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Original/*Obesidad*

Weight loss and metabolic outcomes 12 months after Roux-en-Y gastric bypass in a population of Southeastern Brazil

Marcela AS Pinhel[1], Carolina F Nicoletti[1], Bruno AP de Oliveira[1], Raoana Cássia Paixão Chaves[1], Luciana Tabajara Parreiras[1], Thiago Sivieri[2], Vinicius MC Vulcano[2], Gabriela RL Luz[2], Danielle R Annunciato[2], Luiza MA Morgado[2], Gustavo Marcatto[2], Wilson Salgado Junior[1], Dorotéia RS Souza[2], Carla Barbosa Nonino[1]

[1]*Department of Internal Medicine, Faculty of Medicine of Ribeirao Preto, University of São Paulo, Ribeirao Preto - SP (Brazil).*
[2]*Sao Jose do Rio Preto Medical School, Sao Jose do Rio Preto – SP (Brazil).*

Abstract

Backgroungd: **previous outcome research in bariatric surgery has to document positive changes in co-morbidities associated with obesity.**

Objective: **the study aimed report a description of the impact of bariatric surgery on weight loss and on the resolution of diseases associated with obesity in patients followed up for 12 months in the public health service of São Paulo/Brazil.**

Methods: **the study was conducted on the data for 598 selected patients with grade III obesity subjected to Roux-en-Y gastric bypass evaluated postoperatively and 6 and 12 months after surgery. Anthropometric, demographic and biochemical data and personal history were determined at each time point. Serum glucose, total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides were determined in the biochemical evaluation. Data were analyzed statistically by the Chi-square test, by ANOVA followed by the Bonferroni post-test and by the Student t-test for independent data, significance set at $p<0.05$.**

Results: **weight loss of 45.5±13.7kg (33.5%) was observed during the first year after surgery. Serum glucose, total cholesterol and LDL cholesterol were reduced during the first six months after surgery and the values were maintained up to 12 months, whereas weight and triglycerides were reduced throughout the study period. A reduced prevalence of diabetes mellitus and dyslipidemia was observed after surgery ($p<0.001$).**

Conclusions: **Roux-en-Y gastric bypass is an important procedure for weight loss and control of comorbidities such as diabetes and dyslipidemia at least during the first postoperative year.**

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Key-Words: *Bariatric surgery. Biochemical profile. Superobese patients. Comorbidities.*

Correspondence: Carla Barbosa Nonino.
Clinical Nutrition - Department of Internal Medicine.
Faculty of Medicine of Ribeirao Preto.
University of São Paulo, Ribeirão Preto - SP (Brazil).
Avenida dos Bandeirantes, 3900. Ribeirao Preto, SP, Brazil.
E-mail: carol_nicolettif@yahoo.com.br

LA PÉRDIDA DE PESO Y LOS RESULTADOS METABÓLICOS DESPUÉS DE 12 MESES DE BYPASS GÁSTRICO EN Y DE ROUX EN UNA POBLACIÓN DEL SURESTE DE BRASIL

Resumen

Introducción: **la investigación de los resultados previa en cirugía bariátrica tiene que documentar los cambios positivos en las comorbilidades asociadas a la obesidad.**

Objetivo: **el objetivo del estudio fue informar de una descripción de los efectos de la cirugía bariátrica sobre la pérdida de peso y en la resolución de enfermedades asociadas con la obesidad en pacientes seguidos durante 12 meses en el servicio de salud pública de São Paulo/Brasil.**

Métodos: **el estudio se realizó con los datos de 598 pacientes seleccionados con obesidad grado III sometidos a bypass gástrico en Y de Roux evaluados antes y 6 y 12 meses después de la cirugía. En cada momento se determinaron la antropometría, los datos demográficos y bioquímicos y la historia personal. La glucosa sérica, el colesterol total, el colesterol LDL, el colesterol HDL y los triglicéridos fueron determinados en la evaluación bioquímica. Los datos fueron analizados estadísticamente por el test de Chi-cuadrado, por ANOVA seguido por el post-test de Bonferroni y por la prueba t de Student para datos independientes; significación fijada en $p<0,05$.**

Resultados: **se observó pérdida de peso de 45,5±13,7 kg (33,5%) durante el primer año después de la cirugía. Glucosa sérica, colesterol total y colesterol LDL se redujeron durante los primeros seis meses después de la cirugía y los valores se mantuvieron hasta los 12 meses, mientras que el peso y los triglicéridos se redujeron en todo el período de estudio. Se observó una prevalencia reducida de diabetes mellitus y dislipidemia después de la cirugía ($p<0,001$).**

Conclusiones: **el bypass gástrico en Y de Roux es un procedimiento importante para la pérdida de peso y el control de las comorbilidades como la diabetes y la dislipidemia, al menos durante el primer año postoperatorio.**

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Palabras-clave: *Cirugía bariátrica. Perfil bioquímico. Pacientes superobesos. Comorbilidades.*

Abreviations:

BMI: Body Mass Index.
WHO: World Health Organization.
DM: Diabetes mellitus.
RYGB: Roux-en Y gastric bypass.
TC: Total cholesterol.
LDLc: Low density lipoprotein cholesterol.
HDLc: High density lipoprotein cholesterol.
TG: Triglycerides.
LAGB: Laparoscopic adjustable gastric banding.

Introduction

The incidence of obesity, defined as Body Mass Index (BMI) higher than 30 kg/m^2, has reached epidemic and the World Health Organization (WHO) projects that by 2015, approximately 2.3 billion adults will be overweight and over 700 million will be obese. In Brazil, this prevalence has significantly increased over the last 30 years and, according to the WHO, the country currently occupies 77th position in the ranking of obesity[1].

As a chronic disease, obesity causes a series of severe comorbidities such as an increased incidence of coronary disease, type 2 diabetes mellitus (DM), arterial hypertension and some types of cancer, especially in individuals with grade II (>35 kg/m^2) and III (>40 kg/m^2) obesity[2], with a consequent impact on health and on quality of life[3].

The clinical treatment of severe forms of obesity – based on an adequate diet, physical exercises and pharmacological treatment – has shown little effectiveness in the perspective of reversing the comorbidities. Within this context, in these cases the most valuable therapeutic option has been bariatric surgery[4], which is indicated for patients with BMI ≥ 40 kg/m^2 or BMI ≥ 35 kg/m^2 and with chronic diseases triggered or aggravated by obesity. The surgical procedure promotes a substantial weight loss and improves or resolves the associated comorbidities[5]. However, there is controversy about the influence of previous BMI on the results of the surgery, with evidences showing that an extremely high preoperative BMI (>50 kg/m^2) is associated with rapid weight loss after Roux-en Y gastric bypass (RYGB)[6].

The total number of surgeries performed worldwide in 2011 was 340,768. The United State and Canada performed the largest number of operations (101.645), followed by Brazil (65,000), France (27,648), Mexico (19,000), Australia and New Zealand (12,000), and the United Kingdom (10.000)[7]. In 2011, of the total number of bariatric surgeries performed in Brazil, 45,500 were of the RYGB type[7], which is considered to be the gold standard and which is also denoted metabolic surgery[5]. This procedure consists of stomach restriction for adaptation to a volume of less than 50 ml and the preparation of a Roux-en-Y gastrojejunal anastomosis[8].

These data place Brazil in an outstanding position regarding the number of bariatric surgeries performed, indicating the importance of investigations assessing the repercussions of bariatric surgery in a representative sample of the Brazilian population. Thus, the objective of the present study was to assess the impact of RYGB on weight loss and on the resolution of diseases associated with obesity and to determine whether the preoperative BMI influences the response to surgical treatment of patients treated in the public health service in the state of São Paulo and followed up for 12 months.

Methodology

The medical records of 598 patients with grade III obesity submitted to RYGB at least 12 months before the study were selected. The patients received an indication of surgical treatment according to the criteria established by the American Society for Metabolic and Bariatric Surgery[9]. Two patient cohorts of Southeastern Brazil were included in the study: patients from the University Hospital (n = 442) and patients from the Base Hospital (n = 156). RYGB was the surgical technique used in all procedures and consisted of a 20 to 50 ml reduction of gastric capacity and of duodenal- jejunal bypass with alimentary and biliopancreatic loops measuring about 100 cm. All surgeries were performed by specialized gastro-surgeons. The study was approved by the Ethic Committees of the two institutions.

Anthropometric, demographic and biochemical data and a personal history were collected a three different time points, i.e., preoperatively and 6 and 12 months after surgery. Anthropometric evaluation was based on the determination of weight (kg), height and BMI (kg/m^2). Weight was measured with a Filizola™ digital scale of the platform type with a capacity of 300 kg and 0.2 kg precision, and height was measured with a vertical rod with 0.5 cm precision. BMI was calculated as the weight/height^2 ratio (kg/m^2). Biochemical evaluation consisted of the determination of serum concentrations of glycemia, total cholesterol (TC), low density lipoprotein cholesterol (LDLc), high density lipoprotein cholesterol (HDLc) and triglycerides (TG) using the reference values of the I Brazilian Directives for Cardiovascular Disease Prevention[10]. A blood sample was collected from each patient after a 12 hour fast. Dyslipidemia was classified as changes in at least one of the variables studied (TC, LDLc, HDLc or TG). Remission of diabetes was defined as blood glucose levels were within normal limits after 12 months of surgery.

In order to assess the impact of preoperative BMI on the resolution of comorbidities associated with obesity, the patients were divided into two groups, i.e., patients with BMI ≤ 50 kg/m^2 and patients with BMI > 50 kg/m^2.

Statistical analysis

Data are reported as mean ± SD. The Kolmogorov-Smirnov test was used to test the normality of the data and the differences between the pre and postoperative periods were analyzed by ANOVA followed by the Bonferroni post-test. The Student t test for independent data was used to compare the data for patients with BMI ≤ 50 kg/m² and BMI > 50 kg/m². The Chi-square test was used to determine the prevalence of comorbidities during the study periods. All analyses were performed using the Statistical Package for the Social Science (SPSS version 17.0 [Inc. Chicago. IL]), with the level of significance set at $p < 0.05$.

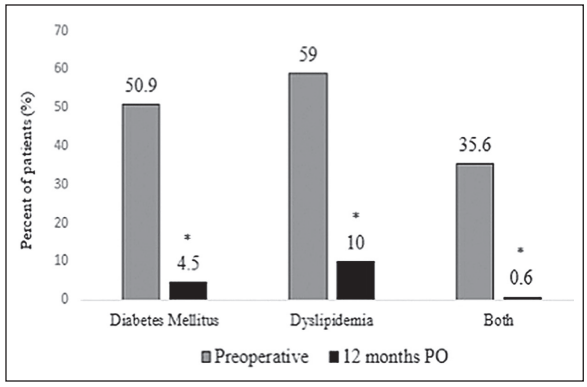

*Fig. 1.—Prevalence of patients with comorbidities associated with obesity before and 12 months after Roux-en-Y gastric bypass (RYGB); PO: Postoperative; *t test; p < 0,05.*

Results

The sample consisted of 598 patients with grade III obesity submitted to RYGB. Mean patient age was 40.2 ± 9.8 years and there was a prevalence of females (82.3%). Table I shows the measurements of weight and BMI, the serum glycemia concentrations and the lipid profile of the patients during the three periods studied. There was a loss of 45.5 ± 13.7 kg (33.5%) during the first year after surgery ($p < 0.05$) and a reduction of serum glucose, TC and LDLc concentrations during the first six months after RYGB, with maintenance of these values up to 12 months. A reduction of weight and TG occurred throughout the study period (12 months). At the end of the study, glycemia was reduced by 18%, TC by 12.2%, LDLc by 12.4% and TG by 32.6%, and HDLc was increased by 30.3%.

Figure 1 illustrates the percentage of patients with diseases associated with obesity before and after surgery. The prevalence of DM and dyslipidemia was reduced after bariatric surgery ($p < 0.001$).

Before surgery, 51% of the patients had a BMI > 50 kg/m². Table II shows the serum concentrations of glucose and the lipid profile of the patients with BMI ≤ 50 kg/m² and BMI > 50 kg/m². It was observed that superobese individuals had lower HDLc concentrations before surgery and higher TG levels 12 months after surgery.

Figure 2 illustrates the prevalence of comorbidities among the patient groups before and 12 months after RYGB. No difference in the frequency of comorbidities was observed between individuals with BMI ≤ 50 kg/m² and BMI > 50 kg/m² at any time point in the study.

Discussion

The present study confirmed the high prevalence of diseases associated with obesity among candidates for bariatric surgery and also demonstrated that surgical treatment is an effective tool for weight loss and for the improvement of DM and dyslipidemia within one year after the procedure.

The prevalence of dyslipidemia varies widely among patients with grade III obesity, ranging from 47 to 91%[11,12]. According to the V Brazilian Directives for Dyslipidemias and the Prevention of Atherosclerosis[10],

Table I
Anthropometric and biochemical characteristics of the patients before and 6 and 12 months after RYGB

	Preoperative	*6 months PO*	*12 months PO*
Weight (kg)	134.4 ± 23.5	101.7 ± 27.3*	89.6 ± 19* †
BMI (kg/m²)	50.3 ± 8.1	37.9 ± 6.4*	33.4 ± 6.6* †
Glucose (mg/dL)	110.2 ± 44.4	85.7 ± 17.9*	83.4 ± 13.2*
TC (mg/dL)	185.7 ± 39	161.1 ± 35.5*	162 ± 32.4*
LDLc (mg/dL)	114.7 ± 32.3	97.5 ± 28.5*	93.8 ± 27.9*
HDLc (mg/dL)	41.9 ± 11	43.7 ± 11.4*	46.4 ± 11.8* †
TG (mg/dL)	150.3 ± 77.3	99 ± 41.3*	85.3 ± 34.7* †

PO: postoperative period; BMI: body mass index; TC: total cholesterol; LDLc: LDL cholesterol; HDLc: HDL cholesterol; TG: triglycerides; *: $p < 0.05$ compared to the preoperative period; †: $p < 0.05$ compared to 6 months PO 6; ANOVA test.

Table II
Biochemical indicators of the patients with a BMI lower or higher than 50 kg/m² during the preoperative period and 12 months after RYGP

	Preoperative		*12 months PO*		*Delta%*	
	≤50 kg/m²	>50 kg/m²	≤50 kg/m²	>50 kg/m²	≤50 kg/m²	>50 kg/m²
Glucose (mg/dL)	111.5±47.4	109±41.6	83.7±14.2	83±12.2	-18.1	-18.4
TC (mg/dL)	185±40	186.3±38.3	162.5±29.8	161.4±34.8	-12.1	-12.2
LDLc (mg/dL)	113.9±32.9	115.3±31.7	92.5±26	94.9±29.5	-15.7	-12
HDLc (mg/dL)	43±11.5	40.7±10.5*	47.6±10.7	45.3±12.5	24.6	22.8
TG (mg/dL)	147.7±73.7	153.8±80.9	81.3±32.5	89.9±36.3*	-36.1	-33.2

TC: total cholesterol; LDLc: LDL cholesterol; HDLc: HDL cholesterol; TG: triglycerides; *:p<0.05 compared to ≤50 kg/m²; t test.

dyslipidemia is considered to be present when just one of the values determined, i.e., TC, HDLc, LDLc or TG, is altered. In the present study there was a significant improvement in serum TC, LDLc, HDLc and TG one year after surgery, with an increase of HDLc and a reduction of the remaining biochemical indicators. In agreement with these findings, several studies have revealed elevated TG and LDLc concentrations before bariatric surgery, with normalization of all parameters at the end of 12 months after the surgical intervention[13,14].

Silva *et al*.[13] in a study of 143 Brazilian patients submitted to bariatric surgery, reported an increased preoperative prevalence of dyslipidemia, with a significant improvement of the lipid profile one year after the intervention. Another study conducted in Brazil by Valesi *et al*.[14] reported normalization of serum TC concentrations in 51.7% of the patients, an improvement in 44.8%, and no changes in 3.5%. Courcoulas *et al*.[15] observed remission of all types of dyslipidemia in 61.9% of their patients after RYGB and in 27.1% after another surgical technique, i.e., laparoscopic adjustable gastric banding (LAGB), in agreement with previous results[16]. On the other hand, Frigg *et al*.[17], while reporting a significant improvement of patients with dyslipidemia, specifically referred to cases of worsening, although their surgical approach (LAGB) differed from that of the present study. Mundi *et al*.[18] detected a 15% rate of conversion from normal to altered biochemical indicators one year after the placement of an adjustable gastric band and an 8% rate two years after the procedure.

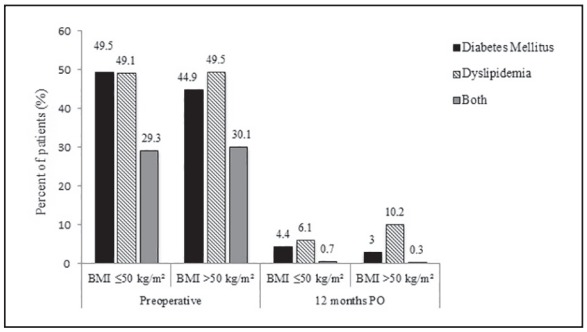

Fig. 2.—Prevalence of patients with comorbidities associated with a BMI of less or more than 50 kg/m² before and after Rouxen-Y gastric bypass. PO: Postoperative; No significant difference was detected; t test; p<0,05.

The improved lipid profile determined by RYGB in obese individuals seems to be related to the weight loss and to the consequent improved hepatic sensitivity to insulin. However, the mechanism of the change in lipid profile after surgically induced weight loss has not been fully elucidated[2]. Weight loss alone does not seem to be an exclusive factor since the correlations between it and the changes detected are not uniform. The influence of a low-calorie and, in some cases, a low-fat diet seems to be an important, although not exclusive, factor. This suggests that excess weight may not be the only cause of dyslipidemia in severely obese patients, but rather part of a complex of metabolic and dietary changes and of other factors resulting in the lipid abnormalities associated with obesity.

The present study also revealed a rate of remission of DM after RYGB around 90%. The rate of remission of this disease after RYGB reported in the literature ranges from 67 to 80%[12,19-21]. The mechanism of diabetes improvement after RYGB is also complex. In addition to the amount of weight lost, endocrine factors are also associated, such as impaired ghrelin secretion, greater stimulation of incretin secretion, improved hepatic sensitivity to insulin, and a consequent improved peripheral resistance to insulin[22-24]. The rapid remission of DM occurring soon after the surgery, i.e., before the significant weight loss, suggests that the surgery per se has effects on glucose homeostasis regardless of weight loss, demonstrating that changes in dietary patterns and in nutrient absorption after RYGB also play an important role in the control of the disease[2,25].

In the present study, comparison of patients with a BMI higher or lower than 50 kg/m² revealed that those with a preoperative BMI>50 kg/m² showed lower HDL cholesterol concentrations and, one year after RYGB, these same patients showed higher TG concentrations.

The presence of pre- and postoperative comorbidities was similar for all groups. Studies have shown that, in most cases, superobese patients (BMI>50 kg/m^2) show the same comorbidities as patients with grade I, II and III obesity. However, technical difficulties during surgery are higher for these patients, with a larger number of postoperative complications and high rates of morbidity and mortality[26]. On the other hand, the literature also shows favorable results not only for weight reduction, but also for the improvement of the profile of metabolic risk within a short period of time in superobese patients submitted to this surgery[27,28].

Conclusion

Within this context it is still unclear how much of a weight loss should occur for a complete resolution of the comorbidities in severely obese individuals. The present study shows that RYGB is an important instrument for weight loss and for the control of comorbidities such as diabetes and dyslipidemia, at least during the first postoperative year. However, studies with a longer follow-up time are needed to determine the efficacy of RYGB during the late postoperative period.

Conflict of interest

All authors declare that they have no conflict of interest.

References

1. Melo ME. Os Números da Obesidade no Brasil: *VIGITEL* 2009 e POF 2008-2009. Available from.
2. Poirier P, Auclair A. Role of bariatric surgery in diabetes. *Curr Cardiol Rep*. 2014;16(2):444.
3. Karmali S, Kadikoy H, Brandt ML, Sherman V. What is my goal? Expected weight loss and comorbidity outcomes among bariatric surgery patients. *Obes Surg*. 2011;21(5):595-603.
4. Christou NV. Impact of obesity and bariatric surgery on survival. World J Surg. 2009;33(10):2022-27.
5. Fried M. Bariatric and metabolic surgery. *Minerva Endocrinol*. 2013;38(3):237-44.
6. Magro DO, Geloneze B, Delfini R, Pareja BC, Callejas F, Pareja JC. Long-term weight regain after gastric bypass: a 5-year prospective study. *Obes Surg*. 2008;(6):648-51.
7. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2011. *Obes Surg*. 2013; 23(4):427-36.
8. Garrido AB Jr. Cirurgia da obesidade. Sociedade Brasileira de Cirurgia Bariátrica. *São Paulo: Atheneu*. 2002;22:155-61.
9. Jeffrey I, Mechanick RFK, Surgerman HJ, Gonzalez-Campoy JM, Collazo-Clavell ML, Guven S, *et al*. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery Medical Guidelines for Clinical Practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. *Surg Obes Relat Dis*. 2008;4(5 Suppl):S109-84.
10. Simão A, Precoma D, Andrade J, Correa Filho H, Saraiva JFK, Oliveira GMM, *et al*. I Diretriz Brasileira de Prevenção Cardiovascular. *Arq Bras Cardiol*. 2013;101(6Supl.2):1-63.
11. Ali MR1, Fuller WD, Rasmussen J. Detailed description of early response of metabolic syndrome after laparoscopic Roux-en-Y gastric bypass. *Surg Obes Relat Dis*. 2009;5(3):346-51.
12. Gavira IM, López FJV, Blanco MC, Valero AG, Jiménez LE, Ossorio MAM, *et al*. Effect of gastric bypass on the cardiovascular risk and quality of life in morbid obese patients. *Nutr Hosp*. 2014;29(3):508-12.
13. Silva EN, Sanches MD. Lipid profile of obese before and after Fobi-Capella gastric bypass. *Rev Col Bras Cir.* 2006;33(2):91-95.
14. Carvalho PS, Moreira CL, Barelli MC, Oliveira FH, Guzzo MF, Miguel GP, *et al*. Can bariatric surgery cure metabolic syndrome? *Arq Bras Endocrinol Metabol*. 2007;51(1):79-85.
15. Valezi AC, Mali Júnior, de Brito ME. Gastroplastia vertical com bandagem em Y-de-Roux: análise de resultados. *Rev Col Bras Cir.* 2004;31(1):49-56.
16. Courcoulas AP, Christian NJ, Belle SH, Berk PD, Flum DR, Garcia L, *et al*. Weight change and health outcomes at 3 years after bariatric surgery among individuals with severe obesity. *JAMA*. 2013;310(22):2416-25.
17. Benaiges D, Flores-Le-Roux JA, Pedro-Botet J, Ramon JM, Parri A, Villatoro M, *et al*. Impact of restrictive (sleeve gastrectomy) vs hybrid bariatric surgery (Roux-en-Y gastric bypass) on lipid profile. *Obes Surg*. 2012;22(8):1268-75.
18. Frigg A, Peterli R, Peters T, Ackermann C, Ackermann C, Tondelli P. Reduction in co-morbidities 4 years after laparoscopic adjustable gastric banding. *Obes Surg*. 2004;14(2):216-23.
19. Mundi MS, Lorentz PA, Swain J, Grothe K, Collazo-Clavell M. Moderate physical activity as predictor of weight loss after bariatric surgery. *Obes Surg*. 2013;23(10):1645-9.
20. Higa K, Ho T, Tercero F, Yunus T, Boone KB. Laparoscopic Roux-en-Y gastric bypass: 10-year follow-up. *Surg Obes Relat Dis*. 2011;7(4):516-525.
21. Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, *et al*. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. *Am J Med*. 2009;122(3):248-256.e5.
22. Renard E. Bariatric surgery in patients with late-stage type 2 diabetes: expected beneficial effects on risk ratio and outcomes. *Diabetes Metab*. 2009;35(6 Pt 2):564-8.
23. Nannipieri M, Mari A, Anselmino M, Baldi S, Barsotti E, Guarino D, *et al*. The role of beta-cell function and insulin sensitivity in the remission of type 2 diabetes after gastric bypass surgery. *J Clin Endocrinol Metab*. 2011;96(9):E1372-9.
24. Chiellini C, Rubino F, Castagneto M, Nanni G, Mingrone G. The effect of bilio-pancreatic diversion on type 2 diabetes in patients with BMI<35 kg/m2. *Diabetologia*. 2009;52(6):1027-30.
25. Dirksen C, Jorgensen NB, Bojsen-Moller KN, Jacobsen SH, Hansen DL, Worm D, *et al*. Mechanisms of improved glycaemic control after Roux-en-Y gastric bypass. *Diabetologia* 2012;55(7):1890-901.
26. Laferrère B. Diabetes remission after bariatric surgery: is it just the incretins? *Int J Obes (Lond)*. 2011;35 Suppl 3:S22-5.
27. Melissas J, Christodoulakis M, Schoretsanitis G, Sanidas E, Ganotakis E, Michaloudis D, *et al*. Obesity-associated disorders before and after weight reduction by vertical banded gastroplasty in morbidly vs super obese individuals. *Obes Surg*. 2001;11(4):475-81.
28. Regan JP, Inabnet WB, Gagner M, Pomp A. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. *Obes Surg*. 2003;13(6):861-64.
29. Wolf AM, Beisiegel U. The effect of loss of excess weight on the metabolic risk factors after bariatric surgery in morbidly and super-obese patients. *Obes Surg*. 2007;17(7):910-9.