Efficacy and cost-effectiveness of the cell saver system in instrumented posterior fusion with thoracic and lumbar vertebral fractures

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ABSTRACT

BACKGROUND: The aim of our study was to determine the efficacy and cost-effectiveness of intraoperative autotransfusion that uses the cell saver system (CSS) in patients undergoing posterior instrumentation and fusion of thoracic and lumbar vertebral fractures.

METHODS: We divided 121 patients who were to undergo posterior instrumentation and fusion due to thoracic and lumbar vertebral fractures into two groups: 59 patients (23 males and 36 females) were in the cell saver group, and 62 patients (22 males and 40 females) were in the control group. Hemoglobin, hematocrit, and red blood cell (RBC) values were recorded for all patients preoperatively, on the postoperative first, second, and third days, and on the hospital discharge day. Transfusion rates and numbers of allogeneic erythrocyte transfusions, as well as the costs of transfused total auto- and allogeneic transfusions were compared.

RESULTS: The numbers of erythrocyte suspensions transfused perioperatively were 0.2±0.6 units in the cell saver group and 0.7±1.4 units in the control group (p=0.01). Statistically significant differences were noted between the two groups on the postoperative first, second, and third days in terms of hemoglobin, hematocrit, and RBC values. These differences had disappeared by the hospital discharge day. The average cost of perioperative blood transfusions was $431±27.4 in the cell saver group and $34.5±66.25 in the control group (p<0.001).

CONCLUSION: The use of the CSS was not cost-effective, but it was particularly successful at reducing the rate and the number of units of postoperative allogenic blood transfusions.

Keywords: Blood transfusion; cell saver system; cost effectiveness; spinal surgery.
cologic stimulation of erythropoiesis, preoperative autolo-
gous blood donation, and intraoperative and/or postopera-
tive CSS-mediated autotransfusion, which can all reduce the
AET requirements during and after major spinal surgery.[1,3,6–9]
Intraoperative use of the CSS reduces the need for AETs; thus, this system may prevent AET complications.[10–11]

The purpose of present study was to determine the efficacy
and cost-effectiveness of intraoperative autotransfusion us-
ing the CSS in patients undergoing posterior instrumentation
and fusion for the treatment of thoracic and lumbar vertebral
fractures.

MATERIALS AND METHODS

Approval for the study was granted by the Local Ethics Com-
mittee. The patients who underwent posterior instrumenta-
tion and fusion due to thoracic and lumbar vertebral fractures
were reviewed retrospectively. An intraoperative autotrans-
fusion system was used in operations due to surgeons’ de-
mand and randomly. Patients older than 18 years and who
had no previous spinal surgery were included. Those without
full medical records or who underwent procedures including
anterior approach and laminectomy were excluded. Patients
who had coagulopathy, postoperative myocardial infarction,
pulmonary embolism, or gastrointestinal bleeding and who
had different surgery due to any fracture were also excluded.
In total, 121 patients were divided into two groups: 59 pa-
tients (23 males and 36 females) were in the cell saver group,
and 62 patients (22 males and 40 females) were in the control
group. All surgeries were performed by the same surgeons.
Demographic features of the patients are given in Table 1.
The AutoLog Autotransfusion System (Medtronic, USA) was
used intraoperatively in the cell saver group, but this system
was not continued postoperatively. Perioperative blood loss
management was performed for both groups.

All surgical procedures were performed under hypotensive
anesthesia and intraoperative hemodilution. The iliac crest
graft was not harvested in any patients. A hemovac drain
with a positive pressure set to continuous suction was used
in all patients, and the postoperative blood loss values were
recorded. Low-molecular-weight heparin and anti-throm-
boembolic stockings were used for the prophylaxis of deep
vein thrombosis. Our indications for AET were hemoglobin
<8 mg/dl with tachycardia and hypotension. The intraopera-
tive and postoperative numbers of transfused allogeneic ery-
throcyte suspension units were recorded. The costs of the
CSS and the AET were also recorded in both groups. No
major complications were observed in any patient.

The hemoglobin, hematocrit, and red blood cell (RBC) values
were recorded preoperatively, then again on the postoperative
first, second, and third days, and on the day of hospital discharge.
The cell saver group was compared with the control group. We
also analyzed the costs of both transfusion strategies.

The SPSS software (SPSS 20.0 for Macintosh, SPSS, Chicago,
IL) was used for the statistical analysis. The data were eval-
uated with descriptive statistical methods (mean±standard
deviation). An independent samples t-test was used for the
analysis of independent groups of quantitative data showing
normal distribution. A crude analysis of independent groups of
qualitative data was obtained with the chi-square test. A 95%
confidence interval and significance at p<0.05 were accepted.

RESULTS

No statistically significant differences were noted with re-
gard to age, gender, body mass index, fusion levels, surgical
duration, or intraoperative and postoperative bleeding be-
tween the two groups (Table 1). The intraoperative bleed-
ing amount was 553.7±393.7 ml in the cell saver group and
479.7±166.3 ml in the control group; postoperative bleeding
was 292.8±135.1 ml in the cell saver group and 284.2±146.8
ml in the control group. No statistical difference was found
between the two groups (p>0.05).

The two groups were also similar in terms of preoperative he-
moglobin, hematocrit, and RBC values. However, statistically
significant differences were noted between the two groups on
the postoperative first, second, and third days in terms of the
hemoglobin, hematocrit, and RBC values. These differences
had disappeared by the hospital discharge day (Table 2).

<table>
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<tr>
<th>Table 1. Clinical characteristics of the patient groups</th>
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<td><strong>Cell saver group (n=59)</strong></td>
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<td><strong>Control group (n=62)</strong></td>
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<td>Intraoperative bleeding (mL)</td>
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<td>Postoperative bleeding (mL)</td>
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We compared the averages of transfused allogeneic erythrocyte suspension units intraoperatively, postoperatively, and perioperatively in both groups (Table 3). We also compared the rates and numbers of patients transfused with allogeneic erythrocyte suspensions in both groups (Table 4).

The average cost of perioperative blood transfusions was $431±27.4 (distribution, $421–560.5) in the cell saver group and $34.5±66.25 (distribution, $0–279) in the control group. The average cost of the perioperative blood transfusions was significantly higher for the cell saver group than for the con-
trol group (p<0.001). The average cost was calculated based on the blood transfusion and hospital stay, and other parameters were same for both groups.

DISCUSSION

Perioperative blood loss still represents a common problem for spinal surgeons in posterior spinal fusion and instrumentation. Multi-level posterior spinal fusion procedures usually involve major blood loss, and these procedures increase the requirement for AETs. The present study showed that the use of the CSS successfully reduced the numbers of patients transfused with allogeneic erythrocyte suspensions, both postoperatively and perioperatively, but not intraoperatively. The CSS method also successfully decreased the numbers of allogeneic erythrocyte suspension units used postoperatively and perioperatively. These findings are not compatible with some studies in literature, but they agree with others.

The findings of the present study also showed that the protection of the hemoglobin, hematocrit, and RBC values until hospital discharge was more successful in the CSS group than in the control group. The blood recovery rate using the CSS was 45.3%, which compared favorably with the results of Reitman et al.

Some authors have indicated that the intraoperative use of the CSS did not diminish the rates of AET in spinal surgery, despite predonated autologous blood transfusions. Our study, as well as that of Owens et al. also found no decrease in the intraoperative numbers of allogeneic erythrocyte suspension units with the use of the CSS, but this number did decrease postoperatively.

Determining which patients would benefit from the CSS use remains a controversial issue. The use of the CSS is suggested especially in multi-level posterior spinal surgery with an estimated prolonged surgery time and excessive blood loss. In addition, some authors have stated that even if this system succeeds in reducing the rates of AETs, it is not necessary, especially for single-level or double-level posterior lumbar fusion. Other authors have also stated that the AES requirements of many spinal surgery patients can be provided by predonated blood transfusions. Nevertheless, other researches have shown that the patients in which the CSS was not used generally had greater requirements for autologous and the allogeneic blood transfusions when compared to the patients in which the CSS was used.

The cost-effectiveness of the CSS is another important issue. The CSS use is not cost-effective in many posterior spinal instrumentation and fusion procedures, as we also determined here. One important reason for the cost increase of the CSS is its fixed cost regardless of the amount of salvaged or transfused blood. The efficiency of this system can be increased by also using it in the postoperative period. The advantage of the CSS is that it can be used safely along with other blood conservation techniques. This system also can be chosen for patients with traumatic vertebral fractures, because autologous blood donation cannot be reserved in these patients.

Most of the previous studies indicated that the rates and numbers of allogeneic erythrocyte suspensions may be affected by the CSS use, because the blood transfusions were performed by autotransfusion with intraoperative collected and predonated blood. In addition, preoperative autologous blood donation may cause a reduction in patient’s preoperative hemoglobin, hematocrit, and RBC values. None of our patients was able to undergo preoperative autologous blood donation.

One strength of the present study is that it included an investigation of the efficiency and cost-effectiveness of the CSS in traumatic vertebral fractures, a feature that is absent from the current literature. A weakness of our study was its retrospective nature.

Conclusion

Intraoperative autotransfusion using the CSS is a safe and effective method for lumbar and thoracic vertebral fracture surgery by posterior instrumentation and fusion. In addition, this method successfully reduced the numbers of allogeneic erythrocytes a suspension unit required, especially postoperatively. This method was also successful in decreasing the postoperative rates and numbers of patients transfused with allogeneic erythrocyte suspensions. The major disadvantage of this system seems to be its cost. In light of our study, we suggest the use of the CSS for surgical treatment of acute vertebral fractures.

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2004;29:1580–3. [CrossRef]

ORJİNAL ÇALIŞMA - ÖZET

Toralak ve lomber vertebraların kırıkları arasında enstrümentasyon ve posterior füzyon uygulanmış hastalarda maliyet ve hücre koruyucu sistem etkinliği

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AMAC: Çalışmamızın amaci toralak ve lomber vertebraların kırıkları nedeniyle posterior enstrümentasyon ve füzyon yapılan ve ameliyat ettikleri otoprotözfüzyon yapılan hastalarda hücre koruyucu sistem etkinliğini ve maliyet etkinliğini belirlemektir.

GEREC VE YONTEM: Toralak ve lomber vertebraların nedeniyle posterior enstrümentasyon ve füzyon uygulanan 121 hasta iki grubu ayırdı: 59 hasta (23 erkek ve 36 kadın) hücre koruyucu grubu, 62 hasta (22 erkek ve 40 kadın) kontrol grubunu dahil etildi. Hastaların hemoglobin, hemotokrit ve kırmızı hücre sayısı (KHS) ameliyat öncesi ve sonrası birinci, ikinci, üçüncü gün ve taburculuk esnasındaki değerleri değerlendirildi.

BULGULAR: Transfuzyon oranları ve allojenik eritrosit transfüzyonlarının (AET)’ler yani sıra, transfüzyona tabi tutulan toplam oto ve allojenik transfüzyonların maliyetleri karşılaştırıldı.

TARTIŞMA: Hücre koruyucu sistemlerin kullanımı maliyet açısından uygundur, ancak özellikle ameliyat sonrası allojenik kan transfüzyonlarının oranını ve maliyeti azaltmada başarılıdı.

Anahtar sözcükler: Hücre koruyucu sistem; transfüzyon; maliyet etkinliği; omurga cerrahisi.