ORIGINAL ARTICLE

Pattern of Coronary Artery Affection in Young Patients Presenting with ST Segment Elevation Myocardial Infarction

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Abstract

Background: ***STEMI is characterized by acute coronary thrombosis accompanied by sustained ST-segment elevation of ≥ 1 mm in ≥ two consecutive ECG leads. Although in young people, acute myocardial infarction (MI) is rather infrequent, its potential for mortality and long-term impairment renders it a significant clinical concern.***

Objective: ***To evaluate the postulated risk variables, clinical presentation, angiographic results, and outcomes of acute MI in young people, known as individuals below forty years of age.***

Methods: ***The present research is a cross-sectional study comprising 100 patients diagnosed with STEMI. The patients underwent clinical assessment, standard laboratory tests, electrocardiogram, Echocardiography, and coronary angiography for diagnostic and therapeutic objectives.***

Results: ***A Total of 100 young participants were included. Participants' sex was predominantly male (89%) with a mean age of 32.8 ± 4.57 years. The most frequently detected type of MI was anterior MI which was detected among (65%) of the patients and the most frequently detected risk factor was smoking which was detected among (78%) of the patients also shows that (65%) of the patients had single-vessel disease, (29%) presented with 2-vessel disease and (6%) 3-vessel disease. Also, the most frequently detected infarcted artery was LAD, which was detected among 66% of the patients.***

Conclusion: ***The most common presentation is Anterior STEMI with atherothrombotic events as an underlying etiology. Smoking is the most prevalent risk variable. Approximately 65% of participants exhibit single-vessel disease, and the most frequently involved artery was the left anterior descending artery.***

Keywords: Coronary Anatomy And Physiology; Coronary Artery Diseases; ST Segment Elevation Myocardial Infarction

1. Introduction

Myocardial infarction is characterized by injury to the myocardium leading to necrosis of cells owing to extended ischemia, resulting from disparity between oxygen availability and the required amount in the myocardial tissue. Myocardial infarction most probably results from inadequate blood supply to the myocardium, attributable to atherothrombotic cardiovascular disease, embolism of coronary arteries, coronary tightness, prolonged tachyarrhythmias, significant loss of blood, profound anemia, or respiratory distress .[1]

Acute myocardial infarction is known to be a prevalent condition that continues to be the primary cause of illness and death globally. Despite myocardial infarction being predominantly an affliction of the elderly, current research indicates an incidence rate between the age brackets of 30–34 and 35–44 years, is 12.9 and 38.2 per thousand males and 2.2 and 5.2 per thousand females, respectively.[2]

Hypertension, diabetes, smoking, hyperlipidemia, overweight, depression, low socioeconomic class, sedentary lifestyle, previous history of MI occurrence or percutaneous coronary intervention (PCI), and positive family history of MI are the main risk factors for MI occurrence in males or females with young age groups .[3]

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The evaluation of acute myocardial infarction is usually established through evaluation of clinical symptoms and signs, electrocardiogram (ECG) analysis, and cardiac biomarkers. In patients with younger age groups, the clinical manifestation of myocardial infarction resembles that of older individuals, with the majority presenting with chest discomfort. Given the reduced suspicion of MI and unusual presentations among certain patients, there is an increased likelihood of delayed identification of acute myocardial infarction in young patients.[4,5]

Cardiac biomarkers as troponin T and troponin I are constituents of the contractile apparatus of cardiac myocytes, these markers are predominantly expressed in the heart. Elevated cTnI levels are solely indicative of cardiac tissue damage. Both troponin T and cardiac troponin I are main biological markers for assessing myocardial damage also they are suggested for usual application .[6]

ECG findings indicative of acute myocardial infarction, excluding bundle branch block hypertrophy of left ventricle, presented as: ST elevation is defined as emergence of fresh ST elevation at the J-point in two adjacent leads, with a threshold of 1 mm in all leads except for leads V2–V3, where the following thresholds are applicable: > 2 mm in males over 40 years, > 2.5 mm in males under 40 years, or > 1.5 mm in females of any age .[7]

STEMI is characterized by either acute thrombosis of coronary arteries or sustained ST segment elevation of ≥ one mm in ≥ two consecutive ECG leads, while NSTEMI is characterized by ischemic manifestations at rest lasting ≥ ten minutes arising from abrupt coronary plaque breakage or degradation developing within twenty-four hours preceding being admitted to hospital, and demonstrating increased levels of creatinine kinase or cardiac troponin I (cTnI) cardiac biomarkers within the first 24 hours of the initial symptoms .[8]

The main aim of this study was evaluating identified risk variables, clinical manifestations, and results of angiography of acute MI among young patients, specifically those under 40 years of age.

2. Patients and methods

The ongoing cross-sectional study was conducted on 100 patients who presented or were referred to the ED in Al-Azhar University hospitals from July 2023 to September 2024. All the studied patients' data were gathered for this research.

Included patients:

All patients (18-40 years) who presented with STEMI.

Patients consented to participation in the study.

Excluded patients:

Patients outside the range of our study age group.

Patients with a previous history of myocardial infarction.

Patients previously treated with PCI or CABG.

Patients with cardiomyopathy.

Patients with significant valvular or congenital heart disease.

Patients who refused to be enrolled in our study.

Methods:

Detailed history taking:

Personal history: Age, sex, occupation, residence.

Risk factors: Diabetes, smoking status, hypertension, hypercholesterolemia, positive family history of cardiac diseases

Past history of previous coronary artery diseases, myocardial infarction (MI), percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG) for exclusion.

Clinical examination (vital signs, signs of heart failure / hemodynamic instability according to Killip classification, signs of comorbidities, local cardiac examination, and application of different clinical risk scores for STEMI, including Killip classification and TIMI risk score).

12-lead surface ECG.

Cardiac biomarkers and basic laboratory investigations:

Other basic laboratory investigations include CBC, serum creatinine, Na, K, HbA1C, and lipid profile.

Cardiac biomarkers including CK-MB and high-sensitive cardiac troponin I.

Coronary angiography with or without PCI to assess the following:

Presence of obstructive atherosclerotic CAD and identification of the IRA and other associated significant CAD.

Localization of the lesion, the number of diseased arteries, and the thrombus grade.

Presence of SCAD or MINOCA, abnormal coronary origin and course, myocardial bridge, ectatic and corkscrow vessels, and slow flow.

Initial and final TIMI flow grade.

Method of revascularization and using GPIIb/IIIa inhibitor infusion or not.

PCI to IRA only or complete revascularization during the index procedure.

Transthoracic Echocardiography. (2D and 3D Echocardiography will be performed during hospitalization and 40 days after intervention. Standard echocardiographic measurements were obtained following the most recent EACVI /ASE guidelines.

Acquisition protocol

All patients will be assessed while resting in the left lateral decubitus posture to acquire sufficient pictures in various standard perspectives.

The study will be ECG-gated and will be saved as cine loops with a frame rate between 60 and 110 frames per second for offline quantification.

These measurements were taken:

Left ventricular dimensions were measured by M-mode examination of the parasternal LAX view.

The left ventricular ejection fraction was assessed using Simpson's biplane approach, which was derived from the apical four- and two-chamber images.

Left ventricular end-systolic and diastolic volumes were measured by 3D mode. LV ejection fraction was calculated as the ratio between stroke volume and end-diastolic volume.

Assessment of RWMA in different echo views including A4CV, A2CV, A3CV and parasternal short axis view with calculation of wall motion score index.

3. Results

This research included one hundred participants with ST-segment elevation myocardial infarction in their presentation. Their ages ranged from 18 to 40 years with a mean ± SD of 32.8 ± 4.57. (89%) were males and (11%) were females. Their BMI ranged from 22 to 33 kg/m2 with a mean ± SD of 27.17 ± 2.67. Also, the most frequently detected risk factor was smoking which was detected among (78%) of the patients, followed by hypertension among (19%), dyslipidemia and family history of CAD among (15%), while the least frequently detected risk factor was diabetes mellitus which was detected among (9%) of the patients. (Table 1).

Table (2) shows that (65%) of the patients had single-vessel disease, (29%) had two-vessel disease and (6%) had three-vessel disease (Figure 2). Also, the most frequently detected infarcted artery was LAD which was detected among (66%) of the patients, followed by RCA which was infarcted among (18%) of the patients, then LCX among (13%) of the patients, then ramus among (2%) of the patients, while the least frequently detected infarcted artery was OM which was detected among (1%) of the patients. As regards localization, (5%) had a distal lesion, (36%) had a mid-segment lesion, (16%) had an ostial lesion and (43%) had a proximal lesion (Figure 1). Regarding the type of lesion, (81%) had Atherosclerosis, (6%) had MINOCA (2 cases with thrombus grade 1), (4%) had SCAD (2 cases with thrombus grade 1 (figure 3), and (9%) had thrombus with non-obstructive coronary artery lesion. As regards the method of revascularization, (10%) had conservative treatment and reevaluation, (9%) had GP Ⅱb/Ⅲa then reevaluation, (56%) had PCI with DES and (25%) had PCI with DES & GP Ⅱb/ Ⅲa. Regarding other CAD, the most frequently detected was LAD among (9%), followed by LCX and RCA among (8%), then LCX, RCA among (6%) and the least frequently detected was LM among (4%), while (65%) had no other coronary artery disease. Also, (84%) of the patients showed total revascularization, while (16%) didn't show total revascularization.

Table (3) shows a statistically significant improvement in 2D transthoracic echocardiographic findings, as the baseline LVEDD was 5.27 ± 0.3 and then reduced to 5.17 ± 0.46 at follow-up (P<0.001). Also, the baseline LVESD was 3.99 ± 0.32 and then reduced to 3.81 ± 0.51 at follow-up (P<0.001). While the baseline EF was 41.38 ± 7.43 and then increased to 47.64 ± 7.99 at follow up (P<0.001).

Table (4) shows a statistically significant increase in LVEDV, as the baseline LVEDV was 116.5 ± 13.73 and then increased to 123.78 ± 15.66 at follow-up (P<0.001). Also, the baseline LVESV was 68.78 ± 9.34 and then reduced to 65.24 ± 15.42 at follow-up (P<0.001). While the baseline EF was 41.26 ± 7.27 and then increased to 47.69 ± 8.01 at follow-up (P<0.001). Also, the baseline WMSI was 1.88 ± 0.24 and then reduced to 1.66 ± 0.28 at follow-up (P<0.001). Also, there was a statistically significant improvement in ejection fraction.

Table 1. Demographic data and risk factors among the studied patients

Variables		*All patients (n=100)*
Age (years)	*Mean ± SD*	*32.8 ± 4.57*
	Range	*(18 – 40)*
Sex (n. %)	*Male*	*89 (89%)*
	Female	*11 (11%)*
BMI (kg/m²)	*Mean ± SD*	*27.17 ± 2.67*
	Range	*(22 – 33)*
Risk factors (n. %)	*Diabetes mellitus*	*9 (9%)*
	Hypertension	*19 (19%)*
	Dyslipidemia	*15 (15%)*
	Smoking	*78 (78%)*
	Family history of CAD	*15 (15%)*

*The same patient may have more than one risk factor.

*BMI = Body mass index, CAD = coronary artery disease

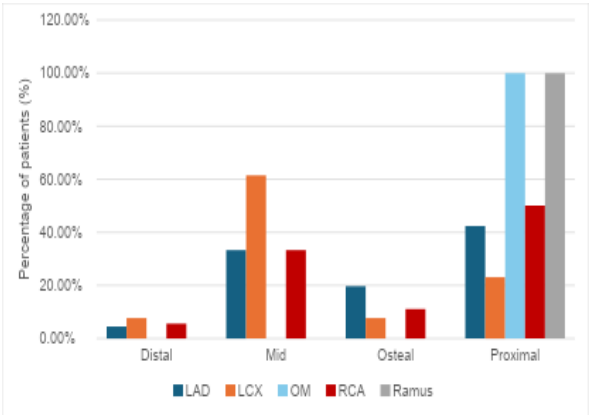

Figure 1, Localization of the lesion in infarct related artery among the studied patients

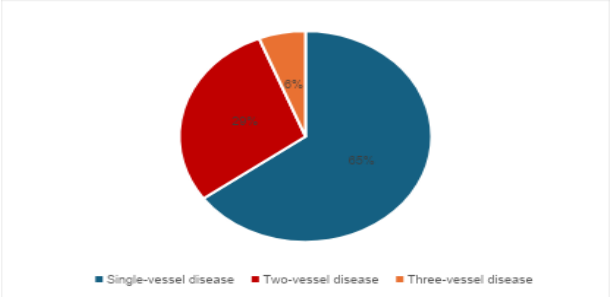

Figure 2. Number of vessels involved among the studied patients

Figure 3. Coronary angiography showing proximal subtotal occlusion of LAD (SCAD), with thrombus grade I.

Table 2. Coronary angiography findings among the studied patients

Variables		*All patients (n=100)*
Number of vessels involved (n. %)	*Single-vessel disease*	*65 (65%)*
	Two-vessel disease	*29 (29%)*
	Three-vessel disease	*6 (6%)*
Infarct-related artery (n. %)	*LAD*	*66 (66%)*
	LCX	*13 (13%)*
	OM	*1 (1%)*
	RCA	*18 (18%)*
	Ramus	*2 (2%)*
Localization (n. %)	*Proximal*	*43 (43%)*
	Mid	*36 (36%)*
	Osteal	*16 (16%)*
	Distal	*5 (5%)*
Type of the Lesion (n. %)	*Atherosclerotic*	*81 (81%)*
	MINOCA	*6 (6%)*
	SCAD	*4 (4%)*
	Thrombus with non-obstructive coronary artery lesion.	*9 (9%)*
Initial TIMI flow (n. %)	*0*	*49 (49%)*
	I	*29 (29%)*
	II	*14 (14%)*
	III	*8 (8%)*
Thrombus grade (n. %)	*0*	*6 (6%)*
	I	*4 (4%)*
	II	*5 (5%)*
	III	*12 (12%)*
	IV	*24 (24%)*
	V	*49 (49%)*
Method of revascularization (n. %)	*Conservative ttt & reevaluation*	*10 (10%)*
	GP IIb/ IIIa inhibitor then reevaluation	*9 (9%)*
	PCI with DES	*56 (56%)*
	PCI with DES & GP IIb/ IIIa	*25 (25%)*
Final TIMI flow (n. %)	*0*	*2 (2%)*
	I	*5 (5%)*
	II	*31 (31%)*
	III	*62 (62%)*
Other CAD (n. %)	*None*	*65 (65%)*
	LAD	*9 (9%)*
	LCX	*8 (8%)*
	LCX, RCA	*6 (6%)*
	LM	*4 (4%)*
	RCA	*8 (8%)*
Total revascularization (n. %)	*Yes*	*84 (84%)*
	No	*16 (16%)*

Table 3. Comparison between baseline and follow-up 2D transthoracic echocardiographic findings among the studied patient

Variables		Baseline (n=100)	Follow-up (n=100)	P Value
LVEDD (cm)	Mean ± SD	5.27 ± 0.3	5.17 ± 0.46	<0.001
	Range	(4.5 – 5.9)	(4.3 – 6.6)	
LVESD (cm)	Mean ± SD	3.99 ± 0.32	3.81 ± 0.51	<0.001
	Range	(3.3 – 4.7)	(3 – 5.2)	
EF (%)	Mean ± SD	41.38 ± 7.43	47.64 ± 7.99	<0.001
	Range	(22 – 57)	(33 – 67)	

Table 4. Comparison between baseline and follow-up 3D transthoracic Echocardiographic findings among the studied patients

Variables		Baseline (n=100)	Follow-up (n=100)	P Value
LVEDV (ml)	Mean ± SD	116.5 ± 13.73	123.78 ± 15.66	<0.001[1]
	Range	(116 – 140.9)	(89.4 – 175.2)	
LVESV (ml)	Mean ± SD	68.78 ± 9.34	65.24 ± 15.42	<0.001[1]
	Range	(51 – 92)	(45.3 – 108.6)	
EF (%)	Mean ± SD	41.26 ± 7.27	47.69 ± 8.01	<0.001[1]
	Range	(24 – 54.7)	(34 – 65.3)	
WMSI	Mean ± SD	1.88 ± 0.24	1.66 ± 0.28	<0.001[1]
	Range	(1.3 – 2.3)	(1 – 2.3)	

4. Discussion

This is a cross-sectional study comprising 100 patients diagnosed with ST-segment elevation myocardial infarction. The patients received clinical assessment, laboratory analysis of cardiac biomarkers, electrocardiogram, Echocardiography, and coronary angiography for diagnostic and therapeutic objectives.

Little studies have evaluated the patterns of coronary artery affection in young patients presenting with ST-segment elevation myocardial infarction, especially in the Arab countries. Balouch et al.[9] study, which we are using as a comparison for our own results, as it evaluated patterns of coronary artery affection in young patients (220 young individuals under 40 years) presenting with acute coronary syndrome and found that the majority of patients (79%) presented with STEMI.

Ages of our patients ranged from 18 to 40 years with a mean ± SD of 32.8 ± 4.57, 89% were males and 11% were females. In Balouch et al.[9] the patient population was primarily male (91.8%), with an average age of 35.3 years ± 5 SD.

In our study, the most frequently detected risk factor was smoking, which was detected among 78% of the patients. Our study agreed with Arisoy et al.[10] who found the same results. Similar to our study, Rallidis et al.[12] have identified a lack of physical activity, smoking, and a favorable family history as significant risk factors for coronary artery disease in the younger population.

Our research reported that the most frequently detected type of MI among our studied participants was anterior MI, which was detected among 65% of the patients. Also, Balouch et al.[9] discovered that a significant proportion of patients (79.1%) were diagnosed with STEMI upon presentation, with anterior wall myocardial infarction being the predominant form (57.3%).

Multivessel disease (MVD) was less prevalent in young patients, comprising only approximately one-third of the entire patient population.

Our study showed that 65% of the patients had single-vessel disease. The most frequently detected infarcted artery was LAD, which was detected among 66% of the patients. Our study agreed with Balouch et al.[9] that discovered that the majority of patients (70%) exhibited single vessel coronary artery disease, with the left anterior descending artery (LAD) being the most frequently affected vessel (53.6%), followed by the right coronary artery (RCA) at 26.8% and the left circumflex artery (LCX) at 26.4%.

Muhammad et al.[11] documented multivessel disease in 40.1% of individuals with STEMI aged < 45 years. Rallidis et al.[12] indicated that the prevalence of MVD in young patients varies between 16% and 56% across different global populations.

Regarding the type of lesion, 81% had atherosclerosis, 6% had MINOCA, 4% had SCAD, and 9% had thrombus with a non-obstructive coronary artery lesion. Balouch et al.[9] found that 6.4% had non-obstructive coronary artery disease. Regarding the thrombus grade, 6% were grade 0, 4% were grade I, 5% were grade II, 12% were grade III, 24% were grade IV, and 49% were grade V. Also, Balouch et al.[9] found that 5.9% were grade 0, 3.2% were grade I, 15.5% were grade II, 12.7% were grade III, 33.6% were grade IV, and 29.1% were grade V. They observed a significant thrombus burden with thrombus grade V in 29.1% and IV in 33.6% of the patients.

As regards the initial TIMI flow, 49% were TIMI 0, 29% were TIMI I, 14% were TIMI II, and 8% were TIMI III. Balouch et al.[9] found that 33.6% were TIMI 0, 25% were TIMI I, 23.6% were TIMI II, and 17.7% were TIMI III.

As regards the method of revascularization, 10% had conservative treatment and reevaluation, 9% had GP IIb/IIIa then reevaluation, 56% had PCI with DES, and 25% had PCI with DES and GP IIb/IIIa. Balouch et al.[9] deployed DES in 86.4%.

As regards LAD, 4.5% had a distal lesion, 33.3% had a mid-segment lesion, 19.7% had an ostial lesion, and 42.4% had a proximal lesion. As regards LCX, 7.7% had a distal lesion, 61.5% had a mid-segment lesion, 7.7% had an ostial lesion, and 23.1% had a proximal lesion. As regards OM, all the patients had a proximal lesion. As regards RCA, 5.6% had a distal lesion, 33.3% had a mid-segment lesion, 11.1% had an ostial lesion, and 50% had a proximal lesion.

Also, Balouch et al.[9] found that as regards LM, all the patients had distal lesion. Regarding LAD, 21.2% had ostial lesions, 40.7% had proximal lesions, 40.7% had mid-segment lesions, and 3.4% had distal lesions. Regarding LCX, 3.4% had ostial lesions, 24.1% had proximal lesions, and 72.4% had mid-segment lesions. Regarding RCA, 5.1% had ostial lesions, 52.5% had proximal lesions, 37.3% had mid-segment lesions, and 1.7% had distal lesions. As regards OM, only the patient had a proximal lesion. As regards ramus, all the patients had a proximal lesion.

As regards the final TIMI flow, 2% were TIMI 0, 5% were TIMI I, 31% were TIMI II, and 62% were TIMI III. Also, Balouch et al.[9] observed that the final TIMI flow grade II-III was observed in 92.7% of the patients.

4. Conclusion

The increasing frequency of coronary artery disease among young individuals is attributed to swift lifestyle alterations, detrimental behaviors such as smoking and substance abuse, along with a heightened incidence of diabetes and hypertension.

The predominant manifestation of STEMI in

young patients is Anterior STEMI, attributed to atherothrombotic events as the underlying cause. Smoking is the predominant risk factor, followed by hypertension and a familial history of coronary artery disease (CAD). Approximately 65% of patients have single-vessel disease, with the left anterior descending artery (LAD) being the most frequently affected vessel, followed by the right coronary artery (RCA) and the left circumflex artery (LCX). There was a statistically significant enhancement in ejection fraction.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

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Conflicts of interest

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