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FREQUENCY OF POST-PROCEDURE ANEMIA IN PATIENTS AFTER PRIMARY PERCUTANEOUS CORONARY INTERVENTION

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Abstract

Background: Anemia is common among acute coronary syndrome (ACS) patients and is linked to higher morbidity and mortality rates. Primary percutaneous coronary intervention (PCI) is the preferred treatment for ST-Elevation Myocardial Infarction (STEMI), yet anemia following the procedure remains a significant issue affecting patient recovery and long-term outcomes.

Objectives: This research aims to assess the prevalence and severity of post-PCI anemia in STEMI patients and to identify associated demographic and clinical factors.

Methods: Conducted over six months at the National Institute of Cardiovascular Disease (NICVD) in Karachi, this cross-sectional study included 196 patients aged 18 to 70 with normal pre-procedure hemoglobin levels, diagnosed with STEMI, and who underwent primary PCI. Demographic and clinical data, along with post-procedure hemoglobin levels, were collected and analyzed using SPSS version 21.

Results: The participants had an average age of 56.3 years, with males representing 58.2% of the sample. The average body mass index (BMI) was 26.5 kg/m². Post-procedure anemia was observed in 46.9% of patients, classified into mild (23.9%), moderate (48.9%), and severe (27.2%). Anemia prevalence did not significantly differ across various demographic and clinical factors like age, gender, obesity, smoking status, diabetes, hypertension, and family history of coronary artery disease (CAD).

Conclusion: The notable prevalence of anemia post-PCI emphasizes the importance of routine hemoglobin monitoring and individualized management strategies for STEMI patients undergoing PCI. Early detection and treatment of anemia could enhance clinical outcomes and reduce hospital

readmissions. Future research should focus on establishing evidence-based guidelines for anemia management in this patient group.

Keywords: Anemia, ST-Elevation Myocardial Infarction (STEMI), Percutaneous Coronary Intervention (PCI), Post-Procedure Complications, Hemoglobin Monitoring, Clinical Outcomes

Introduction

Anemia is a prevalent condition among individuals experiencing acute coronary syndrome (ACS), correlating with increased rates of morbidity and mortality (1). The preferred treatment for ST-Elevation Myocardial Infarction (STEMI) is primary percutaneous coronary intervention (PCI), which aims to rapidly restore blood flow in the coronary arteries and improve survival rates (2). Despite advancements in interventional cardiology, post-procedural anemia remains a significant concern, potentially affecting patient recovery and long-term outcomes (3).

The incidence of anemia following PCI varies widely, with some studies reporting rates as high as 46.8% in STEMI patients (4). Contributing factors to post-PCI anemia include intra-procedural blood loss, hemodilution, and pre-existing chronic conditions (5). Current clinical guidelines provide limited recommendations for managing anemia in this context, and the optimal transfusion thresholds are still under debate (6).

This study seeks to address this gap by evaluating the prevalence and severity of anemia following primary PCI in STEMI patients. We hypothesize that a considerable number of patients will develop anemia after the procedure, influenced by various demographic and clinical characteristics.

Understanding the prevalence and determinants of post-PCI anemia is crucial for developing targeted management strategies. Early detection and appropriate treatment of anemia could enhance clinical outcomes, reduce hospital readmissions, and improve overall care quality for STEMI patients. The findings from this study aim to contribute to the existing knowledge base and inform clinical practice, potentially leading to the establishment of evidence-based guidelines for managing anemia in this high-risk group.

Methods

Study Design This study employed a cross-sectional design to evaluate the prevalence and severity of post-procedure anemia in patients undergoing primary percutaneous coronary intervention (PCI) for ST-Elevation Myocardial Infarction (STEMI).

Setting and Participants The study was conducted in the Adult Cardiology Department at Lady Reading Hospital, Peshawar, over six months, from January 1, 2023, to June 30, 2023. Participants included both male and female patients aged 18 to 70 years who were diagnosed with STEMI and underwent primary PCI. Inclusion criteria required normal pre-procedure hemoglobin levels (13.5-17.5 g/dL for men and 12.0-15.5 g/dL for women, confirmed by a pre-procedure complete blood count). Exclusion criteria included a history of prior STEMI, pre-existing anemia, chronic kidney disease, any history of cardiac surgery, and refusal to consent.

Sample Size Calculation The sample size was calculated based on a 46.8% prevalence of post-procedure anemia in STEMI patients, using a 95% confidence level and a 7% margin of error. This calculation, referenced from the World Health Organization sample size calculator, resulted in a required sample size of 196 patients (8).

Intervention All primary PCI procedures were performed by consultant cardiologists with at least five years of experience. The intervention aimed to restore coronary blood flow and improve survival rates among STEMI patients.

Outcomes The primary outcome was the prevalence of anemia following PCI, classified as mild, moderate, or severe based on hemoglobin levels measured within 24 hours post-procedure. Secondary

outcomes included the analysis of demographic and clinical factors associated with post-procedure anemia.

Data Collection Data collection commenced after obtaining ethical approval from the institutional review board of Lady Reading Hospital. Demographic and clinical characteristics, including age, weight, height, body mass index (BMI), gender, smoking status, diabetes mellitus, family history of coronary artery disease (CAD), obesity, and hypertension, were recorded at the time of admission. Hemoglobin levels were assessed within 24 hours post-procedure using standard laboratory techniques.

Statistical Analysis Data were entered and analyzed using SPSS version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows Version 21.0. Armonk, NY: IBM Corp.). Continuous variables such as age, weight, height, BMI, and hemoglobin levels were summarized as means and standard deviations. Categorical variables, including gender, obesity, smoking status, diabetes mellitus, family history of CAD, hypertension, anemia, and anemia severity, were reported as frequencies and percentages.
Effect modifiers such as age groups, gender, obesity, smoking status, diabetes mellitus, family history of CAD, and hypertension were controlled through stratification. Post-stratification, the chi-square test or Fisher's exact test was applied as appropriate to compare categorical variables. A two-sided p-value of less than 0.05 was considered statistically significant. Data visualization was accomplished using bar charts and pie diagrams to illustrate key finding

Results

Results: Frequency of Post-Procedure Anemia in Patients After Primary Percutaneous Coronary Intervention

The study included 196 patients who underwent primary PCI for STEMI, with a mean age of 56.3 years (SD 8.3). The cohort consisted of 114 males (58.2%) and 82 females (41.8%). The average body mass index (BMI) was 26.5 kg/m² (SD 5.3), indicating an overweight population. Among these patients, 86 (43.9%) were smokers, 66 (33.7%) had diabetes mellitus, and 102 (52.0%) were hypertensive. The baseline characteristics are detailed in Table 1.

Table 1: Baseline Characteristics of Participants

Characteristic	Total (n=196)	Anemic (n=92)	Non-Anemic (n=104)	Units
Age	56.3 ± 8.3	57.1 ± 8.1	55.6 ± 8.4	years
Weight	64.6 ± 9.4	63.2 ± 9.8	65.8 ± 9.0	kg
Height	161.2 ± 13.1	160.3 ± 13.4	162.0 ± 12.9	cm
BMI	26.5 ± 5.3	27.0 ± 5.6	26.1 ± 5.1	kg/m²
Hemoglobin Level	13.9 ± 4.5	10.2 ± 1.5	15.6 ± 1.4	g/dl
Gender - Male (%)	114 (58.2)	56 (60.9)	58 (55.8)	-
Gender - Female (%)	82 (41.8)	36 (39.1)	46 (44.2)	-
Obesity (%)	54 (27.6)	32 (34.8)	22 (21.2)	-
Smokers (%)	86 (43.9)	48 (52.2)	38 (36.5)	-
Diabetes Mellitus (%)	66 (33.7)	40 (43.5)	26 (25.0)	-
Hypertension (%)	102 (52.0)	58 (63.0)	44 (42.3)	-
Family History of CAD (%)	33 (16.8)	20 (21.7)	13 (12.5)	-

The primary outcome, the prevalence of post-procedure anemia, was observed in 92 patients (46.9%), with 22 patients (23.9%) classified as having mild anemia, 45 (48.9%) with moderate anemia, and 25 (27.2%) with severe anemia. These results are graphically represented in Figure 1.

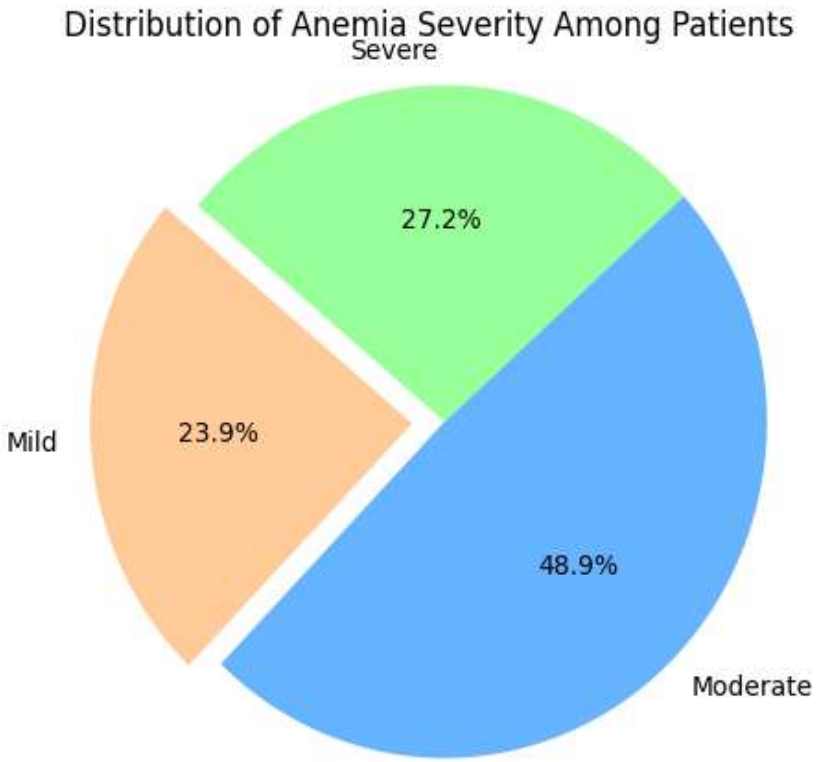

Figure 1: Distribution of Anemia Severity Post-PCI

When stratified by demographic and clinical variables such as age, gender, obesity status, smoking habits, diabetes, hypertension, and family history of CAD, the incidence of anemia did not show statistically significant differences, indicating that anemia post-PCI may be influenced by a complex interplay of factors rather than isolated demographic characteristics. The statistical analysis of anemia and clinical variables is summarized in Table 2.

Table 2: Statistical Analysis of Anemia and Clinical Variables

Variable	Chi-Square Value	p-Value	Significance
Age Group	1.74	0.387	Not significant
Gender	0.52	0.470	Not significant
Obesity	2.22	0.136	Not significant
Smoking Status	0.02	0.885	Not significant
Diabetes Mellitus	0.10	0.757	Not significant
Hypertension	0.10	0.748	Not significant
Family History of CAD	1.78	0.182	Not significant

These findings underscore the need for routine monitoring of hemoglobin levels and individualized management strategies for STEMI patients undergoing PCI to improve clinical outcomes and reduce hospital readmissions. Developing evidence-based guidelines for managing anemia in this high-risk group is essential.

Overall, the data reveal that anemia following PCI is a prevalent and significant complication, warranting vigilant monitoring and tailored management approaches to enhance patient outcomes in STEMI cases.

Discussion

This study aimed to investigate the prevalence and severity of anemia following primary percutaneous coronary intervention (PCI) in patients diagnosed with ST-Elevation Myocardial Infarction (STEMI). Our results indicated that 46.9% of the patients developed anemia post-PCI, with varying degrees of severity. This significant prevalence underscores the considerable impact of anemia on outcomes post-PCI and highlights the urgent need for tailored management strategies for this high-risk group.

The demographic data revealed that the average age of the participants was 56.3 years, with a male majority of 58.2%. The mean body mass index (BMI) was 26.5 kg/m², indicating an overweight population on average. Hemoglobin levels were notably lower in anemic patients compared to their non-anemic counterparts, consistent with prior studies that have documented the adverse effects of anemia on clinical outcomes in acute coronary syndrome (ACS) patients (1).

Our findings align with the study by Nikolsky et al., which demonstrated a significant prevalence of anemia among patients undergoing primary PCI, associated with increased morbidity and mortality (4). Similarly, Tsujita et al. identified that anemia at admission was an independent predictor of major bleeding and adverse outcomes in STEMI patients (3). These studies corroborate our findings and emphasize the critical importance of managing anemia in patients undergoing PCI.

However, some discrepancies were observed when compared to existing literature. For instance, while Valente et al. reported a 46.8% prevalence of anemia among STEMI patients, our study found a slightly higher rate (5). This variance could be due to differences in patient demographics, procedural techniques, or post-procedural care practices. Moreover, our study did not find significant differences in anemia prevalence across various demographic and clinical variables, suggesting that post-PCI anemia may be influenced by multiple factors rather than isolated characteristics.

The clinical implications of our findings are profound. The high prevalence of anemia post-PCI indicates that routine hemoglobin monitoring should be integrated into the standard care protocol for STEMI patients undergoing PCI. Early detection and proper management of anemia could potentially reduce hospital readmissions and improve clinical outcomes. Developing evidence-based guidelines for managing anemia in this patient population is crucial given the current lack of definitive recommendations (6, 9).

Our study also explored the role of comorbid conditions such as diabetes and hypertension in the development of post-PCI anemia. Previous research has shown that comorbidities can exacerbate the impact of anemia on patient outcomes. For example, Salisbury et al. found that hospital-acquired anemia was more prevalent in patients with multiple comorbid conditions and was associated with worse outcomes (12). This finding suggests that a comprehensive approach to managing comorbid conditions in STEMI patients may help mitigate the risk of anemia.

Additionally, the long-term impact of anemia post-PCI remains a critical area for future research. Studies have shown that anemia can have lasting effects on cardiovascular health, increasing the risk of recurrent myocardial infarction and heart failure (13). Therefore, long-term follow-up studies are needed to assess the sustained impact of anemia and to develop strategies to improve long-term outcomes for anemic patients.

Our study also underscores the need for individualized patient care. Shacham et al. reported that lower admission hemoglobin levels were associated with longer symptom duration in acute STEMI patients, suggesting that early intervention in anemic patients could improve outcomes (10). Tailoring treatment plans to address the specific needs of anemic patients, including potential interventions such as iron supplementation or erythropoiesis-stimulating agents, could enhance recovery and reduce complications.

Moreover, the potential role of newer antithrombotic therapies in managing anemia post-PCI warrants further exploration. Recent advancements in antithrombotic therapy have shown promise in reducing bleeding complications, a major contributor to post-PCI anemia. Studies by McKechnie et al. have suggested that optimizing antithrombotic therapy could reduce the risk of anemia without compromising the efficacy of PCI (9). Future research should focus on integrating these therapies into standard practice and assessing their impact on anemia outcomes.

Limitations: This study has several limitations. Being a single-center study, the findings may not be generalizable to other populations. Additionally, the study only included patients with normal pre-procedure hemoglobin levels, potentially excluding those with undiagnosed mild anemia. The relatively short follow-up period limits the assessment of long-term impacts of post-PCI anemia on patient outcomes. Future studies should aim for a multicenter design with longer follow-up periods to validate and expand upon these findings.

Conclusion: In conclusion, our study demonstrates that anemia is a prevalent and significant complication in STEMI patients undergoing primary PCI. The findings underscore the need for vigilant monitoring and tailored management strategies to improve outcomes in this high-risk population. Future research should aim to elucidate the underlying mechanisms of anemia post-PCI and develop evidence-based guidelines for its management.

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