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Social support for patients with coronary artery disease after percutaneous coronary intervention

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ABSTRACT

Background: To assess how social support relates to parameters of patients with coronary artery disease (CAD) after percutaneous coronary intervention (PCI), and how social support affects patient's prognosis within 1 year after surgery.

Methods: The study included 739 male and 236 female patients (975) who underwent PCI. To determine level of social support, the Multidimensional Scale of Perceived Social Support was used. The mean duration of a prospective follow-up was 12.0 ± 1.7 months. The Cox multivariate regression proportional hazard model was used to estimate the hazard ratio (HR) of death from all causes and cardiovascular disease (CVD).

Results: A low level of social support in 5.7% of patients was observed, while 30.5% had a moderate level and 63.8% had a high level. Patients with low and moderate levels of social support were older than those with high level. Among patients with high levels of social support, more were male compared to patients with moderate level. During observation, 24 patients died from all causes (2.5%), while 21 (2.2%) died from CVD. In the multivariate Cox regression model the HR of social support for all causes of death was 0.97 (95% confidence interval, [CI], 0.94–0.99, p = 0.007), while death from CVD was 0.97 (95% CI, 0.94–1.00, p = 0.048). For patients with low level of social support, the HR for death from all causes was 4.52 (95% CI, 1.37–14.95, p = 0.013), while death from CVD was 3.66 (95% CI, 0.94–14.25, p = 0.061).

Conclusion: Social support level was associated with age and gender, and significantly and independently affected CAD patients' risk of death after PCI.

1. Introduction

Cardiovascular disease (CVD) is the leading cause of premature mortality [1]. The literature data suggests a significant influence of psychosocial risk factors, including social deprivation as well as the occurrence and progression of CVD [2]. Studies have shown that socially isolated people have an increased risk of premature death from CVD; a lack of social support leads to a decrease in survival and a worse prognosis among patients with clinical manifestations of CVD [2]. A meta-analysis by Mookadam and Arthur showed that social isolation increases the risk of death by nearly two-thirds among patients after myocardial infarction (MI) [3]. In cardiology practice, low social support is associated with high levels of emotional stress, difficulty modifying behavioral risk factors, more expressed progression of symptoms of coronary artery disease (CAD), and a worse prognosis in patients with existing CVD [4,5]. A high rate of social support is considered a buffer, reducing the negative effects of stress, and thereby has a positive effect on the course of various pathological processes; social support can improve the prognosis of patients with CVD [2]. Social support can be divided into two types: *structural* and *functional* [6]. Structural support refers to the size, type, density, and frequency of contact with the network of people surrounding an individual. Measures of the density of social support, frequency of interactions, the number of close contacts versus peripheral acquaintances, marital status, group or church membership, and geographic proximity describe varying [2]. Functional support is characterized by satisfying specific social needs that can provide a person with a social network, and is divided into different categories: *instrumental* (which helps solve problems, e.g., help completing tangible tasks); *financial* (material aid, gifts); *informational* (help providing necessary information, advice, and counseling); and *emotional* (expressions of sympathy, love, trust, and care) [2,6]. The label “tangible” is often used to describe types of support that are readily

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Table 1
Comparative characteristics of clinical and laboratory parameters in patients, depending on the level of social support.

Parameters		Low level (n = 56)	Moderate level (n = 297)	High level (n = 622)	P
Male, n (%)		39 (69.3)	208 (70.0)*	492 (79.1)*	0.007
Age, years		60.4 ± 9.9	60.2 ± 9.4**	57.7 ± 9.2**	0.001
Alcohol consumption, n (%)		10 (17.9)	93 (31.3)	177 (28.5)	0.10
Smoking, n (%)		18 (32.1)	127 (42.8)	279 (43.9)	0.23
Physical inactivity, n (%)		20 (35.7)	142 (47.8)	288 (46.3)	0.24
Obesity, %		26 (46.4)	149 (50.2)	344 (55.3)	0.20
Body mass index, kg/m^2		29.6 ± 5.2	30.3 ± 5.2	30.7 ± 5.1	0.11
Postinfarction cardiosclerosis, %		22 (39.3)	120 (40.4)	286 (46.0)	0.22
Arterial hypertension, %		47 (83.9)	270 (90.9)	555 (89.2)	0.31
Systolic blood pressure, mm Hg		131.0 ± 17.2	135.5 ± 21.9	135.2 ± 20.2	0.33
Diastolic blood pressure, mm Hg		82.1 ± 11.5	83.0 ± 12.5	83.5 ± 11.3	0.58
Hypercholesterolemia, %		24 (42.9)	134 (45.1)	296 (47.6)	0.66
Total cholesterol, mmol/l		4.95 ± 1.12	4.91 ± 1.35	5.03 ± 1.26	0.42
Low density lipoproteins, mmol/l		3.27 ± 1.11	3.14 ± 1.19	3.23 ± 1.09	0.49
High density lipoproteins, mmol/l		1.17 ± 0.27	1.14 ± 0.32	1.15 ± 0.37	0.50
Triglycerides, mmol/l		1.60 ± 1.05	1.72 ± 1.01	1.77 ± 1.11	0.36
FC of heart failure in NYHA classification, %	I-II	38 (67.9)	215 (72.4)	493 (79.3)	0.023
	III-IV	18 (32.1)	82 (27.6)	129 (20.7)	
Diabetes, %		9 (16.1)	69 (23.2)	135 (21.7)	0.47
Atrial fibrillation, %		7 (12.5)	28 (9.4)	59 (9.5)	0.77
Acute coronary syndrome at admission, %		42.9	34.0	33.3	0.36

Note: NYHA, New York Heart Association.
* $P < 0.01$.
** $P < 0.001$.

seen or quantified such as instrumental or financial support [2].

This study aimed to assess how functional social support relates to clinical and instrumental parameters in patients with CAD after percutaneous coronary intervention (PCI), and how social support affects their prognosis within 1 year after surgery.

2. Methods

2.1. Participants

Our study included all patients after elective and emergency PCI on the hemodynamically significant stenoses of the coronary arteries at the Tyumen Cardiology Research Center (Tyumen, Russia). We enrolled 739 (75.8%) male and 236 (24.2%) female patients (975 in all) aged 33 to 86 (mean age: 58.7 ± 9.4). The mean duration of a prospective follow-up was 12.0 ± 1.7 months. We performed complex clinical examinations using patients' medical histories, measured office blood pressure, body mass index (BMI). All patients underwent electrocardiography and biochemical blood research, including a lipid profile of the blood serum. All patients underwent transthoracic echocardiography using the ultrasound machines Philips iE33 and the General Electric Vivid E9. All echocardiographic alterations were performed according to the recommendations of American Society of Echocardiography and the European Association of Cardiovascular Imaging [7]. All PCIs were performed after coronary angiography. All procedures were conducted in one catheterisation lab using a monoplane flat panel angiographic system (Allura Xper FD10, Philips Healthcare, Netherlands).

2.2. Assessment of social support

We used the Russian version of the Multidimensional Scale of Perceived Social Support (MSPSS) to determine patients' levels of social support [8]. The MSPSS contains 12 questions, each with 7 possible answers ranging from “very strongly disagree” (1 point) to “very strongly agree” (7 points) [9]. The final grade is calculated by adding up the results for all questions. The possible scoring range is between 12 and 84 points; the higher the score, the higher the perceived social support. A score of 48 points or less on the MSPSS indicates a low level of social support; between 49 and 68 points signals a moderate amount, while 69 or more points to a high level of social support. The MSPSS contains three subscales: “friends” (questions 6, 7, 9, and 12); “family” (questions 3, 4, 8, and 11); and “significant other” (questions 1, 2, 5, and 10). The MSPSS questionnaire was translated and validated in Russia [8]. The Russian version of the MSPSS has a high reliability. The Cronbach's α varies for the questionnaire's subscales, from 0.86 to 0.94 [8]. The local ethics committee of our institute approved the study, and the patients participated only after signing an informed consent form.

2.3. Statistical analyses

Statistical analysis was performed using statistic software (SPSS Inc., version 21). The values were presented as M ± SD (mean ± standard deviation). The Kolmogorov-Smirnov test was used to test for normal distribution of the data. For the normally distributed parameters, ANOVA was performed. For non-normal distributed parameters, Kruskal-Wallis tests were performed. For normally distributed parameters, a post-hoc test was performed using the Least-Square Difference (LSD) tests. Post-hoc tests for non-normal distributed parameters were performed using Mann-Whitney *U* tests with Bonferroni correction. For categorical variables, the statistical significance of differences among the several groups was calculated using the likelihood ratio test (LR Chi-square). We then provide pairwise group comparison by the Pearson's «chi-square» ($\chi 2$). Cox proportional hazards regression model was used to assess the hazard ratios (HR) with 95% confidence interval (CI) for all-cause mortality. Univariate analysis was performed at the first stage of the research. In the second stage, HR with 95% CI was calculated after adjustment for the following confounders: age, sex, smoking, alcohol abuse, systolic and diastolic blood pressure (BP), body mass index (BMI), physical inactivity, total cholesterol, low density lipoproteins, high density lipoproteins, left ventricular ejection fraction (LVEF), heart failure functional class (FC) (NYHA), presence of acute coronary syndrome (ACS), and severity of coronary lesions by SYNTAX score. The HR categorical variables were calculated respectively to the selected reference groups. The group with a high level of social support was considered as the reference group. The value $p < 0.05$ was evaluated as statistically significant [10].

3. Results

The average via the MSPSS was 70.0 ± 12.3 points. We observed a low level of social support in 5.7% of patients, a moderate level in 30.5%, and a high level in 63.8%. Table 1 displays the comparative characteristics of clinical, functional, and laboratory parameters in patients, depending on social support. The groups did not differ regarding the frequency of identification of family history for CVD, the prevalence of smoking, alcohol abuse, hypertension, hypercholesterolemia, obesity, diabetes, or atrial fibrillation. There was no statistically significant difference between the groups in terms of blood lipid spectrum or the value of office BP; there was equal frequency in terms of postinfarction cardiosclerosis. In patients with low level of social support, we diagnosed ACS in 42.9% of patients, which was not significantly different from the frequency of ACS in patients with moderate and high levels of social support ($p = 0.362$). The groups differed significantly by sex and age. Among patients with high level of social support, more were male compared to patients with moderate level of social support (79.1% vs. 70.0%, $p = 0.01$ with Bonferroni correction). Patients with low and moderate social support levels were older than those with high level (60.4 ± 9.9 vs. 57.7 ± 9.2 years, $p = 0.09$ and 60.2 ± 9.4 vs. 57.7 ± 9.2 years, $p = 0.001$, respectively). From a statistical angle, the groups varied significantly in terms of FCs of heart failure (see Table 1). However, pairwise comparison did not reveal any statistically significant differences.

According to the indicators of left atrial diameter, end-diastolic volume, end-diastolic size, end-systolic size, and left ventricular mass, the echocardiography groups differed significantly (Table 2). Due to the pairwise comparison among the groups, we only observed statistically significant differences between patients with medium and high levels of social support for the indicators of end-diastolic volume LV ($p = 0.01$) and end-diastolic diameter LV ($p = 0.001$), as well as between the patients with low and high levels of social support for myocardial mass ($p = 0.05$), taking the Bonferroni correction into account. At the same time, there was no difference between groups on the echocardiography parameters indexed to BSA. There was no difference between the groups in the results of the coronary angiography (Table 3).

During the prospective phase, we evaluated the effects of social support on the risk of total and cardiovascular mortality. Within the prospective period 24 (2.5%) patients died, 21 of them (2.2%) died from CVD (20 patients from fatal myocardial infarction and 1 from the stroke). 3 patients died from the external cause. Cases of death from all causes and CVD in dependence of social support levels are presented in Table 4. Patients with low social support level had much greater amount of cases of death from all causes than patients with high social support level (7.1% vs 1.9%, respectively, $p = 0.014$).

Univariate Cox proportional hazards models in evaluation of the effect of social support on all-cause and CVD mortality were presented in Table 5. As seen in the Table, the significant predictors of all-cause patient mortality were social support parameters, as well as social support score for death from CVD. The analysis of the categorical indicators of social support showed that HR of death from CVD (Table 5) was trend to significantly higher in the group of patients with low level of social support compared to the group with high level of social support.

Next, multivariate statistical analysis was performed. Adjusted HR for all-cause mortality on social support score was 0.97 (with 95% confidence interval, or CI, 0.94–0.99, $p = 0.007$); for death from cardiovascular causes was 0.97 (with 95% CI, 0.94–1.00, $p = 0.048$) (Table 6) The increase in social support in 1 point of MSPSS resulted in a decrease in the risk of death from any cause by 3.0%. When analyzing the categorical parameters of social support, we found that the HR of death from all causes (Table 6) was significantly higher in patients with low level of social support, compared to patients with high level. Dew to CVD mortality we find only statistical trend to increase risk in group of patients with low level of social support. We did not find statistically significant differences in the HR of death among patients with a moderate level of social support.

4. Discussion

During our study, we found that the level of social support is associated with age and gender. Compared to patients with a high level of social support, patients with low level were older and among them were more females. In other studies, the same results were obtained [11]. The previous studies also showed that older women are more likely to have low level of social supports, be living on their own, with less financial resources, not access medical supports such as cardiac rehabilitation programs, report poorer health-related quality of life in comparison to men [12]. We received results that there was a big part of widowed females – 38.1%; whereas there was only 4.0% ($p < 0.001$) of widowed males. A probable explanation is the increase in the number of older widowed patients, especially females, who are much less likely than men to remarry, and more likely to live alone [13].

It was more common for patients with low level of social support to have a higher FC of congestive heart failure (CHF). This may reflect the fact that there was a higher percentage of women among patients with

Table 2
Comparative characteristics of echocardiographic indicators depending on the level of social support.

Parameters		Low level (n = 56)	Moderate level (n = 297)	High level (n = 622)	P
Left atrium dimensions	mm	39.2 ± 4.5	40.1 ± 4.7	40.6 ± 4.7	0.036
	mm/m^2	20.4 ± 2.4	20.5 ± 2.5	20.2 ± 2.4	0.23
End-diastolic volume LV	ml	102.5 ± 29.9	105.5 ± 33.1**	111.1 ± 33.4**	0.004
	ml/m^2	52.9 ± 14.2	53.6 ± 15.7	55.0 ± 15.4	0.20
End-systolic volume LV	ml	50.2 ± 20.6	49.8 ± 23.2	53.4 ± 24.6	0.071
	ml/m^2	25.8 ± 10.1	25.3 ± 11.8	26.5 ± 11.8	0.50
End-diastolic size	mm	48.6 ± 4.2	48.8 ± 5.1***	49.9 ± 4.6***	0.001
	mm/m^2	25.3 ± 2.7	25.0 ± 3.1	24.9 ± 2.8	0.57
End-systolic size	mm	34.1 ± 4.7	34.3 ± 5.3	35.2 ± 5.5	0.042
	mm/m^2	17.7 ± 2.7	17.6 ± 3.0	17.6 ± 3.0	0.77
Interventricular septum thickness	mm	11.7 ± 1.6	12.0 ± 1.7	12.0 ± 1.7	0.47
LV posterior wall thickness	mm	10.6 ± 1.2	10.8 ± 1.2	10.8 ± 1.1	0.37
Myocardial mass	gram	206.9 ± 49.7*	215.4 ± 48.3	222.3 ± 51.4*	0.015
	gram/m^2	107.0 ± 24.3	109.7 ± 22.0	110.3 ± 22.7	0.31
LV ejection fraction	%	52.4 ± 8.8	53.9 ± 8.9	53.5 ± 8.6	0.56

Notes: LV, left ventricular.
* $P < 0.05$
** $P < 0.01$
*** $P < 0.001$.

Table 3
Comparative characteristics of angiographic parameters and PCI results depending on the level of social support.

Parameters	Low level (n = 56)	Moderate level (n = 297)	High level (n = 622)	P
Left main stenosis, n (%)	0 (0.0)	5 (1.7)	10 (1.6)	0.41
Left anterior descending artery stenosis, n (%)	37 (66.1)	166 (55.9)	376 (60.5)	0.24
Left circumference coronary artery stenosis, n (%)	12 (21.4)	83 (27.9)	165 (26.5)	0.58
Right coronary artery stenosis, n (%)	17 (30.4)	132 (44.4)	283 (45.5)	0.085
Multivessel coronary artery disease, n (%)	20 (35.7)	113 (38.0)	261 (42.0)	0.40
SYNTAX score, units	9.9 ± 7.3	10.2 ± 7.9	10.7 ± 7.8	0.41

Notes: SYNTAX - SYNergy between PCI with TAXUS ™ and Cardiac Surgery.

low level of social support than those with high level. Women are less likely to experience coronary artery occlusion and have a normal LV EF; at the same time, they tend to have more severe symptoms of CAD and heart failure compared to men of the same age group [14]. Women with CAD are usually older and thus have a greater number of comorbid illnesses that can cause the symptoms of CHF to deteriorate [15]. In women, symptoms of dyspnea, peripheral edema, and decreased exercise tolerance appear more frequently and more pronounced than in men [16]. Furthermore, the literature shows that socially isolated people are more likely to have depressive disorders [2], which may also distort the clinical picture of heart failure.

Our data showed that patients with lower level of social support tended to have smaller hearts. As reported in the literature, women predominate among widowed patients [13]; thus, it is logical to assume that the proportion of these patients would be greater in the group with low social support. Considering that women tend to have smaller hearts than men, it is possible to explain the difference between the groups based on heart dimensions. At the same time, indexing these parameters to BSA completely leveled these differences.

Our findings revealed that social support was independently associated with the risk of death from all causes and also from CVD. Many prospective studies have shown that structural and functional social support are independent risk factors for CVD; furthermore, among people with cardiovascular pathology, structural, and functional social support are independent predictors of adverse outcomes such as acute nonfatal MI or death from cardiovascular causes [2]. Williams et al. [17] examined 1368 patients with proven coronary artery lesions and found that structural social support was a significant risk factor of death, even after considering other associated risk factors. Berkman et al. [18] found that after experiencing MI, patients with low level of functional social support had a higher risk of death than those with a high level of support. Several other studies have shown that patients with CVD tend to have a low level of social support on the MSPSS; low levels of social support has been associated with the progression of the disease and subsequently, with worse prognosis [2,19].

Thus, early determination of low social support values and early attempt of correction of this condition in CAD patients recommended to undergo the PCI will help to increase the effectiveness of this method of CAD treatment and will reduce the risk of death in these patients. Nowadays, there are different types of interventions being implemented, many of which include elements of education and understanding, such as within a context of a support group. Support groups may be particularly useful because of the gaps they may fill in the support needs of patients and the experiential similarity within the group. In addition to support groups, some interventions focus on teaching general psychosocial skills and capitalizing on support within existing networks (e.g., cognitive behavioral therapy) [20].

Table 5
The hazard ratio (HR) and 95% confidence intervals (95% CI) of death from all causes and death from CVD in patients with PCI depending on social support[a].

Endpoint type	Parameters	HR	95% CI	P
Death from all causes	Social support (points)	0.97	0.94–0.99	0.006
	High level of social support	1.00		
	Moderate level of social support	1.42	0.58–3.46	0.45
	Low level of social support	3.86	1.24–11.96	0.019
Death from CVD	Social support (points)	0.97	0.95–1.00	0.028
	High level of social support	1.00		
	Moderate level of social support	1.35	0.52–3.48	0.54
	Low level of social support	3.15	0.88–11.28	0.08

[a] Univariate model.

Table 6
The hazard ratio (HR) and 95% confidence intervals (95% CI) of death from all causes and death from CVD in patients with PCI depending on social support[a].

Endpoint type	Parameters	HR	95% CI	P
Death from all causes	Social support (points)	0.97	0.94–0.99	0.007
	High level of social support	1.00		
	Moderate level of social support	1.22	0.48–3.09	0.67
	Low level of social support	4.52	1.37–14.95	0.013
Death from CVD	Social support (points)	0.97	0.94–1.00	0.048
	High level of social support	1.00		
	Moderate level of social support	1.10	0.41–3.00	0.85
	Low level of social support	3.66	0.94–14.25	0.06

[a] Multivariate model adjusted for: age, sex, smoking, alcohol abuse, systolic and diastolic blood pressure (BP), body mass index (BMX), physical inactivity, total cholesterol, low density lipoproteins, high density lipoproteins, left ventricular ejection fraction (LVEF), heart failure functional class (FC) (NYHA), presence of acute coronary syndrome (ACS), and severity of coronary lesions by SYNTAX score.

5. Limitations

First, the short-term prospective study did not allow obtaining a higher amount of the primary endpoints for the analysis (only 24 cases of death from all causes and 21 cases of CVD death have been registered). Second, unfortunately only 975 (95.8%) from 1018 of our

Table 4
Mortality cases registered in dependence of social support level.

	Low level (n = 56)	Moderate level (n = 297)	High level (n = 622)	P
Death from all causes, n (%)	4 (7.1)*	8 (2.7)	12 (1.9)*	0.05
Death from CVD, n (%)	3 (5.4)	7 (2.4)	11 (1.8)	0.19

* $P < 0.05$.

patients filled out the questionnaire completely, and we were unable to determine the status of life in 49 patients included in the baseline of the study due to loss of contact with them. We plan to continue further monitoring of the prospective cohort to assess the impact of social support on the 5-year risk of death from cardiovascular and all causes. Moreover, the study sample was limited to a certain area (Western Siberia) and thus not reflective of global populations. The findings of our study point out importance of future researches, which should investigate the relationships between functional social support and prognosis of patients with CAD after PCI in other regions.

Our study is limited also because we concentrated only on the study of social support in patients with CAD and we did not estimate other psychosocial risk factors. However, it is known, that patients with low social support can have elevated level of stress, anxiety or depression.

6. Conclusion

The level of social support was associated with age and gender. Social support significantly and independently affected the risk of death in patients with CAD after PCI.

Author contribution

GP contributed to the conception and design, acquisition, analysis and interpretation of data for the work. VK contributed to the conception, analysis and interpretation of data for the work. EY contributed to the acquisition and interpretation of data for the work. IB contributed to analysis and critically revised the manuscript. All authors drafted the manuscript and gave final approval.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Conflicts of interest and source of funding

The authors have nothing to disclose.

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