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Severe chronic heart failure in patients considered for heart transplantation in Poland*

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Abstract

Background: *Based on the results of clinical trials, the prognosis for patients with severe heart failure (HF) has improved over the last 20 years. However, clinical trials do not reflect 'real life' due to patient selection. Thus, the aim of the POLKARD-HF registry was the analysis of survival of patients with refractory HF referred for orthotopic heart transplantation (OHT).*

Methods: *Between 1 November 2003 and 31 October 2007, 983 patients with severe HF, referred for OHT in Poland, were included into the registry. All patients underwent routine clinical and hemodynamic evaluation, with NT-proBNP and hsCRP assessment. Death or an emergency OHT were assumed as the endpoints. The average observation period was 601 days. Kaplan-Meier curves with log-rank and univariate together with multifactor Cox regression model the stepwise variable selection method were used to determine the predictive value of analyzed variables.*

Results: *Among the 983 patients, the probability of surviving for one year was approximately 80%, for two years 70%, and for three years 67%. Etiology of the HF did not significantly influence the prognosis. The patients in NYHA class IV had a three-fold higher risk of death or emergency OHT. The univariate/multifactor Cox regression analysis revealed that NYHA IV class (HR 2.578, $p < 0.0001$), HFSS score (HR 2.572, $p < 0.0001$) and NT-proBNP plasma level (HR 1.600, $p = 0.0200$), proved to influence survival without death or emergency OHT.*

Conclusions: *Despite optimal treatment, the prognosis for patients with refractory HF is still not good. NYHA class IV, NT-proBNP and HFSS score can help define the highest risk group. The results are consistent with the prognosis of patients enrolled into the randomized trials.* (Cardiol J 2012; 19, 1: 36–44)

Key words: acute chronic heart failure, prognosis, risk factors, POLKARD-HF

Introduction

Based on results from randomized trials, one should expect a significant improvement of prognosis in patients with heart failure (HF), including the group of patients with severe HF (NYHA class IV) [2–5]. Moreover, an evaluation of the prognosis in patients has been performed according to the class of HF and type of applied pharmacological therapy [6]. Thus the purpose of the POLKARD-HF study

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was to register and evaluate patients, initially qualified for heart transplantation due to refractory HF, with regard to factors influencing prognosis in this group of patients [7].

Methods

An informed consent was obtained from each patient participating in the study according to the protocol approved by the Local Ethics Committee. The investigation conformed with the principles outlined in the Declaration of Helsinki. Between 1 November 2003 and 31 October 2007, 983 patients with severe HF, initially considered for orthotopic heart transplantation (OHT), were included into the registry. Finally, after treatment correction and detailed evaluation, 658 patients were qualified for OHT, 306 patients for further observations, and 19 patients were not qualified for OHT due to contraindications (in accordance with recommendations of The International Society for Heart and Lung Transplantation and the European Society of Cardiology). The average period of observation was 601 days (range 1–1,462 days). Tests for qualification for OHT included standard clinical evaluation, biochemical evaluation (sodium, NT-proBNP, hsCRP serum concentration), six-minute walking test (6-MWT), maximal oxygen uptake (VO_2max), echocardiographic, electrocardiographic and hemodynamic assessment. Also, Heart Failure Survival Score (HFSS) according to Aaronson was calculated [8]. A value of the score between 8.1–10.5 was considered as low risk; 7.2–8.09 was considered as moderate risk; and 5.5–7.19 was considered as high risk.

NT-proBNP levels (pg/mL) were determined using electroluminescence immunoassays (Roche Diagnostics, the limit of detection was 50 pg/mL). Concentration of hsCRP was conducted with the turbidimetric method amplified by latex particles. This method is standardized in accordance with IFCC/BCR/CAP in compliance with CRM 470 standard for 14 serum proteins. The limit of detection was 0.71 mg/L.

Statistical analysis

Death or an emergency heart transplantation (UNOS status 1) were assumed as the endpoints in the follow-up. The following descriptive statistical methods were used for presenting results: means, standard deviations, medians and quartiles in distribution. Comparison of analyzed continuous parameters was conducted using the analysis of variance (Duncan test) with met criteria for normal distribution (verified with Shapiro-Wilk test), but in case of departure from normality, non-parametrical Mann-Whitney-Wilcoxon test or Kruskal-Wallis test was used. For evaluation of the survival rate in the tercile groups and NYHA groups, Kaplan-Meier curves were used together with the log-rank test for verification of a hypothesis on homogeneity of the survival rate curves. Prediction value of the analyzed variables in terms of occurrence of the endpoint was analyzed using the Cox regression method with single-variable. Multifactor Cox regression model was built with the stepwise variable selection method, introducing crucial predictors into the model, which were defined in the single-variable regression. Significance of type I error was established at the level of 0.05. Statistical analyses were conducted using the statistical package (SAS version 9.1).

Results

Male patients constituted the majority (87.8%) of the 983 patients enrolled into the registry, with a mean age just below 50 years. Body mass index (BMI) did not significantly differ from normal. The left ventricular ejection fraction (LVEF) was severely compromised, together with end systolic/diastolic dilatation, elevated NT-proBNP and hsCRP (Table 1). The patients presented moderate pulmonary hypertension. An Aaronson score equal to 7.7 indicated a moderate risk of death.

HF was caused by dilated cardiomyopathy (486 patients; 49.4%), and ischemic cardiomyopathy (425 patients; 43.2%) whereas hypertrophic cardiomyopathy, acquired/congenital heart defects and arrhythmias constituted only 5.1% of cases. There was no information about etiology in the remaining 2.3% of patients. All patients were treated with optimal tolerated doses of angiotensin converting enzyme inhibitors, beta-blockers and diuretics as judged by treating cardiologists in HF or transplantology departments.

Among the 983 patients initially considered, the probability of not reaching the end-point during the first year of follow-up was approximately 80%, at two years about 70%, and at three years around 67% (Fig. 1).

Out of 658 patients finally qualified for OHT, 164 subjects (24.9%) reached the end event (105 subjects died, and 59 underwent emergency OHT).

Prognosis with regard to heart failure etiology

Patients with ischemic HF were older than patients with dilated cardiomyopathy. The groups differed not only in terms of LV size and function,

Table 1. Baseline characteristics of patients from the POLKARD-HF registry.

Parameter	N	Mean ± SD; Median [min–max]
Age [years]	983	49.38 ± 11.245
Weight [kg]	982	77.9 ± 15.42
Height [cm]	980	172.8 ± 9.71
BMI [kg/m^2]	979	25.982 ± 4.5004
LVEF [%]	978	21.6 ± 8.13
LVEDD [mm]	953	71.93 ± 10.472
LVESD [mm]	905	60.30 ± 13.217
HR [1/min]	962	78.3 ± 15.80
SBP [mm Hg]	975	102.6 ± 14.97
DBP [mm Hg]	975	67.0 ± 11.12
PASP [mm Hg]	629	44.9 ± 17.41
PCWP [mm Hg]	695	20.8 ± 9.41
CI [L/min]	530	1.95 ± 0.854
PVR [Wood Units]	643	3.13 ± 2.392
Gradient [mm Hg]	654	10.61 ± 6.677
hs-CRP [mg/L]	679	3.00 [0.03–347.00]
NT-proBNP [pg/mL]	694	2,294.5 [28.0–46,128.0]
VO_2max [mL/kg/min]	687	13.05 ± 4.345
HFSS	952	7.7 ± 0.98
Na [mEq/L]	973	136.4 ± 4.41

BMI — body mass index; LVEF — left ventricular ejection fraction; LVEDD — left ventricular end-diastolic diameter; LVESD — left ventricular end-systolic diameter; HR — heart rate; SBP — systolic arterial blood pressure; DBP — diastolic arterial blood pressure; PASP — pulmonary artery systolic pressure; PCWP — pulmonary mean wedge pressure; CI — cardiac index; PVR — pulmonary vascular resistance; Gradient — transpulmonary gradient; hs-CRP — hs-C-reactive protein; NT-proBNP — N-terminal natriuretic brain pro-peptide; VO_2max — maximal oxygen uptake; HFSS — Heart Failure Survival Score; Na — Na serum concentration

but there were also significant differences in NT-proBNP concentration, VO_2max and HFSS (Table 2). Despite the aforementioned differences, the probability of the survival rate in both compared groups (Kaplan-Meier survival curves) was similar (Fig. 2).

Prognosis with regard to functional NYHA classification

Out of the 983 patients initially considered for OHT, 19.8% presented NYHA class II, 55% NYHA class III, and 24.5% were in NYHA class IV (Table 3). Patients with NYHA classes III and IV differed significantly in terms of the majority of comparable parameters, except for dimensions of the LV, parameters evaluating pulmonary circulation, and maximum oxygen consumption. NYHA class IV patients differed significantly with regard to LVEF, heart rate, systemic arterial pressure, pulmonary capillary wedge pressure, and cardiac index. The level of NT-proBNP and hsCRP was two-fold higher in NYHA class IV. Low HFSS indicated a high risk of death. Also BMI and sodium concentration were significantly lower in the most severe form of HF.

A comparison between patients with NYHA classes II and III revealed that differences were related to structure and function of the LV and also to heart rate and value of the systemic systolic arterial pressure. Patients in NYHA class II presented lower capillary pulmonary pressure, whereas cardiac index was higher compared to subjects with NYHA class III. Similarly, pulmonary artery systolic pressure, as well as pulmonary gradient, and pulmonary vascular resistance, were significantly

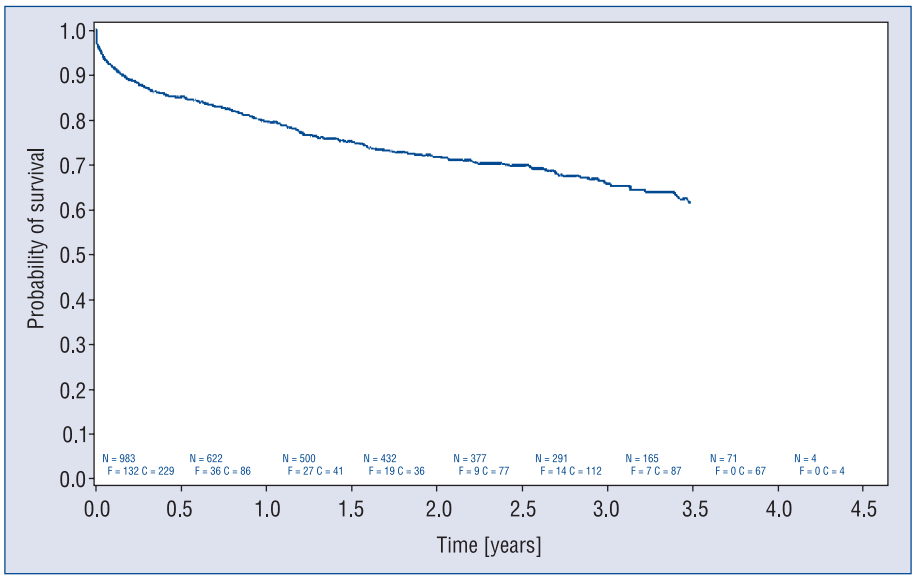

Figure 1. Probability of survival without emergency heart transplantation. Reprinted from: [1], with permission from Elsevier.

Table 2. Comparison of baseline parameters of POLKARD-HF patients stratified by ischemic *vs* non-ischemic cardiomyopathy (CM).

Parameter	Ischemic CM		Dilated CM		P
	N	Mean ± SD; Median [min–max]	N	Mean ± SD; Median [min–max]	
Age [years]	425	54.57 ± 6.013	486	45.80 ± 12.132	< 0.0001
Weight [kg]	424	78.5 ± 13.83	486	78.5 ± 16.02	0.7699
Height [cm]	423	172.2 ± 11.01	485	173.8 ± 7.38	0.0059
BMI [kg/m^2]	422	26.355 ± 3.8408	485	25.947 ± 4.8994	0.0567
NYHA	421	3.1 ± 0.63	484	3.0 ± 0.70	0.2405
LVEF [%]	424	21.7 ± 7.01	485	20.7 ± 7.23	0.0114
LVEDD [mm]	409	71.20 ± 8.733	476	73.75 ± 10.552	< 0.0001
LVESD [mm]	386	59.41 ± 11.598	453	62.29 ± 13.389	< 0.0001
HR [1/min]	419	76.2 ± 13.15	472	80.3 ± 17.59	0.0022
SBP [mm Hg]	424	103.1 ± 14.79	480	102.6 ± 15.20	0.7361
DBP [mm Hg]	424	67.5 ± 11.33	480	66.9 ± 10.92	0.5074
PASP [mm Hg]	288	45.7 ± 18.48	297	44.8 ± 15.99	0.5635
PCWP [mm Hg]	315	20.9 ± 9.88	335	21.0 ± 9.00	0.7334
CI [L/min]	241	1.95 ± 0.619	257	1.95 ± 1.044	0.2153
PVR [Wood Units]	300	3.27 ± 2.555	301	3.10 ± 2.234	0.8758
Gradient [mm Hg]	300	10.86 ± 6.360	313	10.64 ± 7.065	0.4930
hs-CRP [mg/L]	302	3.00 [0.03–134.40]	337	3.20 [0.03–347.00]	0.9704
NT-proBNP [pg/mL]	298	2,094.0 [87.5–26,742.0]	349	2,452.0 [28.0–45,515.0]	0.0093
VO_2max [mL/kg/min]	310	12.32 ± 3.791	338	13.82 ± 4.770	< 0.0001
HFSS	417	7.4 ± 0.83	467	8.0 ± 0.96	< 0.0001
Na [mEq/L]	423	136.4 ± 4.33	480	136.3 ± 4.50	0.7277

Abbreviations as in Table 1.

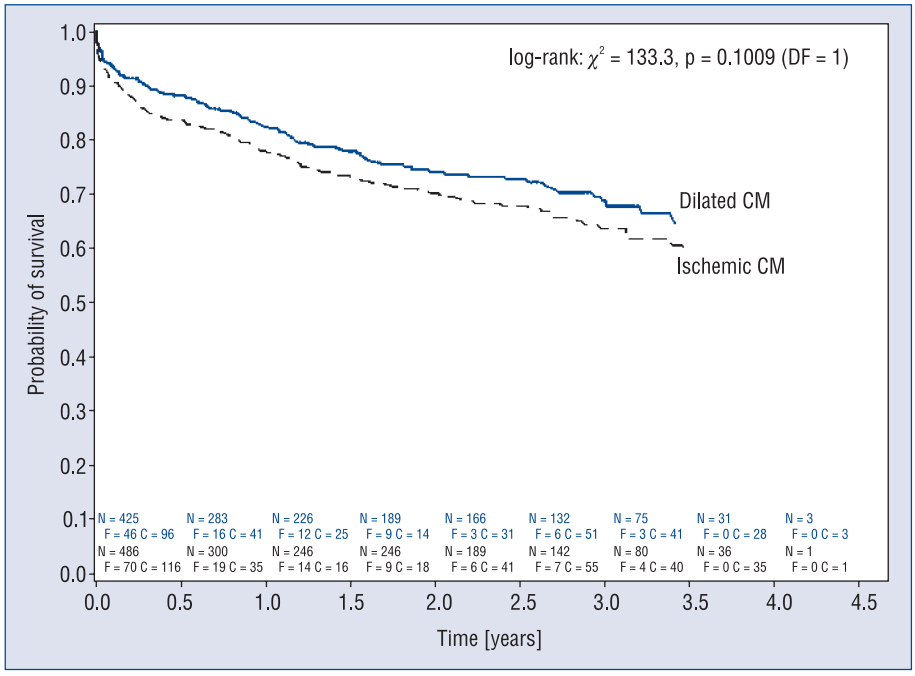

Figure 2. Probability of survival without emergency heart transplantation — patients stratified by ischemic *vs* non-ischemic cardiomyopathy (CM). Reprinted from: [1], with permission from Elsevier.

Table 3. Comparison of baseline parameters of POLKARD-HF patients stratified by NYHA class at admission.

Parameter	NYHA II		NYHA III		NYHA IV		NYHA II *vs* III P	NYHA II *vs* IV P	NYHA III *vs* IV P
	N	Mean ± SD; Median [min–max]	N	Mean ± SD; Median [min–max]	N	Mean ± SD; Median [min–max]			
Age [years]	195	48.17 ± 10.746	541	50.84 ± 10.068	241	47.02 ± 13.465	0.0003	0.6798	0.0034
Weight [kg]	195	79.0 ± 15.24	541	78.6 ± 15.42	240	75.3 ± 15.38	0.6587	0.0305	0.0017
Height [cm]	195	172.9 ± 7.22	541	172.6 ± 11.30	238	173.1 ± 7.33	0.7290	0.9867	0.7247
BMI [kg/m^2]	195	26.382 ± 4.7020	540	26.254 ± 4.4201	238	24.999 ± 4.4267	0.8400	0.0057	0.0002
LVEF [%]	194	25.8 ± 9.56	540	21.6 ± 7.71	238	18.4 ± 6.10	< 0.0001	< 0.0001	< 0.0001
LVEDD [mm]	189	71.07 ± 9.319	526	72.19 ± 11.068	232	72.01 ± 10.052	0.1306	0.5893	0.3240
LVESD [mm]	181	58.62 ± 11.635	498	60.59 ± 14.040	220	61.05 ± 12.496	0.0078	0.0467	0.6348
HR [1/min]	194	74.2 ± 16.10	528	78.0 ± 14.72	234	82.5 ± 17.08	0.0008	< 0.0001	0.0013
SBP [mm Hg]	194	106.3 ± 15.28	537	103.5 ± 14.80	238	97.3 ± 13.90	0.0224	< 0.0001	< 0.0001
DBP [mm Hg]	194	68.9 ± 11.59	537	67.3 ± 10.98	238	64.4 ± 10.66	0.1041	0.0001	0.0027
PASP [mm Hg]	92	39.2 ± 16.24	371	44.9 ± 16.83	160	47.8 ± 18.25	0.0030	0.0003	0.1138
PCWP [mm Hg]	95	18.4 ± 10.03	404	20.5 ± 9.10	190	22.9 ± 9.44	0.0171	< 0.0001	0.0077
CI [L/min]	72	2.08 ± 0.678	312	1.96 ± 0.639	141	1.89 ± 1.265	0.0065	0.0001	0.0110
PVR [Wood Units]	87	2.45 ± 1.661	376	3.09 ± 2.268	174	3.48 ± 2.739	0.0061	0.0006	0.1352
Gradient [mm Hg]	93	8.71 ± 4.624	375	10.87 ± 6.780	180	10.88 ± 7.022	0.0084	0.0479	0.6775
hs-CRP [mg/L]	170	2.19 [0.03–134.40]	381	2.80 [0.03–196.80]	124	6.84 [0.14–347.00]	0.0720	< 0.0001	< 0.0001
NT-proBNP [pg/mL]	173	1,396.0 [28.0–15,616.0]	382	2,297.5 [122.6–46,128.0]	137	4,255.0 [87.5–37,605.0]	< 0.0001	< 0.0001	< 0.0001
VO_2max [mL/kg/min]	159	16.90 ± 4.505	416	11.95 ± 3.630	107	11.53 ± 3.265	< 0.0001	< 0.0001	0.1675
HFSS	193	8.4 ± 0.98	521	7.7 ± 0.84	232	7.2 ± 0.90	< 0.0001	< 0.0001	< 0.0001
Na [mEq/L]	194	137.7 ± 3.43	532	136.6 ± 4.13	241	134.8 ± 5.21	0.0002	< 0.0001	< 0.0001

Abbreviations as in Table 1.

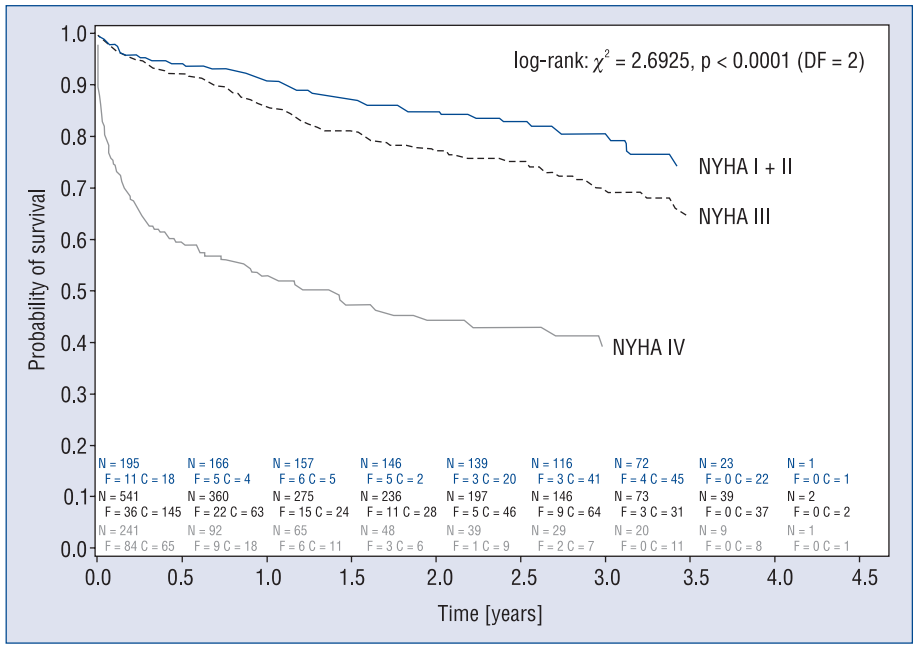

Figure 3. Probability of survival without end-points — patients stratified by NYHA class at admission.

lower in NYHA class II. The following parameters: LVEF, heart rate, systemic systolic arterial pressure, pulmonary capillary pressure, cardiac index, NT-proBNP, HFSS, and sodium concentration differentiated all NYHA classes (II *vs* III, II *vs* IV, and III *vs* IV) (Fig. 3). However, the prognosis in patients with NYHA class II and III was similar, whereas NYHA class IV had a worse prognosis. The probability of six-month survival in most sick patients was 60%, one-year survival rate was approximately 50%, and three-year survival rate was approximately 40%.

Risk factors for death or emergency OHT

The following values of analyzed parameters in Kaplan-Meier survival analysis differentiated the groups: pulmonary artery systolic pressure ≥ 50 mm Hg, pulmonary capillary wedge pressure ≥ 25 mm Hg, LVEF ≤ 17%, functional NYHA class IV, systemic systolic arterial pressure ≤ 90 mm Hg, hsCRP ≥ 6.5 mg/L, NT-proBNP level ≥ 4302 pg/mL, serum Na concentration ≤ 135 mEq/L, BMI ≤ 23.8, and HFSS ≤ 7.19. However, only persisting symptoms compatible with NYHA class IV despite adequate treatment are clearly an indicator of bad prognosis (Fig. 3).

Univariate Cox regression analysis revealed a few factors influencing survival without emergency OHT (Table 4). However, among all factors influencing survival from univariate analysis, in the multifactor Cox regression model, only NYHA IV class (HR 2.578, $p < 0.0001$), HFSS score (HR 2.572, $p < 0.0001$) and NT-proBNP plasma level (HR 1.600, $p = 0.0200$), proved to influence survival without death or emergency OHT (Table 5).

Discussion

Significant progress in the treatment of HF has occurred within the last 20 years. This includes pharmacological treatment, cardiac surgery and electrotherapy [9–12]. In a work published in 1991, and related to the era of HF treatment with digitalis and diuretics, one-year survival rate in patients with NYHA class II was established at 98%, and three-year survival rate at 85%; the survival rate in patients with functional NYHA class III was 80% and 55%, respectively. Moreover, the one-year mortality rate in patients with severe HF exceeded 50% at that time [4]. In 2001, based on meta-analysis of randomized drug trials in patients with HF, Cleland et al. [6] established a two-year mortality rate in patients with moderate HF at approximately 34%, and the one-year mortality rate in patients with severe HF was 52% (data regarding control groups receiving a placebo). Unusual progress in the treatment of systolic HF included the introduction of angiotensin convertase inhibitors and beta-adrenergic receptor blockers.

Table 4. Univariate Cox regression analysis of factors influencing survival without emergency heart transplantation.

Parameter		Hazard ratio estimates (univariate)			P
			95% confidence limits		
		Point estimate	Lower	Upper	
PASP	≥ 50 mm Hg	1.270	0.876	1.840	0.2067
PCWP	≥ 25 mm Hg	1.727	1.199	2.487	0.0033
LVEF	≤ 17%	1.588	1.142	2.208	0.0059
NYHA	IV	3.489	2.517	4.836	< 0.00001
SBP	≤ 90 mm Hg	1.839	1.351	2.502	0.0001
hs-CRP	≥ 6.5 mg/L	1.807	1.300	2.512	0.0004
NT-proBNP	≥ 4302 pg/mL	2.382	1.744	3.252	< 0.0001
Na	≤ 135 mEq/L	2.105	1.550	2.858	< 0.0001
BMI	≤ 23.8 kg/m^2	1.270	0.916	1.762	0.1518
HFSS	≤ 7.19	3.248	2.378	4.435	< 0.0001

Abbreviations as in Table 1.

Table 5. Multifactor Cox regression model built with the stepwise variable selection method of factors influencing survival without emergency heart transplantation.

Parameter		Hazard ratio	Lower	Upper	P
NYHA	IV	2.578	1.703	3.901	< 0.0001
NT-proBNP	≥ 4,302 pg/mL	1.600	1.074	2.385	0.0200
HFSS	≤ 7.19	2.572	1.721	3.845	< 0.0001

Abbreviations as in Table 1.

In the Consensus I study in patients with systolic HF with NYHA class IV, the administration of enalapril reduced the six-month mortality rate by 40% (44% in the control group *vs* 26% in the therapeutic group) and one-year mortality rate by 31%. Reduction in the mortality rate by 16% (SOLVD) to 33% (V-HeFT II) was obtained in other studies evaluating the effects of the administration of angiotensin convertase inhibitors in patients with less advanced HF. The only study evaluating the effects of the drugs blocking beta-adrenergic receptors in patients with severe HF (NYHA class IV) was the COPERNICUS trial [13, 14]. One-year mortality rate in the group of patients receiving a placebo was 18.5%, significantly lower than it was in the studies mentioned above; a 35% reduction in risk of death was obtained in patients receiving a beta-blocker. In collective analysis of the CIBIS II, MERIT HF, and COPERNICUS studies, the following results (placebo group *vs* therapeutic group) were obtained: NYHA class II — 7.2% *vs* 5.4%; NYHA class III — 12.3% *vs* 8.3%; NYHA class IV — 20.7% *vs* 14.4% in favor of patients treated with beta-blockers. Due to the fact that these clinical trials included precisely selected groups of patients, it is not known whether results of these studies may be generalized, especially to patients with severe HF (NYHA class IV). Most studies based on nationwide data and often related to hospitalizations, lose their significance due to low precision of the diagnostic criteria. The most frequently referenced study is the Stewart study from 2001 [15]. Five-year survival rate in this group of patients was worse than it was in patients with neoplastic disease. Probability of the survival in patients with HF was 60% in a one-year period, 45% in a two-year period, 38% in a three-year period, and approximately 25% in a five-year period. In epidemiological studies related to patients with NYHA class IV, conducted in the 1980s (standard treatment with digitalis and diuretics), one-year mortality rate was 50–77%; in NYHA class III it was 10–45%, and in class II 3–25%. In all these studies, the mortality rate in patients with NYHA class III was always significantly higher than in NYHA class II [16].

The POLKARD-HF registry was a specific form of data collection. It included patients with

severe HF below 65 years of age, initially qualified for OHT [7]. One year prognosis in NYHA class IV did not significantly differ from the prognosis presented in the studies conducted in the 1980s.

However, it should be emphasized that the three-year prognosis was significantly better and it was approximately 48%. It is possible that the composite endpoint influenced results obtained within the first year of observation. Emergency OHT mainly applied to patients with NYHA class IV. In the cases of all patients included into the registry, the probability of one-year survival was approximately 82% (in the study of Stewart — 60%), two-year survival — 75% (according to Stewart — 45%), and three--year survival — 68% (38%). It should be pointed out that the patients enrolled into the study of Stewart included patients with any functional class of HF who were hospitalized for the first time with this diagnosis. Therefore, it was a population with significantly less advanced HF [15]. Patients with NYHA classes III and IV constituted 80% of all patients included into the POLKARD-HF registry. The improvement in the treatment of HF, which took place in recent years, probably influenced the prognosis of study subjects. Our results are in line with those of Cleland et al. [6] from 2001. Despite such significant progress, the management in patients with NYHA class IV still includes OHT as the first-line treatment.

Not only NYHA class, but also etiology of the disease, may be important in influencing the prognosis in patients with severe HF. Nevertheless, the results of previous population and drug studies provide discrepant conclusions. Franciosa et al. [17] recorded a significantly higher mortality rate in patients with ischemic *vs* non-ischemic HF (46% *vs* 23%, respectively). Similar results were recorded in the V-HeFT-I study. However, the SOLVD study did not show any differences, emphasizing an unfavorable trend among patients with ischemic cardiomyopathy. These discrepancies may be attributed to the varying methodologies of these studies.

In the presented results, 43% of HF was due to the ischemic etiology, and 49% caused by dilated cardiomyopathy. No differences in the survival rates were established. A tendency towards worse prognosis in patients with dilated cardiomyopathy was observed. Furthermore, significant differences in the profile of these groups were noted. The patients with HF resulting from dilated cardiomyopathy had more advanced signs of heart damage. In these patients, significantly higher values of NT-proBNP were recorded [18–20].

Functional classification of HF in accordance with the New York Heart Association has led to many controversies. In the POLKARD-HF Registry, we conducted a detailed investigation of NYHA classes II, III and IV. Despite all the controversies with regard to NYHA classification, our results are in accordance with previous works confirming that NYHA class IV, apart from hemodynamic, functional and neurohumoral factors, can additionally help to define the highest risk group among severe HF patients [21].

Limitations of the study

The results of the registry are not representative for the whole group of patients with severe HF. It only included patients between 18 and 65 years of age. Our choice of the composite endpoint: death or emergency OHT, may decrease short-term survival rate in patients, especially with NYHA class IV. Biochemical evaluation of NT-proBNP and hsCRP were conducted in approximately 70% of patients enrolled into the registry. The nature of the work (registry) did not consider standardization of obtained measurements and evaluations except for the determination of NT-proBNP and hsCRP.

Conclusions

The prognosis in patients with severe HF has been significantly improved over the last 20 years. Despite an improved survival rate, the prognosis in patients with functional NYHA class IV is still unfavorable. Low serum sodium levels and a substantial increase in NT-proBNP negatively influence survival. OHT still remains the first-line treatment in this group of patients. In our material, we did not confirm HF etiology as a modifying factor in patients qualified for OHT.

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