THE BEST BARIATRIC OPERATION FOR OLDER PATIENTS: OUTCOME AFTER THE BAND, VERTICAL GASTRECTOMY, ROUX-EN-Y GASTRIC BYPASS, AND DUODENAL SWITCH

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Brief title: '**THE BEST BARIATRIC OPERATION FOR OLDER PATIENTS'**

ABSTRACT

Background: Age-related differences in outcome after bariatric surgery have not been well characterized. The laparoscopic vertical sleeve gastrectomy has been performed selectively in high-risk patients as a lower risk, staged duodenal switch and more recently as a single-stage operation for patients of lower body mass index. This study attempts to determine if a particular bariatric operation results in superior outcome for older patients.

Methods: A retrospective comparison of patients 50 years of age and over undergoing one of four different totally laparoscopic bariatric operations was performed (adjustable Lap-Band® placement, vertical gastrectomy, roux-en-Y gastric bypass, and biliopancreatic diversion with duodenal switch).

Results: Between February 2002 and February 2005, 197 (31%) primary bariatric laparoscopic operations were performed on patients over 50 years of age. Laparoscopic vertical gastrectomy achieved weight loss at one year that was on par with that of roux-en-Y gastric bypass and duodenal switch (range 114-126 lbs), with a shorter average operative time (109 mins) and fewer complications (7.7%).

Conclusion: These data suggest that the best bariatric operation for older patients may be the laparoscopic VG because it achieves the greatest weight loss with the shortest operative time and the fewest complications.

Key words: bariatrics, bariatric, elderly, older, obesity

INTRODUCTION

The laparoscopic vertical sleeve gastrectomy (VG) has been performed selectively in high-risk patients as a lower risk, staged biliopancreatic diversion with duodenal switch (DS) and more recently as a potentially single-stage operation for patients of lower body mass index (BMI). We hypothesized that VG may be superior to the adjustable gastric band (Band), the roux-en-Y gastric bypass (RGB), and the DS for patients over the age of 50 because of its low risk profile combined with a capacity to achieve substantial weight loss.

The most commonly performed bariatric operations in the United States are Band placement, RGB, and DS.[1] The Band causes weight loss via gastric restriction, while the RGB and DS utilize the combined mechanisms of restriction and some degree of malabsorption. The DS procedure, as described by Hess, is a technically challenging weight loss procedure that combines moderate restriction with moderate malabsorption to attain a high degree of weight loss.[2]

The laparoscopic vertical sleeve gastrectomy operation is not a new procedure, but is in fact part of the DS operation. Michel Gagner originally conceived of performing the vertical gastrectomy as an isolated procedure – the first stage of a two-stage DS operation. Gagner theorized that performing the DS in two stages would confer the advantages of technical facility, shorter operative times, and interval weight loss between stages, which would result in decreased overall morbidity. Performing just the restrictive component of the DS is a lower risk option for this group of patients. Data on bariatric surgery in elderly patients is sparse, although a handful of studies have demonstrated efficacious weight loss in patients over the age of 50[3] and 60[4] years of age. However, no studies that we are aware of have attempted to identify the operation that is best suited for older patients. This study seeks to address this question by

comparing outcome after VG to the established operations of Band, RGB, and DS in patients 50 years of age and older.

MATERIAL & METHODS

Open, hand-assisted, and revision operations were excluded, leaving a total of 692 totally laparoscopic, primary bariatric operations. Of these, 197 (31%) were performed in patients 50 years of age and over. A comparative analysis of VG, Band, RGB, and DS operations performed between February 2002 and February 2005 in this patient population was done (Figure 1).

Surgical Technique

Patients were placed supine on the operating table, without splitting the legs. All patients had sequential compression devices to the calves or the feet, and received 2 grams of intravenous cefazolin prior to skin incision. Foley catheters were placed for all operations except the Band. Appendectomy and cholecystectomy were not performed routinely; cholecystectomy was only performed if preoperative ultrasound demonstrated the presence of gallstones. Intraoperative endoscopy, postoperative nasogastric tubes, intraabdominal drains, and epidural anesthesia were not used.

Laparoscopic Vertical Gastrectomy

A total of 5 trocars were placed in the configuration shown in Figure 2. After the greater curvature vessels were taken down using the LigaSure V® (ValleyLab), a transoral 32 French esophageal dilator (Cook Medical) was positioned along the lesser curvature. The rationale for use of a 32 French sizing tube was based on Johnston's

work with the Magenstrasse & Mill operation where between 1987 and 2003 he experimented with varying caliber bougies ranging from 30 to 40 French.[5]

Starting at a point on the greater curvature, 6cm from the pylorus, a greater curvature gastrectomy was performed using sequential fires of linear 3.5 mm or 4.8 mm gastrointestinal staplers, creating a 60-80 cc gastric tube. Bioabsorbable Seamguards® were used selectively to buttress the staple-line in diabetic patients or if there was staple-line bleeding. A methylene blue leak test was performed to check staple-line integrity, and then the stomach remnant was removed via an enlarged trocar site.

Laparoscopic Adjustable Gastric Band Placement

The abdomen was entered using a 12 mm Optiview® trocar (Ethicon Endo-Surgery, Inc.) and then three more trocars (5 mm) were placed. Retraction of the left lateral segment was achieved using an epigastric Nathanson retractor. The Lap-Band® device (Inamed Health) was secured around the proximal stomach creating a 10 to 20 cc gastric pouch using the *pars flaccida* technique, which minimized perigastric dissection and kept the device out of the lesser sac.[6] The band was secured around the stomach by 3 or 4 craniocaudal gastric-to-gastric sutures. The tubing was then brought out through the abdominal wall fascia via the 12 mm trocar site. The incision was extended to accommodate the port, which was secured to the abdominal wall using permanent sutures. Patients are evaluated for a band-fill at 6 weeks postoperatively.

Laparoscopic Roux-en-Y Gastric Bypass

The salient feature of this technique was the creation of an antecolic, hand-sewn gastrojejunostomy, in the manner described by Higa.[7] The transverse colon was lifted to locate the ligament of Treitz. A 75 cm biliopancreatic limb and a 100 cm alimentary

limb were measured and the roux-en-Y distal anastomosis was performed using the double-stapled technique. The lesser sac was entered on a point on the lesser curvature, approximately 5 to 10 cm distal to the gastroesophageal junction. A roticulating 45 mm linear stapler was fired perpendicular to the long axis of the stomach to create the distal end of the gastric pouch. Placement of a transoral 32 French Lavacuator® tube along the lesser curvature with the tip resting on the transverse staple line facilitated the creation of a 10 to 20 cc tubular gastric pouch with several fires of linear staplers towards the angle of His. The Roux limb was brought up in an antecolic, antegastric fashion and anastomosed to the gastric pouch using a double-layered hand-sewn technique to create an anastomosis of 10 to 12 mm internal diameter. The anastomosis was then submerged and air insufflation testing was performed.

Laparoscopic Vertical Gastrectomy and Duodenal Switch

The biliopancreatic diversion with duodenal switch as described by Hess[8] is also known as the vertical gastrectomy with duodenal switch. Essential components of this operation include gastric restriction via a pylorus-preserving vertical gastrectomy, and malabsorption conferred by the duodenal switch with functional shortening of the small intestine to a 100cm common channel. This procedure conserves normal vagal and antral-pyloric anatomy thereby eliminating dumping syndrome and marginal ulcers. The operation was performed totally laparoscopically with 6 trocars. A 100 cm common channel was measured proximally from the ileocecal valve, and then another 150 cm was measured proximally to create the alimentary limb. A variable length of remaining small bowel comprising the biliopancreatic limb was anastomosed to the distal ileum at the 100 cm mark from the ileocecal valve to create the common channel and a 150 cm alimentary channel using a double-stapled technique.

The duodenum was divided 4 cm distal to the pylorus and was anastomosed to the retrocolic-tunneled, distal 250 cm of the ileum with a two-layered, hand-sewn, end-to-side technique. A greater curvature vertical gastrectomy was performed by stapling along a 48 French esophageal dilator system (Cook) to create a 100-150 ml gastric tube. Bioabsorbable Seamguards® (W.L. Gore) were used to buttress the staple-line in diabetic patients or if there was staple-line bleeding.

Postoperative Care

Patients were cared for on the ward unless preexisting cardiopulmonary disease warranted intensive care unit care. Postoperative analgesia was achieved with intravenous ketorolac every 6 hours and opioids delivered via a patient controlled anesthesia (PCA) unit. Water-soluble contrast upper gastrointestinal series were performed liberally but selectively, for indications including fever, unexplained tachycardia, elevated white blood cell count, or uncharacteristic pain levels. Band patients were usually discharged on the first postoperative day (POD) while RGB and DS patients were typically sent home on POD 3. VG patients were usually sent home on POD 1 to 2 but some stayed longer because of issues that stemmed from their preoperative co-morbidities. Band and VG patients started a liquid diet on POD 1, RGB and DS patients on POD 2.

Ethical Guidelines of Study and Institutional Review Board

Patients chose to undergo one of four operations: laparoscopic vertical gastrectomy, as a potential first stage of a two-stage laparoscopic biliopancreatic diversion with duodenal switch; laparoscopic adjustable gastric band; laparoscopic roux-en-Y gastric bypass; and laparoscopic biliopancreatic diversion with duodenal switch.

The selection was based on a combination of insurance coverage and personal preference. Institutional Review Board approval was not sought because the study was performed retrospectively on patients who made their own selection of existing, accepted operations.

Calculations and Statistical Methods

Body mass index (BMI) in kg/m^2 was calculated from the weight in kilograms divided by the height in meters squared. Percentage excess weight loss (%EWL) was calculated from (weight lost)/(preoperative weight ─ ideal body weight). Data were expressed as a mean ± standard deviation for continuous variables or as a number with the percentage in parentheses for nominal variables unless indicated otherwise. Statistical significance was defined as $P \leq 0.05$. Statistical calculations were performed using the Statview 5 software program (Abacus Concepts, Berkeley, CA). Differences in donor and recipient variables were evaluated using the unpaired Student's t-test when comparing two continuous variables and the ANOVA test when comparing more than two continuous variables. The Chi-square test was used for comparing nominal variables. When nominal variables were less than 5, Fisher's exact test was used.

RESULTS

Between February 2002 and February 2005, 222 bariatric operations were performed in patients 50 years of age and older. Open, hand-assisted, and revisional operations were excluded, leaving a total of 197 laparoscopic, primary bariatric operations. Of these 197, 56 (28%) were BAND, 39 (20%) were VG, 88 (45%) were RGB, and 14 (7%) were DS.

Perioperative Variables

Perioperative variables are shown in Table 1. The key differences to point out include: (1) VG patients were of greater preoperative weight and BMI, and (2) the VG and Band operations took the shortest time to perform. Average age, duration of follow-up, and estimated blood loss (EBL), were similar across all groups. Conversions to an open procedure were not performed in any patient group.

Postoperative Weight Loss Variables

Postoperative variables are shown in Table 2 and in Graphs 1, 2, and 3. Preoperatively, RGB and DS patients were of similar weight and BMI; VG patients were more obese on average, and Band patients were less (Table 2). The RGB and DS patients were almost identical in their starting weight, postoperative weights and BMI's, rate of weight loss, and %EWL. They experienced approximately 110-120lbs of weight loss and a %EWL of 74-78% at 12 months (Table 2). Band patients were less obese preoperatively but experienced a slower rate of weight loss (Graph 1). At 1 year, they lost about half the weight compared to the other 3 groups (approximate 60lbs versus 120lbs) (Graph 2), and as a result their %EWL was only 56% at 1 year.

The VG patients had the highest preoperative weight and BMI, but experienced a similar rate of weight loss compared to the RGB and DS groups (compare the slopes of Graph 1 and 2). %EWL was misleading lower in the VG group because for a given weight loss, more obese patients will have a lower %EWL than a less obese patient. This is because the calculation of %EWL = (weight lost)/(preoperative weight ─ ideal body weight), includes preoperative weight is in the denominator and therefore %EWL is a dependent, and not independent, variable of preoperative weight.

Complications, Morbidity and Mortality

Complications, morbidity and mortality are depicted in Table 3. VG and Band patients had the fewest complications, DS had the most, and RGB had an intermediate number of complications. VG patients had significantly fewer reoperations and major complications compared to the RGB and DS groups. Specific complications are tabulated in Table 4.

DISCUSSION

Bariatric Surgery in the Elderly

The safety and efficacy of bariatric surgery in the elderly population is not well defined. Significant weight loss clearly can be achieved[4], but it is unclear if the risks outweigh the benefits in older patients who are of higher perioperative risk and have a shorter residual lifespan in which to experience improvements in co-morbidities. While obesity is associated with poorer health and premature death, some studies suggest that there may be a protective effect of being overweight in the older age groups, perhaps because of greater energy reserves in the event of illness.[9]

Studies have shown that even modest weight loss of 10 pounds (range 0 to 34 pounds) in patients 60 years of age or greater can result in significant improvements in diastolic blood pressure, total cholesterol, triglycerides, physical performance, pedometer-measured step counts, and step climb and descent. Self-rated physical functioning and vitality (SF-36 quality of life questionnaire) also significantly improved.[10]

Health benefits in terms of reduction in medication use have been found after biliopancreatic diversion[11] as well as a variety of other bariatric procedures. Murr et al looked at 62 patients older than 50 years undergoing various bariatric operations and

found that the postoperative use of medications for arthritis, diabetes mellitus and asthma was reduced by 23%, 62% and 100%, respectively.[12]

Obesity-related co-morbid medical conditions improve after bariatric surgery. A decrease in the number of patients requiring medical treatment for co-morbidities has been found in older patients after laparoscopic RGB[13] and other bariatric operations.[14] In a study of 68 patients 50 years of age and older after laparoscopic gastric banding, 97% of the patients reported an improvement in their co-morbid conditions.[15]

Some studies that have specifically looked at complications after bariatric surgery in older versus younger patients have not found any significant differences. Cossu et al did not find that age affected the incidence of long-term complications after biliopancreatic diversion.[16] St. Peter et al at the Mayo Clinic, Scottsdale Arizona, compared 110 patients younger than 60 years with 20 patients older than 60 years undergoing RGB and found no difference in complication rate or length of hospital stay.[11] He found that younger patients lost more weight and had a significantly greater reduction in body mass index. Younger patients also demonstrated a more complete resolution of co-morbid conditions, although this difference was not significant. Older patients, who had more co-morbid conditions requiring more medication at the time of surgery, experienced a greater medication reduction during follow-up, although this was not statistically significant. The degree of weight loss that was achieved by the older patients was somewhat less than that of the younger patients.

Sugerman et al studied 80 patients 60 years of age and older undergoing RGB and found, not unexpectedly, that preoperative co-morbidity was greater in these patients, but despite this there were no operative deaths. Co-morbidities decreased following surgery, however, percentage weight loss, %EWL, and improvement in

hypertension and orthopedic problems, although significant, were greater in younger patients.[4]

A Medline search failed to identify any studies that attempted to determine which operation was best suited for older morbidly obese patients. Only a single study comparing laparoscopic versus open RGB was identified and it showed that the laparoscopic approach conferred advantages of fewer ICU days and decreased length of stay in this patient population.[17] Our study compared outcome in patients 50 years of age or older after four different bariatric operations in order to determine which operation is best for older patients.

A New Kind of Restrictive Operation?

Historically there have been a number of restrictive bariatric operations that have met with mixed success. The original horizontal gastroplasty introduced by Printen and Mason in 1973 utilized staplers to create a fundal pouch that emptied into the distal stomach via a stoma (Figure 3).[18] Unfortunately the sizeable pouch had a tendency to stretch and the stoma enlarged, resulting in arrested weight loss and often weight regain.

Edward E. Mason attempted to improve on the operation in 1982 by creating a vertical gastroplasty based on his observation that the thicker wall of the lesser curvature was less likely to stretch and distend (Figure 3).[19] To prevent the stoma at the end of this pouch from stretching, he used a 5cm strip of polypropylene mesh to create a ring around the pouch in this location. A variant of Mason's vertical banded gastroplasty, utilizes a silastic ring instead of mesh (Figure 3). These gastroplasty procedures all had promising 1 to 2 year weight loss profiles (%EWL of 60-70%), but disappointing long-term weight loss (%EWL of 30-40% at 5 years). The weight regain in

all of these gastroplasty procedures can potentially be explained by the undivided staple line through which re-canalization can occur.

A recent development in restrictive bariatric surgery laparoscopic adjustable gastric band placement, where an inflatable band is secured at the cardia, creating a 15-20cc gastric pouch. Infusion of saline via a port narrows the internal diameter of the band and can increase the degree of restriction. Weight loss occurs gradually over a 2 to 3 year period with %EWL that was 56% at 1 year in this series. While re-canalization is not a problem in this operation, the presence of the prosthesis introduces a host of its own problems with slippage, erosions, infection, and port-related complications.[20]

Of all the existing purely restrictive operations, the Magenstrasse and Mill (MM) operation most closely resembles the VG and confers the advantage of lack of a foreign body (Figure 4). The operation uses a bougie placed along the lesser curvature to size and guide the creation of a vertical gastric tube.[5] A EEA stapler is then used to create a circular defect in the antrum, approximately 6cm from the pylorus, which then allows linear staplers to be fired from the antrum up to the angle of His, creating the "Magenstrasse" or "street of the stomach" while preserving the antral "mill". The key difference between the MM and the VG is that the greater curvature of the stomach is entirely transected and removed in the VG, whereas with the MM, the greater curvature, while separated from the lesser curvature along much of its length, is still attached to the rest of the stomach at the antrum.

All the restrictive operations confer the benefit of weight loss without malabsorption, so that vitamin deficiencies, calcium deficiency, and anemia are rare. Unfortunately in the past, weight loss with the restrictive procedures has not been as effective as the RGB and DDS operations, perhaps because of the lack of

malabsorption or because of the as yet undefined contribution of hormonal mechanisms.

Results from Previous Restrictive Operations

Long-term results after VBG are not impressive, with a significant number of patients who still meet the definition of obesity. Fobi reports an average %EWL after laparoscopic VBG at 10 years of 44% in 43 patients.[21] Other authors have found that patients with a BMI of greater than 45 kg/m^2 fail to achieve a BMI of 35 kg/m^2, even at 5 years postoperatively.

Short-term data from multiple authors demonstrate a consistently good % EWL of 60-70% at 1-2 years postoperatively.[22],[23],[24] Long-term data however suggests a strong tendency towards weight regain. Ultimately horizontal gastroplasty failed to achieve greater than 40% EWL in 84-89% of patients. Outcome was somewhat better after vertical gastroplasty with failure to achieve greater than 40% EWL in 73 to 81% of patients.

The MM operation has been performed with a 0% mortality rate and 4% major complication rate in the hands of its creator, David Johnston.[5] In his first 100 patients with an average preoperative BMI of 46.3kg/m^2, a mean weight loss of 84±31lbs, and a %EWL of 58% was achieved at 1 year. Now with over 230 postoperative MM patients, Dr. Johnston has achieved a 5-year %EWL of 61% with a stable weight generally being achieved at 1 year postoperatively.

While the long-term efficacy of the VG is unclear, it may be a more than adequate operation for older patients in whom satisfactory weight loss achieved with a low rate of morbidity is more critical. With its purely restrictive nature and lack of malabsorption, it may also be better suited for older patients who are more likely to be

on medications since dosing will not be affected. In this regard, the Band should also be a preferred option for older patients, especially since its reversible nature will be advantageous in the situation where older patients may develop medical conditions were weight loss and/or malnutrition is a problem. Selection of the Band versus the VG operation in older patients can be guided by the degree of obesity of the patient, with superobese patients (BMI greater than 50kg/m^2) preferentially undergoing VG since VG can achieve significantly better weight loss.

CONCLUSION

The short-term data in this study suggests that the vertical gastrectomy should be a preferred bariatric operation in patients 50 years and older because it achieves the greatest weight loss with the shortest operative time and the fewest complications. Further research will be needed in order to determine the efficacy of the vertical gastrectomy in older patients is over the long term.

Figure 1. Schematic illustrations of the 4 bariatric operations performed in this study

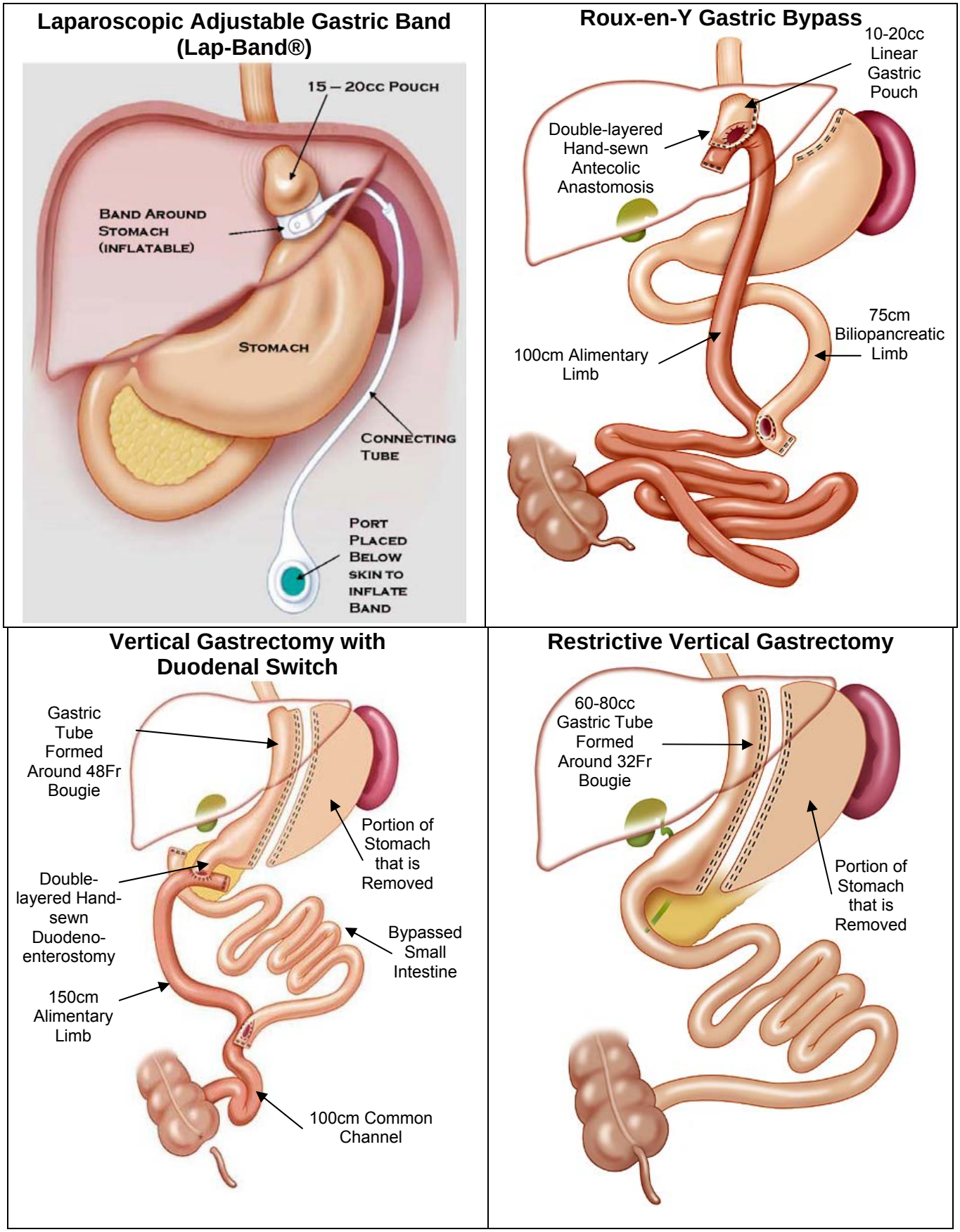
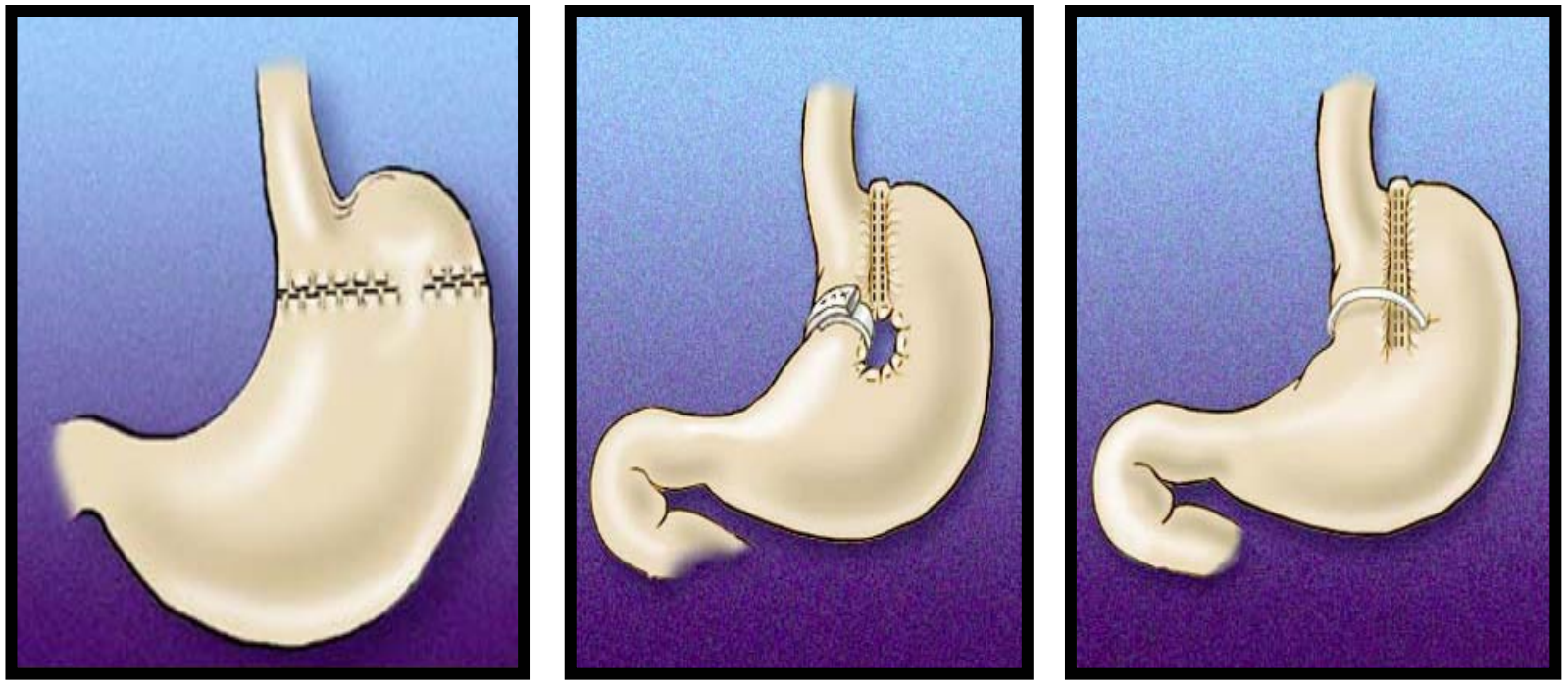


Figure 2. Trocar placement for laparoscopic vertical gastrectomy

Two 12mm trocars are placed bilaterally in the upper rectus sheath will be used for the gastric stapling. Two 5mm trocars are placed, one in each upper quadrant. Liver retraction is achieved with either a 5mm Nathanson retractor in the epigastrium or a paddle in the right upper quadrant (shown as black dots).

Figure 3. Diagrams of different gastroplasty procedures

The vertical banded gastroplasties had promising 1 to 2 year weight loss profiles (%EWL of 60-70%) but disappointing long term weight loss (%EWL of 30-40% at 5 years). All of these gastroplasty procedures have undivided staple lines through which re-canalization can occur potentially explaining the long-term weight regain. (Figures courtesy of the American Society of Bariatric Surgery).



Horizontal Gastroplasty

Vertical Banded Gastroplasty (Mason)

Silastic Ring Vertical Banded Gastroplasty

Figure 4. The Magenstrasse & Mill operation

The operation consists of a Magenstrasse, or “wide street”, of a gastric tube along the lesser curvature formed around a 32Fr bougie, and a preserved antral “mill” to maintain forward food flow. The major terminal branches of the nerve of Latarjet to the antrum are preserved. The secretions of the fundus and body of the stomach empty via a bridge of stomach at the antrum. (Figure courtesy of Obesity Surgery).

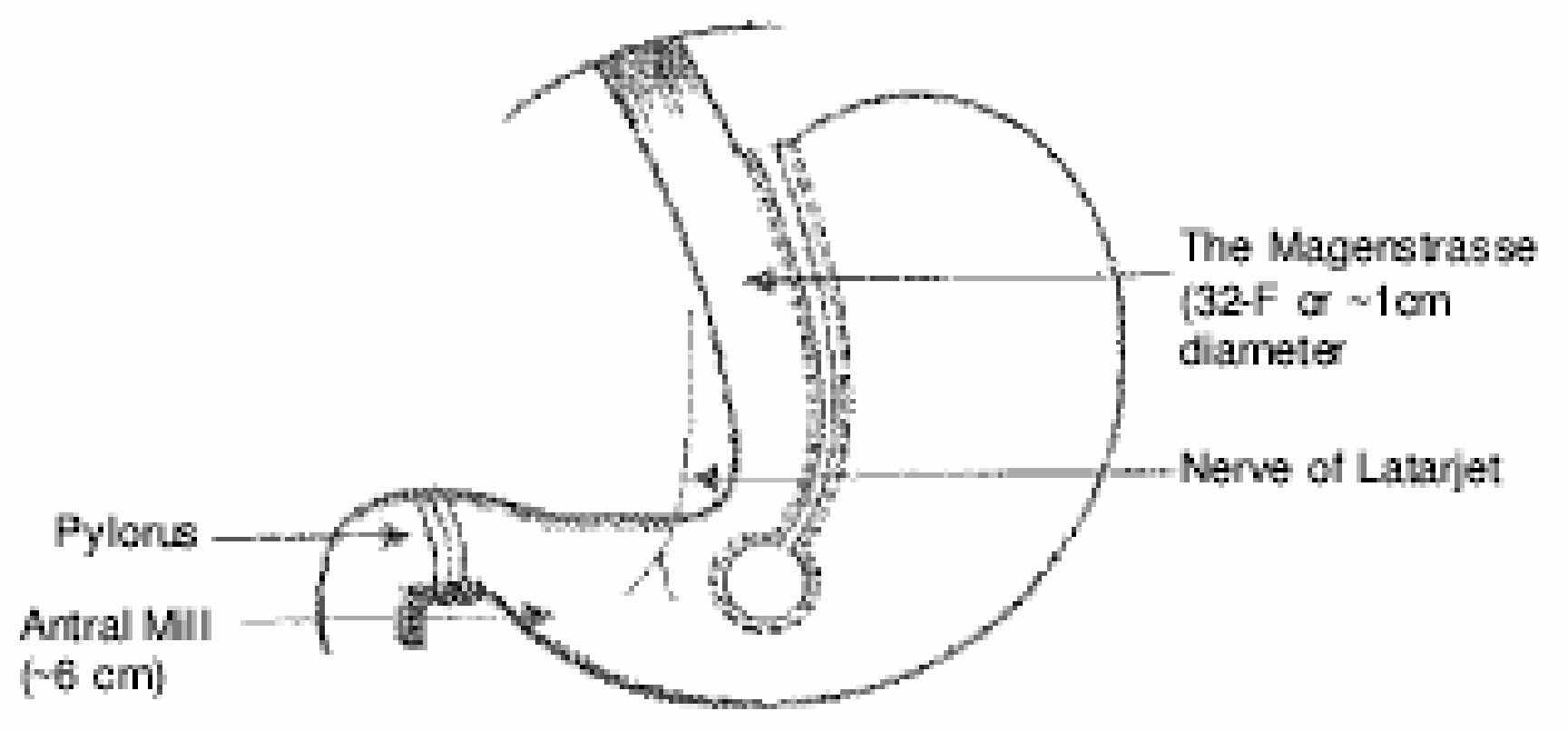


Table 1. Preoperative variables for patients 50 years of age and older undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (Band), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS).

	VG>50y (n=39)	**Band>50y (n=56)**	**RGB>50y (n=88)**	**DS>50y (n=14)**	**P Value**
Age (years)	54±3	55±5	54±3	53±2	P=NS
Male (%)	7 (18%)	9 (16%)	14 (16%)	1 (7%)	P=NS
Preop weight (lbs)	313±83†	248±40	280±42	267±27	†P<0.01 VG vs all
Preop BMI (kg/m^2)	51.6±11.2†	40.9±5.5	45.9±6.2	42.9±3.6	†P<0.01 VG vs all
Follow-up (days)	361±218	389±252	580±225	676±276	NS
OR time (mins)	109±30†	98±26†	142±37*	218±37	†P<0.05 vs RGB, DS; *P<0.05 vs DS
EBL (cc)	52±30	29±17*	54±34	90±42	*P<0.05 Band vs DS
Length of stay (days)	3.6±1.5	2.1±0.9‡	3.9±1.9	3.9±0.8	‡P<0.05 Band vs DS

Table 2. Postoperative weight variables for patients 50 years of age and older undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (Band), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS)

	VG>50y (n=39)	**Band>50y (n=56)**	**RGB>50y (n=88)**	**DS>50y (n=14)**	**P Value**
Preop weight (lbs)	313±83†	248±40	280±42	267±27	†P<0.01 VG vs all
1 yr Weight (lbs)	257±79†	171±30	171±34	167±15	†P<0.01 VG vs all
Preop BMI (kg/m^2)	51.6±11.2	40.9±5.5	45.9±6.2	42.9±3.6	†P<0.01 VG vs all
1 yr BMI (kg/m^2)	41.4±13.0†	29.2±4.3	28.3±4.2	26.5±3.1	†P<0.01 VG vs all
1 yr %EWL (%)	53±18*	56±25*	74±15	78±11	*P<0.01VG and Band vs RGB, DS
1 yr Weight lost (lbs)	126±53	67±23*	117±29	114±14	*P<0.01Band vs all

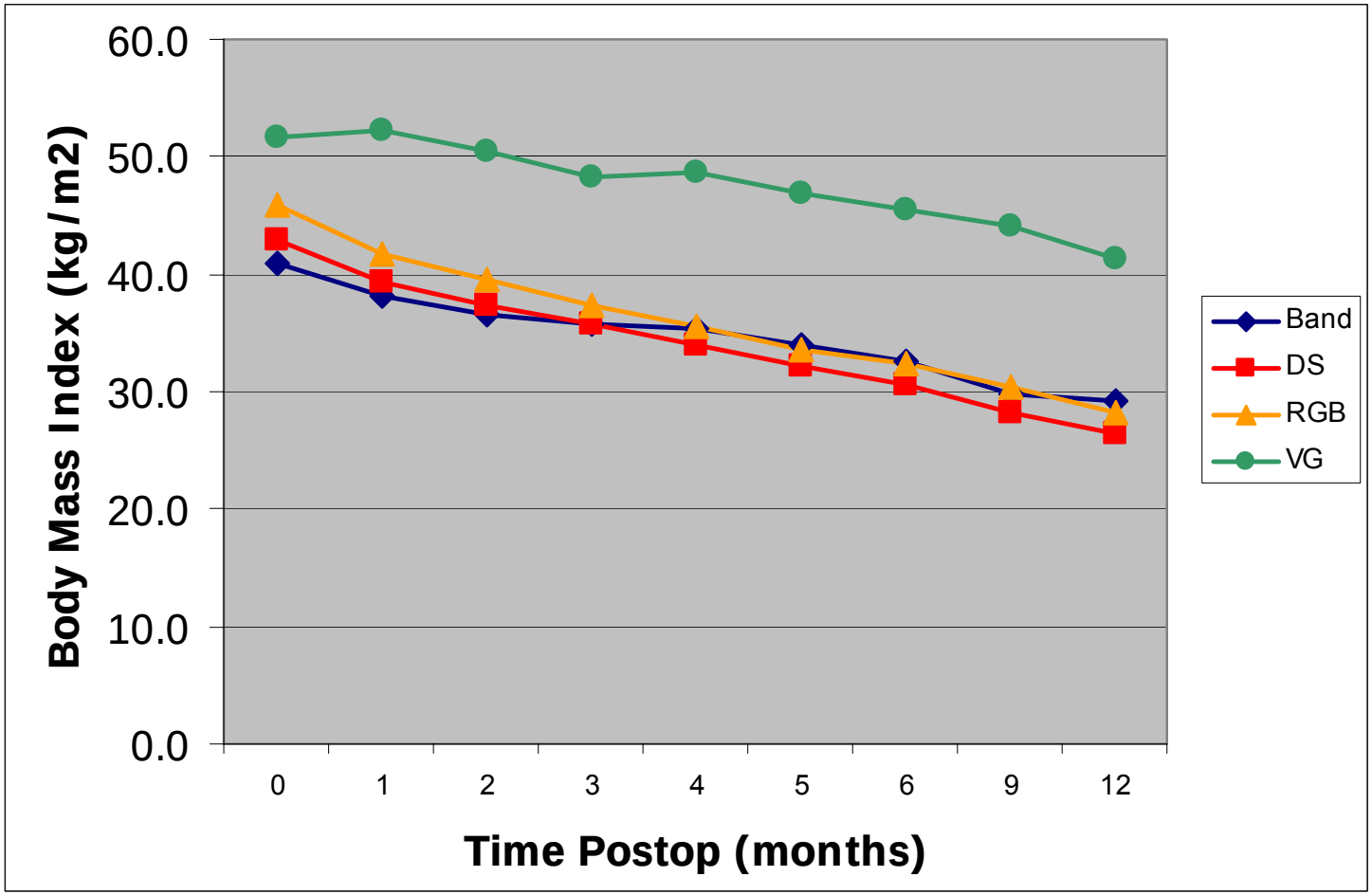
Table 3. Complications in patients 50 years of age and older undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (BAND), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS).

	VG>50y (n=39)	**Band>50y (n=56)**	**RGB>50y (n=88)**	**DS>50y (n=14)**	**P Value**
Non-operative readmissions (%)	0 (0%)	1 (1.8%)	3 (3.4%)	1 (7.1%)	P=NS
Reoperations (%)	1 (2.6%)	2 (3.6%)	3 (3.4%)	2 (14.3%)	P=NS
Deaths (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	P=NS
Minor complications (%)	1 (2.6%)	2 (3.6%)	7 (8.0%)	0 (0%)	P=NS
Major complications (%)	2 (5.1%)	2 (3.6%)	4 (4.5%)	4 (28.6%)†	†P<0.05 DS vs all
Total complications (%)	3 (7.7%)	4 (7.1%)	11 (12.5%)	4 (28.6%)*	†P<0.05 DS vs VG and Band

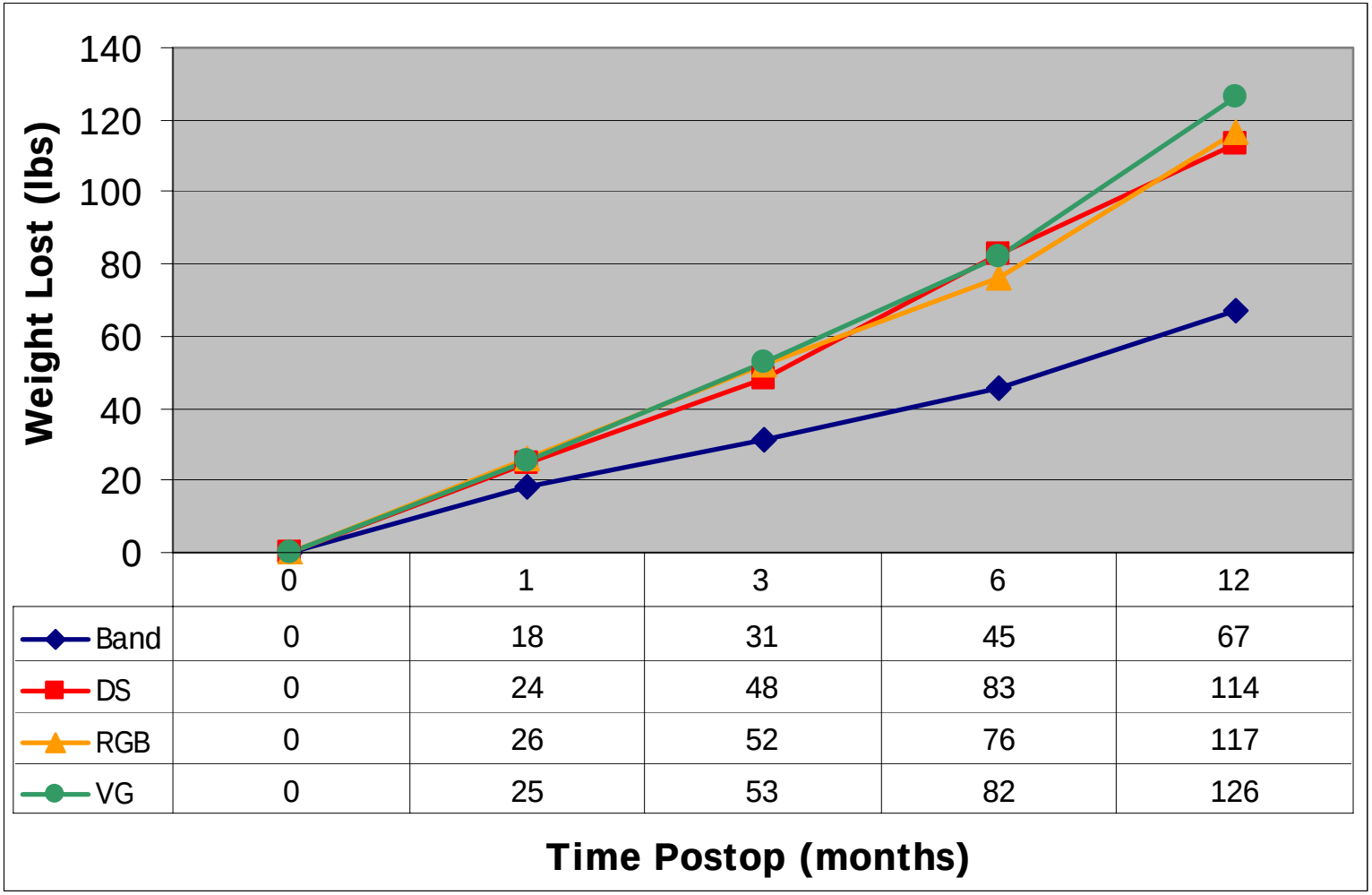
Table 4. Complications occurring in patients 50 years of age and older undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (BAND), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS).

Complications	**VG>50y (n=39)**	**Band>50y (n=56)**
Non-operative readmissions	0	1 – Postop edema with nausea/vomiting, resolved with time
Reoperations	1 – Leak	1 – Band infection, abscess 1 – Port tubing breakage
Deaths	0	0
Minor complications (%)	1– Thrombophebitis	1 – Postop edema with nausea/vomiting, resolved with time
Major complications (%)	1 – Pulmonary embolism 1 – Leak	1 – Band infection, abscess 1 – Port tubing breakage
Complications	**RGB>50y (n=88)**	**DS>50y (n=14)**
Non-operative readmissions	1 – Strictures with dehydration 1 – Kidney stones 1 – Vomiting, dehydration, no stricture	1 – Infected biloma after cholecystectomy
Reoperations	1 – Internal hernia at distal trap 1 – Leak at gastrojejunostomy 1 – Biliary colic	2 – Postoperative pain due to adhesions
Deaths	0	0
Minor complications (%)	3 – Strictures 2 – Kidney stones 1 – Vomiting, dehydration, no stricture 1 – Marginal ulcer	0
Major complications (%)	1 – Internal hernia at distal trap 1 – Leak at gastrojejunostomy 1 – Biliary colic 1 – Bleeding requiring transfusion	2 – Postoperative pain due to adhesions 1 – Infected biloma after cholecystectomy 1 – Intraoperative ventricular tachycardia

Graph 1. Body mass index in patients 50 years of age and older after undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (Band), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS). VG patients were more obese than both RGB and DS patients, but lost weight at a similar rate (slope). Band patients were less obese and lost weight at approximately half the rate of VG, RGB and DS patients.

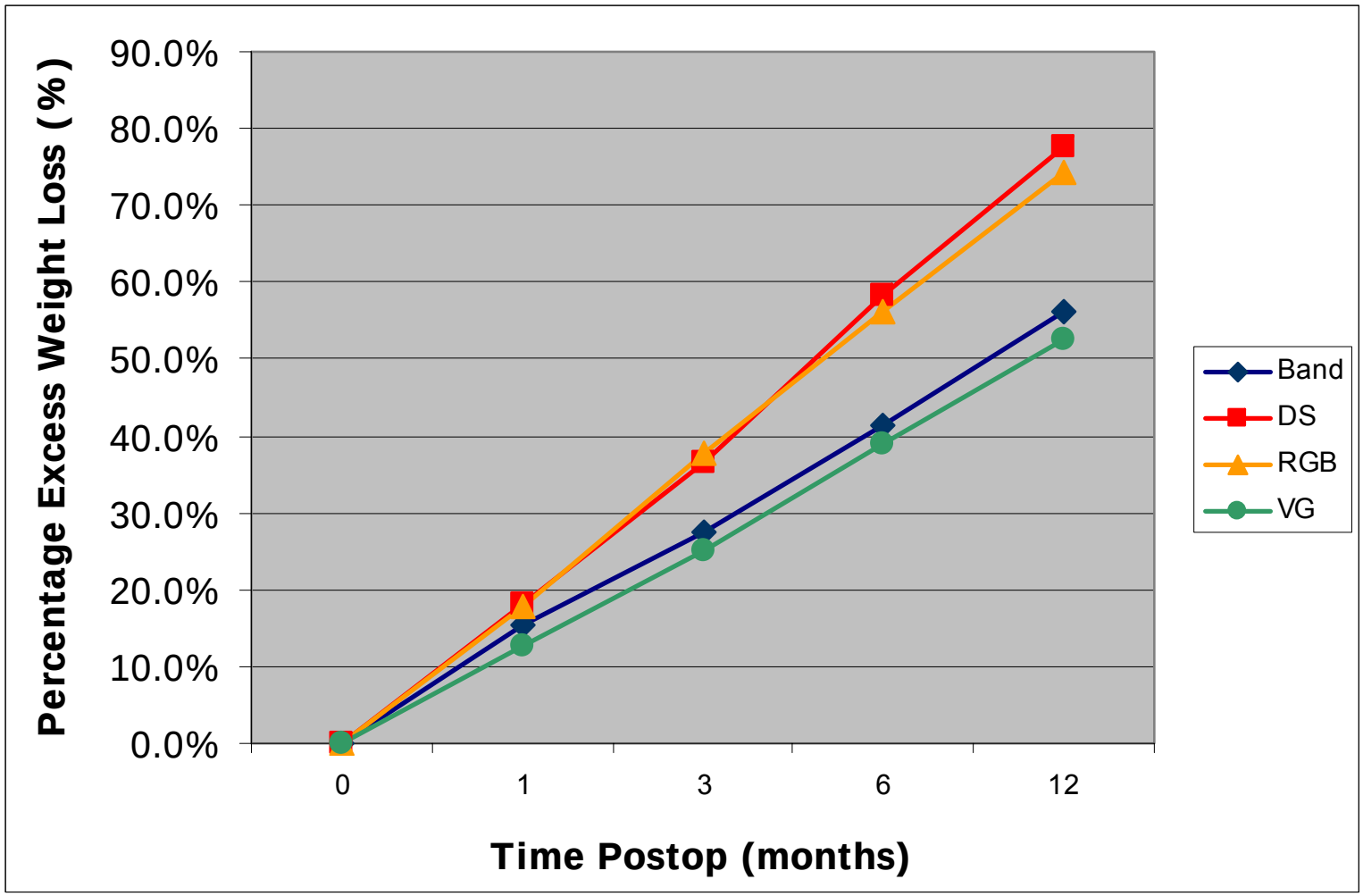


Graph 2. Postoperative weight loss in patients 50 years of age and older after undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (BAND), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS). VG patients lost weight as effectively as RGB and DS patients. Band patients lost approximately half as much weight the other groups.



	0	1	3	6	12
Band	0	18	31	45	67
DS	0	24	48	83	114
RGB	0	26	52	76	117
VG	0	25	53	82	126

Graph 3. Percentage excess weight loss (%EWL) in patients 50 years of age and older after undergoing laparoscopic vertical gastrectomy (VG), adjustable gastric band placement (BAND), Roux-en-Y gastric bypass (RGB), and vertical gastrectomy with duodenal switch (DS). %EWL can be a deceptive parameter when comparing groups of different preoperative weight. Even though VG, RBG, and DS patients lost a similar amount of weight, VG %EWL is misleadingly low because the VG preoperative weight was significantly greater than that of the RGB and DS patients.



ABBREVIATIONS

Band – adjustable gastric band placement

BMI – Body mass index

DS – Hess' biliopancreatic diversion and duodenal switch (also known as the vertical gastrectomy and duodenal switch)

EBL – Estimated blood loss

%EWL – Percentage excess weight loss

ICU – Intensive care unit

POD – Post operative day

RGB – Roux-en-Y gastric bypass

VBG – Vertical banded gastroplasty

VG – Vertical gastrectomy

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