killer cells,[36] decrease in the number of auxiliary CD4 lymphocytes,[39] increase in the number of CD8 suppressor lymphocytes, 39 and suppressed cell-mediated immunity.[40]

However, in our report, no differences were found among cases of postoperative infections, including wound infection, pneumonia, urinary tract infection, and cellulites. Recipients of homologous blood were not at increased risk of infection, compared to autologous blood recipients in a study evaluating hysterectomies.[23] In cases of suppressed immunity, such as burn incidents, sepsis, or trauma, it was found that homologous transfusions were immunosuppressive.[41-43] However, it has been demonstrated that homologous transfusions produced mild immunostimulation in cases of normal immunity in an

untraumatized, nonseptic rodent model.[44] It is also reported that postoperative wound infection is affected mainly by systemic immunosuppression, such as occurs in trauma and sepsis.[44] Many studies report that postoperative wound infection is common in immunosuppressed patients.[27,41-43,45]

No differences in incidence of fever without source was found, but homologous transfusion was associated with longer fever duration. Nonhemolytic febrile transfusion reactions and febrile allergic reactions are more common with homologous than autologous transfusion but do not generally result in serious morbidity.[46] Murphy et al.[25] reported that patients who received homologous blood and those who received autologous blood did not differ in total number of transfused units and fever duration (1.1 vs. 1.3 days). Differences in our report may be because the total number of transfused units was greater in patients with homologous than autologous transfusion.

The common outcome predictors of surgery for spinal stenosis are preoperative walking ability, co-morbidity, such as cardiovascular disease, and increased dural sac cross-sectional area by decompression.[47,48] No differences were found in postoperative clinical results, because autologous transfusion likely did not improve walking ability and cardiovascular function. However, autologous transfusion was associated with increased satisfaction since it decreased total number of units transfused and fever duration.

Limitations of this retrospective and comparative study include a non-randomized design, as patients were not allowed to donate at low hemoglobin values.

Our finding suggests that autologous transfusion does not result in decreased incidence of postoperative infection. However, its use may enhance recovery to the level of average daily living activity by increasing satisfaction due to fewer total units transfused and shorter fever duration.

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