

Prevalence of Anemia in STEMI

Dr. Vishavdeep Jain¹, Dr. Arpan Chouhan², Dr. Amrit Kejriwal³

Name & Full Location Of Institute & Department Where The Work Was Performed: Mgm Medical College And Hospital Sector 1 Kamothe, Navi Mumbai, Maharashtra, India

Corresponding Author: Dr. Vishavdeep Jain

Abstract

Background: Considering high prevalence of Anemia in general population and direct impact on patient health, Anemia causes important physiologic effect on the cardiovascular system; however studies measuring Anemia prevalence in population is rare. CVDs, are the most common cause of death worldwide, including (40%) in high-income countries, and (28%) in low and middle-income countries. Present study was performed to analyze the prevalence of Anemia in patients with cardiovascular disease.

Method: The study was conducted at MGM hospital with 100 ST-elevated myocardial infarction patients between 18 to 70 years age group.

Results: The most common age group amongst study population was 51 to 60 years. 15 % of study population had anemia. Anemia was observed most commonly in the age group of 51 to 60 years. There was statistically no significant difference between sex and study population. Anemia was observed in 17.9 % of hypertension (7 out of 39 cases). There was statistically significant difference between TB and study population and it was statistically not significant between hypertension. There was statistically no significant difference between CPKMB and study population. There was statistically significant difference between MCV and study population. There was statistically significant difference between MCH and study population. There was statistically significant difference between TIBC and study population. There was statistically significant difference between Serum Vitamin B 12 and study population.

Conclusion: The study concluded that the anterior wall myocardial infarction is more commonly associated with anemia. Iron deficiency anemia was observed to be the most prevalent type of anemia seen in STEMI. Appropriate treatment of anemia may lead to decrease in morbidity.

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I. Introduction

Anemia is defined as a hemoglobin concentration in the blood below the lower limit of the normal range for the age and sex of the individual. In adults, the lower extreme of the normal

Hemoglobin is taken as 11.0-13.0g/dl for males and 10- 11.5g/dl for females. One of the major health challenges to global development in this century is the rapid rise of Non-Communicable Diseases (NCDs) in both developed and developing countries. This growing challenge threatens economic and social development as well as the lives and health of millions of people.¹ The study revealed that, most of the identified CVD risk factors were obesity (61.5%), hypercholesterolemia (37.8%), hypertension (30.7%), diabetes (46.7%), physical inactivity (46.8%) and smoking 16.3%.² In westernized countries, CVD accounts for the majority of deaths each year. It is reported that Anemia may present a special risk in these patients.³ Considering high prevalence of Anemia in general population and direct impact on patient health, Anemia causes important physiologic effect on the cardiovascular system; however studies measuring Anemia prevalence in population is rare. CVDs, are the most common cause of death worldwide, including (40%) in high-income countries, and (28%) in low and middle-income countries.⁴ Mark et al, explained that Anemia, is an independent risk factor for CVD outcomes in

¹World Health Organization. Proceedings of the 15th Annual Conference of the Indian Society of Hypertension and 4th International CME on Atherosclerosis, "Hypertension and Coronary Artery Disease," WHO New Delhi India, November. 2005.

²UNRWA United Nations Relief and Work Agency for "Palestine Refugees in the Near East," Annual Report of the Department of Health. 2006.

³Joyce A, Wahr, "Anaemia and Cardiovascular Disease," Transfusion alternative in transfusion medicine, (2). 24-30. 2008.

⁴Fauci A, Braunwald E, Kasper D, Hauser S, Longo D, Jameson J, et al. Harrison, "Principle's of internal medicine," 17 Ed. New York: McGraw publishing Co. 2008.

the ARIC cohort, a community cohort of subjects between the ages of 45 and 64 years.⁵ Present study was performed to analyze the prevalence of anemia in patients with cardiovascular disease and explore STEMI is a clinical syndrome defined by characteristic symptoms of myocardial ischemia in association with persistent electrocardiographic (ECG) ST elevation and subsequent release of biomarkers of myocardial necrosis.

Diagnostic ST Elevation in the absence of left ventricular (LV) hypertrophy or left bundle-branchblock (LBBB) is defined by the European Society of Cardiology/ACCF/AHA/World Heart Federation Task Force for the Universal Definition of Myocardial Infarction as new ST elevation at the J point in at least 2 contiguous leads of ≥ 2 mm (0.2 mV) in men or ≥ 1.5 mm (0.15 mV) in women in leads V2–V3 and/or of ≥ 1 mm (0.1 mV) in other contiguous chest leads or the limb leads. The majority of patients will evolve ECG evidence of Q-wave infarction. New or presumably new LBBB has been considered a STEMI equivalent.

Objectives

To identify the types of anemia as prevalence in STEMI.

Methods

- Study includes 100 ST-elevated myocardial infarction patients admitted at MGM Hospital.
- To evaluate by minimal set of blood tests and Investigations after written informed consent.

Inclusion Criteria:

- Age group between 18 years to 70 years
- ST Elevated Myocardial Infarction Patients.
- Patients with hemoglobin levels of < 11 g/dl in males and < 10 g/dl in females

Exclusion Criteria:

- Age < 18 years and > 70 year
- NSTEMI patients
- Unstable angina
- Chronic Kidney Disease
- Diagnosed cases of anemia on treatment.

Statistical Analysis

All the collected data was entered in Microsoft Excel sheet and then transferred to SPSS software ver. 20 for analysis. Qualitative data was presented as frequency and percentages and analyzed using chi-square test (in case of 2x2 contingency tables). Quantitative data was presented as mean and SD P-value < 0.05 was taken as level of significance.

II. Results

The most common age group amongst study population was 51 to 60 years (46%) followed by 61 to 70 years (28%) and 38 to 50 years (26%). There was male predominance (74%) amongst study population. Worker (49%) was the most common occupation amongst study population followed by farmer (26%), Housewife (19%) and, Business (15%). 21% and 20% of study population were smokers and alcoholic respectively. 61%, 78% and 9% of study population were had Hypertension, Diabetic and TB respectively. CPK-MB was raised in 85% of study population. Microcytic Hypo (10%) was the most common Peripheral smear findings amongst study population followed by Macrocytic and Hypochromic (3%) and Dimorphic Anemia (2%). 4%, 2% and 94% of study population had decreased MCV, increased MCV and normal MCV respectively. 8% and 92% of study population had decreased MCH and normal MCH. 10% and 90% of study population had decreased MCHC and normal MCHC. 10%, 1% and 89% of study population had decreased, increased and normal serum iron respectively. 2%, 10% and 88% of study population had increased, decreased and normal serum ferritin levels respectively. 10% and 90% of study population had increased and normal TIBC. 4% and 96% of study population had increased and normal serum vitamin B 12 respectively. Anterior Wall Myocardial infarction (41%) was the most common ECG findings amongst study population followed by Inferior Wall Myocardial infarction (25%), lateral Wall Myocardial infarction (24%). 15% of study population had Anemia. hemoglobin was significantly lower in Anemia as compared to non-Anemic groups. Anemia was observed most commonly in the age group of 51 to 60 years (46.7%) followed by 38 to 50 years (33.3%) and 61 to 70 years (20%). There was no statistically significant difference age group and study population. Anemia was seen in 6 out of 26 females and 9 out of 74 male populations had anemia. Of the anemic patients males constituted (60%) followed by

⁵Mark J, Sarnak, Hocine Tighiouart, Guruprasad Manjunath, et al, "Anaemia as a Risk Factor for Cardiovascular Disease in the Atherosclerosis Risk in Communities (ARIC) Study," J Am Coll cardiology, 40 (1). 27-33. 2002.

female (40 %). There was no statistically significant difference sex and study population. 40 % (6 out of 15 cases) of anemic population were smokers and 40 % (6 out of 15 cases) were alcoholic and this difference was statistically significant. 46.67 % (7 out of 15 cases) of anemic population had history of hypertension, 33.33% (5 out of 15 cases) had history of DM and 33.33% (5 out of 15 cases) had history of TB and this difference was statistically significant. There was statistically significant difference between TB and study population and it was statistically not significant between hypertension, Diabetes and study population. CPK MB was increased in 80 % of anemic (12 out of 15 cases) while it was normal in 20 % (3 out of 15 cases) of study population. There was statistically no significant difference between CPK MB and study population. MCV was raised in 26.7% (4 out of 15 cases), decreased in 13.3 % (2 out of 15 cases) and normal in 60 % (9 out of 15 cases) study population. There was statistically significant difference between MCV and study population. MCH was decreased in 53.3 % (8 out of 15 cases) and normal in 46.7 % (7 out of 15 cases) study population. There was statistically significant difference between MCH and study population. MCHC was decreased in 66.7 % (10 out of 15 cases) and normal in 33.3 % (5 out of 15 cases) study population. There was statistically significant difference between MCHC and study population. Serum iron was decreased in 66.67 % (10 out of 15 cases), increased in 6.67 % (1 out of 15 cases) and normal in 26.7 % (4 out of 15 cases) study population. There was statistically significant difference between serum iron and study population. TIBC was increased in 66.7 % (10 out of 15 cases), and normal in 33.3 % (5 out of 15 cases) of study population. There was statistically significant difference between TIBC and study population. Serum Vitamin B 12 was increased in 26.7 % (4 out of 15 cases), and normal in 73.3 % (11 out of 15 cases), of study population. There was statistically significant difference between Serum Vitamin B 12 and study populations. The most common ECG finding in anemic study population was AWTMI (46.67 %) (7 out of 15 cases) followed by IWTMI (20 %) (3 out of 15 cases) and LWMI (20 %) (3 out of 15 cases).

III. Discussion

Myocardial infarction results from the imbalance of the oxygen supply and demand of the jeopardized myocardium. Anaemia has been reported to be present in 15% of patients presenting with acute myocardial infarction (AMI)⁶ and in 43% of elderly patients with AMI.⁷ Anaemia has the potential to worsen the myocardial ischemic insult in AMI, both by decreasing the oxygen content of the blood supplied to the jeopardized myocardium⁸ and by increasing myocardial oxygen demand through necessitating a higher cardiac output to maintain adequate systemic oxygen delivery.⁹ Therefore, it is hypothesized that hemoglobin (Hb) concentrations on admission affect the prognosis of patients with myocardial infarction. Transfusion of Anaemic animals up to 100 g/L Hb with fresh blood reduces infarct size and improves cardiac function, but, transfusion to 120 g/L Hb did not demonstrate any additional benefit and was associated with larger infarcts.¹⁰ In the cohort study including nearly 40 000 patients with acute coronary syndrome (ACS), a reverse J-shaped relationship between baseline haemoglobin values and major adverse cardiovascular events was reported.¹¹ The development of Anaemia during hospitalization for AMI was associated with an increased long-term mortality.¹² Shacham et al had indicated that Anemia may begin before the patient seeks medical attention, and a longer duration from symptom onset to emergency admission results in lower admission hemoglobin. They also documented a longer time lag from symptom onset to emergency admission results in a higher level of inflammatory marker. Inflammation was the key in hemoglobin decline during the evolution of STEMI and it emerges before the patient undergoing

⁶Chesebro JH, Knatterud G, Roberts R, Borer J, Cohen LS, Dalen J, Dodge HT, Francis CK, Hillis D, Ludbrook P. Thrombolysis in Myocardial Infarction (TIMI) Trial, Phase I: A comparison between intravenous tissue plasminogen activator and intravenous streptokinase. Clinical findings through hospital discharge. *Circulation*. 1987;76:142–54.

⁷Joosten E, Pelemans W, Hiele M, Noyen J, Verhaeghe R, Boogaerts MA. Prevalence and causes of anaemia in a geriatric hospitalized population. *Gerontology*. 1992;38:111–7. doi: 10.1159/000213315.

⁸Most AS, Ruocco NA Jr, Gewirtz H. Effect of a reduction in blood viscosity on maximal myocardial oxygen delivery distal to a moderate coronary stenosis. *Circulation*. 1986;74:1085–92.

⁹Levy PS, Quigley RL, Gould SA. Acute dilutional Anaemia and critical left anterior descending coronary artery stenosis impairs end organ oxygen delivery. *J Trauma*. 1996;41:416–23. doi: 10.1097/00005373-199609000-00006.

¹⁰Hu H, Xenocostas A, Chin-Yee I, Lu X, Feng Q. Effects of Anaemia and blood transfusion in acute myocardial infarction in rats. *Transfusion*. 2010;50:243–251. doi: 10.1111/j.1537-2995.2009.02385.x.

¹¹Nabais S, Gaspar A, Costa J, Azevedo P, Rocha S, Torres M, Pereira MA, Correia A. Prognostic impact of haemoglobin drop during hospital stay in patients with acute coronary syndromes. *Rev Port Cardiol*. 2009;28:383–95.

¹²Sabatine MS, Morrow DA, Giugliano RP, Burton PB, Murphy SA, McCabe CH, Gibson CM, Braunwald E. Association of haemoglobin levels with clinical outcomes in acute coronary syndromes. *Circulation*. 2005;111:2042–9. doi: 10.1161/01.CIR.0000162477.70955.5F.

invasive procedures or IV fluid hemodilution.¹³ When hemoglobin decreases, the body may increase cardiac output in order to maintain the normal metabolic demands of tissues. This increases the work load of the heart, and results in myocardial damage.¹⁴ The pathophysiological link between Anemia and prolonged QT intervals and increased risk of ventricular arrhythmia is, probably, hypoxia and decreased myocardial oxygen supply.¹⁵

In the present study, the most common age group amongst study population was 51 to 60 years (46%) followed by 61 to 70 years (28%) and 38 to 50 years (26%). Similarly in the study conducted by Joosten E, et al., observed that Anemia is common in elder people, about 12.5% of patients aged 71 years or older had Anemia.⁸ Walid Jomaa et al., reported that Anaemia accounted for 24% of geriatric hospitalized population in some reports and significantly higher in elderly compared to younger patients (52.1% vs. 34.8%, $p < 0.001$).¹⁶

In the present study, there was male predominance (74%) amongst study population. Bolińska S also reported that anaemia was diagnosed in 61 (11%) patients (in 13% of females and 10% of males).¹⁷

In the present study, Worker (49%) was the most common occupation amongst study population followed by farmer (26%), Housewife (19%) and, Business (15%).

In the present study, 21% and 20% of study population were smokers and alcoholic respectively.

In the present study, 61%, 78% and 9% of study population had Hypertension, Diabetic and TB respectively. Walid Jomaa et al.,¹⁶ reported that as compared to non-Anemic patients, Anemic patients were more likely to have a history of arterial hypertension ($p < 0.001$) and diabetes mellitus ($p = 0.007$) and occurrence of anemia was higher in patients with chronic kidney disease (13.4%; $p < 0.01$), hypothyroidism (13.4%; $p = 0.04$), and diabetes (35.8%; $p = 0.04$).

In the present study, Anterior Wall Myocardial infarction (41%) was the most common ECG findings amongst study population followed by Inferior Wall Myocardial infarction (25%), lateral Wall Myocardial infarction (24%).

In the present study, CPKMB was raised in 85% of study population.

In the present study, Microcytic Hypo (10%) was the most common Peripheral smear findings amongst study population followed by Macrocytic and Hypochromic (3%) and Dimorphic Anemia (2%).

These findings are in agreement with the study conducted by Pasricha SR et al., in which the most common cause of anemia was iron deficiency. Out of 20 patients with iron deficiency, three patients had gastric erosions seen in upper gastrointestinal endoscopy. Frequency of different types of anemia according to mean corpuscular volume i.e., microcytic, normocytic or macrocytic were 28.4%, 61.2% and 10.4%, respectively.¹⁸

In the study conducted by Laxmaiah et al., Normocytic, microcytic or macrocytic anemia at the time of admission was seen in 41 (61.2%), 19 (28.4%) and 7 (10.4%) patients, respectively. Microcytic anemia was more commonly associated with female gender ($p < 0.01$). In 46 (68.6%) patients, a single identifiable cause was found and in 5 (7.5%) patients multiple causes were seen whereas in 16 (23.9%) no cause could be identified. A low ferritin $< 20 \mu\text{l}$ concentration was found in 20 patients (29.9%), low plasma vitamin B12 concentration ($< 190 \text{ ng/l}$) in 9 (13.5%), low serum folate ($< 4 \mu\text{g/l}$) concentration in 4 (6%) and an increased plasma Thyroid Stimulating Hormone (TSH) concentration ($> 5.5 \text{ mU/l}$) in 3 (4.5%). Other common causes identified were vitamin B12 deficiency (12%) and folate deficiency (6%). This may be explained by the fact that daily intake of these micronutrients measured was less than Recommended Daily Allowance (RDA) in Indians; especially it was low in Andhra Pradesh state, where study was conducted, compared to other states in the country.¹⁹

¹³Shacham Y, Leshem-Rubinow E, Ben-Assa E, Roth A, Steinvil A. Lower admission haemoglobin levels are associated with longer symptom duration in acute ST-elevation myocardial infarction. *Clin Cardiol* 2014; 37: 73–77.

¹⁴Levy PS, Quigley RL, Gould SA. Acute dilutional Anaemia and critical left anterior descending coronary artery stenosis impairs end organ oxygen delivery. *J Trauma* 1996, 41:416–423.

¹⁵Mozos I, Serban C, Mihaescu R. Anaemia and the QT interval in hypertensive patients. *International Journal of Collaborative Research on Internal Medicine and Public Health* 2012; 4(12): 2084–2091.

¹⁶Walid Jomaa, Imen Ben Al, Sonia Hamdi, Mohamed A. Azaiez, Aymen El Hraïech, Khaldoun Ben Hamda, Faouzi Maatouk, Prevalence and prognostic significance of Anaemia in patients presenting for ST-elevation myocardial infarction in a Tunisian center *J Saudi Heart Assoc* 2017; 29:153–159

¹⁷Bolińska S, Sobkowicz B, Zaniewska J, Chlebińska I, Boliński J, Milewski R, et al. The significance of anaemia in patients with acute ST—elevation myocardial infarction undergoing primary percutaneous coronary intervention. *Kardiologia Pol.* 2011; 69(1):33–39.

¹⁸Pasricha S-R, Flecknoe-Brown SC, Allen KJ, Gibson PR, McMahon LP, Olynyk JK, et al. Diagnosis and management of iron deficiency anaemia: a clinical update. *Med J Aust.* 2010; 193(9):525–32.

¹⁹Laxmaiah A, Rao M, Kumar RH, Arlappa N, Venkaiah K, Brahmam G. Diet and nutritional status of tribal population in ITDA project areas of Khammam district, Andhra Pradesh. *J Hum Ecol.* 2007; 21(2):79–86.

In the present study, 15 % of study population had anemia.(15 out of 100 cases)In the present study, hemoglobin was significantly lower in anemia as compared to nonanemic groups. In the present study, anemia was observed most commonly in the age group of 51 to 60 years(46.7%)followed by 38 to 50 years (33.3%) and more than 70 years (20%). There was nostatistically significant difference between age group and study population.In the present study, anemia was seen in 6 out of 26 females and 9 out of 74 male populationshad anemia. Of the anemic patients males constituted (60 %) followed by female (40 %).There was no statistically significant difference between sex and study population.In the present study, anemia was observed in 28.6 % (6 out of 21 cases) of smokers and 30%(6 out of 20 cases) of alcoholic study population. There was statistically significant differencebetween alcoholics and study population and it was statistically not significant between smokingand study population.

In the present study, anemia was observed in 17.9 % of hypertension (7 out 39 cases), 22.7 % of diabetic (5 out 22 cases) and 55.6 % of TB patients (5 out 9 cases). There was statistically significant difference between TB and study population and it was statistically not significantbetween hypertension, Diabetes and study population.

In the present study, CPK MB was raised in 80 % of anemic (12 out of 75 cases) while it wasnormal in 20% (3 out of 25 cases) of study populationand this difference was statistically notsignificant.

In the present study, MCV was raised in 26.7% (4 out of 15 cases), decreased in 13.3 % (2out of 15 cases) and normal in 60 % (9 out of 15 cases) study populationand this difference wasstatistically significant.In the present study, MCH was decreased in 53.3 % (8 out of 15 cases) and normal in 46.7 % (7 out of 15 cases) study populationand this difference was statistically significant.In the present study, MCHC was decreased in 66.7 % (10 out of 15 cases) and normal in 33.3% (5 out of 15 cases) study populationand this difference was statistically significant.In the present study, Serum iron was decreased in 66.67 % (10 out of 15 cases), increased in 6.67 % (1 out of 15 cases) and normal in 26.7 % (4 out of 15 cases) study population and thisdifference was statistically significant.

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In the present study, Serum Vitamin B 12 was increased in 26.7 % (4 out of 15 cases), andnormal in 73.3 % (11 out of 15 cases), of study population and this difference was statistically significant.

There are several pathophysiological explanations to the worse clinical outcome and mortality inpatients suffering from coronary artery disease and anemia. In anemic patients, there is asignificant reduction of oxygen supply to the myocardium in addition to the impaired coronaryblood flow. Other mechanisms include tachycardia and decrease in blood viscosity.Eventually, recourse to blood transfusion in anemic patients with or without hemorrhagiccomplications was proven to be a powerful predictor of worse outcome in the whole ACSspectrum.

IV. Conclusion

Anterior wall myocardial infarction is more commonly associated with anemia. Iron deficiencyanemia was observed to be the most prevalent type of anemia seen in STEMI. Appropriate treatment of anemia may lead to decrease in morbidity.

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