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UPPER GIT SURGERY

Roux-en-Y gastric bypass: Pilot study results from a resource constrained setting

A Khamajeet,[1] A Diab,[1] T Biesman-Simons,[1] C de Lange,[1] F Noor,[1] D Luchoo,[2] A Melitan,[3] H Bougard[1]

[1] *Division of General Surgery, Department of Surgery, New Somerset Hospital, University of Cape Town, South Africa*
[2] *Department of Statistics and Mathematics, University of Mauritius, Mauritius*
[3] *Misurata University, Libya*

Corresponding author, email: *arvinking444@gmail.com*

Background: Obesity is a growing global health issue, with significant implications for comorbid conditions and overall mortality. Metabolic and bariatric surgery (MBS), particularly Roux-en-Y gastric bypass (RYGB), has proven effective in achieving sustained weight loss and improving comorbidity resolution. MBS is limited in the public sector within South Africa due to cost. This pilot study, taking into consideration the resource constrained setting in South Africa, aims to assess the outcomes of RYGB surgery in a low resource setting, focusing on weight loss, comorbidity resolution, and complications over a 3-year period.
Methods: A retrospective analysis was conducted on 17 patients who underwent RYGB at New Somerset Hospital, South Africa, between August 2017 and February 2020. The primary outcomes included percentage total weight loss (%TWL), excess weight loss (%EWL), and excess body mass index (BMI) loss (%EBMIL), while secondary outcomes involved the resolution of type 2 diabetes, hypertension, gastro-oesophageal reflux disease (GERD), and dyslipidaemia.
Results: At 3 years, the mean BMI decreased from 48.3 kg/m² to 38.35 kg/m², with a mean %TWL of 20.3%, %EWL of 42.5%, and %EBMIL of 43.2%. Notably, there were significant improvements in comorbidities, with a 50% resolution of type 2 diabetes, 71.4% resolution of GERD, and 66.7% resolution of dyslipidaemia. The complication rate was low, with one reported port site hernia.
Conclusion: This study highlights the feasibility and effectiveness of MBS in a resource-constrained setting and demonstrates its potential for improving patient outcomes in the context of the obesity epidemic in South Africa. Further studies with larger cohorts and longer follow-up are needed to validate these findings and explore the long-term impact of MBS on public health.
Keywords: metabolic and bariatric surgery, obesity, comorbidity resolution, excess weight loss, total weight loss, excess BMI loss

Introduction

Obesity has become a global health problem with 890 million adults being affected in 2022, according to the World Health Organization.[1] A recent study by Phelps et al. in the Lancet showed that the prevalence of obesity has doubled in adults and quadrupled in adolescents and children from 1990 to 2022.[2] A report by the World Obesity Federation reported that by 2025, 23.3% of males and 46.7% of females will be afflicted with obesity in South Africa making this condition a matter of grave public concern.[3]

Obesity is associated with many medical conditions such as obstructive sleep apnoea (OSA), type 2 diabetes (T2D), hypertension, dyslipidaemia, cancer, obesity hypoventilation syndrome as well as weight bearing osteoarthritis.[4-7] There is also a multitude of gastro intestinal complications which is associated with obesity such as gastro-oesophageal reflux disease (GERD), erosive oesophagitis, Barrett's oesophagus, oesophageal adenocarcinoma, erosive gastritis, gastric cancer, diarrhoea, colonic diverticular disease, polyps, cancer, liver disease including metabolic dysfunction-associated steatotic liver disease (MASLD), hepatocellular carcinoma, gallstones, acute pancreatitis, and pancreatic cancer.[8] Compounding the effect of these associated diseases is the fact that mortality is increased by 30% for every 5 kg/m² above a body mass index (BMI) of 25.[9]

The one treatment modality for maintaining and achieving consistent weight loss for patients with a BMI of over 35 kg/m², while also aiding in decreasing mortality at the same time, is metabolic and bariatric surgery (MBS).[10,11] MBS has proven efficacious in controlling or reversing conditions such as hypertension, diabetes, dyslipidaemia, and sleep apnoea.[12] The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) registry of 2023 shows that a total of 394 MBS procedures were carried out in South Africa, with 163 procedures being a sleeve gastrectomy and 231 being a RYGB.[13] To our knowledge, only one study has been published to date in South Africa regarding MBS in the public sector, as many provinces still do not provide the service within this setting.[14]

This pilot study of RYGB aims to describe the setup of MBS in a secondary hospital in a developing country and to evaluate the surgical outcome at 3 years looking specifically at weight loss and complication rate, as well as the 3-year impact on the resolution of comorbidities.

Methods

Study design

This retrospective study was conducted at New Somerset Hospital (NSH), a secondary level provincial hospital in the Western Cape, South Africa. All patients who underwent RYGB from August 2017 to February 2020 were included in the study. Data was collected using file review, theatre planning calendar as well as the PACS (Picture Archiving and Communication System) and NHLS (National Health Lab System) where appropriate. Of note, PACS is the imaging archiving system used within the Western Cape.

Patient selection

The MBS unit at New Somerset Hospital considers all patients with a BMI above 40 kg/m² – regardless of comorbidities – as eligible for bariatric surgery. Patients with a BMI over 35 kg/m² are also considered if they have associated comorbid conditions such as T2D, hypertension, GERD, OSA, MASLD, osteoarthritis, lipid abnormalities, gastrointestinal disorders, heart disease, infertility, venous disorders, or an inability to achieve sustained weight loss through conventional methods.

Bariatric pathway

The NSH bariatric pathway involves a dietician assessing diet and lifestyle, a surgeon evaluating medical eligibility, and a psychiatrist ensuring mental readiness before surgery. Patients must meet all the criteria prior to proceeding into the metabolic pathway. (Annexure A).

Comorbidity definition and resolution

Only complete resolution of comorbidities was assessed in this study, while partial resolution was not assessed. T2D was defined as patients on existing anti-diabetic treatment and/or a HbA1c ≥ 6.5%. Resolution of T2D implies a stoppage of anti-diabetic medications with HbA1c < 6.5%, measured 3 months after stopping medications.

Hypertension was assessed as blood pressure of 140/90 mmHg and higher and/or taking anti-hypertensive medications. Resolution implied an arrest of medication due to blood pressure normalisation < 140/90 mmHg.

OSA was assessed as the presence of snoring along with clinical symptoms correlated with the STOP BANG questionnaire, which has been validated for the evaluation of OSA.[15]

Dyslipidaemia was defined as a total cholesterol ≥ 5.5 mmol/L, LDL Cholesterol ≥ 3.5 mmol/L, triglyceride ≥ 2 mmol/l and/or with medications being used for control. Resolution of dyslipidaemia was defined as complete arrest of medication due to lipid levels being below the stated defined value off medications.

GERD diagnosis and resolution was based on the presence of clinical symptoms associated with a positive finding of oesophagitis on endoscopy. Resolution was defined as absence of symptomatology along with confirmation on endoscopy, based on clinical evaluation of oesophagitis and histopathological results.

Assessment of surgical weight loss outcomes

The Reinhold criteria was used to assess the outcome of the operation.[16]

Day 1 prior to surgery and day of surgery

On the eve of surgery, the patient's weight, BMI, and percentage of weight loss was documented. Preoperative compliance with the low caloric, high protein, low-fat fluid diet is also noted, and patients are provided dietary counselling on postoperative progression of diet after surgery. On the day of surgery, patients are encouraged to consume a high protein low caloric, clear fluid diet while in the hospital. Their tolerance to this diet is assessed.

Anaesthesia in a low resource setting (Annexure B)

In low-resource settings, anaesthesia relies on clinical assessment (e.g., stair tests, STOP BANG questionnaire) and limited diagnostics (ECG, basic echocardiogram). Rapid sequence induction uses high flow oxygen 15 L/min) and rocuronium is preferred over sugammadex as muscle relaxant due to cost consideration. Postoperative care combines multimodal analgesia (paracetamol, ketamine, remifentanil) and early mobilisation, with patient-controlled analgesia (PCA) fentanyl for severe pain.

Surgical technique

Our technique for performing RYGB is described in Annexure B.

Postoperative surgical care

The majority of patients are monitored in a routine surgical ward postoperatively. However, patients at significant risk of airway compromise or other acute complications are considered for high care unit admission. Standard prophylaxis with low molecular weight heparin (clexane) is written to prevent deep vein thrombosis and pulmonary embolism. A comprehensive venous blood gas including electrolytes, haemoglobin and C-reactive protein (CRP) is taken on the first postoperative day. Any patients with a significantly raised CRP and/or a tachycardia (> 100 beats/min) significantly deviating from baseline or any concerning abdominal findings should be assessed in theatre with relook laparoscopy unless timeous radiological confirmation of the integrity of the reconstruction can be sought on abdominal computed tomographic (CT) scan with intravenous and oral contrast.

Dietary regimen postoperatively (Annexure A, Table I)

On discharge, patients are reminded of the dietary progression, including a fluid diet for two weeks, followed by pureed foods for two weeks, a soft diet for two weeks, and finally a return to normal consistency thereafter. These guidelines are provided in a booklet given to the patient

Postoperative follow-up

Patients are followed at approximately 1 month, 6 months, 12 months, 24 months and then yearly thereafter.

Primary end points

Primary end points involved seeing the patient between year 1-3 and assessing total weight loss (TWL), excess weight loss (EWL) and excess BMI loss (EBMIL). It also aimed to assess for any postoperative complication.

Secondary end points

Secondary end points were the resolution of comorbidities at 3 years. In our study, we looked at T2DM, GERD, hypertension and dyslipidaemia.

Statistical analysis

All parameters were described using mean, median and standard deviations (SD) or interquartile range (IQR) as well as percentages.

Results

Study population and follow-up population at baseline (Table I)

This study took place between August 2017 and February 2020. A total of 17 patients underwent a RYGB. Gender predominance was female (n = 11, 91.7%). The median age was 47 years (IQR 44–50). The median age was 46 years (IQR 41.5–50). The majority of patients (n = 16, 94.1%) had class III obesity defined as a BMI of greater than 40 kg/m², while 1 of the 17 patients had class II obesity. The mean BMI at initial consultation was 51 kg/m² (SD 5.35) and the mean preoperative BMI after following dietician weight loss regime and liquid diet in the period leading to surgery was 47.3 kg/m² (SD 5.0). There were 5 patients lost to follow-up at 3 years, representing 29.4% of the study population.

Assessment of surgical weight loss (Table II and Figures 1-3)

At 3 years, there were only 12 patients remaining for follow-up. The mean BMI showed a decrease to 38.35 kg/m² (SD 5.0), the mean %TWL was 20.3% (SD 10.4), the mean %EWL was 42.5% (SD18.3) and the mean %EBMIL was 43.2% (SD 16.3). Only 2 patients had a failure of surgery, as defined by Reinhold criteria, with %EWL less than 25%, representing 16.7% of our population.

Resolution of comorbidities (Table III)

Gastro-oesophageal reflux disease

Preoperatively there were 7 patients with GERD proven clinically and endoscopically. Postoperatively, there were 2 patients with reflux symptoms while 5 (71.4%) of them had complete resolution of symptoms. The 2 symptomatic patients were scoped and both showed oesophagitis.

Type 2 diabetes

Preoperatively there were 4 patients with T2D on medications. At 3 years postoperatively 2 (50%) patients had complete remission.

Table I: Baseline demographic and anthropometric data and comorbidities for the total cohort and those with three-year follow-up

Parameters	Cohort of patient at baseline	Study population with follow-up results at 3 years
Demographics	***n* = 17**	***n* = 12**
Age		
Median Age (interquartile range)	46 (41.5–50)	47 (44–50)
Gender		
Female (*n*, %)	16 (94.1%)	11 (91.7%)
Obesity grade		
2 (*n*, %)	1 (5.9%)	1 (8.3%)
3 (*n*, %)	16 (94.1%)	11 (91.7%)
Mean BMI at initial consult (SD)	51.0 (5.35)	52 (5.80)
Mean pre-op BMI (SD)	47.3 (5.0)	48.3 (4.7)
Comorbidities		
T2D	4 (23.5%)	4 (33.3%)
Dyslipidaemia	5 (29.4%)	3 (25%)
HPT	9 (52.9%)	6 (50%)
OSA	2 (11.8%)	2 (16.7%)

T2D – type 2 diabetes, HPT hypertension, OSA – obstructive sleep apnoea, BMI – body mass index

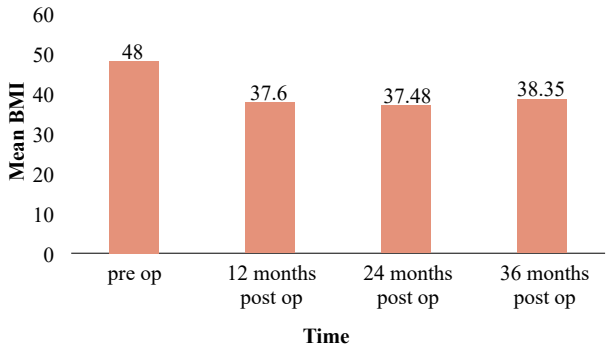

Figure 1: Mean body mass index (BMI) change with time

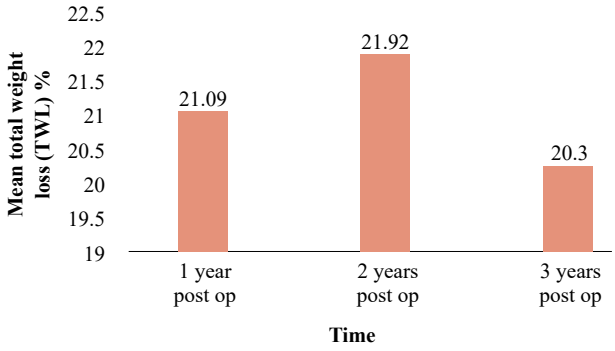

Figure 2: Change in percentage total weight loss (%TWL) with time

Table II: Surgical weight loss at 1, 2 and 3 years

Parameters	Pre-op	1 year post op *n* = 10	2-year post op *n* = 11	3-year post op *n* = 12
Mean BMI (SD)	47.3 (5.0)	37.61 (4.08)	37.48 (4.79)	38.35 (5.0)
Mean TWL (%, SD)		21.09 (6.42)	21.92 (10.0)	20.3 (10.4)
Mean EWL (%, SD)		38.45 (9.41)	38.68 (15.03)	42.5 (18.3)
Mean EBMIL (%, SD)		44.7 (11.3)	45.31(17.25)	43.2 (16.3)

BMI – body mass index, TWL – total weight loss, EWL – excess weight loss, EBMIL – excess body mass index loss

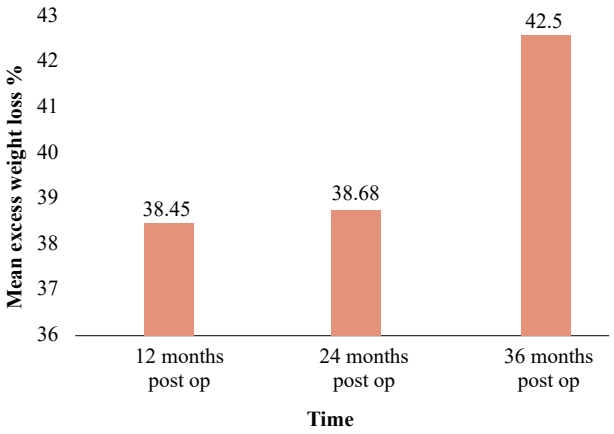

Figure 3: Change in percentage excess weight loss (%EWL) with time

Dyslipidaemia

Preoperatively 3 patients were diagnosed with dyslipidaemia and were on treatment. Postoperatively, there was a 66% resolution of dyslipidaemia with only 1 patient still taking treatment.

Obstructive sleep apnoea

Preoperatively we had 2 patients diagnosed with OSA, clinically evidenced by snoring. Postoperatively, there was a 50% improvement of clinical symptoms and resolution of snoring. One patient reported no change in his symptoms.

Hypertension

There were 6 patients with hypertension in the initial cohort of patients. At 3 years there was only 1 remission, representing a cure rate of 16.7%.

Complications

There was only one port hernia which was diagnosed in our study period.

Discussion

The main finding of our study revealed %TWL at 20.3%, %EWL 42.5% and %EBMIL at 43.2% 3 years after undergoing RYGB. This is smaller than the %EBMIL of 68.1% and %TWL of 29.9% at 3 years from the merged data of the SLEEVEPASS and SM BOSS trial.[17] A small randomised control trial by Kehagias et al. also reported %EWL of 62.1% at 3 years.[18] Pereferrer et al., in a 3 year follow up study post RYGB in Spain, demonstrated a %EWL of 76.8%.[19] Our lower %TWL of 20.3% (vs. the 30–35% in high-resource centres) possibly reflects systemic constraints namely more limited multidisciplinary support: Patients lack regular access to psychiatrists, dietitians, or physiotherapists postoperatively, which are proven to optimise weight loss. Secondly, there is a significant follow-up attrition rate due to many patients travelling long distances for visits, and socioeconomic barriers (e.g., transport costs, work obligations) which may reduce compliance with follow-up. Thirdly, the cultural dietary factors should be taken into account as the local staple diet is high in refined carbohydrates which may impact on metabolic outcomes compared to western cohorts. Fourthly, a lower sample size can have major implications in tabulating weight loss values. Kim HJ et al. demonstrated the importance of regular follow-up and that continued long term follow-up has the potential to increase weight loss in their research.[20]

Our study demonstrated a 50% resolution rate for T2D, a 16.7% resolution rate for hypertension, a 66.7% resolution rate for dyslipidaemia, a 50% resolution rate for OSA, and a 71.2% resolution rate for GERD at 3 years. Comparatively, the 3-year results of the SM BOSS trial revealed resolution rates of 71,2% for hypertension, 77% for T2D, 77.6% for GERD, 82.2% for OSA and 71.7% for dyslipidemia.[21] Regarding resolution of GERD, our results are within the range of the findings found in the SM BOSS trial. Similarly, Lee et al., looking at the outcome of RYGB, showed a remission rate of 65.9% for T2D, 63.6% for hypertension and 100% for dyslipidaemia.[22] It is noted that the SLEEVEPASS trial did show a resolution of 53% for T2D between 0–2 years which is within the range of our findings.[23] The GATEWAY trial also found a resolution rate of 51% for hypertension.[24] The low numbers of hypertensive patients in our study makes it prone to introduce bias but one can still truly appreciate the impact of metabolic surgery on the resolution of hypertension. Haavisto et al. found similar resolution of 45% for OSA post RYGB in their study.[25] That said, it is important to note that no polysomnography was carried out, and our resolution rate was based on the clinical resolution of snoring. This may introduce bias, but it is still significant to find that 50% of patients had no snoring and improved sleep after surgery.

Regarding complications our study reported a late small port site hernia during follow-up. Although we have small numbers, our incidence of 8.33% for port site hernia is much lower than the 34.5% in the HERBALS study.[26] In a meta-analysis by Karampinis et al., it was found that the pooled incidence of trocar site hernias was 3.2%, but in those studies which looked at trocar site hernia incidence specifically, incidence was 24.5%.[26] One must therefore emphasise the importance of closing port sites of 10 mm and higher.

While fistula rates post RYGB has been described to be between 0.4–5.6%, we reported none in our small sample of patients.[27] This is most likely as a result of our low number of patients. It is to be noted that currently there are few centres who are able to deal with endoscopic drainage of fistulas in the country, necessitating a vision for improving training of surgical or medical endoscopists through collaborative efforts with overseas centres. This is even more important, as bariatric surgery becomes more popular.

Table III: Resolution of comorbidities in our study population

	T2D	Hypertension	Dyslipidaemia	OSA	GERD
Preoperative	4/12(33.3%)	6/12(50%)	3/12(25%)	2/12(16.7%)	7/12(58.3%)
Postoperative	2/12(16.7%)	5/12(41.7%)	1/12(8.3%)	1/12(8.3%)	2/12(16.7%)
Resolution	50%	1/6(16.7%)	2/3(66.7%)	1/2 (50%)	5/7(71.4%)

T2D – type 2 diabetes, OSA – obstructive sleep apnoea, GERD – gastro-oesophageal reflux disease

Of note, other post-surgical complications have been described, with rates of 1–16% for a marginal ulceration, 1–2% for gastro-gastric fistula, 32–42% for cholelithiasis, 1.5–5% for small bowel obstruction, 4.5% for dumping syndrome, and 3–7% for anastomotic stricture.[28]

The greatest limitation of this study is the small number of patients which is simply due to the amount of resources available to perform MBS in the public sector. This undoubtedly would skew the results and impact on conclusions that can be drawn. The second limitation remains the loss to follow-up with possible implications on patients' health, such as vitamin deficiencies. This phenomenon, while not isolated to South Africa, merely highlights the difficulties of ensuring proper regular follow-up in resource constrained set ups like ours. However, despite this sample size, the intention was to demonstrate the feasibility of performing MBS in a resource constrained environment with safe outcomes and acceptable weight reduction and comorbidity resolution. This study does address a very important and growing public health concern namely obesity in South Africa.

Conclusion

Our study demonstrates the positive impact of MBS on resolution of comorbidities and weight loss. It also demonstrates that the possibility of performing such surgeries within the public sector is possible and viable. However, it is important to emphasise the need for a consistent and trained multi-disciplinary team involving an endocrinologist, a psychologist, a dietician and the surgeon along with regular follow up to truly achieve good weight loss results. Despite the small size of the study population, in an era of an obesity pandemic which keeps growing, this study is of importance to the public health care system namely in lighting the way forward. It is beneficial to bring to light the intricacies of a bariatric unit set up in a resource constrained setting, so it could be replicated in other resource constrained units who may be inspired to provide a bariatric service.

Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

Ethical approval was obtained for this study from the University of Cape Town Human Research Ethics Committee (HREC reference number: 456/2023).

ORCID

A Khamajeet https://orcid.org/0009-0007-3722-7478
A Diab https://orcid.org/0009-0008-3340-709X
F Noor https://orcid.org/0000-0003-3985-3660
D Luchoo https://orcid.org/0009-0000-6368-5121
A Melitan https://orcid.org/0009-0002-8828-7255
H Bougard https://orcid.org/0000-0002-0820-4134

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ORIGINAL RESEARCH

Three-year pilot study results of bariatric surgery patients post Roux-en-Y gastric bypass in a resource constrained set up in South Africa

Annexure A

Bariatric pathway

Dietician

At NSH, the bariatric pathway starts with the dietician. Once the dietician is satisfied with the patient's eating habits and motivation for surgery, the patient is referred to the general surgeon. This ensures a comprehensive consultation and once the patient satisfies the criteria for surgery, he/she is then referred to the psychiatrist for an assessment. During this process of post validation for surgery, the patient will undergo a series of tests aimed at excluding previously undiagnosed conditions, planning appropriate anatomical reconstruction and considering any surgical complexity.

NSH Dietetics pathway in bariatrics

The dietician consultation involves gathering anthropometric measurements such as weight, height, body mass index, and neck circumference. Additionally, the dietitian enquires about the patient's current dietary habits, history of dieting, exercise routines, smoking and alcohol consumption, as well as socio-demographic information including employment status, dependents, education level, and marital status. They also assess the availability of appliances like fridges and cooking stoves. Furthermore, a basic medical history is obtained from the patient.

During this initial consultation, the dietitian educates the patient on proper dietary habits, the benefits of exercise, meal progression before and after surgery, as well as the necessity of vitamin and mineral supplementation post-surgery.

Subsequent visits with the dietitian involve measuring weight loss progress and evaluating changes in dietary habits and exercise levels. Patients are counselled on following a low caloric, high protein, low-fat fluid diet for two weeks prior to surgery (Table I).

Table I: Bariatric full fluid diet (2 weeks before and after surgery)

Breakfast	Mid-morning	Lunch	Mid- afternoon	Supper
Future Life HP (high protein) (50 g) + 250 ml fat free milk *1 l diluted low cal drink/ iced tea lite (to sip on during the day)	Fruit smoothie 250 ml **or** diabetic supplement drink	Future Life HP (50 g) + 250 ml fat free milk **or** 250 ml liquidised soup (beef, chicken or lentil – low fat), thin consistency Diabetic jelly + lite custard Tea (no sugar) + fat free milk	Fruit smoothie 250 ml **or** diabetic supplement drink	Future Life HP (50 g) + 250 ml fat free milk 250 ml liquidised soup (beef, chicken or lentil – low fat), thin consistency Diabetic jelly + lite custard Tea (no sugar) + fat free milk
Fruit smoothie: 175 ml fat free yoghurt (plain or fruit) 1 small fruit (banana/ mango/ fruit canned in natural syrup, e.g., peaches x ½ cup Sweetner. Peel and chop fruit, put all ingredients together in a blender. If consistency is too thick, add water/ crushed ice/fat free milk				

Surgeon

The consultation with the surgeon takes place with the use of a standardised questionnaire, taking note of anthropometric data as well as eliciting comorbidities of the patient, including those that are associated with obesity, such as dyslipidaemia, hypertension, diabetes and GERD. This will also screen for OSA using stop bang questionnaire. Most of our patients will not undergo an OSA assessment or a bone density measurement due to resource constraints. Investigation is only reserved for patients with poor respiratory baseline, after consultation with the anaesthetist. This surgical consultation also serves to validate the need for surgery as well as assess the overall commitment to surgery and post op care.

The patient will be booked for a gastroscopy to investigate for helicobacter pylori as well as investigate any contra-indications to surgery. This will include malignant lesions to the oesophagus and the stomach. The upper endoscopy will also assess for the presence of hiatal hernias which might need consideration at the time of surgery.

Psychiatrist

The aim of the psychological assessment is to assess the social circumstances of the patients as well as assess for the presence of any undiagnosed psychiatric disorders that would require treatment. In the event of pre-existing psychiatric disorders, the goal is to assess if the disease is stable. The psychiatrist also assesses the understanding and motivation of the patient regarding his upcoming surgery given the surgery is associated with major lifestyle changes. In the event any new disease is diagnosed, or pre-existing psychiatric disease is deemed unstable, a treatment plan is put into place to address those concerns until the patient can re-join the bariatric pathway. Consideration for possible substance dependency is an additional focus area for this consultation and assessment

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Annexure B

Anaesthesia in a low resource setting

When assessing patients pre-operatively we rely heavily on clinical assessment and simple investigations due to limited access to some of the more advanced investigations recommended in literature from higher income settings. Cardiopulmonary testing, sleep studies and echocardiograms are very rarely performed. Instead, we rely on self-reported exercise tolerance and physically walking our patients up flights of stairs to assess effort tolerance, screening by the stop bang score, electrocardiograms and, if necessary, point of care focussed assessment of transthoracic echocardiogram by a member of the anaesthetic team, often with limited operator experience.

When a rapid sequence induction (RSI) is indicated we may consider the use of nasal cannulae with the oxygen flow turned up to 15 l/min in an attempt to prolong the safe apnoea time. Although there is limited evidence for this, we do not have easy access to high flow humidified oxygen cannulae in the theatre environment.

In terms of medication, rocuronium is our neuromuscular blocker of choice. Access to sugammadex is limited to the "can't intubate, can't oxygenate" patient due to cost and policy regarding levels of care and is therefore not routinely used. This limits our ability to provide a deep level of neuromuscular blockade during the surgery without seriously compromising efficiency while waiting for a deep level of neuromuscular blockade to wear off. Anecdotally we have found supplementing our volatile anaesthesia maintenance (desflurane is used for its rapid awakening profile) with a remifentanil infusion helps reduce patient ventilator asynchrony and allows for rapid awakening.

We use quantitative neuromuscular blockade monitoring to ensure a train of four ratio prior to extubation.

Our analgesia regimen generally includes intravenous paracetamol (intra-operatively and for 24 hours postoperatively), parecoxib (if not contra-indicated) for 24 hours, ketamine (at 0.2-0.3 mg/kg lean body weight/hr), a lignocaine infusion or port site infiltration (prior to skin incision) with bupivacaine, a remifentanil infusion and fentanyl (1-2 mcg/kg lean body weight). We routinely give dual or triple anti-emetic prophylaxis (dexamethasone 4-8 mg at induction, ondansetron 4-8 mg towards the end of surgery with either droperidol or metoclopramide as a third agent if indicated).

We rarely maintain anaesthesia with propofol in the place of desflurane, if indicated (most often to reduce post-op nausea and vomiting) we routinely use depth of anaesthesia monitoring.

We aim to get them sitting up without assistance in bed prior to discharge from the anaesthesia recovery unit and mobilising out of bed within a few hours postoperatively. Postoperative analgesia includes regular intravenous paracetamol for 24 hours (then changed to oral) and a patient-controlled analgesia pump with fentanyl 10-20 mcg/ml (with a 6-8 minute lockout), in patients with a high concern for severe postoperative pain ketamine, at a dose of 0.5-2 mg/ml/hour, may be added in to the PCA. Anti-emesis prophylaxis is given as ondansetron with metoclopramide or prochlorperazine as a second agent if needed. Early and appropriately dosed anti-coagulation is hugely important.

Annexure C

RYGB Surgical technique

1. **Patient preparation & positioning**
   - Patients walk into the operating room and climb onto the table independently.
   - The patient is placed in beach chair position.
   - General anaesthesia is administered.
   - The abdomen is prepped and draped sterilely.
2. **Trocar placement (laparoscopic approach)**
   - **5 12 mm trocars** are placed:
     - The first port is placed under direct vision with an optical trocar just off the linear alba in the epigastrium 12 cm below the xiphisternum.
     - 3 additional ports are placed in the same axial plane, two on the patient left and one on the right for the liver retractor.
     - Another port to the right of the linear alba is placed in the epigastrium across the falciform.
   - The liver is retracted upward to expose the proximal stomach.
3. **Creation of the gastric pouch**
   - Identification of the gastro-oesophageal (GE) junction and the angle of His.
   - A small approx. 30 mL gastric pouch is created using a linear stapler:
     - A small gastroepiploic window is created to access the lesser sac preserving the vagus nerve.
     - Gastric division is begun horizontally and continued cranially to create a diamond configuration pouch preserving the angle of His and based on the left gastric artery for blood supply.
   - The remnant stomach remains in place but is excluded from the alimentary pathway.
4. **Jejunal division & Roux limb creation**
   - The ligament of Treitz is identified by lifting the colon and omentum cranially.
   - The jejunum is stapled to the gastric pouch 50 cm distal to the ligament of Treitz using a linear stapler so that at this point the configuration resembles an omega loop. The stapled anastomosis is closed using 2/0 polyglycolic acid handsewn technique.
   - The Roux limb (alimentary limb) is measured 150 cm from the gastrojejunal anastomosis. It is routinely placed antecolic. In very large patients, division of the omentum may assist with offloading tension on the anastomosis.
   - A side-to-side jejunojejunostomy is created between the Roux limb and the biliopancreatic limb (using a linear stapler). This enterotomy is closed using 2/0 absorbable barbed suture.
   - The BP limb is then separated from the gastrojejunal anastomosis with a linear cutter.
5. **Quality Control**
   - A leak test is performed using food dye to ensure integrity of the gastrojejunal anastomosis. The JJ anastomosis cannot be tested in the same fashion.
   - All staple lines are inspected for haemostasis, and all ports are removed under direct vision.