Title: One Anastomosis Gastric Bypass - Key Technical Features, and Prevention and Management of Procedure-Specific Complications

Short Title: One Anastomosis Gastric Bypass

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Abstract:

Introduction: One Anastomosis Gastric Bypass (OAGB) is now a recognised mainstream bariatric procedure being adopted by an increasing number of surgeons. The purpose of this review was to present an evidence-based summary of its key technical aspects and prevention and management of its specific complications.

Evidence Acquisition: We examined PubMed for all published articles on OAGB, including the ones published under one of its various other names.

Evidence Synthesis: An ideal OAGB procedure has a long, narrow pouch constructed carefully to avoid going too close to the greater curvature of the stomach especially at the bottom of the pouch, and maintains a safe distance from the angle of His. A Bilio-Pancreatic limb length of 150 cm appears to be safest and a limb length of > 200 cm is associated with a significantly increased incidence of protein-calorie malnutrition. We recommend routine closure of Petersen's space to prevent Petersen's hernia and suggest a protocol for micronutrient supplementation. This review also presents evidence-based algorithms for prevention and management of marginal ulcers, protein-calorie malnutrition, and Gastro-Oesophageal Reflux Disease after OAGB. We suggest lifelong supplementation with two multivitamin/mineral supplements (each containing at least 1.0 mg Copper and 15 mg Zinc) daily, 1.5 mg vitamin B12 orally daily or 3-monthly injection with 1 mg vitamin B12, 120 mg elemental iron daily, 1500 mg elemental Calcium daily, and 3000 international units of vitamin D daily.

Conclusion: This review examines key technical steps of OAGB. We also discuss how to prevent and manage its specific complications.

Key Words: One Anastomosis Gastric Bypass, Mini Gastric Bypass, Omega Loop Gastric Bypass, Single Anastomosis Gastric Bypass, Technical steps, pouch, Bilio-Pancreatic limb, Complications, Micronutrient Supplementation

Introduction:

The historic controversy surrounding One Anastomosis Gastric Bypass (OAGB) [1-2] seems to have settled and it is now recognised as a mainstream bariatric procedure by the bariatric community [3] and the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) [4].

Though there is little doubt that gastric bypass is an effective bariatric and metabolic procedure with a track record demonstrated over several decades, there is now an increasing recognition that Roux-en-Y configuration for a gastric bypass comes at a price [5]. Not only does this configuration make the gastric bypass technically more demanding with a long learning curve, it is also associated with a definite long-term incidence of internal herniae and chronic abdominal pain [6] that is proving difficult to ignore. These drawbacks have led to surgeons trying several new procedures like vertical banded gastroplasty and gastric banding over the past 30 years. But the meteoric rise of these simpler alternatives was only matched by a precipitous fall as the issues of long-term complications and lack of durability became apparent.

OAGB, on the other hand, is a gastric bypass [7], the only difference with Roux-en-Y Gastric Bypass (RYGB) being in the longer pouch, longer Bilio-Pancreatic Limb (BPL), and absence of Alimentary Limb (AL). It is hence unsurprising that OAGB has been found to yield meaningful improvement in obesity - and its associated co-morbidities - over prolonged periods of time [8]. With these durable outcomes achievable at lower risks compared to RYGB [9] and thousands of articles in the scientific literature confirming the durability of gastric bypass since it was first conceived as a bariatric procedure [10] some 50 years ago, OAGB is set to gain more popularity.

It is hence important to understand its key technical details, postoperative care of patients undergoing it, and prevention of management of its specific complications. The purpose of this review is to summarise these practical aspects of OAGB in one place for newer surgeons wishing to adopt this procedure.

Evidence Acquisition

An online search of PubMed was carried out using key-words like, ‘bariatric surgery', ‘gastric bypass, ‘One Anastomosis Gastric Bypass (OAGB)’, ‘Mini Gastric Bypass’, ‘Omega Loop Gastric Bypass’, ‘Single Anastomosis Gastric Bypass’, ‘Loop Gastric Bypass’, and ‘' to identify all articles on OAGB. Articles were also identified from references of relevant articles. Last of these searches were carried out on 20th June’ 2018.

Given the relative lack of Level 1 evidence and the nature of the topic, we did not think a meta-analysis or a systematic review was feasible. We hence felt an evidence-based narrative review, which takes into account the published evidence as well as our own experience would be the best way to achieve the objectives of this paper.

Evidence Synthesis: For the ease of presentation, we have sub-divided the available evidence in following subsections.

1. Technical Details

OAGB essentially involves the creation of the longest possible gastric pouch that the patient's gastric anatomy would allow followed by an anastomosis between the bottom of the pouch and the jejunum, approximately 150 cm distal to the Duodeno-Jejunal flexure [11-12] (Figure 1).

i) Construction of the Gastric Pouch: In the first consensus statement on OAGB [3], 94.0 % of experts agreed that the construction of the gastric pouch should start in the horizontal portion of the lesser curvature. Carving out the longest possible gastric pouch usually means that a portion of the pyloric antrum has to be incorporated in the gastric pouch but surgeons should be careful to always maintain a distance 2 cm from the greater curvature of the stomach to prevent acute gastric dilatation [13].

The first firing is usually with a 45-mm stapler pointing towards patient's left iliac fossa with a second firing using a 45-mm parallel to the greater curvature pointed towards the middle of the left arm [11] to create a wider lower end for the anastomosis. The rest of the length of the pouch is then constructed using 3-4 firings of 60 mm stapler over a 36 Fr orogastric tube ending just lateral to the fat pad anterior to the intra-abdominal oesophagus. Care must be taken to maintain an equal anterior and posterior wall to prevent twists and kinks. The usual tendency to take more posterior wall causes the pouch to the twist. Dissection at the roof of the lesser sac is carried out medial to all the short gastric vessels and it is unusual to need to divide any vessels for this step of the operation.

In the consensus paper [3], 96.0 % experts agreed that it was acceptable to use orogastric tubes of sizes varying between 32 Fr – 40 Fr and 77.0 % of them agreed that surgeons should avoid getting too close to the angle of His to avoid leaks in this area. There was a further consensus amongst 86.0 % experts that routine use of staple line reinforcement was necessary. Though additional sutures are sometimes needed at the end of the procedure to prevent the tube from twisting, particularly between the right side of the lower end of the pouch and the bypassed

stomach, routine use of anti-reflux sutures or technique was regarded as unnecessary by 81.2 % experts. On the role of the routine crural approximation in patients with a hiatus hernia, there was no consensus but a significant 63.3 % experts felt it unnecessary. We avoid any dissection in the hiatal area unless the patient has a para-oesophageal hernia that needs reducing.

ii) Measurement of Bilio-Pancreatic Limb: Long gastric pouch that usually reaches below the greater curvature of the stomach further means that the routine division of the Greater Omentum is unnecessary for a tension-free gastro-enterostomy and in the consensus paper, 81.2 % experts agreed with this. The small bowel bypass length is measured from the Duodeno-Jejunal flexure which needs to be positively identified after lifting the Transverse Colon. The bowel is rotated clockwise and anastomosed at a point approximately 150-200 cm distal to the Duodeno-Jejunal flexure with the lower end of the gastric pouch using a 45-mm linear stapler.

In the consensus statement, 78.2 % experts agreed that it was acceptable to use a routine BPL of 200 cm with careful monitoring but surgeons should recognise that use of a 180-200 cm BPL is associated with an approximately 1.0 % incidence of severe protein-calorie malnutrition requiring revision [14] and that a BPL of 150 cm will reduce the incidence of particular complication to close to zero [15]. There is further no evidence that bypassing longer than 150 cm of small bowel improves the outcomes with a gastric bypass [16]. Surgeons adopting a tailored limb length depending on patient's body mass index, co-morbidities, eating habits etc. as advocated by Lee et al [17] should be prepared for a higher incidence of protein-calorie malnutrition [15] and liver failure [18] and should be aware that outcomes with a gastric bypass are not proportionate to the length of small bowel bypassed [16, 19]. In the consensus paper, 79.2 % of experts agreed that it was unnecessary to measure the total small bowel length. We do not recommend routinely measuring the entire small bowel limb length as that can increase the risk of injury to bowel and it would further seem unnecessary as we advocate a standard BPL length of 150 cm in all our patients undergoing OAGB.

iii) Gastro-Intestinal Anastomosis: Surgeons should avoid making the anastomosis too narrow as that might lead to impaired clearance of acid from the pouch and predispose to symptoms of acid reflux. At the same time, if one is using a linear stapler to perform the anastomosis, as most surgeons do [20], surgeons should be careful not to use too long a stapler as that reduces the

effective pouch length and can predispose to bile reflux similar to Mason's original loop bypass where fundus was stapled horizontally and anastomosis was placed too high on the stomach. We use a 45-mm linear stapler in our practice inserted at the most dependent part of the pouch usually at the junction of the first two 45 mm firings [11], followed by a 2-layered closure of the stapler entry site using 2 0 Vicryl ®continuous sutures.

iv) Final Steps: A leak test is recommended by 93.0 % experts and we routinely perform this in our patients at the end of the procedure using a dilute methylene blue solution. Petersen's hernia is rare after OAGB [21] and that is probably why 82.2 % of experts in the consensus paper felt that routine closure of this space was unnecessary but an increasing number of cases Petersen's hernia are now being reported [22] and this has led to us now closing these defects routinely in our practice. Closing this space may further have the advantage of anchoring small bowel inferiorly thus preventing the twist of the gastric tube and anastomosis. Admittedly, this will make revising the BPL length for protein-calorie malnutrition more cumbersome but with our standard length of 150 cm for BPL, it should be a very rare complication [15]. Routine placement of nasogastric tubes and surgical drains is unnecessary and was agreed by 92.0 % and 78.0 % experts respectively in the consensus exercise [3].

v) Postoperative Care: Early postoperative care of patients undergoing OAGB is not vastly dissimilar to RYGB patients as essentially it is a gastric bypass [7]. Patients can be allowed sips (up to 30 ml of water per hour) from a few hours after surgery. Routine use of nasogastric tubes and postoperative contrast studies were regarded as unnecessary by 92.0 % and 85.1 % of experts respectively in the consensus paper [3]. We allow patients to drink 1.0 litre of water on the first postoperative day and discharge them home on liquid/pureed diet for 4 weeks on the morning of the second postoperative day. After 4 weeks, patients are advised to gradually increase the consistency of the food and by the end of 3-4 months, most of our patients are eating three small meals a day off a tea-plate.

Patients should preferably be seen by a pharmacist with knowledge of bariatric surgery before being discharged home on Proton Pump Inhibitor (PPI) for marginal ulcer prophylaxis, Deep vein thrombosis prophylaxis, Ursodeoxycholic acid for gallstone prophylaxis, and nutritional

supplements for prophylaxis of micronutrient deficiency. In addition, patients' existing medications like Non-Steriodal anti-inflammatory drugs (NSAIDs) may need to be stopped or amended (anti-diabetic medications).

2. Prevention and Management of Acute Gastric Dilatation

While trying to achieve the longest possible gastric pouch with OAGB, surgeons should be careful not to go too close to the greater curvature [11] as that can then compromise the outlet of the bypassed stomach resulting in acute gastric dilatation in the early postoperative period [13]. We advise maintaining a 2-cm distance from the greater curvature at all times during construction of the OAGB pouch especially the bottom.

This condition should be kept in mind in patients presenting with abdominal pain in the early postoperative period. Diagnosis is easily established on a Computed Tomography (CT) scan. It can be treated either by percutaneous drainage of bypassed stomach followed by radiological dilation at a later date [23] or surgically by anastomosing parts of the stomach, proximal and distal to the narrowed segment, to each other [13].

3. Prevention and Management of Anastomotic Leaks

Leaks from the gastro-jejunal anastomosis with an OAGB are disastrous complications but fortunately almost entirely avoidable as vascularity of the tissues is seldom in question. In our unit, we have performed close to 500 OAGB procedures without any leaks so far. In the whole of the OAGB, only vessels divided are 2-3 small branches of the right gastric artery to gain entry into the lesser sac and small bowel mesentery is not divided at all. Even at the roof of the lesser sac, surgeons can usually avoid dividing any short gastric vessels, if they work medial to the most medial short gastric vessel. Furthermore, the gastrojejunal anastomosis in an OAGB is under considerably less tension compared to the RYGB, even when Omentum is not divided, because of a significantly longer pouch. We close stapler entry holes in 2 layers using 2 0 Vicryl and believe our 2-layered closure helps prevent leaks by further reducing tension on the first layer. We further check for mechanical integrity by performing a methylene blue leak test at the end of the procedure.

However, leaks can happen and have been reported in approximately 1.0 -1.5 % of patients [2, 24-25]. A high index of suspicion is necessary and patients with a persistent heart rate of >120/min should undergo a CT scan with a water-soluble contrast for confirmation of diagnosis. Many of these patients will have basal atelectasis and can, therefore, be appropriately treated with antibiotics and chest physiotherapy. One should also bear in mind that CT scan may miss leaks and patients with persistent unexplained tachycardia or sepsis should be offered prompt laparoscopy.

When they do happen, leaks should be managed along the established general surgical algorithms that involve treatment of sepsis, provisions for nutrition, and control of leak. In one study, emergency conversion to RYGB has been found to reduce morbidity and hospital stay in leaks with OAGB [24].

Leaks from other areas like the staple lines or iatrogenic injury can usually be avoided by choosing appropriate staplers, staying away from the incisura and the angle of His, meticulous haemostasis, and careful attention to established principles to laparoscopic surgery to avoid bowel injuries. Any serosal tear should be sutured promptly and surgeons should ensure haemostasis by ensuring the patient has a normal blood pressure at the end of the surgery [26]. We believe preventing haematomas in the vicinity of staple lines helps prevent late leaks caused by infected haematomas.

4. Prevention and Management of Marginal Ulcers

The risk of marginal ulceration with OAGB at approximately 2.0 -5.0 % [2, 27-29] seems similar to that with RYGB and though there are no studies in the scientific literature specifically evaluating the risk factors of ulcers after OAGB, it seems risk factors are similar too [29]. We advise, and insist, smokers stop smoking prior to the surgery. We screen, and eradicate as appropriate, all our patients for Helicobacter Pylori at the time of their routine preoperative check endoscopy. We further advise all our patients to avoid NSAIDs postoperatively. We further recommend routine PPI prophylaxis with Lansoprazole 30 mg daily for at least six

months. In those who continue to smoke, or are unable to avoid non-steroidal or steroidal anti-inflammatory drugs, we recommend long-term prophylaxis with Lansoprazole 30 mg daily.

When these ulcers happen, they can be treated in much the same way as we treat ulcers after RYGB [30]. Figure 2 presents our treatment algorithm for these ulcers based on our own experience [28] and that of others [29] who perform this procedure. Perforated ulcers can be managed by laparoscopic closure with an Ometoplasty and drainage and bleeding ulcers can be managed with PPI +/- endoscopic intervention as needed [29]. A conversion to RYGB has been suggested for non-healing ulcers [29, 31]. At the same time, one has to recognise that evidence base for most of these practices is rather limited.

5. Prevention and Management of Protein-Calorie Malnutrition

In OAGB, all of the small bowel is bypassed as BPL as opposed to RYGB where a portion of the small bowel is also bypassed as AL. BPL is the only limb which is completely bypassed and hence unavailable for absorption of micronutrients and calories. It is therefore unsurprising that longer BPL results in better weight loss outcomes with RYGB [DD]. OAGB was first conceived with a BPL length of 200 cm [32] which is significantly longer than 50-100 cm long BPL most surgeons use with RYGB. This is probably why OAGB has been found to yield superior weight loss outcomes to RYGB [33].

At the same time, even with RYGB, it has been found that a combined BPL and AL length of 150 cm gives optimum results and that bypassing longer lengths of small bowel does not significantly enhance weight loss outcomes but does increase the incidence of protein-calorie malnutrition [16]. It is therefore unsurprising that OAGB is associated with a definite protein-calorie malnutrition rate [2,15] particularly when surgeons use a BPL length of 200 cm or more [9, 14, 34]. This has even led to deaths [35] and one fails to see how a BPL length of 200 cm is needed for OAGB where all of the bowel is bypassed as BPL when even for RYGB with a much shorter BPL limb, the total small bowel bypass length should probably be no more than 150 cm [16]. We believe a standard BPL length of 150 cm with OAGB will significantly reduce the protein-calorie malnutrition rates without significant loss of efficacy of the operation [12,15]. This is especially important because there is no linear relationship between bypassed small bowel length beyond

150 cm with a gastric bypass and weight loss outcomes though surgeons have often presumed it under the misguided assumption that malabsorption accounts for a significant proportion of clinical response seen with RYGB and OAGB [3,19]. Surgeons bypassing longer lengths of BPL should be aware that though human beings can live on as short as 100 cm small bowel without need for lifelong parenteral nutrition when the pylorus, duodenum, and the colon are preserved [36], there is no data on minimum length of common channel that is needed to prevent protein-calorie malnutrition in the context of a gastric bypass where pylorus and duodenum are both bypassed too. Even a common channel of 300 cm with an OAGB can be associated with a hypoalbuminaemia rate of approximately 14.0 % [37] and that even longer common channels are not completely safe [34]. It is, therefore, our belief that the standard length of BPL should be no longer than 150 cm with OAGB, and possibly even shorter [12]. This would dramatically reduce the protein-calorie malnutrition rates with this operation from previously reported levels of approximately 1.0 % [9] to < 0.1 % [15]. At the same time, the practice of tailoring the BPL limb length according to patient characteristics like Body Mass Index (BMI) [17] should be abandoned as there is no evidence it improves weight loss outcomes but there is significant evidence that it increases protein-calorie malnutrition rates requiring re-intervention [15, 38].

Treatment options include reversal [14,34], conversion to RYGB [15, 39], conversion to Sleeve Gastrectomy [15, 40], and shortening of the BPL [15] but the reversal remains the most popular method [15] of dealing with this life-threatening complication. When it comes to reversal, though surgeons have described reversal without resecting the gastro-jejunostomy where the gastro-enterostomy is taken down at the lower end of the pouch without compromising the bowel lumen followed by an anastomosis between the gastric pouch and the bypassed stomach [D], it seems the morbidity is lower when gastro-jejunal anastomosis is resected followed by two anastomoses – the first one between the pouch and the bypassed stomach and the second one between two ends of jejunum [34]. However, the morbidity in this series in patients who underwent reversal without resection of the anastomosis was probably due to too low transection of the pouch as evident from jejunal stenosis in 3/14 patients and jejunal leak in 1/14 patients. We hypothesise that it would probably be safer to accept a bit of stomach wall on the jejunum rather than the other way around when performing reversal without resecting the anastomosis.

6. Prevention and Management of Gastro-Oesophageal Reflux Disease

Approximately 5.0 – 10.0 % of patients report symptoms of Gastro-Oesophageal Reflux Disease (GORD) after OAGB. Though there has been much controversy about bile reflux following this procedure [1], there is as yet no study formally confirming gastro-oesophageal biliary reflux after this procedure though some entero-gastric bile reflux would probably be inevitable [41] as a result of the loop configuration. Entero-gastric bile reflux is a physiological entity and is seen in a large number of normal people as well as after common surgical procedures like laparoscopic cholecystectomy. We have examined the literature implicating bile reflux in gastric or oesophageal cancer in some detail [1] and our conclusion was that there is no convincing data from clinical studies to implicate bile as a carcinogen and that any potential risk of long-term cancer with OAGB would be far outweighed by its clinical benefits especially in terms of lower incidence of an internal hernia and chronic abdominal pain in comparison with the RYGB. Given a much longer pouch with consequent higher acid production in comparison with the RYGB, it is unsurprising that some patients experience acid reflux after this procedure [28]. That such acid reflux is more commonly seen in the hands of authors [42] who believe a narrow anastomosis is crucial to achieving satisfactory outcomes with the OAGB further corroborates this as a narrow anastomosis could potentially impair the acid clearance from the pouch.

Incidence and prevalence of GORD can be reduced by paying attention to technical details. It is especially important to construct the longest possible gastric pouch that patients' gastric anatomy would allow [11] as shorter gastric pouches are associated with GORD [43]. It is further important to keep the pouch reasonably wide and straight by performing it over an orogastric tube between 32-40 Fr in size and avoid getting too close to the angle of His [3]. Since most surgeons use a linear stapler for performing the gastro-jejunostomy, one has to recognise that use of a longer stapler (like 60 mm) for construction of anastomosis would have an inverse relationship with the length of the pouch. Similarly, a narrow anastomosis performed with a 30-mm stapler or so [41-42] would narrow the outlet and predispose patients to acid reflux by reducing the acid clearance from the pouch.

At the same time, it has to be understood that GORD is a common co-morbidity in patients seeking bariatric surgery and even though the overall effect of OAGB, like all other bariatric

procedures, is to reduce the prevalence of GORD [44], some patients suffer from symptoms of GORD after OAGB. Though there are no studies specifically addressing this issue, one expects this number to be higher than those undergoing RYGB. At the same time, there is some data to suggest that the prevalence of GORD is lower after OAGB than after Sleeve Gastrectomy [SG] [45].

Patients experiencing GORD after OAGB usually experience acid reflux [28, 42] and therefore respond to management with PPI. For patients, who continue to experience persistent symptoms of GORD despite maximal acid suppression, it would be reasonable to rule out problems with pouch outlet such as a stricture or twist by performing an endoscopy and contrast series. At endoscopy, surgeons should attempt to document the pouch length from the diaphragmatic hiatus to the anastomosis. Where available, it would further be useful to carry out pH and impedance studies before converting the patient to a Roux-en-Y configuration [3]. In the first international consensus document published recently on this procedure, there was an overwhelming consensus (91.0 %) amongst surgeons that "Patients developing symptomatic GERD unresponsive to maximal medical therapy after OAGB/MGB can be offered surgical correction in the form of a conversion to RYGB." This can be very simply achieved by performing a jejuno-jejunostomy between the afferent limb just proximal to the gastro-jejunostomy and efferent limb 50 cm distal to it, followed by transection of the jejunum between the two anastomoses – similar to the omega loop technique of performing an RYGB. It is unnecessary to excise the existing gastro-jejunostomy if there is no anastomotic narrowing. A Braun's type anastomosis between the afferent and efferent limbs can also be used to deal with this problem but there is no consensus amongst experts to recommend this approach [3]. Figure 3 lays out our management algorithm for these patients.

7. Prevention and Management of Petersen's Hernia:

Fewer internal spaces and a very large Petersen's space in comparison with the RYGB is one of the key advantages of OAGB. This is why an internal hernia appears to be rare with this procedure [21]. But it does happen and has probably been underreported in previous studies [22]. Since the consequence of an internal hernia can often be devastating, we now routinely

close the infra-colic part of the Petersen's space in these patients by lifting the transverse colon and approximating the back of the Transverse mesocolon to the right side of the mesentery of the bowel loop brought to the pouch using Endohernia ® staplers in 2 layers. Such a closure can also act as an anchor for an otherwise floppy anastomosis and may help in preventing twists and kinks. It may further help prevent cephalad migration of the pouch into the thorax.

8. Prevention and Management of Micronutrient Deficiency

It is now widely recognised that bariatric surgery patients, even those undergoing SG, need regular prophylactic supplementation with a number of micronutrients to prevent clinical deficiency. Since OAGB bypasses more length of the small bowel as BPL, the requirement for such micronutrient supplementation is likely to be higher than patients undergoing RYGB [46]. Appropriate dosages for various micronutrient supplementations after RYGB are now becoming clearer [47-51] but there is as yet no clarity on these doses for patients undergoing OAGB even though there is consensus [3] that these patients need lifelong supplementation with iron, vitamin D and Calcium, Vitamin B12, and a multivitamin containing appropriate amounts of Zinc and Copper.

We hypothesise that OAGB patients should be advised lifelong supplementation with a) two multivitamin/mineral tablet, each containing at least 1.0 gram of Copper and 15 mg of Zinc b) parenteral supplementation with 1 mg vitamin B12 every 3 months or oral supplementation with 1.5 mg vitamin B12 daily c) Iron supplementation with at least 120 mg elemental iron daily d) Calcium supplementation with 1500 mg elemental calcium, and e) vitamin D 3000 international units daily. These doses are based on our experience with OAGB [46] and the literature on RYGB extrapolated to higher requirements with OAGB [47-51]. We believe these dosages can serve as useful starting points for the supplementation of various micronutrients after OAGB until further data emerges. Table 1 lists our suggested dosages for each micronutrient supplementation.

Discussion:

It has taken 20 years for a procedure simpler, less risky, and more efficacious than the erstwhile gold-standard RYGB, to get recognised by the global bariatric community [3-4]. This procedure undoubtedly will have a shorter learning curve in the hands of newer bariatric surgeons but is not without any. It is incumbent on the surgeons performing this procedure to familiarise themselves with its key technical features to be able to achieve best clinical outcomes.

For long, RYGB has been held as a combined restrictive and malabsorptive procedure [52] and OAGB was originally conceived as a procedure that was less restrictive than RYGB but more malabsorptive. It is now emerging that malabsorption accounts for very little weight loss in the early phase after RYGB [19] and probably even less in the long term. Similarly, OAGB is perceived as a malabsorptive procedure [3] and this has led surgeons to try longer lengths of BPL to maximise its benefits. However, though the benefits are at best debatable, there is a price to pay for longer lengths of BPL in terms of protein-calorie malnutrition and liver failure [15, 17-18]. The simplicity of OAGB means that by a simple alteration of the BPL length, the operation can be transformed from a proximal gastric bypass into a distal gastric bypass. The experience with RYGB has taught us that distal gastric bypass only increases the complication rates without offering any additional benefits in terms of weight loss or co-morbidity resolution [16, 53]. We, therefore, suggest, that just like RYGB [16], surgeons should be very careful while bypassing > 150 cm of small bowel with OAGB and only bypass > 200 cm under investigational protocols.

Though OAGB has a lower complication rate in comparison with the RYGB [33], it does have its unique set of complications that surgeons need to be aware of. There is currently little literature on how to perform this procedure, and indeed on how to prevent and manage its complications. This leaves individual surgeons vulnerable when it comes to managing the complications of this procedure and may be putting patients at risk. In this review, we have attempted to analyse the published literature on the prevention and management of the specific complications associated with this procedure. We hope it will improve outcomes of this procedure in the hands of newer surgeons adopting it.

There is further little data on the appropriate micronutrient supplementation dosages after OAGB even though this procedure, with a longer BPL, results in more micronutrient deficiencies in comparison with the RYGB [46]. In this review, we have suggested a supplementation regime that takes into account the data accumulated over the decades with RYGB and extrapolates that to a higher need for OAGB patients. The validity of our suggestion needs to be examined in future studies.

Conclusion:

This review details examines key technical steps of OAGB and provides a protocol for the aftercare of patients undergoing this procedure. We also discuss how to prevent and manage its specific complications.

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Abbreviations:

OAGB: One Anastomosis Gastric Bypass

IFSO: International Federation for the Surgery of Obesity and Metabolic Disorders

RYGB: Roux-en-Y Gastric Bypass

BPL: Bilio-Pancreatic Limb

AL: Alimentary Limb

NSAID: Non-Steroidal Anti-Inflammatory Drugs

PPI: Proton Pump Inhibitor

BMI: Body Mass Index

CT: Computed Tomography

SG: Sleeve Gastrectomy

GORD: Gastro-Oesophageal Reflux Disease

Figure 1: Construction of OAGB Pouch: Key Steps

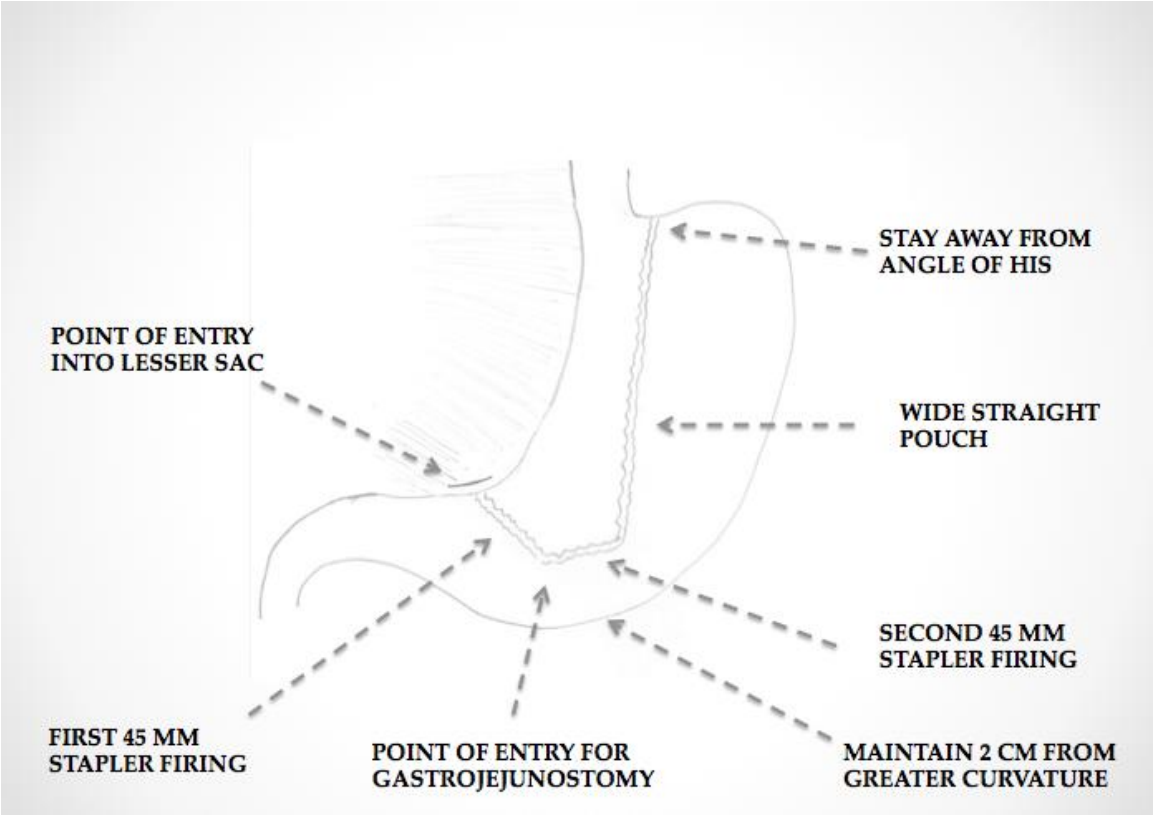

Figure 2: Our Suggested algorithm for management of marginal ulcers after OAGB

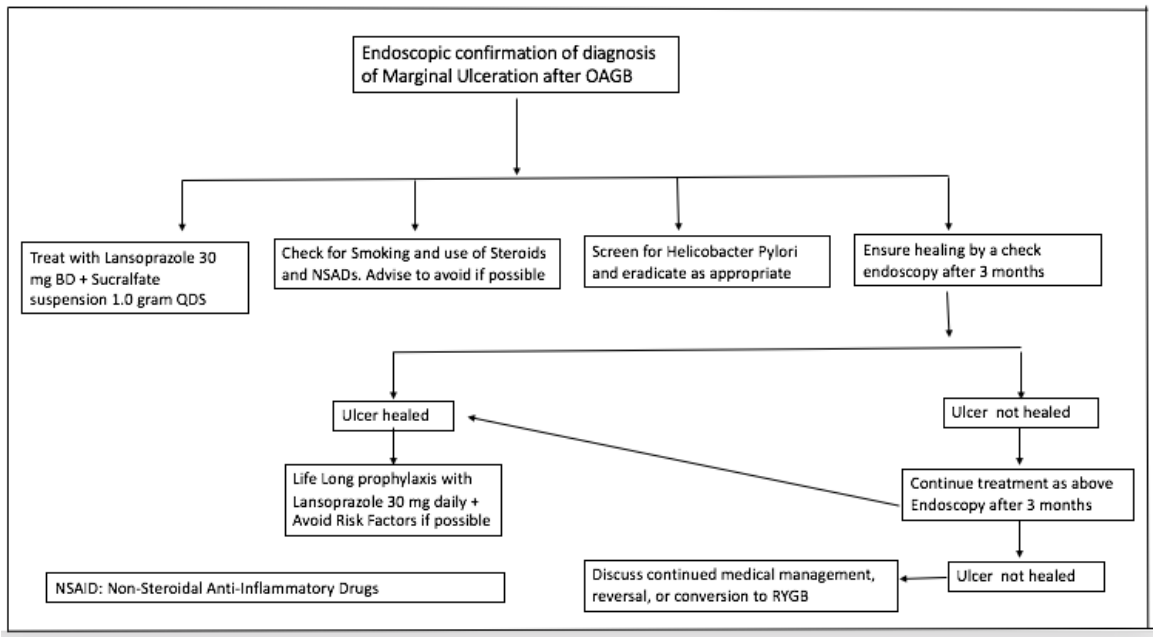

Figure 3: Our Suggested Algorithm for Management of Gastro-Oesophageal Reflux Disease (GORD) after OAGB

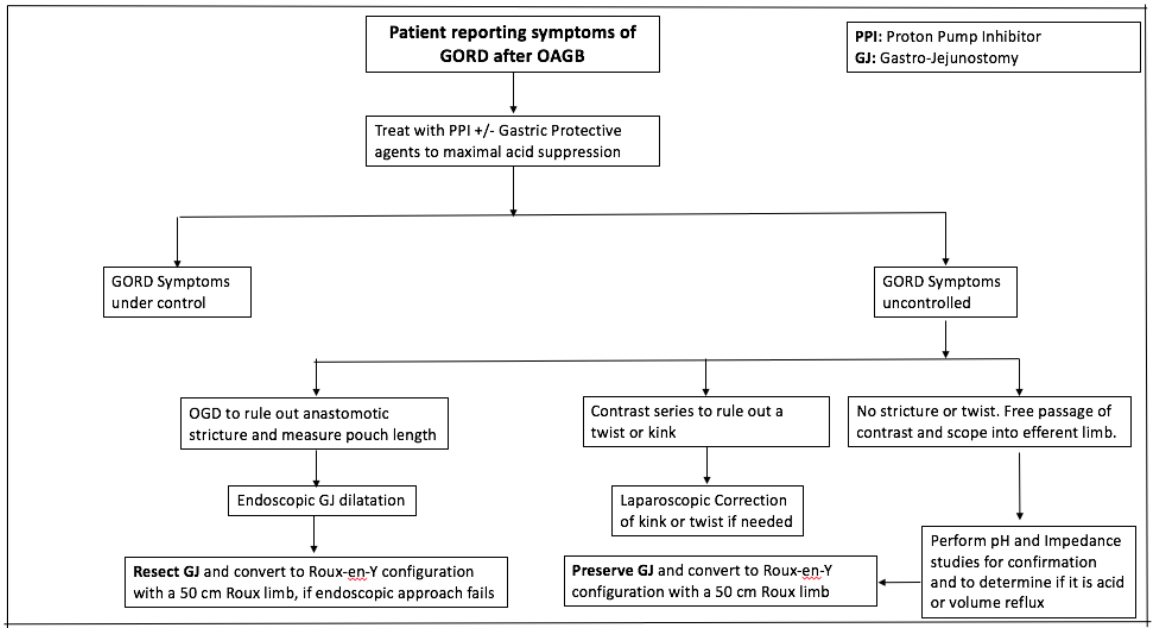

Table 1: Suggested Dosages for Supplementation of various micronutrients after OAGB

Micronutrient	**Dosages**
Multivitamin/Mineral	One tablet twice a day (each containing at least 1.0 mg Copper and 15 mg Zinc)
Vitamin B12	1 mg injection 3 monthly or 1.5 mg orally daily
Iron	120 mg elemental Iron daily
Calcium	1500 mg elemental Calcium daily
Vitamin D	3000 international units daily