OBES SURG (2012) 22:991–994
DOI 10.1007/s11695-012-0642-z

SHORT COMMUNICATION

Effect of Laparoscopic Adjustable Gastric Banding on Modifiable Cardiovascular Risk Factors in Extremely Obese Adolescents

Gisela M. M. Silva · Angélica Osório · Fernando Pereira · Pedro Monteiro · Berta Bonnet Ubierna · Carlos Enes · Cidade Rodrigues · Helena F Mansilha

Published online: 11 April 2012

Abstract Recently, surgical intervention has gained increasing support in adolescents with extreme obesity. This study summarizes the analysis into the effect of laparoscopic adjustable gastric bands (LAGB) on cardiovascular risk factors in 14 extremely obese Portuguese adolescent patients. Data collected both pre- and postoperatively included age, gender, body mass index (BMI), percentage of excess weight loss, cardiovascular risk factors, and cardiovascular outcomes. Ten girls and four boys aged from 13.5 to 17.5 years underwent LABG. The mean preoperative weight and BMI were 127.4 kg and 46.1 kg/m^2, respectively. The average percentage of weight loss calculated was 32% at 1 year, 38.8% at 2 years, and 48.1 % at 3 years of follow-up. Simultaneously, blood pressure and insulin resistance index returned to normal, and there was an increase in high-density lipoprotein levels, 3 years after the LABG was fitted. LABG fitting is a safe and effective treatment strategy for the improvement of cardiovascular status following weight loss.

Keywords Gastrobandoplasty · Obese adolescents · Cardiovascular risk

G. M. M. Silva (✉) · H. F. Mansilha
Department of Pediatrics,
Maria Pia Children's Hospital-Centro Hospitalar do Porto,
Rua da Boavista, 827,
4050-111 Porto, Portugal
e-mail: giselavaqueiro@yahoo.com.br

A. Osório · B. B. Ubierna · C. Enes · C. Rodrigues
Department of Pediatric Surgery,
Maria Pia Children's Hospital-Centro Hospitalar do Porto,
Porto, Portugal

F. Pereira
Department of Pediatric Gastroenterology,
Maria Pia Children's Hospital-Centro Hospitalar do Porto,
Porto, Portugal

P. Monteiro
Department of Pediatric Psychiatry,
Maria Pia Children's Hospital-Centro Hospitalar do Porto,
Porto, Portugal

H. F. Mansilha
Department of Nutrition,
Maria Pia Children's Hospital-Centro Hospitalar do Porto,
Porto, Portugal

Introduction

The Portuguese scenario does not differ greatly from other European countries, with increasing prevalence rates of overweight in adolescents (31.5% of overweight and 11.3 % of obese) [1]. The risk of cardiovascular disease and other illnesses are frequently associated with extreme obesity. In fact, insulin resistance has a central role in the pathogenesis of many obesity-related disorders [2]. Hyperinsulinism or insulin resistance, dyslipidemia, and high blood pressure (metabolic syndrome) are all common in obese adolescents and are associated with a long-term increased cardiovascular disease risk [3].

Unfortunately, current medical and behavioral interventions for extreme obesity in adults and children rarely result in the significant, durable weigh loss necessary to improve health outcomes [2, 4, 5]. Recently, surgical intervention for extreme obesity in adolescents has gained increasing support, due to improving obesity-related comorbidities in adults and adolescents [4].

Current evidence suggests that an early intervention in extremely obese adolescents can minimize obesity comorbidities, avoid cardiovascular risk and premature death, and improve overall health quality. It is conceivable that bariatric surgery performed in adults with childhood-onset obesity may not be as effective for comorbidity treatment as surgery performed earlier [2, 4]. In fact, significant weight loss probably improves the elasticity of small arteries [6] and inflammatory parameters [7]. The aim of this study was to evaluate weight loss and the improvement of cardiovascular risk factors in adolescent patients undergoing laparoscopic adjustable gastric bands (LAGB) at our hospital between July of 2001 and June 2010.

Methods

This procedure was approved by the institutional review board, including the ethics committee, at our institution. Our institution's eligibility requirements for bariatric survey mirror those set by the International Pediatric Endosurgery Group guidelines for the surgical treatment of extremely obese adolescents, which was updated in 2008.

Preoperative evaluation of eligible patients was performed by a multidisciplinary management team experienced in meeting the distinct physical and psychological needs of the adolescent. This team included a pediatric physician with expertise in obesity evaluation and management, as well as nutrition, pediatric psychology, pediatric psychiatry, and pediatric surgery. Additional expertise in gastroenterology, cardiology, pulmonology, endocrinology, and orthopedics was also available, depending on the extended spectrum of obesity-related comorbidities. Preoperative evaluations included weight, height, body mass index (BMI), excess weight, systolic and diastolic blood pressure (BP) percentiles, triglycerides (TG), high-density lipoprotein (HDL) levels, total cholesterol, low-density lipoprotein (LDL) levels, and insulin resistance indices (Homeostasis Model Assessment—HOMA-IR). Follow-up assessments, during the first postoperative year, included a first visit at the end of the first week then monthly visits for the first 3 months. This was then decreased to visits every 3 months. Additionally, clinical and laboratory examinations were performed at regular intervals and evaluated at 1, 2, and 3 years post-LABG, to monitor nutritional status and assess treatment response. The postoperative data also included the percentage of excess weight loss (%EWL) (calculated as 100% × [initial weight−current weight]/[initial weight−ideal body weight for height]), the follow-up time in hospital, hospital mortality, and operative morbidity. All data are reported as means±standard deviation.

Definitions

Hypertension Systolic and/or diastolic BP above the 95th percentile for age, adjusted for height and gender, measured on three or more occasions is defined as hypertension [8].

Dyslipidemia Having measurements as follows: total cholesterol (>191 mg/dl in males and >208 mg/dl in females) or LDL (>130 mg/dl in males and >126 mg/dl in females) or HDL (<30 mg/dl in males and <35 mg/dl in females) or TG (>143 mg/dl in males and >126 mg/dl in females) is characterized as dyslipidemia [9].

Insulin resistance Insulin resistance (IR) is defined as HOMA-IR of more than 3.16 (HOMA-IR=fasting insulin concentration (in milliunits/milliliters)×fasting glucose concentration (in milligrams/deciliter)/405) [10].

Statistical Analyses

Descriptive statistics (mean, standard deviation, maximum, and minimum) were performed, and various parameters were compared using the Mann–Whitney test. Differences were considered significant at $p \leq 0.05$. Data analysis was performed using Microsoft Excel 2010, Portuguese edition, and SPSS for Windows version 17.0.

Results

Gastrobandoplasty using a Lap-Band System was performed on 14 adolescents from July 2001 to June 2010. The group included ten girls and four boys. At the time of this report, almost all patients (12/14) had received at least 3 years of follow-up. The baseline average of patient ages was 16.28 years±1.26; weight was 127 kg±16.55 and BMI was 46.14 kg/m^2±3.15. Preoperative patient characterization is shown in Table 1.

Weight at 1, 2, and 3 years of follow-up averaged 103, 97, and 92 kg, respectively, and BMI averaged 37, 35, and 33 kg/m^2, respectively. This correlates with average %EWL of 32, 39, and 48%.

Although, most of the patients presented with dyslipidemia, hypertension, and insulin resistance before surgery, there were significant improvements in systolic and diastolic BP, lipid profiles, and IR indices post-LABG (Table 1). Ninety-two percent of the patients showed hypertension before surgery, with a complete resolution in all of them 1 year after LABG. About 85.7 % of the patients showed dyslipidemia, and of these, 63.6 % were completely free of disease 1 year after surgery. These adolescents demonstrate significant fasting hyperinsulinemia, as the HOMA-IR index was abnormal in 92.8 % of patients (Table 2). Postoperative HOMA values were

Table 1 BMI, %EWL, and blood pressure before and after LAGB

	Preoperative	1 year post-LABG	2 years post-LABG	3 years post-LABG	*p* value
Number of patients	NA	14	14	12	
Weight (kg)	127.8±16.55 (105–157.8)	103.3±19.19 (74.2–126.3)	97.11±15.98 (72–122)	92.2±14.19 (73–110)	0.003/0.001/0.001
% EWL	NA	32.14±14 (6–55)	38.8±17 (21–75)	48.1±20.5 (11.4–74.5)	
BMI (kg/m^2)	46.14±3.15 (41.39–54.6)	37.28±3.85 (30.48–43.5)	35.62±4.29 (28.76–40,2)	33.7±5.79 (24.4–43.1)	0.001/0.001/0.001
Systolic BP (mmHg)	147±11 (129–166)	123±6 (114–135)	122.91±7.36 (110–136)	132.85±8.1 (122–144)	0.001/0.001/0.001
Diastolic BP (mmHg)	77.64±3.15 (54–95)	68.15±9.43 (50–84)	64.8±7.1 (54–74)	71.4±2.2 (68–75)	0.021/0.002/0.03

Data presented as mean±standard deviation. The *p* values are both for 1, 2, and 3-year values compared with baseline

NA not applicable, *% EWL* percentage of excess weight loss, *BMI* body mass index, *BP* blood pressure

normal in all patients 3 years after surgical weight loss, with complete resolution of IR in 82 and 91 % of the patients, 1 and 2 years after LABG, respectively. The average of follow-up after surgery was 69 months with a good compliance (three to four visits/year per adolescent).

None of the patients experienced intraoperative complications, and the mortality rate was zero. The postoperative recovery was uneventful for all patients. However, late complications included leaking of the port, requiring its replacement in two patients (one of them 5 years after surgery and another 1 year later), and gallstone formation, needing laparoscopic cholecystectomy in one patient (2 years after surgery). With regard to nonsurgical problems, one patient developed asymptomatic micro-nephrolithiasis, and two patients developed symptomatic mild gastroesophageal reflux that was controlled with a brief course of proton pump inhibition. In addition, two patients presented with asymptomatic nutritional deficiencies, such as folic acid deficiency, and one of these patients also developed B12 vitamin and zinc deficiency, requiring a short period of additional polyvitaminic complex.

Discussion

LABG is a minimally invasive procedure with few associated complications, a short operative time, and a reduced hospital stay, during which both definitive anatomic and physiologic gastrointestinal conditions are maintained. Our results indicate that LABG is effective for decreasing cardiovascular risk factors in the most extremely obese adolescents. It must be highlighted that there were no complications directly associated with the procedure itself, and the reported nonsurgical complications were easily managed or transitory, as previously described.

In our study, there was a similar initial BMI and BMI decrease when compared to other adolescent and adult studies (BMI, 46.1 kg/m^2±3,15; BMI decrease, 33 kg/m^2 at 3 years of follow-up) [11]. There is increasing evidence that the resolution of obesity-related comorbidities, such as metabolic syndromes, can be seen in adolescents in the same way as it has been described in adults [12, 13]. In our study, LABG-induced weight loss and the significant and sustained %EWL (±50 %) appears to eliminate some of the modifiable risk factors for cardiovascular disease in this group of patients.

As in other studies, such as those of Holterman et al. (2007) and Conroy et al. (2011), our data showed significant improvements in BP following LABG during the follow-up. At 3 years post-LABG, the average serum triglyceride levels in our patients dropped from 127 to 67 mg/dl, although this decrease was not significant, and the average HDL levels increased from 35 to 52 mg/dl, which was a significant

Table 2 HOMA index and lipid profile before and after LAGB

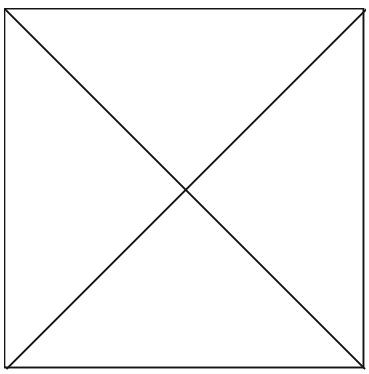
	Preoperative	1 year post-LABG	2 years post-LABG	3 years post-LABG	*p* value
Number of patients	NA	14	14	12	
HOMA index	5±4 (2–20)	2±1.2 (0.39-4.1)	1.69±0.76 (0.58–3.1)	1.55±0.94 (0.6–2.77)	0.009/0.001/0.001
TC (mg/dl)	187.36±46.41(120–243)	157.33±46.41 (120–243)	172±34.2 (120–205)	159.8±38.9 (104–203)	NS
LDL (mg/dl)	125.27±38.22 (76–174)	99±25.19 (120–186)	107.7±29,7 (62–147)	96.2±35.5 (49–124)	NS
TG (mg/dl)	127±82 (44–311)	93±35 (40–151)	89.1±19.1 (60–122)	67.4±10.2 (54–78)	NS
HDL (mg/dl)	35.23±9.38 (20–51)	39.33±8.73 (25–58)	43.6±9.9 (32–60)	52.2±11.6 (38–66)	NS/NS/0.02

Data presented as mean±standard deviation. The *p* values are both for 1, 2, and 3-year values compared with baseline

NA not applicable, *HOMA* homeostasis model assessment, *TC* total cholesterol, *LDL* low-density lipoprotein, *TG* triglycerides, *HDL* high-density lipoprotein

increase (p=0.02). Resolution of dyslipidemia was achieved in 64 % of patients, and there was an improvement in 82 % of the patients. More importantly, the average IR index fell to less than one half of their baseline values 1 year after surgery and remained normal 3 years post-LABG. It is therefore important to highlight that LAGB improves glucose metabolism as well as reducing the risk of developing potentially devastating consequences of insulin resistance in adolescents with extreme obesity.

In general, the frequency and degree of metabolic resolution vary with the %EWL [14], but even in the patient with the lowest %EWL (5.8 %) at 1 year post-LABG, there was still an improvement of these comorbidities. It is also believed that an effective surgical intervention earlier in the life of a morbidly obese adolescent population, in particular for reproductively active females, may be preferable to delayed intervention after decades of exposure to the health effects of morbid obesity. This is particularly important as this procedure may minimize the transgenerational effects of obesity, promoting healthier parents and benefiting the offspring with a more positive metabolic programming [15–18].



Conclusions

According to our knowledge, this is one of the first reports to examine correlations between cardiovascular risk factors and weight changes in adolescents following LABG. In our study, LAGB provided an excellent option not only for weight loss but also for the resolution of cardiovascular risk factors. This was demonstrated by the improvement of BP, serum lipid levels, and measures of glucose homeostasis in adolescents with extreme obesity.

We should now move forward cautiously to provide more intensive obesity management in adolescents. These data support LAGB as an appropriate surgical option for pediatric patients with extreme obesity and cardiovascular risk factors.

Conflict of Interest The authors have nothing to declare.

References

1. Padez C, Mourão I, Moreira P, et al. Prevalence and risk factors for overweight and obesity in Portuguese children. Acta Paediatr. 2005;94:1550–7.
2. Inge TH, Zeller MH, Lawson ML, et al. A critical appraisal of evidence supporting a bariatric surgical approach to weight management for adolescents. J Pediatr. 2005;147:10–9.
3. Buchwald H, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA. 2004;292:1724–37.
4. Inge TH, Xanthakos SA, Zeller MH. Pediatric review—bariatric surgery for pediatric extreme obesity: now or later? Int J Obes. 2007;31:1–14.
5. Bult MJF, Dalen TV, Muller AF. Surgical treatment of obesity. Eur J Endocrinol. 2008;158:135–45.
6. Shargorodsky M, et al. The effect of a rapid weight loss induced by laparoscopic adjustable gastric banding on arterial stiffness, metabolic and inflammatory parameters in patients with morbid obesity. Int J Obes (Lond). 2006;30(11):1632–8.
7. Nascimento H, Rocha S, Rego C, et al. Leukocyte count versus C-reactive protein levels in obese Portuguese patients aged 6–12 years old. Open Biochem J. 2010;10(4):72–6.
8. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics. 2004;114(2 Suppl 4th Report):555–76.
9. Tamir I, Heiss G, Glueck CJ, et al. Lipid and lipoprotein distributions in white children ages 6-19 yrs: the Lipid Research Clinics Program Prevalence study. J Chronic Dis. 1981;34(1):27–39.
10. Keskin M, et al. Homeostasis model assessment is more reliable than fasting glucose/insulin ratio and quantitative insulin sensitivity check index for assessing insulin resistance among obese children and adolescents. Pediatrics. 2005;115:500–3.
11. Abu-Abeid S, Gavert N, Klausner JM. Bariatric surgery in adolescence. J Pediatr Surg. 2003;38:1379–82.
12. Al-Qahtani AR. Laparoscopic adjustable gastric banding in adolescents: safety and efficacy. J Pediatr Surg. 2007;38(9):894–7.
13. Conroy R, Lee EU, Jean A, et al. Effect of laparoscopic adjustable gastric banding on metabolic syndrome ant its risks factors in morbidly obese adolescents. J Obes. 2011;2011:1–8.
14. Inge TH, Krebs NF, Garcia VF, et al. Bariatric surgery for severely overweight adolescents: concerns and recommendations. Pediatrics. 2004;114:217–22.
15. Whitaker RC. Predicting preschooler obesity at birth: the role of maternal obesity in early pregnancy. Pediatrics. 2004;114 (1):e29–36.
16. Boney CM, Verma A, Tucker R, et al. Metabolic syndrome in childhood: association with birth weight, maternal obesity, and gestational diabetes mellitus. Pediatrics. 2005;115:e290–6.
17. Catalano PM. Management of obesity in pregnancy. Obstet Gynecol. 2007;109(2 Pt 1):419–33.
18. Catalano PM. Obesity, insulin resistance, and pregnancy outcome. Reproduction. 2010;140:365–71.