

Interpreting Biliopancreatic Limb Length After One-Anastomosis Gastric Bypass: Insights from a BMI-Tailored Cohort Study

Angelo Iossa

angelo.iossa@uniroma1.it

Sapienza University of Rome

Diletta Di Meo

Sapienza University of Rome

Sara Giovampietro

Sapienza University of Rome

Alessandra Micalizzi

Sapienza University of Rome

Giuseppe Cavallaro

Sapienza University of Rome

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Abstract

Background

The optimal biliopancreatic limb (BPL) length in one-anastomosis gastric bypass (OAGB) remains controversial. Because BPL length is frequently tailored to baseline patient characteristics, observational comparisons may be confounded by patient selection. We evaluated whether BPL length independently influenced long-term outcomes after adjustment for baseline obesity severity.

Methods

This retrospective single-center cohort included 147 consecutive patients undergoing primary OAGB between 2019 and 2022. According to an institutional BMI-tailored strategy, patients received a 150-cm (n = 46), 180-cm (n = 52) or 200-cm (n = 49) BPL. The primary endpoint was percentage total weight loss (%TWL) at 36 months. Multivariable analyses adjusted for baseline BMI.

Results

Baseline BMI differed significantly among groups. Although crude analyses showed significant differences in 36-month %TWL, BPL length was no longer independently associated with weight loss after BMI adjustment, whereas baseline BMI remained an independent predictor. Anemia rates were similar across groups, while hypoalbuminemia occurred numerically more frequently after a 200-cm BPL. Smoking independently predicted marginal ulcer.

Conclusions

Within a BMI-tailored OAGB strategy, extending the BPL beyond 180 cm did not improve long-term weight loss after adjustment for baseline BMI. These findings suggest that observational comparisons of BPL length should account for patient allocation and support individualized BPL selection until high-quality prospective evidence becomes available.

INTRODUCTION

One-anastomosis gastric bypass (OAGB) has emerged as one of the most frequently performed bariatric procedures worldwide because of its technical simplicity, reproducibility, and excellent long-term metabolic outcomes. Since its original description by Rutledge [1], the procedure has gained widespread international acceptance, with contemporary registry data demonstrating a progressive increase in its utilization worldwide [2]. More recently, the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) has published both a position statement and an international Delphi consensus supporting OAGB as an effective and safe bariatric procedure when performed in

appropriately selected patients [3–4]. Nevertheless, despite increasing standardization of the procedure, the optimal biliopancreatic limb (BPL) length remains one of the few technical aspects that continues to generate debate [5]. The BPL constitutes the hypo absorptive component of OAGB and is therefore expected to influence both postoperative efficacy and long-term nutritional safety. While a longer bypass may enhance weight loss and metabolic improvement, it may also increase the risk of protein-calorie malnutrition, hypoalbuminemia, anemia and micronutrient deficiencies, making the balance between efficacy and safety a central issue in surgical planning [6–9]. This uncertainty is reflected in contemporary practice. Fixed BPL lengths ranging from 150 to 200 cm remain widely adopted, whereas many centers individualize limb length according to baseline body mass index (BMI), total small-bowel length, metabolic burden or surgeon preference [5–6]. Despite observational studies, systematic reviews, meta-analyses and more recent randomized evidence, no universally accepted recommendation regarding the optimal BPL length has yet emerged [6–8, 10]. One possible explanation is that, in routine clinical practice, BPL length is rarely allocated independently of patient characteristics. Instead, surgical decision-making frequently incorporates obesity grade and other clinical factors, making it difficult to distinguish the effect of limb length from the characteristics that determined its selection. Our institution routinely adopts a BMI-tailored strategy, whereby progressively longer BPLs are preferentially constructed in patients with more severe obesity. This real-world allocation policy provides the opportunity to evaluate the relationship between BPL length and postoperative outcomes while accounting for the clinical rationale underlying limb selection. Accordingly, the aim of this retrospective comparative cohort study was to compare weight-loss outcomes and postoperative safety among patients undergoing primary OAGB with 150-, 180-, or 200-cm biliopancreatic limbs.

MATERIALS AND METHODS

Study design and patients

This retrospective comparative cohort study included consecutive adult patients who underwent primary laparoscopic one-anastomosis gastric bypass (OAGB) at the SICOB Centre of Excellence, ICOT Hospital (Latina, Italy), between January 2016 and December 2020. The study was conducted in accordance with the Declaration of Helsinki. Because of its retrospective observational design, informed consent for study participation was waived according to institutional regulations, while all patients had previously provided written informed consent for surgery and the anonymized use of clinical data for research purposes. Eligible patients underwent primary OAGB with a predefined biliopancreatic limb (BPL) length of 150, 180 or 200 cm. Patients undergoing revisional procedures, emergency surgery or alternative limb configurations were excluded. Consecutive inclusion reflected routine clinical practice and minimized selection bias.

Institutional strategy for BPL allocation

BPL length was determined according to a predefined BMI-tailored institutional strategy rather than random allocation. Patients with higher baseline BMI and greater metabolic burden were preferentially assigned to longer limbs, whereas shorter BPLs were generally used in patients with lower BMI. Nutritional status, age, obesity-related comorbidities and surgeon judgement could further influence the final operative decision. Consequently, baseline BMI was prespecified as the principal covariate in analyses evaluating postoperative weight-loss outcomes.

Surgical technique

All procedures were performed laparoscopically by experienced bariatric surgeons using a standardized technique. A long narrow gastric pouch was created over a 36-Fr bougie, followed by measurement of the biliopancreatic limb from the ligament of Treitz using graduated laparoscopic graspers until the planned length (150, 180 or 200 cm) was reached. A 5-cm antecolic side-to-side gastrojejunostomy was then fashioned with a linear stapler and closed using a running absorbable suture. Apart from BPL length, operative technique, perioperative management, enhanced recovery pathway and postoperative nutritional supplementation remained unchanged throughout the study period.

Follow-up

Patients underwent standardized multidisciplinary follow-up at 3, 6, 12, 24 and 36 months after surgery and annually thereafter whenever available. Follow-up included clinical assessment, anthropometric measurements, nutritional counselling and routine laboratory investigations according to institutional protocol. Abdominal ultrasonography was routinely performed at approximately 6 months and upper gastrointestinal contrast studies at 12 months. Upper gastrointestinal endoscopy was reserved for symptomatic patients or long-term surveillance. Follow-up completeness exceeded 98%.

Outcomes

The primary endpoint was percentage total weight loss (%TWL) at 36 months. Secondary endpoints included percentage excess weight loss (%EWL), postoperative BMI, marginal ulcer, anemia, hypoalbuminemia, revisional surgery and overall postoperative adverse events. Anemia was defined according to World Health Organization criteria (hemoglobin < 13 g/dL in men and < 12 g/dL in women), while hypoalbuminemia was defined as serum albumin < 3.0 g/dL.

Statistical analysis

Continuous variables are presented as mean $\pm$ standard deviation or median (interquartile range), as appropriate, whereas categorical variables are reported as frequencies and percentages. Baseline characteristics were compared using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test for continuous variables and Pearson's χ^2 or Fisher's exact test for categorical variables. Given the BMI-

tailored allocation strategy, analyses of postoperative weight-loss outcomes were adjusted for baseline BMI using analysis of covariance (ANCOVA). Repeated measures were analyzed using repeated-measures models, and logistic regression was used to identify variables independently associated with postoperative complications. Statistical significance was defined as a two-sided p-value < 0.05. All analyses were performed using IBM SPSS Statistics (IBM Corp., Armonk, NY, USA).

RESULTS

Study population

A total of 147 consecutive patients underwent primary laparoscopic OAGB and met the inclusion criteria. According to the institutional BMI-tailored allocation strategy, 46 patients received a 150-cm biliopancreatic limb (BPL), 52 received a 180-cm BPL and 49 received a 200-cm BPL. Overall, the cohort comprised 111 women (75.5%) and 36 men (24.5%), with a mean age of 47.0 ± 10.8 years and a mean preoperative BMI of 47.1 ± 5.5 kg/m². Baseline demographic and clinical characteristics are summarized in Table 1.

Baseline characteristics

Age, sex distribution, hypertension and type 2 diabetes mellitus were comparable among the three groups. As expected according to the institutional allocation strategy, preoperative BMI increased progressively across BPL groups, from 41.75 ± 2.64 kg/m² in the 150-cm group to 46.43 ± 2.47 kg/m² in the 180-cm group and 52.77 ± 4.10 kg/m² in the 200-cm group ($p < 0.001$). Obstructive sleep apnea was also more frequent in patients receiving longer BPLs ($p = 0.008$).

Weight-loss outcomes

Mean %TWL did not differ significantly among groups at 6 months (30.1%, 29.9% and 29.0% for the 150-, 180- and 200-cm groups, respectively; $p = 0.713$), 12 months (35.7%, 36.4% and 36.2%; $p = 0.902$) or 24 months (35.9%, 38.3% and 37.8%; $p = 0.602$). At 36 months, crude analysis demonstrated a significant between-group difference in %TWL ($32.4 \pm 7.7\%$, $39.0 \pm 8.0\%$ and $38.6 \pm 11.1\%$, respectively; $p = 0.048$), with higher values observed in the 180- and 200-cm groups.

Adjusted analysis

After adjustment for baseline BMI using analysis of covariance (ANCOVA), BPL length was no longer significantly associated with %TWL at 36 months. In contrast, baseline BMI remained independently associated with postoperative weight loss.

Nutritional outcomes and postoperative complications

Overall postoperative morbidity was low. Marginal ulcers occurred in 14 patients (9.5%) and differed significantly among groups (17.4%, 1.9% and 10.2% in the 150-, 180- and 200-cm groups, respectively; $p = 0.033$). Postoperative anemia developed in 17 patients (11.6%), with no significant between-group

differences ($p = 0.658$). Hypoalbuminemia was observed in four patients (2.7%), including one patient in the 180-cm group and three in the 200-cm group. Revisional surgery remained uncommon in all groups.

Multivariable analysis

Multivariable analysis identified smoking as an independent predictor of marginal ulcers, whereas BPL length was not independently associated with postoperative complications.

DISCUSSION

The present study evaluated the association between biliopancreatic limb (BPL) length and postoperative outcomes in a consecutive cohort of patients undergoing primary one-anastomosis gastric bypass (OAGB) according to a BMI-tailored institutional strategy. The principal finding was that the apparent advantage of longer BPLs in terms of percentage total weight loss (%TWL) at 36 months disappeared after adjustment for baseline BMI. Baseline BMI, rather than BPL length, remained independently associated with postoperative weight loss, indicating that crude comparisons between different limb lengths may largely reflect patient selection rather than the isolated effect of bypass length. These findings provide a methodological framework for interpreting the heterogeneous observational literature on BPL length, where surgical configuration is frequently determined by preoperative clinical characteristics rather than randomly assigned. Despite the widespread adoption of OAGB, the optimal BPL length remains one of the least standardized technical aspects of the procedure. Current practice ranges from fixed limb lengths of 150–200 cm to individualized strategies based on baseline BMI, body weight or total small-bowel length, and no universally accepted approach has yet emerged [4, 9]. The 2020 IFSO consensus acknowledged this variability, and subsequent reviews have confirmed that available evidence remains insufficient to recommend a single optimal BPL strategy [4, 9]. Observational studies generally support satisfactory long-term outcomes with BPLs between 150 and 180 cm. Pizza et al. reported effective weight loss and metabolic improvement using BPLs of 150–180 cm, including patients with severe obesity, without supporting routine extension to 200 cm [6]. Similarly, Boyle and Mahawar observed weight-loss outcomes comparable to those achieved with longer limbs using a fixed 150-cm BPL [12], while Liagre et al. demonstrated durable weight loss, sustained comorbidity improvement and a low incidence of protein-calorie malnutrition after eight years of follow-up [13]. Consistent findings were reported by Bertrand et al., whose propensity score-matched study showed comparable weight-loss outcomes after 150- and 200-cm BPLs, with fewer late nutritional abnormalities in the shorter-limb group [7]. Collectively, these data suggest that routine extension beyond 180 cm may not provide a clinically meaningful advantage for most patients. However, the available evidence remains heterogeneous. Slagter et al. highlighted the intrinsic difficulty of evaluating the independent effect of BPL length in observational cohorts, where limb allocation is closely related to baseline patient characteristics [10, 14]. Likewise, recent systematic reviews and meta-analyses have emphasized considerable heterogeneity in patient selection, operative technique, outcome definitions and duration of follow-up, limiting direct comparison across studies [5, 9]. Although pooled analyses have reported a modest improvement in %TWL with 200-cm limbs, this potential benefit has generally

been accompanied by a higher incidence of nutritional deficiencies, without consistent superiority in metabolic outcomes [5]. Overall, the current literature suggests that any incremental weight-loss benefit associated with longer bypasses should always be interpreted considering the accompanying nutritional risk. Randomized evidence provides an important complementary perspective. In the TAILOR superiority trial, tailoring BPL length according to total small-bowel length did not improve one-year %TWL or reduce nutritional complications compared with a standard 150-cm BPL [10]. These findings indicate that anatomical tailoring alone is unlikely to optimize outcomes and suggest that individualized surgical planning should integrate a broader range of clinical variables beyond intestinal length. Our findings help explain part of the heterogeneity observed across previous observational studies. In routine bariatric practice, BPL length is not selected independently of patient characteristics but reflects clinical decision-making based primarily on obesity severity and the anticipated balance between efficacy and nutritional risk. Consequently, baseline BMI influences both the choice of limb length and postoperative weight-loss outcomes. Comparisons that do not account for this allocation process may therefore attribute to BPL length effects that are, at least in part, explained by differences in baseline patient characteristics. This represents a classic example of confounding by indication, a well-recognized limitation of observational surgical research [11]. In our cohort, patients receiving a 200-cm BPL had substantially higher baseline BMI than those treated with 150- or 180-cm limbs because this reflected the institutional surgical strategy rather than random allocation. Accordingly, the higher crude %TWL observed in the longer-limb groups could not be interpreted as evidence of an independent benefit of increasing BPL length. Once baseline BMI was incorporated into the analysis, the apparent association disappeared, suggesting that obesity severity accounted for a substantial proportion of the observed differences. Importantly, these findings should not be interpreted as evidence that BPL length has no biological effect. Adjustment for baseline BMI cannot fully eliminate residual confounding, particularly when BMI and limb allocation are strongly correlated and other determinants of surgical decision-making are not completely captured. Rather, our results indicate that, within a BMI-tailored strategy and a BPL range of 150–200 cm, extension beyond 180 cm did not demonstrate an independent long-term advantage in %TWL after accounting for baseline obesity severity.

CONCLUSIONS

In this BMI-tailored cohort of patients undergoing primary OAGB, the apparent superiority of longer biliopancreatic limbs disappeared after adjustment for baseline BMI, suggesting that patient selection largely accounted for the differences observed in crude analyses. Extension of the BPL beyond 180 cm was not associated with additional long-term weight-loss benefit and was accompanied by a numerical increase in hypoalbuminemia. More broadly, our findings emphasize that observational comparisons of BPL length should be interpreted within the context of the clinical rationale guiding limb allocation. Until robust long-term randomized evidence becomes available, BPL length should remain individualized, balancing obesity severity, expected efficacy and nutritional risk

Declarations

The authors declare no conflict of interest

A.I., D. D.M., S.G. wrote the main manuscript text and analyse data

A.I., D. D.M., S.G., A.M., prepared tables and figures

A.I., G.C. supervised the data analysis

All authors reviewed the manuscript

References

1. Rutledge R (2001) The mini-gastric bypass: experience with the first 1,274 cases. *Obes Surg* 11(3):276–280. 10.1381/096089201321336584
2. Angrisani L, Santonicola A, Iovino P et al (2024) Collaborative Study Group for the IFSO Worldwide Survey. IFSO Worldwide Survey 2020–2021: current trends for bariatric and metabolic procedures. *Obes Surg* 34(4):1075–1085. 10.1007/s11695-024-07118-3
3. De Luca M, Tie T, Ooi G et al (2018) Mini Gastric Bypass–One Anastomosis Gastric Bypass (MGB-OAGB): IFSO position statement. *Obes Surg* 28(5):1188–1206. 10.1007/s11695-018-3182-3
4. Ramos AC, Chevallier JM, Mahawar K et al (2020) IFSO consensus conference statement on one-anastomosis gastric bypass: results of a modified Delphi study. *Obes Surg* ;30(5):1625–1634. 10.1007/s11695-020-04434-2
5. Tasdighi E, Barzin M, Mahawar KK et al (2022) Effect of biliopancreatic limb length on weight loss, postoperative complications, and remission of comorbidities in one-anastomosis gastric bypass: a systematic review and meta-analysis. *Obes Surg* 32(3):892–903. 10.1007/s11695-021-05864-2
6. Pizza F, Lucido FS, D'Antonio D et al (2020) Biliopancreatic limb length in one-anastomosis gastric bypass: which is the best? *Obes Surg* 30(9):3685–3694. 10.1007/s11695-020-04678-y
7. Bertrand T, Rives-Lange C, Jannot AS et al (2022) 150-cm versus 200-cm biliopancreatic limb one-anastomosis gastric bypass: a propensity score-matched analysis. *Obes Surg* 32(9):2839–2845. 10.1007/s11695-022-06153-2
8. Salman MAA, Salman A, Assal MM et al (2023) One-anastomosis gastric bypass with a 150-cm versus a 200-cm biliopancreatic limb: a systematic review and meta-analysis. *Obes Surg* 33(6):1846–1856. 10.1007/s11695-023-06555-6
9. Focquet M (2024) The length of the biliopancreatic limb in one-anastomosis gastric bypass. *Front Surg* 11:1248744. 10.3389/fsurg.2024.1248744
10. Slagter N, van der Laan L, de Heide LJM et al (2024) Effect of tailoring biliopancreatic limb length based on total small bowel length versus standard limb length in one-anastomosis gastric bypass: one-year outcomes of the TAILOR randomized clinical superiority trial. *Br J Surg* 111:znae219. 10.1093/bjs/znae219

11. Kyriacou DN, Lewis RJ (2016) Confounding by indication in clinical research. JAMA 316(17):1818–1819. 10.1001/jama.2016.16435
12. Boyle M, Mahawar K (2020) One-anastomosis gastric bypass performed with a 150-cm biliopancreatic limb delivers weight loss outcomes similar to those with a 200-cm biliopancreatic limb at 18–24 months. Obes Surg 30(4):1258–1264. 10.1007/s11695-019-04359-5
13. Liagre A, Debs T, Kassir R et al (2020) One-anastomosis gastric bypass with a biliopancreatic limb of 150 cm: weight loss, nutritional outcomes, endoscopic results, and quality of life at 8-year follow-up. Obes Surg 30(11):4206–4217. 10.1007/s11695-020-04775-y
14. Slagter N, de Heide LJM, Jutte EH et al (2021) Outcomes of one-anastomosis gastric bypass with various biliopancreatic limb lengths: a retrospective single-center cohort study. Obes Surg 31(10):4236–4242. 10.1007/s11695-021-05555-y

Tables

Table 1
Baseline characteristics

Variable	Overall (n = 147)	150 cm (n = 46)	180 cm (n = 52)	200 cm (n = 49)	p-value
Age, years	47.0 +/- 10.8	47.0 +/- 12.0	47.1 +/- 10.7	46.9 +/- 9.7	0.993
Female sex, n (%)	111 (75.5%)	35 (76.1%)	36 (69.2%)	40 (81.6%)	0.348
BMI, kg/m ²	47.1 +/- 5.5	41.75 +/- 2.64	46.43 +/- 2.47	52.77 +/- 4.10	< 0.001
Hypertension, n (%)	60 (40.8%)	17 (37.0%)	20 (38.5%)	23 (46.9%)	0.559
Type 2 diabetes, n (%)	29 (19.7%)	9 (19.6%)	11 (21.2%)	9 (18.4%)	0.940
Obstructive sleep apnea, n (%)	46 (31.3%)	7 (15.2%)	23 (44.2%)	16 (32.7%)	0.008

Table 2
Weight loss outcomes. In () number of patients at the selected FU

Outcome	150 cm	180 cm	200 cm	p-value
%TWL 6 months	30.1 +/- 7.4 (n = 46)	29.9 +/- 7.3 (n = 52)	29.0 +/- 7.8 (n = 49)	0.713
%TWL 12 months	35.7 +/- 8.2 (n = 38)	36.4 +/- 7.1 (n = 47)	36.2 +/- 8.9 (n = 40)	0.902
%TWL 24 months	35.9 +/- 7.6 (n = 35)	38.3 +/- 8.0 (n = 46)	37.8 +/- 11.6 (n = 40)	0.602
%TWL 36 months	32.4 +/- 7.7 (n = 30)	39.0 +/- 8.0 (n = 43)	38.6 +/- 11.1 (n = 38)	0.048
%EWL 6 months	65.7 +/- 17.6 (n = 46)	64.9 +/- 16.5 (n = 52)	65.5 +/- 15.2 (n = 49)	0.969
%EWL 12 months	77.4 +/- 10.0 (n = 38)	77.3 +/- 14.9 (n = 47)	78.7 +/- 17.2 (n = 40)	0.887
%EWL 24 months	80.7 +/- 7.0 (n = 35)	82.7 +/- 15.9 (n = 46)	86.4 +/- 21.0 (n = 40)	0.292
%EWL 36 months	78.0 +/- 18.9 (n = 30)	83.3 +/- 16.1 (n = 43)	85.4 +/- 19.3 (n = 38)	0.234

Table 3
Incidence of relevant clinical and nutritional complications among groups

Outcome	150 cm (n = 46)	180 cm (n = 52)	200 cm (n = 49)	p-value
Marginal ulcer, n (%)	3 (6.5%)	1 (1.9%)	2 (4.1%)	0.517
Active smokers among MU	2/3 (66.7%)	1/1 (100%)	1/2 (50.0%)	-
Anemia, n (%)	6 (13.0%)	7 (13.5%)	4 (8.2%)	0.658
Hypoalbuminemia (< 3 g/dL), n (%)	0 (0%)	1 (1.9%)	3 (6.1%)	0.164

Figures

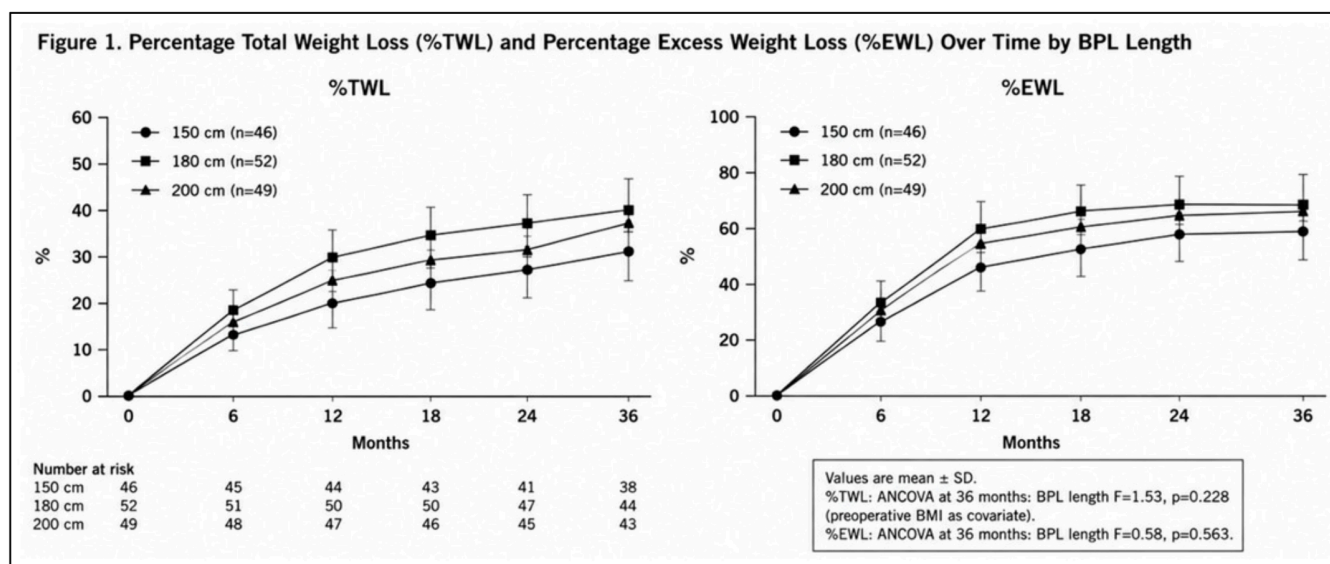


Figure 1

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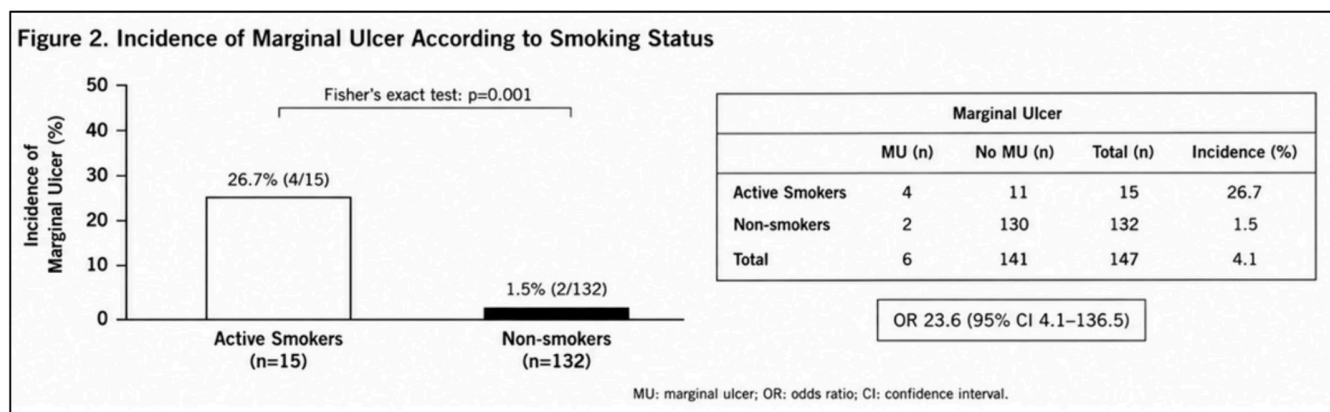


Figure 2

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Figure 3. Conceptual summary of the relationship between BMI-tailored biliopancreatic limb allocation and postoperative weight-loss outcomes after one-anastomosis gastric bypass.

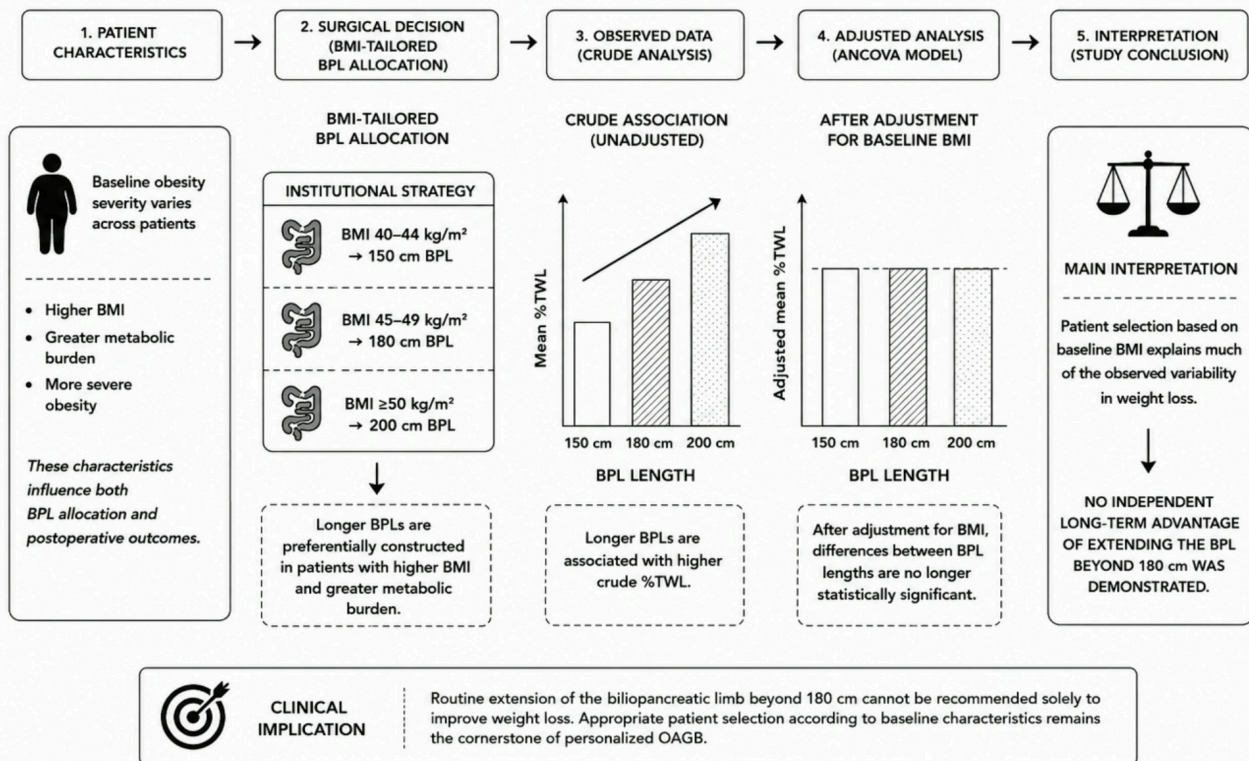


Figure 3

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