https://doi.org/10.29309/TPMJ/2026.33.08.10446 www.theprofesional.com

ORIGINAL ARTICLE

Effect of biliopancreatic limb length on Glycemic control following Roux-EN-Y Gastric bypass.

Nazish Ali[1], Ghulam Siddiq[2], Murad Ali Khan[3], Khizra Manzoor[4]

ABSTRACT… Objective: To compare the effect of short versus long biliopancreatic limb length (BPL) on glycemic control following Roux-en-Y gastric bypass (RYGB) in patients with type 2 diabetes mellitus. **Study Design:** Quasi-Experimental Clinical Study. **Setting:** Department of Surgery, Shifa International Hospital, Islamabad. **Period:** October 2025 to January 2026. **Methods:** A total of 140 patients aged 30–60 years with type 2 diabetes mellitus undergoing Roux-en-Y gastric bypass were considered. Patients were non-randomly allocated into two groups based on biliopancreatic limb length: Group A underwent short biliopancreatic limb bypass, while Group B underwent long biliopancreatic limb bypass. Baseline demographic and clinical characteristics were recorded. HbA1c levels were measured preoperatively and six months postoperatively. The primary outcome was mean reduction in HbA1c at six months. A P-value of less than 0.5 was considered as significance following analysis through SPSS. **Results:** The two study groups didn't differ significantly in terms of baseline clinical characters. The mean preoperative HbA1c was 8.1 ± 1.0 in the short limb group and 8.3 ± 1.4 in the long limb group (p = 0.58). At six months postoperatively, mean HbA1c decreased to 6.5 ± 0.9 in the short limb group and 6.1 ± 0.8 in the long limb group (p = 0.01). The mean HbA1c level was significantly reduced in the long biliopancreatic limb group versus the short limb group (2.2 ± 0.8% vs. 1.9 ± 0.7%; p = 0.002). Significantly high number patients of long limb control reported glycemic control (HbA1c < 6.5%) when compared with short limb group (84.2% vs 60%, p = 0.01). **Conclusion:** A longer BPL length in RYGP was associated with a significantly greater reduction in HbA1c and improved glycemic control at six months postoperatively compared to a shorter biliopancreatic limb.

Key words: Biliopancreatic Limb, Glycemic Control, HbA1c, RYGB, Type 2 Diabetes Mellitus.

Article Citation: Ali N, Siddiq G, Khan MA, Manzoor K. Effect of biliopancreatic limb length on Glycemic control following Roux-EN-Y Gastric bypass. Professional Med J 2026; 33(08):1532-1536. https://doi.org/10.29309/TPMJ/2026.33.08.10446

INTRODUCTION

Severe obesity is a chronic metabolic disorder associated with significant morbidity, including type 2 diabetes mellitus (T2DM). While dietary modification and lifestyle interventions remain the first-line treatment for obesity, their long-term effectiveness in patients with severe obesity is limited. Bariatric surgery has emerged as the most effective and durable therapeutic option, producing sustained weight loss and significant improvement or remission of obesity-related comorbidities, particularly T2DM.[1]

Metabolic (bariatric) surgery has demonstrated substantial benefits in glycemic control, leading to improved insulin sensitivity and long-term diabetes remission. Consequently, international diabetes management guidelines now recognize metabolic surgery as a primary treatment option for selected patients with T2DM. Among the available surgical procedures, Roux-en-Y gastric bypass (RYGB) is considered the gold standard for the management of morbid obesity and its associated metabolic complications.[2]

Despite its proven efficacy, weight regain and recurrence of diabetes have been reported following RYGB, prompting the development of various revisional strategies. These include modification of the bypassed small bowel anatomy by extending the Roux limb, shortening the common limb, or lengthening the biliopancreatic limb.[3] However, there is currently no consensus regarding the optimal limb lengths that maximize metabolic benefits while minimizing complications.[4]

Previous studies suggest that a longer biliopancreatic limb may result in superior glycemic

1. MBBS, PGR General Surgery, Shifa International Hospital, Islamabad.
2. MBBS, FCPS, Professor HOD General Surgery, Shifa International Hospital, Islamabad.
3. MBBS, FCPS, Consultant General Surgery, Shifa International Hospital, Islamabad.
4. MBBS, Resident General Surgery, Shifa International Hospital, Islamabad.

Correspondence Address:
Dr. Nazish Ali
Department of General Surgery, Shifa International Hospital, Islamabad.
drfatimagull113@gmail.com

Article received on:
04/02/2026
Accepted for publication:
11/04/2026

control compared to a shorter limb. Improved HbA1c outcomes have been reported in patients undergoing RYGB with extended biliopancreatic limb (BPL) length, although some studies failed to demonstrate statistically significant differences.[5-7] Moreover, existing evidence is limited, and data from local populations is insufficient.

Therefore, this study intended to compare the effect of short versus long BPL length on glycemic control following RYGB. Generating local evidence will help determine the optimal surgical configuration for improved HbA1c reduction in our population and contribute to better surgical planning and patient outcomes.

METHODS

This quasi-experimental clinical trial was carried from October 2025 to January 2026 in the Surgical Department of Shifa International Hospital, Islamabad after approval from ethical committee (IRB: 412-25-15/10/25). The study participants were estimated using the WHO sample size calculator, ending up in the selection of 140 patients, with 70 patients divided into each group, at a 5% level of significance and 80% power, and an expected controlled glycemic index of 61.9% in patients with short biliopancreatic limb and 83.3% in those with long biliopancreatic limb. Non-probability consecutive sampling was employed.

Patients aged 30–60 years of either gender undergoing bariatric surgery under general anaesthesia with American Society of Anesthesiologists (ASA) physical status classification system I–III were considered for the study. Patients with other clinical conditions such as pregnancy, history of malignancy or bariatric surgery, known liver cirrhosis (defined as coarse liver on ultrasound with ALT and AST levels >40 IU), or renal failure were excluded.

Eligible patients admitted to the surgical wards were enrolled after fulfilling the selection criteria. Baseline demographic characteristics and clinical data including patient's age, gender, body mass index (BMI), history of smoking (>5 pack-years), alcohol consumption (>20 ml/day), any other addiction, diabetes mellitus (DM) (random blood sugar greater than 200 mg/dl), hypertension, dyslipidaemia, characterized by total cholesterol >200 mg/dl, and ASA status were recorded on a structured proforma. Patients were then non-randomly allocated into two groups based on the surgeon's preference. Group A underwent RYGB bypass with a short biliopancreatic limb, while Group B underwent the procedure with a long biliopancreatic limb. All surgeries were performed under general anaesthesia by a single surgical team with the assistance of the researcher. Intraoperative duration and estimated blood loss were documented.

Blood samples for HbA1c assessment were obtained preoperatively and at six months postoperatively. HbA1c values were recorded, and glycemic control was considered achieved if postoperative HbA1c was less than 6.5%.

Data analysis was performed using SPSS (version 25). Quantitative variables such as age, BMI, intraoperative time, blood loss, and pre- and postoperative HbA1c were presented as mean ± standard deviation, while qualitative variables such as gender, smoking status, alcohol use, addictions, diabetes, hypertension, dyslipidaemia, and ASA classification were presented as frequencies and percentages. The average change in HbA1c from baseline to six months after surgery was determined and compared between the two groups using an independent t-test. Statistical significance was defined as a p-value < 0.05. Stratification was performed for potential confounders including age, gender, BMI, smoking, alcohol use, other addictions, diabetes, hypertension, dyslipidaemia, ASA status, intraoperative time, and blood loss, followed by post-stratification comparison through the independent samples t-test.

RESULTS

A total of 140 patients undergoing Roux-en-Y gastric bypass were considered for the study, with 70 patients in each group based on biliopancreatic limb length.The baseline demographic and clinical characteristics of the study participants are shown in Table I. The mean age of patients in the short biliopancreatic limb group was 45.1 ± 7.2 years, while it was 46.7 ± 7.9 years in the long limb group ($p = 0.68$). There was no statistically significant difference between the groups regarding

gender distribution, body mass index, smoking status, alcohol consumption, or presence of other addictions. Similarly, the prevalence of diabetes mellitus, hypertension, dyslipidaemia, and ASA physical status classification did not differ significantly between the two study groups, indicating comparable baseline characteristics.

The mean operative time was 145.6 ± 23.4 minutes in the short limb group and 149.3 ± 22.2 minutes in the long limb group, with no statistically significant difference (p = 0.31). Estimated intraoperative blood loss was also comparable between the two groups (111.5 ± 38.6 ml vs. 118.9 ± 40.2 ml; p = 0.37) (Table-II).

The mean preoperative HbA1c was 8.1 ± 1.0% in the short biliopancreatic limb group and 8.3 ± 1.4% in the long limb group, with no significant difference between the groups (p = 0.58). At six months postoperatively, the mean HbA1c decreased to 6.5 ± 0.9 in the short limb patients and 6.1 ± 0.8% in the long limb patients. This difference was statistically significant. The mean reduction in HbA1c at six months was significantly greater in the long biliopancreatic limb group in contrast to the short limb group (2.2 ± 0.8% vs. 1.9 ± 0.7%; p = 0.002) (Table-III).

Glycemic control, defined as HbA1c < 6.5%, was achieved in 42 patients (60.0%) in the short biliopancreatic limb group and 59 patients (84.2%) in the long limb group. This difference was statistically significant (p = 0.01) (Table-IV).

Over the past decades, various modifications of RYGB have been explored to optimize metabolic outcomes. While several studies have focused on the effect of alimentary limb length on weight loss[8,9], comparatively limited data are available regarding the influence of BPL length on limiting blood glycemic level, especially with in Asian hospital setting and population. Previous studies by reported improved anti-diabetic effects and higher rates of T2DM reduction in patients with longer BPLs, suggesting that BPL length may play a critical role in glucose metabolism after RYGB and these results formed the basis of our hypothesis which was worth testing in our hospitals.[10,11]

The findings of the present study support this concept. In our cohort, patients undergoing RYGB with a longer biliopancreatic limb exhibited a significantly greater reduction in HbA1c levels at six months compared to those with a shorter BPL. Additionally, a higher proportion of patients in the long BPL group achieved target glycemic control (HbA1c < 6.5%). These findings indicate that extending the BPL may enhance early glycemic outcomes following RYGB, even when other operative variables remain comparable.

TABLE-I

Demographic and clinical baseline features of participants (N= 140)

Variable	Short Biliopancreatic Limb (n=70)	Long Biliopancreatic Limb (n=70)	P-Value
Age (years), mean ± SD	45.1 ± 7.2	46.7 ± 7.9	0.68
Male, n (%)	34 (48.6%)	32 (45.7%)	0.74
Female, n (%)	38 (54.3%)	36 (51.4%)	
BMI (kg/m²), mean ± SD	43.8 ± 5.7	42.2 ± 5.1	0.59
Smoking (>5 pack-years), n (%)	20 (28.6%)	18 (25.7%)	0.70
Alcohol use (>20 ml/day), n (%)	11 (15.7%)	8 (12.9%)	0.63
Any other addiction, n (%)	6 (8.6%)	7 (10.0%)	0.77
Diabetes mellitus, n (%)	50 (71.4%)	65 (92.8%)	0.56
Hypertension, n (%)	44 (62.9%)	41 (68.5%)	0.61
Dyslipidaemia, n (%)	36 (51.4%)	38 (54.3%)	0.74
ASA I, n (%)	13 (18.6%)	14 (20.0%)	0.82
ASA II, n (%)	41 (58.6%)	39 (55.7%)	
ASA III, n (%)	17 (24.3%)	16 (22.9%)	

TABLE-II

Operation characteristics of study groups (N=140)

Variable	Short Biliopancreatic Limb (n=70)	Long Biliopancreatic Limb (n=70)	P-Value
Operative time (minutes), mean ± SD	145.6 ± 23.4	149.3 ± 22.2	0.31
Estimated blood loss (ml), mean ± SD	111.5 ± 38.6	118.9 ± 40.2	0.37

TABLE-III

Quantitative assessment of HbA1c before and after surgery (N=140)

HbA1c (%)	Short Limb (n=70)	Long Limb (n=70)	P-Value
Preoperative, mean ± SD	8.1 ± 1.0	8.3 ± 1.4	0.58
Postoperative (6 months), mean ± SD	6.5 ± 0.9	6.1 ± 0.8	0.01
Mean fall in HbA1c, mean ± SD	1.9 ± 0.7	2.2 ± 0.8	0.002

TABLE-IV

Glycemic months at 6 months follow Up (N=140)

Glycemic Control (HbA1c < 6.5%)	Short Limb n (%)	Long Limb n (%)	P-Value
Achieved	42 (60.0%)	59 (84.2%)	0.01
Not achieved	28 (40.0%)	11 (15.7%)	

The metabolic benefit observed with a longer BPL may be attributed to greater exclusion of the proximal small intestine, resulting in enhanced hormonal responses, including increased secretion of glucagon-like peptide-1 and peptide YY, improved insulin sensitivity, and reduced hepatic glucose production. Case-based evidence has also highlighted the importance of BPL length in diabetes control, where shortening of bypassed segments led to recurrence of T2DM and re-lengthening resulted in remission, emphasizing the role of intestinal bypass configuration in metabolic outcomes.[12,13]

Several studies indicate that the extent of malabsorption following RYGB is primarily determined by the length of the common limb, rather than by isolated modifications of the alimentary or biliopancreatic limbs.[14] However, in routine clinical practice, the total small bowel length is highly variable among individuals, and measurement of the common limb is not always feasible. In the present study, the surgical technique focused on modification of BPL length while maintaining adequate bowel continuity to minimize the risk of severe malabsorption and nutritional complications. This approach may explain the favorable glycemic outcomes without reported major metabolic adverse effects during the short-term follow-up.

Improvement in glycemic control following RYGB has important clinical implications, as better diabetes control is associated with reduced risk of microvascular and macrovascular complications.[15,16] Although this study primarily focused on HbA1c reduction and other associated findings are not reported, improvements in associated metabolic conditions such as hypertension and dyslipidaemia were also observed in both groups, though without significant intergroup differences. This suggests that RYGB confers overall metabolic benefits irrespective of limb length, while longer BPL may provide an additional advantage for glycemic control.

This study has certain limitations. First, the non-randomized design may introduce selection bias despite comparable baseline characteristics between groups. Second, the follow-up period of six months limits assessment of long-term durability of glycemic control and late nutritional complications. Third, the length of the common limb and total small bowel length were not measured, which may influence the degree of malabsorption and metabolic response. Larger randomized studies with longer follow-up and standardized measurement of bowel limb lengths are needed to further clarify the optimal configuration of RYGB for glycemic control.

CONCLUSION

A longer BPL length in RYG bypass was linked with a significantly greater reduction in HbA1c and improved glycemic control at six months postoperatively compared to a shorter biliopancreatic limb.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Ribeiro-Parenti L, El Jindi H, Willemetz A, Siebert M, Kapel N, Le Beyec J, et al. **Shortening the biliopancreatic limb length of one anastomosis gastric bypass maintains glucose homeostasis improvement with limited weight loss.** Journal of Clinical Medicine. 2022; 11(17):4976.
2. Kamocka A, Chidambaram S, Erridge S, Vithlani G, Miras AD, Purkayastha S. **Length of biliopancreatic limb in Roux-en-Y gastric bypass and its impact on post-operative outcomes in metabolic and obesity surgery—systematic review and meta-analysis.** International Journal of Obesity. 2022; 46(11):1983-91.
3. Pal A, Rhoads D, Tavakkoli A. **Customization of biliopancreatic limb length to modulate and sustain antidiabetic effect of gastric bypass surgery.** American Journal of Physiology-Gastrointestinal and Liver Physiology. 2018; 314(2):G287-G99.
4. Park JY, Kwon OK, Jeon J-H, Choi Y-K, Park KB. **Impact of the different biliopancreatic limb length on diabetes and incretin hormone secretion following distal gastrectomy in gastric cancer patients.** Scientific Reports. 2021; 11(1):22451.
5. Kwon Y, Lee S, Kim D, ALRomi A, Park S-H, Lee CM, et al. **Biliopancreatic limb length as a potential key factor in superior glycemic outcomes after Roux-en-Y gastric bypass in patients with type 2 diabetes: A meta-analysis.** Diabetes Care. 2022; 45(12):3091-100.
6. Zerrweck C, Herrera A, Sepúlveda EM, Rodríguez FM, Guilbert L. **Long versus short biliopancreatic limb in Roux-en-Y gastric bypass: Short-term results of a randomized clinical trial.** Surgery for Obesity and Related Diseases. 2021; 17(8):1425-30.
7. Ke Z, Li F, Gao Y, Zhou X, Sun F, Wang L, et al. **Short versus long biliopancreatic limb in Roux-en-Y gastric bypass surgery for treatment of type 2 diabetes mellitus.** Videosurgery and Other Miniinvasive Techniques. 2020; 16(1):129.
8. Dogan K, Homan J, Aarts EO, van Laarhoven CJ, Janssen IM, Berends FJ. **A short or a long Roux limb in gastric bypass surgery: Does it matter?** Surgical Endoscopy. 2017; 31(4):1882-90.
9. Mahawar KK, Kumar P, Parmar C, Graham Y, Carr WR, Jennings N, et al. **Small bowel limb lengths and Roux-en-Y gastric bypass: A systematic review.** Obesity Surgery. 2016; 26(3):660-71.
10. Marchesini JCD. **End-to-side duodeno-jejunostomy with half-and-half biliopancreatic limb for the treatment of type 2 diabetes: A proposal for a simpler technique.** Obesity Surgery. 2007; 17(1):138.
11. Stefanidis D, Kuwada TS, Gersin KS. **The importance of the length of the limbs for gastric bypass patients—an evidence-based review.** Obesity Surgery. 2011; 21(1):119-24.
12. Elliott JA, Le Roux CW, Path F. **How long should we make the biliopancreatic limb during Roux-en-Y gastric bypass?** Surgery for Obesity and Related Diseases. 2015; 11(6):1246-7.
13. Kao Y-H, Lo C-H, Huang C-K. **Relationship of bypassed limb length and remission of type 2 diabetes mellitus after Roux-en-Y gastric bypass.** Surgery for Obesity and Related Diseases. 2012; 8(6):e82-e4.
14. Motamedi MAK, Barzin M, Ebrahimi M, Ebrahimi R, Khalaj A. **Severe fatal protein malnutrition and liver failure in a morbidly obese patient after mini-gastric bypass surgery: case report.** International Journal of Surgery Case Reports. 2017; 33:71-4.
15. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. **Harmonizing the metabolic syndrome: A joint interim statement of the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity.** Circulation. 2009; 120(16):1640-5.
16. Bashier A, Bin Hussain A, Abdelgadir E, Alawadi F, Sabbour H, Chilton R. **Consensus recommendations for management of patients with type 2 diabetes mellitus and cardiovascular diseases.** Diabetology & Metabolic Syndrome. 2019; 11(1):80.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Nazish Ali:** Writing, analysis.
2	**Ghulam Siddiq:** Review.
3	**Murad Ali Khan:** Data collection, interpretation.
4	**Khizra Manzoor:** Data analysis.