JMBS
Journal of Metabolic and Bariatric Surgery

J Metab Bariatr Surg 2016;5(2):45-52

REVIEW ARTICLE

A Safe and Efficacious Alternative to Roux-en-Y Gastric Bypass for the Treatment of Morbid Obesity and Type 2 Diabetes - One Anastamosis / Mini Gastric Bypass

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Roux-en-y gastric bypass (RYGB) is currently used to treat obesity and metabolic syndrome. It is however technically challenging with a steep learning curve and long operating times. Laparoscopitc mini-gastric bypass (LMGB) is another surgical method that is acclaimed to achieve similar efficacy and yet safe with acceptable complication rates. We reviewed current literature on LMGB on its efficacy and safety profile. Comprehensive search of available literature using a combination of key words was performed, looking out for efficacy and safety end points. Efficacy end points include excess weight loss, change in body mass index (BMI), resolution of metabolic syndrome or T2DM remission. Safety end points include mortality and morbidity rates, short and long term complications. 18 studies were selected with a total of 9392 patients. Follow up range was from 1 year to 6 years with majority of studies achieving 57%-92% excess weight loss (%EWL) within 1 year. Remission of T2DM rates were mostly more than 84%. Several studies reported better %EWL and T2DM remission when compared to SG and RYGB. Overall mortality rate was 0.152%. Morbidity rates vary from 2.7%-12.5%. Some studies reported lower mortality and complication rates in LMGB when compared to SG and RYGB. In summary, MGB is a safe and effective metabolic-bariatric procedure in treating morbid obesity and T2DM. It should be considered an alternative to standard RYGB. Risk of bile reflux, marginal ulcer and anemia needs to be explained to the patient when counselling for such procedure.

Key Words: Single anastamosis bypass, Gastric bypass, Roux-en-y gastric bypass, Mini gastric bypass, One anastamosis bypass

INTRODUCTION

Epidemic of morbid obesity is rapidly increasing in the world over the past two decades. Obesity is a significant risk which contributes to increased morbidity and mortality from cardiovascular disease, diabetes, osteoarthritis and sleep apnoea. It is a key component of metabolic syndrome. Bariatric-metabolic surgery has been proven to be more effective than conventional medical treatment in treating obesity and keeping metabolic syndrome and Type 2 Diabetes (T2DM) in remission [1]. Laparoscopic Roux-en-Y gastric bypass (LRYGB) has been shown to be effective in

Received: November 30, 2016, Revised: December 14, 2016, Accepted: December 15, 2016
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achieving significant and durable long term weight loss as well as improvement in metabolic syndrome and causing remission in T2DM [2-5]. However, it is technically challenging with a steep learning curve associated with longer operating times and high perioperative morbidity and complications [6-8]. Laparoscopic mini-gastric bypass (LMGB) is an emerging surgical method, first reported by Rutledge [9] was proposed as a simple, safe and efficacious for the treatment of morbid obesity. However, there are concerns about biliary reflux, risk of malignancy, marginal ulcer and reflux esophagitis after LMGB [10-11]. Thousands of LMGB have been performed and efficacy of LMGB on weight loss and remission of T2DM have been reported [12-14]. We provide a critical evaluation of LMGB on its weight loss efficacy and remission of T2DM together with the safety profile and complications associated with this operation.

MATERIALS AND METHODS

This review was performed by 1 author (CT) who performed the selection of studies and abstracted data. Eligible studies were sought in PubMed, Medline, Cochrane library, Embase and Google scholar for key words "mini gastric bypass", "one anastomosis gastric bypass", "mason loop gastric bypass", "omega loop gastric bypass", "loop gastric bypass" or "single anastomosis gastric bypass". End of search date was 30th October 2016. Eligible articles included single or multi-centered, randomized or non-randomized trials providing results of weight loss, excess weight loss, change in body mass index (BMI), excess BMI loss and resolution of metabolic syndrome or T2DM remission. Results for safety profile of LMGB including complications were also looked at. Only full length articles in English language were considered. Some articles were obtained from the references of these articles. Case reports and studies on children were excluded. The abstracts were reviewed and 18 articles were selected for closer analysis. Table 1 summarize efficacy of LMGB. Extraction of data comprised of first author's name, year of publication, study design, sample size, follow up years, percentage follow up, mean age, percentage of patients with T2DM, pre-operative BMI, post-operative BMI, excess weight loss (EWL), excess BMI loss (EBMIL), weight loss, and percentage of patients with T2DM resolution. Data extraction for safety profile and complications include 30 day mortality, 30 day morbidity, conversion rate, late complications, mean operating time, rate of leaks, major bleeding, marginal ulcer, bile reflux, anaemia and any additional remarks.

RESULTS

1. Operative technique and standardization of name

The original technique was first described by Rutledge [9]. After division of the stomach at the junction of the body and antrum, the long gastric tube is created parallel to the lesser curve with a 36F bougie in place. Width of the gastric tube approximates 2 cm. A loop of jejenum at 200 cm distal to the ligament of Treitz is selected for an end to side stapled anastomosis before closure of the enterostomy. Lee [31] tailored the length of the bilio-pancreatic (BP) limb according to BMI, with a longer BP limb resulting in better BMI reduction in the moderate and high BMI group of patients. Garcia-Caballero [32] described a side to side gastro-jejunal anastomosis and hitching up the afferent limb to the lateral portion of gastric tube in an attempt to reduce bilio-panreatic secretions refluxing into the gastric tube, at the same time avoiding gastric pouch twist. Their group named it the One-Anastamosis Gastric bypass (OAGB), also known as BAGUA—*Bypass Gástrico de Una Anastomosis*, in Spanish.

2. Efficacy-weight loss and resolution of T2DM

18 studies were selected with a total of 9392 patients summarized in Table 1. In the only randomized control trial comparing LRYGB and LMGB, Lee [13] randomized 80 patients into 2 arms, 40 patients in each arm. All of them were followed up for 2 years. LMGB patients' mean BMI dropped from 44.8 kg/m2 to 28.7 kg/m2 within 1 year and an EWL of 64.9% at 1 year and 64.4% at 2 years. 55% of these patients had metabolic syndrome and all of them were resolved after the procedure. There was no significant difference in metabolic resolution rates when compared to RYGB.

Remaining studies were retrospective cohort studies, some comparing MGB to RYGB [20,24,28] while others

Table 1. Efficacy of laparoscopic mini-gastric bypass

Author (year of publication)	Study design	Sample size	Follow up years (%)	Mean age	% patients with T2DM	Pre-op BMI	Post op BMI	EWL/EBMIL	WL, remarks
Lee et al. (2005) [13]	Prospective RCT (RYGB vs MGB)	40	2 (100%)	30.7±8.4	55% metabolic syndrome	44.8±8.8	28.7 (1 year) 28.3 (2 years)	64.9% EWL (1 year) 64.4% EWL (2 years)	100% resolution of metabolic syndrome
Wang et al. (2005) [15]	Retrospective cohort	423	3 (13.8% at 1 year, 7.3% at 2 years)	30.8±9.3	18.7%	44.2±7.0	29.2 (1 year) 28.4 (2 years) 28.8 (3 years)	69% (1 year) 72% (2 years) 71% (3 years)	T2DM remission 100%
Rutledge and Walsh (2005) [12]	Retrospective Cohort study	2,410	5 (68%)	39	83%	46±7	29 (12 months)	80% (1 year)	59 kg (1 year)
Carbajo et al. (2005) [16]	Retrospective cohort	209	2 years (NA)	41	NA	48	NA	75% EWL (1 year) 80% EWL (18 months)	No comments on resolution of T2DM
Peraglie (2008) [17]	Retrospective Cohort study (super super obese)	16	2 (12.5%)	40	NA	62.4	NA	57% (1 year) 65% (2 years)	63 kg (1 year) 72 kg (2 years) T2DM remission not reported
Piazza et al. (2011) [18]	Retrospective cohort	197	2 (96%)	37.9	NA	52.9	39.4 (1 year) 30.3 (2 years) 28.3 (3 years)	65% EWL (1 year) 80% EWL (2 years)	T2DM remission 90%
Noun et al. (2012) [19]	Retrospective cohort	1,000	5 (70%)	33.2±10.2	19%	42.5±6.3	28.4 (60 months)	72.5% EWL (18 months) 68.6% EWL (60 months)	32.85% TWL (60 months)
Lee et al. (2012) [20]	Retrospective cohort study (compare to RYGB)	1,163	5.6 (56%)	32.3±9.1	49.3% metabolic syndrome	41±6.1	27.7 (5 years)	72.9% EWL (5 years)	>80% resolution of metabolic syndrome
Milone et al. (2013) [21]	Retrospective cohort (compared SG vs MGB)	16	1 (100%)	39.3	100%	45.8±5.0	NA	BMI −24.2 (1 year)	T2DM remission 87.5% (1 year)
Musella et al. (2014) [22]	Retrospective cohort	974	5 (84%)	39.4	22.9%	48±4.58	28 (60 months)	70% EWL (1 year) 77% EWL (5 years)	T2DM Remission 84.4%
Kular et al. (2014) [23]	Retrospective cohort (Indian subcontinent)	1,054	6 (84%)	38.4±9.6	64%	43.2±7.4	26.2 (1 year) 25.8 (3 years) 26.2 (6 years)	85% EWL (1 year) 88% EWL (3 years) 85% EWL (6 years)	T2DM Remission 93.2%
Disse et al. (2014) [24]	Matched retrospective cohort (compared OLB to RYGB)	20	1 year (100%)	49.5	40%	40.1	28.8 (6 months) 32.3 (12 months)	76.3% EBMIL (6 months) 89.0% EBMIL (1 year)	T2DM Remission 62.5% at 6 months
Bruzzi et al. (2015) [25]	Retrospective cohort	175	5 year (72%)	50±10	22%	47±8	31±6	71.5 %EBMIL	44 kg (5 years) T2DM Remission 82% at 5 years
Guenzi et al. (2015) [26]	Retrospective cohort	804	26 months (NA)	49±11	12.4%	47±9	35	76% (3 years)	T2DM 88% complete remission at 2 years

Table 1. Continued

Author (year of publication)	Study design	Sample size	Follow up years (%)	Mean age	% patients with T2DM	Pre-op BMI	Post op BMI	EWL/EBMIL	WL, remarks
Peraglie (2016) [27]	Retrospective cohort (age >60)	88	6 (42%)	64	45%	43		67% (1 year) 70% (2 years) 72% (6 years)	T2DM Remission 84%
Jammu and Sharma (2016) [28]	Retrospective cohort (compare MGB/SG/RYGB)	473	53.5 months (52%)	46.5	75.9%	56.5	-	92.2% EWL	T2DM remission 95.1%. EWL% and resolution of comorbidities better in MGB.
Kansou et al. (2016) [29]	Retrospective cohort (compared MGB to sleeve)	161	1 year (88.4%)	41.2±11.3	19.9%	42.8±5.0	26.3 (1 year)	79.3% EWL (1 year)	TWL 38.2±8.4% (1 year), T2DM remission 92.6%. LMGB better TWL than sleeve
Plamper et al. (2016) [30]	Retrospective cohort (compared MGB with sleeve in super obese)	169	1 year (90.8%)	43.2±11.1	41.4%	54.1±6.6	34.9±4.8 (1 year)	66.2% EWL (1 year)	%EWL better in MGB than sleeve
		9,392							

compared MGB to sleeve gastrectomy (SG) [21,28-30]. Peraglie studied a specific subset of patients: the super super obese cohort [17] and in another study, those aged more than 60 years old [27].

Patients were followed up from 1 year to 6 years with a follow up rate ranging from 12.5%-100%. Weight loss in MGB was effective post-operatively, achieving 57-92% EWL within 1 year and maintaining it up to 6 years [27]. T2DM remission rates were mostly more than 84% [18,20-23,26-29] except Dessi [24] who reported a remission rate of 62.5% at 6 months. In more recent publication, Jammu [28] reported the highest %EWL in MGB, followed by RYGB and LSG (92.2%, 72.3%, and 53.6 %, respectively; $P<0.05$). In the same study, for T2DM, 94.4 % of patients stopped T2DM medications a few weeks after MGB, while 76.2% and 59.4% of diabetic patients had resolution of T2DM after RYGB and SG, respectively ($P<0.05$). Kansou [29] and Plamper [30] both reported superior weight loss in MGB when compared to SG at 1 year.

3. Safety-complications of laparoscopic mini-gastric bypass

Table 2 details the summary of complications in the same studies. 9 studies reported 0% mortality in their series. 2 studies did not report their mortality rate. [21,26] In the remaining studies, mortality rate ranged 0.08%-0.9%. Not including the 2 studies where mortality was not reported, overall mortality rate was 0.152%. Morbidity rates vary from 2.7%-12.5%, conversion rates 0.17%-2.5%, mean operating time 37.5 mins to 148 mins. Complications of leaks ranged 0.1%-5.1%, major bleeding 0.2%-5% and bile reflux 0.4%-1.6%. In Jammu's series [28], mortality rates in MGB was lowest at 0%, compared to 2.1% in SG and 0.3% in RYGB; leak rate was also lowest when compared to SG and RYGB, 0% versus 1.5% and 0.3% respectively. Plamper [30] showed that the MGB had 0% 30-day mortality versus 0.8% in SG, and a lower overall perioperative complication rate (3.0% vs 9.3%, $P=0.449$). Iron deficiency anemia rates range from 0.1%-9.7%. Lee [20] found that hemoglobin levels were lower in LMGB compared to LRYGB.

Excessive weight loss was not defined in several of the reviewed studies, it is usually assumed to be %EWL of > 100%. Rutledge [12] reported malnutrition in 1.1% of his

Table 2. Safety profile of laparoscopic mini gastric bypass

Author (publication year)	30 day mortality (%)	30 day morbidity (%)	Conversion Rate (%)	Late complications (%)	Mean operating time (mins)	Leaks (%)	Major bleeding (%)	Marginal ulcer (%)	Bile Reflux (%)	Anaemia (%)	Remarks
Lee et al. (2005) [13]	0	7.5%	2.5% (1 patient)	7.5%	148	NA	NA	5.0%	NA	NA	
Wang et al. (2005) [15]	0.47	4.3	0	17.7	95	0.7	0.7	8.0	NA	9.7	Revision 1.7%
Rutledge and Walsh (2005) [12]	0.08	5.9	0.17	11.95	37.5	1.08	NA	5.6	NA	4.9	Malnutrition 1.1%, Revision rate 1%
Carbajo et al. (2005) [16]	0.9%	3.7%	0.9%	NA	93	1.9	0.9%	NA	NA	0.1%	
Peraglie et al. (2008) [17]	0	12.5% (2 patients)	0	NA	78	NA	6.2%	NA	NA	NA	
Piazza et al. (2011) [18]	0.5%	5.6%	NA	NA	120	NA	3	1.5	NA	NA	
Noun et al. (2012) [19]	0	2.7	0	4.7	89	0.5		5.6	0.4	NA	
Lee et al. (2012) [20]	0.17	8.5%	0.1	NA	115.3	1.3	0.2	0.6	NA	NA	Revision 2.8%
Milone et al. (2013) [21]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Musella et al. (2014) [22]	0.2	5.5	1.2	9.0	95	1.03	2.5	1.7	0.9	5.3	
Kular et al. (2014) [23]	0.18	5.9	0	9%	52	0.1	0.3	0.6	2.0	7.6	Excessive weight loss 0.1%, Revision 0.2%
Disse et al. (2014) [24]	0	10% (2 patients)	0	10% (2 patients)	105 (shorter than RYGB)	0	5% (1 patient, port site bleeding)	5% (1 patient, smoiker	0	NA	10% GERD
Bruzzi et al. (2015) [25]	0	3 month morbidity 7.9	0.8	7.9	NA	0.8	0.8	1.6	1.6, intractable converted to RYGB	3.2	
Guenzi et al. (2015) [26]	NA	NA	NA	7.5	NA	2.4	3.6	4.9	NA	NA	No difference in complication rates between diabetics and non diabetics

Table 2. Continued

Author (publication year)	30 day mortality (%)	30 day morbidity (%)	Conversion rate (%)	Late complications (%)	Mean operating time (mins)	Leaks (%)	Major bleeding (%)	Marginal ulcer (%)	Bile reflux (%)	Anaemia (%)	Remarks
Peraglie (2016) [27]	0	NA	0	NA	71	NA	NA	NA	NA	NA	Overall complication 4.5% (minor) Readmission 1.2%
Jammu and Sharma (2016) [28]	0	NA	NA	NA	57.5	0	0.4	0.6	0.4	4.9	13.1% hypoalbumiemia, MGB 0% leak compared to sleeve 1.4%, RYGB 0.3%
Kansou et al. (2016) [29]	0	NA	0	NA	NA	5.1	1.4	7.6	NA	NA	Stenosis 16.9%
Plamper et al. (2016) [30]	0	3.0	NA	NA	81.7	0.6	1.2	NA	NA	NA	MGB lower 30 day complication rate than SG

patients that required revision surgery. Kular [23] reported a revision rate of 0.2% as well as 0.1% of patients having too much weight loss. Wang [15] reported his revision rate of 1.7%. There was no significant difference in revision rates between MGB and RYGB in Lee's [20] study.

DISCUSSION

This review of the safety and efficacy of MGB shows that this procedure can be performed within a shorter operating time, low mortality and morbidity, at the same time effective in the treatment of morbid obesity, metabolic syndrome and T2DM. Efficacy and safety of LMGB were not inferior to SG or RYGB, surgeons in the community raised criticisms about bile reflux. They were also concerned about symptomatic gastritis and oesophagitis as what occurred in the old Mason's loop gastric bypass [11]. Johnson et al. [10] reported a multicenter review of complications and conversions to RYGB after LMGB.

A total of 18 studies were summarized in this article with an analysis of 9392 patients. It includes a prospective randomized control trial [13] and 6 studies comparing MGB with accepted mainstream bariatric-metabolic procedure; SG and/or RYGB. [20-21,24,28-30]. Since the early publications around 2001, there was a paucity of MGB publication until recently However in recent years; there have been multiple publications around the world, including comparative studies and systemic reviews. [33-36]

LMGB is effective in achieving weight loss; BMI reduction and EWL range 57-92%, for up to 6 years according to the reviewed literature. When compared to RYGB, Lee [13] found EWL to be comparable in 1 study but far more superior to RYGB in another of his study [20]. Jammu [28] showed that MGB compared to SG and RYGB was not just superior in EWL, but also in resolution of comorbidities as well. Kansou [29] confirmed similar results when MGB was compared to SG. Proponents of LMGB favor this procedure as they claim it is safer and more effective than the standard RYGB [20,23]. Our review concurred with their views, with an overall mortality rate of 0.152% and morbidity rates from 2.7%-12.5%. Complications of leaks ranged 0.1%-5.1%, major bleeding 0.2%-5% and bile reflux 0.4%-1.6%.

Limitations of this review were that there was only 1

randomized control trial. Remaining studies were retrospective cohort studies. Some studies follow up were short and often incomplete. Reports between studies varied greatly, which made analysis of comparisons difficult. Late adverse outcomes were poorly reported in many studies. More randomized controlled trials and prospective studies with longer follow up will improve the understanding and durability of this procedure.

CONCLUSION

In summary, MGB is a safe and effective metabolic-bariatric procedure in treating morbid obesity and T2DM when compared to accepted bariatric procedures such as SG and RYGB. It should be considered an alternative to standard RYGB given that it has shorter operating time, fewer short and long term complications, better EWL and more effective in the resolution of T2DM. The risk of bile reflux, marginal ulcer and iron deficiency anemia needs to be kept in mind and explained to the patient when counselling for such a procedure. Further prospective studies or randomized control trials need to be conducted with adequate long term follow will improve current literature on this procedure.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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