

CLINICAL STUDIES

A Clinical Study of a Cardiac Rehabilitation Program (Phase II)

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ABSTRACT. Little has been published concerning the practice of cardiac rehabilitation in Puerto Rico. The purpose of this paper was to study and analyze the clinical data collected at the Cardiac Rehabilitation Program Phase II, in order to determine how adequate has been this program in its population. It was intended in this clinical study to determine the characteristics that describe the cardiac population which enters a cardiac rehabilitation program in Puerto Rico. Also, it was the purpose of this study to compare the initial and final evaluation of the patients that completed the program. Seventy-one patients were evaluated and 17 of them finished the whole program. The general population had a low level of daily physical activity,

vital capacity, low back and hamstring flexibility, and a high percent of body fat. The group that completed the program showed significant increase in low back and hamstring flexibility, vital capacity and estimated daily energy expenditure. Low density lipoprotein and estimated daily resting energy expenditure significantly decreased; the patients were more active and resting less at the end of the program. This data suggest that the patients evaluated present various risk factors of coronary disease that might predispose to a second cardiac or surgical event, or progression of the disease. Also, these results suggest that this program might help in improving the risk factors related to health related fitness and physical inactivity.

North-american and european literature concerning cardiac rehabilitation is extensive. Cardiac rehabilitation service is a multiphasic program of medical care that is designed to restore the coronary artery disease (CAD) patient to a productive life (1). The guidelines relative to the practice of cardiac rehabilitation are available (1,2,3). However, little had been published concerning cardiac rehabilitation services in the hispanic population. The hispanic population is one of the major ethnical groups in the USA, in 1994 there were 26,077,000 hispanic residents in the USA (4). Mortality related to heart

diseases in this group in 1993 was 667,700 (4). Within the hispanic group, Puerto Ricans are a numerous subgroup. In 1990 there were 2,728,000 Puerto Ricans in the USA, 68.6% of them were living in the northeast region (4). In 1992, 21.4% of deaths in the island of Puerto Rico were related to heart diseases, being the first main cause of non-violent death (5).

The implementation of cardiac rehabilitation programs in Puerto Rico follows the guidelines and strategies of other countries, specially those of the USA. This fact raises the question of how adequate and feasible is cardiac rehabilitation in Puerto Rican patients. In the USA, several millions of patients with coronary disease, are candidates for cardiac rehabilitation, and only 11-38% participate in these programs (2). A similar phenomena has been seen in Puerto Rico. Although physicians consider physical training very important in the care of patients with coronary disease, referral of patients to cardiac rehabilitation programs following acute coronary events is scarce.

Cardiac Rehabilitation is usually organized in three major phases: Inpatient (Phase I), Outpatient (Phase II),

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and Community Program (Phase III). In Puerto Rico, at this moment there is no evidence of the establishment of structured and organized cardiac rehabilitation programs of the phase I and phase III. However, in the Island exist 5 cardiac rehabilitation programs phase II. Four of them are established in the local cardiologist private practice. The fifth one is established in the School of Medicine of the University of Puerto Rico, in association with the University Hospital of the Health Department of the Government of Puerto Rico.

The Department of Physical Medicine, Rehabilitation, and Sport Medicine of the University of Puerto Rico School of Medicine, established its first Cardiac Rehabilitation Program Phase II in May 1994. The Cardiac Rehabilitation Program Phase II follows a comprehensive program for the recovery and improvement of the physical capacity of the cardiovascular patient. This program is designed for patients who suffered coronary artery disease, myocardial infarction, angioplasty, bypass coronary surgery, and other cardiovascular conditions. This program fulfill the requirements established by the American College of Sport Medicine (ACSM) and the American Association of Cardiopulmonary Rehabilitation (AACPR).

The purpose of this paper was to study and analyze the clinical data collected at the Cardiac Rehabilitation Program Phase II, in order to determine the adequacy of this program in the puertorrican population, following the same procedures and guidelines established in the USA. Second, concerning the patients that completed the Program, it was intended to compare their initial and final evaluation.

Methods

The methodology followed by this Program was generally adopted from the guidelines of the American College of Sports Medicine and American Association of Cardiovascular and Pulmonary Rehabilitation (1,3). The characteristics of the cardiac population that enters the Cardiac Rehabilitation Program Phase II at the University Hospital in Puerto Rico were determined and the functional parameters to be assessed were selected. These parameters were the following: cardiovascular function (heart rate, blood pressure, double product and symptoms reported), lipid profile, blood glucose, health related fitness (submaximal exercise tolerance, low back and hamstring flexibility, vital capacity body composition, and weight), and estimated daily energy expenditure.

Subjects. Seventy-one patients had an initial evaluation at the cardiac rehabilitation program. These patients were referred to the program by their head cardiologist. Most

of them were from the metropolitan and adjacent areas of San Juan. Each of the patients received a full orientation concerning the goals of a cardiac rehabilitation program. The orientation consisted of modification of risk factors such as diet, physical activity, smoking cessation, alcohol consumption and stress management. Also, patients received educational material such as panflets and brochures about sexual education, cardiac rehabilitation, and nutritional guidelines. The patients signed an informed consent following the guidelines of ACSM and AACPR (1,3).

Procedures. The Cardiac Rehabilitation Program (phase II) consisted of four different stages: initial evaluation, exercise prescription, exercise sessions, nutritional counseling and final evaluation. The patients underwent an initial evaluation that included the following stages: 1) medical evaluation, 2) 12 lead electro-cardiogram, 3) health related fitness test battery (1) (percent of body fat using skinfold measurements, low back and hamstring flexibility using the modified sit and reach test, and vital capacity using spirometry), 4) nutritional evaluation, and 6) the Bouchard 3-day Physical Activity Record for the estimation of daily energy expenditure (6). After completing the initial evaluation, the patients were placed in the risk stratification scale established by the AACPR, ACSM and the American Heart Association (AHA) (7). The risk stratification scale place the patients in three levels such as low, moderate and high risk.

The Medical Director prescribed the exercise program for each patient. The exercise prescription was based on the patient's exercise tolerance, determined by a prior exercise stress test (2). The exercise intensity, duration and frequency were planned based on the results of the exercise stress test. The exercise session included 4 phases: 1) a warm up period of 5 min of low intensity exercise; 2) 5 min of stretching exercises for the neck, arms, shoulders, legs, and upper and lower back; 3) 15 to 30 min of conditioning period (aerobic exercise); and 4) a cool down period of 5 min of low intensity exercise. After the exercise sessions patients were monitored for an additional 20 min, in order to observe any cardiac disrhythmias or other complications related to exercise.

The exercise conditioning program was modified as the patient was showing improvement in exercise tolerance, and less symptoms such as fatigue. Strength training exercise (free weights 1-5 lbs) and arm ergometer were added to the exercise sessions as the patient reached a moderate intensity level of aerobic exercise (3.5 METs). During the exercise session, patients were monitored with a ECG telemetry system and a sphyngomanometer for blood pressure measures. Around two minutes prior finishing the conditioning period, peak blood pressure,

heart rate and Rating of Perceived Exertion (RPE) were recorded. The exercise session was supervised by a critical care nurse and exercise physiologist. The head cardiologist was kept informed about the patient health state, exercise progression, and any important event.

After the fulfilment of the program goals, the patient was discharged from the phase II program and oriented to start a community based program. The patient underwent a second evaluation with the same procedures used in the initial one. Also, the patient was asked to complete again the Bauchard 3-day Physical Activity Record. Once finished the program, the patients were educated and stimulated to maintain their exercise home program and continue the dietary modifications. This was an important educational intervention, since the alternative of referring the patients that completed the phase 2 program to a phase 3 community based program was not available.

Statistical Analysis. This was a descriptive, longitudinal, and clinical study. All the data collected was saved in a computerized program (EPI-INFO Version 6). The data was analyzed using a computerized statistical package (SPSS Version 4). The statistical analysis consisted of descriptive statistics (mean, standard deviation, maximum and minimum) of all the variables evaluated at the initial phase. Also, paired t-test were used in order to compare the data of the initial and final evaluation of the group that completed the program.

Results

The data was divided by sex, however significant testing was not performed since the sample size by sex was not proportional (n = 71; male = 53, female = 18). The mean

± standard deviation and range of the variables evaluated at the initial phase of all 71 patients are showed in table 1. The values are presented for females and males. Table 2 presents the means ± sd of the variables evaluated at the initial and final evaluation of the 17 patients that finished the program. The values are presented as pre and post. The asterik indicates the difference between the pre and post values that were significant as determined by paired t-test analysis.

Seventeen patients completed an average of 36 exercise sessions. Most of them reached a level of 5 METs, attending from two to three sessions per week in a 3-4 month period. Sixteen patients enter the exercise program but retired before finishing it, 13 are still active, and 25 did not participate because of a personal decision. The most common reasons for not entering or withdrawing from the program were patient's lack of interest, problems with the medical insurance coverage and unable to defray the program expenses, and problems with the patient's family and job. The average income was between \$12,000 and \$19,000 a year. The average educational level was some years of university or technical school.

Sixty-eight percent of the patients had bypass coronary surgery, 31% of all cases had angina pectoris, and 59% of the patients presented other conditions such as cardiomyopathies, arterial hypertension, myocardial infarction or valve replacement. Some patients had more than one of these conditions. Twenty-four of the patients were diabetics (type I, n=6; type II, n=18). The most common medications taken by the patients were the following: beta blockers, ACE inhibitors, calcium channels blockers, nitrate, aspirin and digoxin. The symptoms commonly reported by the patients were

Table 1. Values of the initial evaluation of the total population of the CRPII.

Variables	Female (n=18)	Range	Male (n=53)	Range
Age (yrs)	59.17 ± 11.79	35-73	59.64 ± 12.36	32-81
Double product (mmHg x b/min)	8807.11 ± 2844.78	4680-16000	8425.23 ± 2069.47	4800-16000
Cholesterol (mg/dl)	216.62 ± 61.07	121.0-321.0	199.59 ± 40.50	116-284
Low density lipoprotein (mg/dl)	126.06 ± 54.81	55.5-240.8	124.77 ± 38.34	50.8-215.3
High density lipoprotein (mg/dl)	48.98 ± 26.22	18.6-113.7	38.72 ± 12.87	18.9-67.5
Triglycerides (mg/dl)	174.77 ± 81.36	69.0-326.0	220.10 ± 172.69	64.0-999.9
Glucose (mg/dl)	114.31 ± 36.55	75.0-207.0	127.03 ± 65.28	57.0-369.0
METSmax	5.17 ± 2.27	2.75-12.00	6.59 ± 2.03	2.50-11.50
Vital capacity (ml)	2070.59 ± 512.17	1590.0-3690.0	3043.08 ± 639.47	1910.0-4830.0
Flexibility-Modified sit & reach (in)	7.03 ± 2.27	2.75-12.00	6.59 ± 2.03	2.50-11.50
Weight (lbs.)	154.29 ± 37.53	103.00-249.00	178.75 ± 38.84	121.50-350.00
Total skinfold (mm)	94.25 ± 31.70	49.30-150.00	74.62 ± 22.21	35.33-147.00
Percent body fat (%)	34.17 ± 8.05	22.3-48.8	25.12 ± 5.56	14.3-39.6
Total energy expenditure	37.91 ± 3.57	33.91-43.19	38.94 ± 3.55	33.45-52.38

Values are presented as mean ± standard deviation.

Table 2. Pre and Post Values of the Patients that Completed the Exercise Program at the CRPII (n=17).

Variables	Pre	Post
Double product (mmHg x b/min)	7875.76±2349.57	7230.94±1453.81
Cholesterol (mg/dl)	198.63±30.18	180.51±28.30
Low density lipoprotein (mg/dl)	131.51±28.57*	109.39±27.18*
High density lipoprotein (mg/dl)	42.43±14.32	44.95±15.07
Triglycerides (mg/dl)	190.06±132.58	165.87±69.61
Blood glucose (mg/dl)	99.25±17.03	98.06±22.65
Vital capacity (ml)	2813.53±760.66*	3051.18±715.29*
Flexibility-Modified sit & reach (in)	6.71±1.70*	7.90±1.70*
Weight (lbs)	170.37±24.99	171.35±24.65
Total skinfold (mm)	78.70±14.29	75.63±19.40
Percent body fat (%)	27.76±4.96	26.78±6.24
Total energy expenditure	38.89±4.44*	42.44±6.60*
Intensity of functional capacity (%)	46.88±5.88*	75.00±6.61*
METs	2.92±0.92*	5.51±0.85*
Duration (min)	13.53±2.35*	29.41±3.00*
RPE	10.18±1.47*	12.29±1.93*

Values are presented as mean ± standard deviation.

* P value < 0.05

respiratory difficulty, chest pain, fatigue, and palpitations. The coronary arteries disease risk factors were low physical activity level (80%), hypercholesterolemia (55%), hypertriglyceridemia (48%), arterial hypertension (49%), diabetes (38%), smoking behavior (51%), and obesity (35%). All of the patients presented more than 3 of these risk factors. The general nutritional interventions resulted in recommendations of reducing dietary caloric intake to 2,000-2,100 kcal average for males and 1,600-1,800 kcal average for females. Also, it was recommended to reduce sodium and fat and increase fiber dietary intake.

Discussion

Concerning the cardiovascular function of the patients, the mean resting heart rate was within the normal values (males = 72±11, females = 74±16 beats/min). The mean resting systolic and diastolic blood pressure were also within normal values for these patients (males = 118/76±22/15, females = 119/73±20/12 mmHg). The cholesterol, low density lipoprotein (LDL) and triglycerides levels were high. The last one being much higher in males than females. The high density lipoprotein (HDL) level was within normal values. The mean blood glucose was slightly elevated in view that 34% of the patients were diabetics.

In physical fitness, it was of interest to describe the exercise tolerance, vital capacity, flexibility, anthropometry and body composition of these patients. The maximal METs from the stress test, as an exercise

tolerance variable, was very low for the females and average for the males. The literature available confirm that for patients with coronary artery disease, with or without abnormal responses on the stress test, the level of maximal capacity is around 7 METs (8). The vital capacity was lower than average norms in females (2,714 - 2,986 ml) and males (3,435 - 4,475 ml) (9). The hamstring and low back flexibility (modified sit and reach) was also very low (< 7 in for males and < 10 in for females) (10). The percent of body fat was very high, defining this population as overweight and obese (> 25-29% for females and > 18-22% for males) (2). All these values reflect that these patients had a very low level of health related fitness.

The estimated energy expenditure as determined by the Bouchard 3-day physical activity record, was also low (7). The time spent in activities such as sleeping or resting in bed (1-1.5 METs) was around 9 hours a day. The average time spent in activities of daily living (sweeping, driving, washing, cooking; 2-3.5 METs) was close to 15 hours a day. The time spent in activities of 4 METs or more (slow walking or gardening) was much less than 1 hour. All these came out in a total daily energy expenditure close to an average of 37 kcal/kg/day. The range of METs per day was 1.5 to 2.0, which is extremely low. These results show that these patients were in a low level of physical activity.

The pre and post values of the initial and final evaluation of the 17 patients that completed the exercise program were also analyzed. Following the t-test analysis, there was a significant improvement in hamstring and low back flexibility and vital capacity (p < 0.05). Also, estimated total energy expenditure significantly increased, while LDL and estimated resting energy expenditure significantly decreased (p < 0.05). The fact that patients were more active and resting less at the end of the program might show that the patients had a higher level of physical activity than before the program.

The patients that enter a cardiac rehabilitation program has already started its initial phases of rehabilitation in terms of the adequate medication and/or revascularization interventions (11). But, they still have other factors to improve such as lifestyle behavior, including physical activity level. Physical activity is almost universally accepted as relevant to health (12). The literature strongly suggest that lifestyle changes, including improvements in physical activity level and health related fitness is of benefit for secondary prevention of coronary events (1,2,3,13,14). The remaining health-related fitness variables showed a tendency to improve, but the statistical analysis was not significant. Significance for those comparisons might be obtained with a larger sample size. In terms of the exercise prescription the patients had a significant increase in

intensity (percent of total functional capacity and METs), duration and RPE reported ($p < 0.05$). This was expected since the patient exercise prescription was modified by increasing it, adjusting to patient's tolerance.

Conclusion

The medical literature suggests that cardiac rehabilitation programs that include exercise training, diet modification, changing smoking behavior and closer medical supervision, can reduce the risk of death by 20% (15). The interest on physical activity and exercise programs as a preventive and rehabilitative measure against coronary artery diseases is primarily due to its low cost, noninvasive characteristics and availability to the people. Also, the benefits of multifactorial programs including exercise, nutritional, psychological and educational interventions has been strongly suggested and studied (14).

The U.S. Public Health Service defines cardiac rehabilitation as «comprehensive services and long term programs involving medical evaluation, prescribed exercise, cardiac risk factor modification, education and counseling. These programs are designed to limit the physiologic and psychological effects of cardiac illness, reduce the risk for sudden death or reinfarction, improve cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients» (1). The multifactorial intervention in cardiac rehabilitation services is very important, with the key components of exercise, education, counseling and behavioral interventions (1).

This study has shown that the implementation of the Cardiac Rehabilitation Program Phase II in Puerto Rico, following the guidelines and strategies published in the literature has been feasible and adequate. These results suggest that the patients present various risk factors of coronary artery disease that may predispose to a second surgical intervention, myocardial infarction, or progression of the disease. Also, these results suggest that a program with multifactorial interventions might help in improving these factors, specially the ones related to health related fitness and physical inactivity.

Resumen

Muy poco se ha publicado sobre la rehabilitación cardíaca en Puerto Rico. El propósito de este estudio fue analizar los datos clínicos del Programa de Rehabilitación Cardíaca Fase II, para determinar cuan adecuado ha sido el programa para sus pacientes. Fue de interés para este estudio, el determinar las características que describen la

población que ingresa en una programa de rehabilitación cardíaca en Puerto Rico. También, fue de interés el comparar las evaluaciones iniciales y finales de los pacientes que completaron el programa. La población general presentó un bajo nivel de actividad física diaria, capacidad vital, flexibilidad de espalda baja y extremidad inferior, y un alto porcentaje de grasa corporal. El grupo que completó el programa demostró un aumento significativo en la flexibilidad de espalda baja y extremidad inferior, capacidad vital, y expendio energético total diario. Mientras, se encontró una disminución significativa en la lipoproteína de baja densidad y el expendio energético durante el descanso diario. Los pacientes eran más activos y descansaban menos al final del programa. Estos datos sugieren que los pacientes evaluados presentan factores de riesgo de enfermedad coronaria que le predisponen a eventos futuros, o al progreso de la enfermedad. Además, estos resultados sugieren que el programa ayuda a mejorar los factores de riesgo de la aptitud física relacionada a la salud y aumenta el nivel de actividad física.

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