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Original Research Article

Gender differences in patients with ST-elevation myocardial infarction

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ABSTRACT

Background: Clinical and morphological features of myocardial infarction (MI) have significant gender differences, but for a long time this problem was not given much attention. In this regard, the issue of gender characteristics of the course and outcomes of MI has become more relevant.
Methods: The study included 100 patients with acute ST-elevation MI (STEMI) who were admitted to the Grodno Regional Cardiological Center (Belarus) for treatment from January to November 2024. Group 1 included 50 female patients, while Group 2 included 50 male patients. All patients underwent clinical, laboratory, and instrumental studies. Statistical analysis was performed using «STATISTICA 12.0».
Results: Female patients were significantly older than males (62.1±9.1 vs 57.6±9.2, p=0.017). Both groups were comparable in prevalence of hypertension and obesity (p>0.05), however females more often had diabetes mellitus (p=0.047). There were no intergroup differences in values of total cholesterol (p=0.23), triglycerides (p=0.54) and low-density lipoproteins (p=0.45), however high-density lipoproteins (HDL) were higher in females (p=0.034). Also, male patients with STEMI had higher troponin levels (p<0.001). Both volumetric parameters in M-mode and LV end-diastolic volume in B-mode showed significant differences (p<0.05), being greater in males.
Conclusions: Female patients with STEMI were characterized by higher prevalence of anterior MI and diabetes mellitus, as well as higher level of glucose and HDL. Male patients had higher levels of high sensitivity troponin levels, as well as larger LV volumes. All these parameters can potentially contribute to further investigations in treatment and prognosis in patients with MI.

Keywords: ST-elevation myocardial infarction, Male gender, Female gender, Troponin, Left ventricular ejection fraction, Metabolic disorders

INTRODUCTION

Acute coronary syndrome (ACS) refers to a group of conditions that causes reduced blood flow to the heart. Some of these conditions include ST-elevation myocardial infarction (STEMI), Non-ST-elevation myocardial Infarction (NSTEMI), and unstable angina.[2,3] All these set of events occur due to decreased blood flow to the heart which is caused by plaque build-up and rupture in the main vasculature of the heart (coronary arteries). Common risk factors include smoking, hypertension, diabetes, high cholesterol and family history.[2] STEMI is the leading cause of death among all cardiovascular pathologies worldwide and is most prevalently seen in developed countries.[1] STEMI has more diverse range of pathophysiology than thought before. It includes, plaque erosions and calcified nodules. Each and every mechanism causes various histopathologic changes and clinical outcomes. For example, a ruptured plaque will need emergent reperfusion, whereas plaque erosion may only need conservative management4. STEMI is always known to be a symptomatic condition. Chest pain is among the top reasons for emergency department visits. The epidemiology of the mortality depends on the

socioeconomic status of the countries. Many research studies have shown that mortality of STEMI is significantly higher in high income countries than middle- and low-income countries.[6] Age and gender also have a major impact on the severity and prognosis of ACS.[3] When it comes to gender, recent studies have shown that the presentation of STEMI is similar in both men and women. But in some cases, non-chest pain symptoms are higher in women and also shows different coronary plaque characteristics. The reason for this has not been clearly proven but scientists believe that there is a contribution of hormonal changes that occurs in menopausal transition.[7] On the other hand, some other studies have shown that women are more prone to have worse outcomes when age comorbidities are not adjusted.[6]

According to the recent studies, younger women have a higher risk of mortality from ACS than men when the comorbidities are unadjusted, and older women have a lower risk of adverse outcomes when compared with older men9. Women are more likely to have a poor health condition at the time of an acute coronary syndrome event. There are also factors such as smoking, diabetes, socioeconomic status, and mental health which may contribute to a higher cardiovascular risk in these women.[7,8]

Therefore, the aim of the study was to establish clinical, anamnestic, laboratory and echocardiographic differences in male and female patients with STEMI.

METHODS

The retrospective single-center study included 100 patients with STEMI who were admitted to the Grodno Regional Clinical Cardiological Center (Belarus) for treatment from January 2024 to November 2024. Group 1 included 50 female patients, while group 2–included 50 male patients. Inclusion criteria for the study participants were: age between 18 and 80 years, and a diagnosis of STEMI, which was based on clinical symptoms, signs, ECG findings, and cardiac biomarker values.

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.

All patients underwent clinical, laboratory, and instrumental studies, including transthoracic echocardiography. Clinical and demographic data, the results of basic laboratory tests, medical history of comorbidities, and duration of arrhythmia were collected for all patients. Coronary angiography with possible percutaneous coronary intervention was performed at the same centre in the X-ray operating room on the Philips Azurion 7 and GE Innova 3100 IQ angiographic units. Echocardiography was performed on Phillips iE33 device with a multi-frequency sensor (frequency 2.5-5.0 MHz). The examination was performed with the patient lying on his left side with his back to the researcher or on his back. The study protocol included the following indicators: left atrium (LA) and right atrium (RA) diameter in 2-chamber and 4-chamber mode, end-systolic diameter and end-diastolic diameter (mm) of the left ventricle (LV); assessment of the state of the valvular apparatus of the heart, degree of regurgitation on the valves.

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. Statistical significance of differences between qualitative characteristics was assessed using the $\chi 2$-Pearson test. 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

Female patients were significantly older than males (62.1±9.1 vs 57.6±9.2, p=0.017). Both groups were comparable in prevalence of hypertension (94% vs 96%, p>0.05), obesity (54% vs 48%, p>0.05), and atrial fibrillation (0% vs 8%, p>0.05). However female patients more often had diabetes mellitus (36% vs 26%, p=0.047) and higher heart failure NYHA class (Class 3-4 in 58% of females and 28% of males, p<0,01). It is interesting to say, that females more often had anterior STEMI (52% vs 36%, p=0.03), while males had inferior one (34% vs 48%, p=0.04). There were no differences in prevalence of other localizations of MI (Table 1).

According to the results of clinical blood count, patients of both groups didn't have significant differences in number of WBCs (8.1 (6.9; 9.2) vs 8.2 (6.5; 9.2) 10×9, p=0.87). Number of RBCs (4.6 (4.3; 5.1) vs 4.2 (3.8; 4.6) 10×12, p=0.04), hemoglobin (145 (137; 155) vs 125 (118; 134), p=0.027) were higher in male patients, while ESR was higher in females (20.5 (10; 30) vs 15.3 (6; 20) mm/h, p=0.017). Interesting to say, that number of platelets was higher in females (291 (245; 325) vs 252 (190; 284) 10×3, p=0.04). In biochemical blood test male patients had higher levels of urea (p=0.039) than females, however their creatinine levels were comparable (p=0.53). It is interesting that despite the above-mentioned females had significantly lower eGFR values (p=0.001). There were no intergroup differences in values of total cholesterol (p=0.23), triglycerides (p=0.54) and low-density

lipoproteins (p=0.45), however high-density lipoproteins were higher in females than in males (1.08 (0.82; 1.19) vs 0.89 (0.73; 1) mmol/l, p=0.034). Also, male patients with STEMI had significantly higher troponin levels (11192 (151.5; 13656) vs 8427 (570; 9963) ng/l, p<0.001) (Table 2).

Table 1: Clinical characteristics of patients.

Parameters	Females (n=50)	Males (n=50)	P value
Age in years, M±SD	62.1±9.1	57.6±9.2	0.017
Body mass index, kg/m2, M±SD	30.5±5.2	29.2±4.1	>0.05
Obesity, N (%)	**27 (54%)**	**24 (48%)**	**>0.05**
Class 1	18 (36%)	20 (40%)	>0.05
Class 2	7 (14%)	4 (8%)	>0.05
Class 3	2 (4%)	0 (0%)	>0.05
Hypertension, N (%)	**47 (94%)**	**48 (96%)**	**>0.05**
Stage 1	7 (14%)	12 (24%)	>0.05
Stage 2	35 (70%)	34 (68%)	>0.05
Stage 3	5 (10%)	2 (4%)	>0.05
Localization of MI, N (%)	-	-	
Anterior	26 (52%)	18 (36%)	0.030
Inferior	17 (34%)	24 (48%)	0.040
Lateral	1 (2%)	1 (2%)	>0.05
anterior-lateral	3 (6%)	2 (4%)	>0.05
Posterior	3 (6%)	2 (4%)	>0.05
Diabetes mellitus	18 (36%)	13 (26%)	0.047
Atrial fibrillation	0 (0%)	4 (8%)	>0.05
Atrial flutter	0 (0%)	1 (2%)	>0.05
Heart failure NYHA class N (%)	-	-	
Class 1	1 (2%)	1 (2%)	>0.05
Class 2	20 (40%)	35 (70%)	<0.001
Class 3	28 (56%)	14 (28%)	<0.001
Class 4	1 (2%)	0 (0%)	>0.05

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

Parameters	Females (n=50)	Males (n=50)	P value
RBC, 10^{12}/l	4.2 (3.8; 4.6)	4.6 (4.3; 5.01)	0.001
Hemoglobin, g/l	124.5 (118;134)	144.6 (137.3;155)	<0.001
WBC, 10^9/l	8.1 (6.9; 9.1)	8.22 (6.59; 9.28)	>0.05
ESR, mm/h	20.5 (10; 30)	15.3 (6; 20)	0.001
Platelets, 10^9/l	291.2 (244.5; 325)	252.4 (189.8; 283.5)	0.040
Urea, mmol/l	5.38 (4.3; 5.98)	6.7 (4.6; 7.95)	0.039
Creatinine, µmol/l	86.4 (64.2; 101)	82.7 (70; 91.8)	>0.05
eGFR, ml/min/1.73m^2	70.8 (54.7; 88.9)	90.1 (77; 98)	0.001
Total cholesterol, mmol/l	4.85 (3.8; 5.8)	4.48 (3.46; 5.25)	>0.05
LDL, mmol/l	2.6 (1.8; 3.1)	2.34 (1.7; 2.8)	>0.05
HDL, mmol/l	1.08 (0.82; 1.19)	0.89 (0.73; 1.0)	0.034
Triglycerides, g/l	1.88 (1.3; 2.4)	2.21(1.29; 2.06)	>0.05
Glucose, mmol/l	6.6 (5.3; 9.3)	5.99 (5.1; 6.28)	0.016
Sodium, mEq/l	141 (139; 124.9)	141.7(139.6; 143.8)	>0.05
Troponin, ng/l	8427 (570; 9963)	11192 (151.5; 13656)	<0.001

Table 3: Echocardiographic parameters of patients (Me (25%;75%)).

Parameter	Females (n=50)	Males (n=50)	P value
LA diameter (2 chamber), mm	37.1 (35; 38.5)	38.6 (36; 41)	>0.05
LA diameter (medial to lateral), mm	38.7 (36; 42)	39.3 (36; 42)	>0.05

Continued.

Parameter	Females (n=50)	Males (n=50)	P value
LA diameter (front to back), mm	51.9 (48.3; 54.7)	53.4 (49; 55)	>0.05
RA diameter (medial to lateral), mm	35.5 (32.3; 37.8)	36.1 (34; 39)	>0.05
RA diameter (front to back), mm	48.2 (45; 50.8)	49.7 (46; 52)	>0.05
LV ESD, mm	34.3 (31; 36)	36.4 (33; 38.8)	>0.05
LV EDD, mm	49.4 (46; 51)	51.2 (48; 54)	>0.05
M-mode	-	-	-
LV ESV, ml	53 (37.5; 55)	61.7 (43.5; 73)	0.022
LV EDV, ml	121.5 (97.5; 1315.5)	131.2 (112.5; 147.5)	0.042
LVEF, %	58.2 (55.5; 64.5)	54.3 (50; 62.5)	>0.05
B-mode	-	-	-
LV ESV, ml	56.4 (40.3; 68)	57.6 (44; 65.5)	>0.05
LV EDV, ml	113.3 (89.5; 128)	121.8 (107;140.5)	0.047
LVEF, %	52.5 (47; 59)	55.5 (50;61)	>0.05
Septal thickness (systolic), mm	16.5 (15; 18)	16.5 (16; 17.75)	>0.05
Septal thickness (diastolic), mm	12.5 (11; 14)	12.5(11; 14)	>0.05
Posterior wall thickness (systolic), mm	15.4 (14; 16)	15.3 (14; 16)	>0.05
Posterior wall thickness (diastolic), mm	11.1 (10; 12)	11.16 (10; 12)	>0.05
Right ventricle diameter, mm	25.1 (24; 27)	27.2 (25; 29)	0.005
Contractility index	1.39 (1.06; 1.56)	1.34 (1.13; 1.5)	>0.05
MR grade 1, N (%)	22 (44%)	17 (34%)	>0.05
MR grade 2, N (%)	16 (32%)	7 (14%)	0.044
MR grade 3, N (%)	2 (4%)	1 (2%)	>0.05
TR grade 1, N (%)	9 (18%)	8 (16%)	>0.05
TR grade 2, N (%)	16 (32%)	6 (12%)	0.036
TR grade 3, N (%)	2 (4%)	1 (2%)	>0.05

The LA, RA diameter and both LV diameters were comparable between the groups (p>0.05). However, both volumetric parameters in M-mode and LV end-diastolic volume in B-mode showed significant differences (p<0.05), being greater in male patients in comparison with females. Both values of LVEF in M and B mode were comparable (p>0.05). It is interesting to say to male patients were characterized by larger diameter of right ventricle (27.2 (25; 29) vs 25.1 (24; 27) mm, p=0.005), however, their TAPSE showed no differences (18.2 (17; 20) vs 18.1 (15.5; 20) mm, p>0.05). On the contrary, female patients had higher grades of mitral and tricuspid regurgitation (MR Grade 2 in 32% of females and 14% of males, p=0.044, TR Grade 2 in 32% of females and 12% of males, p=0.036).

DISCUSSION

According to the literature data, clinical, morphological and other features of MI have significant gender differences, but for a long time this problem was not given much attention. This circumstance was apparently due to the fact that MI most often developed in women of older age groups. Traditionally, there was an opinion that the main cause of death in women was cancer of the uterus, ovaries and mammary gland, while men die mainly from cardiovascular diseases.[10,13] However, in recent years it has become obvious, that the first place in the structure of mortality in both men and women is held by cardiovascular disease including acute MI. In this regard, the issue of gender characteristics of the course and outcomes of MI has become more relevant. This is due, firstly, to the tendency of a decrease in the frequency of MI in young men with a simultaneous increase in the same in elderly women, and, secondly, to a decrease in mortality from MI in men, but not in women.[10]

According to a study that has been carried out in India about the gender differences in the management and outcomes of ACS, the results concluded in this study showed that women in India had a worse outcome with ACS11. The in-hospital death rates and stroke rates were also significantly higher in women. Indian women also showed to have a significantly higher 30 days and 1-year mortality rate following an ACS event.[11] Women who suffered an ACS event were seen to have a higher prevalence of diabetes mellitus and hypertension which are 2 risk major risk factors associated with a cardiovascular event. According to another study that was carried out in Middle East by Khesroh et al authors concluded that gender was a non-significant contributor to mortality but women suffering from ACS were found to be older and suffering from more comorbidities than men8. Women more often presented with an atypical chest pain and took longer to seek medical care than men. In this study also they had found that women are less likely to undergo primary angioplasty and unlikely to be prescribed evidence-based medications such as aspirin, clopidogrel, beta-blockers etc. Due to all these reasons, the long-term outcomes were seen to be worse in women and they tend

to have a higher mortality at 1 year.[8] The research study that we carried out in Grodno State Cardiological Center in Belarus revealed similar findings to above mentioned articles. Authors found that female patients with STEMI were more likely to suffer from an anterior MI and have a higher class of heart failure according to NYHA. Female patients more often suffered from diabetes mellitus which is known to be a major risk factor for and acute coronary event. According to the laboratory studies compared in men and women, female patients were found to have lower levels of hemoglobin (indicating women are more likely to be anemic) and a higher level of ESR and platelets. The elevation in platelets shows that women are more likely to suffer from an acute coronary event such as MI. Female patients were also seen to have low sensitivity to troponin levels compared to men which may indicate the larger areas of LV myocardium involvement, which can worsen the prognosis in males. Findings concluded from comparing echocardiographic data of male and female patients indicated that women had higher grades of mitral and tricuspid regurgitation which shows that most women suffering from an acute coronary event, had pre-existing cardiac pathologies.

Limitations

The main limitation of this study is the small sample size, from a single hospital. Additionally, other important factors that may play a role in these findings, including genetic polymorphisms and treatment characteristics, 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

Female patients with STEMI were characterized by higher prevalence of anterior localization of MI, diabetes mellitus, higher heart failure NYHA class, lower hemoglobin levels, and higher level of platelets and ESR as well as higher level of glucose and HDL. Male patients had higher levels of high sensitivity troponin levels, as well as larger volumetric parameters of LV and linear parameters of right ventricle. All these parameters can potentially contribute to further investigations in treatment and prognosis in patients with STEMI.

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