ORIGINAL ARTICLE

Arrhythmic complications in women with STEMI

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Abstract: Objectives – Severe arrhythmias can appear as a complication in acute myocardial infarction with ST segment elevation (STEMI) and can be a cause of higher in-hospital mortality. The aim of our paper was to show if the arrhythmias can explain study the higher mortality in women with STEMI. **Methods –** We study the arrhythmic complications, both tachyarrhythmias and bradyarrhythmias in female with STEMI admitted in the Cardiovascular Diseases Institute „Prof. Dr. George I. M. Georgescu" Iași between 1 September 2011 and 1 September 2012. Patients enrolled in the study were aged between 29 and 90 years old, 207 women and 445 men, and the mean age of the female population was 68.20 ± 10.8 years. The arrhythmias were diagnosed retrospectively based on the existing electrocardiograms. **Results –** Anterior myocardial infarction was the most common STEMI localization in the analyzed population, regardless of sex, but more women had anterior myocardial infarction than men, with a statistically significant difference: p = 0.021. Ventricular tachycardia appeared as a complication of myocardial infarction in 5.4% of subjects, 4.3% of women and 5.8% of males: p = 0.142. In the first 48 hours, ventricular fibrillation occurred at 2.9% of female and 5% of males, and after this limit, it was more common in the female group(1.9% of females and 0.4% of males, p <0.001). Atrial fibrillation occurred during hospitalization in 5.75% of patients, 7.7% of women and 3.8% of males, p = 0.048. Total atrioventricular block as a complication of myocardial infarction, was more frequent in men (5.3% versus 3.4%), p = 0.441. Total mortality rate during the hospitalization was 5.67%, and it was much among women, compared to men. **Conclusions –** The results of our study show that women had more frequent than men atrial fibrillation and ventricular fibrillation developed 48 hours after admission. This can be explained by the more frequent anterior wall involvement in myocardial infarction in women from our study. The higher mortality can be explained mainly by the higher prevalence of anterior wall myocardial infarction and the older age of women comparative with men, more severe arrhythmias being a consequence of these facts.
Keywords: arrhythmia, myocardial infaction, women, complications, mortality.

Rezumat: Obiective – Aritmiile severe pot apărea drept complicație în infarctul miocardic acut cu supradenivelare de segment ST (STEMI) și pot contribui la creșterea mortalității spitalicești. Obiectivul acestui studiu a fost să arate dacă complicațiile aritmice pot explica mortalitatea crescută la femeile cu STEMI. **Metode –** Am studiat complicațiile tahi- și bradiaritmice la femeile cu STEMI care au fost internate în Institutul de Boli Cardiovasculare „Prof. Dr. George I. M. Georgescu" Iași, în perioada 1 septembrie 2011 și 1 septembrie 2012. Pacienții incluși în studiu au avut vârsta cuprinsă între 29 și 90 de ani, 207 au fost femei și 445 bărbați, vârsta medie a femeilor fiind de 68,2 ± 10,8 ani. Aritmiile au fost diagnosticate pe baza electrocardiogramelor existente în foile de observație. **Rezultate –** Au fost studiați 652 de pacienți care au îndeplinit criteriile de selecție: 207 femei și 445 de bărbați. Infarctul miocardic anterior a reprezentat cea mai frecventă localizare de infarct, atât la bărbați, cât și la femei, deși a fost semnificativ mai frecvent la femei (p=0,021). Tahicardia ventriculară s-a înregistrat la 5,4% dintre pacienți, 4,3% din femei și 5,8% din bărbați (p=142). Fibrilația ventriculară a apărut în primele 48 de ore la 2,9% din femei și 5% din bărbați, pentru ca după 48 de ore să apară mai frecvent la femei (1,9% la femei față de 0,4% la bărbați, p <0,001). Fibrilația atrială a apărut la 5,75% din pacienți, 7,7% femei și 3,8% bărbați (p = 0,048). Blocul atrioventricular total ca o complicație a infarctului miocardic a fost mai frecvent la bărbați (5,3% versus 3,4%, p = 0,441). Mortalitatea pe parcursul spitalizării a fost de 5,67%, fiind mai ridicată în cazul femeilor comparativ cu bărbații. **Concluzii –** Rezultatele studiului nostru au arătat că femeile, în comparație cu bărbații, au avut mai frecvent fibrilație atrială și fibrilație ventriculară apărută după 48 de ore de la internare. Acest lucru poate fi explicat prin predominanța infactului miocardic anterior la femeile din studiu. Mortalitatea crescută la femeile cu infarct miocardic se datorează tocmai frecvenței superioare a localizării anterioare a infarctului, precum și vârstei mai înaintate a femeilor din studiu (cu aproape 8 ani mai mare decât a bărbaților), severitatea aritmiilor la femei fiind o consecință a acestor lucruri.
Cuvinte cheie: aritmie, infarct miocardic, femei, complicații, mortalitate.

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INTRODUCTION

Cardiovascular diseases and, in particular, atherosclerotic coronary artery disease, have been considered, up until a few decades ago, as a disease of male population. Subsequent studies, which included more and more women, however, indicated that cardiovascular diseases also affect women, in whom the vascular involvement manifests with a delay of about 7-10 years[1,2].

Cardiovascular disease is the leading cause of death among women regardless of race or ethnicity. Approximately half of these deaths are due to coronary artery disease. Several studies have reported higher in-hospital mortality in female with ST-segment elevation acute myocardial infarction (STEMI) compared to males[3-6].Over time, several hypotheses have been formulated to explain the higher in-hospital mortality in female STEMI patients, such as the more advanced age, presence of more comorbidities, longer ischemic time, or the suboptimal use of reperfusion strategies.

It has not yet been established whether female gender, through the biological and sociocultural differences it involves, is itself a risk factor for early in hospital mortality in patients with STEMI.

Arrhythmic complications may develop in about 90% of patients who have an acute myocardial infarction (AMI) during or immediately after the event, and in 25% of patients, such rhythm abnormalities appear within the first 24 hours. Many of the severe arrhythmias, which may complicate the evolution of STEMI, occur before hospitalization and they can result in sudden death or reduced cardiac output. The risk of serious arrhythmias, such as ventricular fibrillation, is greatest in the first hour of patients with STEMI. In non–ST-elevation myocardial infarction (NSTEMI) this risk is lower[7].

The mechanism of arrhythmic complication in myocardial infarction is hypoxia, electrolyte imbalances and a generalized autonomic dysfunction that cause an enhanced automaticity of the myocardium and conduction system all on top of a damaged myocardium that acts as substrate for re-entrant circuits.

Premature ventricular contractions, accelerated idioventricular rhythm, and non-sustained ventricular tachycardia are of no prognostic value and require no treatment, except correction of electrolyte disturbances and acidosis when is the case. Most episodes of tachycardia and ventricular fibrillation occur within the first 48 hours of the onset of the infarction and are treated immediately by an external electrical shock[8]. Current guidelines do not recommend prophylactic antiarrhythmic therapy for the prevention of primary ventricular fibrillation[9,10].

The incidence of ventricular fibrillation may be decreased by early myocardial revascularization, by the early administration of intravenous betablockers and by the correction of hypokalemia and hypomagnesemia.

Factors precipitating supraventricular arrhythmias, especially flutter and atrial fibrillation, are: excessive sympathetic stimulation, ventricular dysfunction, atrial infarction, hypokalemia, pericarditis and hypoxia. The occurrence of atrial fibrillation is associated with an unfavorable short and long term prognosis, and with an increased risk of systemic embolization[11,12].

If arrhythmia causes angina or hemodynamic degradation, electrical cardioversion should be used. In stable patients, in the absence of contraindications, a beta-blocker should be given.

Bradyarrhythmias can be induced by an excessive vagal stimulation or may be caused by ischemic injury of the tissue. Intra-ventricular conduction disorders occur in 10-20% of patients, and atrioventricular blocks can be seen in 6-14% of patients with STEMI[13,14]. These complications increase the risk of death because they are generally associated with large areas of infarction.

METHODS

The aim of our study was to detect the particularities of arrhythmic complications in female with STEMI. In order to resolve the proposed goal, we made a retrospective observational study, which included patients with acute myocardial infarction with ST segment elevation, admitted to the Cardiology Clinic of the Cardiovascular Diseases Institute „Prof. Dr. George I. M. Georgescu", Iași between 1 September 2011 and 1 September 2012.

Arrhythmic complications, both tachyarrhythmias and bradarrhythmias, have been diagnosed based on the existing electrocardiograms. Between 1 September 2011 and 1 September 2012, in the Cardiology Clinic were hospitalized 652 patients with acute myocardial infarction who met the inclusion criteria: 207 women and 445 men. Patients enrolled in the study were aged between 29 and 90 years old, with a mean age of the female population of 68.20 ± 10.8 years.

RESULTS

Electrocardiographic localization of the myocardial infarction

Anterior myocardial infarction was the most common STEMI localization in the analyzed population, regardless of gender, but more women had anterior myocardial infarction, with a statistically significant difference: p = 0.021. The second location, as frequency, was inferior myocardial infarction and the incidence was also higher in women: p = 0.927. The posterior and lateral myocardial infarction was diagnosed in less than one-fifth of patients included in the study, regardless their sex (Table 1).

Premature ventricular beats

Premature ventricular beats (PVB) complicated myocardial infarction in 12.8% of patients, without statistically significant differences (p = 0.815) between women (12%) and men (13.1%). In the first 48 hours, ventricular arrhythmia, although insignificantly statistically, was more common in women. After 48 hours, their frequency decreased significantly in both groups, but the percentage of men exceeded the proportion of women.

The severity of this arrhythmia was assessed only based on the need to initiate antiarrhythmic drugs (amiodarone). More women received amiodarone treatment, but the difference was not statistically significant (Table 2).

Ventricular tachycardia

Ventricular tachycardia was present in 5.4% of subjects, representing 4.3% of women and 5.8% of males: p = 0.142. In order to treat it, external electrical shock was required in hemodinamically unstable patients (1.2%), the others received antiarrhythmic drugs (4.2%). Antiarrhythmic drugs were administered to 2.9% of women and 4.7% of men, but the difference between the two groups was not statistically significant: p = 0.342. External electrical shock was needed to solve the ventricular tachycardia in more women (1.4%) than men (1.1%), with a statistically significant difference: p <0.001.

Ventricular fibrillation

Ventricular fibrillation appeared in 6.4% of patients (4.8% of women and 5.4% of men, p= 0.438, without a statistically significant difference). In the first 48 hours, this ventricular arrhythmia occurred at 2.9% of female and 5% of males (p = 0.375). After the first 48 hours, the incidence of this complication decreased significantly, but was more common in the female group (1.9% of females and 0.4% of males, p <0.001) (Figure 1).

Atrial fibrillation

At the time of admission in our clinic, the electrocardiogram already showed atrial fibrillation in 72 patients (11.04%), with no statistically significant difference in the proportion of women (14.5%) and men (9.4%); p = 0.811. Atrial fibrillation occurred during hospitali-

Table 1. Localization of ST-segment elevation, according to the gender of patients

Patients	Women and men		Women		Men	
Localization of STE	Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
V1-V6	373	57,1	131	63,3	242	54,4
D1-aVL	113	17,3	32	15,5	81	18,2
D2,D3,aVF	341	52,2	110	53,1	231	51,9
V7-V8	114	17,5	35	16,9	79	17,8
aVR	38	5,8	10	4,8	28	6,3
V3-V4	90	13,8	35	19,9	55	12,4

Table 2. The presence of premature ventricular beats according to the gender of patients

Patients	All the patients		Women		Men		
PVB	Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %	P value
Absent	569	87,3	182	87,9	387	87	absent
PVB <48 hours	65	10	22	10,6	43	9,7	p=0,747; NS
PVB >48 hours	18	2,8	3	1,4	15	3,4	p=0,098; NS
PVB amiodarone	33	5,1	14	6,8	19	4,3	p=0,473; NS

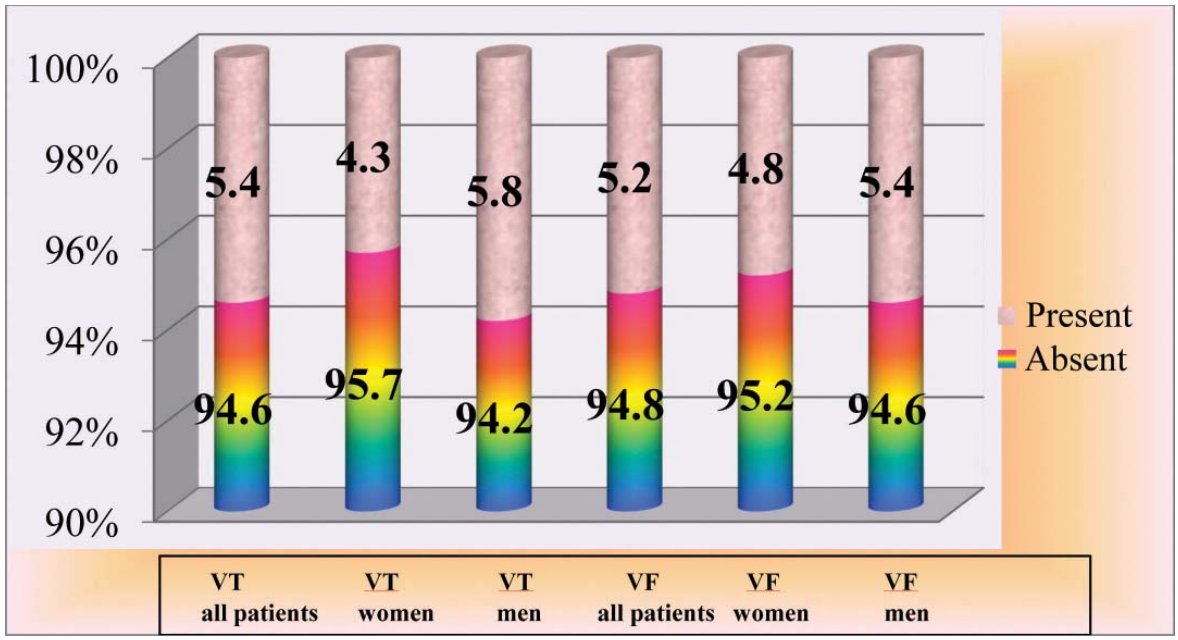

Figure 1. The presence of ventricular tachycardia (VT) and fibrillation (VF) in patients included in the study.

zation in 5.75% of patients (7.7% of women and 3.8% of male, p = 0.048). For all women who developed arrhythmia during hospitalization, this occurred after the first 24 hours. On the contrary, in men, atrial fibrillation appeared especially in the first day (2.02%), and in a smaller percentage (1.79%) in the next days.

Right bundle branch block

The right bundle branch block (regardless of the location of ST segment elevation) was recorded at 5.4% of all the patients, without statistically significant differences between the two genders: it was diagnosed in 6.7% of women and in a lower percentage of men, only 4.7% (p = 0.592) (Table 3).

Atrioventricular conduction disorders

Atrioventricular conduction disorders occurred at 10.5% of patients, with no statistically significant difference between the two genders although the proportion of men was higher (11.1% versus 9.2%, p = 0.841).

Grade I atrioventricular block was detected in a higher percentage of men (4.9%), compared to only 2.4% of women, but the difference was not statistically significant: p = 0.267.

Grade II atrioventricular blocks were also observed more frequently in men (3.3%); only 1.4% of the female group members had this atrioventricular conduction disorder, but the difference between the two sexes did not meet the statistical significance criteria: p = 0.07. The proportion of women with acute coronary syndrome complicated by a total atrioventricular block was higher than that of men (5.3% versus 3.4%), although in this case the difference was not statistically significant: p = 0.441.

Death during hospitalization

Total mortality rate during the hospitalization was 5.67%, and it was higher among women, 30 patients, compared to men, where only a number of 7 men died, p = 0.764. The main causes of death were: cardi-

Table 3. Distribution of right bundle branch block in patients included in the study

Patients	All the patients		Women		Men		
RBBB	Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %	P value
Absent	617	94,6	193	93,2	424	95,3	p=0,378; NS
Non-ant	6	0,9	5	2,4	1	0,2	p=0,002; S
Ant- trans	9	1,4	3	1,5	6	1,4	p=0,004; S
Ant-pers	20	3,06	6	2,9	14	3,1	p=0,168; NS

Non-ant: RBBB in patients with STEMI non-anterior; Ant-trans: transitory RBBB in patients with STEMI anterior; Ant-pers: persistent RBBB in patients with STEMI anterior

ogenic shock, electromechanical dissociation, mechanical complications and asystole.

Analyzing the correlation between different variables considered as particularities of the female population studied and the risk of death during hospitalization, we discovered that there is a high statistically significant correlation between older age and the risk for death. This association was also confirmed by the Pearson correlation ($r = 0.210$ for $p < 0.01$) and ANOVA test ($p < 0.01$). Also, low left ventricular ejection fraction, cardiogenic shock, left ventricular thrombosis, bradyarrhythmias requiring temporary electrical cardiostimulation and ventricular fibrillation were other factors that were associated with an increase in hospital mortality in the case of women, but without a statistically significant correlation.

DISCUSSIONS

The mean age of women included in the study was 68.2 years, with almost 8 years higher than that of males, 60.67 years, with a statistically significant difference ($p < 0.001$). These data are concordant with those from the literature, and the first episode of acute coronary syndrome occurs after menopause and is delayed by about 6-10 years in women than in men[15,16]. The temporal shift in the incidence of acute coronary syndrome in women is most likely due to the protective effect of endogenous estrogens[17].

In our study, the most frequent localization of myocardial infarction, both in women and men, was the anterior one, followed by the inferior localization. Data from the literature about the association between location of the myocardial infarction and gender, are few and inconsistent[17-19]. The gender distribution analysis revealed a greater proportion of posterior (inferior) and lateral/apical localizations in men and a higher incidence of anterior and inferior myocardial infarction in women. The highest percent differences were observed for ST segment elevation in V1-V6 and ST segment elevation in aVR, both in favor of women. The higher incidence of previous myocardial infarction in women was also reported by other studies, but its role as an independent risk factor for adverse prognosis was not confirmed[19,20].

Most patients included in the study were in sinus rhythm at admission. With statistically significant differences, the percentage of women with atrial fibrillation was higher than in men. The higher frequency of atrial fibrillation on the initial electrocardiogram in females was also observed in other studies, but with smaller percentages and undetectable predictive value for evolution[17]. In our study, women had more frequent ventricular tachycardia than males, although the low percentage of patients with this cardiac arrhythmia might disturb this conclusion.

In our study, premature ventricular beats occurred during hospitalization with a higher prevalence (but not statistically significant) among the male population. If during the first 48 hours premature ventricular beats were reported in several women, after the first two days they were more common in males (the gender gap was not statistically significant). In both groups the incidence of this arrhythmia decreased from day 3, and the decrease was more significant in the female group. This evolution of premature ventricular beats could be correlated with the initiation of treatment with amiodarone in a higher percentage of women than men. Several studies have shown that ventricular tachycardia and/or ventricular fibrillation have been associated with an increased risk of late or early hospital death in patients with STEMI treated with fibrinolytic medication[21-23]. However, the prognostic significance of these ventricular arrhythmias after primary percutaneous coronary intervention (PCI) in patients with STEMI was rarely analyzed. The HORIZONS-AMI trial evaluated the incidence, clinical correlation and evolution of VT/FV in the hospital after PCI. Published results suggest that these arrhythmias occur after interventional therapy and prior to discharge to approximately 5% of patients with STEMI, most in the first 48 hours. Independent predictors for their occurrence were Killip >1 at presentation, presence of coronary thrombus, absence of diabetes mellitus and beta blocking medication, as well as a longer symptom-PCI time[22]. There was no correlation between these ventricular arrhythmias and the increased risk of major complications over a three-year follow-up, except for a higher risk of stroke. The variables analyzed were not reported in either the sex of the patients or the therapy applied to the rhythm disorders.

In our study, ventricular tachycardia complicated the myocardial infarction in 5.4% of subjects, and it was more common in men, but the 1.5% difference from women was not statistically significant. Ventricular fibrillation occurred in 6.4% of the patients included in this study, more commonly in males, but with only 0.6% difference (without statistical significance) compared to women. After the first 48 hours, the frequency dropped significantly among both women (1.9%) and men (0.4%) and the 1.5% difference in fa-

vor of women exceeded the statistical significance. Atrioventricular conduction disorders, were more commonly seen in men, with no statistically significant difference with women.

CONCLUSIONS

The results of our study show that women had more frequent than men atrial fibrillation and ventricular fibrillation developed 48 hours after admission. This can be explained by the more frequent anterior wall involvement in myocardial infarction in women from our study. The higher mortality can be explained mainly by the higher prevalence of anterior wall myocardial infarction and the older age of women comparative with men, more severe arrhythmias being a consequence of these facts.

Conflict of interest: none declared.

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