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Rošić, Damir; Krstačić, Goran; Krstačić, Antonija; Brborović, Ognjen; Filipčić, Igor; Mornar Jelavić, Marko

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THE ROLE OF AMBULATORY CARDIAC REHABILITATION IN IMPROVEMENT OF QUALITY OF LIFE, ANXIETY AND DEPRESSION

Damir Rosic[1], Goran Krstacic[2,3,4], Antonija Krstacic[3,4,5], Ognjen Brborovic[6,7], Igor Filipcic[3,4,8] & Marko Mornar Jelavic[2,9]

[1]Institute of Emergency Medicine, Rijeka, Croatia
[2]Institute for Cardiovascular Prevention and Rehabilitation, Zagreb, Croatia
[3]The Faculty of Medicine, Josip Juraj Strossmayer University of Osijek, Croatia
[4]University of Applied Health Sciences, Zagreb, Croatia
[5]University Hospital Center "Sestre milosrdnice", Clinical Hospital of Traumatology, Zagreb, Croatia
[6]School of Public Health "Andrija Stampar", Zagreb, Croatia
[7]University of Zagreb, School of Medicine, Zagreb, Croatia
[8]Psychiatric Hospital "Sveti Ivan", Zagreb, Croatia
[9]School of Dental Medicine, Zagreb, Croatia

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SUMMARY

Background: *Psychological reactions may adversely affect recovery after major cardiac events. This study investigates the role and frequently negligible importance of ambulatory cardiac rehabilitation (ACR) in improvement of quality of life (QoL), anxiety and depression at patients with various cardiac pathology.*

Subjects and methods: *This prospective study included subjects treated for acute coronary syndrome (ACS), those with performed elective revascularization, and OTHERS (after valve replacement, implanted pacemaker or other device, with stable heart failure and coronary artery disease). Their anxiety (State Trait Anxiety Inventory (STAI) questionnaire), depression (Beck Depression Inventory (BDI-II) questionnaire) and QoL data (Short Form Health Survey-36 (SF-36) questionnaire, for physical and mental QoL components) were collected initially and after 3-month of ACR.*

Results: *ACR underwent 170 patients, aged 59 (53-66 years), predominately males (74.7%). At both genders, median duration of ACR was 12 weeks, with reduction of anxiety and depression scores and improvement in almost all components of QoL (P<0.05), except in mental health and bodily pain in males and females, respectively.*

After ACS (63.5%), ACR lasted 12 weeks, with reduction of anxiety and depression scores and improvement in all components of QoL (P<0.05). After elective revascularization (14.1%), ACR lasted 12 weeks, with reduction of anxiety score and improvement in almost all components of QoL (P<0.05), except mental health. At OTHERS (22.4%), ACR lasted 4 weeks, with improvement in almost all components of QoL (P<0.05), except mental health; ACR duration negatively correlated with anxiety and depressive scores (P<0.05).

Conclusion: *ACR during 3-month results with improvement of anxiety, depression and QoL at patients with various cardiac pathology.*

Key words: *ambulatory cardiac rehabilitation - anxiety – depression -- quality of life*

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INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death in our country and worldwide as well (Pagidipati et al. 2013, Ćorić et al. 2014). Despite improved treatment of coronary heart disease (CHD), an organized network of primary percutaneous intervention for treatment of acute myocardial infarction (AMI), and consistent application of evidence-based measures of secondary prevention, a significant number of persons still dies from this disease. Data from the Croatian National Institute of Public Health on the number of deaths in 2013 show that AMI is one of the most common single causes of death in Croatia, at 3456 persons (2063 men and 1393 women) or 6.9% of all mortal outcomes, followed by lung cancers (2802 deaths, or 5.6%) and colorectal cancer (2037 deaths or 4%) (Ćorić et al. 2014, Ivanusa et al. 2015). Psychological reactions that cardiac patients may experience (e.g. anxiety and depression) are strong risk factors for CHD and adversely affect recovery after major CHD events (Contractor 2011, Zullo et al. 2017). Moreover, anxiety and depression may increase the risk of future adverse cardiovascular events at patients without apparent cardiovascular pathology (Sanchez-Gonzales et al. 2013, Rieckmann et al. 2013, Slavich & Irwin 2014, Cohen et al. 2015, Vaccarino et al. 2018).

Cardiac rehabilitation (and secondary prevention) services are defined as comprehensive, long term mea-

sures involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counseling (Balady et al. 2007, Arena et al. 2012, Mampuya 2012, Dalal et al. 2015, Doimo et al. 2019). These measures are designed to limit the physiological and psychological effects of cardiac illness, reduce the risk for sudden death or re-infarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients counselling (Balady et al. 2007, Arena et al. 2012, Mampuya 2012, Dalal et al. 2015, Doimo et al. 2019).

Cardiac rehabilitation is classified into three phases (Mampuya 2012, Ivanusa et al. 2015). Phase I (inpatient, hospital) is organized in a coronary or cardiac surgery intensive care unit. The shorter hospital stay with modern cardiology treatment makes it difficult to conduct formal inpatient education and training programs. Thus, inpatient cardiac rehabilitation programs are mostly limited to early mobilization to make self-care possible by discharge, and brief counseling about the nature of the illness, the treatment, risk factors management and follow up planning (Mampuya 2012, Ivanusa et al. 2015, Vaccarino et al. 2018).

Phase II (outpatient, ambulatory cardiac rehabilitation (ACR)) takes place in specialized institutions. It is effective in improving of physical activity level, exercise tolerance and quality of life (QoL). Physical activity is gradually increased according to generally accepted principles. This phase is characterized by teamwork (an interdisciplinary and transdisciplinary approach), continuous monitoring by a cardiologist, and telemetric electrocardiogram monitoring during physical activity. It is usually performed in outpatient centers 3-5 times a week over three months. After non-invasive cardiovascular and psychological diagnostics, patients and their families are informed about the state of their disease. They are educated and counseled on the disease as well as further treatment and behavior aimed at encouraging changes in health behavior and reducing negative psychosocial consequences of the disease (Mampuya 2012, Ivanusa et al. 2015, Vaccarino et al. 2018).

Phase III is provided in cardiac patient clubs that are usually organized in rehabilitation centers, and lasts for the rest of patient's life. This phase is characterized by maintenance, and if possible improvement, of existing improvements achieved by cardiovascular rehabilitation, along with intermittent evaluations by internist-cardiologists, exercise stress test, and risk factor assessment (Mampuya 2012, Ivanusa et al. 2015, Vaccarino et al. 2018).

The aim of this prospective study was to investigate the role and frequently negligible importance of ACR in improvement of QoL, anxiety and depression at patients with various cardiac pathology. This is the first such study in the Republic of Croatia.

SUBJECTS AND METHODS

Subjects

This prospective study was performed in Institute for Cardiovascular Prevention and Rehabilitation, in Zagreb, Republic of Croatia. It was approved by the appropriate Institute Ethics Committee and included subjects treated for acute coronary syndrome (ACS), those with performed elective revascularization (percutaneous coronary intervention (PCI), coronary arteries bypass graft (CABG)), and OTHERS (after valve replacement, implanted pacemaker or other device, with stable heart failure and coronary artery disease).

This second phase of cardiac rehabilitation included very low and moderate risk patients with at least 36 sessions and it was performed in accordance with guidelines (Balady et al. 2007). Those with high risk (unstable angina, decompensated heart failure, complex ventricular arrhythmias, pulmonary pressure ≥60 mmHg, intracavitary thrombus, recent thrombophlebitis with or without pulmonary embolism, severe obstructive cardiomyopathies, severe or symptomatic aortic stenosis, uncontrolled inflammatory or infectious pathologies and any musculoskeletal condition that prohibits physical exercise) were excluded. Most patients were referred by their cardiologist, internist, family physician, or cardiac surgeon.

Methods

Instruments

Between February and September 2013, we collected baseline demographic, CHD risk factors and psychosocial functioning data. Demographic data included age, gender and educational level. CHD risk factors data included sedentary lifestyle, obesity, arterial hypertension, dyslipidemia, hyperglycemia/diabetes and smoking. Psychosocial functioning was evaluated with State Trait Anxiety Inventory (STAI) for anxiety, Beck Depression Inventory (BDI-II) for depression, and Short Form Health Survey-36 (SF-36) questionnaire for QoL.

A number of reliability and validity tests have been conducted on the STAI and have provided sufficient evidence that the STAI is an appropriate for anxiety studies in research and clinical settings (Spielberger et al. 1970, Spielberger et al. 1983). It is composed of 20 items. Respondents were encouraged to report their general feelings about anxiety on a four-point scale: 1 (almost never), 2 (sometimes), 3 (often), and 4 (almost always). The total score reveals the anxiety level, ranging from 20 to 80. High scores indicate a high level of trait anxiety; scores of 20-29 indicated mild anxiety, and scores ≥30 indicated moderate/severe anxiety.

BDI questionnaire is a 21-item measure of depressive symptoms (Beck et al. 1996, Ceccarini et al. 2014). For each item, participants chose the statement that best reflected how they felt. Responses to the individual

items were then summed, with scores ranging from 0 to 63. Scores of 0 to 9 indicated minimal depression, scores of 10 to 18 indicated mild depression, and scores of 19 to 63 indicated moderate to severe depressive symptoms. It is a relevant psychometric instrument, showing high reliability, capacity to discriminate between depressed and non-depressed subjects, and improved concurrent, content, and structural validity. Based on available psychometric evidence, it can be viewed as a cost-effective questionnaire for measuring the severity of depression, with broad applicability for research and clinical practice worldwide (Wang & Gorenstein 2013).

The SF-36 is a generic measure of health status comprising 36 items related to eight dimensions: physical functioning for the limitation in performing all physical activities, role physical for problems with work or other daily activities, bodily pain, general health, vitality, social functioning, role emotional and mental health (McHorney et al. 1994). The dimensions such as physical functioning, role physical, bodily pain and general health reflect the physical component of health, while the dimensions vitality, social functioning, role emotional and mental health reflect the mental components of health. SF-36 has been adapted and translated into several languages, and its validity and reliability established in several countries (Bullinger et al. 1998, Gandek et al. 1998, Wagner et al. 1998).

ACR program

After an initial analysis, we created an individualized rehabilitation plan (the type, intensity, duration, and frequency of cardiorespiratory therapy), and the patient was placed into one of five existing intensity level groups for the treatment during 12 weeks. Education of the patient and family/partner was performed by all members of the rehabilitation team both individually and in groups, using advice, workshops, and lectures from the fields of cardiology, physical medicine and rehabilitation, psychology, and psychiatry. The psychologist performed patient counseling, education, group therapy based on behavioral-cognitive principles, and participating in cardiovascular consultation. The contents and scope of the counseling, conducted during the interview, and if needed in additional weekly sessions, depended on the patients, their primary disease, comorbidities, and possible psychological difficulties. The psychologist gave two lectures on psychological risk factors for CHD as part of the regular lecture cycle for patients and their families.

We offered to patients to take part in a small, closed relaxation and weight-reduction groups. They learned about diaphragmatic breathing, facilitating relaxation, adequate communication skills, anger management, assertiveness, problem-solving schemes, recognizing and coping with manipulation, etc. The weight reduction group focused on the control of the stimuli which lead to eating, and the control of alimentary processes. Gradual reduction of daily energy intake values coupled with proper ingredient choices and combinations depended on individual risk factors. Both groups met once a week. The psychologist took part in cardiovascular consultation and informed other members on the psychological risk factors and characteristics of the particular patient's personality.

Data collection after ACR

After 3-month of ACR, we performed control meaurements of the all above mentioned baseline parameters.

Statistical analysis

Qualitative data are presented with absolute number and percentage. We used McNemar's test of paired proportions for its analysis. Quantitative data with normal distribution are presented with mean and standard deviation (SD), and compared with paired samples t-test; data without normal distribution are presented with median and corresponding interquartile range.

Correlations between the variables were investigated with Pearson's *r*, Spearman's ρ and Kendall's τ correlation coefficients, classified as a very weak (0-0.19), weak (0.20-0.39), moderate (0.40-0.59), strong (0.60-0.79) and very strong (0.80-1).

The level of statistical significance was set at $P<0.05$. Processing was done with MedCalc 12.7.0.0 for Windows software.

RESULTS

Of the total of 170 patients, aged 59 (53-66) years, we had the highest prevalence of males (74.7%). ACR was the most frequently indicated after ACS (63.5%), then elective revascularization (14.1%) and at *others* (22.4%). We have found the highest prevalence of sedentary lifestyle (88.2%), then obesity (74.1%), hypertension (64.7%), smoking (48.2%), dyslipidemia (40.6%) and hyperglycemia/diabetes (34.7%). The most of patients had middle (65.3%), then high (24.1%) and low (10.6%) level of education. We got the following results:

At overall patients

ACR lasted 12 (8-12) weeks, with reduction of mean values of anxiety (39.2 *vs* 37.1) and depression scores (10.4 *vs* 9.9) ($P<0.05$), without significant differences in the prevalence of mild (43 (25.3%) *vs* 43 (25.3%), $P=1.000$) and moderate/severe anxiety (127 (74.7%) *vs* 127 (74.7%), $P=1.000$), and minimal (95 (55.9%) *vs* 97 (57.1%), $P=0.500$), mild (46 (27.1%) *vs* 48 (28.2%), $P=0.688$) and moderate/severe depression (29 (17.1%) *vs* 25 (14.7%), $P=0.125$) (Figure 1, Table 1). QoL has improved in mean values of general health (62.0 *vs* 72.0), physical (61.3 *vs* 70.1) and emotional role (69.4 *vs* 77.8), physical (75.9 *vs* 80.1) and social functioning (76.3 *vs* 79.3), bodily pain (76.6 *vs* 79.0), vitality (59.3 *vs* 61.6) and mental health (65.1 *vs* 66.4) ($P<0.05$) (Table 1).

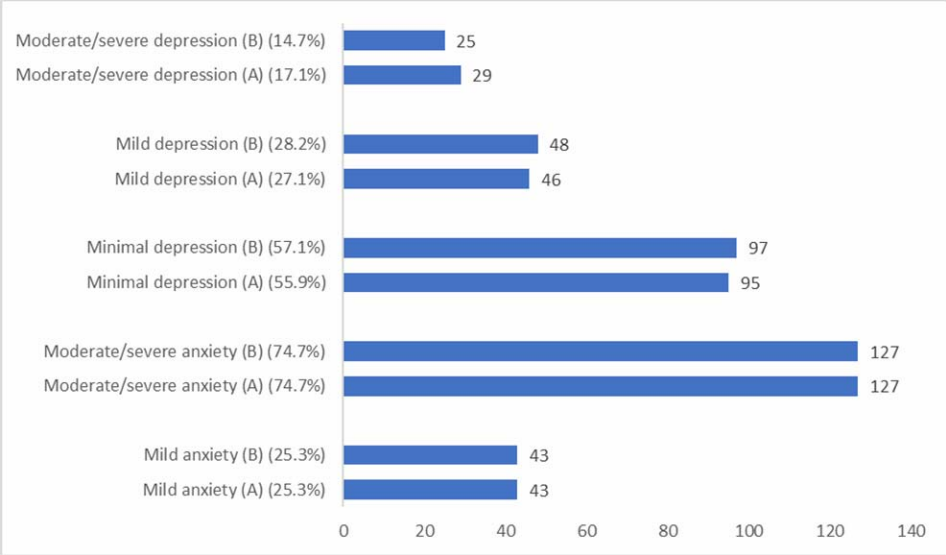

Figure 1. The number of patients with various level of anxiety and depression before (A) and after (B) ACR (N=170), without significant differences (McNemar's test, statistical significance with P<0.05; ACR – ambulatory cardiac rehabilitation)

Table 1. Differences between the examined data before and after ACR at overall patients (N=170)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	39.2	12.2	37.1	9.8	-6.123	169	*0.000*
	Depression score	10.4	8.6	9.9	7.6	-3.888	169	*0.000*
QoL (Physical components)	Physical functioning	75.9	21.4	80.1	15.7	7.713	169	*0.000*
	Role physical	61.3	39.3	70.1	30.8	9.601	169	*0.000*
	Bodily pain	76.6	25.5	79.0	22.3	4.703	169	*0.000*
	General health	62.0	20.3	72.0	12.5	11.448	169	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	59.3	16.7	61.6	14.2	7.183	169	*0.000*
	Social functioning	76.3	23.0	79.3	18.9	5.066	169	*0.000*
	Role emotional	69.4	39.1	77.8	30.1	6.180	169	*0.000*
	Mental health	65.1	15.9	66.4	12.5	2.588	169	*0.011*

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

Values of anxiety and depression scores negatively correlated with values of QoL parameters before (anxiety: r=-0.27 to -0.64; depression: r=-0.21 to -0.61) and after ACR (anxiety: r=-0.23 to -0.56; depression: r=-0.20 to -0.50) (P<0.05). It was weaker after ACR, but still present. Depression positively correlated with anxiety scores at both time points (r_1=0.65, r_2=0.57) (P<0.05).

At males

ACR lasted 12 (8-12) weeks, with reduction of mean values of anxiety (39.1 *vs* 37.0) and depression scores (9.8 *vs* 9.2) (P<0.05), without significant differences in the prevalence of mild (34 (26.8%) *vs* 35 (27.6%), P=1.000) and moderate/severe anxiety (93 (73.2%) *vs* 92 (72.4%), P=1.000), and minimal (80 (63.0%) *vs* 82 (64.6%), P=0.500), mild (26 (20.5%) *vs* 26 (20.5%), *P*=1.000) and moderate/severe depression (21 (16.5%) *vs* 19 (15.0%), P=0.500) (Table 2). QoL has improved in mean values of general health (62.2 *vs* 72.5), physical (64.8 *vs* 72.6) and emotional role (68.8 *vs* 77.4), physical (77.7 *vs* 81.7) and social functioning (77.5 *vs* 80.1), bodily pain (77.4 *vs* 80.0) and vitality (61.2 *vs* 63.5) (P<0.05), without improvement of mental health (66.8 *vs* 67.9) (Table 2).

At females

ACR lasted 12 (6-12) weeks, with reduction of mean values of anxiety (39.6 *vs* 37.3) and depression scores (12.1 *vs* 11.7) (P<0.05), without significant differences in the prevalence of mild (9 (20.9%) *vs* 8 (18.6%), P=1.000) and moderate/severe anxiety (34 (79.1%) *vs* 35 (81.4%), P=1.000), and minimal (15 (34.9%) *vs* 15 (34.9%), P=1.000), mild (20 (46.5%) *vs* 22 (51.2%), P=0.500) and moderate/severe depression (8 (18.6%) *vs* 6 (14.0%), P=0.500) (Table 3). QoL has improved in mean values of general health (61.3 *vs* 70.6), physical (51.2 *vs* 62.8) and emotional role (71.3 *vs* 79.1), physical (70.3 *vs* 75.3) and social functioning (72.7 *vs* 76.7), vitality (53.5 *vs* 56.3) and mental health (60.3 *vs* 62.0) (*P*<0.05), without improvement of bodily pain (74.4 *vs* 76.3) (Table 3).

Table 2. Differences between the examined data before and after ACR at males (N=127)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	39.1	12.5	37.0	10.2	-5.252	126	*0.000*
	Depression score	9.8	9.0	9.2	7.8	-3.301	126	*0.001*
QoL (Physical components)	Physical functioning	77.7	21.3	81.7	15.6	6.300	126	*0.000*
	Role physical	64.8	38.7	72.6	30.4	7.611	126	*0.000*
	Bodily pain	77.4	25.1	80.0	21.5	4.275	126	*0.000*
	General health	62.2	21.5	72.5	13.0	9.948	126	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	61.2	17.2	63.5	14.5	5.530	126	*0.000*
	Social functioning	77.5	22.3	80.1	18.7	3.998	126	*0.000*
	Role emotional	68.8	39.6	77.4	30.5	5.446	126	*0.000*
	Mental health	66.8	15.7	67.9	11.7	1.824	126	0.071

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

Table 3. Differences between the examined data before and after ACR at females (N=43)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	39.6	11.5	37.3	8.8	-3.112	42	*0.003*
	Depression score	12.1	7.3	11.7	6.7	-2.324	42	*0.025*
QoL (Physical components)	Physical functioning	70.3	21.1	75.3	15.3	4.480	42	*0.000*
	Role physical	51.2	39.7	62.8	31.0	6.043	42	*0.000*
	Bodily pain	74.4	26.8	76.3	24.7	1.965	42	0.056
	General health	61.3	16.3	70.6	11.2	5.623	42	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	53.5	13.9	56.3	12.0	5.225	42	*0.000*
	Social functioning	72.7	24.7	76.7	19.6	3.138	42	*0.003*
	Role emotional	71.3	38.2	79.1	29.1	2.892	42	*0.006*
	Mental health	60.3	15.5	62.0	13.8	2.301	42	*0.026*

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

At patients after ACS

ACR lasted 12 (11.5-12) weeks, with reduction of mean values of anxiety (39.9 *vs* 37.3) and depression scores (10.7 *vs* 10.1) (P<0.05), without significant differences in the prevalence of mild (24 (22.2%) *vs* 27 (25.0%), P=0.375) and moderate/severe anxiety (84 (77.8%) *vs* 81 (75.0%), P=0.375), and minimal (61 (56.5%) *vs* 62 (57.4%), P=1.000), mild (28 (25.9%) *vs* 31 (28.7%), *P*=0.625) and moderate/severe depression (19 (17.6%) *vs* 15 (13.9%), P=0.125) (Table 4). QoL has improved in mean values of general health (61.3 *vs* 71.3), physical (64.1 *vs* 71.3) and emotional role (66.0 *vs* 75.0), physical (78.4 *vs* 81.9) and social functioning (75.6 *vs* 79.3), bodily pain (78.7 *vs* 80.9), vitality (59.1 *vs* 61.8) and mental health (63.5 *vs* 65.4) (P<0.05) (Table 4).

At patients after elective revascularization

ACR lasted 12 (11.5-12) weeks, with reduction of mean values of anxiety score (39.8 *vs* 37.8), without significant differences in mean values of depression score (10.5 *vs* 10.5) and prevalence of mild (8 (33.3%) *vs* 6 (25.0%), P=0.250) and moderate/severe anxiety (16 (66.7%) *vs* 18 (75.0%), P=0.250), and minimal (11 (45.8%) *vs* 11 (45.8%), P=1.000), mild (9 (37.5%) *vs* 9 (37.5%), P=1.000) and moderate/severe depression (4 (16.7%) *vs* 4 (16.7%), P=1.000) (Table 5). QoL has improved in mean values of general health (61.0 *vs* 71.2), physical (44.8 *vs* 60.4) and emotional role (62.5 *vs* 70.8), physical (64.6 *vs* 72.7) and social functioning (70.8 *vs* 72.9), bodily pain (67.5 *vs* 71.2) and vitality (59.6 *vs* 61.5), without improvement of mental health (66.5 *vs* 67.0) (P<0.05) (Table 5).

At others

ACR lasted 4 (4-12) weeks, without significant differences in mean values of anxiety (36.9 *vs* 35.9) and depression scores (9.3 *vs* 8.7), and prevalence of mild (11 (28.9%) *vs* 10 (26.3%), P=1.000) and moderate/severe anxiety (27 (71.1%) *vs* 28 (73.7%), P=1.000), and minimal (23 (60.5%) *vs* 24 (63.2%), P=1.000), mild (9 (23.7%) *vs* 8 (21.1%), P=1.000) and moderate/severe depression (6 (15.8%) *vs* 6 (15.8%), P=1.000) (Table 6). QoL has improved in mean values of general health (64.6 *vs* 74.8), physical (63.8 *vs* 73.0) and emotional role (83.3 *vs* 90.4), physical (75.8 *vs* 79.6) and social functioning (81.6 *vs* 83.2), bodily pain (76.6 *vs* 78.3) and vitality (59.5 *vs* 61.4) (P<0.05), but without improvement of mental health (68.8 *vs* 68.8) (Table 6). In this group, we had negative correlation of ACR duration with anxiety (ρ=-0.31, P=0.058; τ=-0.25, P=0.024) and depressive scores (ρ=-0.29, P=0.078; τ=-0.23, P=0.039).

Table 4. Differences between the examined data before and after ACR at patients after ACS (N=108)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	39.9	12.0	37.3	9.3	-5.538	107	*0.000*
	Depression score	10.7	8.7	10.1	7.5	-3.586	107	*0.001*
QoL (Physical components)	Physical functioning	78.4	19.5	81.9	14.7	5.711	107	*0.000*
	Role physical	64.1	39.3	71.3	31.1	6.563	107	*0.001*
	Bodily pain	78.7	25.6	80.9	22.3	3.471	107	*0.001*
	General health	61.3	20.4	71.3	12.7	8.987	107	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	59.1	17.1	61.8	14.2	5.705	107	*0.000*
	Social functioning	75.6	24.2	79.3	19.2	4.237	107	*0.000*
	Role emotional	66.0	40.2	75.0	31.0	5.167	107	*0.000*
	Mental health	63.5	15.1	65.4	11.7	2.917	107	*0.004*

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

Table 5. Differences between the examined data before and after ACR at patients after elective revascularization (N=24)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	39.8	13.4	37.8	11.5	-2.470	23	*0.021*
	Depression score	10.5	8.4	10.5	8.0	0.171	23	0.866
QoL (Physical components)	Physical functioning	64.6	25.7	72.7	17.6	4.175	23	*0.000*
	Role physical	44.8	36.1	60.4	27.5	6.191	23	*0.000*
	Bodily pain	67.5	26.5	71.2	21.7	2.415	23	*0.024*
	General health	61.0	19.9	71.2	12.0	4.392	23	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	59.6	18.1	61.5	15.9	2.584	23	*0.017*
	Social functioning	70.8	23.2	72.9	20.4	2.145	23	*0.043*
	Role emotional	62.5	39.7	70.8	34.5	2.304	23	*0.031*
	Mental health	66.5	19.6	67.0	16.1	0.430	23	0.671

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

Table 6. Differences between the examined data before and after ACR at OTHERS (N=38)

Findings	Parameters	Before ACR (mean)	SD	After ACR (mean)	SD	*t*	*df*	*P*
Psychological testing	Anxiety score	36.9	12.2	35.9	10.1	-1.586	37	0.121
	Depression score	9.3	8.8	8.7	7.6	-1.981	37	0.055
QoL (Physical components)	Physical functioning	75.8	22.1	79.6	16.3	3.399	37	*0.002*
	Role physical	63.8	39.7	73.0	31.5	4.646	37	*0.000*
	Bodily pain	76.6	23.8	78.3	22.3	2.197	37	*0.034*
	General health	64.6	20.3	74.8	12.4	5.435	37	*0.000*
QoL (Mental components)	Vitality (energy/fatigue)	59.5	14.9	61.4	13.5	3.812	37	*0.001*
	Social functioning	81.6	18.3	83.2	16.3	2.368	37	*0.023*
	Role emotional	83.3	32.7	90.4	20.4	2.458	37	*0.019*
	Mental health	68.8	15.3	68.8	12.0	0.000	37	1.000

ACR – ambulatory cardiac rehabilitation; QoL – quality of life; Data presented with mean and standard deviation (SD) were compared with paired t-test. Statistical significance with P<0.05

DISCUSSION

According to the literature data, about 20% patients with CHD or heart failure is depressed, which is ≥3 times greater than in the general population (Lane et al. 2002, Ruo et al. 2003, Rutledge et al. 2006, Cohen et al. 2015, Vaccarino et al. 2018). Patients with CHD, heart failure and depressive symptoms are more likely to have physical limitations and poor QoL (Ruo et al. 2003, Gottlieb et al. 2009, Cohen et al. 2015, Vaccarino et al. 2018). Moreover, they have increased risk for recurrent cardiovascular events and mortality; depressed patients with ACS have double the risk of future adverse cardiovascular events, which is similar to conventional risk factors such as reduced ejection fraction and diabetes (Jiang et al. 2001, Nicholson et al. 2006, Bartoli et al. 2013, Cohen et al. 2015, Vaccarino et al. 2018). Depression may be associated with lower physical activity, more intensive smoking and lower adherence to cardiovascular medications (Kronish et al. 2006, Bautista et al. 2012, Cohen et

al. 2015, Vaccarino et al. 2018). It has been linked with inflammatory processes, autonomic nervous system dysfunction, and impaired coronary flow reserve that increases risk of myocardial ischemia (Sanchez-Gonzales et al. 2013, Rieckmann et al. 2013, Slavich & Irwin 2014, Cohen et al. 2015, Vaccarino et al. 2018).

Anxiety is associated with cigarette smoking, excess alcohol consumption, lower physical activity, and poor diet, which increases the risk of CVD (Strine et al. 2005, Antonogeorgos et al. 2012, Cohen et al. 2015, Celano et al. 2016). Anxiety leads to excess activation of the hypothalamic-pituitary-adrenal axis and sympathetic nervous system, increases release of plasma catecholamines, and causes endothelial damage, ultimately leading to atherosclerosis, CHD, and acute coronary events (Cohen et al. 2015, Celano et al. 2016). Acute anxiety is associated with increased cardiovascular reactivity to stress and resting heart rate, decreased heart rate variability, baroreflex dysfunction, and greater variability in ventricular repolarization (Rozanski et al. 2005, Cohen et al. 2015, Celano et al. 2016). These effects may increase the risk of incident CVD and lower the threshold for cardiac ischemia, arrhythmias, and sudden cardiac death.

Generally, cardiovascular rehabilitation has been proven to be an effective treatment to continuously apply after pharmacological and invasive and/or surgical treatment of the acute phase of the disease (e.g. after AMI) (Balady et al. 2007, Mampuya 2012, Arena et al. 2012, Dalal et al. 2015, Doimo et al. 2019). ACR allows clinically stable (low to moderate risk) patients to lead active lives in their places of residence, thanks to the efforts of a rehabilitation team of medical workers (Arena et al. 2012). The psychologists have special role in rehabilitation process through psychodiagnostics, patient counseling, education, group therapy based on behavioral-cognitive principles, and participating in cardiovascular consultation. Psychodiagnostics includes two types of activity – testing and conversation/interviews. In Croatia, as in other countries, it is adaptable and economical, but underused because it is ignored by medical professionals themselves, but also due to possible remoteness of available rehabilitation centers. This participation is particularly poor in rural areas and in eligible patients who have lower socioeconomic status, limited education, advanced age, and/or female sex (Arena et al. 2012, Ivanusa et al. 2015).

According to our knowledge, this is the first study in the Republic of Croatia and literature about the effectiveness of ACR on improvement of psychological, QoL and cardiac status at patients with various spectrum of cardiac pathology. Also, the literature data about the psychosocial effectiveness of ACR after ACS, revascularization and, especially, after valve replacement and device implantation procedures is somewhat scarce or insufficient. These facts represent the unique characteristics and advantages of our study.

We have found improvement of anxiety and depression scores, as well as of QoL, mostly after ACS and elective revascularization, which could be explained with longer duration of ACR in these groups. Also, correlation between anxiety, depression and QoL was weaker after rehabilitation, but it was still present. As no one of the patients have taken no medications for anxiety and depression before and during the rehabilitation procedure, that finding may suggest successful rehabilitation. So, we are sure that the additional efforts of psychologists, as well as an additional involvement of psychiatrists, may lead to much more improvement of anxiety, depression and QoL.

Cardiac rehabilitation in distressed patients may be difficult (McGrady et al. 2009, Contractor 2011, Zullo 2017), but reduces the blood pressure, blood glucose, lipid levels and body weight (central obesity and metabolic syndrome), which are traditional risk factors for myocardial (re)infarction due to atherosclerosis, chronic inflammation and endothelial dysfunction (Yusuf et al. 2004, Ranjit et al. 2007, Mornar Jelavic et al. 2015).

After an acute coronary event, elective percutaneous coronary revascularization, or CABG, conduction of ACR during two and 3-month results with improvement of anxiety and depressive scores, and QoL (Milani et al. 1996, Tuniz et al. 2004, Pourafkari et al. 2016). Other authors also reported effectiveness of two and 3-month cardiac rehabilitation at patients with CHD and after CABG in improvement of QoL and depression (Solak et al. 2015).

At patients with stable heart failure (NYHA class II-III), ACR during 2-month may result with better values of anxiety, depression and QoL (Kulcu et al. 2007, Keihani et al. 2015).

Study limitations

The sample of patients who participated in the study was rather specific, due to the fact that we excluded high risk subjects at whom ACR was contraindicated. Furthermore, there was no parallel control group of patients who did not participate in the rehabilitation program, so the resulting effects cannot be clearly attributed to the effectiveness of the ACR. Also, there was no follow-up that would test the continuance of the observed changes. So, future investigations should be performed on a larger number of patients with monitoring of their psychosocial and cardiovascular condition during follow up period, for at least 6-12 months.

CONCLUSION

The findings of this study showed that ACR is associated with improvement of anxiety, depression and QoL at patients with various cardiac pathology. We emphasized the necessity of more intensive psychological approach, as well as possible future cooperation

with psychiatrists, given the known negative effects of depression and anxiety on the QoL and recovery of patients after major CHD events. Finally, we do hope that this article can serve as an incentive for future scientific research and more frequent application of ACR as a safe and successful procedure for patients with various cardiac pathology.

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Contribution of individual authors:

Damir Rosic, Goran Krstacic, Igor Filipcic & Marko Mornar Jelavic: design study, analyses of data results, statistical analyses, literature searches, manuscript writing.

Antonija Krstacic & Ognjen Brborovic: design study, analyses of data results, statistical analyses, literature searches.:

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Correspondence:

Marko Mornar Jelavic, MD, PhD
Institute for Cardiovascular Prevention and Rehabilitation
Draskoviceva 13, HR-10 000 Zagreb, Croatia
E-mail: mjelavic@yahoo.com