



# THE EFFECT OF THE USAGE OF CELL-SAVER AND TRANEXAMIC ACID ON THE AMOUNT OF INTRAOPERATIVE ALLOGENIC BLOOD TRANSFUSION WHILE MANAGING BLOOD LOSS IN ADOLESCENT IDIOPATHIC SCOLIOSIS SURGERY

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#### ABSTRACT

**Background Data:** Reconstructive adolescent idiopathic scoliosis surgery performed by applying pedicle screw system with posterior approach is a major surgical procedure. Allogenic blood transfusion is one of the oldest known method for volume loss during this surgery. In order to reduce the amount of intraoperative and postoperative blood transfusion, methods such as cell-saver (CS) and tranexamic acid (TXA) have been used. Our study was performed to assess the efficacy and safety of these two methods.

**Materials and Methods:** In our hospitals spine surgery clinic, between 2012 and 2018, a total of 58 patients whom met the inclusion criteria, were divided into 3 groups and these two methods (CS and TXA groups) were compared with the patients who underwent surgery without applying any blood loss reduction procedure. Group 1 consisted of patients whom we applied cell-saver only (n: 19), group 2 consisted of patients whom we applied tranexamic acid only (n: 19) and group 3 consisted of the patients whom had undergone surgery without applying any other blood loss reduction procedure (n: 20). Gender, age, screwing levels, how many units allogenic blood transfusion were performed except than autogenic blood transfusion by CS during the operation were respectively determined in all three groups. Also complications related to blood loss reduction procedures intraoperatively and postoperatively were evaluated.

**Results:** When all 3 groups were considered together, the statistical difference was significant in terms of the amount of blood transfusion (p.0). While there was no significant difference in the amount of blood transfusion between group 1 and group 2 (p.4), there was significantly less amount of blood transfusion between group 1 & group 3 and between group 2 & group 3 (p.0 and p.0, respectively). None of the patients had major or minor complications related with managing blood loss.

**Conclusions:** The usage of cell-saver and/or tranexamic acid during reconstructive adolescent idiopathic scoliosis surgery significantly reduces the amount of intraoperative allogenic blood transfusion. Especially we think about that 10mg/kg bolus and 1mg/kg/hour maintenance doses of tranexamic acid are effective and safe.

**Key Words:** Adolescent idiopathic scoliosis, Tranexamic acid, Cell-saver.

**Level of Evidence:** Retrospective Clinical Study, Level III

#### INTRODUCTION

In reconstructive scoliosis surgery with posterior spinal instrumentation systems; wide surgical incisions, long surgical periods and spongy bone structure of the spine cause large amounts of blood loss<sup>(16)</sup>. As all major surgeries, various methods are used to manage this excessive blood loss in scoliosis surgery. The methods

that are used to avoid the possible side effects of perioperative allogenic blood transfusion which are most commonly used in spinal surgery are cell-saver (CS) and IV & topical tranexamic acid (TXA)<sup>(1,12,15)</sup>.

The use of TXA as an antifibrinolytic agent in order to reduce the amount of intraoperative blood loss has become

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increasingly widespread in the 1990's. TXA (trans-4-aminomethyl-cyclohexane-1-carboxylic acid) is a synthetic lysine analogue. It shows its effect by binding to the lysine receptors on plasminogen molecules, inhibits the activation of plasminogen to plasmin and blocks fibrinolysis<sup>(15)</sup>. CS is a method that can be explained as a sequence of processes. First of all we collect the lost blood in the intraoperative period. Then the blood is anticoagulated, washed, filtered and given back to the patient respectively<sup>(13)</sup>.

There are studies in the literature that both methods reduce the amount of intraoperative blood transfusion. Especially the cell-saver method is a more expensive method that is indicated as a disadvantage<sup>(10)</sup>.

In our study, we aimed to compare these two methods used in adolescent idiopathic scoliosis (AIS) surgery performed with posterior approach with the patients who underwent surgery without applying any blood loss reduction procedure, retrospectively. Our hypothesis was to investigate whether these two methods were effective or not.

## MATERIALS AND METHODS

Patients who underwent spinal surgery with only a posterior approach between 2012 and 2018 in the spinal surgery clinic of our hospital were identified and file records were checked.

The patients with the diagnosis of AIS, whose file records which were completely written (gender, age, anesthesia application forms), whom we applied pedicle screws only, whom we gave TXA dose 10 mg/kg bolus and 1 mg/kg/hour infusion and in which cases intraoperative blood loss management procedure (amount of CS or how many units allogenic blood transfusion) were exactly clear, were included in the study. The exclusion criteria of our study were; in which cases hybrid fixation methods were used, the patients whom we performed revision surgery, patients who had any osteotomy, whom we gave the TXA dose other than the aforementioned values and in which cases the amount of intraoperative blood transfusion were not clear.

A total of 58 patients who met the inclusion criteria were divided into 3 groups. Group 1 consisted of patients whom we applied cell-saver only (n: 19), group 2 consisted of patients whom we applied tranexamic acid only (n: 19) and group 3 consisted of the patients who had undergone surgery without applying any other blood loss reduction procedure (n: 20). Gender, age, screwing levels, how many units allogenic blood transfusion were performed except than autogenic blood transfusion by CS during the operation were respectively determined in all three groups. Also complications related

to blood loss reduction procedures intraoperatively and postoperatively were evaluated.

## Statistical Analysis

Kolmogorov Smirnov test was used to evaluate the distribution of continuous variables. Kruskal-Wallis analysis was performed to evaluate the difference between the groups. Tamhane's Posthoc analysis was applied to determine the difference between the groups.  $p < 0.05$  was significant.

## RESULTS

The mean age of the patients was 16 ( $\pm 4$ ) in group 1, 15 ( $\pm 3$ ) in group 2 and 14 ( $\pm 4$ ) in group 3. There was no statistically significant difference between the ages ( $p = .24$ ). When the screwing levels were examined, the mean was 12 ( $\pm 1$ ) in group 1 and 10 ( $\pm 2$ ) in group 2, and 11 ( $\pm 2$ ) in group 3. Although there was a statistically significant difference between these three groups in terms of screwing levels ( $p.01$ ), we think that this difference is not clinically significant.

The amount of allogenic blood transfusion during the operation was determined as 1.37 ( $\pm 1$ ) units in group 1, 1.7 ( $\pm .5$ ) units in group 2 and 2.7 ( $\pm .8$ ) units in group 3. When all 3 groups were considered together, the statistical difference was significant in terms of the amount of blood transfusion ( $p.0$ ). While there was no significant difference in the amount of blood transfusion between group 1 and group 2 ( $p.4$ ), there was significantly less amount of blood transfusion between group 1 & group 3 and between group 2 & group 3 ( $p.0$  and  $p.0$ , respectively). None of the patients had major or minor complications related with managing blood loss.

## DISCUSSION

Blood loss management is one of the most challenging subjects for the surgeons and anesthesiologists in spinal surgery as in all other major surgeries. Allogenic blood transfusion is the oldest known procedure to prevent the hypovolemic condition caused by high amounts of blood loss during surgery<sup>(6)</sup>. However; for the allogenic blood transfusion, the source is exhaustible and it is an increasingly costly method. There is also a risk of infection in allogenic transfusion. Although the rates of viral infections are relatively low, the risk of postoperative bacterial infection has been increased in several studies<sup>(14)</sup>.

Reducing the amount of intraoperative blood loss consequently decreases blood transfusion which is an intended condition for the safety of the spinal surgery. For this reason, CS which is used to make autogenic blood transfusion and antifibrinolytic agents, have been increasingly used in major surgeries.<sup>(12,15)</sup>

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Both methods can be performed as separate procedures or can be used together. We applied these methods separately in our study.

There are studies which suggest that the use of CS in spinal surgery decreases the need for blood transfusions, but there are also studies that provide a low benefit or nothing at all as well <sup>(3,7)</sup>. This difference is closely related to the surgical procedure performed and the number of instrumented levels. Charles et al. stated in their study that usage of CS in patients with adult lumbar fusion showed a significant difference but they also stated that this difference was not as much as they expected. Another outcome in the same study is that the CS group is more expensive than the control group <sup>(3)</sup>. Similarly, in the study of Gause et al. unlike us, patients who underwent lumbar laminectomy and fusion in the postoperative period were divided into two groups with and without CS, and a significant increase in the number of blood transfusions was detected in the CS group <sup>(5)</sup>.

In an another study demonstrating the efficacy of CS in the intraoperative period, Bowen et al. reported that usage of CS significantly reduced allogenic blood transfusion, especially in scoliosis surgery lasting longer than 6 hours and in patients with blood loss greater than 30 % of total blood volume <sup>(2)</sup>. Based on this study, we can interpret that usage of CS would be advantageous especially in cases where long segment instrumentation will be performed and amount of blood loss is expected to be high.

In our study, patients whom we gave CS group 1 needed less intraoperative blood transfusion than patients whom had undergone surgery without applying any other blood loss reduction procedure group 3. Also group 1 consisted of patients whom underwent a prolonged surgery like AIS in which long segment instrumentation was performed. The most important drawback for the usage of CS is the higher costs. Although we do not have any data in this study about this, we think that it is worth research.

Another method used in blood loss management is the usage of pharmacological agents. Some of these agents whose antifibrinolytic properties are used, include tranexamic acid, aprotinin, and aminocaproic acid. TXA is an agent that can be used safely in most major surgeries <sup>(4,15)</sup>. In the meta-analysis of Li et al.; they found that intravenous administration of TXA, particularly at high doses ( $\geq 15$  mg/kg) reduced the need for blood transfusion and did not increase the risk of deep vein thrombosis (DVT), but they pointed out that the quality of evidence for the publications included in the study was not high <sup>(11)</sup>.

Jones et al. found that in 36 AIS patients whom were divided in two groups (TXA used and unused) in a similar way to our

study, TXA showed a significant reduction in total blood loss. They also detected that an estimated amount of blood loss less than 6 % in TXA group compared to the other group <sup>(9)</sup>. In the same study about the levels of instrumentation; they also reported that the efficacy of TXA in 9 or less level instrumentation was worth investigating. In our study, TXA was used in the patients in group 2. These patients had a significant difference in blood transfusion, compared to whom had undergone surgery without applying any other blood loss reduction procedure. The mean fusion level of this group was 10 ( $\pm 2$ ).

In a multicenter, prospective and double-blind study, Colomina et al. compared the TXA with placebo. As a result, TXA did not significantly reduce transfusion requirements, but they noted that perioperative blood loss was significantly reduced in adults with major spinal surgery <sup>(4)</sup>. In the editorial interpretation of the same study, "intraoperative tranexamic acid reduces blood loss and transfusion under certain conditions, but its effectiveness is not clear in major spine surgery" is noted.

For the administration dose of TXA, although different studies have shown different opinions, it has been reported that usage of high dose (at least 10mg/kg bolus followed by more than 1mg/kg/hour) reduces the intraoperative blood loss, the requirement for blood transfusion and shortens the operation time generally <sup>(8)</sup>.

The adverse effects of the usage of TXA are deep venous thrombosis, pulmonary embolism, myocardial infarction, hypersensitivity reaction, renal insufficiency, and rarely seizures <sup>(8-9,15)</sup>. In the meta-analysis of Hui et al. postoperative thromboembolic risk does not increase with TXA. These effects were mostly reported as case reports <sup>(8)</sup>. In our study, we did not encounter any adverse effects in the intraoperative or postoperative period.

Limited sample size, the surgeries performed by different surgeons, lack of knowledge about the exact amount of intraoperative blood loss and the lack of cost analysis for CS were the limitations of our study.

## CONCLUSION

The usage of cell-saver and/or tranexamic acid during reconstructive adolescent idiopathic scoliosis surgery which is considered to be among the major spinal surgeries, significantly reduces the amount of intraoperative allogenic blood transfusion. Cost-effective study of the CS method may be beneficial in terms of total patient cost. Especially we think about that 10 mg/kg bolus and 1mg/kg/hour maintenance doses of tranexamic acid are effective and safe.

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