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Original Research

Retrospective cohort study of 925 OAGB procedures. The UK MGB/OAGB collaborative group

A. Hussain[a,*], M. Van den Bossche[b], D.D. Kerrigan[c], A. Alhamdani[d], C. Parmar[d], S. Javed[c], C. Harper[c], J. Darrien[c], R. Singhal[e], S. Yeluri[a], P. Vasas[a], S. Balchandra[a], S. El-Hasani[f,g]

[a] Doncaster and Bassetlaw Teaching Hospitals, Doncaster, United Kingdom
[b] Spire Southampton Hospital, Southampton, United Kingdom
[c] Phoenix Health, Chester, United Kingdom
[d] Whittington Hospital, London, United Kingdom
[e] Heart of England Hospital, Birmingham, United Kingdom
[f] King's College Hospitals, London, United Kingdom
[g] Chelsfield Park Hospital, United Kingdom

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ABSTRACT

Background: Mini-One Anastomosis Gastric Bypass is a new operation that provides comparable outcomes to the common bariatric procedures. Revisional surgery is still needed after a number of MGB-OAGB procedures. The aim of this study is to report the causes and management of these revisions.

Methods: From 2010 to 2018, 925 MGB-OAGB operations were performed at 7 bariatric units across the United Kingdom and included in this retrospective cohort study. The data was retrospectively collected and analysed. The primary end point was the identification of the causes and management of revisions. Follow up ranged from 6 months to 3 years.

Results: Twenty-two patients [2.3%] required revisional surgery after MGB-OAGB. Five patients [0.5%] developed severe diarrhoea managed by shortening the bilio-pancreatic limb to 150 cm. Four patients [0.4%] developed afferent loop syndrome and bile reflux was reported in another 3 [0.3%] cases; all were managed by either conversion to Roux en Y Gastric Bypass or a Braun anastomosis. Postoperative bleeding was controlled laparoscopically in 3 patients [0.3%]. Liver decompensation that was reported in 2 patients [0.2%] was treated by shortening the BPL in one patient and a reversal to normal anatomy in another. The liver failure resolved in both patients. Other indications for revision included two gastro-jejunal stenosis [0.2%], one perforated ulcer [0.1%], one patient [0.1%] with excessive weight loss and one case [0.1%] of protein malnutrition. None of the 22 patients undergoing revisional surgery after MGB-OAGB died. Lost to follow up rate was 0.2%.

Conclusion: Complications requiring revisional surgery after MGB-OAGB are uncommon [2.3%] and the majority can be managed by bilio-pancreatic limb shortening, the addition of a Braun side-to-side anastomosis or conversion to RYGB. Bilio-pancreatic limb length of 200 cm or more resulted in serious complications of liver failure, protein malnutrition, excessive weight loss and diarrhoea.

1. Introduction

Primary One Anastomosis Gastric Bypass/Mini Gastric Bypass [MGB-OAGB] has been associated with a very good outcome. The largest UK's MGB-OAGB/series reported more than 500 patients [1] with no mortality but morbidity that warrant revisions in up to 3.9% and in other series up to 3.4% of patients [1–7]. MGB-OAGB is also an acceptable option for revising failed and complicated restrictive operations such as Adjustable Gastric Band [AGB] and Laparoscopic Sleeve Gastrectomy [LSG] with a similar safety profile to Roux EnY Gastric Bypass [RYGB]. Revision to MGB-OAGB has the advantage of being a simpler procedure than RYGB, with better weight reduction; however iron-deficiency anaemia has been reported as a common finding at long-term follow-up [8]. Despite variations in the technique and a lack of consensus on standardisation of the BPL length, meta-analysis and systematic reviews showed MGB-OAGB to be a highly effective procedure compared to the other commonly performed bariatric operations. However it is not fully recognised worldwide due to a variety of

* Corresponding author.
E-mail address: abdulzahra.hussain@nhs.net (A. Hussain).

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reasons, the most important are bile reflux and unknown cancer risk on long-term scales. As with any other bariatric surgery, MGB-OAGB is not without risks, although these risks are common to all types of bariatric surgery. Bile reflux was the most common reason for revision [9]. More serious and potentially fatal complications such as anastomotic leak, liver failure, protein malnutrition and excessive weight loss have also been reported [10,11].

OAGB/MGB is widely used as a third commonly performed primary bariatric procedure after RYGB and LSG [12,13]. Many OAGB/MGB complications are related to relatively longer bilio-pancreatic limb (BPL) (comparing to RYGB), which has led to the adoption of various methods of deciding on the length of the BPL [14–18]. Other indications for revising an MGB-OAGB are afferent loop syndrome and anastomotic obstruction, severe diarrhoea and the complications of anastomosis ulceration such as bleeding, perforation and stricturing. There is general agreement to avoid liver failure, diarrhoea and major nutritional deficiencies, a 200 cm long BPL is the maximum acceptable length [18–20]. However, not all surgeons agree on specific bypassed length [21,22]. The aim of this paper is to report the UK MGB-OAGB collaborative group's experience of revisional surgery for complications after MGB-OAGB. The study did not need ethical approval because MGB-OAGB is an approved routine procedure in the UK. The study is registered on ClinicalTrials.gov with Unique Identifier Number: NCT03859596.

2. Methods

The UK MGB-OAGB collaborative group of 12 consultant bariatric surgeons was founded in 2017 and the data of the MGB-OAGB procedures were retrospectively collected and analysed in this cohort study. The total number of patients who underwent MGB-OAGB was 925. Of which 12 patients underwent MGB-OAGB after LSG and AGB surgeries. Protocol: The treatment pathway is the SAME at each National Health Service [NHS] centre. The indications for referral, pre-operative consultations, dietary management post-operative medications and the follow up after surgery are similar and comply with agreed bariatric practice governed by British Obesity and Metabolic Surgery Society [BOMSS], [http://www.bomss.org.uk/wp-content/uploads/2014/09/BOMSS-guidelines-Final-version1Oct14.pdf], and the National Institute for health and Care Excellence[NICCE] guidelines[https://www.nice.org.uk/guidance/cg189/chapter/1-Recommendations#surgical-interventions]. For all MGB-OAGB operations, the decision to operate is agreed by the operating surgeon and the individual patient after bariatric multidisciplinary team [MDT] decision to go ahead with gastric bypass procedure. The local bariatric MDT decides the need for revision. The presence of reflux and hiatus hernia, Barrett's oesophagus, family history of upper gastro-intestinal cancer, diabetes, Body Mass Index [BMI] and the patient choice were the main factors to influence the decision of the procedure type. Each centre is offering RYGB, LSG, MGB/OAGB and AGB. All of the patients are discussed at the bariatric MDT meetings. The anonymised data were retrospectively collected by the surgical team at each of the seven institutions and electronically sent to the lead of the collaborative group using encrypted system in compliance with data act. The follow up is conducted by clinical visits, blood tests and radiology [ultrasound scan USS and computed tomography CT] when needed. The operations were performed between September 2010 and May 2018. While the principles of the MGB-OAGB technique are followed in each case [long slender gastric pouch, wide gastro-jejunostomy, and suitable length of the bilio-pancreatic limb [BPL], however there were variations in the length/type of the staple cartridge that used to create the anastomosis, hand sewn or stapled Gastro-Jejunostomy [GJ] anastomosis, the length of the BPL, the bougie size, the method of enterotomy closure and the addition of the anti-reflux mechanism that proposed by Carbajo, and the method of the enterotomy closure. The start point of stapling is at the crow's foot. The omentum was only divided in selected cases such as male patients with a very, thick omentum and high BMI. A long gastric pouch of average 15 cm was created over a 34–36F. After identifying the duodeno-jejunal junction, a BPL ranging from 150 to 300 cm was measured [depending on the unit/surgeon's technique]. The end-side or side-side gastro-jejunostomy was made using either hand-sewn or stapled technique. The use of the drains and the closure of Petersen's space were varied between different surgeons. The patients were discharged after 2–3 nights. All patients were prescribed iron, calcium, multivitamins and trace elements, B12 and PPI medications. The follow up was aimed to 3 years. In the UK the NHS and the private practice are following the National Institute of the health and Care Excellence [NICE] guidelines in obesity management and post-operative follow up. Thus there is a very strict follow up after the operation. The patients are seen two weeks after the primary surgery, then every three months for the first year and 6 months for the rest of the follow up until they are discharged to the GPs. If any complications, a different and longer pathway of follow up is adopted until complete recovery and then, they were discharged to their general practitioners [GPs]. The paper was written to comply with STROCSS guidelines [www.strocssguideline.com] [23]. Multiple logistic regression tests were performed to understand the association to the potential factors shown in Table 3 and or prediction of the revisions.

3. Results

In this study 913 patients [98.7%] underwent primary MGB-OAGB, with a further 12 [1.3%] patients had revisions of failed AGB and LSG to MGB-OAGB. The demographic features are highlighted in Table 1. The follow up in this cohort ranged from 6 months to 3 years [mean 2.5 years]. Of the 925 MGB-OAGB procedures, 22 [2.3%] patients developed complications requiring revisional surgery [Table 2]. The revisions and associated risk factors are shown in Table 3. The time scale of the complications is shown in Fig. 1. The most common morbidity was diarrhoea [5 patients, 0.5%]. The BPL length was more than 2.5 m in these patients. This was managed by shortening the BPL to 150 cm. Afferent loop syndrome was clinically and radiologically confirmed in 4 patients [0.4%] and were managed by conversion to RYGB in 3 patients and Braun anastomosis in one. Bile reflux and bleeding were diagnosed in 3 [0.3%] patients. The length of the pouch was more than 15 cm and gastroscopy showed bile in the lower half of the pouch with gastritis. There was no hiatus hernia, esophagitis or bile in the lower oesophagus. No PH study was performed for any patient as the clinical and endoscopic diagnosis was that of bile gastritis/pouchitis. Braun anastomosis was performed for one patient and the other two were converted RYGB.

Table 1
Demographic features, technique and co-morbidities.

Character	No(%)/(mean)	Standard deviation
Primary procedures	913 (98.7%)	
Revisional after LSG&AGB	12 (1.3%)	
Age	19-71 (44) years	11.23
Women/Men	613/312 (66.3,33.7%)	
BMI	33-79 (48)	7.37
BMI > 50	333 (36%) KGS/m^2	
Weight [kilograms]	78-235 (123.4) kgs	23.63
Diabetes	240 (25.7%)	
Obstructive Sleep Apnoea	84 (8.8%)	
Arthritis	273 (29.5%)	
Asthma	61 (6.5%)	
Psychiatric [anxiety/depression]	277.5(30%)	
End-side/side-side GJ anastomosis	728(78%)/(197/21%)	
Biliopancreatic limb length 150/150-250	386(41%)/539(59%)	
Drain use	114 (12%)	
Excess weight loss	43–77% (59)	10.49
Length of stay	2–35 days (2.28)	

Table 2
Causes and management of revisions after One Anastomosis Gastric Bypass.

Revisional surgery/Re operation cause	No (%)	Management
Diarrhoea	5 (0.5%)	Shortening BPL to 150 cms
Afferent loop syndrome	4 (0.4%)	1 Braun/3 RYGB
GORD	3 (0.3%)	2 RYGB,1 Braun
Bleeding	3 (0.3%)	Exploration/bleeding control
Gastro--jejunostomy stenosis	2 (0.2%)	Revision of anastomosis
Liver decompensating/Failure	2(0.2%)	1 Shortening BPL/1 Reversal
Protein malnutrition	1(0.1%)	Reversal to normal anatomy
Excessive weight loss	1 (0.1%)	Shortening BPL to 150 cm
Perforated ulcer	1(0.1%)	Repair with patch
Total	22(2.3%)	

Post-operative bleeding was explored and controlled laparoscopically in 3 [0.3%] patients. Less commonly encountered complications, with an incidence of 0.2 and 0.1% included an early gastro-jejunal stenosis due to excessive oedema/technical narrowing [treated by refashioning the gastro-jejunal anastomosis within the first week and a perforated stomal ulcer [laparoscopic patch repair after 6 months of the operation]. This perforation developed after radiological dilatation of the GJ stricture. Excessive weight loss in two other patients who had BPL length of 300 cms was managed by shortening of the BPL to 150 cm. The BMI before and after the primary operation was 48,52 and 16,17 kg/m^2 respectively. One of the most serious problems encountered after MGB-OAGB was liver decompensation/failure, which was reported in 2 patients [0.2%]. It was almost certainly the result of an excessive malabsorption resulting from a BPL that was too long. Complete reversal of the MGB-OAGB to normal anatomy was required in one patient and shortening of the BPL to 150 cm in the other. Two patients [0.2%] declined follow up after initial 10 months period. The 30-day mortality for the 22 patients undergoing revisional surgery to treat complications of MGB-OAGB was zero. The revision rate was 3.09–4% for the units that adopted longer bilio-pancreatic limb [200–300 cm] and the units that have done more than 90 MGB-OAGB operations, while it was 0–4% for the other units [BPL of 150 cm or less, performed less than 90 procedures]. The logistic regression analysis showed significant association/prediction for bile reflux with smoking, steroids use and bilio-pancreatic limb length [p value 0.014]. There was significant association between diarrhoea and the female gender, hypertension, stapled anastomosis and the BPL length [p value 0.0013]. There is no significant association between the other revisions and the factors shown in Table 3. The overall revision rate was 2.3%.

4. Discussion

The most important finding of this largest UK MGB-OAGB study to date was the outstanding safety and low revision rate of the MGB-OAGB on short-midterm follow up. A published meta-analysis of primary MGB-OAGB showed an overall major complication rate of 3.4% [4]. The results of this study compare favourably with a revisions rate of 2.3% due to major complications. None of the patients failed to lose weight. The initial MGB-OAGB studies reported low [0.14%] overall mortality(4). This was comparable to the British Obesity and Metabolic Surgery Society BOMSS cumulative mortality figure for more than 20,000 patients operated upon during 2012–2016[www.bomss.org.uk].Out of the 925 MGB-OAGB operations, we revised 22 [2.3%] for variety of acute and mid-term complications, the commonest of which was intractable diarrhoea that was invariably associated with a long BPL of more than 2 m. All revisions were preceded by optimisation of the nutritional status. Dismantling the GJ by stapling just above the anastomosis and creating a new one at 150 cm from the duodeno-jejunal junction [DJJ] had resulted in complete resolution of the diarrhoea [revisability]. Diarrhoea has been widely reported previously, although not in Dr Rutledge's first study of 1274 patients [19,24,25]. We aimed to shorten the BPL in case of protein malnutrition or diarrhoea. However, in severe cases we have no hesitation to reverse the procedure purely for safety and after warning the patients of weight regain.The afferent loop syndrome, ALS [20] is a recognised complication after Billroth II, RYGB and Wipple's reconstruction [26,27] and it was our second commonest complication, occurring in 4 patients [0.4%]. The long BPL and ante-colic anastomosis of an MGB-OAGB are possible predisposing factors, but the most credible explanation is a technical fault during creation of the gastro-jejunal anastomosis. The abdominal pain, vomiting and distension were the most common symptoms. Clinically diagnosed ALS is usually confirmed during

Table 3
Causes of revisions and the associated potential risk factors. EWL (Excess weight loss), GJ (Gastro-jejunostomy), LFTs (Liver function tests), ALS (Afferent loop syndrome).

Revision	BMI Kgm/^{2}m	M/F	Hypertension Yes/No	Smoking Yes/No	Steroid Yes/No	Stapled/hand anastomosis	BPL [cm]	P value
Perforated stomal ulcer	51	M	Y	Y	N	Hand	210	0.3208
ALS	54	F	N	N	N	Hand	200	0.254
	50	F	N	N	N	Hand	180	
	49	F	N	N	N	Hand	200	
	44	F	Y	N	N	Hand	160	
Bleeding	50	F	N	N	N	Stapled	150	0.664
	45	F	N	N	N	Stapled	150	
	41	F	Y	N	N	Hand	150	
Deranged LFTs/Liver failure	50	F	N	N	N	Hand	300	0.0629
	52	F	N	Y	N	Hand	350	
Diarrhoea	40	M	N	N	N	Stapled	200	0.0013
	46	M	Y	N	N	Stapled	230	
	73	F	N	N	N	Stapled	220	
	42	F	N	N	N	Stapled	180	
	45	F	N	N	N	Stapled	200	
GJ stenosis	47	F	Y	Y	N	Hand	150	0.629
	43	F	N	N	N	Hand	150	
EWL	49	F	Y	Y	N	Hand	250	0.328
Bile reflux	42	F	N	N	Y	Stapled	150	0.0143
	39	M	N	Y	N	Stapled	180	
	45	F	N	N	N	Hand	200	
Protein malnutrition	73	F	N	N	N	Stapled	220	0.328
Total 22(2.3%)								

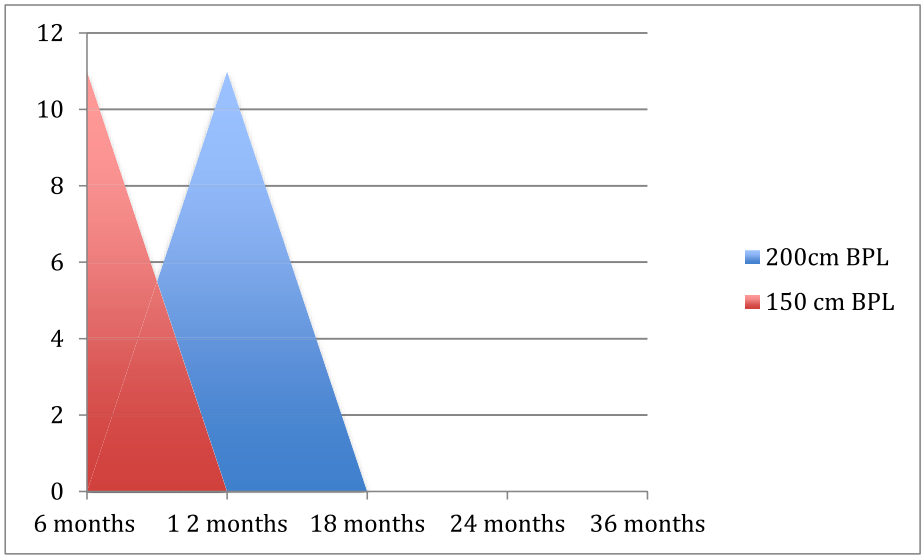

Fig. 1. Time scale and number of complications.
[Number of patients]
150
cm BPL complications are: Gastro-jejunostomy stenosis [2], GORD [3], Perforated ulcer [1], Afferent loop syndrome [2], Bleeding [3]
> 200
cm BPL complications are: Liver failure [2], Diarrhoea [5], Protein malnutrition [1], Excessive weight loss [1], Afferent loop syndrome [2].

laparoscopy while computed tomography [CT scan] may suggest the diagnosis when the BPL and the gastric remnant are abnormally distended in the presence of a collapsed common limb. Laparoscopic revisions of the anastomosis, correction of any obstruction or kinking or revision to RYGB are all possible treatment options [28,29]. Bleeding from the anastomosis and the gastric pouch staple line was reported in 3[0.3%] of our patients all required blood transfusion and laparoscopic control of bleeding with sutures, despite an attempt at endoscopic control in one patient.

Bile reflux and potential malignancy are the major criticisms of the MGB-OAGB procedure. Bile reflux was reported to be less than 1% in previous powerful studies [20,30–32]. There is a lack of any published data reporting an increased risk of upper GI malignancy in OAGB patients [30]. Previous long-term study [22–30 years] of 1000 patients who had Billroth II operation [which is similar to the MGB-OAGB being having one GJ anastomosis with possible bile reflux] for peptic ulcer showed no significant risk of cancer than the general population within the first decades after operation [33]. Recent Chevalier's study showed no dysplastic changes or cancer in rats after 16 weeks of bile reflux exposure. This is equivalent to 12–16 years of human life [34]. The MGB-OAGB is creating a low-pressure system compared to pylorus-preserving operations like LSG and single anastomosis duodeno-ileal [SADI] procedures. Furthermore, LSG and SADI can also be associated with significant reflux [35]. Gagner et al. reported gastro-oesophageal reflux symptoms in 31% of patients with 8 years follow up after LSG [36]. Non-alcoholic fatty liver disease [NAFLD] and non-alcoholic steatohepatitis [NASH] affects 75–100% and 24–98% of patients with severe obesity respectively [37]. There is evidence that bariatric surgery could improve NAFLD and NASH disease [38–41]. We don't fully understand why some patients can decompensate after bariatric surgery and develop acute fulminant liver failure with an associated high mortality. Brolin et al. showed that in the presence of liver cirrhosis, gastric bypass can result in a 3% mortality [42]. More metabolically powerful operations like Scopinaro's bilio-pancreatic diversion [BPD] have been followed by liver failure requiring transplantation [43]. These observations are dictating a tailored approach of surgical planning is required in every bariatric patient [44,45]. The data of the pre-operative liver disease in our cohort is lacking and therefore their effects on the outcomes of surgery are not known. Two of our patients [0.2%] developed liver failure. Neither had a history of liver disease and they were not excessive drinkers. The metabolic consequences of an excessively long BPL were the most likely contributory factor. Interestingly, previous studies have not confirmed a strong association between a BPL greater than 200 cm and liver failure [18,46]. Fortunately, both patients were successfully managed by either complete reversal [reversibility] of the MGB-OAGB or shortening of the BPL to 150 cm. Liver function normalized in the first few weeks after revisional surgery.

We reported 2 gastro-jejunostomy stenosis [0.2%] that needed revision of the anastomosis using 45 mm cartridge and closure of the enterotomy with sutures. This problem is common to all gastro-intestinal GI anastomosis. The incidence after RYGB could reach 6.8% [47] and can be managed by endoscopic dilatation. Our patients developed severe stenosis that was not amenable to endoscopy dilatation. The operation was reversed to normal anatomy in one patient [0.1%] who developed persistent protein-calorie malnutrition. Previous MGB-OAGB studies confirmed less than 5% revision rate and about 50% of these revisions were due to protein-calorie malnutrition(4). Our very low complication of the protein malnutrition could be explained by the fact that majority of our group adopted 150 cm as the maximum safe BPL length. Reversals to LSG, to normal anatomy or shortening the BPL are all valid options, but each case has to be taken on its merits. One patient [0.1%] developed perforation of a stomal ulcer that was successfully managed by an emergency laparoscopy and patching of the ulcer. Both MGB-OAGB and RYGBcould be complicated by stomal ulceration, with an incidence after RYGB of 0.6–16%, while the ulcer perforation could be as high as 1% [19,48]. A lower [1.5%] incidence of stomal ulceration has been reported after MGB-OAGB. One of the features of the MGB-OAGB is the ability to adjust the BPL length [adjustability]. BPL of 200 cm or more could result in excessive weight loss requiring revision. This was the case with only one patient [0.1%] in this series; after the BPL was shortened to 150 cm he maintained his weight within an acceptable range. We noticed that the BPL of 200 cms and above had resulted in serious complications of protein malnutrition, liver failure and diarrhoea, but with an excellent excess weight loss of 77–100%.

On the other hand a BPL length of 150 cms had produced an acceptable EWL comparable to the RYGB in most studies, and no aforementioned serious complication. So to be on the safe side a length of150 cms is considered preferable option. Two patients declined the routine follow up [0.2%].Limitations of the study: This is a multi-centre study of 7 units and 12 surgeons that were involved in reflecting on their early experience of a procedure relatively new to the UK. We expect some of the reported complications be associated with our learning curve. The length of the BPL and all serious complications of protein malnutrition dictate the power of the procedure. Diarrhoea and liver failure developed with a BPL of 200 cm or more. The stomal ulcers and the ALS are potential complications. This does not mean that these

complications will not happen, but we expect the complication rate in our next 1000 MGB-OAGB to be even lower through adopting 150 cm as the longest BPL length. There were differences between surgeons in the bougie size, the gastric pouch creation technique, the BPL length, the method used to create the GJ anastomosis and the use of drains. This heterogeneity may have influenced some of the outcomes reported.The other limitation of this study is the follow up. It is a short-midterm study and a longer period of follow up is needed in order to identify important potential late complications of the MGB-OAGB such as bile reflux and the risk of dysplasia and malignancy in the UGI tract, although the current study was reassuring in that respect with no cases of cancer, dysplasia or Barrett's changes in symptomatic patients who were objectively assessed by endoscopy and histology.

All revisions were declared by the individual surgeon who checked the accuracy of his/her data. There are possible confounding factors in reporting these revisions. One of the factor is the number of the patients who had completed the follow up of 3 years and were discharged but revised at other centres.No data were available for them. The other factor is the non-inclusion of the recent revisions/complications because it did not fall within the study period, which may potentially influence the revision rate. The variability in the technique, the size of the stoma, the orientation of the gastro-jejunostomy, the application of the anti-reflux sutures, the fixation of the anastomosis, the type/size of stapler cartridge, the creation and method of the enterotomy closure, may affect the results.

5. Conclusions

The number of patients who require revisional surgery to treat post-operative complications after MGB-OAGB is small [2.3%] and either shortening the BPL, addition of a Braun anastomosis or conversion to a RYGB can successfully and safely manage them. Creation of a BPL longer than 200 cm was an important pre-disposing factor for the most serious complications. The data of this study suggest 150 cm as the safest BPL length that could avoid serious nutritional deficiencies, liver failure and diarrhoea. A further RCT comparing the BPL length of 150 cm to 200 cm or more is needed to confirm our findings.

Ethical approval

Not applicable as it is retrospective study of routine operation.

Sources of funding

No fund for this study.

Author contribution

All authors contributed to data, data collections, reviewing/editing and approving the final version.

Conflicts of interest

No conflict of interest in relation to this study.

Trial Registry Number.

The study was registered on clinicaltrials.gov UIN: NCT03859596.

https://clinicaltrials.gov/ct2/show/NCT03859596?cond=mini+gastric+bypass&draw=2&rank=11.

Guarantor

MR A HUSSAIN.

Consultant bariatric surgeon at Doncaster and Bassetlaw teaching hospitals.

Doncaster UK.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Provenance and peer review

Not commissioned, externally peer-reviewed.

CRediT authorship contribution statement

A. Hussain: Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing, Conceptualization, Software, Formal analysis, Writing - original draft, Visualization, Supervision, Project administration. **M. Van den Bossche:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **D.D. Kerrigan:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **A. Alhamdani:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **C. Parmar:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **S. Javed:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **C. Harper:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **J. Darrien:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **R. Singhal:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **S. Yeluri:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **P. Vasas:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **S. Balchandra:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing. **S. El-Hasani:** Methodology, Validation, Investigation, Resources, Data curation, Writing - review & editing, Conceptualization.

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Appendix A. Supplementary data

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