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GOJAZNOST U KARDIOLOGIJI

Obesity and cardiology

Abstract

Introduction: Morbid obesity is associated with a number of ventilatory and cardiovascular disorders and increased risk for cardiovascular diseases, which can be improved by weight loss. Cardiopulmonary testing (CPET) is proposed for the objective evaluation of the effects of bariatric surgery in morbid obese patients.

Aim: To evaluate the change of CPET and hemodynamic parameters in patients treated with bariatric surgery.

Methods: We performed CPET in 250 morbid obese patients during for the preoperative assessment. We analyzed 50 patients (37 women, mean age 38±10 years) before and 6 months after bariatric surgery. All patients underwent CPET (treadmill, Bruce protocol) with expiratory gas analyses.

Results: The mean weight before treatment was 126.69 ±19.21kg, and BMI was 43.8 ± 5.4 kg/m^2. Averaged body weight reduction was -29, 6 kg, and BMI -10 kg/m2 after 6 months follow-up, with significant difference in comparison to baseline values (43.8±5, 4 vs 33.9±14, 3; p<0.0001). CPET parameters showed increase in VO2 at ventilatory anaerobic threshold (17.86±3.44 vs 20.86±4.70; p<0.0001), Peak VO2 (20.79±3.63 vs 24.97±4.37; p<0.0001) and improvement of ventilatory efficacy VE/VCO2 slope (34.64±4.34 vs 24.74±3.39; p<0.0001), and $PetCO_2$ confirming the improvement of cardiopulmo-

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nary function. Hemodynamic parameters were also improved with decrease in resting heart rate ($p<0.0001$), resting and peak systolic ($p<0.0001$) and diastolic blood pressure ($p<0.0001$ and $p=0.002$). **Conclusion:** These results show significant relationship between weight loss and improvement of anaerobic capacity after bariatric treatment. CPET is shown to be a valuable and reliable tool for the objective assessment of functional improvement.

Key words: morbid obesity, bariatric surgery, cardiopulmonary test

Sažetak

Uvod: Morbidna gojaznost je povezana sa poremećajem kardiopulmonalnog kapaciteta, što se može poboljšati nakon gubitka telesne težine. Kardiopulmonalni test fizičkim opterećenjem – ergospirometrija (CPET) je predložena za objektivnu procenu efekata barijatrijske hirurgije u lečenju morbidno gojaznih pacijenata.

Cilj: Ispitivanje promene kardiopulmonalnih i hemodinamskih parametara kod morbidno gojaznih bolesnika lečenih barijatrijskom hirurgijom.

Metodologija: U okviru preoperativne procene rizika, CPET test je urađen kod 250 morbidno gojaznih bolesnika. Mi smo analizirali 50 bolesnika (37 žena, starosti 38±10 godina) pre i 6 meseci nakon intervencije. CPET je rađen na pokretnoj traci (Bruce protokol) pre i 6 meseci nakon operacije, uz analizu ekspiratornih gasova tokom testa.

Rezultati: Prosečna težina pre operacije bila je 126,69 ± 19.21kg, a BMI 43.8 m^2 ± 5.4 kg/m^2. Prosečni gubitak telesne težine bio je -29,6 kg, a BMI -10 kg/m2 nakon 6 meseci, uz značajnu razliku BMI (43.8 ± 5, 4 vs 33.9 ± 14, 3; $p<0.0001$). Takođe je došlo je i do poboljšanja CPET parametara sa povećanjem VO_2 na anaerobnom pragu (17.86 ± 3.44 vs 20.86 ± 4.70; $p<0.0001$), vršne potrošnje Peak VO_2 (20.79 ± 3.63 vs 24.97 ± 4.37; $p<0.0001$), i poboljšanja ventilatorne efikasnosti VE/VCO_2 slope (34.64 ± 4.34 vs 24.74 ± 3.39; $p<0.0001$), i $PetCO_2$. Poboljšani su hemodinamski parametri, sa smanjenjem srčane frekvencije ($p<0.0001$), sistolnog ($p<0.0001$) i dijastolnog ($p<0.0001$ i $p=0.002$) krvnog pritiska u mirovanju.

Zaključak: Ovi rezultati pokazuju značajnu povezanost između gubitka telesne težine i poboljšanja anaerobnog kapaciteta nakon operacije, a CPET test se pokazao kao pouzdan za objektivnu procenu kardiopulmonalnih parametara.

Ključne reči: morbidna gojaznost, barijatrijska hirurgija, ergospirometrija

Uvod

Gojaznost je jedan od najvećih zdravstvenih problema u svetu i kod nas, posebno kada se zna da prevalenca ubrzano raste i predstavlja glavni faktor rizika za smanjen funkcionalni kapacitet i samim tim i za kardiovaskularne bolesti (KVB), tako da je smanjenje telesne težine (TT) jedna od osnova uspostavljanja dobrog vođenja zdravstvenog sistema i uticaja na buduće neželjene KV događaje (1).

Jedan od savremenih načina lečenja morbidne gojaznosti jeste barijatrijska hirurgija (2-5).

Do sada nije bilo detaljnih ispitivanja efekta barijatrijske hirurgije na kardiopulmonalni kapacitet, koji je značajan prediktor mortaliteta i morbiditeta kako kod opšte populacije tako i kod gojaznih (6). Cilj našeg istraživanja je bilo ispitivanje kardiopulmonalnog kapaciteta pre i posle barijatrijskog lečenja morbidne gojaznosti.

Metodologija

Studija je sprovedena u Kabinetu za ergospirometriju, Klinike za kardiologiju, KCS. Analizirano je 50 bolesnika (37 žena, 13 muškaraca, 38±10 godina starosti) sa BMI 43,8 ± 5,4 kg/m^2 koji su upućeni na barijatrijsko lečenje gojaznosti. Svim bolesnicima je urađen klinički pregled i ergospirometrijsko ispitivanje pre operacije i šest meseci nakon operacije. Isključeni su pacijenti sa neregulisanim krvnim pritiskom, ishemijskom bolešću srca, značajnim valvularnim manama, izraženom hroničnom opstruktivnom bolesti pluća ili plućnim ograničenjem za test i sinkopama. Svi bolesnici su pre testa potpisali informativni pristanak. Testiranje je odobreno od strane etičkog komiteta KCS.

Parametri ergospirometrije i monitoring

Za analizu ekspiratornih gasova tokom CPET korišćen je sistem Shiller CS-200. Ergospirometrija je izvedena na pokretnoj traci prema standardnom Bruce protokolu. Tokom testa kontinuirano je praćena potrošnja kiseonika (VO_2) i određivana je potrošnja na ventilatornom anaerobnom pragu (VAT), kao i vršna potrošnja (peak VO_2) uz praćenje ventilatornih parametara i rezerve disanja (6, 7,8).

Kontinuirano je praćen 12-kanalni EKG i meren krvni pritisak. Merenja pritiska i EKG snimci vršeni su u mirovanju, na kraju svakog nivoa i tokom oporavka. Indikacije za prekid bile su: RER = 1.1, zamor, gušenje, Intenzivan bol u grudima, horizontalna ili nishodna ST depresija/elevacija >1mm u trajanju od 0,08 s nakon J tačke, hipertenzivna reakcija na napor (240/120mmHg), opasni poremećaji ritma.

Rezultati

Uključeno je 50 bolesno gojaznih osoba čiji su demografski podaci prikazani u Tabeli 1. Na kontrolnom pregledu 6 meseci nakon barijatrijske hirurgije registrovano je značajno smanjenje TT (Tabela 2). Redukcija TT bila je -29,6 kg, a BMI -10 kg/m^2 nakon 6 meseci (Grafik 1). BMI indeks je maksimalno bio smanjen za 21,8 kg/m^2 , ali je kod nekih bolesnika porast bio za 3,6 kg/m^2.

Može se videti da je značajno poboljšanje VO_2 na anaerobnom pragu 6 meseci posle ($p<0.001$) (Tabela 3 i Grafik 2).Takođe je zabeležen statistički značajan porast Peak VO_2 6 meseci nakon operacije ($p<0.0001$). Ventilatorna efikasnost takođe pokazuje značajno poboljšanje, ali su vrednosti pre operacije takođe uredne jer je uredna ventilatorna funkcija ($VE/VCO_2<35$) bila jedan od kriterijuma za manji rizik od barijatrijske hirurgije. Barijatrijska hirurgija i značajno smanjenje telesne težine, zajedno sa promenom stila života, doveli su do značajnih hemodinamskih promena u mirovanju, kao i na samom testu (Tabela 4).

Diskusija

Hronična, bolesna gojaznost dovodi do niza promena kardiovaskularnog i pulmonalnog sistema koje ugrožavaju zdravlje i smanjuju mogućnost adekvatnog snabdevanja organa i tkiva kiseonikom posebno u uslovima povećanih potreba (1, 9, 10).

PeakVO_2 precizan pokazatelj je kardiopulmonalnog kapaciteta i bolesnici koji imaju nisku potrošnju imaju i veći rizik od intervencije (9, 10). Henis i sar. su zaključili da bolesnici sa nižom VO_2 na pragu imaju duže trajanje hospitalizacije (9). **Stegen** i sar. su uradili CPET kod 15 bolesno gojaznih osoba (BMI 43.0 kg/m^2) pre i 4 meseca nakon barijatrijske intervencije. Bolesnici koji su trenirali imali su bolje rezultate na CPET testu nakon 4 meseca praćenja. Nezavisno od toga, barijatrijska intervencija je dovela do značajne redukcije TT (11). U našoj studiji smanjenje telesne težine posle 6 meseci redukovano je za 76% u odnosu na početne vrednosti. Redukcija telesne težina bila je -29,6 kg, a BMI -10 kg/m^2 nakon 6 meseci. Ovo je u skladu sa svetskim rezultatima i može se upravo objasniti dobrim postproceduralnim vođenjem bolesnika sa promenom stila života (12, 13).

Zaključak

Iz svega navedenog možemo zaključiti da je kardiopulmonalni kapacitet pod značajnim uticajem bolesne gojaznosti i da se poboljšava nakon redukcije telesne težine i da je ergospirometrija nezaobilazna metoda u pravilnoj proceni bolesnika u okviru priprema za barijatrijsko lečenje bolesne gojaznosti.

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Tabela1. Demogarfske karakteristike studirane populacije

		Raspon
Starost (god)	38 ± 10	20–61
Telesna težina (kg)	126,69 ±19,2	98–174
Telesna visina (cm)	171,1 ± 14,8	150–190
BMI (kg/m²)	43,8 ± 5,4	33,3–56,6
Pol, ženski % (n)	74 (37/50)	/

Tabela 2: Telesna težina i BMI 6 meseci nakon intervencije

	Pre	Posle	p
Telesna težina (kg)	126,7 ± 19,2	97,1 ± 17,9	<0.0001
BMI (kg/m²)	43,8 ± 5,4	33,9 ± 14,3	<0,0001

Tabela 3. Potrošnja kiseonika i ventilatorni parametri pre i 6 meseci nakon barijatrijske hirurgije

	Pre	Posle	p
VO2 na pragu (ml/kg/min)	17,86 ± 3,44	20,86 ± 4,70	<0.0001
PeakVO2 (ml/kg/min)	20,79 ± 3,63	24,97 ± 4,37	<0,0001
VE/VCO2 slope	26,64 ± 4,34	24,74 ± 3,39	0,003

VO2 – potrošnja kiseonika; Peak VO2 – vršna potrošnja kiseonika;
VE/VCO2 slope – ventilatorna efikasnost

Tabela 4. Krvni pritisak i srčana frekvenca pre i 6 meseci nakon barijatrijske hirurgije

	Pre	Posle	p
SF u miru (otk/min)	98,7 ± 12,2	88,01 ± 13,46	<0,0001
Max SF (otk/min)	179 ± 8	160 ± 17	NS
SKP u miru (mmHg)	135 ± 14	131 ± 13	0,017
Max SKP (mmHg)	181 ± 26	162 ± 22	<0,0001
DKP u miru (mmHg)	85 ± 8	80 ± 9	<0,0001
Max DKP (mmHg)	98 ± 12	92 ± 10	0.002

SF – srčana frekvenca; SKP– sistolni krvni pritisak; DKP – dijastolni krvni pritisak;

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OBESITY AND CARDIOLOGY

Abstract

Introduction: Morbid obesity is associated with a number of ventilatory and cardiovascular disorders and increased risk for cardiovascular diseases, which can be improved by weight loss. Cardiopulmonary testing (CPET) is proposed for the objective evaluation of the effects of bariatric surgery in morbid obese patients.

Aim: To evaluate the change of CPET and hemodynamic parameters in patients treated with bariatric surgery.

Methods: We performed CPET in 250 morbid obese patients during for the preoperative assessment. We analyzed 50 patients (37 women, mean age 38±10 years) before and 6 months after bariatric surgery. All patients underwent CPET (treadmill, Bruce protocol) with expiratory gas analyses.

Results: The mean weight before treatment was 126.69 ±19.21kg, and BMI was 43.8 ± 5.4 kg/m2. Averaged body weight reduction was -29, 6 kg, and BMI -10 kg/m2 after 6 months follow-up, with significant difference in comparison to baseline values (43.8±5, 4 vs 33.9±14, 3; $p<0.0001$). CPET parameters showed increase in VO2 at ventilatory anaerobic threshold (17.86±3.44 vs 20.86±4.70; $p<0.0001$), Peak VO2 (20.79±3.63 vs 24.97±4.37; $p<0.0001$) and improvement of ventilatory efficacy VE/VCO2 slope (34.64±4.34 vs 24.74±3.39; $p<0.0001$), and PetCO2 confirming the improvement of cardiopulmonary function. Hemodynamic parameters were also improved with

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decrease in resting heart rate ($p<0.0001$), resting and peak systolic ($p<0.0001$) and diastolic blood pressure ($p<0.0001$ and $p=0.002$). **Conclusion:** These results show significant relationship between weight loss and improvement of anaerobic capacity after bariatric treatment. CPET is shown to be a valuable and reliable tool for the objective assessment of functional improvement.

Key words: morbid obesity, bariatric surgery, cardiopulmonary test

Background and objectives

Obesity is one of the most serious health problems in the world and in our country, especially when it is known that the prevalence is rapidly increasing with significant reduction of the functional capacity and and increase of the risk for cardiovascular disease (CVD), so that weight loss (TT) impoves both funstional class and at the same time reduces the risk for CVD[1].

One of the most important procedure for treating morbid obesity is bariatric surgery. (2-5) So far, there has been no detailed examination of the effect of bariatric surgery on cardiopulmonary capacity, which is a significant predictor of mortality and morbidity in both the general population and obese[6]. The aim of our study was to investigate cardiopulmonary capacity before and after bariatric treatment of morbid obesity.

Methodology

The study was conducted in the Laboratory for cardiopulmonary testing, the Clinic for Cardiology, KCS. We analised 50 patients (37 women, 13 men, 38 ± 10 years of age with BMI 43.8 ± 5.4 kg / m2 scheduled for bariatric treatment of morbid obesity. All patients performed physical examination and ergospirometric examination before and six months after surgery. Patients with uncontrolled hypertension, ischemic heart disease, significant valvular disease, known chronic obstructive pulmonary disease or pulmonary limitation for test and syncope are excluded. All patients signed an informative consent before the test. Testing was approved by the KCS Ethics Committee.

Ergospirometry parameters and monitoring

The Shiller CS-200 system was used to analyze expiratory gases during CPET. Ergospirometry was performed with treadmill Bruce protocol. During the test, oxygen consumption (VO2) is continuously monitored and the consumption on the ventilation

anaerobic threshold (VAT) as well as the PeakVO2) is measured, along with monitoring of the ventilation parameters and breathing reserve (6,7,8).

12-channel ECG was monitored continuously and blood pressure measured at rest, during the test, and recovery. Indications for the test termination were: RER = 1.1, fatigue, sever chest pain, horizontal or downslopping ST depression / elevation> 1mm for 0.08 seconds after J point, hypertensive response to effort (240 / 120mmHg), hazardous rhythm disorders.

Results

We examined 50 patients with morbid obesity whose demographic data are shown in Table 1. A significant reduction in TT (Table 2) was registered 6 months after bariatric surgery. Reduction of TT was -29.6 kg, and BMI -10 kg / m2 after 6 months. The BMI index was maximally reduced by 21.8 kg / m2, but in some patients the increase was 3.6 kg / m2.

VO2 at the anaerobic threshold singificantly improved 6 months after surgery ($p < 0.001$) (Table 3). There was statistically significant increase in peak VO2, 6 months after surgery ($p < 0.0001$). Ventilatory efficacy also showed significant improvement. Bariatric surgery and significant weight reduction, together with lifestyle changes, led to significant haemodynamic improvement (Table 4).

Discussion

Chronic, morbid obesity induces significant changes in cardiovascular and pulmonary systems [1,9,10].

PeakVO2 is a precise indicator of cardiopulmonary capacity and patients with low consumption have a higher risk of surgical intervention [9,10]. Heniss et al. showed that patients with lower VO2 at the anaerobic threshold have a longer duration of hospitalization (9). Stegen et al. Have performed CPET in 15 patients with morbid obesity (BMI 43.0 kg / m2) before and 4 months after bariatric intervention. Patients who performed supervized training had better CPET results after 4 months of follow-up. Irrespective of this, bariatric intervention led to a significant reduction in TT [11]. In our study, weight loss after 6 months was 76% compared to baseline. Weight reduction was -29.6 kg, and BMI -10 kg / m2 after 6 months. This is consistent with important studies and can be explained by good postprocedural management of patients with lifestyle changes [12.13]

Conclusion

We can conclude that cardiopulmonary capacity is under significant influence of morbid obesity and is improved after weight reduction in patients treated with ba-

riatric surgery and that ergospirometry is an unavoidable noninvasive tool in precise assessment of patients before bariatric treatment.

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Table1. Demographic characteristics of the study population

		Raspon
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Telesna visina (cm)	171,1 ± 14,8	150–190
BMI (kg/m^2)	43,8 ± 5,4	33,3-56,6
Pol, ženski % (n)	74 (37/50)	/

Table 2. Body weight and BMI before and 6 months after bariatric surgery

	Before	After 6 months	p
Body weight (kg)	126,7 ± 19,2	97,1 ± 17,9	<0.0001
BMI (kg/m^2)	43,8 ± 5,4	33,9 ± 14,3	<0,0001

Table 3. VO2 and ventilatory response during the test before and 6 months after bariatric surgery

	Before	After 6 months	p
VO2 at VAT (ml/kg/min)	17,86 ± 3,44	20,86 ± 4,70	<0.0001
PeakVO2 (ml/kg/min)	20,79 ± 3,63	24,97 ± 4,37	<0,0001
VE/VCO2 slope	26,64 ± 4,34	24,74 ± 3,39	0,003

VO2 – oxygen consumption; VAT – ventilatory anaerobic treshold;
VE/VCO2 slope – ventilatory efficiecy.

Table 4. Blood pressure and heart rate during the test before and 6 months after bariatric surgery

	Before	After 6 months	p
Baseline HR (otk/min)	98,7 ± 12,2	88,01 ± 13,46	<0,0001
Max HR (otk/min)	179 ± 8	160 ± 17	NS
Baseline SBP (mmHg)	135 ± 14	131 ± 13	0,017
Max SBP (mmHg)	181 ± 26	162 ± 22	<0,0001
Baseline DBP (mmHg)	85 ± 8	80 ± 9	<0,0001
Max DBP (mmHg)	98 ± 12	92 ± 10	0.002

HR – heart rate; SBP – systolic blood pressure; DBP – diastolic blood pressure;