

# Does Preoperative Anemia Affect Complications after Thoracic Surgery? A Tertiary Center Experiences

Çiğdem Yıldırım Güçlü<sup>1</sup>, Bülent Mustafa Yenigün<sup>2</sup>, Fatih Kurt<sup>1</sup>, Akif Kaya<sup>1</sup>, Başak Ceyda Meço<sup>1</sup>

<sup>1</sup>Department of Anesthesiology and Intensive Care, Ankara University Faculty of Medicine, Ankara, Türkiye

<sup>2</sup>Department of Thoracic Surgery, Ankara University Faculty of Medicine, Ankara, Türkiye

## Abstract

**BACKGROUND/AIMS:** Preoperative anemia has been associated with an increased risk of postoperative complications after major surgeries. The incidence of anemia is not low according to the literature. We designed this study to find out our incidence of preoperative anemia and the relationship between preoperative anemia and postoperative complications in thoracic surgical patients.

**MATERIAL AND METHODS:** This study was designed as retrospectively study. The demographic features, including age, sex, the American Society of Anaesthesiologists scores, preoperative hemoglobin (Hb) levels, transferrin saturations, comorbidities, blood types and blood product transfusions, complications, mortality, types of surgery, lengths of intensive care unit (ICU) stay, chest tube removal times and lengths of hospital stay were recorded. The relationships between anemia and complications were evaluated.

**RESULTS:** A total of 225 patients were initially included in this study, with 2 patients later being excluded. The preoperative Hb value of 40.4% of the patients was below 13 mg/dL. Complications were seen in 58 (26.0%) patients in total. Complications were observed in 22 (24.4%) patients with preoperative Hb levels below 13 mg/dL and in 36 (27.1%) patients with preoperative Hb levels above 13 mg/dL. Postoperative erythrocyte suspension (ES) was used in 9.7% of patients without complications, while this rate was 24.1% in those patients with complications.

**CONCLUSION:** This study did not find a correlation between preoperative anemia and postoperative complications after thoracotomy, but anemic patients required more ES transfusion and ES is related with prolonged ICU and hospital stay. We can conclude that preoperative anemia indirectly affects postoperative complications in thoracic surgery.

**Keywords:** Anemia, postoperative complications, thoracotomy

## INTRODUCTION

Preoperative anemia has been associated with an increased risk of postoperative complications, extended lengths of hospital stay, and increased risk of death.<sup>1</sup> The anemia incidence in patients with lung cancer was found to be 37.6% in the European Cancer Anemia survey.<sup>2</sup> In the study by Chamogeorgakis et al.<sup>3</sup>, preoperative anemia was 28% in male and 8% in female patients undergoing thoracic surgery.

As anemia is related to many complications, it is important to receive anemia treatment before surgery. However, the time needed for correction means postponing the surgery, which is generally unacceptable to surgeons. Therefore, many anemic patients undergo surgery without sufficient treatment.

This study was designed to evaluate the incidence of anemia in our hospital as its primary endpoint. The secondary endpoint was to determine the relationship between anemia, postoperative

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**ORCID IDs of the authors:** Ç.Y.G. 0000-0002-8416-3418; B.M.Y. 0000-0001-6543-5441; F.K. 0000-0002-4238-2284; A.K. 0009-0004-1350-2808; B.C.M. 0000-0003-2951-9634.



**Address for Correspondence:** Çiğdem Yıldırım Güçlü

**E-mail:** drcigdemyldrm@yahoo.com.tr

**ORCID ID:** orcid.org/0000-0002-8416-3418

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complications and the effects of blood transfusions on postoperative complications in anemic patients.

### MATERIALS AND METHODS

The patients included in this study underwent thoracic surgery between May, 2020 and April, 2022. We retrospectively reached the data of 225 patients in total who underwent thoracotomy between these dates and were eligible for this study. This study was designed as a retrospective one; permission was taken from the hospital to use the patients' data. Ethical approval was obtained from the Ankara University Hospital Ethical Committee (approval number: 2022/613, date: 30.11.2022), and the clinical trial was registered under the reference number NCT05673161. Those patients aged under 18 years, who had urgent surgery, had known bleeding disorders, renal insufficiency, hepatic insufficiency, or congestive heart failure were excluded from this study.

We recorded demographic features including age, sex, the American Society of Anaesthesiologists (ASA) scores, preoperative hemoglobin (Hb) levels, transferrin saturations, comorbidities, blood product transfusions, complications, mortality, types of surgery, lengths of intensive care unit (ICU) stay, chest tube removal times and lengths of hospital stay. The patients were divided into two groups according to their preoperative anemia presence. Anemia was defined as a Hb level <13 g/dL in both males and females.<sup>4</sup> Complications were determined as cardiac, respiratory, infectious or other complications after surgery.

#### Statistical Analysis

The SPSS 11.5 program was used to analyze the study data. Mean ± standard deviation and median were used as descriptors for quantitative variables, and the percentage of patients for qualitative variables. The Mann-Whitney U test was used to determine whether

there was a difference between each category of the qualitative and quantitative variables, since the assumptions of normal distribution were not provided. The chi-squared and Fisher's exact tests were used to examine the relationship between two qualitative variables. A value of p<0.05 was considered statistically significant.

### RESULTS

A total of 225 patients were included in this study; two patients were subsequently excluded from this study because of missing data, and ultimately, the data on a total of 223 patients were analyzed within the scope of this study.

Fifty-five (24.7%) of the patients included in this study were female, 168 (75.3%) were male, and the mean age of the patients was 60.75±10.22 years. There were 75 (33.6%) patients with an ASA score of 1, 141 (63.2%) patients with a score of 2, and 7 (3.1%) patients with a score of 3. The preoperative Hb value of 40.4% of the patients was below 13 mg/dL, and the preoperative Hb value for 59.6% of the patients was equal to or greater than 13 mg/dL. In addition, 48.4% of the patients had a postoperative Hb value below 13 mg/dL, while 51.4% had a postoperative HB value greater than 13 mg/dL (Table 1).

There were 20 (30.1%) patients with a preoperative Hb value above 13 mg/dL and a transferrin saturation below 20%. Complications were seen in 6 (27.3%) patients with transferrin saturation ≤20% and in 11 (21.6%) patients with transferrin saturation >20%, but there was no significant difference in complication rates between these two groups (p=0.597).

Intravenous (i.v.) Fe was given to 7 (7.8%) of the patients with a preoperative Hb value below 13 mg/dL. Complications were seen in 2 (28.6%) of these patients who were given i.v. Fe and in 20 (24.1%) of the

Table 1. Demographics		
Variables		
Gender, n (%)	Female	55 (24.7)
	Male	168 (75.3)
Age (n=223)	Mean ± SD	60.75±10.22
	Median (minimum-maximum)	62.00 (20.00-81.00)
Surgery type, n (%)	Lung resection and mediastinal lymph node dissection	191 (85.8)
	Video-thoracoscopy, wedge resection	8 (3.6)
	Wedge resection, (single or multiple)	6 (2.7)
	Thoracotomy, major exploration	6 (2.7)
	Lung resections after neoadjuvant chemoradiotherapy	4 (1.8)
	Lung resection, chest wall resection + reconstruction	3 (1.3)
	Lobectomy/segmentectomy	3 (1.3)
	Pneumonectomy and major vascular surgery	1 (0.4)
	Lobectomy with concomitant decortication	1 (0.4)
	ASA, n (%)	1
2		141 (63.2)
3		7 (3.1)
Preop Hb, n (%)	<13 mg/dL	90 (40.4)
	≥13 mg/dL	133 (59.6)
Postop Hb, n (%)	<13 mg/dL	108 (48.4)
	≥13 mg/dL	115 (51.6)

Hb: hemoglobin, SD: Standard deviation, ASA: American Society of Anaesthesiologists.

patients who were not given i.v. Fe. However, there was no significant difference between these two groups in terms of complication rates ( $p=1.000$ ).

The transfusion of blood product was only seen in the postoperative period. Postoperative erythrocyte suspension (ES) was used in 20 (22.2%) patients with preoperative Hb levels of 13 mg/dL or below. Postoperative ES was used in 10 (7.5%) patients with preoperative HB levels above 13 mg/dL, and there was a statistically significant difference between these two groups ( $p=0.002$ ) (Table 2).

Complications were seen in 58 (26.0%) patients in total. Complications were observed in 22 (24.4%) patients with preoperative Hb levels below 13 mg/dL and in 36 (27.1%) patients with preoperative Hb levels above 13 mg/dL. However, no significant difference was found between these two groups in terms of complication rates ( $p=0.661$ ) (Table 3).

While the mean postoperative ES was  $1.06\pm 0.25$  units in patients without complications, it was  $1.50\pm 0.76$  in those patients with

complications. There was a significant difference between these two groups in terms of their mean postoperative ES ( $p=0.043$ ).

When evaluated as a ratio, postoperative ES was used in 9.7% of patients without complications, while this rate was 24.1% in those patients with complications. There was a significant difference between these two groups in terms of postoperative ES use ( $p=0.006$ ).

There was no significant difference between those patients with preoperative Hb values below and those above 13 mg/dL in terms of tube removal time, length of stay in the ICU or hospital stay ( $p=0.440$ ,  $p=0.912$  and  $p=0.653$ , respectively) (Table 4).

A significant difference was found between those patients with and those without postoperative ES in terms of length of stay in the ICU and hospital stay ( $p=0.038$  and  $p<0.001$ , respectively). While the mean length of stay in the ICU was  $2.62\pm 2.06$  days in those patients who did not need postoperative ES, this period was  $3.47\pm 2.57$  days in those patients who needed postoperative ES. The mean hospital stay was significantly higher in those patients who received postoperative ES (Table 5). However, the length of ICU stay and hospital stay did not differ statistically between anemic and nonanemic patients ( $p=0.912$  and  $0.653$ , respectively).

### DISCUSSION

The results of this retrospective study did not conclude a correlation between preoperative anemia and postoperative complications after thoracotomy. However, an important result of this study was that ES transfusion is related to prolonged ICU and hospital stays. Anemic patients required more ES transfusion, so preoperative anemia is related to postoperative ES transfusion, which is related to prolonged ICU and hospital stays.

Anemia is one of the most common and modifiable risk factors for major surgeries. The most common etiology of preoperative anemia is iron deficiency. The major causes of anemia in lung cancers include impaired intestinal iron absorption and reduced bone marrow response to erythropoietin.

**Table 2. Postoperative ES use according to Hb level**

Variables		Preop Hb		p-value
		<13 mg/dL	≥13 mg/dL	
		n (%)	n (%)	
Postop ES	(-)	70 (77.8)	123 (92.5)	0.002
	(+)	20 (22.2)	10 (7.5)	

Hb: Hemoglobin, ES: Erythrocyte suspension.

**Table 3. Complications according to Hb level**

Variables		Preop Hb			p-value
		<13 mg/dL	≥13 mg/dL	Total	
		n (%)	n (%)	n (%)	
Complications	(-)	68 (75.6)	97 (72.9)	165 (74.0)	0.661
	(+)	22 (24.4)	36 (27.1)	58 (26.0)	

Hb: Hemoglobin.

**Table 4. Chest tube removal time, ICU stay and hospital stay according to Hb level**

Variables	Preop Hb				p-value
	<13 mg/dL		≥13 mg/dL		
	Mean ± SD	Median (min.-max.)	Mean ± SD	Median (min.-max.)	
Chest tube removal time (days)	4.99±5.29	4.00 (1.00-47.00)	5.47±5.15	4.00 (1.00-46.00)	0.440
ICU stay (days)	2.73±2.00	2.00 (1.00-9.00)	2.74±2.26	2.00 (1.00-16.00)	0.912
Hospital stay (days)	7.62±4.31	6.00 (3.00-22.00)	7.81±4.20	7.00 (2.00-21.00)	0.653

Hb: Hemoglobin, ICU: Intensive care unit, SD: Standard deviation, min.: Minimum, max.: Maximum.

**Table 5. ICU stay and hospital stay in means of ES use**

Variables	Postop ES				p-value
	(-)		(+)		
	Mean ± SD	Median (min.-max.)	Mean ± SD	Median (min.-max.)	
ICU stay (days)	2.62±2.06	2.00 (1.00-16.00)	3.47±2.57	3.00 (1.00-11.00)	0.038 <sup>a</sup>
Hospital stay (days)	7.31±3.92	6.00 (2.00-21.00)	10.47±5.15	9.00 (4.00-22.00)	<0.001 <sup>a</sup>

ICU: Intensive care unit, ES: Erythrocyte suspension, SD: Standard deviation, min.: Minimum, max.: Maximum.

One of the main causes of the increase in mortality is the elevation in the frequency of blood and blood product transfusions.<sup>5</sup> The results of a previous study concluded that more than 1/3 of patients who underwent thoracotomy were anemic. Thoracotomies are challenging cases in terms of oxygen transport and bleeding. This means that anemia becomes increasingly important for these patients.

As anemia is an important risk factor, treatment of anemia becomes especially crucial for these patients. Implementing patient blood management principles improves outcomes after surgery and anemia treatment is one of these.<sup>6</sup> Another important issue is not only to give Fe, but also to wait enough time for its efficaciousness. Unfortunately, only a small portion of the patients received Fe before surgery, and treatment was performed within one week prior to the surgery. In two of the 7 patients who were treated with Fe, complications were observed. Hence, it is difficult to draw any conclusions from this result.

Fernandes et al.<sup>7</sup> concluded that anemic patients undergoing pulmonary resection demonstrated an increased incidence of respiratory and infectious complications. This previous study concluded that there was no significant difference between anemic and nonanemic patients in terms of complications. Taylor et al.<sup>8</sup> conducted a large-volume multicenter retrospective study and found that anemia did not emerge as an independent predictor of postoperative complications or perioperative mortality, but anemia was independently associated with a significantly reduced overall survival for patients undergoing lung resection.

Preoperative Hb level is the major risk factor for perioperative blood transfusion practices in oncologic thoracic surgery.<sup>9</sup> It has been reported that blood transfusion increases the chance of recurrence in patients undergoing surgery for lung cancer.<sup>10</sup> This previous study showed that ES transfusion was statistically related to complications, where all transfusions were applied during the postoperative period. This can be explained by following “patient blood management” rules during the intraoperative period.

Patient blood management has changed our clinic practice regarding transfusions. The approach includes the optimization of hematopoiesis, minimizing blood loss, and evaluating anemia tolerance. Optimization of hematopoiesis consists of anemia treatment, which is an important element in reducing transfusions. Another important issue is to use restrictive transfusion thresholds when deciding on transfusion. Although there are many scientific studies supporting the patient blood management approach, some surgeons still decide on transfusion by just looking at declines in Hb levels.

Preoperative anemia is one of the strong risk factors for the need for perioperative red blood cell transfusions in lung surgery patients.<sup>9</sup> Although we could not find a relationship between anemia and postoperative complications, we found that ES transfusion was related to postoperative complications. Performing surgery in anemic patients may lead to ES transfusion, which may result in complications after thoracic surgery.

The length of ICU stay and hospital stay were also affected by ES transfusion. ES transfusion resulted in longer ICU and hospital stays according to previous results. Saraçoğlu et al.<sup>5</sup> found that preoperative anemia was associated with an extended length of stay in the hospital and in the ICU.

The results of this study conclude that anemia is not associated with postoperative complications after thoracic surgery, but ES transfusion is. The anemic patients included in this study generally had mild anemia, which did not result in complications. However, complication rates increased with ES transfusions.

## CONCLUSION

Even though our results did not find a relationship between preoperative anemia and complications, we can say that preoperative anemia has an indirect effect on postoperative complications in thoracic surgery.

## MAIN POINTS

- Erythrocyte suspension transfusion is related to prolonged ICU and hospital stays in patients undergoing thoracic surgery.
- Anemic patients undergoing thoracic surgery required more erythrocyte suspension transfusions.
- Preoperative anemia indirectly affects postoperative complications in thoracic surgery.
- Preoperative anemia should be treated in those patients undergoing thoracotomy.

## ETHICS

**Ethics Committee Approval:** Ethical approval was obtained from the Ankara University Hospital Ethical Committee (approval number: 2022/613, date: 30.11.2022), and the clinical trial was registered under the reference number NCT05673161.

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: Ç.Y.G., B.M.Y., B.C.M., Concept: Ç.Y.G., B.C.M., Design: Ç.Y.G., B.M.Y., F.K., A.K., B.C.M., Data Collection and/or Processing: Ç.Y.G., F.K., A.K., Analysis and/or Interpretation: Ç.Y.G., B.M.Y., Literature Search: Ç.Y.G., B.M.Y., F.K., A.K., Writing: Ç.Y.G., B.C.M.,

## DISCLOSURES

**Conflict of Interest:** No conflict of interest was declared by the authors.

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