Lethal outcomes in patients with symptomatic heart failure developed after Q-wave myocardial infarction

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Summary. *The article analyses clinical characteristics and mortality of patients with symptomatic chronic heart failure following Q-wave myocardial infarction. During the study 224 patients (mean age 64.1±9.7) with symptomatic chronic heart failure and left ventricular ejection fraction <40% were followed-up for 1–5 years (on the average, 2.6±2.0 years).*

The majority of the studied patients had had anterior or anterior-lower Q-wave myocardial infarction (61.6% and 25.9%, respectively) and an identified Canadian function class II–IV angina pectoris (74.6%), and one-fifth of the patients (19.6%) had unstable angina pectoris. All patients were diagnosed with chronic heart failure New York Heart Association function class II–IV, the majority of patients had disturbances in cardiac rhythm and conduction, almost a half of them (46.0%) had left ventricular aneurysm, 92.8% of patients were diagnosed with marked changes in left ventricular geometry, 84.4% of patients had II–IV° mitral regurgitation, a half of the patients had significant left ventricular diastolic dysfunction, and 6.3% of patients had previously experienced thromboembolic complications. During the follow-up period 132 patients died. The comparison of the characteristics of patients who survived with those of patients who died showed that the deceased patients were statistically significantly older compared to survivors; in addition to that, marked stenoses of three coronary arteries, severe chronic heart failure, ejection fraction ≤20%, ventricular extrasystoles, and sinal tachycardia were more common in the former group, and patients who died less frequently were overweight and less frequently used beta adrenoblockers.

The evaluation of Kaplan-Meier curves showed that total mortality resulting from the development of chronic heart failure symptoms and indications of chronic heart failure during the 1st year was 21.0%, during the 2nd year – 40%, during the 3rd year – 55.0%, during the 4th year – 61.0%, and during the 5th year – 65.0% the highest mortality was observed when left ventricular ejection fraction ≤20%, and age >75. The development of severe chronic heart failure resulted, on the average, after 1.5±1.1 years.

It is obvious that symptomatic chronic heart failure caused by ischemic cardiomyopathy and marked left ventricular systolic dysfunction following Q-wave myocardial infarction is a rapidly progressing process conditioning high risk of lethal outcome within the period of several years.

Introduction

During the last decades, the usage of thrombolytic medications, angiotensin-converting enzyme (ACE) inhibitors, beta-adrenoblockers, and anti-lipidic and anti-aggregation medicines as well as myocardial revascularization surgery had a positive influence on the post myocardial infarction (MI) patients' survival during the early period. However, during the later period, the development of symptomatic chronic heart failure (CHF) resulting from the increase in the left ventricular (LV) dysfunction due to ischemic cardiomyopathy conditions high

risk of death during the nearest several years despite any applied measures. CHF is diagnosed in 1–3% of population, and in 70% of cases this condition is cased by an ischemic heart disease (IHD) (1, 2). The onset of CHF results in the worsening of patients' quality of life, the increase in the need for medications and in-patient treatment, more frequent ischemic consequences, and increased mortality.

According to the findings of NHANE long-term epidemiological study, mortality due to CHF within the period of 10 years was 42.8%, and within 15 years – 56.0% (3). Mc Murray J.J. et al point out that the onset of symptomatic CHF, more than 60% of patients die within 5 years (4). Despite the prevalence of CHF and unfavorable outcome in case of IHD, this syndrome is not sufficiently studied. Up to now, attention has been focused on acute ischemic syndromes (AIS). From 1997 to 2002 MEDLINE published 7245 articles on AIS issues, and only 291 – on the issues of CHF (5). The majority of authors point out the lack of a unified nomenclature of CHF clinical conditions as well as the lack of risk stratification and tactics of pathophysiological treatment, which indicates that further studies of this clinical syndrome are required (5, 6).

The aim of our study was to determine lethal outcomes within the period of five years in patients with CHF following Q-wave MI, and the influence of age and the level of LV dysfunction on mortality.

Material and methods

The studied sample consisted of 224 patients (162 men and 62 women) aged 36 to 88 years (mean age 64.1±9.7 years) having had MI and selected from patients who were treated for CHF at the Clinic of Cardiology of Kaunas University of Medicine Hospital.

All patients were diagnosed with New York Heart Association (NYHA) CHF function class (FC) II–IV and LV ejection fraction (EF) <40%.

During the in-patient treatment, all patients underwent ECG and echocardiography (EchoCG) studies, and one-fifth of patients (17.9%) underwent angiography of coronary arteries (CA); all findings were subsequently evaluated. Anginal syndrome was evaluated on the basis of function class proposed by the Canadian Society of Cardiologists (CSC), and CHF – according to the classification of NYHA. The following findings of EchoCG were evaluated: LV posterior diastolic size (PDS), the size of the left atrium (LA), LV wall movement index

(WMI), LV EF according to Simpson's method, the degree of the mitral regurgitation (MR); in addition to that, the type of geometrical remodeling and the character of LV diastolic function were determined.

The duration of survival within five years from the date of the diagnosis of medium to severe CHF was determined. During the follow-up period 132 patients died.

Cases of death were determined on the basis of the data in medical documentation or relatives' rectification. Cardiovascular death was determined if the patient died suddenly or due to the exacerbation of cardiac symptoms within 6 hours, or in case the patient died due to gradually progressing heart failure, stroke, or thromboembolic complications.

Analysis of statistical data. The analysis of statistical findings was performed using "EPI–INFO 6.0" software. χ^2 criterion was applied to evaluate the dependence of indications. The curves of the probability of death were determined using Kaplan-Meier method. Log-range criterion was used to compare several mortality curves. The difference between the curves was considered to be statistically reliable if the value of the log-range criterion p was below 0.05.

Results

Clinical characteristic of the material

The majority of the studied patients (72.3%) were men. Patients' mean age was 64.1±9.7 years, and one-third of patients (30.8%) were older than 70 years of age. More than a half (55.4%) of the studied patients had arterial hypertension, and in 45.2% of these cases the arterial blood pressure was partially corrected. One-third (35.3%) of patients had increased body weight (BMI>25), and one-tenth (11.6%) of the patients had diabetes mellitus. All patients had previously had Q-wave MI; in more than a half of the subjects (61.2%) Q-wave MI was anterior, in one-fourth of all cases (25.9%) – anterior-lower, and in one-fifth of all cases (19.6%) unstable angina pectoris (UAP) had been found. Nearly all patients complained of anginal pains: Canadian FC II angina pectoris was found in more than one-third (37.5%) of the patients, and another one-third of them (37.1%) had FC III–IV. Most patients were diagnosed with medium to severe CHF – FC III (67.0%) and FC IV (20.5%) (NYHA). One-third (32.1%) of patients had sinal tachycardia, almost a half (49.1%) of them had ventricular extrasystoles, 19.2% of patients had atrial paroxysmal arrhythmias, 15.6% – constant atrial fi-

brillation, 19.2% – full His bundle branch block (HBBB), 6.3% had previously experienced thromboembolic complications, almost one-tenth of patients (8.0%) had previously experienced a stroke, and over ten patients (5.4%) had had ventricular fibrillation.

Almost in all patients (92.8%) marked changes in LV geometry were found – either concentric (22.9%) or eccentric (69.9%) LV hypertrophy. Disturbance in LV diastolic function in a half of patients manifested itself by impaired relaxation (49.6%), and in the rest of them – in pseudo-normal (21.7%) or restrictive (28.7%) dysfunction. In a half (47.3%) of patients LV PDS was >60.0 mm, on the average – 60.0 ± 8.1 mm, and in three-fourths of patients (75.5%) LA was >60.0 mm, on the average – 66 ± 7.9 mm. All patients had marked LV systolic dysfunction: LV EF <40.0%, on the aver-

Table 1. **Clinical characteristic of the study material**

Indications		Contingent n=224 (%)	Survivors n=92 (%)	Deceased n=132 (%)	p
Men		162 (72.3)	69 (75.0)	93 (70.4)	SN
Mean age(m.)		64.1±9.7	61.9±9.5	66.4±9.0	<0.001
Age ≥70 years		69 (30.8)	19 (20.6)	50 (37.9)	<0.05
Arterial hypertension		124 (55.4)	53 (57.6)	71 (53.8)	SN
Diabetes mellitus		26 (11.6)	13 (14.1)	13 (9.8)	SN
Overweight (BMI>25)		79 (35.3)	45 (48.9)	34 (25.8)	SN
Experienced Q-wave miocardial infarction	anterior	137 (61.2)	59 (64.1)	78 (59.1)	SN
	lower	29 (12.9)	9 (9.8)	20 (15.1)	SN
	anterior-lower	58 (25.9)	24 (26.1)	34 (25.8)	SN
Angina pectoris syndrome	UAP	44 (19.6)	17 (18.5)	27 (20.4)	SN
	SAP FC 0–I	13 (5.8)	5 (5.4)	8 (6.1)	SN
	II	84 (37.5)	39 (42.4)	45 (34.1)	SN
	III–IV	83 (37.1)	31 (33.7)	52 (39.4)	SN
Chronic heart failure FC	II	28 (12.5)	8 (8.7)	20 (15.1)	SN
	III	150 (67.0)	72 (78.3)	78 (59.1)	<0.01
	IV	46 (20.5)	12 (13.0)	34 (25.8)	<0.05
Sinal tachycardia		72 (32.1)	23 (25.0)	49 (37.1)	<0.05
Ventricular extrasystoles		110 (49.1)	37 (40.2)	78 (55.3)	<0.05
Past ventricular fibrillation		12 (5.4)	3 (3.3)	9 (6.8)	SN
Paroxysmal disturbances of atrial rhythm		43 (19.2)	18 (19.6)	25 (18.9)	SN
Chronic atrial fibrillation		35 (15.6)	11 (12.0)	24 (18.2)	SN
Left BHP		43 (19.2)	15 (16.3)	28 (21.2)	SN
Right BHP		12 (5.4)	5 (5.4)	7 (5.3)	SN
Aneurysm of the left ventricle		103 (46.0)	43 (46.7)	60 (45.5)	SN
Thrombus in an aneurysm		33 (14.7)	13 (14.1)	20 (15.2)	SN
Thromboembolic complications		14 (6.3)	2 (2.2)	12 (9.1)	SN
Stroke		18 (8.0)	6 (6.5)	12 (9.1)	SN
Stenosis of coronary arteries ≥70 % (n=40)	one	7 (17.5)	4 (16.0)	3 (2.3)	SN
	two	18 (45.0)	14 (56.0)	4 (26.7)	SN
	three	15 (37.5)	7 (28.0)	8 (53.3)	<0.05
Revascularization of myocardium		32 (14.3)	18 (19.6)	14 (10.6)	SN
Electrocardiostimulation		7 (3.1)	3 (3.3)	4 (3.0)	SN
Usage of beta-adrenoblockers		88 (39.3)	44 (50.5)	40 (30.3)	<0.01

BMI – body mass index; UAP – unstable angina pectoris; SAP – stable angina pectoris; FC – funktion class; SN – no statistical difference.

***Table 2.* Echocardiographic characteristic of the study material**

Indications		Survivors n=92 (%)	Deceased n=132 (%)	p
Left ventricle	concentric remodeling	9.0	5.7	SN
	concentric hypertrophy	20.5	24.8	SN
	eccentric hypertrophy	70.5	69.5	SN
Diastolic dysfunction of the left ventricle	impaired relaxation	44.0	53.8	SN
	pseudo-normal function	24.0	20.0	SN
	restriction	32.0	26.2	SN
Mitral regurgitation	0–1	19.6	12.9	SN
	II°	47.1	51.6	SN
	III–IV°	33.3	35.5	SN
Posterior diastolic size of the left ventricle being 60 mm		47.0	48.7	SN
The size of the left atrium being > 60 mm		72.0	78.8	SN
Movement index of the walls of the left ventricle being >2.0		72.9	66.1	SN
Left ventricular ejection fraction	31–39 %	81.5	68.2	SN
	≤20 %	18.5	31.8	<0.01

SN – no statistical difference.

age, $27.0\pm7.6\%$, WMI >1.5 (on the average – 2.22 ± 0.33). LV aneurysm was detected in nearly a half of patients (46.0%), of which in 32.0% of cases aneurysm contained a thrombus. The bigger part of patients had II° MR, and one-fourth of patients had III°–IV° MR.

Most patients had marked (>70.0%) stenoses of two or three (82.5%) coronary arteries (CA), and one-fifth of patients (17.5%) had stenoses in one artery.

Fourteen percent (14.3%) of patients underwent myocardial revascularization (percutaneous angioplasty of coronary arteries (3.1%) or surgery of junctions between aorta and coronary arteries (11.2%)), 5.4% of patients underwent resection of LV aneurysm, and 3.1% – electro-cardiostimulation.
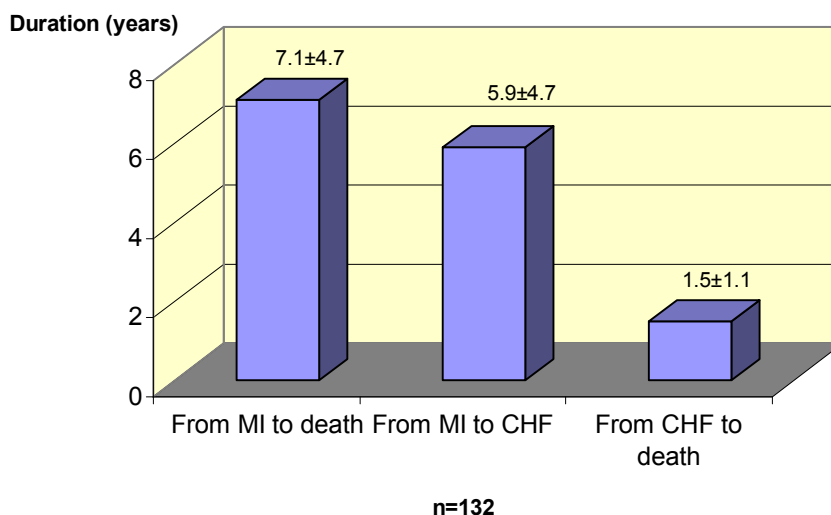

Fig 1. **Time from Q-wave myocardial infarction to the development of chronic heart failure and death**

Most patients used nitrates (92.5%), aspirin (83.0%), AKF inhibitors (88.3%), or diuretics (76.6%), and one-third of them used beta-adrenoblockers (39.3%) or digoxin (45.4%).

The comparison of the clinical characteristics of survivors and deceased patients showed that patients who died were statistically significantly older than those who survived (66.4±9.0 and 61.9±9.5 years). The patients who died more frequently had stenoses of three CA>70%, IV NYHA FC, ventricular extrasystoles, sinal tachycardia; they less frequently were overweight and less frequently used beta-adrenoblockers (Table 1), and more frequently had significantly (≤20%) decreased EF (31.8% and 18.5%, p<0.01) (Table 2).

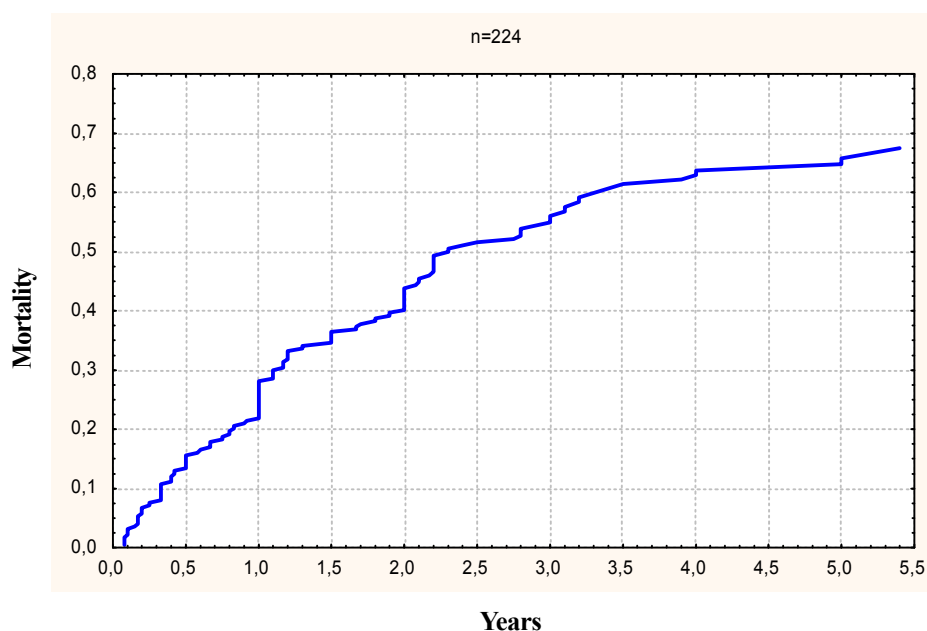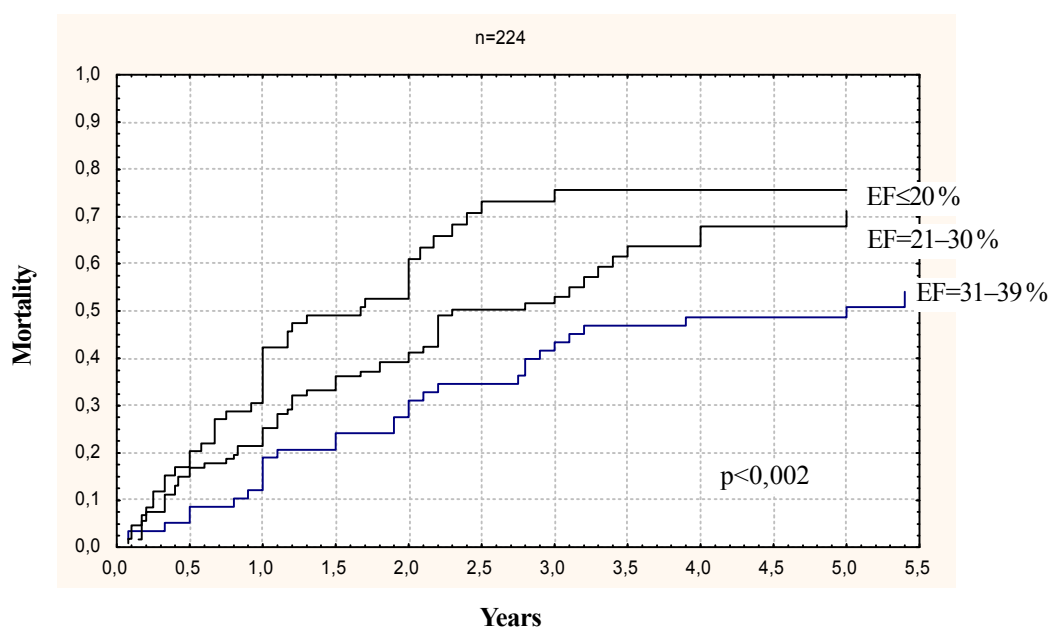**Fig. 2. Mortality due to symptomatic chronic heart failure**

Fig. 3. The influence of the extent of the left ventricular ejection fraction (< 40.0%) on mortality
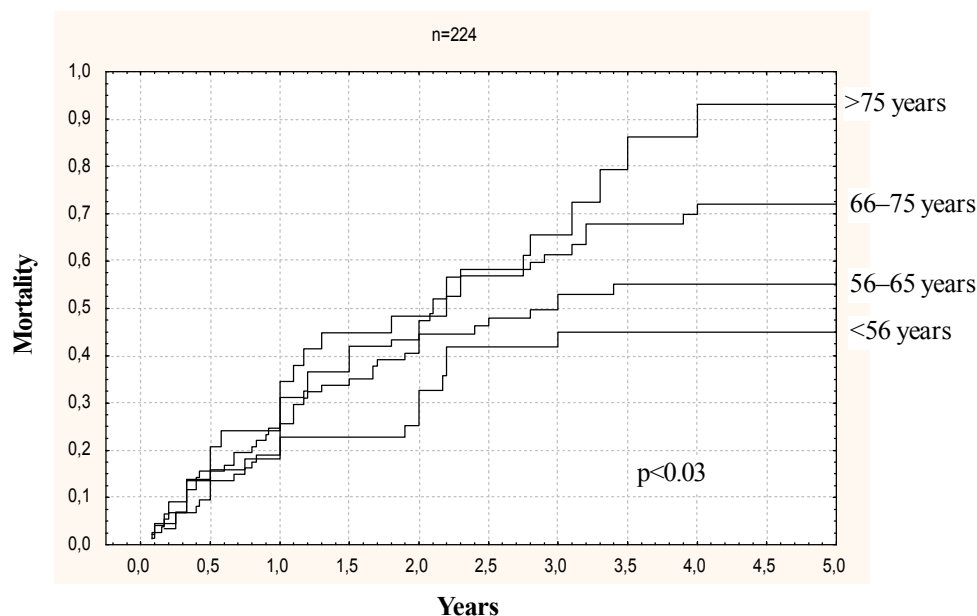
Fig. 4. **Mortality in different age groups with decreased (< 40.0%) left ventricular ejection fraction**

Lethal outcomes within five years in patients with symptomatic CHF

More than a half of patients 132 (58.9%) died during the five years of follow-up. The evaluation of the duration of follow-up in groups of patients who survived and those who died resulted in mean duration of follow-up being 2.6±2.0 years.

The duration from the occurrence of MI to death was 4 months to 22 years, on the average, 7.1±4.7 years (Fig. 1).

Symptomatic CHF occurred 4 months to 17 years after Q-wave MI, on the average, within 5.9±4.7 years. Death occurred after 1 month to 5 years (on the average, 1.5±1.1 years) after the diagnosis of symptomatic CHF.

One-third of patients (38.6%) died suddenly, nearly a half (44.8%) of patients died as a result of progressing CHF, and a small part of patients died because of stroke (3.8%), thromboembolic complications (4.5%), or other causes (8.3%).

About a half of patients (56.7%) died at home, one-third (38.5%) in the in-patient unit, and a small part of them (4.8%) – on the street.

The probability of total censored mortality determined using Kaplan-Meier method, during the first year was 21.0%, within two years – 40.0%, within three years – 55.0%, within four years – 61.0%, and within five years – 65.0% (Fig. 2).

A marked decrease in LV EF statistically significantly increased the risk of lethal outcome (Fig. 3).

When EF was 31–40%, the probability of lethal outcome within five-year period was 48.0%, when EF was 21–30% − 67.0%, and when EF≤ 20% − 76.0% (p<0.002).

Mortality of patients older than 65 years with aging increased significantly compared to mortality of patients younger than 65 years (p<0.03) (Fig. 4).

When patients' age was <56 years, the total mortality within five years was 45%, at the age of 56–65 years – 55%, at the age of 66–75 years – 72%, and at the age of >75 years – 93%

Discussion

According to the findings of Framingham study, US National Health and Food Investigation Service, and study of Men Born in 1913, CHF is detected in 3–20 cases per 100 of general population, and rises up to 100 cases per 100 people older than 65 years (3, 7, 8). Similar findings are also presented in the UK study on the frequency of CHF – 40–60 cases per 100 people older than 70 years (9). Thus, CHF in the general population is found in 1–3% cases, and in people older than 70 years – in 10% of cases.

Most frequently CHF is caused by ischemic cardiomyopathy following MI, or a hypertensive heart disease; both pathologies present at the same time especially accelerate the progression of CHF. CHF resulting in poor condition of patients, namely, dyspnea, weakness, increase in the abdominal volume, and peripheral edemas, is a frequent cause of inca-

pacity to work and repeated in-patient treatment as well as conditions high risk of lethal outcome.

Studies performed during 1985–1995 in the US and Scotland show that the most frequent cause of in-patient treatment of people older than 65 years was CHF (78.0% of men and 85.0% of women) (2, 3).

Most patients (60.0%) die within five years after the development of symptomatic CHF (4). Mean survival from the onset of symptomatic CHF in men is 2.47 years, and in women – 2.36 years (10). Mortality due to CHF in the US, Scotland, and Holland amounts to 15.0% annually. According to Stewart S. et al., the mortality of patients after the diagnosis of symptomatic CHF is the following: within 30 days – 19.9%, within 1 year – 44.5%, within 5 years – 76.5%, and within 10 years – 87.6% (10).

S. Aliot points out that the presence of CHF results in 40–50% of cases of sudden death due to lethal ventricular arrhythmias, since the altered myocardial structures are highly vulnerable (11). A half of patients with CHF die due to progressing heart failure, and a small part of patients die due to other causes (12).

The patients with symptomatic CHF observed in our study also showed marked changes in their clinical indications – all patients had experienced Q-wave MI (on the average, 5.9±4.7 years before) prior to the appearance of CHF symptoms, and the majority of these patients had experienced anterior or lower MI, had Canadian FC III–IV angina pectoris, disturbances in cardiac rhythm and conduction, LV aneurysm, marked LV and LA geometrical remodeling, and pronounced mixed LV dysfunction.

Lethal outcomes and causes of death in our patients were comparable to those found in other studies: more than a half of patients died within five years, and mean survival in the presence of symptomatic CHF was 1.5 ± 1.1 years. Our patients more frequently died due to the progression of CHF rather than suddenly, though this difference is not statistically significant; a small part of patients died from stroke, thromboembolic complications, and other causes.

The evaluation of the clinical characteristics and lethal outcomes in our patients shows that patients with symptomatic CHF belong to a group of high risk for unfavorable consequences. This is conditioned by the initial risk factors – marked stenoses of one to three CA, experienced extensive Q-wave MI, geometric LV remodeling, high degree of MR, LV aneurysm, marked LV systolic and diastolic dysfunction, and older age.

Rapidly progressing symptomatic CHF and unfavorable conditions in our patients could have been conditioned by a small number of performed myocardial revascularizations and a limited use of beta-adrenoblockers in the presence of MI. recent findings show that after Q-wave MI, there still remains some viable myocardial in the site of the scar, and therefore myocardial revascularization, even at the later stage of the post-infarction period, could improve LV function and survival of such patients (13). Haughton T. et al. point out that the use of beta-adrenoblockers in the presence of CHF following MI decreases the amount of ischemic consequences (14).

The aim of this article was to draw the clinicians' attention to high mortality among patients with symptomatic medium and severe CHF, its causes, and the necessity for timely revascularization and an adequate choice of medications with respect to CHF treatment guidelines in order to decrease the risk for the progression of CHF after MI.

It is obvious that symptomatic CHF caused by ischemic cardiomyopathy and marked systolic LV dysfunction following Q-wave Mi is a rapidly progressing process resulting in a high risk of death within several years.

Conclusions

The assessed probability of lethal outcome in the presence of medium to severe symptomatic CHF after Q-wave MI using Kaplan-Meier curve during the first year was 21.0%, within two years 40.0%, within three years – 55.0%, within four years – 61.0%, and within five years – 65.0%

The mean period from the diagnosis of symptomatic CHF to death was 1.5±1.1 years.

Mortality in the presence of symptomatic CHF statistically significantly increased together with the increase in systolic LV dysfunction (with the decrease in EF<30%, $p<0.002$) and with aging ($p<0.003$).

CHF was related to marked geometric LV remodeling – concentric and eccentric LV hypertrophy, diastolic dysfunction – impaired relaxation, pseudo-normalization, and restriction, as well as with to cardiac arrhythmias and anginal syndrome.

Nearly a half of patients died due to progressing CHF, one-third of patients died suddenly, and a small part of patients died due to stroke, thromboembolic complications, and other causes.

Mirštamumas pasireiškus lėtiniam širdies nepakankamumui po persirgto Q bangos miokardo infarkto

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Santrauka. Straipsnyje nagrinėjama ligonių, sergančių simptominiu lėtiniu širdies nepakankamumu, pasireiškusiu po persirgto Q bangos miokardo infarkto, klinikinės charakteristikos ir mirštamumas. 224 ligoniai, sergantys simptominiu lėtiniu širdies nepakankamumu ir turintys kairiojo skilvelio išstūmimo frakciją mažiau kaip 40 proc., buvo stebėti penkerius metus (vidutiniškai – 2,6±2,0 metus).

Dauguma ligonių buvo sirgę priekiniu ar priekiniu-apatiniu Q bangos miokardo infarktu (61,2 ir 25,9 proc.), sirgo II–IV Kanados funkcinės klasės krūtinės angina (74,6 proc.), penktadalis (19,6 proc.) sirgo nestabiliąja krūtinės angina. Visiems ligoniams nustatyta lėtinis širdies nepakankamumas (Niujorko širdies asociacija) II–IV funkcinė klasė, daugumai – širdies ritmo ir laidumo sutrikimų, beveik pusei (46,0 proc.) – kairiojo skilvelio aneurizma, 92,8 proc. – dideli kairiojo skilvelio geometrijos pakitimai, 84,4 proc. – II–IV° mitralinio vožtuvo nesandarumas, pusei – ryški kairiojo skilvelio diastolinė disfunkcija, 6,3 proc. – anksčiau buvo įvykusios tromboembolinės komplikacijos. Stebėjimo laikotarpiu mirė 132 ligoniai. Palyginus išgyvenusių ir mirusių ligonių klinikines charakteristikas, nustatyta, kad mirusieji statistiškai reikšmingai buvo vyresnio amžiaus, mirusiųjų grupėje dažniau buvo didelio laipsnio trijų vainikinių arterijų stenozė, sunkus lėtinis širdies nepakankamumas, išstūmimo frakcija 20 proc. ir mažiau, skilvelinės ekstrasistolės, sinusinė tachikardija, rečiau nustatytas antsvoris, rečiau vartoti beta adrenoblokatoriai.

Įvertinus Kaplan-Meierio kreives, nustatyta, kad mirštamumas, pasireiškus lėtinio širdies nepakankamumo simptomams ir požymiams per pirmuosius vienerius metus siekė 21,0 proc., dviejų – 40 proc., trijų – 55,0 proc., ketverių – 61,0 proc., penkerių – 65,0 proc. Didžiausias mirštamumas, kai kairiojo skilvelio išstūmimo frakcija 20 proc. ir mažiau, o amžius daugiau kaip 75 metai. Esant sunkiam lėtiniam širdies nepakankamumui, mirtis ištiko vidutiniškai po 1,5±1,1 m.

Akivaizdu, kad simptominis lėtinis širdies nepakankamumas, sukeltas išeminės kardiomiopatijos ir ryškios kairiojo skilvelio sistolinės disfunkcijos po persirgto Q bangos miokardo infarkto, yra greitai progresuojantis procesas, lemiantis didelę mirties riziką kelerių metų laikotarpiu.

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