Robotic-assisted gastroplication in a morbidly obese adolescent: early improvement in metabolic and neurohormonal parameters

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Abstract

Bariatric surgery has to be considered in the management of severely obese adolescents when all conservative measures have been proven to be unresponsive. Short term metabolic and neurohormonal profile changes after robotic-assisted gastroplication are evaluated. The benefits and the usefulness of this surgical - reversal procedure in adolescent need to be defined. Fiveteen years old girl with body mass index 42.2 kg/m^2, hyperinsulinism, hyperandrogenism, amenorrhea, polycystic ovarian syndrome, hypertension with left ventricular hypertrophy. Gastric volume after surgical procedure reduction was 80-100 mL. One month postoperatively significant weigh loss was obtained. Insulin levels, insulin-resistance, leptin and ghrelin concentration were substantially ameliorated. We can conclude that bariatric surgery should be considered for a minority of severely obese adolescents under the supervision of a multidisciplinary pediatric team. Our experience confirmed that the gastroplication is safe, feasible and effective and furthermore is a reversible technique. The early improvement of the obesity co-morbities is allowed. The increased surgical accuracy in robotic assistance could limit postoperative complications rate in obese adolescents.

Introduction

The prevalence of morbid obesity in adolescents is rising at an alarming rate. Conservative measures, such as dieting and physical exercise could be proven inadequate. Bariatric surgery in severely obese adolescents, non responding to medical treatment, is considered the treatment of choice.[1]

Bariatric surgery produces lead to weight loss in both short and long term. However, the precise mechanism of action are not fully understood. An increasing number of studies suggest that postsurgical changes within the neurohormonal system may account for a proportion of postsurgical weight loss.[2]

In addition, the surgical procedure decreases significantly the co-morbidities; metabolic changes, in particular insulin secretion, is linked to body fat reduction, nevertheless it is not clear whether these improvements are immediate or delayed.[3,4]

Case Report

We reported a very early amelioration in metabolic and neurohormonal profile, after robotic-assisted gastroplication, in a morbidly obese adolescent. The girl with body mass index (BMI) 38.8 kg/m^2, at the age of 13 years and 6 months, was referred at our Institute by primary pediatric care. Eighteen months of organized and supervised programme of lifestyle modification, including family involvement, didn't show significant results. She was affected by hyperinsulinism, hyperandrogenism, amenorrhea, ultrasound signs of polycystic ovarian syndrome (PCOS), hypertension with left ventricular hypertrophy as co-morbidities. At 15 years of age, deterioration in weight (BMI 42.2 kg/m^2) appeared. Skeletal and developmental maturity was reached. No major controindications for bariatric surgery were found, including eating disorders and psychopathologies. A multidisciplinary intervention with specific nutritional, psychological and training sessions started two months before surgery. Capability to commit to comprehensive medical and psychological evaluation before and after surgery as well as girl and family willingness to participate in a postoperative multidisciplinary treatment were documented; informed consent was obtained. Presurgical clinical, metabolic and hormonal parameters are described in Table 1. We performed a complete nutritional assessment by anthropometric measures, bioimpedence analysis, indirect calorimetry (IC) and dietary diary. The resting energy expenditure measured by IC (2090 Kilocalories per day) was 99% of the basal metabolism estimated by FAO/WHO formulas.[5]

The respiratory quotient was 0.79 showing a prevalent use of fat as energetic source, confirmed by dietary diary, outlining a high fat diet (total fat: 45.7% of the energy intake). We instructed the patient and her family with dietary recommendations and guidelines for post-surgical period.The subject performed a modified Bruce test to assess maximum oxygen consumption. The aim of the physical training conditioning was to develop aerobic capacity with adapted exercises: flexibility and resistance exercises were programmed twice a week. Gastroplication was done in Robotic surgery Da Vinci system® (Intuitive Surgical, Inc., Sunnyvale, California, USA) by using 3 trocars instruments (8.5 an 2 trocars 5-mm).

The omentum and the gastrepiploic vessels were dissected away from the greater curvature. The short gastric vessels, the posterior gastric vein, and the posterior gastric attachments were dissected starting from the antrum towards the left crus of the diaphragm and the angle of His. Following the completion of the dissection to the distal antrum (5 cm from pylorus), a 36-Fr bougie was inserted into the stomach. Under its guidance, a row of 10-12 extra-mucosal non absorbable interrupted sutures (2-0 Ethibond™) was placed along the apposed gastric walls of the dissected greater curvature starting 1 cm below the angle of His.

An additional row of non-absorbable interrupted sutures (2-0 Ethibond™) was used as reinforcement, narrowing the stomach permanently (80-100 mL of volume). No intra or post-

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operative complications occurred. Hospital time stay was 96 hours (48 hours postoperative). Proton pump inhibitors and anticoagulation were prescribed for 14 days. Medical treatment for pain control was required for only 2 days postoperatively and then stopped.

A liquid very low calories diet (VLCD) with high protein content (about 40% of the energy intake) was prescribed 48 hours post-surgery. No vomiting episodes nor dumping symptoms arose. Two weeks post-surgery the patient switched to a soft high protein VLCD supplemented with symbiotic, multivitamin and essential amino acids.

The patient's compliance to the diet and the nutritional status were assessed weekly, providing her and her family psychological support. Three weeks post-surgery the physical training with low intensity aerobic session restarted. As reported in Table 1, 4 weeks later the patient showed a significant improvement in clinical, metabolic and hormonal parameters with gut peptides modifications.

Discussion

Current bariatric surgery procedures can include either a prosthetic device or gastric resection to reduce gastric volume. A reduction in gastric capacity can also be achieved by plication of the anterior stomach or the greater curvature. This approach is an alternative procedure in bariatric surgery similar to vertical sleeve gastrectomy. As a reversible surgical technique not requiring the use of foreign materials could be introduced in paediatrics procedures in order to respect the physiological development of the child.[6,7]

The rapid clinical and metabolic improvement following early postoperative period supports this technique to be an effective alternative in young patients. Few studies in adolescent bariatric surgery are reported in the literatureand no robotic-assisted gastric plication in paediatrics have been previously described.[8-13]

Insulin-resistance (IR), defined as a lower ability of insulin to stimulate glucose uptake by skeletal muscle and adipose tissue, is the primary metabolic disorder associated with obesity as well as reduced insulin's ability to suppress hepatic glucose production.

The impact of surgical procedure on insulin levels and insulin-resistance in our patient was substantial. Even though the mechanism behind this IR early improvement remains unclear,[3] it should be considered an independent risk factor for cardiovascular diseases since its role in the development of other metabolic syndrome criteria, such as dyslipidemia and hypertension.[14] It is not exactly known which IR extent is associated with the MS criteria. In our patient the blood pressure drop was probably influenced by the insulinemia reduction. Insulin abnormalities and obesity coexist commonly with PCOS; bariatric surgery may also lead benefits in PCOS patients.[15] Postoperative improvement in androgens profile, hyperinsulinism and leptin levels also reflects improvement in the reproductive metabolic status.

Body weight is tightly regulated by a complex homeostatic mechanism involving the hypothalamus and brainstem with integrate inputs from higher cortical centres with nutritional and energy status peripheral signals.[16] Leptin and ghrelin are two important humoral signals implicated in the physiological regulation of food intake.

Leptin is primarly produced in the adipose tissue proportionally to body fat. It regulates appetite, energy expenditure and helps adipose metabolism control by the stimulation of lipolysis and suppression of lipogenesis.[17] According to several studies, we noted a favourable change in leptin levels after surgery. The improvement was similarly observed in other bariatric procedures as well as from pharmacological and dietary methods aiming at weight loss,[2] suggesting fat loss rather than the surgery itself is responsible for such change. A decline in plasma leptin level provides only a small contribution to short term satiety, whereas contributes incisively to long-term body weight regulation.

Ghrelin is an orexigenic peptide secreted mainly by the stomac, acting on hypothalamic neurons through the bloodstream via vagal afferents containing ghrelin receptors, as well as through direct release within the hypotathalamus.[17,18] Fasting ghrelin is lower in obese as compared to normal weight individuals, and ghrelin concentration rises after weight loss. Despite lower ghrelin levels, overweight, obese and insulin-resistant subjects often keep on gaining weight, suggesting

Table 1. Clinical, metabolic and hormonal parameters at the pre and post-surgical time.

Parameters	Pre-surgical time	One month after surgery
BMI kg/m2	42.2	36.68
Waist circumference (cm)	122	116.5
Waist to height ratio	0.7	0.6
% fat mass	42.4	37.5
% total body water	36.9	40.8
% fat-free mass	57.6	62.5
Cole index (% excess BMI)	193	174
Fasting blood glucose (mg/dL)	90	81
Fasting insulin (IU/mL)	66	9
HOMA-IR	14.7	1.8
HbA1c (%)	5.6	5.2
Homocisteine (mcmol/L)	15.7	11.9
PCR (mg/dL)	0.8	0.4
Total cholesterol (mg/dL)	149	134
HDL-Cholesterol (mg/dL)	53	43
ALT (mU/mL)	18	21
AST (mU/mL)	24	28
GGT (mU/mL)	38	19
Systolic blood pressure (mmHg)	140	110
Diastolic blood pressure (mmHg)	100	70
Testosterone (ng/mL)	140	61.8
Ghrelin (pg/mL)		
Fasting	38.2	65.3
Post-prandial	28.3	36.4
Leptin (pg/mL)		
Fasting	8121.2	3436.9
Post-prandial	10508	5261.8
VO_2 max (mL/kg/min)	25.2	28.3

BMI, body mass index; HOMA-IR, homeostatic measurement assessment-insulin resistance; PCR, polymerase chain reaction; ALT, alanine aminotransferase; AST, aspartate aminotransferase; GGL, glycogenolysis.

downregulation of ghrelin in response to overeating or excess body weight.[18]

After gastroplication, we observed fasting ghrelin increase. Similar results have been described after adjustable gastric banding and vertical banded gastroplasty. Contrariwise others demonstrated a decrease, or no change at all, in ghrelin levels after gastric bypass or gastric banding.[2] Whether the hormonal changes post-surgery are secondary to weight loss or due to the nature of the surgery itself is still unknown. Also the heterogeneity of post-surgical ghrelin levels trends has to be elucidated. This discrepancy may be due to surgical technique the differences, such as the treatment or not of the vagus nerve.[19]

Conclusions

Bariatric surgery should be considered for a minority of severely obese adolescents with multidisciplinary pediatric team supervision. Our experience confirmed that the gastroplication is feasible, safe and immediately effective as far as clinical, metabolic and neurohormonal improvement is concerned. This technique could be used as an alternative bariatric surgery in young patients with BMI <45 kg/m^2, even if comparative studies and long-term follow-up are necessary to confirm our findings. Due to improved visualization, increased accuracy and positioning, it is certainly plausible that robotic assistance could be an additional benefit in surgical treatment. This approach appears to be a safe option within the field of bariatric surgery in paediatrics. It allows a under full intraoperative view, a post-operative medical treatment for control pain. Hospital stay is also modified on respect of traditional laparoscopic surgery.

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