Open Access   Research Article

Physiological Variables in Cardiovascular Rehabilitation with Resistance Training in Patients with Ischemic Heart Disease

Adrian González Méndez [1] *, Ana Isabel López Cruz [2], Sandra Rodríguez Hernández [3], Lorelys Molinet González [4], Nidia Elena Díaz Rodríguez [5]

[1]Graduate in Health Technology, Physical Therapy and Rehabilitation profile. Assistant Professor. Associate Researcher. Department of Postgraduate and Research, Faculties of Medical Sciences, Sancti Spiritus. E

[2]Dra. Medicine. Specialist in First Degree in Comprehensive General Medicine and in normal and pathological Physiology. Instructor Professor. Department of Basic Biomedical Sciences, Faculties of Medical Sciences, Sancti Spiritus.

[3]Dra. Medicine. Specialist in First Degree in Comprehensive General Medicine and in normal and pathological Physiology. Instructor Professor. Department of Basic Biomedical Sciences, Faculties of Medical Sciences, Sancti Spiritus.

[4]Dra. Medicine. Specialist in First Degree in Comprehensive General Medicine and in normal and pathological Physiology. Instructor Professor. Department of Basic Biomedical Sciences, Faculties of Medical Sciences, Sancti Spiritus.

[5]Dr. Veterinary medicine. MSc. Preventive Veterinary Medicine. Assistant Professor Departamento Medios Diagnósticos, Faculty of Medical Sciences, Sancti Spiritus.

*Corresponding Author: Adrian González Méndez, Universidad de Ciencias Médicas, Departamento de Postgrado e Investigaciones, Sancti Spiritus, Cuba.

Citation: Adrian G. Méndez, López Cruz AI, Sandra R. Hernández, Lorelys M. González, Díaz Rodríguez NE, et al, (2024), Physiological Variables in Cardiovascular Rehabilitation with Resistance Training in Patients with Ischemic Heart Disease, *J. General Medicine and Clinical Practice,* 7(4); **DOI:**10.31579/2639-4162/145

Abstract

Introduction: Resistance training recognized as an essential component in cardiac rehabilitation programs.

Objective: to evaluate the behavior of physiological variables after the application of resistance training complementary to aerobic training in patients diagnosed with ischemic heart disease. Method: A quasi-experimental before-after study without a control group was carried out with the objective of evaluating the behavior of the physiological variables after the application of cardiovascular rehabilitation with supervised resistance training complementary to aerobic training in patients diagnosed with ischemic heart disease at the Gym of Ergometry and Cardiovascular Rehabilitation of the Cardiology Service of the Provincial General Universitario "Camilo Cienfuegos" Hospital of Sancti Spiritus.

Results: The average age was 64 years and the male sex (84.62%). The main diagnosis was Acute Coronary Syndrome with ST elevation. Peak oxygen consumption increased to 22 ± 1 ml/kg/min and METs to 8.5 (p=0.000). The blood pressure response was normal (maximum 210 mmHg) and the maximum heart rate reached was 122 ± 54 beats per minute (p=0.00). The workload increased from 20.5 ± 11 pounds to 38 ± 18 pounds. No changes in physiological safety variables reported.

Conclusions: The functional capacity of the patient was significantly increase according to peak oxygen consumption and according to METs, as well as the basal heart rate and muscle strength enhanced without changes in the safety variables.

Kew Words: cardiovascular rehabilitation programs; ischemic heart disease; hyperinsulinism

Introduction

Cardiovascular rehabilitation programs (CRP) constitute a multifactorial system of action, a set of activities necessary to ensure patients with heart disease an optimal physical, mental and social condition, which allows them to occupy, by their own means, such a normal place. as possible in society.

It should be noted that these programs are mainly indicated when ischemic heart disease is diagnosed. [1]

Cardiac rehabilitation procedures in people who have suffered an acute coronary infarction are closely related to the prognosis and subsequent risk of developing new infarctions (secondary prevention). The existence of

associated risk factors, such as hyperlipidemia, hyperglycemia, arterial hypertension, obesity and hyperinsulinism, increase the chances of a poor prognosis and condition endothelial dysfunction; Therefore, to fulfill the main objective of improving the prognosis, it is necessary not only to reduce morbidity and mortality, but also to increase functional capacity and reform the risk factors for coronary heart disease, the psychological profile and quality of life.[1]

The precept of physical exercises, like any other therapy, must be based on a good knowledge of the benefits and risks, as well as on the particularity and individual characteristics of the patient; When this is the case, the benefits are maximum. [1]

Currently it has been shown that physical training programs reduce the mortality of patients with cardiovascular disease by around 12% for each metabolic unit (MET: unit of measurement of the metabolic rate; it is based on the amount of energy necessary for a person to remain seated and awake corresponds to 3.5-4 mL O2/kg/min=1.2 call/min) of increase in exercise capacity, so that patients with uncomplicated acute myocardial infarction are suitable for mobilization early, which could begin from the first day in the medical institution. [2]

Current medical practice seeks to prevent diseases and achieve this at the lowest possible cost. In this regard, regular physical activity can help achieve these goals, especially if it is considered a healthy lifestyle habit. The acute response to exercise produces an increase in O2 needs and sympathetic activity, which represents a potentially risky situation, so it is necessary to know the state of cardiovascular health and, failing that, the individualized behavior of the patient. want to do physical exercise. [3]

It should be noted that heart disease, in any of its four basic forms (coronary, valvular, myocardial or congenital), can alter the exchange of O2 and CO2 during physical activity. In fact, heart disease, throughout its evolution, causes a decrease in functional capacity, which can be used as an evaluation method; The loss of physical capacity is basically due to a decrease in cardiac output, which does not increase adequately during physical activity for various reasons. In the case of the patient with ischemic heart disease—in the clinical forms given by the World Health Organization (WHO), which include cardiac arrest, angina pectoris, acute myocardial infarction, heart failure and arrhythmias—the degree of involvement depends on systolic and diastolic function, as well as the anatomical and functional severity of the injuries. [3]

Cardiac rehabilitation programs (CRP) are multifactorial action systems, which were recommended by the WHO in the 60s of the last centuries, and have been defined as the "set of activities necessary to ensure cardiac patients a physical, mental and optimal social situation that allows them to occupy, by their own means, a place as normal as possible in society"; It is mainly indicated if there is ischemic heart disease, but it is applicable to all types of cardiovascular disease. [3]

Currently, the benefits in terms of cost-effectiveness of cardiac rehabilitation and secondary prevention (PR- Cuyp's) programs have been identified, determining a significant improvement in quality of life, reduction in mortality and recurrence of hospitalizations, this secondary to the gains obtained in maximum oxygen consumption, which allows greater tolerance to effort. [4]

The objective of this work is to evaluate the behavior of physiological variables after the application of cardiovascular rehabilitation with resistance training to patients with a diagnosis of ischemic heart disease in the Ergometry and Cardiovascular Rehabilitation Gymnasium of the Cardiology Service of the Provincial General University Hospital. Camilo Cienfuegos" from Sancti Spíritus.

Methods

A quasi-experimental before-after study was carried out without a control group with the objective of evaluating the behavior of physiological variables after the application of cardiovascular rehabilitation with supervised resistance training complementary to aerobic training in patients with a diagnosis of ischemic heart disease in the Gym. of Ergometry and Cardiovascular Rehabilitation of the Cardiology Service of the "Camilo Cienfuegos" Provincial General University Hospital of Sancti Spíritus in the period from January 1 to December 31, 2018.

Study universe: consisting of the 87 patients who, during the study period, were admitted to the Ergometry and Cardiovascular Rehabilitation Gymnasium of the Cardiology Service of the "Camilo Cienfuegos" General University Hospital in the province of Sancti Spíritus with a diagnosis of ischemic heart disease on a rehabilitation. The inclusion period for the study was carried out between the months of January and June 2018. During that stage, all patients who attended the gym with a diagnosis of ischemic heart disease undergoing rehabilitation were analyzed. The sample consisted of 39 patients who met the following criteria:

Inclusion criteria:

• Patients of both sexes.

• Diagnosis of ischemic heart disease in any of its manifestations: acute coronary syndrome with ST-segment elevation (STEACS), acute coronary syndrome without ST-segment elevation (NSTEACS), chronic stable angina, ischemic heart disease after percutaneous coronary intervention (PCI) and surgery myocardial revascularization.

• Have an early evaluative ergometric study with a functional capacity (FC) equal to or greater than 4 MET, according to New York Heart Association (NYHA) criteria.

• Stable ischemic heart disease with optimal medical treatment.

• Willingness to participate in the study.

Exclusion criteria:

• Patients with unstable angina, significant ventricular arrhythmias, heart failure and blood pressure equal to or greater than 140/90 mmHg in the previous two weeks.

• Patients with myocardial ischemia and/or hypo or hypertensive response in the stress test.

• Present diseases of the osteomyoarticular or neurological systems that prevent physical training.

Discontinuation criteria:

• Suspended on two or more occasions from the rehabilitation program due to decompensation of his underlying illness.

• Voluntary abandonment.

• Poor adherence to treatment.

The data were processed automatically by the statistical software SPSS (Statistical Package for Social Sciences), version 17.0 for Windows. The results were presented using frequency distribution tables. Descriptive statistics were used to obtain the averages, standard deviations, minimum and maximum values and frequencies. The t test for related samples was applied to the quantitative variables, considering it statistically significant when $p \leq 0.01$ and the 99% confidence intervals were calculated. Qualitative variables were expressed as percentages.

During the development of the research, the ethical and legal aspects were considered in obtaining the information and informed consent was obtained from the participants following the provisions of the 1976 Helsinki Declaration for medical research: respect for people (autonomy), beneficence, non-maleficence and justice.

Results

During the 6 months of the inclusion period, a total of 87 patients were admitted to the Ergometry and Cardiovascular Rehabilitation Gymnasium of the Cardiology Service of the "Camilo Cienfuegos" General University Hospital in the province of Sancti Spíritus with a diagnosis of ischemic heart disease undergoing rehabilitation. Those who did not meet the inclusion criteria described above were excluded (n=23) and after the evaluation of the early evaluative ergometric test, 25 more patients were excluded from the study due to having functional capacity less than 4 MET, myocardial ischemia and hypertensive response. during the test. The remaining 39 joined the PRC. There were no losses during the study.

The distribution of patients in a resistance exercise program according to demographic and clinical variables. The average age was 64 ± 10 years with a minimum age of 37 years and maximum age of 78 years and predominance of the group from 50 to 59 years with 71.7%. Regarding sex, a predominance of males (84.62%) compared to females (15.38%) is observed. The main diagnosis for which patients attended the rehabilitation gym was Acute Coronary Syndrome, with ST segment elevation (48.72%) and without ST segment elevation (23.08%). Patients with a diagnosis of Chronic Stable Angina (12, 82%) and Myocardial Revascularization Surgery (15, 38%) had a lower representation (Table 1).

Variable	No	%
Age (years)		
Mean ± SD	64 ± 10	
Minimum Value/ Maximum Value	37/78	
Under 40 years	2	5.1
40 to 49 years	1	2.5
50 to 59 years	28	71.7
60 years and more	8	20.5
Sex		
Male	33	84.62
Female	6	15.38
Diagnosis		
ACS	19	48.72
SCASEST	9	23.08
CRM	6	15.38
Chronic Stable Angina	5	12.82

Table 1: Characterization of patients in a resistance exercise program according to demographic and clinical variables.

Source: patient interview and medical examination

STEACS: acute coronary syndrome without ST segment elevation.

NSTEACS: acute coronary syndrome with ST segment elevation.

CRM: Myocardial Revascularization Surgery.

When evaluating the behavior of the response variables before and after resistance training, it can be seen that the changes in functional capacity according to peak oxygen consumption and according to METs, as well as in basal HR and muscle strength were statistically significant ($p \leq 0.01$), while the modifications produced in the variables basal BP, peak BP and training HR were not (Table 2).

Variables	Before			After			Difference of stockings	p value	99% Interval trust
	Mean ± SD	Min.	Max.	Mean ± SD	Min.	Max.			
FUNCTIONAL CAPACITY									
VO$_2$ peak (ml/kg/min)	13 ±2	eleven	twenty	22 ± 1	16	26	-8.6±3.2	0.000	-10.1-7.19
MET	5± 1	4	8	8.5±2	7	10	-2.5±0.7	0.000	-2.8; -2.1
BLOOD TENSION (mmHg)									
baseline BP	130± 5	120	135	126±8	115	135	4.1 ±9	0.31	-10.9; 19.2
peak TAS	154±18	130	180	175±17	165	210	-21.6±10	0.03	-39.4-3.8
HEART RATE (beats/minute)									
Baseline HR	87±15	72	99	75.7±8	60	88	-13.7± 9	0.000	-16.8-10.7
FC come in. dear	120±15	104	135						
training HR reached	109±10	99	128	122±5	130	125	-13.6±14	0.243	-96.5; 69.2
MUSCLE STRENGTH (pounds)									
Workload	20.5±1	5	47	38±18	fifteen	71	-17.5	0.000	-21.8-13.2

Source: medical examinations of patients

VO$_2$ max: Maximum oxygen consumption. MET: metabolic equivalent

BP: Blood pressure SBP: Systolic blood pressure.

HR: Heart rate. SD: standard deviation,

Training HR: Training heart rate

Max : Maximum value. Min.: Minimum value

Table 2: Physiological response variables before and after resistance training.

Before the application of PRC, functional capacity evaluated according to peak oxygen consumption was moderately to severely decreased (13±2 ml/kg/min) and later increased to 22±1 ml/kg/min (normal FC). Regarding functional capacity according to METs, this was limited in the first stress test, an average of 5±1 METs can be observed (less than 7 METs is considered high risk for cardiovascular events). In the second stress test, the modifications produced in this variable were highly significant (p=0.000), reaching 8.5±2 METs , for a mean difference of -2.5±0.7 (more than 7 METs are considered low risk for cardiovascular events). The modifications in muscle strength generally evaluated for all muscle groups before and after

ER were highly significant (p=0.00) with an increase in the magnitude of the workload for each muscle group and the subsequent increase in muscular strength and physical capacity of patients averaged from 20.5±11 pounds before rehabilitation to 38±18 pounds after.

The behavior of the physiological safety variables TAS, TAD and HR during resistance training is shown, it is evident that during lifting the load the response in systolic blood pressure was an average of 162 ± 8.80 mmHg , while for DBP the mean was 101±6.83 and for HR it was 113±5.70 (Table 3).

Variables	Minimum	Maximum	Half	Standard deviation
Systolic blood pressure (mph)	150	175	162	8.80
Diastolic blood pressure (mmHg)	95	110	101	6.83
Frequency Cardiac (beats/minute)	110	125	113	5.70

Table 3. Physiological safety variables during resistance training

Source: medical examinations of patients

Discussion

In relation to age and sex, these results coincide with those of Domínguez et al., (5) where males predominated and maximum oxygen consumption improved from 15.6 ml/kg/min to 24.3 ml/kg/min. min. In Atef and Abdeen [6] a total of 30 patients were randomly distributed into 2 groups (15 patients/group). No significant differences in age (P = 0.77; P > 0.05), weight (P = 0.71; P > 0.05), height (P = 0.49; P > 0.05), BMI (P = 0.55; P > 0.05) and resting heart rate (P = 0.99; P > 0.05) between groups A and B.

Coinciding with the results of a similar study carried out by Arias et al., [7] functional capacity increased in the incremental stress test (1.76 METS; 95% CI 1.59 to 1.96 p < 0.001).

In Ortega et al., [8] the male sex was the most prevalent with 64 (87.7%) with an N = 73, and a mean age of 54.5 ± 8.7, a statistically significant decrease was observed. of systolic blood pressure (p= 0.041), but not diastolic blood pressure (p= 0.170). Statistically significant differences were obtained in all stress test parameters (p <0.001). Statistically significant differences were obtained in all stress test parameters (p <0.001).

In Heyden [9] where a combined phase II cardiovascular rehabilitation exercise program was evaluated, VO2 improved by 7.34% with a magnitude of change of 1 ml/kg/min, p<0.001, VO2 improved by 25.65% with a magnitude of change of 5.49 ml/kg/min, p<0.001)]. Both groups (24 and 32 sessions) improved, increasing oxygen consumption between pre and post test, this effect was the same for both groups with (p<0.001). The METs achieved improved by 7.52% with a magnitude of change of 0.21, p<0.001). Muscular strength (MIR improved by 21.90% with magnitude of change of 2.46 repetitions, p<0.001.

Głowczyńska et al., [10] worked with 850 enrolled patients, 291 (34.2%) patients had MD, 425 patients were assigned to the `hybrid comprehensive telerehabilitation` (HCTR) group, the Cardiopulmonary Stress Test (CPET) was performed twice before and after the telerehabilitation program in 385 patients, 129 (33.5%) had diabetes mellitus (DM) (HCTR-DM group) and 256 patients (66.5%) did not have DM (group HCTR-no DM), 425 patients assigned to the usual care (UC) group CPET was done twice in 397 patients, 137 (34.5%) had DM (UC-DM group) and 260 patients (65.5%) did not had DM (CU- nod group). At the time of randomization, the ventilator anaerobic threshold was higher in patients without DM compared to patients with DM either after HCTR (15.9 ± 5.7 vs. 13.6 ± 4.5 [ml/kg/min], < 0.001) and CU (15.6 ± 5.8). vs 13.9 ± 5.5 [ml/kg/min], p = 0.029). The difference in peak VO2 was greater in the HCTR non-DM group compared to UC-non-DM (1.33 [95% CI: 0.92, 1.74] vs. 0.07 [95% CI: - 0.33, 0.48] ml/min/kg, p < 0.001).

Betancourt et al., [11] in their study, oxygen consumption showed an increase of 3.6 ml/kg/min during rehabilitation, finding statistically significant differences in the three measurement moments, but a greater increase was evident between weeks 1 and 6 (p = 0.00), when a change of 2.2 ml/kg/min was recorded. The measurement of initial and final systolic/diastolic blood pressure showed a decrease (p < 0.05).

Regular physical activity in patients with cardiovascular diseases reduces the risk of death. Physical exercises improve cardiorespiratory function in various situations, which is why it is important to use it as a form of prevention and treatment of ischemic heart disease.

Conclusions

Resistance training complementary to aerobic training in patients with ischemic heart disease undergoing cardiovascular rehabilitation significantly improved the patient's functional capacity according to peak oxygen consumption and according to METs, as well as basal heart rate and enhanced muscle strength without alterations in safety variables or appearance of cardiovascular complications during training. Cardiac rehabilitation programs are beneficial to achieve better control of cardiovascular risk factors, lifestyle changes and functional capacity.

References

1. Cartaya-Ortiz E, (2021). del Prado-de la Torre LM. Risk factors for coronary disorders in patients with ischemic heart disease included in a cardiovascular rehabilitation program. *MEDISAN;* 25(1): 111-122.

2. del Prado de la-Torre LM, Cartaya-Ortiz E. (2021). Influence of physical therapy on the functional capacity of patients with ischemic cardiopathy. *MEDISAN.*; 25 (3): 662-674.

3. Cartaya-Ortiz E, del Prado de-la Torre L, León-Duharte D. (2019). Modifications of the electrocardiographic tracing and heart contractility in patients with ischemic cardiopathy rehabilitated by means of physical exercise. *MEDISAN;* 23(1): 65-76.

4. Citalán-Jiménez JA, Lara-Vargas JA, Pineda-Juárez JA, Salgado-Solorio MC, Reza-Orozco MA, Arteaga-Martínez R et al. (2022). Myocardial efficiency index in heart patients after a cardiac rehabilitation program. Arch . *Cardio. Mex.*; 92(4): 446-453.

5. Domínguez-Choy LO, Madrigal-Perera S, Duarte-Reyes L, Negrín-Valdés T, Hernández-Toledo C. (2020). Resistance training program in the rehabilitation of patients with ischemic heart disease. UnivMéd Pinareña; 16(S1):e451.

6. Atef, H, Abdeen H. (2021). Effect of exercise on sleep and cardiopulmonary parameters in patients with pulmonary artery hypertension . Sleep&Breathin = Schlaf&atmung ; 23(4), 1953.1960.

7. Arias-Labrador E, Vilaró-Casamitjana J, Blanco-Díaz S et al. (2022). Effects of an interdisciplinary program combined with continuous variable aerobic training and dynamic strength in acute coronary syndrome, Rehabilitation. *Sciencedirect ;* 56: 99-107.

8. Ortega-Fernández L, Abad-García MM, Ferreira-Diaz MJ, Coria-Abel MC, Cerecedo-Fernández M, (2022). Imedio-Granullaque MI, Pereira-López EM, Franco-Gutiérrez R. Efficacy of a cardiac rehabilitation program in the control of cardiovascular risk factors: experience during the first year in our center. *Dialnet;* 29 (85): 5-12.

9. Heyden -López F. (2022). Effect of a combined phase II cardiovascular rehabilitation exercise program on the body composition, aerobic resistance and strength of older adults with cardiovascular disease [Thesis to qualify for the degree of Magister Scientiae] National University. Heredia-Costa Rica.

10. Głowczyńska R, Piotrowicz E, Szalewska D, Piotrowicz R, Kowalik I, et all., (2021). Effects of hybrid comprehensive telerehabilitation he cardiopulmonary capacity in heart failure patients depending on diabetes mellitus: subanalysis of the TELEREH-HF randomized clinical trial. *Carciovascular Diabetology*; 20(1), 106.

11. Betancourt-Peña J, Ruiz-Serna Ó, Martínez-Gómez S, Saavedra-Fernández P, Assis -Jorge K., et all., (2021). Changes in physical capacity and some physiological variables in patients with heart failure at 6 and 12 weeks of a cardiac rehabilitation program. Rev. Colomb. *Cardiol;* 28(5): 502-509.

To Submit Your Article Click Here: **Submit Manuscript**

Ready to submit your research? Choose Auctores and benefit from:

➢ fast, convenient online submission
➢ rigorous peer review by experienced research in your field
➢ rapid publication on acceptance
➢ authors retain copyrights
➢ unique DOI for all articles
➢ immediate, unrestricted online access

At Auctores, research is always in progress.

Learn more https://www.auctoresonline.org/journals/general-medicine-and-clinical-practice