Length and Volume of the resected stomach in patients with morbid obesity submitted to Sleeve gastrectomy or resective Gastric Bypass compared to Controls.

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Abstract:

Background: Gastric bypass (GBP) and sleeve gastrectomy (SG) are currently some of the procedures often performed for morbid obesity. In Chile, due to the high rate of incidence of gastric cancer, we frequently perform a GBP with resection (RGBP) of the distal excluded segment during GBP. Similarly, sleeve gastrectomy involves a gastric resection of different magnitude. Objective: To determine through a prospective study the length of the lesser and greater curvature and the volume or total capacity of the resected gastric segment in morbid obese patients submitted either to Laparoscopic Resectional GBP (LRGBP) or Laparoscopic SG, compared to controls. Methods: Sixty six patients with different ranges of morbid obesity were compared to 20 controls subjects. The length of both curvatures and the total volume of saline needed to distend the stomach were measured. Patients with morbid obesity were submitted to RGBP (n= 30) or to a SG (n= 33). The stomachs used for control were obtained from autopsy material during the first day after death. Results: The length of the lesser curvature was similar in patients submitted to RGBP (mean 14.8 ± 2.27cm) and controls (mean 15.1 ± 1.61cm). The length of the greater curvature was shorter in RGBP patients (mean 32.6 ± 2.9cm) (p=0.001) and SG patients (33.9 ± 4.5) (p=0.005) when compared to controls. Gastric volume of the resected stomach after sleeve gastrectomy was significantly less compared to gastric bypass (818 ± 150 cc vs 1152 ± 190 cc) or to control subjects (1190 ± 245 cc) respectively (p= 0.001).

Conclusions: This paper confirms the previous results comparing the stomach volume in controls subjects and obese patients and there are not differences in the size of the stomach between groups of morbid obese patients. However, there are significant differences concerning the anatomic measurements of the stomach after RGBP compared to SG in comparison to control subjects.

Key Words: Lengths and Volumes. Sleeve Gastrectomy. Gastric Bypass

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Introduction

Open or laparoscopic gastric bypass (LGBP), is considered the “gold standard” for surgical treatment of patients with morbid obesity 1-5. Recently, sleeve gastrectomy (SG) has been also proposed for the surgical treatment of a wide spectrum of obese patients 6-8. In these operations, a small gastric pouch is created. In our country we frequently perform resection of the distal excluded segment of stomach after GBP due to the high incidence of gastric cancer. It is a common feeling among patients and also among some physicians that the length and volume of the stomach in morbidly obese patients is larger than in normal subjects. Reviewing the available literature referring to patients with morbid obesity, we have not found any objective reference dealing with length and volume of the stomach among these patients, except previous study from our group 9. The purpose of the this prospective study was to determine the length and volume of the resected stomach in patients with morbid obesity submitted to gastric resection during GBP or SG compared to control subjects.

Material and Methods

1. Patients studied: This is a prospective study which includes patients who were operated on due to morbid obesity. All are given a thorough explanation about the operation and the risks, and afterwards, all of them sign a written informed consent in which they accept the operation. Thirty patients, (24 women and 6 men) with a mean age of 37.8 years (18-66) were submitted to a LRGBP 6, 7 and 33 patients, 21 women and 12 men, with a mean age of 38.2 years (19 to 88), were submitted to LSG 8. The resected distal gastric segment was always sent for histological analysis. The body mass index (BMI) among morbidly obese patients submitted to RGBP was 42.1 Kg/m2 (35-54), corresponding to 10 patients with a BMI between 35 and 39.9 Kg/m2, and 20 patients with BMI ≥ 40 Kg/m2. The BMI in patients submitted to a SG was 38.9 Kg/m2 corresponding to 17 patients with a BMI between 35-39.9 and 16 patients with a BMI ≥ 40 Kg/m2. The control group consisted of 15 women (75%) and 5 men (21%), with a mean age of 48.3 years (19-78) and a BMI of 22.6 Kg/m2 (19-25). Control subjects corresponded to deceased patients due to traffic accident or homicides, studied at the morgue. In our country, any subject who dies due to a traffic accident or an act of violence must be submitted by law to a complete autopsy study by the Legal Forensic Office before 24 hours after the time of death. During this procedure, all internal organs are carefully examined, including the stomach. One of the authors (AB) remained during the autopsies, measuring the length and volume of the resected stomach.

2. Techniques and Method of measurement: Among control subjects, the entire stomach was taken out without the greater omentum and the pylorus was sutured, as well as the esophagogastric junction.
LSG 8 was performed by dividing the greater curvature vessels using a Ligasure device (Covidien®, USA) starting at 2cm from the pylorus until the His angle, sectioning the short gastric and posterior fundic vessels. Once this maneuver is completed, a 32-Fr bougie is introduced by the anesthesiologist into the stomach and the surgeon pushes it along the lesser curvature into the pyloric channel and duodenal bulb. Then, an EndoGIA device (Covidien®, USA) 4.8mm staplers (green cartridge) is introduced by the 15 mm port located at the right upper quadrant in order to start the division of the antrum 2-3 cms from the pylorus, which is completed with another green cartridge up to the angular incisure. The gastric tubulization is performed by division of the gastric corpus straight to the His angle by applying 3-4 charges of 3.8mm stapler EndoGIA (blue cartridge), parallel to the lesser curvature. With the purpose of decreasing the incidence of leaks at suture line and to evaluate the gastric volume, a reinforcement with absorbable sutures over the stapleline is performed, leaving a small tubulized stomach of 60-80 ml capacity controlled by the instillation of methylene blue through a nasogastric tube placed after removing the bougie, with the purpose to eliminate any leaks of the suture line and to evaluate of the gastric capacity. For this purpose we transitorily block the flux to the duodenum just at the prepyloric site. The resected specimen is easily removed through the 15 mm. port of the right upper abdominal quadrant. The volume of the resected stomach was measured through the instillation of saline solution. In these patients, the resected gastric segment corresponded to almost the entire portion of the greater curvature parallel to the intact lesser curvature. The width of the antrum, corpus and fundus was also determined.

For LRGBP, we divide the vessels along the greater curvature from the angle of His until 1 cm distal to the pylorus. The right gastric artery is divided and the section of the duodenum was performed with EndoGIA blue stapler (Covidien®, USA). The gastrohepatic ligament is divided and the lesser curvature is exposed 3 cm below the cardia. Then, a small gastric pouch of 15 to 20 ml is created by sectioning the stomach 3 cm distal to the esophagogastric junction. The gastric section was performed with linear blue stapler Endogia 45mm (Covidien®, USA) applied perpendicular to the lesser curvature first and then parallel up to the angle of His for the gastric resection including the fundus. In this way, the resected specimen includes the entire length of the greater curvature and the lesser curvature, except the proximal 3 cm side-to-side gastro-jejunal anastomosis was performed with 45 mm blue cartridge stapler and the jejuno-jejunostomy with white 45mm EndoGIA cartridge. In Figure 1 and 2, lines A, B and C show the points of measurement of the gastric width of the fundus, corpus and antrum after both types of resection. Afterwards, a needle was used to puncture the stomach and the total gastric volume was measured by puncturing the stomach and instillation of saline solution until full distension was achieved and stopped when a minimum of the solution appeared through the stapler line.

3.-Statistical evaluation: For statistical calculations, the Fisher exact test and the Chi square test were employed taking a p < 0.05 as significant.

Results

Table 1 shows the measurements of the length of both curvatures, and the total gastric volume of controls and patients with morbid obesity submitted to a RGBP or a SG. The length of the lesser curvature was similar between the

Figure 1. Pequeña bolsa remanente en BPGR y medidas de la curvatura menor y mayor con el fundus, cuerpo y antro gástrico

Figure 2. Gastrectomía vertical subtotal y medida de longitud de las curvaturas menor y mayor y anchura de fundus, cuerpo y antro gástricos en pacientes con obesidad mórbida ("Middle curvature" es la “nueva” curvatura mayor)

Figure 3. Medida de volumen después de rellenar con agua y distender el segmento gástrico resecado
control group and RGBP group. The length of the greater curvature was significantly greater in the controls compared to patients who underwent RGBP and sleeve gastrectomy. The total gastric volume of the resected stomach was significantly less in patients with a SG compared to controls and to patients with a RGBP.

Table 2 shows the same measurements in patients with morbid obesity submitted to RGBP or SG separated according to the severity of the obesity. Measurements of the greater curvature were similar in both operations. There were no significant differences in any of the parameters evaluated among patients with different degrees of obesity.

Table 3 presents the maximum width of the fundus, corpus and antrum of the resected stomach after a RGBP and SG. The fundus width was significantly greater in patients with a BMI of 40 kg/m² submitted to a RGBP compared to SG patients. The corpus and antrum width were significantly greater in patients submitted to a LRGBP compared to SG patients.

Discussion

Few papers have focused on studying the measurements of the resected stomach volume, in order to determine the optimal magnitude for a gastrectomy among patients submitted to bariatric surgery. In a previous study Csendes et al 9 concluded that the size and total gastric volume were similar in obese patients submitted to a RGBP in comparison to controls. Therefore, there is no "increased capacity" or greater stomach size in patients with morbid obesity. The results of the present study suggest that by performing several objective measurements concerning the anatomy of the stomach in patients with morbid obesity submitted to a LRGBP or SG compared to controls, the stomach variation measurements depend on the surgical techniques employed and not due to the obesity itself.

The available data in the surgical literature concerning gastric bypass indicates that all authors are only interested in the final volume of the small proximal pouch created for the gastric bypass. In the early era of gastric bypass, patients underwent a 90% distal gastric exclusion, leaving a proximal 10% for gastric bypass 10, 11. These authors suggested that a functional volume less than 100 ml should be achieved with this technique 12. At the same time, Adler and Terry proposed to measure the size of the small gastric pouch through the amount of saline required to distend the pouch 13. However, in recent years, all authors who performed an open 2-5, 14-16 or laparoscopic gastric bypass 4, 5 have pointed out the need to create a small pouch with a total capacity of 20 to 60 ml, which corresponds to 2-5% of the total gastric capacity. However, no mention is made in any publication concerning the size, volume of the stomach of these patients in comparison to controls. The length of the lesser curvature which is left in situ is 3 cm and no greater

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**Table 1: Measurements of the length and volume of the whole stomach in controls and the length and volume of the resected stomach in patients with morbid obesity submitted to resectional gastric bypass or sleeve gastrectomy.**

<table>
<thead>
<tr>
<th>BMI (%)</th>
<th>9-13</th>
<th>Marzo-Abril 2011</th>
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<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Controls</td>
<td>RGBP</td>
<td>Sleeve Gastrectomy</td>
</tr>
<tr>
<td>n = 20</td>
<td>n = 20</td>
<td>n = 20</td>
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<td>A</td>
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<td>x = 10</td>
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**Table 2: Measurements of the length and capacity of the resected stomach in patients with morbid obesity submitted to resectional gastric bypass or sleeve gastrectomy according to the BMI (kg/m²).**

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>≤ 39.9</th>
<th>40-49.9</th>
<th>≥ 50</th>
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<tbody>
<tr>
<td>A</td>
<td>B</td>
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<td>D</td>
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<td>n = 20</td>
<td>n = 17</td>
<td>n = 17</td>
<td>n = 17</td>
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<td>A</td>
<td>B</td>
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<td>x = 10</td>
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**Table 3: Anchura máxima del fundus cuerpo y antrum del estómago resecado después de GEPR y GV de acuerdo con IMC (kg/m²).**

<table>
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curvature should be left in situ, with resection of all gastric fundus. Therefore, gastric bypass is physiologically equivalent to at least a 95 to 98% subtotal gastrectomy, leaving only 2 to 3% of total gastric volume, which is less than the volume left after SG 17-19.

In patients submitted to a sleeve gastrectomy the greater curvature is almost completely removed because we start gastric resection at 2-3 cm from the pylorus until the His angle using a 32-Fr bougie as a guide for tubulation and the line of transection is close to the lesser curvature, leaving a tubular segment with a 60-80 ml volume as we have measured in a previous study 8. However, most surgeons start gastric transection 6-7 cm from the pylorus in front of the crow’s foot of Latarjet’s nerve and therefore the size and volume of the gastric tube will obviously be different. It was recently suggested that the volume of the resected stomach must be > 500 ml in order to assure good results in terms of food intake restriction. Weiner et al. 20 suggested that a removed gastric volume of > 500 ce seems to be a predictor of failure or early weight regain. Yehoshua et al. 21 reported a mean volume of the entire stomach of 1514 ± 482 cc, the remaining sleeve with a mean volume of 135 ± 37 cc (90-220) and the mean volume of the removed stomach of 786 ± 281 (400-1500). There is most likely an enormous variety in the method and evaluation of the “in situ” gastric capacity. In any case, these findings could be considered important factors for the prognosis of results later on because an increase in the capacity of the gastric remnant could result in less weight loss after surgery or increase in weight late after surgery. Parikh et al. 22 compared the use of 40- Fr bougie v/s 60-Fr bougie for performing sleeve gastrectomy and reported no differences of percentage of excess weight loss (%EWL) between the two groups. However, we believe that the increased capacity of this large tubulated stomach could be associated with weight regain later on.

The width of the resected stomach at fundus, corpus and antrum obviously are correlated with a variable volume of the resected stomach and therefore with the residual volume of the “in situ” remnant gastric pouch. It is probable that a narrower tube could be associated with greater restriction for food intake and maybe followed by better results at a long-term follow-up.

Therefore, we believe that it is important to consider the anatomical characteristics of the resected stomach and therefore the gastric remnant tube after bariatric surgery, because these measurements could be a predictor factor for the late results in terms of weight stability or increase after surgery. It is important to evaluate the size of the resected specimen due to the fact that a large proximal tube could be left in situ. This is why surgeons are interested in proximal pouch measurement and appropriate anatomical landmarks in order to create small pouches. It is possible to postulate that in super obese patients the size of resection could be different due to technical difficulties to perform appropriate resection. We do not have this experience because in our country this degree of obesity is rare. However, Csendes 9 studied the stomach size in controls and obese patients, and no differences between the groups were observed.

We always divide the antrum very close to the pylorus in order to perform a very narrow gastric tubulization in order to accomplish the purpose of restrictive procedure. The antral pump is preserved and gastric emptying is fast after this operation 23.

In summary, there are significant differences concerning the anatomic measurements of the stomach depending on different techniques such as gastric bypass and sleeve gastrectomy in comparison to control subjects.

Table 1 Measurements of the length and volume of the whole stomach in controls and the length and volume of the resected stomach in patients with morbid obesity submitted to resectional gastric bypass or sleeve gastrectomy.

Table 2 Measurements of the length and capacity of the resected stomach in patients with morbid obesity submitted to resectional gastric bypass or sleeve gastrectomy according to the BMI (kg/m2).

Table 3 Maximum width of the fundus, corpus and antrum of the resected stomach after a resectional gastric bypass or sleeve gastrectomy, according to the BMI (kg/m2).

References:


