Review Article

Revisional surgery after one anastomosis/mini gastric bypass: A narrative review

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One anastomosis gastric bypass (OAGB)/mini gastric bypass is now considered to be a safe and efficient method for morbidly obese patients but has complications and adverse events such as other surgical procedures. The present paper outlines the need for and the nature of revisional surgery in the long-term following OAGB in accordance with the preferred reporting items for systematic reviews and meta-analysis guidelines. A literature search was carried out in PubMed. All articles on OAGB for which the authors described a patient needing revisional surgery in the long term after OAGB were examined.

Key words: Bariatric surgery, gastroesophageal reflux disease, malnutrition, marginal ulcer, morbid obesity, one anastomosis gastric bypass, revisional surgery, weight regain

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INTRODUCTION

One anastomosis gastric bypass (OAGB)[1] is now recognized as an effective and established bariatric and metabolic procedure by global community of bariatric surgeons.[2,3] It has many potential advantages such as technical ease, shorter operative time, lower complication rates, simpler revision and reversal, and lower incidence of internal herniation over Roux-en-Y gastric bypass (RYGB), the longest serving bariatric procedure.[4-7]

Regardless of these advantages, about 4% patients need revisional/reversal surgeries in the long-term after OAGB[5] due to protein-calorie malnutrition and/or excessive weight loss, persistent gastroesophageal reflux disease (GERD),[8] persistent marginal ulcer (MU), inadequate weight loss, or weight regain. Revisions for complications have been reported in about 1%–2% patients for GERD,[9-11] 0%–2% for MUs,[6,12] 0%–1.01% for severe malnutrition, and about 0.5% for incomplete weight loss and weight regain.[1,5,6,11-17]

Despite the worldwide increasing popularity of OAGB, there are some concerns about its long-term complications, and there is currently no consensus on the management of these complications. There is further no systematic review in the literature attempting to understand the need for revisional surgery for complication management and inadequate therapeutic response after this procedure. This poses difficulties for individual surgeons when they have to deal with these problems in their individual practice.

The aim of this review was to understand the need and the nature of the revisional surgery in the long-term following OAGB in accordance with the preferred reporting items for systematic reviews and meta-analysis guidelines.

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METHODS

We performed a search in PubMed and EMBASE with using one or more of keywords such as "OAGB," "Mini gastric bypass (MGB)," "omega loop gastric bypass," "single anastomosis gastric bypass," "Revision," "reversal," "redo," "severe malnutrition," "protein-calorie malnutrition," "GERD," "GERD," "GERD," "GORD," "acid reflux," bile reflux," "Reflux", "Severe weight loss," "insufficient weight loss" "MU," "anastomotic ulcer," "Ulcer," "complication" to find all articles on OAGB where authors described any patient needing revisional surgery in the long term-after OAGB.

This review focuses only on revisional surgeries for MU, GERD, malnutrition, weight regain and inadequate weigh loss after OAGB. Any related articles specifically addressing revisional surgeries in patients undergoing OAGB, including original articles, case reports, and video reports were retrieved and included in this review. All articles published until November 31, 2018 were included. We found all reported series of OAGB, and after considering repeated results in timely reported results by the same team, finally, 17,166 reported cases of OAGB included in this review. We tried to find the causes of surgical revision of OAGB due to complications related to operation. MU (83/17,166), GERD (219/17,166), malnutrition (144/17,166), and weigh regain/inadequate weigh loss (19/4010) were the most reported complication in the reported series.

We excluded surgery for early complications after OAGB, as the purpose of this review was to understand the need and nature for long-term revisions after OAGB with an overall aim of reducing these complications in the future. Non-English language articles were also excluded.

RESULTS

Marginal ulcer

The incidence of MU after OAGB is reported from 0.2% to 8% in different studies,[1,5,6,9,10,12-14,18-22] that is comparable with RYGB.[22] It seems that the long narrow pouch in OAGB can be an important factor to the prevention of MU, because of bufferization of gastric acid with bile stream.[12] Furthermore, the use of absorbable suture in anastomosis,[23] performing retrogastric gasterojejunostomy,[12] prophylactic proton pomp inhibitors (PPIs) prescription for at least 6 months but preferably longer after OAGB[2,18] can have preventive effects in MU [Table 1].

Some authors recommend PPIs and antibiotics as the first-line treatment of MU.[1,6,14,21,24] In resistant and bleeder MUs, revisional procedures are suggested such as conversion to RYGB,[12,16,19,20,25-27] conversion to sleeve gastrectomy (SG)[17,19] and other procedures such as Braun jejunojejunostomy, anastomosis revision, or complete reversal.[6,19] In perforated MU, laparoscopic or open repair with omental patch and drainage are mentioned.[11,12,18,19]

Gastro-esophageal reflux disease

There is a big fear of post OAGB GERD in some bariatric surgeon, it may be under-reported;[3] however, there is not any evidence about its carcinogenic effect on stomach and esophagus.[22] Indeed not only OAGB by preserving the gastroesophageal junction function does not make reflux but also leads to decreased reflux

Table 1: Marginal ulcer -related information in published studies

Studies	Patients number	Time frame	Incidence, *n* (%)	Risk factors	Conversion (%)
Alkhalifah *et al*.[5]	1731	2001-2015	5 (2.9)	NA	NA
Rutledge and Walsh[6]	2410	1997-2004	9 (4)	NA	0.12
Musella *et al*.[1]	2678	2006-2015	3 (1.1)	Smoking	NA
Carbajo *et al*.[13]	1200	2002-2008	6 (0.5)	NA	NA
Seetharamaiah *et al*.[18]	101	2012-2015	2 (2)	NA	NA
Chevallier *et al*.[12]	1000	2006-2013	20 (2)	Smoking, short pouch	RYGB
Taha *et al*.[14]	1520	2009-2015	3 (0.2)	NA	NA
Bruzzi *et al*.[10]	175	2006-2008	7 (4)	NA	NA
Johnson *et al*.[20]	32 complicated patients	2006	NA	NA	RYGB
Rutledge[21]	1274	1997-2001	2 (1.8)	Staple line dehiscence, small pouch size, pouch orientation, postoperative mucosal ischemia, NSAIDs, *Helicobacter pylori*	NA
Apers *et al*.[9]	287	2012-2013	10 (3.5)	NA	NA
Noun *et al*.[15]	1000	2005-2011	6 (0.6)	NA	NA
Hussain and El-Hasani[24]	519	2014-2018	8 (1.5)	Ischemia, Stapeled anastomosis?	PPIs, sucralfate
Bolckmans *et al*., 2018[25]	28 complicated patients	2007-2016	4		RYGB

NA=Not available; NSAIDs=Nonsteroidal anti-inflammatory drugs; PPIs=Proton pomp inhibitors; RYGB=Roux en y gastric bypass

episodes due to less exposure between gastric acid and esophagus.[28] On the other hand, large jejunal loop can increase the lower esophageal sphincter pressure[29] and a dependent gasterojejunostomy in OAGB,[12,18] lead to prevention of GERD. There is a physiologic condition named duodenogastric reflux which only in disabling symptoms, the medical and surgical interventions are indicated.[8]

The incidence of post-OAGB GERD has been reported from 0% to 30% in different studies.[5,9-11,13-15,18,30-34]

Carbajo *et al*., in their study, concluded that their modification in OAGB can decrease the postoperative GERD incidence to zero[32] however this modification is not essential, based on first consensus statement of OAGB.[2]

There are some reports about GERD improvement after OAGB. Rutledge and Walsh resulted in GERD improvement after OAGB in 77% and 85% of GERD suffering patients in two studies.[6,21] Carbajo *et al*. also reported GERD improvement in 100% of patients after OAGB.[13]

In the presence of medical resistant GERDs that usually are seen about 2 years after OAGB,[12] revisional surgeries or complete reversal are indicated [Table 2].

Most authors suggest the conversion of OAGB to RYGB as the best procedure,[1,8-12,16,20,25,26] with or without pouch shortening,[13] without biliopancreatic limb length change in the presence of sufficient efferent limb[35] or dismantle the gastrojejunostomy and make a new RYGB with shorter biliopancreatic limb in the presence of short common limb.[34-37]

An alternative approach may be Braun jejenojejunostomy that there is not any agreement about it.[2] Some authors support Braun jejenojejunostomy,[1,8,13,14,20] but others conclude that it is an insufficient method.[26]

Lee *et al*. suggest the conversion of OAGB to SG or complete reversal to the improvement of persistent GERD symptoms.[11]

It seems that the preoperative symptomatic GERD is a relative contraindication of OAGB.[2]

Malnutrition

There are some large series regarding OAGB outcomes [Table 3]. It is obvious that early diagnosis of malnutrition during strict postoperative program and oral supplementation as well as consulting with nutritionist and dietician to improve all nonoperative causes that influence nutritional status. Carbajo *et al*.,[13] and Chevallier *et al*.,[12] did not perform reversal operation for any patient. They report malnutrition in 1.1% (14 cases out of 1200 patients), and 0.2% (2 cases out of 1000 patients) who managed with intravenous (IV) therapy and enteral supplementation. They outlined problems due to deficiency are mostly observed among poor compliant cases.[12] Other authors in larger series performed reversal of OAGB to normal anatomy or conversion to SG. Rutledge and Walsh reported 2410 patients with OAGB, 31 cases (1%) developed excessive weight loss, and all of them underwent revision to a gastroplasty (gastrojejunostomy taking down and gastrogastrostomy essentially reversal of the procedure).[6] Taha *et al*. reported 3 of 1520 OAGB patients with more than 100% excess weight lost (EWL) treated by revision surgery.[14] Italian experience in OAGB with 2678 patients revealed five case of EWL more than 100%, three of them needed reoperation.[30] Lee *et al*. also reported 9 of 1322 cases (0.7%) of malnutrition selected for reoperation by different revision strategies.[11] In another 1000 OAGB series reported by Noun *et al*. four patients (0.4%) affected by excessive weight loss, two of them reversed to normal anatomy, and another two cases converted to SG.[15] Alkhalifah *et al*. l reported 43 patients (2.5% of overall and 61.4% of total revision) of malnutrition who underwent revision surgery. They did not specify the type of revision surgery, but no patient in this series underwent revision to normal anatomy.[5] Genser *et al*. reported 26/2934 patients with severe malnutrition, all managed by complete reversal of OAGB and conversion to normal anatomy.[16] When reoperation is indicated for malnutrition, all authors prefer to use again laparoscopic approach with feasible techniques and safe outcome.

One hundred and fifty-three patients underwent reoperations for malnutrition-related complications in 12 studies[1,5,6,11-17,24,25] in the long-term follow up of 17938 patients (0.84%).

Weight regain/inadequate weigh loss

Another source of debate is the potential risk OAGB patients have to develop weight regain or inadequate weigh loss in the late period. Previous papers define weight regain as more than 10 Kg,[6] or more than 20% of primary weight.[11] Inadequate weigh loss or weight loss failure considered in patients with ≤25% EBMIL.[12,30] We did not find the exact period of these definitions in the literature. Some series did not report any patient (s) with regain or inadequate weight loss.[6,13,15]

Lee *et al*. reported eight patients (out of total 23 revision surgery) with weigh regain/inadequate weigh loss. The treatment was either duodenal switch or biliopancreatic diversion.[11] In Musella *et al*., series 11/2678 patients showed weigh loss failure after 5-year follow-up, they revealed that this late onset complication is significantly correlated with

Table 2: Gastro-esophageal reflux disease related information in published studies

Studies	Patients number	Time frame	Incidence (%)	Risk factors	Conversion (%)
Carbajo *et al.*[32]	209	2002-2004	0	NA	NA
Seetharamaiah *et al.*[18]	101	2012-2015	2	Short gastric pouch, nondependent GJ	NA
Apers *et al.*[9]	287	2012-2013	3.8	Short gastric pouch	RYGB (2.1)
Noun *et al.*[15]	1000	2005-2011	0.4	Revisional OAGB/MGB	RYGB
Hussain and El-Hasani[24]	539	2014-2018	1 (0.18)	NA	RYGB
Alkhalifah *et al.*[5]	1731	2001-2015	8.5	NA	NA
Carbajo *et al.*[13]	1200	2002-2008	2	NA	NA
Musella *et al.*[30]	974	2006-2012	0.9	NA	NA
Bruzzi *et al.*[10]	175	2006-2008	NA	NA	RYGB (1.6)
Lee *et al.*[11]	1322	2001-2009	NA	NA	RYGB (1), LSG, reversal
Taha *et al.*[14]	1520	2009-2015	1.2	NA	Braun JJ
Saarinen *et al.*[34]	13	2014-2015	NA	NA	RYGB
Musella *et al.*[1]	2678	2006-2015	2	Preoperative GERD, short gastric pouch <9 cm	RYGB (1.1), Braun JJ
Chevallier *et al.*[12]	1000	2006-2013	0.7	NA	RYGB
Bolckmans *et al.*, 2018[25]	28 complicated patients	2007-2016	NA	NA	RYGB

NA=Not available; OAGB/MGB=One anastomosis gastric bypass/mini gastric bypass; GJ=Gastrojejunostomy; GERD=Gastro-esophageal reflux disease; RYGB=Roux en y gastric bypass; JJ=Jejunojejunostomy; LSG=Laparoscopic sleeve gastrectomy

Table 3: Malnutrition related information in published studies

Studies	Patients number	Time frame	Number of patients with malnutrition	Distance of GJ from ligament of Treitz[20]	Intervention
Taha *et al.*[14]	1520	2009-2015	3	150-250	Reoperation (not specify)
Rutledge and Walsh[6]	2410	1999-2004	31	180	Division of the GJ, and gastro-gastrostomy
Musella *et al.*[1]	2678	2006-2015	5	165-260	2 - conservative treatment 1 - restaurative laparoscopic surgery 2 - loop resizing
Chen *et al.*[17]	1583	2001-2015	14	NA	Convert to sleeve
Carbajo *et al.*[13]	1200	2002-2008	14	250-350	Medical treatment
Genser *et al.*[16]	2934	2005-2015	26	180	Division of the GJ, and gastro-gastrostomy
Noun *et al.*[15]	1000	2005-2011	4	150 (and increased by 10 cm for each BMI point above 40)	2 - convert to sleeve 2 - total reverse
Chevallier *et al.*[12]	1000	2006-2013	2	200	Medical treatment
Alkhalifa *et al.*[5]	1731	2001-2015	43	150-250	Reoperation (not specify)
Lee *et al.*[11]	1322	2001-2009	9	NA	Reoperation (not specify)
Hussain and El-Hasani[24]	519	2014-2018	1	NA	Shortening of BPL
Bolckmans *et al.*[25]	28 complicated patients	2007-2016	1	NA	Shortening of BPL and conversion to RYGB

GJ=Gastrojejunostomy; NA=Not available; BMI=Body mass index; BPL=Billiopancreatic limb; RYGB=Roux en y gastric bypass

a learning curve <50 cases, the performed management was loop resizing in seven, and pouch resizing in four patients.[1]

Nineteen patients (out of 4010) underwent reoperations for weight regain/inadequate weigh loss in two studies[1,11] in the long-term.

DISCUSSION

One of the most important advantages of OAGB/MGB is simplicity of reversal and revision[6,8] that makes this procedure safe and more popular. Although there are few conditions need revision or reversal after OAGB, all of them can be resolved after redo surgeries.

The important risk factors of MU can be listed as small gastric pouch,[12] cigarette smoking,[1,12,23] NSAIDS,[19,23] corticosteroids,[23] alcohol,[19] application of nonabsorbable sutures,[26] and learning curve < 50 operations.[1] The nicotine of cigarette is an important factor in MU and perforated ulcer,[19] and it needs to PPIs usage for unlimited period after OAGB in smokers, especially after perforated MU disease.[12] that

has comparable incidence with RYGB; if the patient does not respond to first-line medical treatment or complicated MU, revisional surgery is recommended. In this condition, the most popular revisional surgery is conversion to RYGB,[12,16,19,20,26,27] also there is not any consensus for the procedure of choice for revisional surgery, and resizing the gastric pouch. Some surgeons recommend to avoid performing OAGB in smoker patients due to ulcerogenic effects of nicotine.[19] Furthermore, in a survey on 27,672 patients, RYGB, Reversal, Braun JJ, total gastrectomy, laparoscopic sleeve gastrectomy, and Vagotomy were done for this complication.[19]

Some risk factors of post OAGB GERD are preoperative GERD,[1] revisional OAGB,[15] and short gastric pouch, especially <9 cm.[1,9,37] Although symptomatic GERD can be a relative contraindication for OAGB,[2] some authors reported significant improvement of GERD after OAGB.[6,13,21] If GERD is persistent and resistant to optimal medical therapy, revisional surgery must be considered. Maybe the most effective procedure in this sequence is conversional RYGB,[1,8-13,16,20,26,34-37] also there are some different methods such as simple jejunojejunostomy and conversion to RYGB by cutting the loop, gastric pouch shortening and re-anastomosis, biliopancreatic, alimentary, and common limb length modifications. There are some controversies about efficacy of Braun's jejunojejunostomy.[2,8,13,14,20,26]

The malnutrition is a rare and late complication of OAGB. The mechanism of this entity is not clearly defined, but it can cause serious unwanted adverse events, and it will be lethal if leave untreated.[38,39] Despite main reasons are either jejunal bypass-induced malabsorption or restricted ability to ingest protein-rich foods due to small gastric pouch, however other economic, psychological, social, family, and personal factors also play major roles in developing malnutrition.[13] Clinical manifestations of malnutrition include EWL, anemia, and hypoalbuminemia.[40]

To reduce the rates of malnutrition, we suggest that surgeons should avoid using a bilio-pancreatic limb length of > 150 cm.[41]

We did not find objective and approved definition of excessive weight loss in literature, even in ASMBS, and surgery for obesity and related diseases standard methods for reporting bariatric operation outcomes.[42] However, in Chevallier *et al*., series of one thousand patients treated by OAGB excessive weight loss defined as more than 100% EWL and serum albumin level <3 g/dl.[12] Another study considered more than 50% EWL along with albumin level <3.5 g/dl and generalized or peripheral edema without response to nutritional support (i.e., oral and IV).[38] Therefore, there is no accepted definition for excessive weight loss based on our search.

The management of weight regain or inadequate weight loss after OAGB mainly is surgical intervention. Duodenal switch, biliopancreatic diversion, pouch resizing, or lengthening the bypassed intestine are reported by various papers.[1,11]

CONCLUSION

OAGB is now a relatively simple and effective procedure in weight loss surgery and resolution of weight-related comorbidities, with few acceptable complications that can be managed by medical treatment or simple revisional procedures in medical-resistant cases, that surgeons performing OAGB, must be aware these complications and their managements.

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There are no conflicts of interest.

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