



Original Article

## Proportion of Anemia in Patients Presenting for Elective Non Cardiac Surgeries in a Tertiary Hospital: A Retrospective Study

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### ABSTRACT

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Received: 27-02-2026

Accepted: 21-03-2026

Available online: 09-04-2026

**Introduction:** An independent correlation exists between preoperative Anemia and increased perioperative morbidity and mortality, advocates diagnostic evaluation and early intervention. When left unaddressed, Anemia can increase the risk of postoperative complications such as myocardial infarction, stroke, cognitive dysfunction, as well as increased length of stay, mortality, duration of ventilator requirement and avoidable blood transfusions. Hence, patients with severe anemia should be reassessed and possibility of delaying the surgeries to be considered aiming to build up Iron stores, if the procedure tends to be elective.

#### Aims:

1. To know the proportion of anemic patients undergoing elective non cardiac surgeries.
2. To know the time of Haemoglobin assessment prior to elective surgeries.

**Material and Methods:** This is a cross sectional study conducted in all elective, non cardiac major, intermediate and minor surgeries for a period of 1 month conducted in our department.

**Results and Conclusion:** In this study, almost one third (33%) of the patients are found to be anemic pre operatively. The proportion is more in females (37%) as compared to males (29 %).

Only 22.8 % of patients had the Hb estimation done at the recommended 3 or more weeks from the surgery, and the proportion of Anemia among them was 40 %. Nearly 20 % of the Hb estimation was done within a day of surgery, with the proportion of Anemia being approximately 47 %.

Anemia being the most common preventable comorbidity /modifiable risk factor, it is recommended to check for it atleast 3 weeks in advance, which gives enough time prior to surgery for completing the evaluation and correcting it.

Early recognition of the problem and proactive interventions including the use of oral iron and parenteral iron therapy aiming to build up iron store can prevent avoidable transfusions and transfusion-related problems.

**Keywords:** Anemia, perioperative, non cardiac, anesthesia.

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### INTRODUCTION

Anemia is a commonly encountered finding either during the preoperative assessment or during the postoperative management of the patient. Evidence suggests that the presence of anemia in the perioperative period can predispose patients to other complications. Awareness of the consequences of anemia in the perioperative period can lead to better recognition and early management of this potentially modifiable risk.

Mild anemia as defined by the World Health Organization (WHO) is hemoglobin less than 13 gm/dL in men and less than 12 gm/dL in women, with moderate anemia defined as hemoglobin less than 11 gm/dL and severe anemia as hemoglobin less than 8 gm/dL in both genders.(2)

An independent correlation exists between preoperative anemia and increased perioperative morbidity and mortality, advocates to provide early and timely diagnostic evaluation and intervention .If possible, the underlying cause of anemia should be found, treated and classified . The most common type of anemia is Iron deficiency, caused by decreased dietary intake, malabsorption, or bleeding. Other causes can be megaloblastic anemia, anemia of chronic inflammation, haemolytic anemia or blood cell dyscrasias.

Patients with multiple preoperative risks with anemia undergoing a major surgical procedure on anticoagulant treatment may be also at risk for intraoperative organ ischemia or massive transfusion and a complicated postoperative period. Anemia tends to be overlooked in the preoperative stages of evaluation, resulting in avoidable transfusions that carry their own set of potential risks.(3)When left unaddressed, anemia can increase the risk of postoperative complications such as myocardial infarction, stroke, cognitive dysfunction, as well as increased length of stay, mortality, and duration of ventilator requirement.(4)

In this study we have targeted to know the proportion of anemic patients who had undergone elective non cardiac surgeries in our institution and also to assess the time of Hb assessment prior to elective surgeries.

### **AIMS AND OBJECTIVES**

1. To find the proportion of anemic patients undergoing elective non cardiac surgeries.
2. To find the time of Hb assessment prior to elective surgeries.

### **MATERIALS AND METHODS**

This is a cross sectional study including all elective surgeries for a period of 1 month (1st December to 31st December, 2023) conducted in the department of Anaesthesia, Believers Church Medical College and Hospital, Thiruvalla, Kerala.

### **INCLUSION CRITERIA**

1. All elective list surgeries.
2. Age > 18 years

### **EXCLUSION CRITERIA**

1. Surgeries under local anesthesia.
2. Cardiac surgeries.

After obtaining approval from institutional ethics committee (IEC No: IEC/2025/06/489), the trial protocol was registered in Clinical Trials Registry -India (CTRI number: CTRI/2026/01/102324)

Data were collected from electronic health records and medical charts at our institution and extracted using a standardized form. Hence informed consent was waived off. Data were anonymized to ensure confidentiality. 543 patients were enrolled for the study, from the total 830 surgeries done during the period after excluding 138 emergency cases, 65 Paediatric cases and 84 cases done under local Anaesthesia.

### **Statistical Analysis**

Data was analyzed in R Version 4.4.1. Data was first cleaned. A univariate descriptive analysis was done and measures of central tendency and spread were calculated. Hypothesis testing was also done using appropriate tests of statistical significance.

### **RESULTS AND ANALYSIS**

#### **1) AGE AND GENDER DISTRIBUTION OF PRE-OP ANEMIC PATIENTS WITH SURGICAL RISK STRATIFICATION**

A total of 543 patients were included. 33% of patients were admitted for Orthopedic procedures, 20% were admitted for General Surgery procedures, 11 % patients were OBG procedures and 36 % were admitted for other surgical procedures.

42% of the cases were classified as surgical risk grade 1, 42% were classified as risk grade 2 and 15% were classified as

risk grade 3.

A total of 179 patients (33%) were anemic. 37% of females were anemic while 29% males were anemic.

<b>Table 1: Study Participants</b>		
	<i>Median</i>	<i>IQR</i>
<b>Age</b>	53	34-66
<b>Gender</b>	<i>N</i>	<i>%</i>
Male	272	50
Female	271	50
<b>Surgical Department</b>	<i>N</i>	<i>%</i>
General Surgery	106	20
Gynecology	60	11
Orthopedics	181	33
Others	196	36
<b>Surgical Risk Grade</b>		
I	230	42
II	230	42
III	83	15

## 2) HEMOGLOBIN INITIAL ESTIMATION TIME PRIOR TO SURGERY

- Hb estimation on average is done a median of 8 days before surgery.
- In 6% of cases Hb was estimated only on the morning of the surgery and in 14% of cases on just the day prior to surgery.
- Approximately a quarter (26 %) of the Hb was estimated with in day 2 to day 7, and the most (31 %) between day 8 to day 21 (1 to 3 weeks).
- Between day 22 to day 56 (3 to 8 weeks), 18 % of cases had Hb estimation and in 4.8 % before 56 days (8 weeks) before surgery.

<b>Table 2: Timing of Haemoglobin Estimation</b>		
	<i>Median</i>	<i>IQR</i>
<b>No of days prior to surgery that Hb was estimated</b>	8	2-20
<b>Number of Days before Surgery Hb was first estimated</b>	<i>N</i>	<i>%</i>
>56 days prior to Surgery	26	4.8
22 to 56 days prior to Surgery	98	18
8 to 21 days prior to Surgery	169	31
2 to 7 days prior to Surgery	141	26
Day Prior to Surgery	78	14
Day of Surgery	31	5.7
<b>Results of First Haemoglobin Estimation</b>	<b>Males (n=271)</b>	<b>Females (n=272)</b>
Haemoglobin (Median,IQR)	13.7 (12.5 -14.7)	12.3 (11.2 – 13.1)
Number of Anemic Patients	78 (29%)	101 (37%)
<b>Results of Post-Operative Haemoglobin</b>	<b>Males (n=182)</b>	<b>Females(n= 180)</b>
Haemoglobin (Median , IQR)	13 (11.6- 13.8)	11.2 (10.1 – 12.1)
Number of Anemic Patients	97 (54%)	54(30%)

## 3) ANEMIA DETECTION TIME PRIOR TO SURGERY

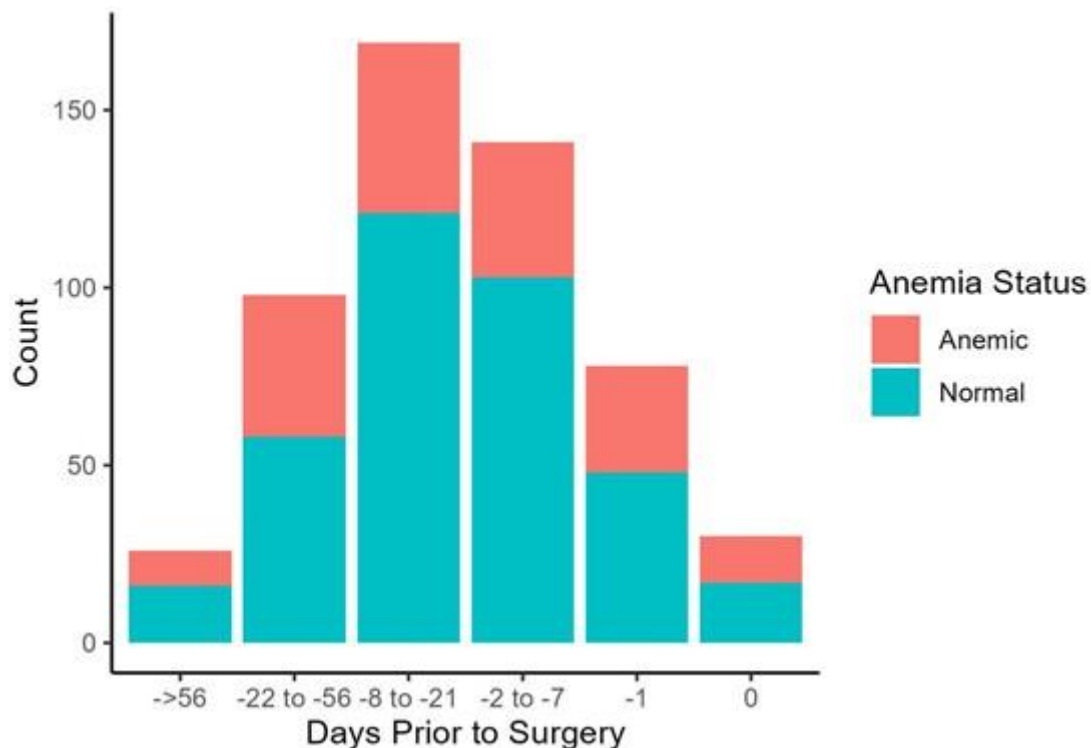
- Proportion of anemia in the 31 patients who had the Hb estimation done on the day of surgery is the highest (43%), and

among the 78, who had the estimation done a day prior to the surgery is 38 %.

- Proportion of anemia in the 141 patients who had the Hb estimation done between day 2 and 7 of surgery is 27 %, and among the 169, who had the estimation done between day 8 and 21 is 28 %.

- Proportion of anemia in the 98 patients who had the Hb estimation done between day 22 and 56 of surgery is 41 % and among the 26, who had the estimation done > 56 days is 38 %.

Timing of Surgery	Anemic
>56 days prior to surgery (n = 26)	10(38%)
22 to 56 days prior to surgery (n = 98)	40 (41%)
8 to 21 days prior to surgery (n = 169)	48 (28%)
2 to 7 days prior to surgery (n = 141)	38 (27%)
Day Prior to Surgery (n= 78)	30 (38%)
Day of Surgery (n= 31)	13(43%)



#### 4) ESTIMATION OF BLOOD UNITS TRANSFUSED PRE AND INTRA OP

Out of the 33 patients (6%) who received blood transfusions, 27 blood units transfused preoperatively and 13 units transfused intraoperatively. 7 patients needed transfusions both pre and intraoperatively. 58% of these patients were female. 13 patients had undergone orthopedic surgeries and 12 had undergone general surgery procedures. 45% of the patients who needed transfusions had a surgical risk grade of 3.

- The 1st Hb value was measured 9 days prior to surgery on average.
- The average Preoperative Hb that needed transfusion was 9.1 (IQR 7.7 to 10.1).
- The median Post Operative Hb was 10.1 (IQR 9.6-10.7).
- A total of 71 units were utilized for 543 surgeries. These include both pre-op and post op transfusions.

#### 4) PERCENTAGE OF ANEMIC PATIENTS POST OPERATIVELY

Hb was recorded post operatively in 361 patients. The average post operative Haemoglobin was 11.2 among females and 13 among males. 70% of females were anemic post operatively while only 46% of males were anemic. This difference is statistically significant ( $p < 0.001$ ). However, the Hb was estimated postoperatively only for 361 patients out of the total 543 patients. Hence the percentage of post operative anemic tends to be lower than the estimated percent.

#### DISCUSSION

Perioperative anemia is a significant concern in surgical patients, impacting outcomes and recovery. The proportion of patients experiencing anemia around the time of surgery varies widely, influenced by factors such as the type of surgery, patient demographics, and underlying medical conditions.

### **Prevalence and Factors Influencing Perioperative Anemia**

1. **Incidence:** Studies show that perioperative anemia affects approximately 30-50% of surgical patients, with higher rates observed in major surgeries, particularly orthopedic, cardiac, and oncologic procedures.
2. **Patient Demographics:** Older adults, patients with chronic diseases (e.g., chronic kidney disease, heart failure), and those with nutritional deficiencies (iron, vitamin B12, folate) are at greater risk.
3. **Surgical Type:** Intraoperative blood loss and the surgical approach (open vs. minimally invasive) contribute to the development of anemia. Major surgeries are more likely to result in significant blood loss, leading to a higher incidence of anemia.

### **Consequences of Perioperative Anemia**

**1) Cardiac:** Anemia is directly and indirectly associated with increased perioperative cardiac complications, including longer hospital stays, higher rates of infection, and increased mortality. A hematocrit below 39% was found to be inversely associated with adjusted 30-day death or cardiac event risk.(5). It is important to note that the presence of preoperative anemia is associated with an increased incidence of blood product transfusion, which in itself increases perioperative cardiac risk.(6). Similarly, intraoperative hematocrit nadir below 25% and RBC transfusion were both independent risk factors for increased troponin levels, and exposure to both low intraoperative hematocrit and transfusion conferred the highest risk of all. The group exposed to both anemia and blood transfusion had the highest mortality rate ( $P = 0.0007$ ), while the group that neither had anemia or received transfusion was associated with the lowest morbidity risk.(7) Preoperative anemia may be a potential but not independent risk factor for cardiac events postoperatively, but transfusions postoperatively definitively led to adverse outcomes. Postoperative hemoglobin drop, especially on day 1 was predictive of negative cardiac outcomes, especially CABG.(1)

**2) Pulmonary :** Anemia and perioperative pulmonary problems are closely related, but blood transfusion-related consequences are more significant. In a multicentric study conducted in 2010, it was observed that hemoglobin below 10 g/dL increases the risk of postoperative pulmonary complications (PPCs) nearly three-fold and is identified as an independent risk factor for PPCs on multivariate analysis.(8). In a 2012 study of 1,170 noncardiac surgical patients, perioperative anemia (hemoglobin <10 g/dL) is associated with increased risk for PPC on univariate, but not multivariate analysis.(9)

Studies agree that respiratory complications are increased by the transfusion of blood products. Transfusion is known to cause a host of pulmonary issues, including transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), transfusion-related immunomodulation (TRIM), and related nosocomial pneumonia.(10). In a multivariate analysis of pulmonary complications after pneumonectomy, the odds of suffering a respiratory complication are increased by 47% after a single unit blood transfusion (OR 1.47; 95% CI 1.06-2.05).(11) In addition, patients who suffer perioperative pulmonary complications experienced greater perioperative blood loss and required more hemodynamic support with colloids, blood products, and vasopressors.(12)

In summary, while preoperative anemia is linked to higher PPCs, blood product transfusions during this time may be a more accurate indicator of these problems. Anemia is a substantial risk factor for PPCs according to widely used algorithms that predict pulmonary risk.

**3) Neurologic:** Anemia and cerebrovascular events (CVEs) tend to have strong correlation because of the compromised tissue oxygen delivery to the central nervous system.. In particular, ischemic stroke and IDA have been connected via a variety of pathways. It has been proposed that endothelial adhesion molecular genes are triggered to generate thrombi in the hyperkinetic state linked to anemia, hence raising the risk of stroke. Moreover, IDA raises erythropoietin (EPO) levels, which may result in reactive thrombocytosis.

“Anemic hypoxia” from impaired oxygen tissue delivery can lead to ischemic tissue damage in the brain, as evidenced by neuroimaging of anemic stroke patients.(13) Anemia and stroke are closely intertwined. Zeng et al,(14) found that 26% of the anemic patients with hemoglobin <10 g/dL died within 6 months of stroke versus 19.7% of the non-anemic patients after adjusting for potential confounders ( $P < 0.05$ ).

**4) Cognitive:** Postoperative cognitive dysfunction is a common occurrence after major cardiac, vascular, and orthopedic surgeries, occurring at a rate of 40–60%.(15) The literature on the association between acute anemia and postoperative cognitive function has given mixed results. In a study of 108 elderly subjects undergoing cardiopulmonary bypass, those with severe anemia (defined as hematocrit <18%) experienced a higher degree of cognitive impairment than those with mild anemia (defined as hematocrit >27%).(15)

It has been demonstrated that intermittent hypoxia, which is characterized by nonsustained repeated episodes of hypoxia in between intervals of normal oxygenation with subsequent reoxygenation, affects synaptic plasticity and the production of neuronal proteins necessary for learning. A more recent secondary analysis of the prospective multicenter observational CESARO-study that included 800 patients showed that postoperative anemia was associated with a much higher incidence of delirium and hospital stays.(16) Cell hypoxia is frequently observed during major surgeries, particularly in anemic individuals, and its possible contribution to postoperative cognitive impairment should be taken into account, despite conflicting findings.

**5) Functional status:** There is plenty of literature showing an association between anemia and functional capacity, risk of fracture, and mortality in the elderly.(17).(18).(19).In a previous study, baseline physical performance was assessed in 1,146 older adults with standing balance, a timed walk, and a timed test of five chair rises. Physical performance was reassessed over 4 years for functional decline. The mean decline of physical performance was found to be significantly higher in subjects with anemia (2.3%) compared to non-anemic older adults (1.4%) (P = 0.003

Early screening of anemia and its treatment way before an elective surgery is crucial and plays a pivotal role in building up iron stores and preventing avoidable blood transfusions in the perioperative set up. In our study, we have targeted to analyse the initial Hb estimation time and found out that 6% of cases Hb was estimated only on the morning of the surgery and in 14% of cases on just the day prior to surgery. However only in 4.8% of cases Hb was estimated as early as 56 days before surgery. The negative consequences of preoperative anemia on various systems discussed above is worth emphasizing, based on this.

Also keeping in consideration that 38% patients were anemic >56 days prior to surgery while 41% were anemic within 22 to 56 days prior to surgery, its suggestive to correct anemia and build up iron stores preoperatively way before an elective surgery atleast 3-8 weeks prior to surgery. Taking into consideration that 43 % were anemic on the day of surgery, the proportion of uncorrected anemic patients coming for elective cases is found to be considerably high making the pre and intraoperative blood transfusion rates to climb .

Also we have found out that 70% of females were anemic post operatively while only 46% of males were anemic. This difference is statistically significant (p<0.001). However, Hb was estimated postoperatively only for 361 patients out of the total 543 patients. Hence the percentage of post operative anemic tends to be lower than the estimated percent

### **Management strategies**

Considering that the evidence mostly indicates positive results when packed red cell transfusions (PRCT) are avoided, it is essential to approach the treatment of anemia with this viewpoint in mind. Preoperative evaluation should occur at the earliest, to ensure adequate time for interventions.

If surgery is emergent, proceed with surgery and initiate concurrent evaluation and treatment of anemia. Studies have shown that administration of iron and erythropoietin, even as a single dose before surgery can limit the overall perioperative PRCTs needed in a patient.(20) When reasonable, elective surgeries should be deferred to allow for appropriate evaluation and treatment of anemia.

For patients with anemia due to nutritional deficiencies, initiate nutrient replacement as soon as possible. The response occurs in about 1–2 weeks and correction is expected in 6–8 weeks. Replace vitamin B12 and/ or folate, when indicated, in conjunction with iron. Iron therapy is recommended for patients with IDA and for non-anemic patients with low iron stores (ferritin <100, transferrin saturation <20%) scheduled for surgery with predicted total preoperative hemoglobin loss >3 g/dL (>1,200 mL in 70 kg adult) to protect against IDA.(21) If time permits (4 weeks or more), oral iron supplementation can be considered.(22) Ferrous and ferric formulations are equally efficacious but ferrous salts are more cost-effective.(23)

Erythropoietin analogs (EPO) can be considered with or without iron for perioperative management in most anemic patients.(24) Based on previous studies in different surgical specialties, it appears that giving a dose of IV iron (up to 1,000 mg) either as iron carboxymaltose or dextran along with high doses of EPO, B12, and folate will decrease the need for PRCT postoperatively.(25) Even when hemoglobin is in the normal range, this strategy can still be used to mitigate postoperative anemia when the anticipated blood loss during surgery is high.

### **CONCLUSION**

Perioperative anemia is a prevalent condition that poses significant risks to outcomes in surgical patients. Understanding its prevalence, its impact on cardiac, pulmonary, neurological, cognitive, and functional statuses and associated factors is crucial for implementing effective management strategies.

In our study we have highlighted to focus on the initial Hb estimation time to be atleast 3-8 weeks prior to surgery preoperative screening and optimization to improve surgical outcomes and enhance patient recovery. The most notable change in contemporary perioperative medicine notions is a move away from the idea of "transfusion-first" and toward patient blood management (PBM).

Early recognition of the problem and proactive interventions including the use of intravenous iron infusions and use of erythropoietin analogs aiming to build up iron stores can go a long way in preventing transfusions and transfusion-related problems. Anemia is one modifiable risk factor that can improve postoperative outcomes in high-risk patients and procedures.

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