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Risk factors profile and angiographic characters of young adults presenting with ST-elevation acute myocardial infarction

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Abstract:
Objective: ST-elevation myocardial infarction is a disease of elderly; however, there is rising trend of STEMI among youth who have unique characteristics. Aim of this study was to investigate risk profile and angiographic findings in young Egyptians with STEMI as compared to elderly.

Methods: We studied 235 patients admitted to Ainshams university hospital with STEMI. They were divided into 2 groups >40 and ≤40 years, risk profile and angiographic findings were further compared.

Results: Males were predominantly affected at young age. Smoking was prevalent in both groups. Elderly had higher prevalence of diabetes (P<0.01), and hypercholesterolemia (P0.015), while young patients were more likely to be drug addicts (P<0.001) and to have a family history of premature CAD (P<0.001). Anterior STEMI was significantly higher in youth (P0.049) while inferior STEMI was higher in elderly (P0.042). MINOCA was exclusively found in young group (P<0.0001). Culprit LAD lesion was higher in the young group (P0.016). Independent predictors of STEMI in youth were drug addiction (OR 8.8, P<0.0001) and family history of premature CAD (OR 12.4, P<0.0001).

Conclusion: STEMI in young Egyptians was predominantly observed in men, smoking was the most common risk factor like in elderly, However Youth have unique risk profile and angiographic findings. They tend to be drug addicts and to have positive family history of premature CAD with less diabetes or hypercholesterolemia. They have less extensive CAD. Anterior STEMI was the most common presentation and LAD was the most common culprit.

Keywords: STEMI, young, risk factors, angiography

Introduction: Coronary artery disease (CAD) is the leading cause of death among adults globally and also in Egypt as reported by WHO in 2019. **(1,2)** ST elevation Myocardial infarction (STEMI) is the lethal presentation of CAD. It has been mainly considered a disease of elderly patients and is a rare entity in the young population. Recently, the diagnosis of STEMI seems to be increasing among youth, which attracts special attention due to its unique features and overwhelming impact on their active lifestyle.

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Aim: To investigate the demographic data, risk profile and angiographic features of Egyptian patients presenting with STEMI at the age ≤40 years in comparison to older patients >40 years.

Patients and methods:

The study included all patients presenting to Ain Shams university hospitals with acute STEMI and survived primary PCI and was approved by the Local Ethical Committee of the faculty of medicine/Ain shams University and the participants signed an informed written consent to participate in the study.

Asymptomatic Patients who presented late after 48 hours of chest pain onset, Presence of serious comorbidity that preclude coronary angiography like active gastrointestinal bleeding or coagulopathy, and those who refused to be part of the study were excluded from the study.

This is a cross-sectional observational study that included 235 patients with STEMI. Patients were divided into 2 groups: >40 and ≤40 years old. A complete medical history was obtained which included age, detailed risk profile related to cigarette smoking, drug abuse, Tramadol use, Cannabis smoking, hypertension (systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg and/or regular use of antihypertensive medication) **(4)**. Diabetes mellitus (HbA1c >6.5% or fasting plasma glucose ≥126 mg/dl and/or postprandial plasma glucose ≥200 mg/dl or a past history of DM and/or taking hypoglycemic drugs) **(5)**. Hypercholesterolemia (serum cholesterol of ≥ 200 mg/dl or triglyceride >150 mg/dl or low-density lipoprotein >130 mg/dl or high-density lipoprotein cholesterol <50 mg/dl for female and <40 mg/dl for male or known cases of dyslipidemia and/or those on medication for dyslipidemia) **(6)**. History of premature CAD defined as male <55 years or female <65 years in first-degree family members **(7)**. A 12 lead ECG was done to all patients to localize the infarction location. All patients underwent primary PCI with the angiographic findings were recorded that included the culprit artery, presence of multivessel disease, degree of stenosis, thrombus burden and the need of intra-coronary tirofiban administration. The net result of revascularization was assessed using TIMI score. **(8)**

Statistical analysis:

Data were collected and analyzed by IBM computer using statistical program for social science (SPSS) version 16, quantitative variables were described as mean, standard deviation (SD) and range, qualitative variables were described as number and percentage. Unpaired t-test was used to compare quantitative variables, in parametric data (SD < 50% mean). Comparison between groups as regards qualitative variables was done by using chi-square test. Fisher exact test was used instead of chi-square when one expected cell is less than 5. One-way ANOVA (analysis of variance) test was used to compare more than two groups as regard quantitative variable. Spearman correlation co-efficient test was used to rank variables versus each other positively or inversely. P value > 0.05 non-significant (NS), P < 0.05 significant (S), P < 0.001 highly significant (HS). Multivariant logistic regression analyses were used to assess independent predictors of STEMI in young with odds ratio and 95% confidence interval (CI). The CI was adjusted to 95%, and the margin of error accepted was adjusted to 5%. Thus, p<0.05 was considered significant.

Results: The Patients' age ranged from 18 to 87 years with a mean age of 53.7 ± 11.57. Males were the majority representing 83% of cases. The prevalence of STEMI in the young population was 19%.

Based on patients' age, patients were divided into 2 groups. Group of patients aged 40 years or less that included 45 patients and the group of patients above that age of 40 that included 190 patients. Both groups were comparable as regards the prevalence of smoking and gender distribution with predominant male gender in both groups. The prevalence of DM and hypercholesterolemia were significantly higher in the older age group. On the other hand, drug abuse and family history of premature CAD were significantly higher in the young group. The details are shown in table 1.

Admission 12 lead ECG showed that 60.4% of the whole study population had anterior STEMI and 32.8% of patients had inferior STEMI. Anterior followed by inferior STEMI was predominant at the young age group. The details are shown in table2.

The angiographic data revealed that, the LAD was affected in 80% of cases of both groups. Both groups are comparable as regards the prevalence of single or multiple vessel affection. Normal Coronaries showed significant prevalence at the young age group (P-value 0.001). Total occlusion of the culprit lesion showed no significant difference between groups, also subtotal occlusion or

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significant obstruction >85% of the culprit lesion showed higher prevalence in old age however it did not reach a statistical significance. The details are shown in table 3.

Both groups showed nonsignificant difference as regards the need to use intracoronary tirofiban and the rate of success as the majority in both groups had TIMI 3 flow. The details are shown in table 4. The multivariate regression analysis of risk factors associated with acute STEMI showed that family history of premature CAD and addiction are independent predictors of STEMI in the young (with OR 8.8 and 12.4 respectively P-value 0.001) for both. These data are shown in Table 5.

Discussion:

ST-elevation myocardial infarction is a deadly form of CAD that was previously thought to be primarily a disease of the elderly and a rare occurrence in the younger population. The incidence of CAD among the young population appears to be on the rise recently all over the world. This is an alarming change that attracted special attention because of its peculiar characteristics and the negative impact it has on their active lifestyle **(3)**.

There are limited data on the incidence of MI in young patients. According to data from numerous studies, premature coronary artery disease affects 2-11% of hospitalized MI patients. **(3).** In Egypt, we are facing an increase in the frequency of STEMI cases among youth. **(2,9)**

In our study, the prevalence of acute STEMI in the young population was 19%. This finding is supported by Shehata et al who reported a prevalence of 21.8% of acute STEMI among Egyptian young patients **(10)**. On the other hand, Mansour et al, reported a prevalence of 9% of acute MI patients were under the age of 45. The difference in age limits included in both studies, may explain the disparity **(11).**

The male gender appears to be one of the most consistent risk factors for coronary atherosclerosis. In epidemiologic research, the preventive effects of estrogens in avoiding atherosclerosis have been clearly proven, with a male: female ratio of 20:1 in a profile of acute MI in young patients **(12)**.

In the current study, male gender predominates in young STEMI cases. This finding is supported by Shehata et al and Mansour et al who found that 86% and 95% of their patients were males, respectively. **(10,11)** Males represented about 90% of young MI patients under 45 years old, according to Chan et al. **(13)** In addition, 91% of the participants in study by Sinha et al were men. **(14)** This gender bias could be attributed to increased smoking prevalence in males and the estrogen protective effect in females under the age of 40 years old. **(11)**

Smoking is a substantial risk factor for CAD as it impacts all stages of atherosclerosis from endothelial dysfunction to acute clinical events which are characterized by high thrombus burden, also smoking aggravates coronary vasoconstriction. **(15)**

In the current study, 87% of young patients were smokers. This is supported by many studies that demonstrated that the association between smoking and young MI (**11, 16**). In Egypt, there is higher smoking prevalence in all age groups as compared to other countries **(2).**

Cannabis is the most extensively used illicit substance in the world. About 160 million people between 15–64 years old have tried cannabis at least once in their life (**17**). The processes through which cannabis causes damage in the myocardium and coronary arteries appear to be complex. During cannabis smoking, delta-9-tetrahydrocannabinol, the metabolite of cannabis, rapidly reaches peak levels in the bloodstream and stimulates the sympathetic nervous system by increasing heart rate and cardiac output by more than 30% in a dose-dependent manner. Increase in blood pressure can occur when sitting or supine and abrupt fall can occur when standing with orthostatic hypotension due to decrease in peripheral vascular resistance. Furthermore, smoking cannabis is linked to an increase in carboxyhemoglobin, which results in a reduction in oxygen carrying capacity. All of these factors contribute to induce myocardial supply/demand mismatch. Vasospasm is consequently another pathological mechanism. Cannabis increases oxidative stress through increasing the development of oxidized low-density lipoproteins, factor 7 activity, platelet activation and aggregation, and inducing an inflammatory response. These factors lead to plaque disruption in the presence of a vulnerable, but not necessarily stenotic, atherosclerotic plaque **(18)**.

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In our study, nearly half of the young patients with MI were illegal drug users and drug addiction was an independent risk factor for STEMI in young patients. Cannabis was the most commonly abused substance, followed by tramadol; no cocaine addiction was documented. This is supported Mansour et al who found that cannabis was significantly associated with Acute MI in young Egyptians. **(11**) Many studies found that the risk of MI increases with cannabis smoking and that cannabis use was strongly linked to a significant increase in all-cause and cardiovascular death **(19,20,21)**.

The prevalence of all traditional risk factors as DM, dyslipidemia was significantly higher in the older age group except hypertension. The prevalence of hypertension did not show significant difference between both groups. This finding is supported Mansour et al, who found that up to 35% of young patients had hypertension. **(11)** This finding may be explained by the observation that Hypertension among young people is frequent, impacting 1 in every 8 adults aged 20 and 40 years. **(22)**

Family history of premature was an independent predictor of STEMI in our young population. In the Malmo Diet and Cancer Study, a family history of premature CAD was associated with an incidence of CAD with a hazard ratio of 1.52 (95% CI: 1.39–1.65*).* **(23)** Recently, Ambroziak et al concluded that MI in young population is linked to a higher number of relatives with a history of premature MI/ischemic stroke and that the family history of premature atherosclerosis extends to second-degree relatives. **(24)**

Anterior STEMI was the most common presentation in all our patients of both groups. A finding that agrees with the study of Shaheen et al., who stated that anterior MI is the most common region of infarction in Egyptian patients. **(2)** The high incidence in the young population is supported by many studies **(10,25)**

When compared to individuals who acquire CAD later in life, the coronary angiographic profile of young patients with MI is substantially different. In the CASS study, patients below the age of 45 years had higher prevalence of normal coronary arteries, minor coronary artery abnormalities and Single vessel disease **(26)**. Myocardial infarction without obstructive coronary artery disease (MINOCA) is observed in 5% to 6% (range of 5-15%) of all patients with acute infarction who are referred for coronary angiography **(27).**

In our cohort of young patients, coronary angiography revealed less extensive disease that is mostly affecting one vessel. MINOCA was detected exclusively in the young patients with a prevalence of 6%. This finding is supported by Sinah et al who stated that there was a preponderance of single vessel disease among young Indian patients presenting with STEMI **(14)**. Furthermore, Hosseini et al stated that significant coronary artery lesions were found in 94.8% of older patients, with the majority presenting as multi-vessel disease **(3)**.

Plaque rupture is still the most common cause of myocardial infarction in all age groups, but plaque erosion, coronary microvascular dysfunction, spontaneous coronary artery dissection, and coronary spasm caused by drug use are more common among the young. **(28)**

In our work, the rate of total occlusion was high at the young age group. This is explained by the observation that the rate of rupture/dissection is higher in younger individuals, and the culprit lesions include more thrombus whereas, lesions in the elderly are predominantly calcified. **(29)** However, old patients in our study also showed a high incidence of culprit total occlusion which could be explained by the high smoking prevalence among Egyptians in all age groups, **(2)** which raises the risk of cardiac events with heavy thrombus burden. **(15)**

The rate of success of primary intervention was comparable between the two our study groups. This finding is supported by the study of Cantarelli et al who demonstrated similar rates of success of Primary PCI in young and older group of patients with STEMI **(30)**.

Study limitations: The recent study has some limitations that include the limited number of patients derived from a single center.

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Conclusions:
The risk factor profile of acute STEMI in young Egyptians is not different from many countries being predominantly affecting male gender. Family history of premature CAD and drug addiction are predictors of STEMI at the young age. Their angiographic profile shows less extensive CAD with higher rate of MINOCA and total occlusion.

Abbreviations:
STEMI: ST-elevation myocardial infarction, CAD: Coronary artery disease, MINOCA: Myocardial infarction with nonobstructive coronary arteries, ECG: Electrocardiogram, PCI: Percutaneous coronary intervention, TIMI: Thrombolysis in Myocardial Infarction, DM: Diabetes mellitus, HTN: Hypertension, LAD: Left anterior descending artery, LCX: Left circumflex artery, RCA: right coronary artery, MI: Myocardial infarction.

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Conflict of interests: None declared.

Table 1 shows demographic features and risk factors distribution between groups.

Variables		**No. = 235**
Age	Mean ± SD	53.7 ± 11.57
	Range	18 – 87
Age	Age>40	190 (80.9%)
	Age ≤40	45 (19.1%)
Gender	Female	40 (17.0%)
	Male	195 (83.0%)

Risk factors	**Age>40**		**Age ≤40**		**P-value**	**Sig.**
	No.	**%**	**No.**	**%**		
HTN	79	41.6%	12	26.7%	0.065	NS
DM	78	41.1%	7	15.6%	0.001	HS
Hypercholesterolemia	84	44.2%	11	24.4%	0.015	S
Smoking	143	75.3%	39	86.7%	0.100	NS
Addiction	13	6.8%	19	42.2%	0.001	HS
Family history	4	2.1%	8	17.8%	0.001	HS

Table 2 Types of STEMI and distribution between groups.

STEMI	**No.**	**%**
Anterior	142	60.4%
Inferior	77	32.8%
Lateral	10	4.3%
Posterior	6	2.6%

STEMI	**Age>40**		**Age ≤40**		**P-value**	**Sig.**
	No.	**%**	**No.**	**%**		
Anterior	109	57.4%	33	73.3%	0.049	S
Inferior	68	35.8%	9	20.0%	0.042	S
Lateral	8	4.2%	2	4.4%	0.944	NS
Posterior	5	2.6%	1	2.2%	0.874	NS

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Table 3: Compares coronary angiographic data of both groups.

Variable		Age>40		Age ≤40		P-value	Sig.
		No.	%	No.	%		
	MINOCA	0	0.0%	3	6.7%	0.0001	HS
Number of diseased vessels	One vessel disease	93	48.9%	27	60.0%	0.182	NS
	Two vessel disease	68	35.8%	12	26.7%	0.245	NS
	Three vessel disease	29	15.3%	3	6.7%	0.131	NS
Culprit	LAD	111	58.4%	35	77.8%	0.016	S
	RCA	57	30.0%	8	17.8%	0.099	NS
	LCX	22	11.6%	2	4.4%	0.155	NS
Culprit lesion	Total occlusion	135	71%	31	74%	0.775	NS
	Subtotal occlusion	55	29%	11	26%	0.546	NS

MINOCA: Myocardial infarction with nonobstructive coronary arteries
LAD: Left anterior descending artery, LCX: Left circumflex artery, RCA: Right coronary artery. NS: non-significant (P>0.05), significant (P<0.05)

Table 4: compares the reperfusion outcome and the need to use of intracoronary Tirofiban in the study groups.

variables		Age>40		Age ≤40		Test value*	P-value	Sig.
		No.	%	No.	%			
TIMI score	**TIMI1**	**5**	**2.6%**	**0**	**0.0%**	**1.210**	**0.271**	**NS**
	TIMI2	**46**	**24.2%**	**14**	**31.1%**	**0.911**	**0.340**	**NS**
	TIMI3	**139**	**73.2%**	**31**	**68.9%**	**0.331**	**0.565**	**NS**
IC Tirofiban	**No**	**138**	**72.6%**	**32**	**71.1%**	**0.042**	**0.838**	**NS**
	Yes	**52**	**27.4%**	**13**	**28.9%**			

TIMI: Thrombolysis in Myocardial Infarction IC: Intra-coronary

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Table 5: Multivariate regression analysis for predictors of STEMI in young patien

Variables		S.E.	Wald	P-value	Odds ratio (OR)	95% C.I. for OR	
						Lower	Upper
Diabetes mellitus		**0.511**	**2.513**	**0.113**	**0.445**	**0.163**	**1.211**
Hypercholesterolemia		**0.478**	**2.441**	**0.118**	**0.474**	**0.186**	**1.209**
Addiction		**0.442**	**24.258**	**0.001**	**8.839**	**3.713**	**21.038**
Family history		**0.718**	**12.344**	**0.001**	**12.454**	**3.050**	**50.857**

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