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Preliminary Results of a Cardiac Rehabilitation Program in Patients with Compensated Heart Diseases in Sub-Saharan Africa (Benin): A Pilot Study

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Abstract

Background: In sub-Saharan Africa, socio-economic conditions limited access to cardiac rehabilitation programs (CRP) designed according to the usual models in the treatment of patients with cardiovascular disease (CVD).

Objective: To evaluate the effectiveness of a program of CRP based on Borg scale of perceived effort.

Methods: A Prospective, descriptive study aimed to be analytical focused on 27 patients with compensated heart diseases (CHD) included in a CRP for 30 workouts during 10 weeks. These patients were evaluated by Borg scale of perceived exertion with measuring heart rate (HR), body mass index (BMI) and blood pressure (BP) of rest at the beginning and at the end of the program.

Results: It was recorded a significant reduction in the heart rate ($p<0.0001$), systolic BP ($p<0.0001$) and diastolic BP ($p=0.0002$) while BMI reduction did not get a significant reduction ($p=0.15$).

Discussion: According to the studies encountered, intensities of physical activities such as those which have been subjected to patients are sufficient to cause different physiological adaptations noted at the end of this present program. Conclusion: This CRP appears to be an alternative to physical training in patients with CHD from socially disadvantaged conditions.

Keywords: Rehabilitation program effort; Compensated heart disease; Borg scale; Sub-saharan Africa

Introduction

In sub-Saharan Africa, socio-economic conditions as well as epidemiological transition consist of tropical diseases and the emergence of metabolic diseases creates a favorable framework for the expansion of cardiovascular disease (CVD) [1]. This contrasts with the paucity of epidemiological studies as well as preventive measures or treatment taking into account the epidemiological context and socio-economic characteristics of this region.

By the 1960s, numerous studies demonstrated that early activity after a myocardial infarction (MI) safely negates the adverse effects associated with prolonged bed rest [2]. Afterwards, as a result of the work of Hellerstein [3], Wenger [4], Tobis and Zohman [5,6], and others, the concept of progressive supervised activity for the post-MI patient and the postsurgical patient has taken its rightful role in the practice of medical therapeutics. Current guidelines and studies regarding cardiac rehabilitation, recommend exercise protocols based on assessment of parameters such as oxygen consumption, Watt [7], anaerobic threshold [8]. All these parameters are determined by expensive equipment and thus hardly accessible in most African countries.

In 2009, Carvalho et al. [9] concluded in a study that focused on patients with heart failure, as from the scale of perceived effort developed by Borg et al. [10], it was possible to submit these patients to an effort corresponding to the heart rate (HR) between the anaerobic threshold and the respiratory compensation point. According to several authors, the intensity of exercise is safe and beneficial for patients with compensated heart disease [11,12]. Such intensity of physical activity is considered safe for the patient with heart disease [13].

Starting from the assumption that such a program would be beneficial for patients with compensated heart diseases, the objective of this study is to evaluate the effectiveness of a Cardiac Rehabilitation Program for effort (CRP) based on wide perception of effort by Borg scale, on body mass index (BMI), heart rate (HR) and blood pressure (BP) in patients with compensated heart disease able to offset effort.

Material and Methods

Type of study

This is a prospective descriptive study aimed to be analytical and focused on patients with heart compensated diseases on the Department of Medicine physical and Rehabilitation of National Hospital University-Koutougou Hubert Maga (CNHU-HKM) of Cotonou in 2010.

Study population

Patients have been interviewed during medical consultations on the Care, Education and Research Unity in Cardiology (USERC) of National University Hospital-Hubert Maga koutoukou (CNHU-HKM) Cotonou, Republic of Benin.

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Inclusion criteria have been:

- Having a diagnosis of coronary artery disease (CAD), heart failure (HF) or hypertension on the basis of additional tests (biochemical tests, electrocardiogram, Doppler echocardiography Doppler or heart X-ray).
- Having the ability to perform the efforts of everyday without risk of major complications, assessed as New York Heart Association functional class I or II [14,15].
- Do not suffer from any cardiovascular disease likely to limit physical exertion.
- Do not participate to any physical training program during the previous six months of the beginning of the study.

Were excluded from the study subjects decompensated or contraindicated for physical effort, holders of recent or unstable coronary artery disease, congestive heart failure, high blood pressure (hypertension) severe at rest or with a history of syncope of effort.

Patients in the study were given information about the ins and outs of the program to seek their informed consent. Their participation was free and single. The study received the approval of the heads of Cardiology and Rehabilitation and the Director of CNHU HKM. This was a cover for its realization. This approval was the best ethic caution we could have obtained for this type of study.

Evaluations

At the beginning and at the end of the physical training program, patients were subjected to a series of evaluation comprising primarily respiratory status and muscle balance. The values of body mass index were determined for each individual by dividing body weight (in kilograms) by the square of height (in centimeters).

Previously to the examination, the patients were encouraged to have a good sleeping night, avoid exhausting physical activities as well as caffeine, alcohol drinks and cigarette smoking. In order to avoid the circadian cycle effect, examinations before and after the training program were performed in day time for all the participants. At their arrival, the patients remained lying for 10 minutes with the heart rate monitor (Polar Electro Oy, Kempele, Finland) on the chest. The displayed value is then annotated each interval of 5 seconds for one minute after the 10 minutes resting period. The resting HR was the mean of these values. Measurements of resting BP were performed as recommended by the American Heart Association (AHA) for the measurement of BP [16].

Cardiac rehabilitation protocol

The CRP was held at the Department of Physical Medicine and Rehabilitation of CNHU HKM C. It is a period of 10 weeks with 3 sessions per week for a total of 30 sessions. Each session lasts one hour and is divided into four steps: 10 minutes warm up, 5 minutes of stretching, 35 minutes of fitness and 10 minutes of relaxation. The main activity is performed on a cycle ergometer or rowing.

Previously to the beginning of the study, a schedule predicting examination and training date for each patient has been designed in order to control them adherence to the rehabilitation program.

Patients were trained in groups of three nevertheless, in order to avoid any bias regarding the perception of effort, the stage of main activity cycling or rowing was performed individually, in separated training rooms.

Exercise protocol and evaluations were administrated by two independent groups of experienced physical therapists specialised in cardiac rehabilitation.

The intensity of the exercise is based on the perception of effort of the patient determined by Borg scale of perceived effort. Based on the work of Carvalho et al. [9], patients were instructed to provide a physical effort between stages "medium" and "a little difficult" corresponding to levels 11 and 13 of the Borg scale. Figure 1 illustrates the successive sequences of step facility.

Carvalho et al. [9] showed in a group of patients with heart failure at such an intensity of physical activity, heart rate of the individual lies between that corresponding to the anaerobic threshold and respiratory compensation point determined during Ergo-spirometric test.

All patients maintained the same medication and did not participate in any other physical training program throughout the study period.

Statistical analysis

The Kolmogorov-Smirnov test was used to determine whether or not the normal distribution. For comparison of variables obtained before and after CRP, the paired-sample t test (for variables whose distribution was normal) and the Wilcoxon test were used. The data were analyzed using the BioEstat 5.3 software. The significance level was set to 5%.

Results

From 61 patients interviewed, 27 have been included in the study. The Figure 1 shows the number of patients excluded (with reasons given), trained, who dropped-out (with reason given) and included in the study.

Table 1 shows the main characteristics of the participants. CAD as hypertensive patients had preserved left systolic function (ejection fraction >45%). CAD patients were referred for cardiac rehabilitation after an acute coronary syndrome with or without ST-segment elevation on electrocardiogram. HF patients had left ventricular systolic dysfunction, defined as ejection fraction lower than or equal to 45%. Heart failure resulted from ischemic cardiomyopathy or idiopathic dilated cardiomyopathy.

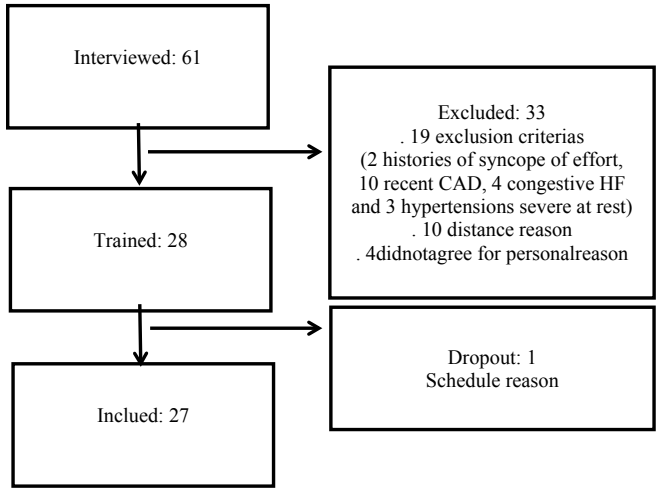

Figure 1: Flowchart showing the number of patients interviewed, excluded, trained, who droppedout, and included in the study.

	Before ER	After ER	P
HR	96 (19.73)	78.55 (14.41)	<0.0001
SBP	139.30 (11.75)	124.67 (9.35)	<0.0001
DBP	88 (81; 91)	82 (80; 89)	0.0002
BMI	29.3 (26.15; 33)	27.1 (25.35; 30.2)	0.15

The values of HR and SBP are expressed as mean (standard deviation), while the DBP and BMI are expressed as median (first interval quartil; quartil third interval).

Table 1: Comparison of values of heart rate (HR), systolic blood pressure (SBP), Diastolic blood pressure (DBP) and body mass index (BMI) before and aftercardiac rehabilitation program (CRP).

Patients performed a total of 30 sessions of CRP, one of 28 trained dropped-out for professional schedule reason. From the 27 others included, 5 performed the end evaluations on average 10 ± 3.3 days after the date predicted by the schedule.

Figure 2 illustrates the different phases of intensity of physical exercises during the stage of main activity on cycle ergometer or rowing: Phase 1: 5 minutes at 11 of the Borg scale, Phase 2: 10 minutes at 13 of Borg scale, phase 3: 5 minutes at 11, Phase 4: 10 minutes at 13, Phase 5: 5 minutes at level 11.

Table 2 shows the comparison of the resting HR, systolic BP, diastolic BP and BMI before and after the CRP. HR as systolic BP distributions have seen normal while diastolic BP and BMI was not. So to compare HR as systolic BP obtained before and after the CRP, the paired-sample t test has been used while the Wilcoxon test have been used for diastolic BP and BMI. It should be noted a significant reduction in the heart rate ($p<0.0001$), SBP ($p<0.0001$) and DBP ($p=0.0002$) while the reduction in BMI is proved non-significant.

Discussion

The best way to determine the safe and efficient level of physical activity has always been one of the principal topics in CRP research area.

Currently, the training level has been determined by conventional ergometric [17] or spiroergometric test [8]. Both these process require expensive equipment and are so very little accessible in the sub-Saharan African countries.

Thus CRP based on physiological parameters determined by this equipment is difficultly practicable in this region. It is important to find alternative programs, safe and efficient to treat the increasing part of patients from socially disadvantaged conditions.

The results of this study showed that the CRP performed with exercises of intensities equal to level 11 and 13 of Borg scale allowed to obtain a statistically significant reduction in HR, resting SBP and DBP while it was not sufficient to induce a reduction in the weight of the patients studied.

From 33 patients excluded after the interviews, 10, despite their will to participate to the CRP, could not for living too far from the research local (Figure 1). This shows the importance to promote CRP in several hospitals to answer the increasing request.

Only one of the 28 patients trained dropped out for professional reasons (3.57%, Figure 1). That can be considerate as a high adherence to the study when compared with others studies about RCP. Recently, Martin et al. [18] reported 50% of patients dropping out prematurely in a similar CRP including CAD patients. Forhan et al. [19] stated that the presence of both diabetes and obesity are independent determinants of CRP nonadherence while according to French et al. [20] perceptions predict attendance at CRP. In the current study, only one patient is diabetic, 20 with overweight (Table 1) and illness perceptions have not been investigated. However, these factors seem to not affect the adherence of the study.

Regular physical activity induces changes in the cardiovascular system, especially with regard to HR and resting BP [21,22]. These changes are called "adaptations of the cardiovascular system."

Due to the relative easiness of its measurement, the behavior of the HR has been sufficiently studied in different conditions associated with exercise [23,24]. The resting HR is considered as an efficient marker of the effect of physical training on the body. Its adaptation results in bradycardia.

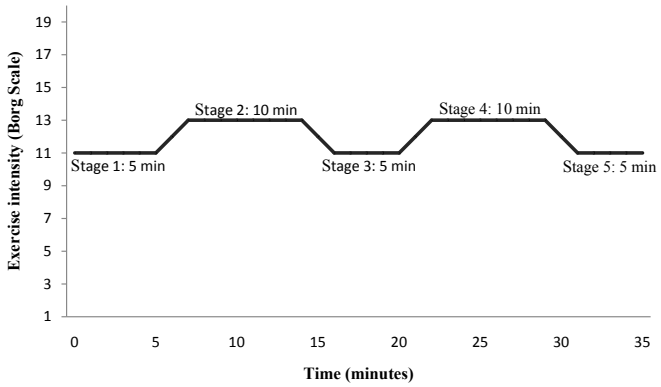

Figure 2: Illustration of the different phases of exercise's intensity during the main activity stage on cycle ergometer orrowing: Phase 1: 5 minutes at 11th level of the Borg scale, Phase 2: 10 minutes at 13th phase 3: 5 minutes at 11th, Phase 4: 10 minutes at 13th, Phase 5: 5 minutes at 11th.

	Coronry heart disease	Heart failure	Hypertension
	n=10	n =8	n=9
Gender (Women/Men)	5/5	2/6	0/9
Age (years)	45.8 ± 11.1	43.25 ± 8.8	43.0 ± 9.7
Height (cm)	172 ± 25	169 ± 22	164 ± 12
Weight (Kg)	88.4 ± 10.4	83.9 ± 8.3	82.6 ± 10.6
Body mass index (Kg/m²)	29.8 ± 5.32	29.4 ± 5.9	30.72 ± 4.2
Aetiology of heart failure			
Ischemic cardiomyopathy (n)	4	-	-
Dilated cardiomyopathy (n)	6	-	-
Left ventricular ejection fraction (%)	57.8 ± 4.6	28.9 ± 7.0	69.2 ± 5.5
Medication			
β-blockers (n)	4	5	1
Vasodilators (n)	8	5	2
Diuretic (n)	3	4	3
Antialdosterone (n)	2	6	1
Antiplateletsagents (n)	10	5	5
Anti-hypertensive (n)	3	2	8
Oral antidiabetics (n)	1	0	0
Insulin (n)	0	0	0
Riscfactors			
Tobacco smoking (n)	4	1	0
Diabetes (n)	1	0	0
Heredity (n)	4	3	7
Overweight (n)	6	5	9
Dyslipidemia (n)	7	2	4

Table 2: Patient's main characteristics.

Decreased values of resting HR have been observed in studies using aerobic exercise programs. So Tulppo et al. [25] noted a significant reduction in HR after an aerobic training program for 8 weeks including six 30-min sessions a week for the moderate-volume training group and six 60-min sessions a week for the highvolume training group at an intensity of 70-80% of maximum HR. Munk et al. [26] reached similar results after 6 months of aerobic exercise at 2 sessions per week in a group of coronary failure patients beginning by a warm up for 10 minutes at 50% to 60% of VO2 peak (60% to 70% of peak HR) before walking four 4-minute intervals at 90% to 95% of peak HR. Carvalho et al. [9], found that between the 11th and 13th level of the Borg scale, the land group had an exercise training HR nearer the respiratory compensation point (85% of the peak HR). In the current protocol the patients performed 35 minutes on such intensity (Figure 2), this explain that we have reached the same results after a less time.

Several studies have evaluated the effect of exercise on resting BP [27,28]. Katz and Wilson [29] obtained decreased BP values after 6 weeks of a program of physical training in female population, less time than the duration of the current study. This can explain the decrease of both systolic and diastolic BP seen in the current study.

The effectiveness of physical activity in reducing the body weight has been shown by several studies on topics overweight or obese [30]. The small reduction in BMI in the current study is probably due to the fact that obese subjects ultimately represented only a small portion (14.8% vs. 74.04% overweight) of the sample.

The limitations of this study lie in the small number of patients who participated and the duration of the program and in the absence of a control group (not trained group). In this regard, the originally design projected a control group in order to compare his variables with the trained group variables. However, from a total of 32 patients evaluated at the beginning, only 7 have been evaluated at the end of the study, principally for schedule difficulties.

Subsequent studies more important regarding number of participant protocol's duration and presence of a control group are necessary to investigate others aspects of this protocol.

Conclusion

The exercise program based on the stages of "medium" and "a little difficult" to the Borg scale was effective in reducing HR and resting BP in patients with heart disease compensated stage. It appears from this study that such a program could be an effective alternative for physical training for patients with compensated heart disease in socially disadvantaged backgrounds.

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