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Cardiac rehabilitation after cardiac surgery is limited by gender and length of hospitalisation

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Abstract

Background: Cardiac rehabilitation (CR) is recommended after cardiac surgery. Secondary prevention through exercise training is one of the best scientifically-proven ways of decreasing mortality and enhancing quality of life in cardiovascular disorders. Studies into the use of CR in different groups of patients after cardiac surgery are limited.

Aim: To find the factors determining the reasons for the lack of CR in cardiac surgery patients.

Methods: The study group consisted of 82 patients (mean age 58.6 years, 80.7% male) in stable II/III NYHA class, who had undergone coronary artery bypass graft surgery, valvular surgery, or both. The following were analysed: age, gender, body mass index, basic laboratory results such as serum lipids level, cholesterol ratio LDL/HDL, creatinine and glucose levels, results of electrocardiography, echocardiography and coronary arteriography, presence of hypertension, diabetes, coronary artery disease, renal failure, previous stroke, obliteration of peripheral arteries, EuroSCORE and length of hospitalisation. Patients were divided into two groups: those referred for CR (n = 46, the CR group) and those referred for CR but who did not receive it (n = 36, non-CR group).

Results: From multiple logistic regression analysis with backward stepwise, only female gender (p = 0.0208, OR = 0.07) and length of hospitalisation (p = 0.0198, OR = 1.17) were significant for non-CR patients.

Conclusions: We found a lower rate of use of CR after cardiac surgery in those patients hospitalised for longer periods, and in women.

Key words: cardiac rehabilitation, cardiac surgery

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INTRODUCTION

Cardiovascular (CV) disorders are still the leading cause of mortality and morbidity. The current approach in cardiology, based mainly on intervention, seeks to restore quality of life (QoL), or to improve or maintain functional capacity, especially in cardiac surgery patients. There are many publications and social services dedicated to primary prevention, but there have been few studies to date into cardiac rehabilitation (CR) following cardiac surgery. A new document from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation looks at all the components of CR for CV conditions, including cardiac surgery [1]. After surgical interventions CR programmes similar to the other clinical conditions base on the core CR components and objectives common to all clinical conditions with approaching the surgical procedure itself [1]. Secondary prevention through exercise training CR [2], which can be started in the early in-hospital phase [1], is one of the best scientifically-proven ways of decreasing mortality in CV disorders. Its benefits include components of the metabolic syndrome such as a loss of body weight [3, 4]. It also decreases blood pressure [4, 5] and serum triglycerides, increases HDL cholesterol [6–9], and improves insulin sensitivity and glucose homeostasis [10–12]. Primary candidates for CR are patients who have experienced a myocardial infarction (MI). Currently, it has been broadened to include patients who have undergone percutaneous transluminal coronary angioplasty (PTCA), have stable chronic heart failure (HF), or those who have undergone cardiac surgery [13–18].

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The aim of this study was to evaluate the clinical parameters and results of laboratory tests of patients who have undergone cardiac surgery and were referred for cardiac rehabilitation, and to find the factors determining an absence of CR after cardiac surgery.

METHODS

Study group

The study comprised 82 patients (mean age 58.6 ± 9.67 years, 80.7% male) who had undergone coronary artery bypass graft surgery (CABG), valvular surgery, or both. All patients were in stable II/III NYHA class. The study was retrospective, with data analysed from all operated patients in the cardiac surgery department over a one month period.

Patients were divided into two groups: those referred for CR (n = 46, the CR group) and those referred for CR but who did not receive it (n = 36, the non-CR group). The study procedures were approved by the Bioethics Committee.

ECG, echocardiography and angiography

Twelve-lead ECG was analysed to assess heart rate, PQ, QRS and QT duration. All patients underwent standard 2D and Doppler echocardiography. All echocardiographic parameters were evaluated according to the ASE/EAE recommendation. Left ventricular ejection fraction was measured at four- and two-chamber apical view by the Simpson method.

Conventional coronary arteriography was performed using a femoral or radial approach. The assessment involved the right coronary artery, left main, left anterior descending and left circumflex coronary arteries. Stenosis ≥ 50% of the left main, and ≥ 75% of the other coronary arteries, was considered significant. The results of coronary arteriography were analysed as one-, two- or three-coronary disease.

Analysed data

The following were analysed: age, gender, body mass index, basic laboratory results such as serum lipids level, cholesterol ratio LDL/HDL, creatinine and glucose levels, results of ECG, echocardiography and coronary arteriography, presence of hypertension, diabetes, coronary artery disease, renal failure, previous stroke and heart infarct, obliteration of peripheral arteries and length of hospitalisation. Nobody with exertional limitation or a history of walking impairment, or depressive disorders or anxiety was included.

We also identified a risk of cardiac surgery procedure using The European System for Cardiac Operative Risk Evaluation (EuroSCORE and logistic EuroSCORE). The estimates were based on the website interactive calculator www.euroscore.org.

Statistical analysis

Continuous variables are presented as mean values ± SD or medians and interquartile range depending on normality of distribution. Nominal variables are presented as percentages. For comparing continuous variables, we performed t-student test and variation analysis (ANOVA). Group differences estimated by variation analysis were verified by *post-hoc* Tukey test. Differences between obtained and expected distribution for nominal variables were compared by χ^2 test and Fisher-Yates test. A p value < 0.05 was considered significant.

RESULTS

The baseline characteristics of patients are presented in Table 1. Most of the patients had undergone CABG and the distribution of the type of heart operation was similar in both populations. Patients who participated in CR were significantly younger ($p = 0.04$) and their hospitalisation duration was markedly shorter ($p = 0.004$). Also, there was a visible difference in gender distribution in both the analysed populations ($p = 0.03$), with women prevalent in the non-CR group (28.5% *vs* 8.6%). There was a trend toward a higher logistic EuroSCORE and greater insulin treatment in the non-CR group. Other analysed parameters were similar in both groups (Table 1). There were also no significant differences in laboratory tests, or in such examinations as ECG, echocardiography or coronary arteriography (Table 2). From multiple logistic regression analysis with backward stepwise, only female gender (OR = 0.07, p = 0.0208) and length of hospitalisation (OR = 1.17, p = 0.0198) were significant for non-CR patients.

DISCUSSION

Studies on the use of CR in different groups of patients following cardiac surgery have been scarce in Polish literature. We found one study assessing the safety and efficacy of CR after CABG in patients with diabetes [19] and the preliminary results of different types of training used post-CABG [20]. In the present study, for the first time, a cardiac surgery population is described in terms of lack of CR after surgery. Multiple logistic regression analysis revealed that only female gender and length of hospitalisation were significant for non-CR patients. In these patients, 47% experienced longer hospitalisation (more than a median of 13 days), usually as a result of complications or co-morbidities such as haemorrhage, HF, or arrhythmias such as cardiac arrest or atrial fibrillation. Recently, other authors have found similar results. The National Survey on Gender Differences in CR, performed in the USA [21], considered patients after MI, PTCA and CABG and stated that enrollment for CR was lowest among women, non-whites and patients over the age of 65. Moreover, Suaya et al. [13] studied the use of CR after MI and CABG and concluded that women, older individuals and patients with co-morbidities such as congestive HF, previous stroke, diabetes mellitus and cancer, were significantly less likely to attend CR. Also Beswick et al. [22] showed a low use of CR in people aged over 65, women and in patients with a more severe presentation of cardiac disease after a primary diagnosis of MI or PTCA. Moreover, a study

Table 1. Patient characteristics

Parameters	Participated in cardiac rehabilitation (n = 46)	Not participated in cardiac rehabilitation (n = 36)	P
Age [years]	56.6 ± 9.3	61.3 ± 9.6	0.043
Male gender	91	71	0.035
Hospitalisation [days]	12.2 ± 4.4 (4–27)	15.5 ± 5.2 (10–24)	0.004
Smoking [%]	40	35	0.064
Body mass index	29.9 ± 7.6	28.2 ± 3.7	0.924
Hypertension [%]	67	65	0.936
Diabetes [%]	28	28	0.98
Obliteration of peripheral arteries [%]	2	0	0.936
Renal failure [%]	0	3	0.911
Previous stroke [%]	4	5	0.91
Insulin treatment [%]	2	14	0.079
Coronary artery disease [%]	85	79	0.811
Previous myocardial infarction [%]	47	45	0.93
Ejection fraction [%]	53.5 ± 10.3 (35.0–74.0)	55.6 ± 10.7 (29.0–78.0)	0.30
CABG [%]	83	77	0.732
Number of grafts	2 ± 1.31	2 ± 1.28	0.98
Valve surgery [%]	15	19	0.721
CABG with valve surgery [%]	2	4	0.917
EuroSCORE	2.3 ± 3.4	3.5 ± 3.0	0.788
Logistic EuroSCORE	2.1 ± 1.74	4.2 ± 2.3	0.075

Figures are expressed as mean ± SD and ranges; CABG — coronary artery bypass grafting

Table 2. Results of laboratory tests, electrocardiography and coronary arteriography in the studied patients

Parameters	Participated in cardiac rehabilitation (n = 46)	Not participated in cardiac rehabilitation (n = 36)	P
Laboratory test			
Total cholesterol level [mg/dL]	168.0 ± 41.0 (107–282)	162.8 ± 48.2 (103–299)	0.39
LDL-cholesterol [mg/dL]	88.0 ± 36.0 (11.0–195.0)	85.7 ± 39.8 (39.0–185.0)	0.47
HDL-cholesterol [mg/dL]	44.5 ± 14.7 (20.0–80.0)	44.7 ± 13.8 (21.0–79.0)	0.89
Triglycerides [mg/dL]	173.8 ± 79.9 (42.0–987.0)	143.4 ± 79.4 (60.0–373.0)	0.48
LDL/HDL index	4.1 ± 1.4 (1.4–8.2)	3.9 ± 1.3 (1.9–6.9)	0.42
Creatinine [mg/dL]	0.9 ± 0.3 (0.2–1.6)	0.9 ± 0.20 (0.4–1.4)	0.56
Glucose [mg/dL]	108.1 ± 46.8 (70–277)	115.9 ± 31.5 (79.0–221)	0.15
Electrocardiography			
Heart rate	70.7 ± 13.3 (45.0–98.0)	73.9 ± 13.2 (44.0–102.0)	0.27
PQ [ms]	17.6 ± 3.4 (12.0–30.0)	16.8 ± 2.6 (12.0–22.0)	0.36
QRS [ms]			0.21
QT [ms]	37.1 ± 3.8 (28.0–47.0)	35.9 ± 3.1 (30.0–42.0)	0.13
Coronary arteriography			
1-artery disease [%]	18	15	0.76
2-arteries disease [%]	21	18	1.0
3-arteries disease [%]	46	42	0.81

Figures are expressed as %, mean ± SD and ranges.

from Australia [23] looked at equality of access to CR in patients with cardiac disease and revealed that males and younger patients (median age 67 for men and 72 for women) were more often invited to CR.

Male-female differentials in access to CR in patients for whom CR was recommended have been presented by Stewart Williams [24]. He found that group characteristics did not explain approximately 18% of male-female inequality in

referral to CR and was discriminating against women. One of the group characteristics that explained this inequality was the fact that women were generally older than men. In our study, age over 65 years was a variable of the borderline significance ($p = 0.0670$, OR = 1.07). It may be the result of a small population of patients.

Cardiac rehabilitation in patients who have undergone cardiac surgery is recommended by the American Heart Association, the American College of Cardiology and the European Society of Cardiology [1, 2]. There are very many documents presenting the benefits of exercise in cardiac patients [3–12, 25]. Cardiac rehabilitation reduces mortality and hospital readmissions in coronary artery disease, enhances QoL and prognosis in HF, and profits by improving physical function or decreasing CV risk factors. The small uptake of CR in patients after cardiac surgery is regrettable. In the first study from the USA, enrollment for CR after CABG was only 23.4% [21] and in the second 31% [13]. Compared to these investigations, the use of CR in 56% of patients who have undergone cardiac surgery in our study is relatively high.

Limitations of the study

The main limitation of this study is the small number of patients. There is a need for further investigations in a larger population of patients who have undergone cardiac surgery, especially valvular procedures. The other limitation is the retrospective method of analysis which meant we only looked at the data which was approachable, without any prospective analysis of QoL, morbidity or the long-term results of cardiac surgery procedures.

CONCLUSIONS

We found a lower use of CR after cardiac surgery in patients who were hospitalised for longer periods, and in women.

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Płeć żeńska i dłuższy okres hospitalizacji zmniejszają częstość przeprowadzania rehabilitacji kardiologicznej u chorych po zabiegach kardiochirurgicznych

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Streszczenie

Wstęp: Rehabilitacja kardiologiczna (CR) stanowi standard postępowania po leczeniu kardiochirurgicznym. Korzyści z wysiłku fizycznego w ramach wtórnej prewencji kardiologicznej są dobrze udokumentowane zarówno w zakresie zmniejszenia śmiertelności, jak i poprawy jakości życia, a postępowanie rehabilitacyjne jest uznane za ważny element decydujący o wczesnych i odległych efektach leczenia kardiochirurgicznego. Niewiele jest jednak badań z wykorzystaniem CR w okresie wczesnym po różnych procedurach kardiochirurgicznych.

Cel: Celem pracy było określenie czynników determinujących zaniechanie odbycia wczesnej CR wśród chorych po operacjach kardiochirurgicznych.

Metody: Do badania włączono 82 chorych (średni wiek 58,6 roku; 80,7% mężczyzn) po pomostowaniu tętnic wieńcowych, operacjach zastawkowych lub obu procedurach wykonanych łącznie. Wszyscy pacjenci byli w II/III klasie czynnościowej wg NYHA. U pacjentów wykonano spoczynkowe badanie EKG, podstawowe badania laboratoryjne, badanie echokardiograficzne i koronarografię. Analizie poddano: wiek, płeć, wskaźnik masy ciała, stężenia frakcji lipidowych w surowicy, wskaźnik aterogenności LDL/HDL, stężenie kreatyniny i glukozy w surowicy, parametry echokardiograficzne oraz wyniki koronarografii, jak również obciążenie chorobami współistniejącymi, takimi jak nadciśnienie tętnicze, cukrzyca, choroba wieńcowa, niewydolność nerek, przebyty udar mózgu, miażdżyca tętnic obwodowych i dodatkowo ryzyko operacyjne wg skal EuroSCORE i logistic EuroSCORE oraz czas hospitalizacji. W celu identyfikacji czynników determinujących niezgłoszenie się chorych na CR przeprowadzono analizę jedno- i wieloczynnikową. Do modelu wieloczynnikowego włączono te zmienne, dla których znamienność w porównaniach jednoczynnikowych osiągnęła $p < 0,15$. Chorych analizowano w dwóch grupach: skierowanych na wczesną pooperacyjną CR ($n = 46$) i skierowanych, ale nieuczestniczących w rehabilitacji ($n = 36$).

Wyniki: Analiza wieloczynnikowa regresji logistycznej wykazała, że płeć żeńska ($p = 0,0208$; $OR = 0,07$) oraz czas pobytu w szpitalu związany z operacją ($p = 0,0198$; $OR = 1,17$) były istotnie związane z zaniechaniem rehabilitacji.

Wnioski: Wczesną CR po operacjach kardiochirurgicznych rzadziej odbywali chorzy dłużej hospitalizowani oraz kobiety.

Słowa kluczowe: rehabilitacja kardiologiczna, kardiochirurgia

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