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Effects of Exercise on Glycemic Levels, HDL, LDL, Cholesterol and Triglycerides in Patients Undergoing Cardiovascular Surgery

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Abstract

Introduction: Cardiovascular disease is the main cause of death and disability worldwide and although permeability in myocardial vascularity is achieved through surgical procedures, post-intervention strategies are necessary to maintain coronary patency.

Objective: To identify the benefits of exercise on glycaemia, HDL, LDL, Cholesterol and Triglycerides in patients undergoing cardiovascular surgery.

Materials and methods: Observational and descriptive study with 33 subjects (19 men and 14 women). Laboratory, anthropometric and physiological data were collected. On the other hand, exercise tolerance was estimated using the 6-minute walk test. The exercise program lasted 24 sessions of aerobic exercise between 50 to 70% of the maximum heart rate, for 60 min a day, 3 times a week for a month.

Results: We identified patients with a medical diagnosis of 35% myocardial revascularization, angioplasty with 42%, valve replacement 9%, pacemaker placement 7%, Bentall surgery and closure of atrioventricular communication by 3%. A significant improvement was observed in the values of maximum oxygen consumption, ejection fraction, lipid profile and fasting glucometry; The double product as an indicator of myocardial oxygen consumption did not have a significant difference.

Conclusions: An exercise program with an adequate prescription improves the cardiovascular response to exercise, fasting glucose levels and the lipid profile in patients undergoing cardiovascular surgery.

Keywords: Cardiac Rehabilitation; Cardiovascular Disease; Maximum Oxygen Consumption

Introduction

Cardiovascular Diseases (CVD) are a group of disorders of the heart and blood vessels. Currently, one in three people die due to an event associated with cardiovascular diseases; in the world an Acute Myocardial Infarction (AMI) occurs every four seconds and every five seconds a stroke (ACV) [1].

Likewise, CVD represents a global public health problem, this is due to its high prevalence, they are considered the main cause of death in the adult population in most countries. In developing countries it is expected that there will be a frequency in the increase since economic and demographic changes have occurred that contribute to the increase of risk factors [2].

Currently, in Latin America and the Caribbean, 31% of total deaths have been due to diseases of cardiovascular origin. It is estimated that approximately 20.7 million deaths occur in this region because of these diseases in the next 10 years [3]. In Mexico, heart disease has been the leading cause of death for more than 20 years [4].

Cardiac Rehabilitation (RHC) is a proportional measure for the treatment of patients who have suffered an Acute Myocardial Infarction (AMI), providing better physical, psychological and social conditions. This will be done so that the patient can have as much functional independence as his condition allows. The RHC significantly reduces mortality in people after a cardiac event by up to 30% [4,5].

The main objective of the cardiovascular rehabilitation is the improvement in the quality of life of the patients, for which it is necessary a joint and coordinated work of diverse specialties of the sanitary area. This intervention protocol presents physical training sessions and psychological action guidelines, emphasizing the need to control the risks present in patients with heart problems or disorders [6].

It has been shown that there is a significant reduction in the mortality of patients with cardiovascular diseases included in cardiac rehabilitation programs. In order to take some control over the patient's progress, the 6-minute Walk is used. This consists in that, during 6 minutes, a person carries out a walk in a determined distance to his maximum physical capacity

without arriving to run, having like specific intention to measure the maximum distance that an individual can cross during a period of six minutes walking as fast as posible [7,8].

The 6-minute walk is considered as a simple alternative to be able to evaluate the clinical effects that occur during the therapeutic phases, allowing to show the changes of the clinical state of the patients [9]. In this way, this study aims to identify the benefits of exercise on blood glucose, HDL, LDL, cholesterol and triglycerides in patients undergoing cardiovascular surgery.

Materials and Methods

A longitudinal experimental study was conducted with 33 subjects (19 men and 14 women), with an average age of 64 ± 11 years. The participants attended an exercise program in a clinic of last level in Colombia, which had a postoperative diagnosis of cardiovascular surgery; the participants had to sign an informed consent that was previously endorsed by the ethics committee of the institution in which the study was carried out.

Patients who presented severe pain in the lower limbs, unstable angina, heart rate ≥ 120 bpm, systolic blood pressure ≥ 180 mmHg diastolic blood pressure ≥ 100 mmHg and arterial oxygen saturation at rest ≤ 89% at rest were excluded from the study as a preventive measure. Likewise, those participants who presented hemodynamic instability during the tests or those who expressed not wanting to continue participating as an object of study were excluded.

An interview was conducted as an instrument for the collection of information, which was intended to help the collection of sociodemographic, anthropometric and physiological data. Exercise tolerance was estimated using the 6-minute walk test, which was applied by specialists in the area of cardiac rehabilitation, before and after 12 sessions of cardiac rehabilitation based on exercise. The VO2 value was expressed in MET (Resting metabolic unit), the expected distance was assessed from the Sherrill formula10: (2.11 * size in cm) - (2.29 * weight in kg) - (5 , 78 * age) + 667 in women, and (7.57 × size in cm) - (5.02 × age) - (1.76 × weight in kg) - 309, for the case of men.

The protocol of the 6-minute walk test was carried out according to the regulations proposed by the American Thoracic Society (ATS) guidelines for the 6-minute walk test [10,11]. In terms of perceived dyspnea and effort, an assessment was made using the modified Borg scale [9]. On the other hand, to collect the parameters of heart rate and respiratory, as well as systolic and diastolic blood pressure, were obtained manually, while oxygen saturation was obtained with the help of a portable pulse oximeter (Nellcor Puritan Bennett). Indirectly, the double product was estimated as an indicator of myocardial oxygen consumption.

The exercise program lasted 24 sessions which consisted of aerobic exercise between 50 to 70% of the maximum heart rate for a duration of 60 minutes a day, 3 times a week, for two months.

Analysis of Data

For the description of the quantitative variables, the average, the standard deviation and the median were used. The comparison between before and after the intervention was made by paired t test. The SPSS program version 15.0 was used for the analysis of the data.

Results

The exercise program that was carried out for the present investigation included 75 patients; of which 25 of them came out by exclusion criteria. Of the remaining 50, 17 did not continue the study (10 due to abandonment of the program, 5 due to hospitalization).

Within the sociodemographic characteristics studied, an average age was identified for both genders of 64 ± 11 years. 58% of the population was made up of men and the remaining 42% were women. As for the academic level, 48% were high school graduates, 36% were university students and 16% had only completed primary school. The postoperative diagnoses found were myocardial revascularization 35%, angioplasty with 42%, valve replacement 9%, pacemaker placement 7%, Bentall surgery and closure of atrioventricular communication in 3% both surgical procedures.

The risk factors identified were: arterial hypertension, dyslipidemia, diabetes and smoking, among others (Table 1). Most of them started together in the same subject (Table 2). When comparing VO2 as an indicator of tolerance to exercise and the meters reached before and after the intervention with an exercise program based on aerobic exercise, a significant improvement was observed in both variables. As also, in the fraction of ejection, lipid profile and fasting glucometry of the participants. However, when the behavior of the double product was analyzed as an indicator of myocardial oxygen consumption, no difference was found (Table 3).

Variables	Sample	Male	Female	Total
Gender	33	19	14	58% - 42%
Age	33			64 ± 11
Academic level				
Primary	5	5	0	16%
High school	16	7	9	48%
Academic	12	5	7	36%
Diagnosis				
Angioplasty	14	8	6	42%
Myocardial revascularization	12	7	5	36%
Valvular replacement	3	2	1	9%
Pacemaker	2	1	1	6%
Bentall surgery	1	1	0	3%
Closing of CIA	1	0	1	3%
Body mass index				25±3,9
Infrapeso	2	0	2	6%
Normopeso	13	9	4	39%

Overweight	12	8	4	36%
Obesity	6	2	4	18%
Abdominal circumference	33	90 ± 6,5	89 ± 7,2	100%
Ejection fraction				
Greater than 45%	17	8 (49 ± 4,1)	9 (48 ± 2,8)	51,5%
Less than 45%	16	11 (41 ± 3,5)	5 (39 ± 4,7)	48,4%
Lipidic profile				
Cholesterol	33	211 ± 32,3	195 ± 29,5	100%
HDL	33	45 ± 8,2	41 ± 2,6	100%
LDL	33	149 ± 15,4	116 ± 13,4	100%
Triglycerides	33	143 ± 21,2	120 ± 12	100%
Fasting blood glucose	33	157 ± 6,1	141 ± 4,5	100%
CIA: interatrial communication; HDL: High density lipoproteins; LDL: Low density lipoproteins.				

Table 1: Characteristics of the study population (n = 33).

Features	**Male**	**Female**
Overweight or Obesity by BMI	10,5%	33,3%
Abdominal obesity	42,1%	50%
Dyslipidemia	36,8%	36,7%
Arterial	86%	74%
hypertension		
Diabetes	47%	51%
Renal disease	11%	8%
Sedentary	93%	91%
Depression	11%	8%
Anxiety	18%	11%
Smoking	79%	57%
Alcoholism	30%	11%
Inadequate food intake	45%	54%
IAM history	92%	91%
Female gender	0%	42,4%
Age†	94%	85%
BMI: Body mass index; AMI: Acute myocardial infarction.		
* Less than 150 minutes per week.		
† Women> 65 years and Men> 40 years according Rev Colomb Cardiol 2011; 18(4):177-182).		

Table 2: Cardiovascular risk factors.

Variable	Pre (n=33)	Pos (n=33)	Value of p
Ejection fraction	43 ± 7,1	49 ± 6,3	<0,001
6 minute walk			
VO2	9,6 ± 2 mL/kg1 /min	11,09 ± 1,9 mL/kg-1 /min-1	0,002
Meters traveled	244,5 ± 80,1 m	303,2 ± 78,1 m	0,002
Double product	9.946 ± 1.959	9.435 ± 1.763	0,4
Lipidic profile			
Cholesterol	241 ± 12,5	217 ± 5,5	<0,001
HDL	44 ± 9,2	32 ± 4,8	0,001
LDL	138 ± 13,3	132 ± 5,4	0,002
Triglycerides	158 ± 11,9	140 ± 9,8	0,002
Fasting blood glucose	151 ± 9,1	126 ± 2,5	<0,001
Abdominal circumference	93 ± 9,5	85 ± 6,1	0,001
Sedentary	92%	0%	< 0,05
HDL: High density lipoproteins; LDL: Low density lipoproteins.			

Table 3: Analysis of post-training changes.

Discussion

Exercise in cardiac rehabilitation is fundamental as a preventive method. This type of training generates positive effects in the physical, mental, psychosocial and in the rate of morbidity and mortality due to heart disease. Following this order, in the present investigation we managed to corroborate a certain part of this statement from the lipid point of view where improvement of the levels of HDL, LDL, TG and CT was found. These results are similar to improvements in BMI (-1.47%), waist / hip ratio (-1.14%), HDL-C (+ 3.76%), TG (-2.2%), LDL -C (-7.0%), Total cholesterol (-4.9%) and aerobic capacity (+ 193%) presented in a study from Costa Rica [12], like others made in Chile [13], Argentina [14], España [15], Cuba [16] and another one of Spanish and Chilean authors [17].

In addition, there is abundant evidence that exercise improves the lipid profile and that making changes in the diet provides benefits for the cardiac patient, which depends on the ability to achieve a lipid-lowering effect. Regular physical exercise such as that acquired by patients in

this program can help control body weight and achieve reductions in plasma triglycerides and increase the level of HDL-cholesterol [18]. However, they are contradictory to those presented by Ávila J. and Betancourt J. (2014) (p => 0.2 vs <0.001) [19].

On the other hand, It is noteworthy that the usual practice of physical exercise is the only non-pharmacological measure capable of raising HDL cholesterol levels. Triglycerides are also reduced with continued physical exercise. Equally well-known are the beneficial effects of physical exercise on hyperglycemia, which acts on two fundamental levels: on the one hand, physical exercise favors the consumption of glucose by the muscle; on the other hand, it is the only non-pharmacological measure capable of reducing the resistance of the muscle to the action of insulin. That is why exercise is an important component in the management of diabetes, so it can be used to promote the health and quality of life of patients affected with the disease. In the present study, after an exercise intervention in patients undergoing cardiovascular surgery, glycemic levels were reduced in the study population (151 ± 9.1 vs 126 ± 2.5, p = <0.001). Such as the results presented by Expósito-Tirado, J.A., AguileraSaborido, A., López-Lozano, A.M., et al. (2012) referring to glycosylated hemoglobin and therefore blood glucose levels.

Likewise, to those shown by Andrade J., Rogés R., Pérez L., et al (2014) [16], with reduction in the average values of the biochemical variables, being more evident in glycaemia (8.1 ± 1, 7 vs. 5.8 ± 1.0 mmol/L, p= 0.0025), glycosylated hemoglobin (8.0 ± 1.0 vs. 5.9 ± 1.0%, p= 0.0040) and triglycerides (3 , 2 ± 1.1 vs. 1.7 ± 0.4 mmol/L, p= 0.0012). Also to those presented by Trejo-Bahena NI, Sánchez-González DJ, Loeza-Magaña P. et al. [20] in different variables such as blood glucose 110.6 ± 4.623mg/dL vs 103.0 ± 3.521mg/dL, p= 0.19; total cholesterol 125.3 ± 3.921mg/dL vs 116.5 ± 3.754mg/dL, p= 0.1087; HDL 40.24 ± 1463 mg/dL vs 43.36 ± 1.703mg/dL p= 0.1668; LDL 62.25 ± 3.497mg/dL vs 53.40 ± 2.774mg/dL, p= 0.0493; triglycerides 126.5 ± 7.464 vs 116.2 ± 6.879mg/dL.

Conclusion

A program of physical exercise if performed with an adequate prescription improves the cardiovascular response to exercise, blood glucose levels and the lipid profile in patients undergoing cardiovascular surgery.

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