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Original Article

Thirty-Day Mortality Frequency in Acute Coronary Syndrome Patients with Varying Hematocrit Levels

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ABSTRACT

Objective: To find the frequency of various hematocrit levels in patients of acute coronary syndrome (ACS) and to compare the frequency of 30-day mortality in patients of ACS with varying hematocrit levels.
Study Design: Prospective longitudinal study.
Place and Duration of Study: Emergency department, Punjab Institute of Cardiology, Lahore, Pakistan, from Dec 2024 to May 2025.
Methodology: A total of 150 patients with ACS were taken into consideration for the study. Five ml of blood were taken for assessment of hematocrit and hemoglobin levels at baseline and compared with reference ranges. Patients were called after 30 days for follow-up. If patients died during the first 30 days, their mortality was recorded.
Results: The mean age of patients was 55.27±10.56 years. Out of 150 patients, 109 (72.67%) were males. Normal, low, and high hematocrit levels were noted in 90(60%), 50(33.33%), and 10(6.67%) patients, respectively. In patients having low hematocrit levels, mortality occurred in 8(16%) patients, and in patients having high hematocrit levels, mortality occurred in 9(90%) patients (p-value <0.001)
Conclusion: The frequencies of normal, low, and high hematocrit levels were 60%, 33.3% and 6.67%, respectively. Furthermore, it is concluded that hematocrit levels are significantly associated with mortality within 30 days of ACS.

Keywords: Acute Coronary Syndrome, Anemia, Hemoglobin, Hematocrit, Mortality.

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INTRODUCTION

Acute coronary syndrome (ACS) is a collection of symptoms brought on by reduced coronary artery blood flow, which causes a portion of the heart muscle to either die or malfunction.[1] Its usual presentation is central chest pain. ST-segment elevation and non-ST-segment elevation myocardial infarction are the major and most prevalent types of ACS (50.4% and 33.5%).[2] The most common associated factors are hypertension, diabetes, smoking, family history of hyperlipidemia, obesity, atherosclerosis, and postmenopausal females.[3] Its complications include cardiogenic shock, pericarditis, cardiac arrhythmias, ventricular septal rupture, mitral regurgitation, ventricular wall rupture, aneurysm, and pseudo-aneurysm.[4]

ACS is one of the main causes of mortality after the age of forty and a significant global health concern.[5] Multiple new recommendations have been introduced in the 2020 ESC guidelines for the management of acute coronary syndromes with a focus on diagnosis, prognosis, and management of patients presenting without persistent ST-segment elevation.[6] The European Society of Cardiology (ESC) clinical practice guideline for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation was updated in 2020 and focused on the diagnostic pathway, decision-making regarding coronary imaging, and optimal antithrombotic strategy.[7] Ischemic heart disease is responsible for nine million fatalities worldwide.[8] By 2030, the prevalence is predicted to rise from 1,655 to 1,845 per 100,000 individuals.[9] Multidisciplinary treatment and thorough management techniques are crucial. Since it greatly enhances prognosis, cardiac rehabilitation.[10]

Although there is some observation about anemia being associated with increased mortality in acute myocardial infarction, this association is still conflicting due to limited and controversial data in this context, and the evidence is especially lacking in developing countries. In a similar vein, the majority of researchers have only looked at the link between low hemoglobin and acute myocardial infarction, whereas our study aimed to track 30-day mortality in patients

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diagnosed to have ACS and the relationship between patients' hematocrit levels and mortality.

METHODOLOGY

This Prospective longitudinal study was carried out at the Emergency Department of Punjab Institute of Cardiology, Lahore, Pakistan, from Dec 2024 to May 2025. After approval from the Institutional Review Board (IRB letter no EC-G/PIC/2024 and approval number 7625 (dated 27 Dec 24), patients were enrolled.

Inclusion Criteria: Patients of either gender, aged between 25-75 years, who presented with "ACS" were enrolled.

Exclusion Criteria: Patients who had already received thrombolysis, a previous history of myocardial infarction, heart failure, need cardiac or ventilator support, chronic obstructive pulmonary disease, and were on iron replacement therapy, or had chronic liver or renal disease were excluded.

The sample size came to 150 using the WHO calculator, using the percentage of raised hematocrit as 11%.[8] Patients were recruited in the study using non-probability, consecutive sampling after obtaining informed consent.

Acute coronary syndrome (ACS) was diagnosed as: STEMI: assigned as patients presenting with chest pain and new ST-elevation >2 mm at J point in 2 contiguous leads in males or >1.5 mm in females in V2 and V3, and ST-elevation >1 mm in other contiguous chest leads or limb leads with raised troponin and CK-MB. NSTEMI: assigned as patients presenting with chest pain and no ST elevation or in any other contiguous chest or limb leads with raised troponin and CK-MB.

After all aseptic measures were taken, 5 ml of blood was taken from the left cubital vein with low sucking pressure, and within half an hour, the sample was deposited in the pathology lab of Punjab Institute of Cardiology for all the baseline investigations, including the hematocrit and hemoglobin levels, and was compared with reference ranges. Normal hematocrit levels were taken as 40.7%-50.3% for men and 36.1%-44.3% for women. Levels below 40.7% for men and below 36.1% for women were labeled as low hematocrit levels. Similarly, levels above 50.3% for men and above 44.3% for women were labeled as high hematocrit levels. Patients were called to the OPD for follow-up for 30 days, and mortality was recorded if it occurred. If any patient did not come to OPD, then follow-up of such patients was done through telemedicine via phone call. Data was collected by the researcher himself on a pre-designed proforma.

Data was entered and analyzed using Statistical Package for Social Sciences (SPSS version 25).Thirty-day mortality was presented as frequency and percentages. Mortality in various hematocrit groups was compared using Chi-square test/Fisher's exact test, taking *p*-value ≤ 0.05 as significant.

RESULTS

The mean age of enrolled cases was 55.27±10.56 years. In this study, 109(72.67%) cases were male, while 41(27.33%) cases were female. The male-to-female ratio was noted as 2.6:1. Diabetes mellitus was found in 98(65.3%) patients, and hypertension in 103(68.7%) patients (Table-I).

Table-I: Baseline Features of Acute Coronary Syndrome Patients (n=150)

Variables	Output
Age (years, Mean±SD)	55.27±10.56
Gender	
Males	109(72.7%)
Females	41(27.3%)
History of	
Diabetes Mellitus	98(65.3%)
Hypertension	103(68.7%)

We found normal hematocrit levels in 90(60%) patients, low hematocrit levels in 50(33.33%) patients, and high hematocrit levels were found in 10(6.67%) patients (Figure-1). Thirty-day mortality occurred in 17(11.33%) patients, as seen in Figure-2. In patients having low hematocrit levels, mortality occurred in 8(16%) patients, and in patients having high hematocrit levels, the mortality occurred in 9(90%) patients. The difference was statistically significant (*p*-<0.001), which can be seen in Table-II.

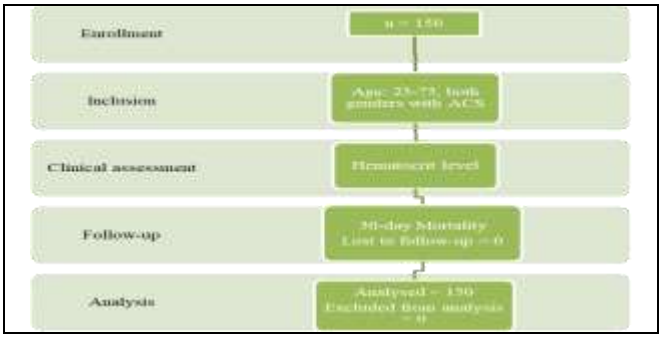

Figure-1: Patient Flow Diagram (n= 150)

In patients aged ≤50 years, the mortality was noted in 2(90.1%) cases with low hematocrit level, and

in 2(66.7%) cases having high hematocrit level (*p*-value<0.001). Similarly, in cases aged >50 years, mortality was noted in 6(21.4%) cases with low hematocrit level, and in 7(100%) cases having high hematocrit level (*p*-value<0.001). In males, mortality was noted in 6(16.7%) cases with low hematocrit level, and in 5(83.3%) cases having high hematocrit level (*p*-value<0.001). Similarly, in females, mortality was noted in 2(14.3%) cases with low hematocrit level, and in 4(100%) cases having high hematocrit level (*p*-value<0.001). In diabetic cases, mortality was noted in 3(10.7%) cases with low hematocrit level, and in 8(88.9%) cases having high hematocrit level (*p*-value<0.001). Similarly, in non-diabetic cases, mortality was noted in 5(22.7%) cases with low hematocrit level, and in 1(100%) case having high hematocrit level (*p*-value<0.001). In hypertensive cases, mortality was noted in 6(27.3%) cases with low hematocrit level, and in 8(88.9%) cases having high hematocrit level (*p*-value<0.001). Similarly, in non-hypertensive cases, mortality was noted in 2(7.1%) cases with low hematocrit level, and in 1(100%) case having a high hematocrit level (*p*-value=0.019), which can be seen in Table-III.

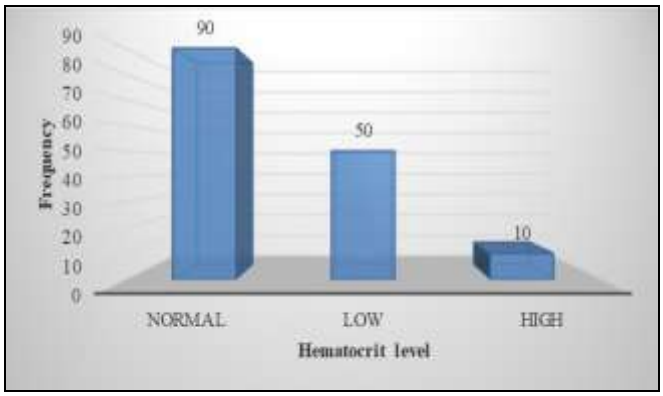

Figure-2: Distribution of patients in various hematocrit level groups (n = 150)

Table-II: Comparison of Mortality Within 30 Days in Patients with Varying Hematocrit Level (n=150)

		Hematocrit levels			*p*-value
		Normal n=90	Low n=50	High n=10	
Status of patient within 30 days	Survived	90(100.0%)	42(84.0%)	1(10.0%)	<0.001
	Dead	0 (0.0%)	8 (16.0%)	9(90.0%)	

DISCUSSION

In this study, a normal hematocrit level was noted in 90(60%) patients, a low hematocrit level was found in 50(33.33%) patients, and a high hematocrit level in 10(6.67%) patients. In patients having low hematocrit levels, mortality occurred in 8(16%) patients, and in patients having high hematocrit levels, mortality occurred in 9(90%) patients (*p*-value<0.001). Both abnormal hematocrit levels and cardiovascular problems from non-cardiac surgery are more likely to occur in elderly people. Although hematocrit readings are almost always measured before major surgery, little is known about the prognostic consequences of preoperative anemia or polycythemia for this high-risk group.[11] The majority of investigations have disagreed on the hematocrit threshold at which this might be detrimental, although high hematocrit levels have been linked to a higher risk of atherosclerosis and in the progression of cardiovascular diseases.[12]

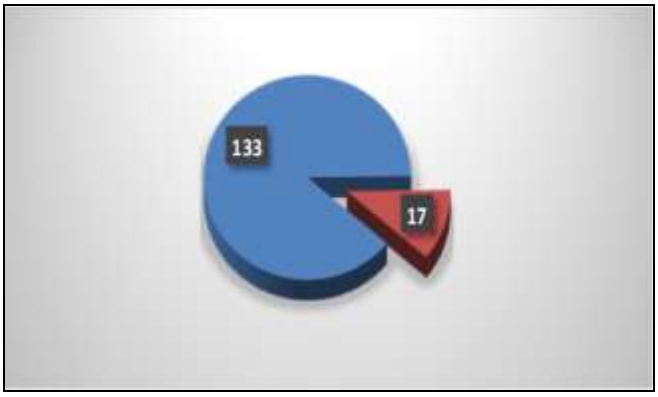

Figure-3: Mortality Noted within 30 days of Hospital Admission (n = 150)

Table-III: Comparison of Mortality Within 30 days in Patients with Varying Hematocrit Levels with Respect to Increasing Age, Gender, and Comorbidities (n=150)

Variables	Hematocrit Levels			*p*-value
	Normal n=90	Low n=50	High n=10	
Age				
Age ≤ 50 years	0(0.0%)	2(9.1%)	2(66.7%)	<0.001
Age >50 years	0(0.0%)	6(21.4%)	7(100.0%)	<0.001
Gender				
Male	0(0.0%)	6(16.7%)	5(83.3%)	<0.001
Female	0(0.0%)	2(14.3%)	4(100%)	<0.001
Diabetic Status				
Diabetic	0(0.0%)	3(10.7%)	8(88.9%)	<0.001
Non-diabetic	0(0.0%)	5(22.7%)	1(100.0%)	<0.001
Diabetic				
Hypertensive	0(0.0%)	6(27.3%)	8(88.9%)	<0.001
Non-hypertensive	0(0.0%)	2(7.1%)	1(100%)	0.019

According to Mahmoodi *et al.*, the prevalence of myocardial infarction in patients with anemia was 17.9% and 14.0%, respectively, whereas in patients

with high levels within the normal range, myocardial infarction occurred in 8.8% and 20.2% cases.[13] In one research conducted by Rogers *et al*., 1042 consecutive patients with ST elevation myocardial infarction were divided into three groups based on their baseline hematocrit: erythrocytosis (>46% for women and >47% for men), anemia (<36% for women and <39% for men), and normal (39%-47% for men and 36%-46% for women).[14] A study by Bodoloea *et al*., used baseline (admission) hematocrit readings showing that 116(11%) had erythrocytosis, 718(69%) had normal hematocrit, and 208(20%) had anemia. These groups' 30-day mortality rates were 7.3%, 2.2%, and 4.8%, respectively.[15] These values are consistent with findings of our study, and patients with low hemoglobin levels are at a higher risk of adverse events.

Both lower and higher hemoglobin levels were associated with a higher cumulative 2-year death risk, according to recent clinical studies. Ali *et al*., indicated that a high hematocrit score was linked to a higher risk of myocardial infarction.[16] High viscosity is known to be correlated with high hematocrit, and a highly viscous fluid takes more pump effort to circulate than a less viscous fluid. Additionally, Burch *et al*., reported that there is less flow of a very viscous fluid will be the main factor.[17]

Wu *et al*., highlighted that lower admission hematocrit levels were linked to higher 30-day mortality in a large study of older patients with myocardial infarction.[18] Similarly, Lipsic *et al*., reported that individuals with severe anemia upon admission had higher 30-day death rates, according to another retrospective analysis of 1841 patients.[19] One study by Greenberg *et al*., demonstrated that the measurement of hematocrit can be used as a useful prognostic marker in patients with STEMI.[20] It also highlighted that the incidence of myocardial infarction is influenced by both anemia and elevated hematocrit levels. However, Arant *et al*., explained that anemia, particularly in women, may be a possible predictor of unstable angina incidence in ACS patients.[21] This result was consistent with the other research as well.

Rao *et al*., found that transfusion was linked to a higher 30-day death rate in patients with ACS and anemia, but that this effect was insignificant when the hematocrit was less than 25%.[22] The results of this were inconsistent with the results of our study, as we observed a significant association. This may be because the study was conducted on data from three large international trials of patients with acute coronary syndromes (the GUSTO IIb, PURSUIT, and PARAGON B trials) that enrolled 24,112 patients. But a study by Wu *et al*., found that patients with hematocrit levels between 39.0% and 50.9% had the lowest chance of unfavorable outcomes. In elderly patients with ACS, Wu *et al*., discovered that when the hematocrit was less than 30%, transfusion was advantageous. A higher risk of 30-day postoperative death and cardiac events was linked to even small departures from this ideal range.[23] This was also in favor of the findings of our study.

Additionally study by Sabatine *et al*., recommended transfusion when hemoglobin levels were less than 12 g/dL.[24] The prognosis improved for ACS patients with ST-segment elevation; however, Welch *et al*., also presented that prognosis deteriorated for ACS patients without ST-segment elevation, irrespective of the hemoglobin level.[25]

LIMITATIONS OF STUDY

In any event, further research on this subject is required in the future to assess the results of our investigation. A bigger sample size and a multicenter method should be used for the research. Given that our study's modest size is one of its shortcomings. Effect of other variables like smoking, tobacco chewing, lifestyle, dietary habits, occupation etc., should also be assessed to see how these factors, along with low hemoglobin level, could enhance the risk of 30-day mortality.

CONCLUSION

According to this study, the frequency of normal, low, and high hematocrit levels of the patients was 60%, 33.3% and 6.67% respectively. Furthermore, it is concluded that hematocrit levels are associated with the 30-day mortality in patients of ACS.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SM & SI: Data acquisition, data analysis, critical review, approval of the final version to be published.

AR & BM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SM & MAA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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