72 - EVALUATION OF VO2MAX IN MORBIDLY OBESE PRE AND POST BARIATRIC SURGERY

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INTRODUCTION

The maximum oxygen consumption is the best variable used to determine and classify the cardiorespiratory fitness of a person (AMERICAN COLLEGE OF SPORTS MEDICINE, 2006). It represents the maximum amount of oxygen that can be captured, transported and consumed by cellular metabolism, while a person performs dynamic exercise involving a large percentage of muscle mass. It is also known as maximal aerobic power for its measurement is described both in a relative and in an absolute manner by volume of oxygen (or milliliters liters) per minute (KRUELet al. 2003). The form takes into account the relative weight (ml.Kg-1.min-1), which is the most used because the energy needs vary by body weight (DENADAI, 1995).

In the obese population is considered an important parameter to analyze morbidities associated with high weight, and the quantification of the highest oxygen uptake (O2) by an individual is due to the interaction of the respiratory, cardiovascular and muscular, because the maximal oxygen uptake is dependent on the pulmonary uptake, transport and use by the circulation mitochondrial (ARAUJO, 2002). Due to this interaction, there are factors intrinsic to these systems that end up limiting the maximum oxygen consumption.

The morbidly obese population presents anatomical and physiological changes that hinder the uptake of oxygen and therefore have values below when compared with non-obese population (ZANCONATO et al., 1989; GORAN et al., 2000; EKELUND et al., 2004; Loftin, et al. 2004).

The research therefore aimed to assess cardiorespiratory fitness by maximal oxygen consumption of obese patients before and after bariatric surgery by applying the Balke protocol, which is a protocol compatible with the evaluation of groups with lower cardiorespiratory fitness or limitations on the step amplitude, as is the case of overweight patients (ROWLAND; 1990).

DEVELOPMENT

It is a quantitative cross-sectional study aimed at determining the maximal oxygen consumption in obese patients in order to check the cardiorespiratory both pre and post-bariatric surgery. The population was addressed morbidly obese who are on the waiting list for bariatric surgery. They attend the sessions of physical therapy at the Rehabilitation Clinic-FAG. We excluded patients who had cardiac disease, chronic degenerative diseases, smoking or bone deformities that prevented testing. Patients with cognitive disorders who do not understand the procedure were not assessed, and those not medically released. The study was approved by the ethics committee of the institution.

The selection of an appropriate protocol for assessment of functional capacity is of fundamental importance (MCARDLE, KATCH, KATCH, 1992). The modified Balke protocol is the best method for people who had obesity, chronic degenerative diseases or children, for being a constant speed and less intense (3.4 mph or 5.47 km / h). To implement the Balke protocol were used treadmill, a stethoscope and sphygmomanometer to measure blood pressure, pulse oximetry to capture the heart rate and oxygen saturation. The test was performed in Cardiopulmonary Physiotherapy Gym at Rehabilitation Clinic -FAG with 16subjects who underwent bariatric surgery at the São Lucas Hospital- FAG. After a period of three months after the surgery these individuals were asked to return to retake the test. The blood pressure, heart rate, respiratory rate and O2 saturation were collected before and after the test. The patient was explaining the whole procedure after testing and was referred to the treadmill. The protocol consists of a test that has constant speed, starting with tilt zeroed after 2 minutes the incline starts with 2% in the 4th minute of testing the inclination to spend 4%, in the 6th minute to tilt to 6% at 8 ° inclination minutes increased to 8% at 10 ° slope will minutes to 10% at 12 ° inclination is increased to 12% at 14 ° slope goes to 14% at 16 ° will tilt to 16%, being the inclination final stages totaling 9. The patient can stop the test at any time, if not longer bear the realization of physical activity.

After the tests, the calculation of maximum oxygen uptake was done by mathematical formula: VO2max = (1.75 x maximum tilt supported) + 6.10 ml/kg/min-1 in that part of the protocol used.

RESULTS AND DISCUSSION

The sample consisted of 16 subjects, 3 males and 13 females. The age range was between 21-51 years. None achieved the last stage of the test, and the maximum was reached pre-operative stage was 7 that corresponds of 12% and the maximum stage reached after surgery was eight corresponding to a slope of 14%. After the tests, the calculation of maximum oxygen consumption was done by mathematical formula that was part of the protocol used. The results are shown in Table1.

The statistical analysis was by descriptive statistics with mean and standard deviation, where was done the normal distribution test Shapiro-Wilk, followed by T-test for comparison between means, the significance level was 5% and the software used was SPSSversion20. The results showed that the variables weight, stage and VO2máx both pre and post-bariatric surgery were statistically significant, as expressed in Table1.

Table 1 – Mean and standard deviation of age, height, pre and post internship and VO2max pre and post.

Variables	N	Mean	SD
Age	16	35,93	8,8
Height (m)	16	1,60	0,1
Weight Pre (Kg)	16	120,76	39,2
Stage Pre			
VO2 máx Pre (ml.Kg-1.min-1)	16	4,06	1,5
	16	21,31	5,3
Weight Post (Kg)	16	94,75*	31,9
Stage Post	16	5,06*	1,8
VO2 máx Post (ml.Kg-1.min-1)	16	24,81*	6,5

*Significant Values p<0,05

The maximal oxygen uptake (VO2máx) provides a measure of the maximum energy during aerobic and functional capacity of the cardiorespiratory system (ASTRAND; RODAHL, 2003). Therefore, the estimated VO2max is considered the most reliable factor in determining an individual's aerobic capacity. The VO2max depends on the interaction of pulmonary, cardiovascular and muscular systems. As in obese these systems are compromised due to anatomical changes, diseases associated and sedentary lifestyle, consequently this population has levels of maximum oxygen consumption lower than the population with weight in the normal range. With respect to body composition Fox (1979) says that obesity is related to physical inactivity, which would cause a decrease in VO2maxof the individual.

Dempsey et al (1999) report that the decrease pulmonary ventilation and diffusion deficits cause a desaturation, consequently decrease the VO2max, and that ventilation is being compromised because respiratory mechanics is altered due to excess fat tissue in the abdominal cavity which compresses the chest and diaphragm muscle, affect the expansibility; and the diffusion deficit is due to a low cardiac output, for oxygenation depends on cardiac output. These limitations are evident when the values of VO2max relative to body mass are observed, and these are lower in obese than non-obese. (ZANCONATO et al, 1989; GORAN et al, 2000; EKELUND et al, 2004; LOFTIN, et al,2004). These alterations corroborate this study, reporting a decrease in the fitness of individuals in the present study.

Skinner (1991) reveals, despite the aging process begins shortly after birth, and this is counter balanced by growth, where as the effects of the same follow up when we stop growing, around 20 years, can be seen around 30 years old, when cardiorespiratory fitness would be in about 13-12 METs, respectively, for men and women. We would fall in VO2max values of approximately 1 MET every 7 years or 0,5 mlO2/ kg/ minute per year. Based on across-sectional study, McArdle, Katch&Katch (1992), calculated that after 25 years VO2máx declines steadily about 1% per year, or 0,4mlO2/kg/minute per year. This rate of decline is twice as fast in sedentary than inactive individuals as they age. In the present study, subjects had a mean age of 35.93 years and already have loss of maximal oxygen consumption.

Nunes et al (2004) distributed to normal individuals the minimum and maximum values of VO2 máx in mlO2/kg/min respectively according to the age and sex, being for the male population between 20 and 29 years 16.8 and 59.6, between 30 and 39 years 18.3 and 57.6, between 40 and 49 years 17.4 and 55.1, between 50 and 59 years 142 and 53.5, between 60 and 69 years and 14.849.7 and over 70 years 15.4 and 38.1. As for the female population values of VO2 máx in mlO2/kg/min minimum and maximum respectively, between 20 and 29 years 20.0 and 55.6, between 30 and 39 years 17.3 and 50.7, between 40 and 49 years 14.9 and 52.0, between 50 and 59 years 15.8 and 46, 1, between 60 and 69 years and 15.7 37.3 and over 70 years16.9 and 32.5. According to the author, the research´s values are within the expected.

Balderrama et al (2007) used assessment methodsVO2max in people of different sexes and ages, presenting: 1) a direct method of measuring the maximal oxygen consumption, 2) estimated by heart rate and 3) a stress test with steps using predetermined graphics. In this study we can see that the results of the different methods varied, and the indirect methods are less accurate than the direct method, but these are not recommended for people with increasing age, untrained and present risks being therefore the indirect method more effective when the population being evaluated have different age groups, which is the case in the study. The average age of participants was 43,55 and the average VO2max found in this population was 31,3ml/kg/min-1 which differs from the results found in this study.

In relation to the treadmill protocols, Nemeth et al (2008) investigated a submaximal treadmill test to predict VO2max in obese children using the Protocol Ebbeling (The Ebbeling Treadmill Test), where between 2-4 minutes, the subject walked on the treadmill in order to reach a comfortable speed that where should be between 2 and 4.5mph and average heart rate does not exceed 50-70% of maximum heart rate obtained by the formula 220-age. Walked up the pace with a given slope of 5 percent for four minutes, recording the average heart rate during the last 30 seconds of the test. According to the study protocol was accurate in this assessment of maximal oxygen consumption in obese group and the mean value of VO2max obtained in the study was 24, 51ml/kg/min-1.

Vianna e Cader et al (2010) studied a group of people who participated in a physical activity program for 4 months and another group who did not practice any physical activity, were evaluated before and after 4 months blood pressure, BMI and VO2max. To evaluate the maximal oxygen uptake test was performed by walking 1600 meters, where the time to perform the route was timed, after data collection the value of VO2max was obtained through a mathematical formula taking into account the weight, time of the1600 meters, sex, age, and final heart rate. The value of the average VO2max of the control group was 21, 7ml/kg/min-1. And the group participating in the program was 29, 1ml/kg/min-1. It is noteworthy that the individuals of this study also participated in a rehabilitation program in preoperative surgery and may have contributed to the increase of oxygen consumption preoperatively.

When assessing VO2max children and adolescents, they also have lower values. Berndtsson e Mattsson et al (2006) studied the maximal consumption of O2 in obese children using a protocol with cycleergometer where the work load was varied according to age and sex of the child. The VO2max was estimated from the heart rate and workload using the nomogram provided by Astrand Ryhming. Research shows that obese children had VO2max relatively lower when compared to the control group. Zanconato et al. (1989) evaluated children and adolescents obese and non obese. The results revealed no differences in absolute VO2max between groups, however when expressed in values relative to body mass, obese boys and girls showed an VO2max lower than non-obese. The ventilatory threshold was lower in the obese group when expressed in values relative to body mass, however, in percentage of VO2max obese groups (83.6%) and non-obese (77.9%) did not differ. The final load of work and testing time was lower in the obese group, the maximum heart rate (HRmax) on the test was similar between groups. The authors concluded that obese individuals had lower cardiorespiratory fitness than non-obese and similar ventilation. Goran et al. (2000) conducted a study that examined the influence of body mass and body composition in aerobic fitness. The sample consisted of 129 children (9.6 ± 1.3years). Evaluations were conducted for the determination of VO2max on a treadmill. The researchers concluded that the obese individual does not have a lower aerobic capacity when on the active muscle mass, but when expressed relative to total body mass, the values are committed by the larger body.

In relation to body weight, Conde et al (2003) evaluated the interaction between VO2max, BMI and flexibility in 99 subjects, who were able to conclude that in both sexes, the risk of people withVO2max below or within the average present high BMI was greater than for those with high oxygen consumption. With the restriction of in take a rising from bariatric surgery, individuals showed significant loss of body weight, improving cardiorespiratory function and respiratory function, contributing to the increase inVO2max after three months.

Most studies cited show that VO2max is lower in obese than non-obese, indicating that the high weight alters respiratory mechanics and commits the cardiopulmonary efficiency during exercise. The lack of training and inactivity in this population is also a factor that contributes to the lack of physical fitness.

The results show a significant improvement in VO2max, the patients were able to achieve more growth stages after bariatric surgery, which demonstrates an improvement in cardiorespiratory fitness uptake of oxygen. The significant weight loss

and changes in habits of life of these patients contributed to the increase in VO2max.

CONCLUSIONS

Through research it can be concluded that the Balke protocol is indicated for the assessment of maximal oxygen uptake in the obese population. According to the results, we found that the obese population has compromised cardiorespiratory fitness presenting low values of VO2max. The bariatric surgery has proven effective intervention in significant weight loss and increasing VO2max after three months post operatively.

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EVALUATION OF VO2MAX IN MORBIDLY OBESE PRE AND POST BARIATRIC SURGERY

ABSTRACT

Introduction: Obesity is now a major public health problem, because the heavy weight, coupled with a sedentary lifestyle, is directly related to pathological conditions that cause high morbidity and mortality. Several interventions are used to improve health and therefore the quality of life of obese patients. The VO2max is a variable that should be assessed and monitored in the obese population, because it is an important parameter associated morbidities, and the quantification of the highest oxygen uptake by an individual is due to the interaction of the respiratory, cardiovascular and muscular. Objective: To evaluate the maximal oxygen uptake of morbidly obese individuals in the pre-and post-bariatric surgery. Methods: We evaluated 16 patients between 21 and 51 years, 3 patients were male and 13 female patients. These patients were already with the date of bariatric surgery marked, and returned to perform the test after 3 months of surgery. They signed an informed consent form and the project was approved by the IRB of the institution. Individuals performing treadmill exercise test following the protocol of Balke. Results: Statistical analysis revealed that the variables weight, stage and VO2max both pre and post-bariatric surgery had statistically significant. Conclusions: It was possible to identify that the obese population has compromised cardiorespiratory fitness, revealing values of maximum oxygen consumption lower when compared to the normal population, but after bariatric surgery VO2max values increased, which demonstrates an improvement in cardiorespiratory fitness.

KEYWORDS: Obesity. VO2max. Bariatric Surgery.

ÉVALUATION DES VO2MAX EN OBESITE MORBIDE CHIRURGIE PRE ET POST- CHIRURGIE BARIATRIC

RESÚMÉ

Introduction: L'obésité est devenue un problème majeur de santé publique, parce que le poids lourd, couplé à un mode de vie sédentaire, est directement liée à des conditions pathologiques qui entraînent une morbidité et une mortalité élevées. Plusieurs interventions sont utilisées pour améliorer la santé et donc la qualité de vie des patients obèses. La VO2max est une variable qui doit être évaluée et surveillée dans la population obèse, car il est un paramètre important morbidités associées, et la quantification de l'absorption maximale d'oxygène par un individu est due à l'interaction de l'appareil respiratoire, cardio-vasculaire et musculaire. Objectif: L'évaluation de la consommation maximale d'oxygène de personnes souffrant d'obésité morbide à la chirurgie pré-et post-bariatrique. Méthodes: Nous avons évalué 16 sujets âgés de 21 et 51 ans, 3 mâles et 13 femelles. Ces personnes étaient déjà à la date de la chirurgie bariatrique marqué, ils retournèrent à effectuer le test après 3 mois de la chirurgie. Ils ont tous signé un consentement éclairé et le projet a été approuvé par l'IRB de l'institution. Les personnes effectuent l'exercice de stress test en suivant le protocole Balke. Résultats: L'analyse statistique a révélé que le poids variables,

le stade et VO2 max à la fois de la chirurgie pré-et post-bariatrique étaient statistiquement significatives. Conclusions: Il a été possible d'identifier la population obèse a compromis la capacité cardiorespiratoire, révélant des valeurs de consommation maximale d'oxygène faible par rapport à la population normale, mais après les valeurs de VO2max de chirurgie bariatrique ont augmenté, ce qui démontre une amélioration de la condition cardiorespiratoire.

MOTSCLÉS: Obésité.VO2max. Chirurgie bariatrique.

EVALUACIÓN DE VO2MÁX EN OBESIDAD MÓRBIDA PRE Y POST CIRUGÍA BARIÁTRICA

RESUMEN

Introducción: La obesidad es actualmente un importante problema de salud pública, debido a que el peso pesado, junto con un estilo de vida sedentario, está directamente relacionada con las condiciones patológicas que causan alta morbilidad y mortalidad. En varias intervenciones se utilizan para mejorar la salud y por lo tanto la calidad de vida de los pacientes obesos. El VO2max es una variable que debe ser evaluado y controlado en la población obesa, debido a que es un parámetro importante morbilidades asociadas, y la cuantificación de la captación máxima de oxígeno por un individuo se debe a la interacción de los sistemas respiratorio, cardiovascular y muscular. Objetivo: Evaluación del consumo máximo de oxígeno de los individuos con obesidad mórbida en la cirugía de pre-y post-bariátrica. Métodos: Se evaluaron 16 sujetos de entre 21 y 51 años, 3 hombres y 13 mujeres. Estas personas ya estaban con la fecha de la cirugía bariátrica marcada, y volvieron a realizar la prueba después de 3 meses de la cirugía. Todos firmaron un consentimiento informado y el proyecto fue aprobado por el IRB de la institución. Las personas que llevan a cabo pruebas de resistencia tras el protocolo de Balke. Resultados: El análisis estadístico reveló que el peso de las variables, el estadio y el VO2 max, tanto pre y post cirugía bariátrica fueron estadísticamente significativas. Conclusiones: Fue posible identificar a la población obesa ha puesto en peligro la capacidad cardiorrespiratoria, mostrando los valores de consumo máximo de oxígeno bajo en comparación con la población normal, pero después de valores de VO2max de cirugía bariátrica se incrementaron, lo que demuestra una mejora en la aptitud cardiorrespiratoria.

PALABRAS CLAVE: Obesidad. VO2max. Cirugía Bariátrica.

AVALIAÇÃO DO VO2MÁX EM OBESOS MÓRBIDOS PRÉ E PÓS-CIRURGIA BARIÁTRICA

RESUMO

Introdução: A obesidade é hoje um dos principais problemas públicos de saúde, pois o peso elevado, juntamente com o sedentarismo, está diretamente relacionado com condições patológicas que causam altas taxas de morbidade e de mortalidade. Várias intervenções são utilizadas para melhorar a saúde e conseqüentemente a qualidade de vida dos pacientes obesos. O VO2máx é uma variável que deve ser avaliada e monitorada na população obesa, pois é um importante parâmetro de morbidades associadas, sendo que a quantificação da mais alta captação de oxigênio por um indivíduo é decorrente da interação dos sistemas respiratório, cardiovascular e muscular. Objetivo: Avaliar o consumo máximo de oxigênio de indivíduos obesos mórbidos no pré e pós-operatório de cirurgia bariátrica. Métodos: Foram avaliados 16 sujeitos entre 21 e 51 anos, sendo 3do sexo masculino e 13 do sexo feminino. Esses indivíduos já estavam com a data da cirurgia bariátrica marcada, e retornaram a realizar o teste depois de 3 meses da intervenção cirúrgica. Os mesmos assinaram o TCLE e o projeto foi aprovado pelo CEP da instituição. Os indivíduos realizam teste de esforço ergométrico seguindo o protocolo de Balke. Resultados: A analise estatística revelou que as variáveis peso, estágio e VO2máx tanto pré quanto pós-cirurgia bariátrica tiveram resultados estatisticamente significativos. Conclusões: Foi possível identificar que a população obesa apresenta o condicionamento cardiorrespiratório comprometido, revelando valores de consumo máximo de oxigênio baixos quando comparados a população normal, porém após a cirurgia bariátrica os valores de VO2máx aumentaram, o que demonstra uma melhora no condicionamento cardiorrespiratório.

PALAVRAS-CHAVE: Obesidade. VO2máx. Cirurgia Bariátrica.