

ORIGINAL ARTICLE

Impact of biliopancreatic length following revision of sleeve gastrectomy to one anastomosis gastric bypass.

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ABSTRACT... Objective: To evaluate the early Impact of Biliopancreatic Length on the outcome in revisional bariatric surgeries. **Study Design:** Retrospective Review. **Setting:** Lady Reading Hospital, Peshawar. **Period:** 1st March 2017 to 28th February 2022. **Methods:** Prospectively maintained data of 43 patients with the BMI of less than 50, who underwent laparoscopic OAGB Patients were placed in three groups including Group A 180cm, B 220cm and C 250 cm respectively corresponding to the biliopancreatic limb length. The patients were set for follow-up at 7th, 14th, 28th postoperative days for the first one month and then subsequently at 3 months and 6 months. All data was evaluated on SPSSR version 22.0 and is depicted in tabulated form. Continuous data was compared using Student t tests and Mann Whitney U test. In low figures from a 2X2 table Fischer's exact test was performed and the significance of a test was considered as a p value of lower than 0.05. Multivariate analysis was performed to exclude confounding elements such as gender and pre-operative data. **Results:** A total of 43 patients were included in the study. Patients who completed 6-months of follow-up were analyzed. Preoperative weight after LSG & before REVISION OAGB were 113 ± 28.5 kg (180cm), 106.9±22.7 (220cm), 117.1±17.3 (250cm) and BMI were 45.8 ±4.1 (180), 41.9 ±5.3 (220cm), 44.3 ±4.7 (250cm). A total of 43(%) patients attended the 6 months follow-up after revision OAGB (clinical and hematological) (group A = 18; group B = 12, group C = 13). A total of 43 (%) TWL achieved in 180 cm, 220 cm, and 250 cm groups were 27.4(+19.1), 17.8(+14), and 28.9(+9.5) respectively (p=0.81). There was no protein deficiency reported at 6 months of follow-up. Regarding albumin levels in group A at 1st, 3rd & 6th month was 3.4 ±0.3, 3.3 ±0.4, & 3.6 ±0.3 respectively while Albumin in Group B at 1st, 3rd, & 6th month was reported as 3.2 ±0.4, 3.2 ±0.3, & 2.8 ±0.4 respectively and Albumin levels in Group C at 1st, 3rd, & 6th Month was 3.6 ±0.3, 3.1 ±0.4, 2.7 ±0.5 respectively (p=0.07). A significant difference was noted in the long lengths of Biliopancreatic group C with a mean figure of 22.1 g/ml. (p=0.01). **Conclusion:** Results in terms of weight loss and its relationship to length of biliopancreatic limb while performing one anastomosis Gastric Bypass (OAGB) has no significant benefit. A modest Biliopancreatic limb length attains similar results after revision from Sleeve gastrectomy to OAGB. Adding length to the bypassed bowel confers nutritional complications especially Serum Ferritin.

Key words: Biliopancreatic Length, Body Mass Index, Pediatric Surgery.

INTRODUCTION

Being one of the most common procedures amongst a long list of bariatric options for people with morbid obesity, the One anastomosis Gastric Bypass (OAGB) and the Mini gastric bypass (MGB), has long been sparked the debate in their comparison to the Roux en Y gastric Bypass (RYGB).¹

With the benefits of an anti-reflux procedure, the RYGB has dominated in the past two decades as

the most preferred procedure for a revision from Sleeve Gastrectomy following severe reflux or weight gain.² Recent literature suggests and have shed light on modified techniques of Both OAGB and MGB, which are gaining popularity and is performed by many bariatric surgeons across the globe.³

A crucial aspect of these procedures is determining the optimal biliopancreatic limb length.

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The Standard biliopancreatic limbs varying from 150-250cm, based on the eating habits, age and socioeconomic strata; there has been debate as to what would be the ideal Biliopancreatic limb length in a case of revision following a sleeve gastrectomy.^{4,5} The number of surgeons emphasizes on recording the total gut length during surgery is very scantily presented in literature, However, others advocate the argument for a ratio of 40/60 percent biliopancreatic limb to total gut length ratio has become the main interest.^{6,7,8}

According to the literature, notably these revisions are considered more aggressive than the usual primary one anastomosis gastric bypass (OAGB).⁶

Most literature supports and suggests having a biliopancreatic limb of 250cm is ideal although a study conducted by (Chen et al) recommends a common channel of (400cm) to prevent protein deficiency due to malabsorption.⁶

Study suggesting a sub set of patients with already existing common limbs of <400cm following lengthening to >400cm all patients had improvement of protein deficiency. Although, most surgeons have made it mandatory to measure the entire gut length during all revisional bariatric procedure, the argument to which gut length would ideally suit for revisions after sleeve gastrectomy (LSG).⁹

Further investigation is needed to determine the most suitable gut length for revisions following sleeve gastrectomy.

METHODS

This is a retrospective review, which is maintained prospectively. The data of 43 patients with the BMI of less than 50, who underwent laparoscopic OAGB from 1st March 2017 to 28th February 2022 were included. This study was conducted at the surgical division of Lady Reading hospital, Peshawar with follow up duration of 6 months. Following approval from the institutional ethical committee (235/LRH/MTI, Dated: 11/07/2024), in all patients included in the study, 40% of patients had primary sleeve gastrectomy at the

same institute and 60 % had primary sleeve gastrectomy at other facilities and presented for revisional surgery, with the preferable choice for OAGB due to inadequate weight loss or increase in weight after achieving a target BMI post -Sleeve Gastrectomy.

Details of previous procedures and co-morbidities (diabetes, hypertension & OSA) and their resolution from the primary surgery were recorded. Pre-operative investigations included serological *Helicobacter pylori* infection, nutritional markers, endoscopy, radiological studies to outline the existence of Hiatal hernia/ Marginal ulcer and the size of the sleeve. Patients operated at other centers underwent re-evaluation with Computerized tomography and gastrograffin meal for anatomy of the sleeve pre-operatively. Patients were divided into three groups based on biliopancreatic limb length i.e (180cm, 220cm, 250cm) into Group (A, B and C respectively. An informed consent was taken in all cases with no blinding due to ethical issues.

Prior to anesthesia all patients were subjected to DVT prophylaxis with enoxaparin and also pneumatic compression stockings. During operation the entire gut lengths were measured in all cases following inspection of the sleeve. Patients considered to have common channels less than 400cm were rearranged to other groups with shorter bilio-pancreatic limbs (<220cm). The sleeves were dissected from the gastric bed and a window along the crow foot (lesser curvature) was made. Then the sleeves were sectioned to convert to pouches of approximately 15-18cm with endo staplers' triple rows staple lines. The counted length of biliopancreatic limb was anastomosed to the gastric pouch posterior to the staple line with the Endo stapler technique. The enterotomy and gastrotomies were then closed with 2/0 sutures of surgeon's preferences. An intra-operative leak test was performed to assess the patency of the anastomosis.

Postoperatively patients were monitored and orally allowed the same evening after complete recovery from anesthesia. Early mobilization and thromboprophylaxis was followed till 14 days

postoperatively. The patients were discharged by the attending physicians and follow-up dates at 7th, 14th, 28th postoperative days for the one month and then subsequently at 3 months and 6 months, were explained to the patient. During follow-up weight, complaints and relevant nutritional and metabolic markers were evaluated.

The preoperative data including data from before the primary procedure were compared in all patients and compared with the postoperative outcomes. All data was evaluated on SPSS^R version 22.0 and is depicted in tabulated form. Continuous data was compared using Student t tests and Mann Whitney U test. In low figures from a 2X2 table Fischer's exact test was performed and the significance of a test was considered as a p value of lower than 0.05. Multivariate analysis was performed to exclude confounding elements such as gender and pre-operative data.

RESULTS

All patients between March, 2017 and February 2022, all were assessed for eligibility, and 43 were included in the study, Patients who completed six months follow-up were analyzed i.e. 22 males and 21 females. Preoperative weight after LSG & before REVISION OAGB were 113 ± 28.5 kg (180cm), 106.9 ± 22.7 (220cm), 117.1 ± 17.3 (250cm) and BMI were 45.8 ± 4.1 (180), 41.9 ± 5.3 (220cm), 44.3 ± 4.7 (250cm). Table-I

The patients included were divided into three groups based on the length of their biliopancreatic limb (BPL): Group A (180cm, n = 18), Group B (220cm, n = 12), and Group C (250cm, n = 13). A total weight loss (TWL) achieved was significant in all groups, with no statistically significant difference between them. i.e. in 180 cm, 220 cm, and 250 cm groups were $27.4 (+19.1)$, $17.8 (+14)$, and $28.9 (+9.5)$ respectively.

Additionally, there was a significant improvement in type 2 diabetes mellitus (T2DM) i.e. Diabetes was present in n = 12 (27.90%) patients preoperatively. 5 patients (11.62%) in group A were with HBA1c 6.7%, 3 patients (6.97%) in group B with HBA1c of 6.5% and 4 patients (9.30%) in group C were with HBA1c 6.5%. Among these, at

6-Months follow-up, 80% (n = 4) in group A with Hba1c 4.8%, 100% (n = 3) in group B with Hba1c 5.3%, and 100% (n = 4) in group C with Hba1c 5.1% were able to stop all their hypoglycemic medications.

At 6-months of follow-up, 4/10 (100%) in group "A", 3/10 (100%) in group "B", and 3/10 (100%) in group "C" had their hypertension resolved, allowing them to discontinue all of their medications. Improvement of obstructive sleep apnea (OSA) was also noted in all the 3 mentioned groups. There were no significant differences statistically in the resolution of T2DM and hypertension between these three groups.

The mean operative time was 88.6 ± 12.5 min in group A, 78.9 ± 18.7 min in group B & 90.3 ± 18.8 min in group C, there was no significant difference statistically. The median hospital stay was $3.0 (\pm 0.8)$ days for group A, $3.7 (\pm 0.8)$ days for group B & $4.9 (\pm 1.3)$ days for group C. Intraoperative and perioperative complications are reported in Table-III. Intraoperative complications occurred in 1 (5.5%) out of 18 patients in the groups A (bowel injury n = 1): which was recognized and managed laparoscopically during surgery. In our bariatric unit, unhealthy dietary habits were not considered an absolute contra-indication to OAGB. All the patients were educated about the increase risks involved in sedentary life style in the incidence of peri-operative complications leading to failure of desired surgical goal i.e weight loss and other metabolic complications.

Nutritional/Hematological Outcomes At -6 months follow-up, vitamin D3 deficiency was noted in 18/43 (41.8%) group A, 12/43 (27.9%), and 13 (30.23%) patients; No vitamin B12, Iron & ferritin deficiency was reported in 6 months of follow up in our study so far. There was no protein deficiency reported at 6 months of follow-up. Regarding albumin levels in group A at 1st, 3rd & 6th month was 3.4 ± 0.3 , 3.3 ± 0.4 , & 3.6 ± 0.3 respectively while Albumin in Group B at 1st, 3rd, & 6th month was reported as 3.2 ± 0.4 , 3.2 ± 0.3 , & 2.8 ± 0.4 respectively and Albumin levels in Group C at 1st, 3rd, & 6th Month was 3.6 ± 0.3 , 3.1 ± 0.4 , 2.7 ± 0.5 respectively (p=0.07).

Preoperative Data	180cm h=18	220cm h=12	250cm h=13	P-Value
Age (years) (s.d.)	33.8 (+6.9)	37.1(+8.3)	35.5(+7.8)	0.887
Gender				
Male	7(38.8%)	6(50%)	9(69.2%)	0.14
Female	11(61.1%)	6(50%)	4(30.7%)	
Mean Time since LSG (months) (s.d.)	19.3(+2.1) months	18.1(+1.5) months	22.4(+3.3) months	0.622
Pre-operative weight before OAGB (kg)(s.d)	113(+28.5)	106.9(+22.7)	117.1(+17.3)	0.717
Weight before LSG (kg) (s.d.)	135.2(+21.4)	133.8(+25.6)	131.7(+23.8)	0.83
BMI post LSG (Kg/M ²) (s.d.)	45.8 (+4.1)	41.9 (+5.3)	44.3 (+4.7)	0.899
Diabetes				
• Insulin dependent	05(27.7%)	04(33.3%)	06(46.15%)	0.556
• Non-insulin dependent	03(16.6%)	02(16.6%)	03(23%)	
Hypertension (%)	04(22.2%)	03(25%)	03(23%)	0.536
OSA (%)	05(27.7%)	04(33.3%)	04(30.7%)	0.418
Osteoarthritis (%)	02(11.1%)	03(25%)	-	0.361
Pre-operative albumin (g/dl) (s.d.)	3.8(+0.7)	3.6(+1.1)	3.9(+0.9)	0.386
Ferritin (mg/ml)	55.1(+23.3)	61.3(+18.2)	49.5(+23.1)	0.134
Vitamin B 12(pg/ml)	218.7(+45.5)	199.9(+37.6)	193.4(+54.1)	0.224
Vitamin D3(ng/ml)	24.6(+8.1)	28.4(+11.8)	27.5(+9.9)	0.834
Hemoglobin Levels(g/dl)	12.1(+2.1)	13.0(+1.8)	11.9(+2.2)	0.44
HbA _{1c} %	6.7% (+0.9)	6.5% (+0.9)	6.5% (+1.1)	0.418
Mg(mg/ml)	1.8(+0.4)	1.9(+0.4)	2.0(+0.5)	0.6
Zn (mg/dl)	77.6(+9.7)	81.4(+14.5)	73.4(+12.1)	0.593

Table-I. Preoperative demographic and biochemical markers

Postoperative Data	180cm h=18	220cm h=12	250cm h=13	P-Value
Post revision weight at 6 months(kg) (s.d)	85.6(+9.4)	89.1(+8.7)	88.2(+7.8)	0.81
Post revision BMI at 6 months(s.d.)	34.79(+2.2)	34.9(+3.8)	33.4(+3.7)	0.661
Post-operative albumin(g/dl)				
At 1 month	3.4(+0.3)	3.2(+0.4)	3.6(+0.3)	0.09
At 3 months	3.3(+0.4)	3.2(+0.3)	3.1(+0.4)	
At 6 months	3.6(+0.3)	2.8(+0.4)	2.7(+0.5)	
Ferritin(mg/ml)	58.3(+11.6)	41.6(+13.1)	22.1(+16.4)	0.01
Vitamin B 12(pg/ml)	194.4(+24.3)	188.6(+39.1)	187.7(+21.9)	0.91
Vitamin D3(ng/ml)	24.8(+6.1)	22.3(+8.1)	12.6(+7.8)	0.07
Hemoglobin Levels(g/dl)	11.9(+2.1)	10.3(+2.2)	10.1(+1.9)	0.118
HbA _{1c} %	4.8% (+0.7)	5.3(+0.9)	5.1(+0.8)	0.436
Mg(mg/ml)	1.8(+0.3)	1.7(+0.2)	1.6(+0.5)	0.291
Zn(mg/dl)	82.3(+19.1)	61.4(+13.6)	64.8(+13.9)	0.111
Dosage reduction of antidiabetic medication (%)	52%	64%	71%	0.647
Remission of HTN(%)	40%	53%	42%	0.874
Improvement of OSA symptoms (%)	100%	100%	100%	0.963

Table-II. Post operative markers at 6th month follow-up.

Intraoperative Data	180cm h=18	220cm h=12	250cm h=13	P-Value
Mean Blood Loss (ml) (s.d)	67.3(+29.6)	81.8(+22.2)	77.6(+24.6)	0.334
Postoperative length of stay (days) (s.d)	3.0(+0.8)	3.7(+0.8)	4.9(+1.3)	0.87
Operative time (min) (s.d)	88.6 (+12.5)	78.9(+18.7)	90.3(+18.8)	0.685
ICU stay (%)	03(16.6%)	04(33.3%)	04(30.7%)	0.5
No. of patients on ventilators (%)	02(11.1%)	01(8.3%)	01(7.6%)	0.583
Peri-operative reoperation (%)	01(5.5%)	-	-	0.719
Bowel Injury	1(5.5%)	-	-	0.773

Table-III. Perioperative data

Perioperative Complications	180cm h=18	220cm h=12	250cm h=13	P-Value
DVT/PE (%)	01(5.5%)	-	01(7.6%)	0.48
Pulmonary Complications (%)	02(11.1%)	01(8.3%)	02(15.3%)	0.355
Rhabdomyolysis (%)	-	--	01(7.6%)	0.5
Bleeding (%)	-	01(8.3%)	-	0.651
Postoperative Leak (%)	01(5.5%)	-	01(7.6%)	0.31
Wound/port-site infection (%)	02(11.1%)	02(16.6%)	03(23%)	0.39
Mortality (%)	-	01(8.3%)	-	0.182

Table-IV. Post operative complications

Keeping in view said results Hypoalbuminemia noted in group B and C at 6 months. At 6 months of follow up no significant difference noted among all three groups regarding Hemoglobin levels. Nutritional and supplemental therapy advised to the patients of all groups to avoid any possible post-op nutritional deficiencies in near future. A significant difference was noted in the long lengths of Biliopancreatic group C with a mean figure of 22.1mg/ml. ($p=0.01$)

DISCUSSION

Obesity, a chronic disease is most effectively treated with bariatric surgery.¹⁰ The bariatric procedures, based on restrictive actions (sleeve gastrectomy) and a malabsorptive components (OAGB) are the powerful tools of the process.¹¹ Restrictive procedures like SG are widely performed due to its technical ease, low risks and acceptable medium-term outcomes.¹ However, despite LSG documented success, significant numbers of Patients that have undergone LSG fail to achieve adequate weight-loss during long term follow-ups. Instead, Laparoscopic OAGB had attained its place as one of the widespread , simple and effective bariatric procedures.¹² This

procedure initially called mini-gastric bypass or one anastomosis gastric bypass (OAGB) appeared to be less challenging technically and was considered which has potentially reduced morbidity.¹¹

In the bariatric surgical fraternity, there is a consensus regarding the pouch size in OAGB, however, the optimal biliopancreatic limb (BPL) length in OAGB remains debated, as it impacts malabsorption. This involves a bypass segment of small intestine, which remains a significant site for the absorption of proteins, vitamins and mineral. However, the potency of the classic OAGB with 180-cm biliopancreatic limb (BPL) to achieve weight loss decreases with an increase in BMI.^{6,13,14}

Many studies suggest that a longer BPL may not ensures better weight loss or comorbidity resolution, rather this exposes them to major risks such as malabsorption of proteins, minerals and vitamins.^{15,16}

A Systematic review conducted by Chetan D. Parmar et al. reported satisfactory weight loss

and comorbidity resolution. In his study the mean BMI at revisional bariatric surgery was 41.6 kg/m² (range 28–70.8). After OAGB-MGB the mean percentage excess weight loss (EWL) was 50.8% at 6 months, Revisional OAGB/MGB leads to satisfactory resolution of comorbidities i.e. with type 2 diabetes mellitus (T2DM) in 80.5%, hypertension (HT) 63.7% and GERD in 79.4%.¹

Whereas in another prospective study conducted by Anmol Ahuja et al. found that longer limb lengths may be necessary for patients with higher BMI or uncontrolled comorbidities. This showed that 150-cm BPL length was adequate with minimal complication and was with good results in general. While 180-cm BPL can be used in super obese whereas when greater weight loss is required, whereas the BPL of 250cm should be used with caution as it might result in higher nutritional deficiencies.¹⁷

Our study evaluated the effectiveness of different BPL length in all the three included groups, total body weight loss (TWL) achieved in 180 cm, 220 cm, and 250 cm were 27.4KG (+19.1), 17.8KG (+14), and 28.9KG (+9.5) respectively with mean percentage EWL of all the 3 groups of 24%, along with satisfactory resolution of said comorbid in all the patients during 6 months of follow-up.

The primary aim was to assess, if at a 6-Months follow-up, any significant differences among the 3 groups (A, B, C) in terms of EWL or resolution of comorbidities could be significantly considered. The results showed no significant difference in weight loss or comorbidity resolution among the groups.

In comparison with other studies, like Kamal Mahawar's research, shows approximately half of the populations in the study were able to stop taking all of their medications, whereas 38.0% (n = 24) in OAGB-200 & 50.0% (n = 13) in OAGB-were able to reduce their medication need. Similarly, with regard to hypertension, almost two thirds of the population discontinued all of their medication, whereas roughly one third were able to lower their dosage.¹⁸

Another study by Ahuja et al. mentioned that in all three groups of BPL lengths of 150-cm, 180-cm, and 250-cm groups, T2DM resolved in 71.4%, 73.3%, and 81.8% of patients and hypertension resolution occurred in 61.9%, 64.1%, and 68.7%, respectively with no statistically significant difference in all the three groups.¹⁷

The secondary endpoint was to evaluate the absorption of vitamins and minerals in all the mentioned groups at 6 months of follow-up. Recent literature indicates the possibility of deficiencies of vitamins in patients undergoing OAGB.^{19,20,21,22}

Nutritional/Hematological Outcomes At -6 months follow-up, vitamin D3 & ferritin deficiency was reported in All the included groups (A, B, & C) Where-as no vitamin B12, Iron as well as protein deficiency was reported in our study so far.

Regarding albumin levels in group A at 1st, 3rd & 6th month was 3.4 ±0.3, 3.3 ±0.4, & 3.6 ±0.3 respectively while Albumin in Group B at 1st, 3rd, & 6th month was reported as 3.2 ±0.4, 3.2 ±0.3, & 2.8 ±0.4 respectively and Albumin levels in Group C at 1st, 3rd, & 6th Month was 3.6 ±0.3, 3.1 ±0.4, 2.7 ±0.5 respectively indicating down trend of albumin levels in group B and C at 6 months. In comparison with a study conducted in University of Campania "Luigi Vanvitelli", Naples, Italy concluding that there was no difference statistically present between blood levels of vitamin D3, vitamin B12, total protein, and albuminemia. However, values of iron and ferritin were significantly lower in group C.⁴

The limitation of this study was the comparison of longer segment bypassed bowel lengths to assess further nutritional deficiencies of macronutrients in patients undergoing revisions from LSG to gastric bypass. Prospective trials with a need to assess the ideal limits of bypassed segments and more longer segments in procedures like SADI-S should be performed with longer follow-up periods. However, our study highlights the need for further research on optimal BPL lengths and potential nutritional deficiencies in OAGB procedures.

CONCLUSION

Our study found no significant correlation between weight loss and biliopancreatic limb length in one anastomosis gastric bypass (OAGB) procedures. A moderate Biliopancreatic limb length achieved comparable results after revision from Sleeve gastrectomy to OAGB. Adding length to the bypassed bowel confers nutritional complications especially Serum Ferritin levels. Further research is necessary to assess the impact of longer bowel lengths on other potential deficiencies including protein deficiencies, to determine the optimal limb length for OAGB procedures needs further evaluation. As great concepts theoretically at the times are not now.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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3	Adil Bangash: Study concept.
4	Rohail Bangash: References writing.
5	Akash Kumar: Data collection.
6	Maaz Bin Ayub: Statistics.
7	Uzair Khalil: Data collection, references.
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