

## Original Article

# Prevalence of Iron Deficiency Anemia in Patients Scheduled for Cardiac Surgery: A Survey at a Cardiovascular Medical and Research Center in Iran

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### ABSTRACT

**Background:** Preoperative anemia is associated with increased morbidity and mortality rates among patients undergoing major surgery. This study aimed to investigate the prevalence of preoperative iron deficiency in patients scheduled for cardiac surgery at a cardiovascular medical and research center in Iran.

**Methods:** This prospective cross-sectional study was conducted at the Rajaei Cardiovascular Medical and Research Center in Iran between October 2018 and September 2019. A total of 165 patients aged 18 years or older who were scheduled for elective cardiac surgery were included. The prevalence of iron deficiency anemia was determined using several iron parameters: serum iron levels, serum ferritin levels, total iron-binding capacity, transferrin saturation, complete blood count, serum blood urea nitrogen levels, serum creatinine levels, and C-reactive protein. Data were collected from patients' medical records.

**Results:** A total of 165 patients were included in the study, with a male-to-female ratio of 1.3:1. The mean age was 60.6±9.9 years. The prevalence of anemia was 52.1%, higher in women than in men (55.8% vs 44.2%). Iron deficiency anemia was the most common type (75.6%), followed by anemia of chronic disease (15.1%) and other types (9.3%). Iron deficiency anemia was more prevalent in women (60%) than in men (24.7%), whereas anemia of chronic disease was more frequent in men (11.8%) than in women (2.9%).

**Conclusions:** Our study revealed a high prevalence of anemia among cardiac surgery patients, particularly iron deficiency anemia. These findings emphasize the importance of preoperative anemia screening and management in cardiac surgery settings, which has significant implications for patient care. (*Iranian Heart Journal 2024; 25(3): 21-26*)

**KEYWORDS:** Iron deficiency, Cardiovascular surgery, Anemia

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Patient blood management (PBM) is an evidence-based, multidisciplinary approach to optimizing care for patients who might require blood product

transfusions. PBM aims to maintain hemoglobin concentration, optimize hemostasis, and minimize blood loss during surgery or medical procedures, with the

ultimate goal of improving patient outcomes.<sup>1, 2</sup> PBM strategies, such as iron therapy, erythropoietic agents, vitamin B12, and folate, can effectively correct anemia and reduce the need for blood transfusions.<sup>3, 4</sup> The significance of PBM is further highlighted by the fact that even mild preoperative anemia is associated with increased morbidity and mortality rates among patients undergoing major surgery.<sup>5</sup> Moreover, blood transfusions have been independently linked to worse outcomes, with preoperative anemia being the most common predictor of perioperative transfusions.<sup>6, 7</sup> Among various types of anemia, iron deficiency (ID) anemia is particularly common, affecting up to 50% of patients undergoing major surgery.<sup>8</sup> ID anemia can result from chronic blood loss, inadequate iron intake, or a combination of both and is often associated with persistent inflammation, especially in patients with cardiovascular disease.<sup>9</sup> Randomized trials have shown that preoperative oral or intravenous iron therapy can improve iron stores and reduce the risk of allogeneic red blood cell transfusion in patients undergoing cardiac surgery.<sup>10</sup> Given the high prevalence of ID anemia and its associated risks, timely diagnosis and management of ID in patients scheduled for surgery is crucial. This study aimed to investigate the prevalence of preoperative ID among patients scheduled for cardiac surgery at a cardiovascular medical and research center in Iran.

## METHODS

**Study Design:** This cross-sectional study was conducted at the Rajaei Cardiovascular Medical and Research Center in Iran between October 2018 and September 2019.

**Study Population:** A total of 165 patients aged 18 years or older who were scheduled for elective cardiac surgery were included in the study. Patients who underwent emergency or non-elective cardiac surgery were excluded.

**Data Collection:** Several iron parameters, including serum iron levels, serum ferritin levels, total iron-binding capacity (TIBC), transferrin saturation (TSAT), complete blood count (CBC), serum blood urea nitrogen (BUN) levels, serum creatinine levels, and C-reactive protein (CRP), were collected from patients' medical records.

**Definition of Anemia:** Anemia was defined according to the World Health Organization (WHO) criteria, with hemoglobin (Hb) concentration of less than 13 g/dL for men and less than 12 g/dL for women.<sup>11</sup> ID anemia was defined as a serum ferritin level of less than 100 µg/L or a serum ferritin level of 100 to 299 µg/L with a TSAT of less than 20% and a CRP serum level of less than 5 mg/L. Anemia of chronic disease was defined as an increased serum ferritin level, TSAT of less than 20%, and CRP of less than 5 mg/L. Anemia severity was classified based on the WHO criteria: Hb levels of 11 to 11.9 mg/dL for non-pregnant women and 11 to 12.9 mg/dL for men over 15 years of age were defined as mild anemia, Hb levels of 8 to 10.9 mg/dL were defined as moderate anemia, and Hb levels of less than 8 mg/dL were defined as severe anemia.<sup>11</sup>

**Statistical Analysis:** Quantitative variables were reported as mean  $\pm$  standard deviation (SD), and qualitative variables were expressed as frequencies and percentages. Data analysis was performed using SPSS version 22 software, employing statistical tests such as  $\chi^2$ , Mann-Whitney *U*, and *t* tests.

## RESULTS

A total of 165 patients were included in the study, with a male-to-female ratio of 1.3:1. Of these patients, 93 (56.36%) were male, and 72 (43.63%) were female. The mean age of the patients was 60.6 $\pm$ 9.9 years. The mean Hb and hematocrit levels of the patients were 12.4 $\pm$ 1.9 g/dL and 38.1 $\pm$ 5.05%, respectively. Among the patients studied, 112 (68%) were

candidates for coronary artery bypass graft surgery, 46 (28%) were candidates for valve surgery, and 7 (4%) were candidates for combined valve and coronary surgery. Anemia was prevalent in the study population, with 86 (52.1%) patients being anemic. The prevalence of anemia was higher in women than in men (55.8% vs 44.2%, respectively;  $P<0.05$ ), indicating a significant relationship between anemia and sex. Anemia severity was also analyzed in the study population and was found to be associated with sex, with women being more likely to have moderate anemia than men (52.1% vs 21.1%, respectively;  $P<0.05$ ) (Table 1). The types of anemia were determined based on the predefined criteria mentioned earlier. Table 2 presents the studied variables in the patients according to their anemia type. The results showed significant differences in TIBC, TSAT, and iron levels among the 3

types of anemia studied ( $P<0.05$ ). ID anemia was the most common type, accounting for 65 (75.6%) of the anemic patients. Anemia of chronic disease and other types of anemia accounted for 13 (15.1%) and 8 (9.3%) of the anemic patients, respectively. The prevalence of ID anemia was significantly higher in women than in men (60% vs 24.7%, respectively;  $P<0.05$ ). Conversely, the prevalence of anemia of chronic disease was significantly higher in men than in women (11.8% vs 2.9%, respectively;  $P<0.05$ ). Furthermore, creatinine levels in the group with other types of anemia were outside the normal range and significantly lower than those in the other 2 groups (Table 1). This finding may suggest impaired kidney function in patients with other forms of anemia; nonetheless, additional tests not defined in this study would be necessary to confirm this hypothesis.

**Table 1:** The Frequency of Patients by Type and Severity of Anemia

		Male	Female	P value
Anemia		44.2% (38)	55.8% (48)	0.001*
Severity of Anemia	Mild	31.2% (29)	31.9% (23)	<0.05*
	Moderate	8.6% (8)	34.7% (25)	
	Severe	1.1% (1)	0.0% (0)	
Type of Anemia	IDA	24.7% (23)	60% (42)	<0.05*
	ACD	11.8% (11)	2.9% (2)	0.03*
	Other types of anemia	50% (4)	50% (4)	0.1

IDA: iron deficiency anemia, ACD: anemia chronic disease

(\*) A P value <0.05 was considered significant.

**Table 2:** The Studied Variables Based on the Type of Anemia

Variable	IDA	ACD	Other Types of Anemia	P value
Age	61(48.5-67.0)	67(55-69)	66(57-70.75)	0.1
Sex (male/female)	(23/42)	(11/2)	(4/4)	0.005 *
Hb, g/dL	11.1(10.2-11.8)	11.8(10.6-12.2)	11.5(10.9-11.7)	0.3
Hct, %	34.8(31.8-36.5)	36.1(33.1-37.1)	35.7(33.6-38.5)	0.3
s-Iron, ng/dL	45(34-54.5)	50(23-57.5)	76(41-78)	0.1
TIBC, mg/dL	335(300-369)	281(248-310)	286(243-318)	0.001 *
TSAT index, %	13.2(9.9-17.4)	17(11.4-19)	24(10.3-28.7)	0.02 *
s-Ferritin, ng/dL	64(27-105)	489(451-544)	132(127-390)	0.001 *
s-BUN, mg/dL	18(15.3-21)	19.5(14.7-21)	25(18.1-32.9)	0.1
s-Cr, mg/dL	1(0.8-1.1)	1(0.9-1.1)	1.4(1-1.65)	0.003 *

Hb: hemoglobin, Hct: hematocrit, TIBC: total iron-binding capacity, TSAT: transferrin saturation, s-BUN: serum blood urea nitrogen, s-Cr: serum creatinine, IDA: iron deficiency anemia, ACD: anemia chronic disease

(\*) A P value <0.05 was considered significant.

## DISCUSSION

In this study, we investigated the prevalence of ID anemia among patients scheduled for cardiac surgery at a cardiovascular medical and Research center in Iran. The results showed that anemia was prevalent in 52.1% of the study population. ID anemia was the most common type, accounting for 75.6% of the anemic patients, consistent with previous studies indicating that ID anemia is a common type of anemia worldwide.<sup>12, 13</sup>

In a study by Alizadehasl et al,<sup>14</sup> conducted in Iran, reported a 24% prevalence of anemia. Given the similar population characteristics and research setting at the same center, the 52% prevalence of anemia found in the present study is surprising. This substantial increase in the frequency of pre-surgical anemic patients is concerning. Whether the overall prevalence of anemia in Iran has increased during this period, potentially influencing our study results, remains unclear. However, if this increase is attributable to changes in the transfusion practices of the center's clinicians, it warrants further investigation. Anemia prevalence was higher in women than men, indicating a significant association between anemia and sex, consistent with previous studies.<sup>15</sup> Anemia severity also showed a significant association with sex, as women were more likely to have moderate anemia than men. This finding aligns with studies by Sim et al<sup>17</sup> and others, which reported a higher likelihood of moderate and severe anemia in women than men.<sup>16</sup> A possible explanation for this observation may be the higher prevalence of iron deficiency anemia in women, leading to a gradual decrease in hemoglobin levels and an increased risk of moderate anemia.

ID anemia was the most prevalent type in the study population, affecting 75.6% of anemic patients, which chimes with previous studies reporting ID anemia as the most common type among patients undergoing

cardiac surgery.<sup>18</sup> The high prevalence of ID anemia in women compared with men may be attributed to iron loss through menstruation, pregnancy, and lactation. Inadequate iron stores can impair erythropoiesis and reduce hemoglobin levels, potentially increasing the need for blood transfusions during surgery.<sup>19</sup> In cardiac surgery patients, allogeneic red blood cell transfusions are associated with increased morbidity and mortality risks. Therefore, timely diagnosis and management of ID anemia can help reduce the need for transfusions and improve patient outcomes.

Anemia of chronic disease and other anemia types accounted for 15.1% and 9.3% of anemic patients, respectively. Anemia of chronic disease is common among patients with chronic conditions, such as heart failure, chronic kidney disease, and inflammatory disorders.<sup>20</sup> In this study, the prevalence of anemia of chronic disease was higher in men than women, consistent with previous studies.

Additionally, creatinine levels in the group with other types of anemia were outside the normal range and significantly lower than those in the other 2 groups, potentially suggesting impaired kidney function in patients with other forms of anemia. Nevertheless, further testing beyond the scope of this study would be necessary to confirm this hypothesis.

## CONCLUSIONS

Our study demonstrated an increase in the prevalence of anemia, particularly ID anemia, among patients scheduled for cardiac surgery compared with previous years at our center. Given the global emphasis on managing blood transfusions through preoperative anemia correction, particularly with iron supplementation, it is crucial to reevaluate transfusion practices at

our center. These findings underscore the importance of preoperative anemia screening and management in cardiac surgery patients, with significant implications for their clinical care.

**Conflict of Interest:** The authors declare no conflicts of interest, financial or otherwise, related to the subject matter or materials discussed in this manuscript.

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