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Special article

Gastroesophageal reflux after Roux-en-Y gastric bypass: Is it just related to technical details?☆

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ABSTRACT

Although it is uncommon, gastroesophageal reflux disease can present after Roux-en-Y gastric bypass, and it is usually related to technical errors. Hiatal hernia, a narrow calibrated gastrojejunostomy and a long gastric pouch are all factors associated with the development of pathologic gastroesophageal reflux. Techniques are available to treat this condition, such as funduplications with the gastric remnant, gastropexy to the arcuate ligament, teres ligament repair, or sphincter augmentation with the LINX device.

Despite the growing number of reports of gastroesophageal reflux after Roux-en-Y gastric bypass, it should be still considered the best surgical option for patients with obesity and a large hiatal hernia or complications secondary to gastroesophageal reflux disease.

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Reflujo tras bypass gástrico. ¿Solo depende de aspectos técnicos?

RESUMEN

La enfermedad por reflujo gastroesofágico se puede presentar tras bypass gástrico en Y de Roux, en general secundariamente a defectos técnicos. La hernia de hiato, la anastomosis calibrada estrecha y la mayor longitud de los reservorios son las causas fundamentales de reflujo. Aunque difícil, existen posibilidades técnicas para la resolución del reflujo tras bypass, como son la confección de técnicas antirreflujo con el remanente gástrico, las pexias al ligamento arcuato o con el ligamento redondo, o la implantación del dispositivo magnético LINX.

A pesar de la publicación de casos aislados de reflujo, el bypass gástrico laparoscópico debe seguir siendo considerado la mejor técnica bariátrica en el seno de un reflujo patológico, de una hernia de hiato voluminosa, o de complicaciones del reflujo.

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Palabras clave:

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Introduction

Currently, there is growing concern due to a considerable number of patients who describe gastroesophageal reflux (GER) after undergoing Roux-en-Y gastric bypass (RYGB). The paradox of how antireflux surgery itself can cause pathological reflux is difficult to explain, but the basis for this explanation probably lies in the pathophysiology of reflux disease after any type of bariatric surgery.

RYGB was first described in 1977 by Ward O. Griffen,¹ and it had been carried out by chance during a prospective study comparing the Mason bypass² with the jejunoileal bypass.³ The author justified this technical variation due to difficulties in performing the omega-loop anastomosis and the presence of bile vomiting in a significant number of patients at the beginning of the series. A few years earlier, Holt and Large⁴ introduced distal gastrectomy with vagotomy and Roux-en-Y gastrojejunostomy for the treatment of GER. Initially, the technique was performed in patients with achalasia undergoing Gröndahl cardioplasty. Later, after confirming the positive results, it was extended to patients with peptic esophagitis, either with or without stricture. The authors performed non-radical gastrectomy with resection of 30%–40% of the stomach, to which they added vagotomy and a bypass with a 30 to 45-cm Roux loop. This also demonstrated the absence of alkaline reflux in the esophagus. Herrington and Mody,⁵ based on the studies by Ferguson and Cross highlighting the role of alkaline reflux in esophagitis,^{6,7} systematically used distal gastrectomy with duodenal diversion for the treatment of persistent GER after previous failed surgeries. The Chilean Attila Csendes group^{8,9} developed their study along these same lines, recommending duodenal diversion (antrectomy, vagotomy, and Roux-en-Y) for patients with Barrett's long segment, because in this patient subgroup they had found a decrease in Barrett length, something that no other technique had demonstrated previously.

In recent years, all the evidence in favor of duodenal diversion has been called into question due to the increasing number of published cases with gastroesophageal reflux after gastric bypass. Its pathogenesis is still not well understood, and there is no consensus on how to treat it.

Concept of GER and assessment after bariatric surgery

To understand the presence of reflux after RYGB, it is necessary to properly define GER. Although the diagnosis of reflux and its relationship with obesity have been discussed in other chapters of this monograph, we will comment on the most important factors related with RYGB. According to the Lyon recommendations, reflux disease is diagnosed empirically and treated in clinical practice based on the symptoms assessed.¹⁰ Functional tests should be performed when initial treatment fails, when the diagnosis is uncertain, or when reflux complications need to be treated or prevented.

Bariatric surgery alters the normal anatomy of the upper stomach and is performed to treat patients with frequent eating disorders. Binge eating disorder, rumination and

bulimia may all be confused with GER. However, the presence of anastomotic stricture, a twisted or stenotic limb, and “candy cane” syndrome can also alter esophageal emptying or Roux loop emptying, causing GER symptoms and compatible alterations observed on functional studies. Furthermore, we must consider that the 2 mechanisms that are recognized as being most frequently responsible for the development of GER — effacement of the lower esophageal sphincter¹¹ and transient relaxation¹² — are both related to postprandial distension of the gastric fundus, which cannot occur after RYGB-type surgery as the fundus is disconnected from the esophagus and lower esophageal sphincter.

For these reasons, diagnostic certainty is very difficult to achieve and requires anatomical and functional tests, including endoscopy, contrast-enhanced radiography, pH monitoring, impedance, manometry, and probably also gastric emptying tests. In addition, targeted psychological assessment must always be added.

Incidence and pathophysiology of GER after RYGB

In the introduction, we mentioned that RYGB is considered the best bariatric technique to treat GER. Several factors justify this statement: greater weight loss (compared to sleeve gastrectomy), disconnection of the gastric body with the consequent decrease in the number of parietal cells whose secretion may affect the distal esophagus, diversion of the bile content, lower pressure on the lower esophageal sphincter in a retrograde manner, and rapid emptying of the gastric reservoir. Alteri and Pryor¹³ recently reviewed the results of bariatric surgery on GER, finding variable levels of resolution of GER after RYGB, while the need to take proton pump inhibitors had been eliminated in approximately 60% of cases, and symptoms of retrosternal burning had disappeared in 80% of operated patients. Some isolated studies also refer to a decrease in Barrett's segment length and even the disappearance of the metaplastic epithelium.¹⁴

Nevertheless, not all patients have a clinical response, nor does the need for antisecretory drugs disappear. Yet neither symptoms nor the use of proton pump inhibitors are demonstrative of the persistence of GER or the appearance of *de novo* GER. The correlation between symptoms and the observed presence of GER occurs in approximately 60% of patients.¹⁵ Endoscopic studies found approximately 6% of patients with C or D esophagitis after RYGB, who would be diagnosed as GER according to the Lyon criteria. Approximately 6% of pathological pH monitoring studies are also reported.¹⁶

What is the explanation for the fact that RYGB can be related to both persistence of GER as well as *de novo* GER? What are the differences between RYGB and the classic duodenal diversion? The first explanation is that, despite the construction of a small reservoir, which is configured with the lesser gastric curvature, the presence of acid-secreting parietal cells is maintained in this area, although it is 50% smaller than the gastric body. These cells will maintain secretory capacity by at least 2 of the 3 accepted pathways: the neural, mediated by acetylcholine and due to vagal preservation; and the hormonal, secondary to gastrin secretion in the preserved

gastric body; only somatostatin-mediated paracrine secretion is eliminated. At present, after the results observed with the one-anastomosis gastric bypass (OAGB), there is a tendency to create longer reservoirs, and therefore with a greater volume of parietal cells and higher acid production.¹⁷

The parietal lower esophageal sphincter is apparently not modified by surgery,¹⁸ but the sphincter component of the arcuate fibers (sling fibers) is affected, which are divided in the same manner as in sleeve gastrectomy.

But probably the big difference is that performing a calibrated and narrow gastrojejunal anastomosis, with the intention of being restrictive, will increase pressure on the sphincter and facilitate the reflux of both gastric secretion and food contents. Clinical stenosis requiring intervention (endoscopic or surgical) occurs in 3%–6%,¹⁹ and is probably more related to the circular mechanical technique and surgical manipulation of the esophageal hiatus of the diaphragm.

If the esophagitis is caused by the postprandial presence of a unbuffered acid pocket floating over the gastric contents without mixing in a subcardial location,²⁰ or a sheet as described by Pandolfino with the capacity to cross the gastroesophageal junction,²¹ the same pocket would remain after gastric bypass in susceptible individuals, although less buffered if possible due to the lack of a gastric antrum, and less mixed with the contents of the reservoir for the same reason, with the potential to injure the distal esophagus. This has been demonstrated in a small number of patients after gastric bypass by the Patti group.²² The authors performed dual-channel impedance with centimeter-by-centimeter withdrawal, which confirmed that, despite the absence of a fundus, there was a subcardial acid pocket in 20% of the patients evaluated after gastric bypass.

Clapp et al.²³ published a series of patients who presented a significant hiatal hernia in the long-term follow-up after RYGB. Hiatal hernia, which in the past was not considered of great importance in gastrectomies or duodenal diversion, is responsible for the appearance of pathological reflux in some patients after RYGB. The difficult emptying of the herniated reservoir is responsible for the damage to the distal esophagus. Clapp's group published a series of 7 patients who had been re-operated an average of 12 years after the original surgery, with an initial mean BMI of 45 kg/m², and later 34 kg/m² at the time of hernia surgery. The mean hernia size was >4 cm, and the authors attributed the GER symptoms to its presence, as it was the reason for diagnosis in all patients. However, in the repair surgeries performed, a "candy cane" limb was treated in more than half of the patients, and the gastrojejunostomy was redone due to an excessively short alimentary limb and bile reflux present in one patient; this suggests that other factors could also be involved in the development of symptoms in this short patient series.

For Braghetto et al.,²⁴ long-term hernia is the most frequent cause found in patients with esophagitis after gastric bypass. Although in some cases the hernia occurs in the long term due to an untreated open hiatus and subsequent loss of hiatal fat after weight loss, in a considerable number of patients the problem arises in the immediate postoperative period when a present hernia is not reduced. Thus, the impact is doubled: first due to the hernia itself, and second due to the larger size

of the final reservoir after not reducing the gastric fundus and not performing the division at the angle of His.

The existence of a gastrogastic fistula, either secondary to an ulcer in the staple line or to a stomach that was not initially divided completely (up to 1.7% in the Higa article²⁵), guarantees the passage of acid content to the reservoir, and it is one of the causes to rule out in cases of peptic esophagitis after RYGB.

Treatment of GER after RYGB

Although GER after RYGB does not seem very common, there is great concern about this complication, firstly due to the large number of patients undergoing this surgery around the world and secondly due to its difficult treatment after the anatomical changes involved in RYGB. Although different techniques have been described for the surgical treatment of primary GER, most entail partial or complete fundoplication and closure with or without reinforcing the pillars of the diaphragm after obtaining adequate length of the intra-abdominal esophagus, which necessarily implies hernia reduction if it exists.²⁶ After gastric bypass there is no "functional" fundus (ie, connected to the rest of the stomach), which prevents performing a dynamic fundoplication.

Different treatments have been proposed for GER after RYGB, the most radical being resection of the reservoir and esophagojejunostomy. Without going so far, there are 4 surgical possibilities to increase the pressure of the lower esophageal sphincter: fundoplication with the gastric remnant, magnetic sphincter augmentation with the LINX system, Hill's repair, and ligamentum teres cardiopexy.

Fundoplication with the gastric remnant was described by Kawahara in 2010²⁷ and later rediscovered by the Higa group.²⁸ Its greatest benefit would be the support of the esophagus in an intra-abdominal position, since the sphincter compression mechanism based on gastric filling does not exist when the stomach is disconnected. Most surgeons argue that there is a dynamic anti-reflux mechanism in the Nissen or Toupet fundoplication, which is based on the increased pressure of the valves in the postprandial period that compress the esophagus, preventing reflux; plus, in the absence of gastric fullness, these are not present, allowing for normal esophageal emptying. This is suggested by the DeMeester group studies,²⁹ but it is not supported by documented scientific evidence. In contrast, the increased length of the lower esophageal sphincter, its increased intra-abdominal length, and its reduced distensibility have been shown to be determining factors in the resolution of GER,³⁰ all of which can be achieved with fundoplication of the gastric remnant. Similar to the Nissen technique, partial Toupet-type fundoplication with the remnant has also been reported to provide good results.³¹

Although the Hill repair (suture of the lesser curvature below the cardia to the arcuate ligament³² or base of the right crus) offered very good results during the 1970s and 1980s for the Lucius Hill group, it has not been widely used for the treatment of primary GER. With the enormous growth of bariatric surgery, the technique has been dusted off by Hill's heirs, Ralph Aye and Lee Swanström, who have developed it

for both sleeve gastrectomy and gastric bypass patients.³³ Although the authors have published good results, their group has extensive experience in the technique, which is not the case of other surgical services, so their results are probably not easily reproducible.

The use of the LINX device for the treatment of GER after RYGB was described for the first time by Hawasli et al. in 2016,³⁴ reporting clinical resolution of the condition and decrease in acid exposure levels demonstrated with pH monitoring. Broderick et al.³⁵ published 13 cases using this system for the treatment of GER after bariatric surgery: 8 after sleeve gastrectomy and 4 after RYGB. Two of the patients required endoscopic dilation, which reportedly provided a good clinical response, although there was no follow-up pH monitoring study. In the sleeve gastrectomy group, only one patient out of 9 continued treatment with reduced doses of proton pump inhibitors; meanwhile, in the gastric bypass group, 3 out of 4 (75%) continued treatment after surgery.

Cardiopexy with the round ligament was described in France in the 1960s³⁶ and made popular in our country by Narbona.³⁷ It consists of a technically simple solution that is anatomically comparable to fundoplication with the remnant or LINX with autologous tissue, but it is not dynamically variable. Although there are not enough publications with long-term results to consider it a good solution for GER after RYGB, Runker et al.³⁸ described a series of patients in Germany who underwent bariatric surgery with or without hernia repair with the ligamentum teres and found a much better result with this technique, reporting a hernia recurrence rate of 15% vs 72%. From the standpoint of the surgeon, the advantage of this procedure is that it is technically simple, with little added surgical time and no use of prosthetic material.

Lastly, something should be said about endoluminal treatments. However, the opinion of the authors is that most involve recouping techniques that had been discarded in the past due to their poor results. The most widely used technique is by Stretta,³⁹ which involves the endoscopic application of radiofrequency to the mucosa of the gastroesophageal junction in order to induce stenosis to impede GER. The procedure was first published as a rescue treatment for GER after RYGB in 2006 in a series of 7 patients, resulting in clinical and functional resolution in 5. The lack of publications over the following 16 years suggests that this technique is not a definitive solution for this problem.

Conclusions

RYGB continues to be the best alternative for the joint treatment of morbid obesity and GER. Although the persistence of GER and the appearance of *de novo* reflux after RYGB have been reported, the rate of presentation is very low. In most patients, the origin is due to technical errors, and, whether this is the case or not, surgical rescue is a possibility for these patients.

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Conflict of interests

The authors declare that they have no conflict of interest.

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