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ORIGINAL ARTICLE

Cardiac rehabilitation and risk factor modifications in the coronary artery disease: Experience from a middle-east cardiac rehabilitation center

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Abstract

Background and objectives: To describe patient characteristics and risk factors profile of patients in a cardiac rehabilitation program.

Methods: This single-center, prospective, observational study included all the patients who completed the cardiac rehabilitation program with exercise sessions, including dietary plan, counseling, stress management, and relaxation sessions. Effects of pre- and postexercise program on patients' baseline characteristics, blood pressure, blood chemistry and lipid profile status were recorded and compared.

Results: A total of 264 patients enrolled and completed the cardiac rehabilitation exercise program. The mean age of the patients was 52 years and 70.8% of the patients were men. Among 264 patients, 22.3% had diabetes mellitus, followed by hypertension (37.1%), and dyslipidemia (29.5%). Exercise training showed significant improvement in the functional outcomes, including 6-min walk distance (500 vs. 521.5 m; $P<0.001$), systolic blood pressure (130.7 vs. 123.2 mmHg; $P<0.001$), diastolic blood pressure (75.9 vs. 72.5 mmHg, $P<0.001$), HbA1c (5.2 vs. 3.4%, $P=0.001$), and total cholesterol (4.3 vs. 4.1 mmol/L, $P<0.001$).

Conclusion: Cardiac rehabilitation is an essential and an integral part in the care of cardiac patients. Overall, there was a reduction in blood pressure, blood sugar, and cholesterol levels with improved exercise tolerance. The benefits and the desired outcomes are achievable to improve the overall care provided.

Keywords: Coronary artery disease, cardiac rehabilitation, risk factors

Introduction

Cardiac rehabilitation programs (CRPs) are recognized as an essential part in the care of patients with cardiovascular disease. It is recommended (Class I) by the American Heart Association and the American College of Cardiology in the treatment of patients with coronary artery disease and heart failure as a useful and effective measure to be implemented in the comprehensive care to these patients.[1-4] Cardiac rehabilitation is as cost-effective as coronary artery bypass grafting and can reduce the mortality rate by up to 25%.[5-7] In the Gulf region, the CRPs are getting more recognition as an effective tool in the management of cardiac patients. Limited

data are available regarding the effectiveness of the program in the local population of the Gulf and there are no registries as such for these patients up to date. In the Kingdom of Bahrain, the CRPs started actively in 2008. The cardiac patients are referred and encouraged to participate in our local CRP after an acute cardiac event or acute coronary syndrome, that is unstable angina, non-ST elevation myocardial infarction, and ST elevation myocardial infarction followed by percutaneous coronary intervention or coronary artery bypass graft surgery. The patients with heart failure and rhythm abnormalities are also encouraged to attend the program. The program aims to increase activity levels, improve nutrition, optimize pharmacological therapy, minimize the detrimental effect of cardiovascular risk factors, and address psychological issues. The American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation Consensus Document stressed on the multidisciplinary approach for the cardiac patients not only involving exercise training but improving the healthy active lifestyle and reducing disability.[1, 8, 9] The available program in Bahrain has grown over the years providing a multidisciplinary approach and has incorporated all the stages and aimed at different levels in the care of cardiac patients to provide the recommended care to the different cardiac patient attending the program. This study aimed to establish patients' baseline data characteristics and to have an insight regarding our local experience.

Materials and methods

Cardiac rehabilitation

The CRP was followed according to the cardiac rehabilitation clinical practice guidelines.[2] The cardiac rehabilitation services available in Salmaniya Medical Complex were supervised exercise training including treadmill, bicycling and cardio exercises, and cardiac risk factor modification delivered by the expertise (nurses, exercise physiologists, dieticians, and stress management specialists).

Study population

This was a single-center prospective observational study. The total number of patients enrolled and completed the cardiac rehabilitation exercise program was 264. Patients were recruited from cardiac rehabilitation. Patients with ejection fraction >30% and with mild- or moderate-risk stratification profile were included in the study; however, patients with high-risk stratification profile unstable angina, uncontrolled congestive heart failure, uncontrolled hypertension, dysrhythmias compromising hemodynamic status, recent acute myocardial infarction prior to revascularization, severe valvular stenosis, and hypertrophic obstructive cardiomyopathy were excluded from the study.[2] None of the enrolled patients were excluded unless the patients failed in session's attendance and continuation of the program. The low-risk patients were encouraged to attend 12 sessions, the moderate-risk patients for 24 sessions, and the high-risk patients for 36 sessions on average of one session per week. The patients were required to visit the dietician at least two times during the program and attend two stress management sessions.

Clinical evaluation and procedure

Patient demographics (age, nationality, and gender), complete cardiovascular history (acute coronary syndrome, heart failure, coronary artery bypass graft surgery, and history of percutaneous coronary intervention), and the reason for referral for the CRP were recorded. Borg scale score, and data related to body mass index, fasting blood sugar (FBS), HbA1c, and lipid levels of all patients were collected at the initial visit, at the completion of the program sessions, and at 4 months. The Borg scale is a perceived exertion scale to document and measure the patient's exertion and intensity during the exercise session.[10] The purpose of data collection was to compare the (1) baseline clinical characteristics of the patients (2) improvement in the exercise tolerance (3) improvement and control in blood pressure, and (4) improvement in blood chemistry and lipid profile. A written research approval was obtained by the secondary care medical research subcommittee in the Ministry of Health, Salmaniya Medical Complex, Kingdom of Bahrain.

Statistical analysis

All analyses were performed using IBM SPSS 20. Data were presented as absolute numbers, percentages, or means with standard deviations. The frequencies of categorical variables in subgroups were compared by the Chi-square or Kruskal Wallis test. Continuous variables were compared by two-tailed Wilcoxon rank sum test. $P < 0.05$ in two-sided tests were considered as significant.

Results

Demographic and baseline clinical characteristics are summarized in Table 1. The mean age of patients was 52 years and the mean body mass index was 30.4 kg/m^2. Out of 264 patients, 70.8% were men. The top referral indications to the program exercise were coronary artery disease (93.2%), heart failure (4.8%), and other cardiac conditions, mainly arrhythmias (2.1%). The cardiovascular risk factors were dyslipidemia (29.5%), diabetes mellitus (22.3%), and arterial hypertension (37.1%). In terms of therapy in the acute hospital setting, 22.7% of patients underwent revascularization that is, percutaneous coronary intervention or coronary artery bypass grafting.

The mean FBS levels in the study population at pre- and postexercise program were 6.7 ± 2.4 mmol/L vs. 6.5 ± 3.9 mmol/L, $P = 0.33$). However, in patients with diabetes mellitus subset population, the pre- and postexercise FBS was 8.6 ± 2.6 mmol/L vs. 7.4 ± 2.2 mmol/L, $P = 0.001$). The HbA1c level at pre- and postexercise program was 5.2 ± 1.0% vs. 3.4 ± 1.1%, $P < 0.001$). The mean total cholesterol level at entry was (4.3 ± 1.1 mmol/L), mean low-density lipoprotein cholesterol was 2.4 ± 0.8 mmol/L, mean high-density lipoprotein cholesterol was 1.0 ± 0.5 mmol/L, and the mean triglycerides level was 1.6 ± 0.9 mmol/L. At the end of the program, lipid parameters were considerably improved (total cholesterol, 4.1 ± 1.0 mmol/L; mean low-density lipoprotein cholesterol, 2.2 ± 0.8 mmol/L; and mean triglycerides level, 1.4 ± 0.7 mmol/L). However, no significant change was observed in the level of the mean high-density lipoprotein cholesterol (Table 2). The mean systolic blood pressure decreased to 123.2 mmHg (130.7 mmHg at entry, $P = 0.0001$), and the mean diastolic pressure decreased to 72.5 mmHg from 75.9 mmHg at entry. No significant change in the Borg scale at pre- and postexercise (2.9 ± 1.1 vs. 2.8 ± 1.1; $P = 0.29$) was observed. No cardiovascular events such as chest pain, myocardial infarction, and stroke were encountered during the exercise hours for all enrolled patients.

Table 1: Baseline clinical characteristics of all patients

Variables	N (Mean range or %)
Age (Years)	52 (42.1–61.9)
Gender (Male)	187 (70.8%)
Body mass index (kg/m^2)	30.4 (24.1–36.7)
Diabetes mellitus	59 (22.3%)
Hypertension	98 (37.1%)
Hyperlipidemia	78 (29.5%)
Percutaneous coronary intervention or coronary artery bypass surgery	60 (22.7%)
Cardiomyopathy (Dilated or ischemic)	15 (5.7%)

Table 2: Pre- and postexercise program

Parameters	Pre-exercise program	Postexercise program	*P*-value
	Mean ± SD (mean range)	Mean ± SD (mean range)	
6-min walk test (Meters)	500 ± 77.9 (422.1–577.9)	521.5 ± 91.7 (429.8–613.2)	< 0.001
Body mass index (kg/m^2)	30.4 ± 6.3 (24.1–37)	30.1 ± 6.2 (23.9–36.3)	0.001
Systolic blood pressure (mmHg)	130.7 ± 14.5 (145.2–174.2)	123.2 ± 13.8 (109.4–137)	< 0.001
Diastolic blood pressure (mmHg)	75.9 ± 10.4 (65.5–86.3)	72.5 ± 9.1 (63.4–81.6)	< 0.001
FBS (mmol/L)	6.7 ± 2.4 (4.3–9.1)	6.5 ± 3.9 (2.6–10.4)	0.33
HbA1c (%)	5.2 ± 1.0 (4.2–6.2)	3.4 ± 1.1 (2.3–4.5)	< 0.001
Total cholesterol (mmol/L)	4.3 ± 1.1 (3.2–5.4)	4.1 ± 1.0 (3.1–5.1)	< 0.001
LDL cholesterol (mmol/L)	2.4 ± 0.8 (1.6–3.2)	2.2 ± 0.8 (1.4–3)	0.006
HDL cholesterol (mmol/L)	1.0 ± 0.3 (0.7–1.3)	1.1 ± 0.8 (0.3–1.9)	0.49
Triglyceride (mmol/L)	1.6 ± 0.9 (0.7–2.3)	1.4 ± 0.7 (0.7–2.1)	< 0.001
Borg scale score	2.9 ± 1.1 (1.8–4)	2.8 ± 1.1 (1.7–3.9)	0.29

FBS, Fasting blood sugar; *HbA1c*, Glycosylated hemoglobin; *LDL*, Low-density lipoprotein; *HDL*, High-density lipoprotein.

Discussion

According to our knowledge, this is one of the first registry data on cardiac rehabilitation from the gulf region. The present paper reflects the risk factor control and clinical characteristics of patients referred for cardiac rehabilitation. The majority of the patients experienced substantial improvement in blood glucose and lipid levels, blood pressure control, and physical status. Data regarding the patients' clinical characteristics and baseline outcomes of pre- and postexercise program has been documented. Additionally, we are planning to follow these patients and have a long-term outcome data regarding the readmission rate to the cardiology floor, symptoms improvements, quality of life, and mortality outcomes.

Mutwalli et al. tested home-based CRP in patients with postcoronary artery bypass graft surgery and showed improvement in the health-related quality of life, risk factor profiles, and physical function.[11] A meta-analysis and Cochrane systemic review showed no difference between the home- and center-based cardiac rehabilitation; however, they were effective in improving the quality of life outcomes.[12] The culture and the lifestyle in the Gulf region may dictate the follow-up and continuity in the program. There are no studies yet in this field from the region. However, a review published by Jackson et al. for 32 studies with 12,804 patients showed that patients were more likely to participate in CRPs when they were actively referred by their treating physician with the endorsement of the effectiveness of such a program, educated, married, showed high self-efficacy, and easily accessible program.[13] The rate of participation affected by the availability of transportation and being a woman with other family obligation even after referral. Hence, with lifestyle in Gulf region and social factors may affect the participation and this may be a limitation to the programs in the region.

The CRP is primarily prescribed for patients who have received a diagnosis of acute coronary syndrome, have undergone coronary intervention whether endovascular or coronary artery bypass grafting, or have chronic stable angina.[6] The aim of such program is secondary prevention involving a prescribed exercise and interventions to modify coronary risk factors. Additionally, this program aims to prevent disability resulting from coronary artery disease, subsequent cardiac adverse events, hospitalization, and death.[6]

The benefit of cardiac rehabilitation has been described in several studies. O' Conner et al. reviewed 22 studies and observed 20% mortality reduction in patients with myocardial infarction referred to cardiac rehabilitation with the exercise session.[7] Furthermore, if we combine exercise with nutritional counseling, it reduces the atherosclerotic process, recurrent hospitalization, and cardiac events.[14-16]

We plan to follow this study with subsequent studies and analyze long-term outcomes and including other parameters of significance such as the heart rate, Borg scale, double product, and metabolic equivalent of the task. Further collaborative work between the different CRPs in the region may play a major role in a better understanding of postacute cardiac condition recovery and transition after hospital discharge.

Limitations

The current registry was prospective, including all patients who completed the CRP and representing the real-time setting. However, selection bias could not be excluded by physicians and patients, as those patients voluntarily participating in the program were more likely to have an interest and probably increased knowledge and educational level. In contrast, the compliance rate was an issue to be addressed in further studies, as the rate of attendance to complete the whole program was essential and an integral part in influencing recovery. In addition, missing data or under-reporting of some characteristics that were not collected from the beginning of the registry might have some potential effect, for example, heart rate, full medication list, and inflammatory markers. The results of the study, especially with the improvement of the risk factors could be related to drug therapy. Unfortunately, this could not be assessed uniformly, as the patients were following with different outside facilities. Nevertheless, the program was continuous, rigorous with all the component of dietician visits, psychological support, and relaxation sessions. Therefore, we believe that the data are not far away from other registries and data of other CRPs in the western countries.

Conclusion

The present registry data provide an insight regarding the patients' characteristics, risk factors, and the effect of the CRP in the Gulf population. The

main objective of cardiac rehabilitation is optimal control of risk factors and biochemical parameters such as exercise capacity, blood pressure, and levels of FBS, HbA1c, and cholesterol. Overall, there was a reduction in blood pressure, blood sugar, and cholesterol level with improved exercise tolerance, measured by 6-min walk distance. These goals are achievable with a multidisciplinary team and proper usage of the available resources. The Gulf region has other active CRPs and this should be further tested in a larger registry to show programs efficacy and cardiovascular outcomes.

Disclosure statement

The authors report no financial relationships or conflicts of interest regarding the content herein. This is an investigator-initiated research project.

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