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Case report

Effects of cardiac rehabilitation, diet and exercise on peak aerobic capacity in obiese patient

Marina Ostojic[1], Jelena Simic[1], Branko Beleslin[1,2], Vojislav Giga[1,2], Ana Djordjevic Dikic[1,2], Nikola Boskovic[1], Ivana Nedeljkovic[1,2]

[1]Cardiology Clinic, University Clinical Center of Serbia, [2]Faculty of Medicine, University of Belgrade

Abstract Obesity is a highly prevalent chronic condition among young population associated with significant morbidity and mortality including increased risk for developing cardiovascular diseases. Cardiac rehabilitation (CR) involving diet and exercise represent basic for improvement of functional capacity and lost of vait in obese patients.

We presented the case of a young obese patient who underwent guided diet and cardiovascular rehabilitation with significant improvement on peak aerobic capacity. At beginning of process our patient was obese with body-mass index of 30.1 kg/m^2, his waste circumference was 110 cm. Laboratory analyses showed elevated total cholesterol 5.8 mmol/L and impaired glicemic control with hemoglobin A1c (HbA1c) 6.0 %. The echocardiography was completely normal. Cardiopulmonary test was performed before guided rehabilitation showing very pour functional abilities with peak oxygen consumption (peak VO2) 32,0 ml/kg/min, at middle of rehabilitation with improvement in peak VO2 42.9 ml/kg/min and at the end of process showing significant improvement of the peak VO2 to 49.1 ml/kg/min, with reduction of BMI to 22.4 kg/m^2 and improvement in laboratory findings.

Guided CR may improve functional capacity. In long-term, regulation of BMI in young patients may be translated into better quality of life and reduction of potential development of obasity-associated morbidities.

Key words cardiovascular rehabilitation, cardiopulmonary test, peak oxygen consumption, obesity

Introduction

Over the past decades, the prevalence of obesity has greatly increased worldwide. Obesity is associated with increased risk for cardiovascular disease, diabetes mellitus, cancer, and osteoarthritis with following increased risk of disability[1]. Lifestyle modification involving guided nutritional education and diet and cardiovascular rehabilitation (CR) through physical activity is considered the standard of care in obesity management of obese patients[2,3]. Other therapeutic interventions including pharmacotherapy and bariatric surgery have been demonstrated to be also beneficial [4]. All these measure can be implemented through programs of personalized or group-based behavioral therapy in specialized medical centers.

We presented a case report of young obese patient who underwent intense inpatient and outpatient rehabilitation program, including behavior intervention, diet, regular exercise and lifestyle counseling.

Presentation

D.N., age 16, is an overweight middle school student, body-mass index (BMI) of 30.1 kg/m^2. His sedentary lifestyle and unhealthy eating habits lead to low functional capacity. Hi struggle with low grades in sport activity school classes and try to lose weight starting different recreative sports disciplines (football, basketball, swimming) unsuccessfully. We started guiding cardiac rehabilitation with diet and cardiac exercise with complete cardiovascular examination and further following his progression through laboratory and cardiopulmonary testing.

In the beginning we performed a physical examination confirmed a normal finding of the heart and lungs. At rest, a 12 – lead channel electrocardiogram (ECG) recorded sinus rhythm, frequency 60 /min, with an image of the right bundle branch block (RBBB) (Picture 1). Echocardiography examination revealed a normal dimension of left ventricular (LV) with completely normal ejection fraction (Table 1). Considering the echocardiography finding without signs of structural heart disease, a cardiopulmonary exercise test (CPET) was performed with Schiller CS200. The test showed very low functional capacity with peak oxygen consumption (peakVO_2) up to 32, 0 mm/kg/min, with early O_2 puls plato fulfillment without signs of myocardial ischemia (Table 2).

The guided program begins with diet leading to weight loss of 8.5 kg trough six months period. After that initial loss of weight, he began with a regular daily walking sessions following guided physical activity in a Special

Corresponding author: Marina Ostojić, Cardiology Clinic, University Clinical Center of Serbia, Višegradska 26, 11000 Belgrade, E-mail: drmarinaostojic@gmail.com

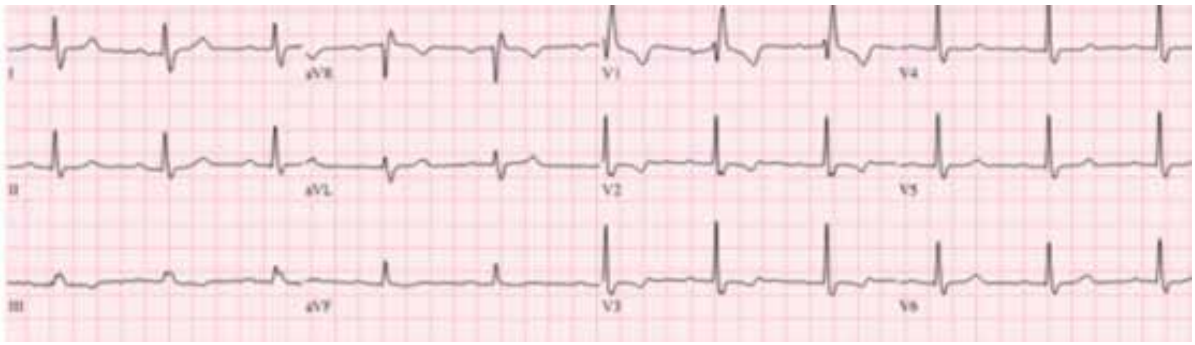

Figure 1. Electrocardiogy of obese young patient with right bundle branch block pattern

Table 1. Laboratory tests at baseline and after cardiovascular rehabilitation

Parameters	Before rehabilitation	End of rehabilitation	Normal range
WBC, 10*9/L	5.8	6.2	4.0-10.0
RBC, 10*12/L	5.01	5.38	4.0-6.3
Hemoglobine, g/L	156	165	120-180
Hematocrite, L/L	1.44	0.49	0.400-0.520
Trombocite, 10*9/L	191	189	140-440
Total cholesterol, mmol/L	5.8	3.4	<5.2
HDL cholesterol, mmol/L	1.4	1.0	<1.0
LDL cholesterol, mmol/L	4.1	2.5	<4.1
Triglicerides, mmol/L	1.1	0.95	<1.7
Urea, mmol/L	4.8	5.0	3.0-7.5
Creatinin, umol/L	92	98	64-111
eGFR, ml/min/1.73m2	>60	>60	>60
Uric acid, umol/L	326	320	210-460
AST, U/L	19	19	<55
ALT, U/L	15	17	<34
Alkaline Phosphatase, U/L	110	105	40-150
Fasting glucose, mmol/L	6.0	4.2	3.9-5.8
HbA1c, mmol/moL	6.1	4.4	4-5.6
TSH, uIU/ml	3.4	3.7	0.4-4.9
FT4, pmol/L	16	15	9.0-19.1

WBC-white blood cell; RBC-red blood cell; AST- Aspartate amino-transferase; ALT- Alanine amino-transferase.

Table 2. Echocardiographic parameters

Parameters	Value
LA (mm)	35
EDD LV (mm)	52
ESD LV(mm)	30
EFLV (%)	66
Septum (mm)	10
Inferior wall (mm)	10
Mass (mg/m2)	72
E/A	0.63/0.41
E' (m/s)	0.08
E/E'	7.8
RV (mm)	22
TAPSE (mm)	29

LA- left atrium|; EDD LV- end-dijastolic dimension of left ventricule; ESD LV – end-sistolic dimensions of left ventricule EF LV-ejection fraction

hospital for metabolism disease on Zlatibor 'Čigota' with two-stage of one months programs. We performed CPET during CR at one year and at the end after 24 months showed significant improvement in maximal METs with peak VO_2 of 42.3 and 49.1 mm/kg/min respectively. Laboratory analyses showed improvement of lipid profile and regulated level of fasting glucose (Table 3). BMI at the end of program was 22,3 kg/m^2

Discusion

Numerous studies demonstrate the value of peak VO_2 as a prognostic tool ahead of traditional cardiovascular risk factors. Its value has been declared as more important than adiposity level in an obese patient[5]. Still, there are many factors that can affect peak VO_2, such as: body size, weight and body composition[6], physical fitness at the time of test, state of cardiopulmonary function, level of hemoglobin concentration, function of mitochondria and baseline genetic factors[6].

Table 3. Cardiopulmonary test parameters at beginning, during carediac rehabilitation and at the end of rehabilitation

Parameters	Before rehabilitation	After 10 months	End of rehabilitation
BMI (kg/m2)	30.1	24.9	22.3
Duration of test (sec)	415	490	618
SBP baseline (mmHg)	130	120	120
SBP max (mmHg)	170	150	145
DBP baseline (mmHg)	85	80	80
DBP max (mmhg)	90	90	90
HR baseline /min	60	62	61
HR maks /min	165	193	205
VAT VO2 (ml/kg/min)	15.0	18.0	22.0
PeakVO2 (ml/kg/min)	32.0	42.9	49.1
% predicted VO2 max	78	92	98
RER	1.2	1.2	1.2
VE/VCO2 slope	22.78	26.1	26.0

BMI- body mass index; SBP-systolic blood pressure; DBP-diastolic blood pressure; HR-heart rate; VAT- Ventilatory anaerobic threshold; RER-respiratory exchange ratio

In the young population, it is also necessary to favor the influence of growth on both body fat and exercise capacity. In a normal young person, the absolute O_2max increases roughly corresponding to body size[7]. In the beginning of CR, the lower peak VO_2max may be explained by grossly reduced oxygen usage by adipose tissue during exercise[8].

Loss of weight is an important topic in different obese populations, and different intervention treatments (such as diet, guided exercise, bariatric surgery) are constantly being optimized. The improvement in exercise capacity after intervention protocols was associated with improved body architecture[9]. Our patient underwent CR with the regulation of BMI, body composition and regulation of laboratory findings, along with excellent improvement in functional class (A) at the level of a good trained individual with peak VO_2 of 49.1mm/kg/min.

Furthermore, when conducting CR the ratio of peak VO_2 and body composition, especially muscle mass, may provide information useful for further guidance of rehabilitation programs which aims to improve aerobic performance as well as strength determined primarily by muscle mass[10].

Conclusion

Guided CV rehabilitation including diet and exercise lead to significant improvement of functional status and class of fitness of young obese patient with the regulation of all laboratory parameters.

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Sažetak

Efekti rehabilitacije, dijete i fizičke aktivnosti na aerobni kapacitet kod gojaznog pacijenta

Marina Ostojić[1], Jelena Simić[1], Branko Beleslin[1,2], Vojislav Giga[1,2], Ana Đorđević Dikić[1,2], Nikola Bošković[1], Ivana Nedeljković[1,2]

[1]Klinika za kardiologiju, Univerzitetski Klinički centar Srbije, [2]Medicinski fakultet, Univerzitet u Beogradu

Gojaznost je hronično stanje sa velikom prevalencom među mlađom populacijom. Povezana je sa značajnim povećanjem morbiditeta i mortaliteta, uključujući povišen rizik za razvoj kardiovaskularnih bolesti. Kardiovaskularna rehabilitacija (KR) podrazumeva promenu načina ishrane uz vođenu fizičku aktivnost i predstavlja osnovu za poboljšanje funkcionalnog kapaciteta i redukciju telesne težine kod gojaznih bolesnika.

U ovom prikazu slučaja opisaćemo mladog gojaznog pacijenta koji je prošao vođeni tretman KR sa promenom režima ishrane i postepenim uvođenjem fizičke aktivnosti sa posledičnim značajnim poboljšanjem aerobnog kapaciteta. Na početku procesa naš pacijent je bio gojazan sa indeksim telesne težine (BMI) 30.1 kg/m^2 i obimom struka 110 cm. Laboratorijski je registrovan povišen ukupni holesterol 5.8 mmol/L i poremećena tolerancija glukoze sa vrednostima HbA1c 6.0 %. Ehokardiografski nalaz je bio potpuno normalan. Kardiopulmonalni test je izvršen na početku KR kada je registrovan jako nizak stepen funkcionalnih sposobnosti sa vršnom potrošnjom kiseonika (peak VO_2) 32,0 ml/kg/min. Godinu dana nakon početka rehabilitacije registrovano je poboljšanje peakVO_2 42.9 ml/kg/min, dok je na kraju procesa registrovano značajno unapređenje funkcionalnog kapaciteta sa vršnim VO_2 to 49.1 ml/kg/min, uz redukciju BMI na 22.4 kg/m^2 i poboljšanje laboratorijskih parametara.

Vođena KR može popraviti funkcionalni kapacitet. Dugoročno, uspešna regulacija BMI kod mladog gojaznog pacijenta može voditi boljem kvalitetu života i redukciji potencijalnog razvoja bolesti povezanih sa gojaznošću.

Ključne reči: kardiovaskularna rehabilitacija, kardiopulmonalni test, gojaznost, vršna potrošnja kiseonika