Short Term Outcome of Percutaneous Coronary Intervention in Anaemic Patients Presenting with Coronary Artery Diseases

Moaz Emad El Din El Saiyed [a*]**, Mohamed Bayoumi Nassar** [a]**,**
Ehab Abd El Lateif El Gendy [a] **and Seham Fahmy Badr** [a]

[a] *Cardiovascular Medicine Department, Faculty of Medicine, Tanta University, Tanta, Egypt.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: Percutaneous coronary intervention (PCI) has been an effective and widely used treatment for patients with coronary artery disease (CAD). The presence of anaemia in critically ill patients undergoing surgical procedures has been associated with worse clinical outcomes.
Hence, the current study was conducted to assess short term outcome of percutaneous coronary interventions in anaemic patients presenting with coronary artery diseases.
Methods: This prospective observational study enrolled 200 patients who underwent PCI. Patients were classified into 2 groups: anaemic patients and non-anaemic patients. The anaemic patients were furtherly be classified according to severity of anaemia into 3 grades mild anaemia, moderate anaemia, and severe anaemia.
All cases were subjected to complete history taking, clinical examination and baseline laboratory

tests: including CBC, serum urea and creatinine, cardiac enzymes include serum troponin, CK-MB and standard 12-lead ECG.

Results: The mean Heart Rate was statistically significantly higher in the anaemic group as compared with the non-anaemic group. The mean Ejection Fraction was statistically significantly lower in the anaemic group as compared with the non-anaemic group. The percentage of LM affection in the anaemic group was statistically significantly higher as compared with the non-anaemic group. The incidence of arrythmia in the anaemic group was statistically significantly higher as compared with the non-anaemic group. Severe anaemic and low EF% patients were associated with higher incidence of stroke and MI.

Conclusions: Patients with baseline anaemia before PCI have a higher incidence of PCI associated complications. Therefore, anaemia could be a predictor of PCI related complications.

1. INTRODUCTION

"According to the WHO, cardiovascular disease contributes to 30% of world mortality and 10% of the global disease burden. Myocardial infarction (MI) is characterised by the presence of myocardial cell necrosis resulting from substantial and prolonged ischemia, which is typically, but not always, an acute symptom of atherosclerosis-related coronary artery disease (CAD)" [1].

"Anemia is described as a reduction in the number of circulating red blood cells (RBCs); it affects about 6% of the population owing to poor food, intestinal issues, chronic illnesses, infections, and other factors. Anemia can be caused by a reduction in the generation of new RBCs, the hemolysis of RBCs, or blood loss" [2]. The incidence of anaemia in individuals with acute coronary syndrome (ACS) ranges from 10 to 32 percent. Anemia is more prevalent in women, young children, and individuals with chronic conditions. Because older persons are more likely to have cardiovascular disease or other chronic medical disorders, their risk of anaemia is higher [3-5].

Multiple randomized controlled trials (RCTs) registries have indicated that the occurrence of anaemia in ACS is related with poorer prognosis, including mortality, ischemia episodes, and heart failure [3-7].

"The necessity to re-investigate anaemia as a risk sign or independent risk factor for patients with CAD is highlighted by the older age of the affected patients and the increased frequency of co-morbidities (e.g., malignancy, diabetes, gastrointestinal tract disorders, and chronic renal disease)" [4-8].

"Reduced myocardial oxygen supply, increased myocardial oxygen demand and ischemia, and increased bleeding risk are mechanisms for a poor prognosis" [8-12]. This study was therefore planned to evaluate the short-term outcome of percutaneous coronary interventions (PCI) in anaemic in cases with CAD.

2. METERIALS AND METHODS

This prospective observational study enrolled on two hundred patients who underwent PCI over the period of 6 months in the period from October 2020 to March 2021 at Cardiology department, Tanta University Hospital, Tanta, Egypt. Patients were classified into 2 groups; Group A: - non anaemic patients: Haemoglobin (Hb) level more than or equal 13 g/dL in men and more than or equal 12 g/dL in women. Group B: anaemic patients who were subdivided according to Hb level to: mild anaemia or grade 1: Hb from 10 g/dL to the lower limit of normal, moderate anaemia or grade 2: Hb from 8 to less than 10 g/dL and severe anaemia or grade 3: Hb below 8 g/dL.

Inclusion criteria: the presence of acute coronary syndrome (ACS): ST segment elevation myocardial infarction [STEMI], Non-ST segment elevation myocardial infarction (Non-STEMI) and Unstable angina. Patients complains from chronic coronary syndrome (CCS).

Exclusion criteria: the presence of history of coronary artery bypass graft (CABG), chronic liver diseases, blood cancer, bleeding disorder, genetic anaemia disorder.

All cases were subjected to complete history taking, clinical examination and baseline laboratory tests: including CBC, serum urea and creatinine, cardiac enzymes include serum troponin and CK-MB, standard 12-lead ECG was

obtained within 10 minutes of first medical contact (FMC).

Echocardiography: All studies were performed using (a GE vivid seven cardiac ultrasound phased array system with tissue Doppler imaging using M4S transducer 4 MHz) to assess LV systolic function using Biplane Simpson Method in the apical 4 & apical 2 views also left ventricular volumes were assessed (End diastolic volume and end systolic volume).

Left coronary imaging: A contrast injection in the left coronary cusp was a reasonable first step to define the ostium of the left main (LM) coronary artery, an antero-posterior (AP) view or a shallow right anterior oblique (RAO) caudal view may be useful to evaluate middle and distal LM coronary artery stenosis. A shallow left anterior oblique (LAO) or LAO cranial view was usually best to visualize osteal LM stenosis.

Right coronary imaging: The RCA should be approached in the 30-degree LAO projection. The Judkin Right 4 (JR4) was advanced to the aortic valve level and was slowly withdrawn approximately 2 cm while clockwise rotation was applied to rotate the catheter anteriorly to the right sinus of Valsalva then the catheter should sit in the RCA ostium. The infarcted related artery (IRA) was identified. Multi-vessel disease was defined as presence of ≥ 1 lesion with >50% stenosis in ≥ one major epicardial coronary artery or its major branches remote from the IRA. Reperfusion success is measured by TIMI blood flow grade: Reperfusion was considered successful (TIMI 3) or abnormal (TIMI 0-1-2) according to the TIMI blood flow grade.

2.1 Statistical Analysis

SPSS (Statistical Package for the Social Sciences) version 27 for Windows® (IBM SPSS Inc, Chicago, IL, USA) was used to code, process, and analyse the obtained data (161).

Using the Shapiro Walk test, the normal distribution of the data was examined. The quantitative data were reported as the mean ± standard deviation (Standard deviation). Frequencies and relative percentages were used to depict qualitative data. Significant if p value is less than 0.05.

3. RESULTS

There was no statistically significant difference between the two groups regarding the age, gender, occupation, marital status and the residence.

There was statistically significantly difference between the two groups regarding CKD and IHD. There was no statistically significant difference between the two groups regarding the hypertension, DM, smoker, hyperlipidaemia, previous MI, previous PCI and malignancy. The HR was statistically significantly lower in non-anaemic group than anaemic (p=0.035).

Hb was significantly lower in the anaemic group compared to the non-anaemic group (p<0.001). The CKMB in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p=0.01). Troponin in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p<0.001).

The EF was statistically significantly lower in the anaemic cases as compared with the non-anaemic group (p<0.001). The EF after 6 months in the anaemic cases was statistically significantly lower as compared with the non-anaemic group (p<0.001). There was a statistically significant difference between baseline and EF after 6 months in both anaemic and non-anaemic cases (p<0.001). STEMI was significantly higher in the anaemic group compared to the non-anaemic group (P<0.001), while NSTEMI, UA and chronic coronary syndrome were significantly higher in the anaemic group compared to the non-anaemic group (P<0.001).

Table 1. Socio-demographic characteristics of the studied cases

		Anemic N=76	Non anemic N=124	P value
Age /years		60.43±10.06	60.98±11.64	0.734
Gender	Female Male	53(71.6)	69(58.5)	
		21(28.4)	49(41.5)	0.065
Occupation	Not working	0(0.0)	4(3.4)	
	Manual worker	31(41.9)	44(37.3)	0.365
	Employee	29(39.2)	43(36.4)	
	Housewife	14(18.9)	27(22.9)	

		Anemic N=76	Non anemic N=124	P value
Marital status	Single Married	1(1.4)	2(1.7)	
	Others	66(89.2)	94(79.7)	0.215
		7(9.5)	22(18.6)	
Residence	Rural	39(52.7)	74(62.7)	
	Urban	35(47.3)	44(37.3)	0.170

χ^2=Chi-Square test χ^{2MC}: Monte Carlo test t: Student t test

Table 1. Comparison of medical history and vital signs among studied cases

	Anemic N=76	Non anemic N=124	P value
Hypertension	57(75.0)	77(62.1)	0.06
DM	47(61.8)	71(57.3)	0.522
CKD	16(21.1)	5(4.0)	**<0.001***
Smoker	47(61.8)	64(51.6)	0.158
IHD	27(35.5)	68(54.8)	**0.008***
hyperlipidemia	54(71.1)	94(75.8)	0.457
Previous MI	33(43.4)	54(43.5)	0.986
Previous PCI	33(43.4)	54(43.5)	0.986
Malignancy	14(18.4)	12(9.7)	0.074
Cerebrovascular accident	5(6.6)	6(4.8)	0.600
SBP (mm Hg)	126.71±15.52	127.09±14.53	0.859
DBP (mm Hg)	77.89±18.21	79.03±10.39	0.574
HR (b/min)	92.57±14.44	88.51±12.29	**0.035***
RR (breaths/ min)	17.51±1.46	17.33±1.29	0.360
TEMP (C)	37.29±0.31	37.32±0.29	0.445

*DM: Diabetes mellitus. CKD: Chronic kidney disease. IHD: Ischemic heart disease. MI: Myocardial infarction. PCI: Percutaneous coronary intervention. SBP: Systolic blood pressure. DBP: Diastolic blood pressure. HR: Heart rate. RR: Respiratory rate. TEMP: Temperature $\chi2$=Chi-Square test *statistically significant. *: Statistically different as P value ≤ 0.05*

Table 3. Comparison of laboratory findings among studied cases

	Anemic N=76	Non anemic N=124	P value
Creatinine (mg/dL)	1.82±0.63	1.69±0.62	0.143
INR	1.154±0.19	1.14±0.16	0.554
Hb (gm/dL)	9.24±1.45	13.24±0.81	**<0.001***
PLT (x 10^3/ mcL)	319.17±99.66	327.15±93.32	0.568
Urea (mmol/L)	77.38±25.26	70.50±24.93	0.061
CKMB (IU/L)	89.0	4	**<0.001***
Troponin (ng/mL) +ve N (%)	73(96.1)	89(71.8)	**<0.001***

*INR: International normalized ratio. Hb: Hemoglobin. PLT: Platelet count. t: Student t test. *: Statistically significant. All parameters described as mean± SD CKMB: Creatine Kinase-Myocardial Band. $\chi2$=Chi-Square test, *: Statistically different as P value ≤ 0.05., Z: Mann Whitney U test*

Table 4. Comparison of ejection fraction and patient presentation among studied cases and during follow up

	Anemic N=76	Non anemic N=124	P value
EF% in hospital follows up	42.50±11.48	56.65±6.60	**<0.001***
EF after 6 months	50±10.26	65.68±1.25	**<0.001***
Paired t test comparing baseline and after 6 months	p**<0.001***	p**<0.001***	
STEMI	48(63.2)	30(24.2)	
NSTEMI	25(32.9)	59(47.6)	**<0.001***
UA	2(2.6)	30(24.2)	
Chronic coronary syndrome	1(1.3)	5(4.0)	

*EF: Ejection fraction. STEMI: ST-elevation myocardial infarction. NSTEMI: Non-ST-Elevation Myocardial Infarction. UA: Unstable angina. χ^{2MC}: Monte Carlo test. *: Statistically different as P value ≤ 0.05*

Table 5. Comparison of angiographic& LMC and complications findings among studied cases

		Anemic N=76	Non anemic N=124	P value
Angiographic findings	1	63 (82.9)	99(79.8)	
(Number of affected vessels)	2	11(14.5)	20(16.1)	
	3	2(2.6)	5(4.0)	0.818
LMC		12(15.8)	7(5.6)	**0.018***
Femoral bleeding		3(16.7)	3(13.6)	
Retroperitoneal bleeding		5(27.8)	9(40.9)	0.158
Hematoma		3(16.7)	0	
Gastrointestinal bleeding		3(16.7)	4(18.2)	
Cerebrovascular bleeding		2(11.1)	0	
AKI		2(11.1)	6(27.3)	
Arrythmia		47(61.8)	39(31.5)	**<0.001***
Stroke		11(14.5)	9(7.3)	0.09
MI		7(9.2)	9(7.3)	0.621
Repeated revascularization		5(6.6)	7(5.6)	0.787
Death		15(19.7)	3(2.4)	**<0.001***
Readmission		20(26.3)	15(12.1)	**<0.01***
MI		4(5.26)	1(0.8)	0.07
Stroke		0	0	

*LMC: Left Main Coronary. MI: Myocardial infarction. AKI: Acute kidney injury *: Statistically different as P value ≤ 0.05. χ^2=Chi-Square test*

Table 6. Association between grade of anemia and incidence of complications among studied cases

	Grade of anemia			P value
	Grade 1 n=21(%)	Grade 2 n=38(%)	Grade 3 n=17(%)	
Retroperitoneal bleeding	0	2(20.0)	1(50.0)	
Hematoma	1(16.7)	3(30.0)	1(50.0)	0.605
Gastrointestinal bleeding	1(16.7)	2(20.0)	0	
Femoral bleeding	1(16.7)	2(20.0)	0	
Cerebrovascular bleeding	2(33.3)	0	0	
AKI	1(16.7)	1(10.0)	0	
Arrythmia	12(57.1)	23(60.5)	12(70.6)	0.679
Stroke	5(23.8)	1(2.6)	5(29.4)	**0.012***
MI	2(9.5)	1(2.6)	4(23.5)	**0.046***
Repeated revascularization	3(14.3)	1(2.6)	1(5.9)	0.222

*AKI: Acute kidney injury. MI: Myocardial infarction. χ2MC: Monte Carlo test χ2=Chi-Square test. *: Statistically different as P value ≤ 0.05*

Table 7. Comparison of after 6 months complications among studied cases according to anemia grade

	Grade of anemia			P value
	Grade 1 n=21(%)	Grade 2 n=38(%)	Grade 3 n=17(%)	
Death	4(19)	8 (21.1)	3(17.6)	0.954
Readmission	0	7(18.4)	13(76.5)	**<0.001***
MI	1(4.8)	1(2.6)	2(11.8)	0.372

*MI: Myocardial infarction. *: Statistically different as P value ≤ 0.05.*
χ2MC: Monte Carlo test χ2=Chi-Square test

Table 8. Univariate & multivariate analysis of MACE predictors among studied cases

Predictors	MACE incidence		Univariate		Multivariate	
	MACE N=164	No MACE N=36	P	Unadjusted OR	P	Adjusted OR
age /years	60.74±10.7	60.92±12.7	.755	0.994(0.959-1.03)		
SBP	126.52±14.88	128.89±14.89	.498	0.995(0.963-1.028)		
DBP	78.54±14.55	78.89±10.36	.697	1.01(0.964-1.05)		
HR	90.12±13.67	89.75±11.43	.856	0.990(0.951-1.03)		
RR	17.38±1.37	17.50±1.34	.555	0.893(0.617-1.29)		
TEMP	37.31±0.29	37.29±0.29	.508	2.07(0.523-8.22)		
EF	50.19±11.58	56.17±7.08	.008*	0.946(0.909-0.985)	0.353	0.978(0.932-1.025)
Creatinine	1.77±0.61	1.63±0.68	.399	1.31(0.698-2.46)		
INR	1.15±0.19	1.10±0.089	.111	1.31(0.698-2.46)		
HB	11.41±2.33	13.14±0.70	<0.001*	0.589(0.446-0.778)	0.002*	0.626(0.464-0.844)
PLT	321.77±95.65	334.81±96.07	0.436	0.998(.995-1.0)		
Urea	73.63±25.53	70.75±23.96	0.505	1.01(0.991-1.02)		
Gender				1.04(0.485-2.21)		
Male	100(82.0)	22(18.0)	0.926			
Female	57(81.4)	13(18.6)				
Not working	4(100)	0				
Manual worker	59(78.7)	16(21.3)				
employee	64(88.9)	8(11.1)	0.119			
Housewife	30(73.2)	11(26.8)				
single	2(66.7)	1(33.3)				
married	134(83.8)	26(16.2)	0.275			
others	21(72.4)	8(27.6)				
rural	89(78.8)	24(21.2)	0.196	0.6(0.275-1.31)		
urban	68(86.1)	11(13.9)				
Hypertension	109(81.3)	25(18.7)	0.731	1.147(0.526-2.50)		
DM	66(80.5)	1(19.5)	0.643	0.842(0.407-1.74)		
	98(83.1)	20(16.9)				
Smoker	69(77.5)	20(22.5)	0.140	0.581		
	95(85.6)	16(14.4)		(0.281-1.20)		
IHD	75(78.9)	20(21.1)	0.285	1.48(0.718-3.07)		
Hyperlipidemia	119(80.4)	29(19.6)	0.322	1.57(0.641-3.83)		
Previous MI	73(83.9)	14(16.1)	0.538	0.793(0.379-1.66)		

Predictors	MACE incidence			Univariate		Multivariate
	MACE N=164	No MACE N=36	P	Unadjusted OR	P	Adjusted OR
Previous PCI	69(79.3)	18(20.7)	0.385	1.38(0.668-2.84)		
Malignancy	22(84.6)	4(15.4)	0.710	0.807(0.260-2.50)		
Cerebrovascular accident	8(72.7)	3(27.3)	0.410	1.77(0.446-7.04)		
STEMI	7(9.0)	71(91)	<0.001*	50.71(5.17-497.37)	.005*	44.71(5.17-490.36)
NSTEMI	18(21.4)	66(78.6)		18.33(2.01-167.02)	.001*	17.3(2.0-160.5)
UA	6(18.8)	26(81.2)		21.67(2.12-221.20)	.010*	19(2.0-220.0)
CCS	5(83.3)	1(16.7)			.009* r	

SBP: Systolic blood pressure. DBP: Diastolic blood pressure. HR: Heart rate. RR: Respiratory rate. TEMP: Temperature. EF: Ejection fraction. INR: International normalized ratio. Hb: Hemoglobin. PLT: Platelet count. DM: Diabetes mellitus. MI: Myocardial infarction. PCI: Percutaneous coronary intervention. STEMI: ST-elevation myocardial infarction. NSTEMI: Non-ST-Elevation Myocardial Infarction. UA: Unstable angina. CCS: Chronic coronary syndrome. OR: Odds ratio, CI: Confidence interval

There was no statistically significant difference between the two groups regarding the number of affected vessels (p=0.818). The percentage of LMC affection in the anaemic group was 15.8% that was statistically significantly higher as compared with the non-anaemic group (5.6%) (p=0.018). The incidence of arrythmia in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p<0.001). The readmission and mortality at 6 months in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p<0.001).

Severe anaemic patients were associated with higher incidence of stroke and MI while other complications showed no statistically significant difference according to the severity of anaemia.

The incidence of readmission was significantly higher in Grade 3 anaemic group, then grade 2 and not reported in grade 1 group (p<0.001). The incidence of mortality and MI was insignificantly different between grade 1, grade 2 and grade 3.

In univariate regression analysis, EF, Hb and diagnosis were significant predictors of MACE (P values=0.008, <0.001, <0.001 respectively). In multivariate regression analysis, Hb (OR (95% CI): 0.626(0.464 - 0.844), (P=0.002) and diagnosis (OR (95% CI): 44.71(5.17-490.36), 17.3(2.0-160.5), 19(2.0-220.0) and (P=0.005, 0.001, 0.010, 0.009) respectively) were the only significant predictors for MACE.

CASES:

Case 1:

Male patient 41 yrs old, known to be DM, HTN, Smoker, not known to be cardiac patient, presented by typical chest pain started from 4 hrs and he was vitally stable B/P 110 _70, HR 80 B/M, Respiratory Rate 23, Temperature 37.5, and Random blood sugar 300.
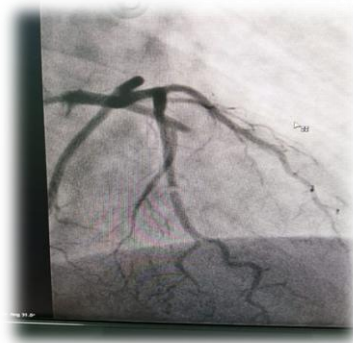
Troponin level was positive 4, CKMB 90, Creatinine 0.84, Urea 27, INR 0.95, HB level 11.2 g\dl.

ECG showed anterior STEMI, ECHO showed preserved Function EF 60 % with lateral hypokinesia.

Patient given Aspirin 300mg, clopidogrel 600mg, Statin 40mg and 5000 units UF Heparin.

Coronary angiography showed LAD totally occluded at Mid segment, LCX Distal 70% occluded and RCA Atherosclerotic vessel with no-significant lesion.

Primary PCI done to LAD and for Elective PCI to LCX.

Case 2:

Female patient 61 yrs old, known to be DM, not known to be cardiac patient, presented by typical chest pain started from 2 hrs she was vitally stable B/P 100 _80 HR 70 B/M, Respiratory Rate 20, Temperature: 37.8 and Random blood sugar 240.

Troponin level was Positive 2.1, CKMB 60, Creatinine 1.0, Urea 31, INR 1.0, HB level 8.4 g\dl.

ECG Inferior STEMI, ECHO showed good LV systolic Function EF 66% with Inferior hypokinesia.

Patient given Aspirin 300mg, clopidogrel 600mg, Statin 40mg and 5000 units UF Heparin.

Coronary angiography showed LAD & LCX Atherosclerotic vessels with No-significant lesions, RCA showed Mid segment Sub-total occlusion. Then Successful primary PCI to RCA.

Fig. 1. Before PCI to LAD
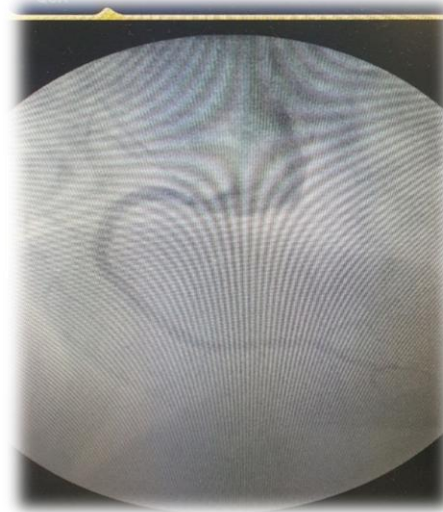

Fig. 2. After PCI to LAD

Fig. 3. Before PCI to RCA

Fig. 4. After PCI to RCA

4. DISCUSSION

"According to the WHO, cardiovascular disease contributes to 30% of world mortality and 10% of the global disease burden. Myocardial infarction (MI) is characterised by the presence of myocardial cell necrosis caused by substantial and prolonged ischemia, which is typically, but not always, an acute symptom of atherosclerosis-related coronary heart disease" [1].

The incidence of anaemia in individuals with acute coronary syndrome (ACS) ranges from 10 to 32 percent. Anaemia is more prevalent in women, young children, and individuals with chronic conditions. Because older persons are more likely to have cardiovascular disease or other chronic medical disorders [3-5], they are at a greater risk for anaemia.

"Multiple registries of randomised controlled trials (RCTs) have indicated that anaemia in ACS is related with poorer clinical outcomes, including mortality, ischemia events, and heart failure" [3-7]. "Changing demographic characteristics toward the elderly with a higher prevalence of comorbidities (e.g., malignancy, diabetes, gastrointestinal tract disorders, and chronic renal disease) underscore the need to re-examine anaemia as a risk marker or independent risk factor for patients with coronary artery disease" [4-8].

In the current study, 38 percent of participants had anaemia. Al-Hijji et al., 2018 [13] comprised 5668 consecutive unique patients with acute coronary syndrome who had PCI at the Mayo Clinic between January 1, 2004, and December 31, 2014. The results of the current study were consistent with those of Al-Hijji et al. One-third of patients treated with PCI for ACS were anaemic, according to Wang et al., 2015a [14] among 4109 patients who had PCI. 946 (23.1%) individuals exhibited anaemia. There were 866 (21.1%) patients with mild anaemia and 80 (1.9%) patients with moderate-severe anaemia (Hb 100 mg/dL).

In a Danish cohort research by Davidsen et al., 2020 [15] comprising 2,837 patients with SA having PCI, we examined the link between anaemia and bleeding, ACS, and death over a 3-year follow-up period. 14.6 percent of the overall study population had anaemia. In the current study, the mean EF in the anaemic cases was 42.50 ± 11.48 % that was statistically significantly as compared with the non-anaemic group 56.65 ± 6.60 % (p<0.001). Moreover, EF% during follow up was significantly higher in non-anaemic group than the anaemic group.

This was in accordance with Al-Hijji et al., 2018 [13] who showed presentation with reduced left ventricular ejection fraction of 40% or less was 2-fold more common in patients with anaemia (P<.001).

Our results revealed that regarding the laboratory investigations the INR, creatinine and urea levels showed insignificant difference between anaemic and non-anaemic groups.

Further, a comparable results were recorded by Chairat et al., 2020 [16] who found that there was no significant difference between anaemic and non- anaemic groups in terms of creatinine level.

Depending on the present findings, STEMI was significantly higher in the anaemic group compared to the non-anaemic group (P<0.001), while NSTEMI, UA and chronic coronary syndrome were significantly higher in the anaemic group compared to the non-anaemic group (P<0.001).

Moreover, the present study showed that the CK-MB in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p=0.01). Troponin in the anaemic group was statistically significantly higher as compared with the non-anaemic group (p<0.001).

In accordance with our results, Park et al., 2018 [17] reported that the anaemic group showed statistically significant increase in CK-MB compared to the non-anaemic group (p=0.004). Troponin in the anaemic group was significantly higher as compared with the non-anaemic group (p<0.01).

In the current study, the percentage of LM affection in the anaemic group was 15.8% that was statistically significantly higher as compared with the non-anaemic group (5.6%) (p=0.018).

In the anaemic group, most cases were affected by single vessel disease, double vessels were affected in 14.5% and triple vessel were affected in 2.6% with no statistically significant difference between both anaemic and non-anaemic groups (p=0.818).

Besides, Solomon et al., 2012 [18] reported a comparable results where, there was no significant difference in anaemic and non-anaemic group regarding the number of diseased vessel (p=1).

In the current study, there was no statistically significant difference in the incidence of bleeding complications in hospital between the cases in the two groups.

This was in disagreement with Davidson et al [15] who showed that patients with anaemia had a significantly higher proportion of bleeding events compared with patients without anaemia [15].

Leonardi et al., 2021 [19] and his colleagues showed that patients with haemoglobin reduction ≥ 3 g/dl were proportionally more common (19% vs. 6%) in the group with adjudicated bleeding.

Some researchers showed that prolonged use of DAPT for 1 year increases the rate of major bleeding events after PCI Valgimigli et al., 2013, Jeger et al., 2014 [20], both baseline anaemia and bleeding increase mortality Willis and Voeltz, 2009 [11].

Nagao et al., 2019 [21] demonstrated that even a moderate degree of anaemia was related with a significantly elevated risk of serious bleeding. Even among individuals without anaemia, a lower baseline haemoglobin value was related with an increased risk of long-term haemorrhage.

In the current study, there was statistically significant difference in the incidence of arrhythmia in anaemic patients (61.8%) that documented during follow up of patients in hospital was higher as compared with non-anaemic patients (31.5%) (p<0.001).

This was matched with Wang et al., 2015a [14] who showed that incidence of reperfusion arrhythmia that was indicator for successful revascularization is higher in patients with anaemia than patients without anaemia.

In the study done by Nagao et al., 2019 [21], moderate/severe anaemia was related with an increased risk of long-term ischemic outcome, although this was driven by a greater incidence of ischemic stroke as opposed to MI.

Kunadian et al., 2014 [22] discovered in their analysis of the ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy Trial) trial that anaemia independently increased the absolute risk of cardiovascular mortality and MI 1 year after presenting with ACS by 1.5% and 2.1%, respectively.

In the current study, the incidence of mortality at 6 months in the anaemic group was 19.7% that was statistically significantly higher as compared with the non-anaemic group (2.4%) (p<0.0010). However, there was no statistically significant difference in the incidence of overall mortality at 6 months between the cases according to the severity of anaemia.

Pilgrim et al., 2012 [23] reported that severe anaemia was associated with impaired survival. The overall mortality (along 4 year-follow up) was 10.7% in the cases with severe anaemia and 4.7% in the cases with mild/no anaemia.

Several mechanisms can be held responsible for the observed increase in all-cause mortality and cardiac death in particular. Reduced blood haemoglobin levels may compromise myocardial oxygen delivery and therefore result in ischemia when they fall below the functional capacity of myocardial reserve [24].

In the current study, anaemia, decreased EF and diagnosis were associated with MACE by univariate regression analysis. However, with Multivariate regression analysis, decreased haemoglobin and diagnosis were the independent risk factor for MACE.

This was in agreement with Davidsen et al., 2020 [15] who showed that confirm that anaemia was an independent predictor of bleeding, ACS and mortality in patients with SA undergoing PCI, even after adjusting for covariates.

Kwok et al., 2016 [25] did a meta-analysis on adverse outcomes and death in anaemic patients following PCI using data from 44 trials with 230,795 participants. This meta-analysis revealed that the prevalence of anaemia among PCI patients was 16%, with a substantially elevated risk of MI, death, haemorrhage, and MACE.

In addition, Jiang et al., 2018 [26] shown an increased incidence of bleeding and cerebrovascular stroke in patients with pre-PCI anaemia, as well as an increased incidence of bleeding, MI, TVR, MACE, and all-cause mortality in post-PCI anaemic patients throughout a 2-year follow-up period.

Previous studies showed that the presence of low haemoglobin levels before and/or after PCI is a powerful and independent predictor of future cardiovascular events Sabatine et al., 2005, Mahendiran et al., 2020, Nagao et al., 2019 [20]. There were some limitations to this study, it was single centre study that included a relatively small sample size of cases and this study follow up the cases for 6 months only after the procedure and this gave a limited overview of the long term associated outcomes. These limitations could decrease the power of the obtained results and should be overcome in subsequent studies.

5. CONCLUSIONS

Patients with baseline anaemia before PCI have a higher incidence of PCI associated complications, anaemia could, therefore, be used as a predictor of PCI related complications (Especially in cases with severe anaemia) and our results have important clinical implications, with the assessment of Hb levels is crucial during peri procedures.

ETHICAL APPROVAL AND CONSENT

The Ethical Committee, Faculty of Medicine, Tanta University approved this study. Informed consent was obtained from all enrolled cases.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mendis S, Thygesen K, Kuulasmaa K, Giampaoli S, Mähönen M, Ngu Blackett K, et al. World Health Organization definition of myocardial infarction: 2008–09 revision. International Journal of Epidemiology. 2011;40:139-46.
2. Johnson RL, Rubenstein S. Anemia in the emergency department: evaluation and treatment. Emergency Medicine Practice. 2013;15:1-5.
3. Amsterdam EA, Wenger NK, Brindis RG, Casey Jr DE, Ganiats TG, Holmes Jr DR, et al. AHA/ACC guideline for the management of patients with non–ST-elevation acute coronary syndromes: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014;130:2354-94.
4. O'gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK, De Lemos JA, et al. ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association task force on practice guidelines. Journal of the American College of Cardiology. 2013;61:e78-e140.
5. Anker SD, Voors A, Okonko D, Clark AL, James MK, Von Haehling S, et al. Prevalence, incidence, and prognostic value of anaemia in patients after an acute myocardial infarction: data from the OPTIMAAL trial. European Heart Journal. 2009;30:1331-9.
6. Sabatine MS, Morrow DA, Giugliano RP, Burton PB, Murphy SA, McCabe CH, et al.

Association of hemoglobin levels with clinical outcomes in acute coronary syndromes. Circulation. 2005;111:2042-9.

7. Tsujita K, Nikolsky E, Lansky AJ, Dangas G, Fahy M, Brodie BR, et al. Impact of anemia on clinical outcomes of patients with ST-segment elevation myocardial infarction in relation to gender and adjunctive antithrombotic therapy (from the HORIZONS-AMI trial). The American Journal of Cardiology. 2010;105:1385-94.

8. Nikolsky E, Aymong ED, Halkin A, Grines CL, Cox DA, Garcia E, et al. Impact of anemia in patients with acute myocardial infarction undergoing primary percutaneous coronary intervention: analysis from the controlled abciximab and device investigation to lower late angioplasty complications (CADILLAC) trial. Journal of the American College of Cardiology. 2004;44:547-53.

9. Giraldez RR, Sabatine MS, Morrow DA, Mohanavelu S, McCabe CH, Antman EM, et al. Baseline hemoglobin concentration and creatinine clearance composite laboratory index improves risk stratification in ST-elevation myocardial infarction. American Heart Journal. 2009;157:517-24.

10. Levy PS, Quigley RL, Gould SA. Acute dilutional anemia and critical left anterior descending coronary artery stenosis impairs end organ oxygen delivery. Journal of Trauma and Acute Care Surgery. 1996;41:416-23.

11. Willis P, Voeltz MD. Anemia, hemorrhage, and transfusion in percutaneous coronary intervention, acute coronary syndromes, and ST-segment elevation myocardial infarction. The American Journal of Cardiology. 2009;104:34C-8C.

12. Moscucci M, Fox KA, Cannon CP, Klein W, López-Sendón J, Montalescot G, et al. Predictors of major bleeding in acute coronary syndromes: the global registry of acute coronary events (GRACE). European Heart Journal. 2003;24:1815-23.

13. Al-Hijji MA, Gulati R, Lennon RJ, Bell M, El Sabbagh A, Park JY, et al., editors. Outcomes of percutaneous coronary interventions in patients with anemia presenting with acute coronary syndrome. Mayo Clinic Proceedings; 2018: Elsevier.

14. Wang H, Yang Y, Ma L, Wang X, Zhang J, Fu J, et al. Impact of anemia and dual antiplatelet therapy on mortality in patients undergoing percutaneous coronary intervention with drug-eluting stents. Scientific Reports. 2015;5:1-12.

15. Davidsen L, Kragholm KH, Aldahl M, Polcwiartek C, Torp-Pedersen C, Soegaard P, et al. Long-term impact of baseline anaemia on clinical outcomes following percutaneous coronary intervention in stable angina. Open Heart. 2020;7:e001319.

16. Chairat K, Rattanavipanon W, Tanyasaensook K, Chindavijak B, Chulavatnatol S, Nathisuwan S. Relationship of anemia and clinical outcome in heart failure patients with preserved versus reduced ejection fraction in a rural area of Thailand. International Journal of Cardiology Heart & Vasculature. 2020;30:100597.

17. Park JY, Choi BG, Rha S-W, Kang TS. Five-year outcomes in patients with anemia on admission undergoing a coronary intervention for acute myocardial infarction in Koreans: propensity score matching analysis. Coronary Artery Disease. 2018;29:647-51.

18. Solomon A, Blum A, Peleg A, Lev EI, Leshem-Lev D, Hasin Y. Endothelial progenitor cells are suppressed in anaemic patients with acute coronary syndrome. The American Journal of Medicine. 2012;125:604-11.

19. Leonardi S, Gragnano F, Carrara G, Gargiulo G, Frigoli E, Vranckx P, et al. Prognostic implications of declining hemoglobin content in patients hospitalized with acute coronary syndromes. Journal of the American College of Cardiology. 2021;77:375-88.

20. Jeger R, Jaguszewski M, Nallamothu BN, Lüscher TF, Urban P, Pedrazzini GB, Erne P, Radovanovic D, AMIS Plus Investigators. Acute multivessel revascularization improves 1-year outcome in ST-elevation myocardial infarction: a nationwide study cohort from the AMIS Plus registry. International Journal of Cardiology. 2014 Mar 1;172(1):76-81.

21. Nagao K, Watanabe H, Morimoto T, Inada T, Hayashi F, Nakagawa Y, et al. Prognostic impact of baseline hemoglobin levels on long-term thrombotic and bleeding events after percutaneous coronary interventions. Journal of the American Heart Association. 2019;8: e013703.

22. Kunadian V, Mehran R, Lincoff AM, Feit F, Manoukian SV, Hamon M, et al. Effect of

anemia on frequency of short-and long-term clinical events in acute coronary syndromes (from the Acute Catheterization and Urgent Intervention Triage Strategy Trial). The American Journal of Cardiology. 2014;114:1823-9.

23. Pilgrim T, Vetterli F, Kalesan B, Stefanini GG, Räber L, Stortecky S, et al. The impact of anemia on long-term clinical outcome in patients undergoing revascularization with the unrestricted use of drug-eluting stents. Circulation: Cardiovascular Interventions. 2012;5: 202-10.

24. Ko EJ, Kim YK, Cho J-H, Kim YS, Kang S-W, Kim N-H, et al. The differential effects of anemia on mortality in young and elderly end-stage renal disease patients. Kidney Research and Clinical Practice. 2020;39: 192.

25. Kwok CS, Tiong D, Pradhan A, Andreou AY, Nolan J, Bertrand OF, et al. Meta-analysis of the prognostic impact of anemia in patients undergoing percutaneous coronary intervention. The American Journal of Cardiology. 2016;118: 610-20.

26. Jiang L, Gao Z, Song Y, Xu J, Tang X, Wang H, et al. Impact of anemia on percutaneous coronary intervention in Chinese patients: A large single center data. Journal of Interventional Cardiology. 2018;31:826-33.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/95236