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Original Research Article

Clinical and angiographic features of young patients with myocardial infarction

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ABSTRACT

Background: Myocardial infarction (MI) is less common in young adults than in middle-aged and elderly people, but clinical interest to this problem is increasing due to the potential for premature death and long-term disability. Aim of the current study was to identify clinical, laboratory, and angiographic features of young (≤45 years) patients with MI.
Methods: The study included 81 patients with acute MI who were divided into 2 age categories: 34 patients ≤45 years old (group 1), and 47 patients >45 years old (group 2). All patients underwent laboratory and instrumental studies, including coronary angiography. Statistical analysis was performed using STATISTICA 12.0.
Results: The gender composition was represented predominantly by men (88% versus 81%, p>0.05). Young patients more often had ST-segment elevation on ECG (88%), while in older patients N-STEMI was more common (26% versus 12%, p=0.035). Younger patients had significantly higher troponin levels (p=0.028), indicating potentially greater myocardial injury. Angiographically, the incidence of single vessel disease was higher in patients below 45 years old (67.6 versus 29.7%, p<0.001).
Conclusions: The study identified that risk factors for early development of MI include primarily male gender, smoking, obesity, and hypertension. Single-vessel lesions with the involvement of the left anterior descending artery were the most common angiographic finding. The ability to predict the risk of developing cardiovascular disease in young people opens new prospects for developing a strategic approach to the care of young people at elevated risk.

Keywords: Coronary angiography, Myocardial infarction, Percutaneous coronary intervention, Troponin, Young patients

INTRODUCTION

Acute myocardial infarction (MI) is an injury to the myocardium that has been clinically expressed on laboratory diagnostics like cardiac troponin or with ischemic changes on the electrocardiogram (ECG).[1] Even though the rate of MI has declined over the past few years, the event of fatality has not reduced.[2]

Pathogenesis behind MI is a failure of coronary blood supply to meet the myocardial demand. The reason for the failure can be different in the patients, but the most common is due to narrowing of the coronary arteries due to atheromatous plaques with various superimposed factors like vasospasm or thrombosis.[3] In 2008 out of all global deaths 12.7% were accounting due to ischemic heart diseases and it continues to be the largest cause of death in the world.[4] The incidence of acute myocardial infarction has increased again over the Russian federation and globally.[5] Among cardiovascular diseases, ischemic heart disease has the highest prevalence rate and death count across the world. The mortality rate due to cardiovascular diseases has significantly increased over the years from 1990 to 2022.[6]

Risk factors of MI in young patients includes smoking, male sex, dyslipidemia, and single vessel disease, a positive family history of coronary artery disease (CAD),

obesity than the traditional coronary risk factors such as diabetes, hypertension, chronic kidney disease.[7,8] Substance use such as marijuana and cocaine is also a highly prevalent risk factor which brings the worst mortality rate in MI in young patients. Quitting smoking is a mainstay preventive method for MI in young patients. Patients with familial lipoprotein disorders, mainly increased lipoprotein (a) >50mgd/l have an associated 3-fold higher risk.[9] Almost 75% of young patients do not have a history of CAD, as their first manifestation of ischemic heart diseases is MI or angina pectoris.[10]

The clinical presentation of acute MI is not drastically different between young and old patients. Even though chest pain is the most frequent presentation of MI, silent MI is more prevalent in older patients.[8] The chest pain can typically radiate to the left arm, jaw, back or shoulder and be associated with dyspnea, diaphoresis, light-headedness, and tachycardia.[3]

Type I diabetes mellitus, long term excessive alcohol intake and peripheral artery disease were the factors that were more relevant to death. The mean elapsing time between acute MI and death was 8.6±4 years for patients who are <40 years. The mortality rate is higher in patients if they develop complications like heart failure, ventricular arrythmias, or reinfarction.[10] As complications are common in older elderly patients, it significantly increases the risk of mortality.[11] The significant features that are predicting poor long-term prognosis are anterior wall MI, previous MI, and reduced ejection fraction. Long term mortality rate is lower in patients who received thrombolytic therapy or revascularization therapy than the patients who did not receive highlighting the importance of early restoration of vascular patency.[10] The prognosis of young patients is higher than older patients. Patients without vessel disease have a significantly higher survival rate irrespective of age.[12]

Aim of the study was to identify clinical, anamnestic, laboratory and angiographic features of young (≤45 years old) patients with MI.

METHODS

The study included 81 patients with acute MI who were admitted to the Grodno Regional Clinical Cardiological Center (Belarus) for treatment from January 2024 to November 2025. Patients were divided into 2 age categories: group 1 included 34 patients ≤45 years old, while group 2- included 47 patients > 45 years old. Patients ≤45 years of age were selected based on the WHO criteria for young people.

Exclusion criteria from the study were: chronic rheumatic heart disease, myocarditis, pericarditis, pulmonary embolism, valvular pathology of the heart requiring surgical correction, prosthetic heart valves, oncological diseases, and severe concomitant extracardiac pathology.

In this study, patients were diagnosed with MI based on clinical symptoms, signs, ECG findings, and cardiac biomarker values, and they underwent coronary angiography with possible percutaneous coronary intervention (PCI) at the same center according to the Judkins method (1967) in the x-ray operating room on the Philips Azurion 7 and GE Innova 3100 IQ angiographic units. The computer program of the GE Innova 3100 IQ unit was used for the quantitative assessment of stenoses.

Statistical analysis was performed using the STATISTICA 12.0 software package with a preliminary check for normal distribution using a distribution histogram. Quantitative data, the distribution of which was not normal, were given as a median, 25%, and 75% quartiles. Since most of the quantitative characteristics did not obey the normal distribution law, non-parametric methods were used for comparison. The Mann-Whitney test was used to assess differences in quantitative traits between two independent groups. At a significance level of p less than 0.05, it was believed that the studied indicator in the compared groups had statistically significant differences.

The study was performed in accordance with good clinical practice standards and the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion in the study.

RESULTS

Clinical and anamnestic characteristics of the studied patients are presented in Table 1.

The gender composition was represented predominantly by men, who made up more than 85% of the total number of patients (88% versus 81%, p>0.05). Risk factors analysis revealed smoking to be present in two thirds of all patients (67% versus 72%), without a statistically significant difference between group 1 and group 2 (p>0.05). Patients of both groups were comparable in prevalence of hypertension (91% versus 98%, p>0.05), regardless of stage, and obesity (15% versus 28%, p>0.05). However, in young patients, BMI was significantly lower (p=0.033) and obesity stages 2 and 3 were less common (6% versus 19%, p=0.045). Also, young patients less often had such comorbidities as diabetes mellitus (3% versus 17%, p=0.047) and atrial fibrillation (3% versus 17%, p=0.047).

It is interesting to say, that young patients more often had ST-segment elevation on ECG upon admission (88% of all cases), while in older patients N-STEMI pattern was more common (26% versus 12%, p=0.035). Also, young patients had a three times lower rate of lateral STEMI in comparison with older patients (9% versus 27%, p=0.05), while there were no differences in prevalence of other localizations of STEMI, including LV anterior and inferior wall involvement.

Table 1: Clinical characteristics of patients [Me (25%; 75%)].

Parameters	Group 1 (n=34)	Group 2 (n=47)	P value
Male gender, N (%)	30 (88.3)	38 (80.9)	>0.05
Age, years	44 (39; 44)	64 (57; 75)	<0.001
Duration of hospitalization, days	13 (12; 14)	13 (12; 14)	>0.05
Smoking, N (%)	23 (67.7)	34 (72.3)	>0.05
Body mass index, kg/m^2	23.9 (24; 30.4)	28.2 (25,1; 31.9)	0.033
Obesity, N (%)	5 (14.7)	13 (27.7)	>0.05
Class 1, N (%)	3 (8.8)	4 (8.5)	>0.05
Class 2 and 3, N (%)	2 (5.9)	9 (19.1)	0.045
Hypertension, N (%)	31 (91.2)	46 (97.9)	>0.05
Stage 1, N (%)	8 (23.5)	6 (12.8)	>0.05
Stage 2, N (%)	23 (67.7)	34 (72.3)	>0.05
Stage 3, N (%)	0 (0)	6 (6.4)	>0.05
STEMI, N (%)	30 (88.2)	35 (74.5)	0.035
anterior, N (%)	15 (44.1)	17 (37.8)	>0.05
inferior, N (%)	19 (55.9)	20 (44.4)	>0.05
lateral, N (%)	3 (8.8)	12 (26.7)	0.05
anterior-lateral, N (%)	2 (5.9)	5 (11.1)	>0.05
N-STEMI, N (%)	4 (11.7)	12 (25.5)	0.035
Previous MI, N (%)	3 (8.8)	20 (42.6)	<0.001
Diabetes mellitus, N (%)	1 (2.9)	8 (17.0)	0.047
Atrial fibrillation, N (%)	1 (2.9)	8 (17.0)	0.047
Atrial flutter, N (%)	1 (2.9)	0 (0)	>0.05
Complications			
Ventricular tachycardia, N (%)	0 (0)	3 (6.38)	>0.05
Pulmonary edema, N (%)	0 (0)	0 (0)	>0.05
Cardiogenic shock, N (%)	1 (2.9)	0 (0)	>0.05
Ventricular fibrillation, N (%)	0 (0)	0 (0)	>0.05

Table 2: Laboratory parameters of patients [Me (25%; 75%)].

Parameters	Group 1 (n=34)	Group 2 (n=47)	P value
RBC, 10^{12}/l	4.8 (4.4; 5.3)	4.6 (4.3; 4.9)	>0.05
Hemoglobin, gm/l	150 (142; 163)	140 (132; 150.5)	0.008
WBC, 10^9/l	11.4 (8.9; 13.6)	9.5 (7.1; 10.8)	0.006
ESR, mm/hour	8.6 (4; 12)	14.8 (9; 19)	0.007
Platelets, 109/l	242 (191; 295)	214 (176; 240)	>0.05
Urea, mmol/l	4.7 (3.8; 5.2)	6.5 (5; 7.4)	0.001
Creatinine, µmol/l	81.3 (71.4; 92.8)	91.1 (73.4; 101)	>0.05
eGFR, ml/minute/1.73 m^2	91.4 (78.6; 100.7)	74.3 (60; 87)	0.001
Total cholesterol, mmol/l	5.37 (4.2; 6.6)	4.83 (3.67; 5.82)	>0.05
Glucose, mmol/l	7.2 (5.8; 7.7)	7.4 (6.0; 7.6)	>0.05
LDL, mmol/l	2.3 (2.1; 2.4)	2.52 (1.7; 3.1)	>0.05
HDL, mmol/l	0.8 (0.82; 1.06)	1.01 (0.8; 1.2)	>0.05
Triglycerides, gm/l	0.94 (1.14; 1.97)	1.9 (1.3; 2)	>0.05
AST, IU/l	56.2 (25.6; 60.7)	48.1 (21.2; 51.9)	>0.05
ALT, IU/l	53.7 (27; 58.2)	41.2 (18; 42.8)	0.044
Sodium, mEq/l	141 (140; 143)	138 (137; 140)	>0.05
Potassium, mEq/l	4.2 (3.9; 4.4)	4.2 (3.8; 4.5)	>0.05
Troponin, ng/l	14390 (794; 30992)	9437 (420; 7622)	0.028

Note: RBC- red blood cells; WBC- white blood cells; ESR- erythrocyte sedimentation rate; eGFR- estimated glomerular filtration rate; LDL- low-density lipoproteins; HDL- high-density lipoproteins; AST- aspartate aminotransferase; ALT- alanine aminotransferase.

Table 3: Coronary angiography parameters.

Parameters	Group 1 (n=34)	Group 2 (n=47)	P value
Affected vessel	-	-	-
Left main coronary artery, N (%)	1 (2.9)	5 (10.6)	>0.05
Left anterior descending artery, N (%)	16 (47.1)	27 (57.5)	>0.05
Left circumflex artery, N (%)	5 (14.7)	20 (42.6)	<0.001
Right coronary artery, N (%)	11 (32.4)	28 (59.7)	0.010
Ramus intermedius, N (%)	9 (26.5)	15 (31.9)	>0.05
Stenting, N (%)	30 (88.2)	33 (70.2)	0.049
MINOCA, N (%)	2 (5.9)	2 (4.2)	>0.05
Total number of stents	1.5 [1; 2]	2.1 [1; 3]	0.022
CABG, N (%)	2 (5.9)	10 (21.2)	0.036
Conservative therapy	2 (5.9)	4 (8.5)	>0.05
Number of vessel disease (stenosis >50%)	-	-	-
1 affected vessel	23 (67.6)	14 (29.7)	<0.001
2 affected vessels	6 (17.6)	16 (34.0)	>0.05
3 or more affected vessels	3 (8.8)	15 (31.9)	0.014

Note: MINOCA- myocardial infarction with non-obstructive coronary arteries; CABG- coronary artery bypass graft.

No significant differences were observed in specific post-infarction complications, including ventricular arrhythmias and acute heart failure development.

Laboratory parameters of patients are presented in Table 2.

Laboratory parameters of the patients showed that younger patients with MI had notably higher WBC counts (p=0.006), suggesting an inflammatory response. However, it is interesting that ESR levels were higher in older patients (8.6 versus 14.8 mm/hour, p=0.007).

Also, older patients had significantly lower levels of urea [4.7 (3.8; 5.2) versus 6.5 (5; 7.4) mmol/l, p=0.001] and higher eGFR [91.4 (78.6; 100.7) versus 74.3 (60; 87) ml/minute/1.73 m^2, p=0.001], pointing to better metabolic profile.

Also, younger patients had significantly higher troponin levels [14390 (794; 30992) versus 9437 (420; 7622) ng/l, p=0.028] than patients of group 2, indicating potentially greater myocardial injury.

Other laboratory parameters, including lipid profile parameters (total cholesterol, triglycerides, LDL, HDL) were comparable, as well as electrolytes and glucose (p>0.05).

Coronary angiography parameters of young and old patients with MI are presented in Table 3.

Angiographically, the incidence of one vessel disease was much higher in patients below 45 years old (67.6 versus 29.7%, p<0.001). But the incidence of significant three-vessel disease was statistically much higher in older patients (8.8% versus 31.9%, p=0.014).

There were no differences in the incidence of left main coronary artery disease between the 2 groups (p>0.05), as well as left anterior descending artery (LAD) (p>0.05). However, left circumflex artery involvement was significantly less common in the young patients (14.7% versus 42.8%, p<0.001), as well as right coronary artery stenosis (32.4% versus 59.8%, p=0.010).

The majority of patients in both groups were successfully treated with percutaneous coronary intervention, with a total number of drug-eluted stents higher in older patients [2.1 (1; 3) versus 1.5 (; 2), p=0.022]. Only 2 patients in Group 1 had significant multi-vessel disease and were treated by coronary artery bypass graft (CABG), while in group 2 10 patients underwent CABG (p=0.036), and another 2 refused the surgical treatment and were treated conservatively. It is interesting to say that 2 patients in both groups did not have any significant coronary artery stenosis (<50%) and were diagnosed with myocardial infarction with non-obstructive coronary arteries.

DISCUSSION

The problem of acute MI in patients under 45 years of age, despite its apparent insignificance, is nonetheless a pressing issue. According to the National Center for Health Statistics, more than 700,000 people in the United States seek medical attention for heart pain each year, with almost a third of these patients being hospitalized.[13]

The study revealed that those at increased risk for early development of MI include primarily young men, smokers, those who are overweight or obese, those with hypertension, and those with a hereditary predisposition to early cardiovascular disease. Overweight and obesity are known to be independent predictors of myocardial infarction and 40% of all cases of CVD are associated with smoking.[1,3] An increased prevalence of coronary

atherosclerosis has also been observed among relatives of patients with early-onset MI.[8] It is also known that elevated blood pressure (especially uncontrolled hypertension) contributes to the development and progression of cardiovascular disease, including an increased risk of MI.[13]

There were no differences between the groups in the localization of MI, except for lateral MI, which was less common in young patients (p=0.05). Based on coronary angiography results, it was established that single-vessel atherosclerotic coronary disease is typical of young patients, while two-vessel and multi-vessel disease are typical of middle-aged and elderly individuals. LAD disease was predominant in both groups, while right coronary artery disease was less common in young patients compared to older patients.

Similar data are presented in a study by Ricci et al, where the authors note that single-vessel lesions or intact coronary arteries are more common in young patients than in the group over 50 years old, while multi-vessel coronary lesions were statistically significantly less common in young patients, and lesions of two arteries were diagnosed with the same frequency in both groups.[14]

Many studies provide data showing that in young individuals, single-vessel lesions are most common, which are mainly associated with the involvement of the LAD in the pathological process.[15,16] Lesions of the left main coronary artery in young patients were much less common compared to older patients, which is confirmed by our data.[17]

The main limitation of this study is the small sample size, from a single hospital. Additionally, other key factors that may play a role in these findings, including genetic polymorphisms and blood clotting factor levels, were not assessed. Nonetheless, our results must be interpreted with caution, and larger studies with higher patient numbers should be carried out to confirm our findings.

CONCLUSION

Although MI in young people remains a relatively rare event, a steady increase in its incidence has been observed in recent years. Those at increased risk for early development of MI include primarily young men, smokers, and individuals with obesity and hypertension. The causes of MI are varied and represent several types of acute mismatch between the myocardial oxygen demand and its delivery through the coronary arteries. In young patients with MI, blood flow in the coronary artery may be impaired due to atherothrombosis, spasm, arterial obstruction due to hemorrhage into an atherosclerotic plaque, and many other non-atherogenic causes.

Despite the existence of universal patterns, the development of myocardial ischemia is always individual, and its course is determined by many factors. With prompt and comprehensive medical care, the prognosis for young patients with MI is significantly better than that of older patients. A better understanding of the causes and mechanisms of MI development in young patients is a serious medical and social challenge. The ability to predict the risk of developing cardiovascular disease in young people based on traditional risk factors, half of which are modifiable, opens new prospects for developing a strategic approach to the care of young people at a substantial risk.

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