

## A Five-Year Evaluation of CBC Changes Following Scoliosis Surgery

### Abstract

**Introduction:** Scoliosis is one of the most common spinal deformities, often requiring extensive surgical intervention. These surgeries are usually followed by profuse blood loss and need for blood transfusion, which can lead to a number of postoperative complications. This study is aimed of analyzing the changes in complete blood count (CBC) parameters of the patients who have had scoliosis surgery with in a 5 years period in a teaching unit. underwent scoliosis correcting surgery over a period of five years.

**Materials & Methods:** Retrospective analysis of data of 70 patients who underwent scoliosis surgery in 5 years period was done in this study. Demographic information, body mass index (BMI), hemodynamic status, duration of surgery, quantity of blood loss, and details of intraoperative and postoperative blood transfusions were recorded. CBC parameters RBC, WBC, PLT, HB, and HCT were evaluated preoperatively and on all five days postoperatively.

**Results & Discussion:** 70 patients with mean age of  $24 \pm 18.43$  years were studied. The females accounted for 65.7% and males accounted for 34.3% of the patients. Assessment of weight, height, and BMI showed 58% with normal physical status, 22% were overweight, and 20% underweight. The results demonstrated that elevated body weight ( $p = 0.007$ ), low BMI ( $p = 0.033$ ) and prolonged operating time ( $p = 0.007$ ) were significantly associated with greater demand for blood transfusion intraoperatively. Substantial decreases in RBC, PLT, HB, and HCT were noted during the five days of postoperative period. In contrast, WBC count increased dramatically on the day of surgery, then decreased stepwise.

**Conclusion:** Since hemoglobin levels are likely to stabilize spontaneously after scoliosis surgery, unjustified transfusions need to be avoided. In cases with higher risk factors, preventive strategies before surgery may reduce complications to some extent. This study provides a useful platform for building more efficient care protocols for scoliosis surgery.

**Keywords:** Scoliosis, Complete blood count (CBC), Blood transfusion, Hemoglobin, Spinal surgery.

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### Introduction

Scoliosis is one of the common spinal deformities, characterized by abnormal lateral curvature accompanied by vertebral rotation<sup>(1,2)</sup>. In severe cases, corrective surgery is inevitable and typically involves extensive incisions and prolonged operative time<sup>(3,4)</sup>. These conditions lead to substantial blood loss and the frequent need for blood transfusion<sup>(5,6)</sup>. Blood management and the prevention of unnecessary transfusions are among the most important challenges in the care of these patients, as increased exposure to allogeneic transfusion is associated with complications such as infection, coagulopathies, and acute lung injury<sup>(7,8)</sup>.

Accordingly, close monitoring of complete blood count (CBC) indices before and after surgery is a low-cost, rapid, and effective method for assessing the clinical status of patients. Nevertheless, only a limited number of studies in Iran have systematically evaluated these changes over a long-term period. Therefore, the aim of the present study was to investigate five-year trends in CBC indices in scoliosis patients undergoing corrective surgery, as well as factors associated with blood transfusion requirements.

## Materials & Methods

### Study design

This study was designed as a retrospective cohort based on clinical records.

### Study population and sampling

The study population included all scoliosis patients who underwent corrective surgery between 2015 and 2020 at Shohada, Valiasr, and Madani hospitals in Tabriz. Sampling was performed by census, and a total of 70 patients with complete records were included.

**Inclusion criteria** were documentation of pre- and postoperative CBC (first 5 days of hospitalization), intraoperative blood loss, perioperative transfusion volume (intra- and postoperative up to 5 days), and hemodynamic status during surgery, recovery, and intensive care.

**Exclusion criteria** included incomplete records, hematologic disorders, underlying conditions such as diabetes or congenital heart disease, preoperative use of anticoagulants, and diagnoses of thalassemia or hemophilia.

### Data collection

Data were extracted using a checklist that included demographic characteristics, BMI, duration of surgery, intraoperative blood loss, transfusion volume, and CBC parameters.

### Statistical analysis

Data were analyzed using SPSS version 22. Paired t-test, multivariate linear regression, and the Kolmogorov–Smirnov test were applied. A significance level of  $p < 0.05$  was considered.

## Results

### Demographic characteristics

The mean age of the patients was  $24.04 \pm 18.43$  years. Females comprised 65.7% of the cohort, while 34.3% were male. BMI analysis showed that 22% were obese, 58% normal, and 20% underweight (Table 1).

### CBC changes

RBC, Hb, and HCT levels showed a significant decrease one day after surgery, which persisted until the fifth postoperative day. Platelet count (PLT) demonstrated a significant reduction on the first postoperative day, followed by a marked increase by day five. White blood cell count (WBC) exhibited a significant rise on the first postoperative day and subsequently declined. The results indicated that the mean values of the variables on the first postoperative day were significantly different from those before surgery. Furthermore, the mean values of the variables on the first and fifth postoperative days differed significantly from each other (Table 2,3 and 4).

### Blood transfusion

Intraoperative transfusion was performed in 85% of patients, and 30% required transfusion postoperatively. The mean transfusion volume was 1098.6 mL, primarily PRBCs (Table 5).

### Regression analysis of transfusion predictors

Based on the multivariate regression model, higher body weight, lower body mass index, and longer surgical duration were associated with an increased volume of blood transfused ( $P < 0.05$ ) (Table 6).

**Table 1: Demographic characteristics of patients**

Variable	n	Minimum	Maximum	Mean	SD
Age (years)	70	3.00	73.00	24.04	18.43
Weight (kg)	68	13.00	105.00	52.22	21.49
Height (cm)	64	86.00	180.00	150.33	20.96
BMI (kg/m <sup>2</sup> )	63	12.75	36.33	22.62	5.16

**Table 2: CBC parameters before and after surgery**

Parameter	Preoperative	Day 1 Post-op	Day 5 Post-op
RBC (million/ $\mu$ L)	4.83 $\pm$ 0.59	4.36 $\pm$ 0.69	3.33 $\pm$ 0.40
Hb (g/dL)	13.72 $\pm$ 1.52	12.66 $\pm$ 1.50	9.63 $\pm$ 1.21
HCT (%)	40.92 $\pm$ 4.10	37.03 $\pm$ 4.95	28.80 $\pm$ 3.43
WBC (k/ $\mu$ L)	7.64 $\pm$ 2.03	15.66 $\pm$ 6.03	7.56 $\pm$ 3.18
PLT (k/ $\mu$ L)	257.65 $\pm$ 68.73	197.18 $\pm$ 71.65	204.28 $\pm$ 93.07

**Table 3: Comparison of CBC parameters before and one day after surgery**

Parameter	Preoperative	Day 1 Post-op	p-value
RBC (million/ $\mu$ L)	4.83 $\pm$ 0.59	4.36 $\pm$ 0.69	.000
Hb (g/dL)	13.72 $\pm$ 1.52	12.66 $\pm$ 1.50	.000
HCT (%)	40.92 $\pm$ 4.10	37.03 $\pm$ 4.95	.000
WBC (k/ $\mu$ L)	7.64 $\pm$ 2.03	15.66 $\pm$ 6.03	.000
PLT (k/ $\mu$ L)	257.65 $\pm$ 68.73	197.18 $\pm$ 71.65	.000

**Table 4: Comparison of CBC parameters one day and five days after surgery**

Parameter	Day 1 Post-op	Day 5 Post-op	p-value
RBC (million/ $\mu$ L)	4.36 $\pm$ 0.69	3.33 $\pm$ 0.40	.000
Hb (g/dL)	12.66 $\pm$ 1.50	9.63 $\pm$ 1.21	.000
HCT (%)	37.03 $\pm$ 4.95	28.80 $\pm$ 3.43	.000
WBC (k/ $\mu$ L)	15.66 $\pm$ 6.03	7.56 $\pm$ 3.18	.000
PLT (k/ $\mu$ L)	197.18 $\pm$ 71.65	204.28 $\pm$ 93.07	.000

**Table 5: Transfusion volume during surgery**

Component	n	Minimum (mL)	Maximum (mL)	Mean (mL)	SD
FFP	8	200.00	1200.00	606.25	356.00
PRBC	60	100.00	2800.00	1002.00	584.67
Total transfusion	60	100.00	2800.00	1098.66	660.38

**Table 6: Multivariate regression predicting intraoperative transfusion volume**

Variable	B	Std. Error	Beta	p-value
Constant	1572.49	939.86	–	.102
Age	-2.37	6.64	-0.068	.722
Gender	38.09	174.70	0.029	.828
BMI	-77.48	35.22	-0.609	.033
Surgical duration (min)	229.45	80.30	0.410	.007
Weight (kg)	30.78	10.80	0.911	.007
SBP	-7.43	7.02	-0.181	.296
DBP	-12.66	11.46	-0.182	.275

## Discussion

The present study was conducted with the aim of investigating five-year changes in CBC following scoliosis surgery. The study sample was collected retrospectively from the archives of Shahid Madani, Valiasr International, and Shariati Hospitals in Tabriz,

including all patients who had undergone scoliosis surgery between 2015 and 2020. Data related to 70 scoliosis surgeries were obtained. The mean age of the patients was  $18.43 \pm 24$  years. Of the study population, 65.7% were female and 34.3% were male. Assessment of weight, height, and body mass index (BMI) showed that 58% were of normal body status, 22% were overweight, and 20% were

underweight. Scoliosis surgery is generally associated with considerable intraoperative bleeding. In the present study, the mean intraoperative blood loss was  $1213.89 \pm 830$  mL. These findings were similar to those reported by Borden et al., where the mean blood loss in patients undergoing combined anterior and posterior approaches was  $1277 \pm 821$  mL<sup>(9)</sup>.

In the current study, intraoperative blood transfusion was required in 85% of cases, and 30% also required postoperative transfusion. Dick et al., in their study on pediatric scoliosis surgery, reported that overall 24.4% of patients received allogeneic transfusion, with this percentage showing a decreasing trend over a 15-year period<sup>(10)</sup>. Kim et al. similarly reported that 9.7% of patients with AIS undergoing posterior corrective surgery required massive transfusion<sup>(11)</sup>. Yu et al. also demonstrated that 59.7% of patients experienced severe blood loss<sup>(12)</sup>. Cristante et al. noted that most scoliosis patients in their study required blood transfusion, although none required massive transfusion<sup>(13)</sup>.

The findings of the present study demonstrated that scoliosis surgery is accompanied by a marked decline in hematological indices during the early postoperative days, which in most cases improves without the need for specific therapeutic intervention. Hemoglobin, as one of the principal indicators of transfusion need, reached its lowest level by postoperative day five and subsequently recovered, consistent with the findings of Soliman et al.<sup>(14)</sup>. Overall, blood transfusion in these patients should only be performed under critical conditions and with consideration of clinical indicators, as unnecessary transfusion increases the risk of adverse events.

In addition, the findings showed that patients with low BMI and higher body weight were at the greatest risk of requiring transfusion. These results are consistent with the studies of Thompson and Dupuis<sup>(15,16)</sup>. Similarly, Kim et al. reported that low BMI was associated with massive transfusion<sup>(11)</sup>. Borden et al. further identified operative time, male sex, and increased preoperative kyphosis as independent predictors of greater blood loss<sup>(9)</sup>.

Examination of patients' hemodynamics during hemoglobin decline showed that none of the measured variables had a significant correlation with the amount of blood loss or intraoperative transfusion volume. CBC indices, including RBC, PLT, Hb, and HCT, demonstrated significant reductions up to the fifth postoperative day. WBC levels increased

on the first postoperative day and subsequently declined by day five.

Statistically significant differences were observed between preoperative and postoperative values for most indices, including day five. These findings are in line with those of Soliman et al., who reported the lowest hemoglobin levels on the second and third postoperative days and considered monitoring beyond the third day unnecessary<sup>(14)</sup>.

## Conclusion

The present study emphasizes that careful monitoring of CBC parameters in patients undergoing scoliosis surgery can play a pivotal role in risk assessment, prediction of transfusion requirements, and reduction of postoperative complications. Considering the natural course of CBC index correction after the third postoperative day, blood transfusion should be undertaken cautiously and strictly based on clinical evidence. Moreover, surgery duration and body mass index should be regarded as key factors in predicting intraoperative blood loss.

## Limitations

The present study is a retrospective cross-sectional investigation, and a prospective study is recommended. The scope of this study was limited by the relatively small number of participants. Therefore, conducting larger-scale studies in this field is warranted.

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