IMPACT OF ANEMIA ON OUTCOMES IN ACUTE CORONARY SYNDROME: A CLINICAL, PATHOPHYSIOLOGICAL AND BIOCHEMICAL PERSPECTIVE

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ABSTRACT

Objective: To determine the outcome in hospital anemic patients presenting with acute coronary syndrome.

Methodology: A single centred, prospective, cross-sectional study conducted from June 10 to December 09, 2022 on 147 patients with acute coronary syndrome along with anemia admitted in cardiology department of Sheikh Zayed Medical College/Hospital were included in the study after fulfilling inclusion criteria. Labs were recorded to document anemia (labelled as Hb less than 10mg/dl); along with other demographics and study parameters. These cases were followed to look for in- hospital cardiogenic shock, heart failure, recurrent infarction and/or death.

Results: In this study there were total 143 cases out of which 93(65.03%) were males and 50(34.97%) females with mean age was 49.59±6.03 years. The frequency of DM was 21(14.69%), HTN was 47(32.87%), smoking was 38(26.57%). In the present study, cardiogenic shock was seen in 27(18.88%), heart failure in 32(23.38%), recurrent infarction in 28(19.58%) and mortality was seen in 8(5.59%) of cases. There was significantly high cases of cardiogenic shock in cases with STEMI affecting 22 out of 82 cases with p=0.03. Heart failure was also significantly high in cases with STEMI where it was seen in 23 out of 82 cases with p values of 0.04. Recurrent infarction was significantly high in cases with Hb less than 7 where it was seen in 11 out of 53 cases with p=0.04 and with STEMI with p=0.03. Mortality was also significantly high in cases with Hb less than 7g/dl where it was seen in 5 out of 53 cases.

Conclusion: Complications are higher in cases having acute coronary syndrome along with anemia and the most common one seen is heart failure. Furthermore, cardiogenic shock, heart failure, recurrent infarction are significantly associated with STEMI while, recurrent infarction and mortality

are significantly high in cases with Hb less than 7mg/dl.

Key Words: Acute Coronary Syndrome, Myocardial Infarction, Shock, Anemia.

INTRODUCTION:

Acute coronary syndrome (ACS) is an emergency cardiac condition which includes either ST-elevation myocardial infarction (STEMI) or non-ST elevation myocardial infarction (NSTEMI), or unstable angina. This subgroup of coronary artery disease (CAD) is responsible for around one- third of total deaths among people of age more than 35 years.[1]

While, anemia is defined as lack of enough healthy red blood cells or decreased hemoglobin levels to carry the required amount of oxygen to the body tissues. Hemoglobin is the protein found in red blood cells that binds oxygen carrying it from lungs to all other tissues in the body. Anemia can cause lethargy, weakness, muscular body-aches and shortness of breath. There are many types of anemia; each having its own causes and different management strategies. Anemia can be categorised as mild to severe or short-term to long-term or as per its etiology. Anemia can be an alarming sign for some critical illness.[2]

There are three main determinants of overt anemia i.e adequate erythropoiesis as from bone- marrow, adequate erythropoietin production from kidneys and adequate haemodilution. Ischemic heart disease can effect any of these pathogenic determinants thus, leading to Haemoglobin abnormalities. Therefore, addressing the underlying cause of anemia in that patient may possibly lessen the negative prognostic impact of anemia in the acute settings of coronary artery disease.[3]

Anemia has a strong association with CAD showing significantly bad clinical outcomes.[4,5] In a study, out of all the patients presenting with ACS, about 16.8% having STEMI and 27.7% having NSTEMI were found having pre-existing anemia. Among them, most or the patients were in old ages and were mostly suffering from either renal diseases or peripheral vascular diseases or diabetes mellitus and/or ischemic heart disease. Additionally, it was observed that around 30.7% of the patients with CAD developed anemia during hospitalisation; apart the ones having pre- existing anemia.[4,6]

METHODOLOGY:

✦ Study Design: Cross-sectional Study

✦ Study Setting: Department of Cardiology, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan.

✦ Study Duration: This study was conducted from June 10 to December 09, 2022; after getting ethical approval from the Institutional Review Board of Sheikh Zayed Medical College/ Hospital, Rahim Yar Khan.

✦ Sample Size: The sample size was calculated to be 143 by taking 95% confidence interval with 5% margin of error and 80% power of test.

✦ Sampling Technique: Non-probability Consecutive Sampling

✦ Inclusion Criteria: All patients (aged between 30-60 years; regardless of gender) presenting with acute coronary syndrome along with anemia to the Chest-Pain-Unit of Cardiology Department of Sheikh Zayed Medical College/Hospital, Rahim Yar Khan were included in the study.

✦ Exclusion Criteria: Any patient with s/p CABG or s/p any surgical intervention within 24 hours before/after presentation or electrolyte imbalance (potassium more than 6 mEq/L) or having any pre-existing chronic liver/kidney disease (assessed by history and medical record) was excluded from the study.

Taking the study subjects, ACS was managed as per protocols and a complete blood count was performed to document anemia (labelled as Hb less than 10mg/dl). Then, the data of each patient regarding his/her identity, socio-demographic profile, history of diabetes mellitus, hypertension, smoking, haemoglobin level and type of ACS was recorded on the study performa.

Upon treatment of these patients, they were retained in cardiac ward till stabilisation followed by discharge or else. These patients underwent BP monitoring 4 hourly and daily ECG to look for level of BP and new changes in ECG. Systolic BP less than 90 mmHg for more than 1 hour was labeled as

cardiogenic shock. The cases with new changes in ECG underwent serum CK-MB level to label as recurrent infarction. Moreover, patients underwent trans-thoracic echocardiography on day 03 of admission by a consultant cardiologist with at least 1-year post- fellowship experience and were assessed for heart failure. The cases were looked for mortality as well. The results of outcome variables were noted on the study performa i.e cardiogenic shock, heart failure, recurrent infarction or death. Then, data was digitalised and analyzed with the help of SPSS version 21. Quantitative variables like age were presented in terms of mean±SD (Standard Deviation) while, frequencies & percentages are calculated for qualitative variables like gender, history of diabetes mellitus, hypertension, smoking and type of ACS. Effect modifiers were controlled through stratification. Post-stratification chi-square test was applied and p-value of <0.05 was considered significant.

RESULTS:

A total of 143 patients were included in the study. Mean age of study subjects came out to be 49.59±6.03 years; including 34(23.78%) study subjects aged between 30-45 years while remaining 109(76.22%) study subjects aged between 46-60 years. Demographic characteristics of study subjects showed that 93(65.03%) were males and 50(34.97%) were females.
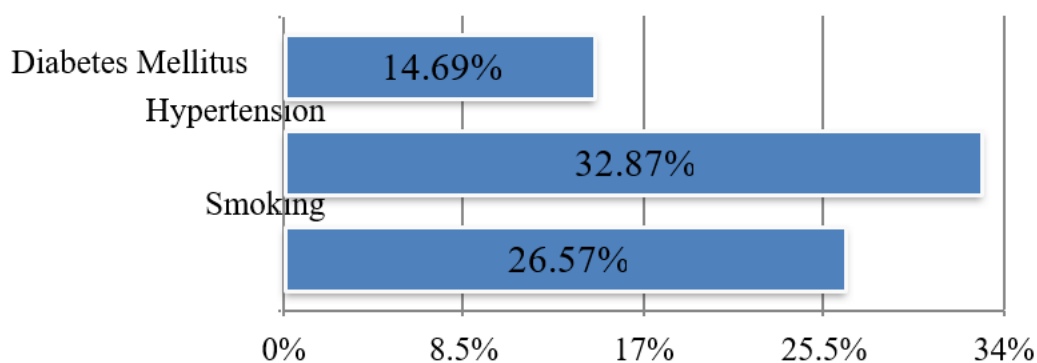

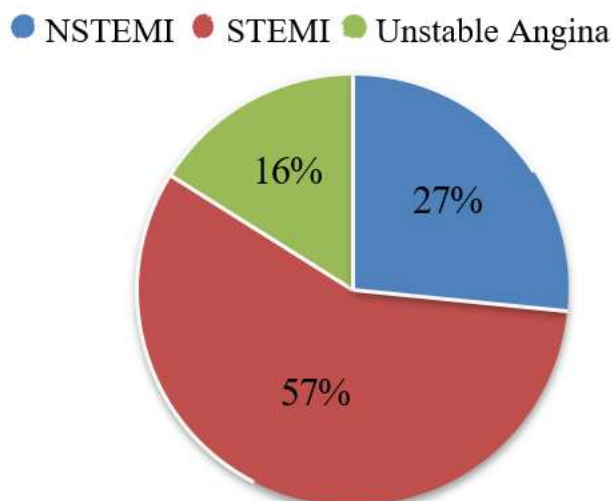**Figure 01.** showing distribution of multiple risk factors among study subjects.

Figure 02. Showing distribution of study subjects as per type of ACS at presentation.
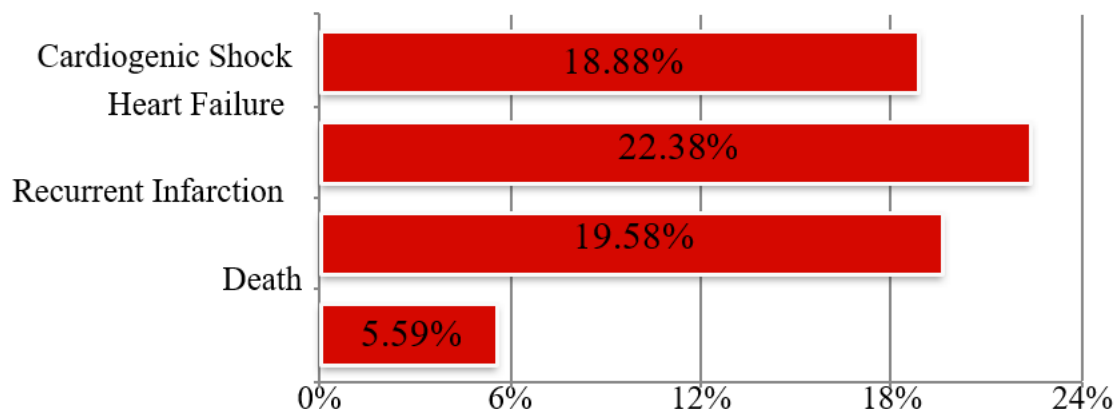
Figure 03. showing overall distribution of complications of ACS among study subjects.

Cross tabulation done to determine the relationship between our study variables for outcome in hospital anemic patients presenting with acute coronary syndrome is as under:

Characteristics		Complication of ACS			
		Cardiogenic Shock	Heart Failure	Recurrent Infarction	Death
Age Groups	30-45 years	6 (17.65%)	5 (17.71%)	4 (11.76%)	1 (2.94%)
	46-60 years	21 (19.26%)	27 (24.77%)	24 (22.01%)	7 (6.42%)
	p-value	0.78	0.66	0.67	0.51
Gender	Male	18 (19.35%)	19 (20.43%)	17 (18.28%)	5 (5.37%)
	Female	9 (18%)	13 (26%)	11 (22%)	3 (6%)
	p-value	0.44	0.87	0.45	0.34
Hemoglobin Concentration	<7g/dl	12 (22.64%)	14 (26.41%)	11 (20.75%)	5 (9.43%)
	≥7g/dl	15 (16.67%)	18 (20%)	17 (18.89%)	2 (2.22%)
	p-value	0.67	0.14	0.04	0.02
Hx of Diabetes Mellitus	Yes	5 (23.81%)	8 (38.1%)	6 (28.57%)	2 (9.52%)
	No	22 (18.03%)	24 (19.67%)	21 (17.21%)	6 (4.92%)
	p-value	0.78	0.45	0.45	0.45
Hx of Hypertension	Yes	11 (23.4%)	12 (25.53%)	11 (23.4%)	2 (4.26%)
	No	16 (16.67%)	20 (20.83%)	17 (17.71%)	6 (6.25%)
	p-value	0.18	0.45	0.58	0.34
Hx of Smoking	Yes	6 (15.79%)	7 (18.42%)	6 (15.79%)	2 (5.26%)
	No	21 (20%)	25 (23.81%)	22 (20.95%)	6 (5.71%)
	p-value	0.68	0.56	0.24	0.38
Duration of ACS	<6 Hours	7 (16.67%)	7 (16.67%)	6 (14.29%)	1 (2.38%)
	≥6 Hours	16 (15.84%)	30 (29.7%)	22 (21.78%)	5 (4.95%)
	p-value	0.56	0.88	0.44	0.56
Type of ACS	STEMI	22 (26.83%)	23 (28.05%)	22 (26.83%)	4 (4.88%)
	NSTEMI	5 (12.82%)	8 (20.51%)	6 (15.38%)	2 (5.13%)
	Unstable Angina	0	1 (4.35%)	0	0
	p-value	0.03	0.04	0.03	0.45

DISCUSSION:

Acute coronary syndrome is labelled as a group of diseases that corresponds to acutely reduced blood flow to the cardiac muscles i.e STEMI, NSTEMI, Unstable Angina. STEMI or NSTEMI happens when there is cardiac cell death thus, damaging/destroying the heart tissues. While, Unstable angina results due to decreased flow of blood to the heart i.e not severe enough causing death of cardiac tissues or a myocardial ischemia. But, this decreased flow of blood towards cardiac muscles increases risk of a myocardial ischemia. Cardiac enzymes including troponin, CK-MB/CK ratio are used to differentiate for myocardial ischemia apart from ECG criteria. Acute coronary syndrome, often causing severe chest pain, is a cardiac emergency that needs immediate medical care/intervention. Thus, improving the flow of blood towards cardiac muscles and/or treating the relevant complications and/or preventing any further problems.[1,7]

Cardiovascular Diseases are responsible for around one third of all deaths in the world; with 7.5 million deaths due to ischemic heart diseases. Out of these stats, around 1.8 million deaths per annum are due to acute coronary syndromes including sudden cardiac arrest.[8]

Anemia and acute coronary syndrome are fatal conditions at their own and can affect the patients in different ways and can also damage the myocardium synergistically as well. The prevalence of anemia is variable across the globe and is variable due to socioeconomic status, parasitic infections, quality of life etc. In a study done at Punjab Institute of Cardiology (Lahore, Pakistan), the incidence of cases presenting with acute coronary syndrome (ACS) and anmeia was found to be 28.95%.[9]

In our study, out of the 143 cases suffering form acute coronary syndrome and anemia, cardiogenic shock was seen in 27(18.88%), heart failure in 32(22.38%), recurrent infarction in 28(19.58%) and mortality was seen in 08(5.59%) of cases. These findings were in line with the results of the various previous studies and trials that revealed the same complication rates among the patients. Previous reports have suggested that ACS patients suffering from anemia have significantly worse in-hospital and longer-term outcomes. They include congestive heart failure, cardiogenic shock, risk of major bleeding, re-infarction and immediate or long-term mortality effect.

Lorente V. et al revealed in their study that those with anemia had significantly higher rates of in-hospital complications than non-anemic patients with ACS; comprising refractory ischemia in 10.2% vs 3.7%, re-infarction in 3.1% vs 1.2%, major bleeding in 8.6% vs 10.2% and increased likelihood of mortality/readmission (HR = 2.80, 95% CI: 2.03–3.86, P = 0.001).[10]

An umbrella review done by Christian Jung et al concluded that the patients being admitted with ACS having co-existing anemia at the time of admission tend to have worse clinical outcomes (RR 2.08 95%CI 1.70–2.55).[11]

According to the results of our study, Cardiogenic shock, heart failure and recurrent infarction were significantly associated with cases that had STEMI. Among patients with STEMI, cardiogenic shock was seen in 26.83% cases (p=0.03), heart failure in 28.05% cases (p=0.04), recurrent infarction in 26.83% cases (p=0.03) and death in 4.88% (p=0.45). These findings come in line with the results found by a study done by Ali Reza Rai et al which found cardiogenic shock in 8.2% patients having anemia with STEMI, heart failure in 68.1%, in- hospital death in 12.2% and one-year mortality in 14%.[12]

The other risk factor that led to significantly high degree of recurrent infarction and mortality was severe anemia. Recurrent infarction was seen in 11 out of 53 cases with Hb less than 7g/dl and mortality was also significantly high them as seen in 5 out of 53 cases as compared to 2 out of 90 cases with Hb more than 7g/dl. This trend of increased complication rate with decreasing hemoglobin levels has also been described by Junyu Pei et al in their study.[13]

CONCLUSION:

Complications are higher in cases having acute coronary syndrome along with anemia and the most common one seen is heart failure. Furthermore, cardiogenic shock, heart failure, recurrent infarction are significantly associated with STEMI while, recurrent infarction and mortality are significantly high in cases with Hb less than 7g/dl.

LIMITATIONS:

This study was conducted on a limited data available at a single center. And it did not elaborate the different types of anemia with these outcomes nor did the stratification of data with pre- existing vs in-hospital anemia and a few other outcomes could have also been included which are common in this confluent co-morbid condition. That's why, further studies on this subject with large number of patients in multi-centre environments are needed for a clearer picture about effect modifiers contributing towards complications in patients with ACS having anemia.

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