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Research Article

Impact of Patient Follow-Up on Weight Loss after Bariatric Surgery

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ABSTRACT

Context: Bariatric surgery is an effective method in inducing significant weight loss in patients suffering from obesity. Despite the strong evidence on its clinical effects, the data on its mid- and long-term follow-ups and durability are limited. This study is to evaluate the impact of bariatric surgical procedures on weight loss and resolution of comorbidities after surgery.

Subjects and Methods: This was a retrospective, single-center cohort study including 146 participants in whom laparoscopic sleeve gastrectomy, Roux-en-Y gastric bypass, one-anastomosisgastric bypass, and balloon were performed between 2021 and 2024. Standardized weight loss measures were compared using an analysis of covariance.

Results: The mean (standard deviation) age of patients involved in this study is 43.41 ± 12.09 years with a preoperative weight and body mass index (BMI) of 117.23 ± 23.027 and 44.93 ± 8.02, respectively. The mean follow-up period is 2.9 years (0.83–4 years). Patients reported a mean percentage total weight loss (%TWL) of 8.1 ± 15.66%, percentage excess weight loss (%EWL) of 18.92 ± 40.56, and excess BMI loss of 18.38 ± 42.7 at the follow-up point. The remission of diabetes was significantly improved by 17%. 0.89% of patients adhered to follow-up visits till the end of the study.

Conclusions: Bariatric surgery demonstrated a beneficial association resulting in substantial weight loss and remission of diabetes. Further large, multi-site cohort studies on Indian population are needed to substantiate the evidence.

Keywords: Excess Weight Loss, Laparoscopic Sleeve Gastrectomy, One-Anastomosis Gastric Bypass, Roux-En-Y Gastric Bypass, Total Weight Loss.

INTRODUCTION

Bariatric surgery is an effective intervention for long-term weight loss as well as to ameliorate obesity-related comorbidities.[1] Considerable evidence has suggested that bariatric surgery is associated with improvement or remission of type 2 diabetes in patients with obesity, reducing the mortality rate linked to diabetes.[2-5] In addition, bariatric surgery has shown to provide additional health benefits, including improvements in cardiometabolic comorbidities such as dyslipidemia, hypertension, and obstructive sleep apnea.[6] Owing to these favorable outcomes, the use of bariatric surgery is evolving rapidly resulting in a noticeable increase in the number of procedures undertaken globally. Roux-en-Y gastric bypass (RYGB) and laparoscopic sleeve gastrectomy (LSG) are the most accessible bariatric surgeries for weight loss surgery which are found to be superior than other procedures such as adjustable gastric banding.[7-11] Intragastric balloon placement is a simple endoscopic method offering a minimally invasive and expansive role for managing obesity and associated conditions.[12] Another promising bariatric procedure, i.e., one-anastomosis gastric bypass (OAGB), is found to be at least as effective as RYGB in terms of weight loss and comorbidity resolution and associated with fewer major complications.[13,14] It is noninferior to other established bariatric procedures and is particularly suitable for metabolic/ diabetes treatment.[15] Despite the availability of these techniques, the evidence on the durability of weight loss is minimal as only a few Indian studies have reported mid-.and long-term follow-up outcomes in patient cohorts.[16-20] Most published studies of bariatric surgery are retrospective, short-term studies with insufficient follow-up.[21] In a systematic review of 7371 bariatric studies, only 29 studies (0.4%) associated with 7971 patients had 2 years of follow-up, out of which only 4 studies had 5 or more years of follow-up.[22] Incomplete follow-up has been a limitation to the interpretation of registry-based reports on the safety profile of bariatric surgical procedures.[23] Despite the proven efficacy of bariatric surgery

in short-term follow-up, data regarding its mid- and long-term outcome on weight loss and comorbidities are still limited and need to be further evaluated, particularly from Indian population. In this study, four surgical procedures, i.e., RYGB, LSG, OAGB, and balloon, have been used to induce weight loss and lower comorbid risk factors in individuals suffering from obesity. To address the mid- and long-term durability of these procedures, we analyzed 4-year weight change in patients with the aim to provide evidence for clinical practice.

SUBJECTS AND METHODS

This is a single-center, retrospective cohort study aimed at evaluating the impact of bariatric surgery on weight control in patients suffering from obesity in Indian population. One thousand four hundred and sixty-eight participants who underwent bariatric surgery during the years March 2021–December 2024 were included in this study. Follow-up data were accessed and the best available data for each patient were collected telephonically as well as from hospital electronic records. Preoperatively, participants were evaluated for medical or surgical history, and a clinical examination was performed. Baseline characteristics including age, height, weight, and body mass index (BMI) were recorded. Weight and BMI were recorded before and after bariatric surgery. Risk factors and comorbidities, including arterial hypertension, diabetes mellitus, and hypothyroidism rates, were collected. Then, one of the four following surgical procedures was used: RYGB, LSG, OAGB, and balloon. After surgery, percentage total weight loss (%TWL), percentage excess weight loss (%EWL), percentage excess BMI loss at ideal BMI 25, and comorbidity status at different follow-up times were analyzed. Remission of hypertension was defined as normal BP levels at 12 months (systolic BP <140 mmHg and diastolic BP <90 mmHg) without antihypertensive therapy.[24] Remission of hypothyroidism, as per American Thyroid Association hyperthyroidism guidelines, was defined as laboratory euthyroidism 1 year after discontinuation of medication.[25] The study protocol was approved by the institutional ethics committee, and all patients provided informed consent before entering the study. All procedures performed in this study involving human participants were in accordance with the ethical standards of the International Council for Harmonisation guidelines for Good Clinical Practice.

Statistical Analysis

All the continuous variables were assessed for normality using a Shapiro–Wilk's test. All the categorical variables were expressed either as percentage or proportion. The comparison of all the normally distributed continuous variables was done by independent sample *t*-test or Welch's test depending on variance. For normally distributed variables, a comparison of two related groups was checked with pair *t*-test, and for more than two groups, one-way ANOVA was used. All the nonnormally distributed continuous variables' comparisons were done by Mann–Whitney "U" test, based on the number of groups. Comparisons of categorical variables were taken care by either Chi-square test or Fisher's exact test based on the number of observations. For paired dichotomous nominal data, to test the statistical difference, McNemar's test or binomial test was performed based on the number of observations available. Statistical analyses were performed using IBM SPSS statistics software version 20 (Chicago, IL, USA). All "*P*" < 0.05 were considered statistically significant.

RESULTS

A total of 1468 participants underwent bariatric surgery during the study period. Of them, 89 (60.7%) were women and 57 (39.3%) were men. The mean age of the participants was 43.41 ± 12.09 (standard deviation) years (range: 6–78 years). The mean height, preoperative weight, and preoperative BMI were 161.57 ± 9.878, 117.23 ± 23.027, and 44.93 ± 8.02, respectively. Among the enrolled participants, RYGB surgery was adopted by 95 (65%) patients, sleeve gastrectomy by 45 (30.7%) patients, OAGB by 5 (3.4%) patients, and balloon by 1 (0.5%) patients. The presurgical characteristics of patients are found in Table 1. The details of number of surgeries performed on a yearly basis are shown. In our cohort, there is a decline in terms of adherence to long-term follow-up after bariatric surgery, with 0.89% of patients completing the 4 years of follow-up. The mean follow-up from the time of surgery was 2.9 (±2.30) years, and the median follow-up was 2.29 years.

Weight at Different Follow-Up Times during 4-Year Follow-Up Period

From the statistics of patients who underwent RYGB, LSG, OAGB, and balloon, we calculated the %TWL, %EWL, and the percentage excess BMI loss at ideal BMI 25 at different follow-up times. Follow-up weight data were obtained

from measurements recorded in the electronic health records during outpatient visits, as well as by contacting patients through SMS, available messenger, and telephone from 2021 through 2024. Preoperative weight data were available for 146 patients with a mean weight of 117.23 ± 23.02, and 1 year after surgery, weight was reduced to a mean weight of 88.18 ± 24.14, which is statistically significant (*P* = 0.00). However, for only a small percentage of patients (*n* = 39, 26.9%), follow-up information was recorded at 1-year time point. At the end of 4 years, complete follow-up is available for 12 patients (0.8%) with a mean weight of 100.13 ± 18.855, which is statistically insignificant (*P* = 0.06).

Table 1. Overall Baseline Characteristics and Preoperative Variables (N=1468)

Patient Characteristics	Mean±SD	Range
Gender, *n* (%)		0
Male	57 (39.3)	_
Female	89 (60.7)	
Age (years), mean±SD	43.41±12.096	
Height (cm), mean±SD	161.57±9.878	119-194.55
Weight (kg): Preoperative	117.23±23.027	53.1-260
BMI (kg/m2): Preoperative	44.93±8.02	32.3-105.48

After bariatric surgery, %TWL started to decrease from 21.19 ± 15.43% of the initial weight on month 1 after surgery to 8.1 ± 15.66% at the follow-up point of 4 years; however, the difference is statistically insignificant (*P* = 0.91) during long-term follow-up. The %TWL data of the patients with follow-up information at different follow-up times and outcomes are listed in Table 2. In terms of %EWL at ideal weight of BMI 25, patients had maintained significantly greater weight loss from 49.4 ± 38.94 reaching to 18.92 ± 40.56 (*P* = 0.79) at 4 years [Table 3]. The mean BMI significantly decreased (4.52 ± 7.06, *P* = 0.93) at 4 years from 9.86 ± 7.905 1st postoperative month. The percentage excess BMI loss at ideal BMI 25 also reduced from 49.31 ± 39.254 to 18.38 ± 42.717 at 4-year follow-up.

Table 2. Change in Percentage Total Weight Loss at Different Follow-Up Times

Percentage TWL	*N*	Mean±SD	Range	Percentage
1 month	81	−21.19±15.43	−63.4-86.65	
3 months	74	−22.08±15.97	−73.7-54.35	0
6 months	38	−20.93±14.88	−68-38.96	0
9 months	39	−26.93±16.81	−69.6-74.94	0
1 year	38	−24.4±17.9	−70-53.5	0.34
2 years	59	−31.79±16.16	−70.5-67.61	0
3 years	38	−34.23±16.82	−72.3-47.67	0.02
s4 years	22	−28.37±16.74	−70.2-40.38	0.02

*Pair *t*-test, Significant if *P*<0.05, Otherwise - not significant, All the *P* have been calculated comparing the preoperative value. TWL: Total weight loss, SD: Standard deviation

Table 3. Change in Percentage Excess Weight Loss at Ideal Weight of Body Mass Index 25 at Different Follow-Up Times

Percentage EWL at Ideal Weight of BMI 25	*N*	Mean±SD	Range	*P**
1 month	82	49.4±38.941	−294.73–171.92	

3 months	74	52.85±39.37	−160.46–199.75	0
6 months	38	48.82±36.786	−217.43–190.17	0
9 months	39	60.22±48.758	−464.7–149.33	0
1 year	38	54.9±50.281	−448.57–167.3	0.7
2 years	59	74.58±39.673	−185.16–197.94	0
3 years	37	80.89±55.918	−626.22–219.92	0.06
4 years	22	69.67±44.266	−139.56–171.58	0.06

*Pair *t*-test, Significant if $P<0.05$, Otherwise - not significant, All the *P* have been calculated comparing the preceding value with the current value. SD: Standard deviation, BMI: Body mass index, EWL: Excess weight loss

Table 4. Comorbidities Status at Different Follow-Up Times

Comorbidity	***n*=146**	**Active, *n* (%)**	**Remission#, *n* (%)**	**Recurrence#, *n* (%)**	***P****
Diabetes mellitus	Preoperative	40 (27.8)			
	1st postoperative week	14(9.9)	26 (64.5)		0
	Latest (mean 2.9 years)	7 (5.1)	33 (81.6)		0
Hypertension	Preoperative	8 (5.5)			
	1st postoperative week	10(6.8)		19 (23.5)	0.13
	Latest (mean 2.9 years)	1 (0.5)	36 (90.1)		0
Hypothyroidism	Preoperative	7 (4.8)			
	1st postoperative week	8 (5.1)		4 (5.63)	0.69
	Latest (mean 2.9 years)	3(1.6)	27 (66.2)		0

*McNemar's test compared from baseline, Significant if $P<0.05$, Otherwise - not significant, #From baseline

Changes in Relevant Comorbidities

Among the patients (n = 146), 40 (27.8%) had preoperative diabetes mellitus in whom remission rates were found to be increased from 64.5% (n = 26) at the 1st postoperative week to 81.6% (n = 33, 17% increase, P = 0.00) at a mean follow-up of 2.9 years. It is worth noting that hypertension rates decreased from 5.5% preoperative (n = 8) to 0.5% (n = 1, 5% reduction, P = 0.00) at mean 2.9 years. Remission of hypertension was reported to be occurred in 90.1% of patients (n = 36) at the mean follow-up and recurrence was reported in 23.5% of patients at a mean postoperative period of 2.9 years (n = 19). Hypothyroidism rates decreased from 4.8% (n = 7) to 1.6% (n = 3, 3% reduction, P = 0.00). Remission was observed in 66.2% of patients (n = 27) at the mean follow-up of 2.9 years, while recurrence was reported in 5.63% of patients at the 1st postoperative week (n = 4) [Table 4].

DISCUSSION

In this single-center study, we address the mid-.and long-term weight change and resolution of comorbidities associated with current bariatric procedures using a large cohort of patients with obesity. To our knowledge, this study is the one of its kind reporting four surgical procedures of bariatric surgery on the remission rate of comorbidities and weight loss in a diverse group of patients with obesity. Bariatric surgery has become a widely acknowledged treatment option to help control the obesity epidemic. Since bariatric surgical procedures are often irreversible interventions, outcomes must be assessed for long-term effects in a large sample size to minimize bias toward overly optimistic estimates of the intervention effectiveness. The evidence from our study concludes that patients were able to sustain significantly greater weight loss up to 4-year postoperative surgery. Our observations are consistent with the findings from the Swedish Obese Subjects study which reported a greater weight loss at 10 years associated with RYGB.[26] However, our follow-up rate for weight measures was substantially lower (0.89% vs. 66.0% of those eligible) than the Swedish Obese Subjects

study. In our study, the remission rates of diabetes (17%) were observed. The results seem to be quite lower than those previously reported, but the results are variable from one study to the other. For instance, a study which followed up for a period of 5 years reported the resolution of diabetes in 83% of their patients who underwent RYGB.[27] On the other hand, a recent randomized trial reported 42% remission after RYGB and 37% after SG 12 months after the surgery.[17] This discrepancy could be attributable toward the phenotypic differences among patients in our cohort. Adherence to a frequent follow-up plan after bariatric surgery is suggested to be associated with improved weight loss. [28-30] The Centre of Excellence accreditation guidelines mandate persistent attempts to ensure routine follow-up after bariatric surgery.[31] In our retrospective study, the follow-up rates dropped from 24.73% at <1 year to 0.89% at 4 years attributing to incomplete retention or follow-up.

For instance, a bariatric surgery outcome study reported treatment failure rates of 42% when 61% of the initial cohort was followed up 8 years after surgery.[32] However, evidence suggests that the ideal follow-up rate in bariatric surgery outcome studies is 80% or greater than any original cohort, and this is rarely achieved.[33,34] On the contrary, many small single-institution studies demonstrated that adherence to routine follow-up is associated with improved weight loss. In a study, the number of postoperative visits was associated with higher percentage of excess body weight loss (%EBWL) and increased likelihood of %EBWL >50 at 12 and 24 months postoperatively.[29] Of note, low follow-up rates in our cohort suggest that additional mechanisms will need to be implemented to improve patient adherence and to generate a basis for the assessment of long-term impact of bariatric surgery. This study has several important strengths, including a high degree of generalizability because we included outcomes from a diverse group of patients, and direct analysis of the four surgical procedures currently performed. On the flip side, the main limitation of our study, like in the majority of other retrospective studies, is that the high percentage of patients was lost to follow-up.

CONCLUSIONS

The results of our study suggest that bariatric surgery demonstrated substantial weight loss and resolution of comorbidities as well as improved long-term outcomes. Our findings provide further evidence in reinforcing the significance of bariatric surgery in controlling obesity and its comorbidities. There is a need for additional studies to understand the long-term outcomes of bariatric surgery on obesity control from large, multi-site Indian cohorts that have a high degree of long-term follow-up.

Patient Declaration of Consent Statement

Written consent was obtained from the study participants after explaining the details of the surgery, its pros and cons, and all intraoperative, early and late postoperative complications that could occur. Further, all participants were informed of the research and that the data would be used for research purposes, giving patients the right to decline participation.

REFERENCES

1. Maciejewski ML, Arterburn DE, Van Scoyoc L, Smith VA, Yancy WS Jr., Weidenbacher HJ, *et al*. Bariatric surgery and long-term durability of weight loss. JAMA Surg 2016;151 :1046-55.
2. Sjöström L, Narbro K, Sjöström CD, Karason K, Larsson B, Wedel H, *et al*. Effects of bariatric surgery on mortality in Swedish obese subjects. N Engl J Med 2007;357:741-52.
3. Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, *et al*. Weight and type 2 diabetes after bariatric surgery: Systematic review and meta-analysis. Am J Med 2009;122:248-56.e5.
4. Dixon JB, O'Brien PE, Playfair J, Chapman L, Schachter LM, Skinner S, *et al*. Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. JAMA 2008;299:316-23.
5. Gill RS, Birch DW, Shi X, Sharma AM, Karmali S. Sleeve gastrectomy and type 2 diabetes mellitus: A systematic review. Surg Obes Relat Dis 2010;6:707-13.
6. Nguyen NT, Varela JE. Bariatric surgery for obesity and metabolic disorders: State of the art. Nat Rev Gastroenterol Hepatol 2017;14:160-9.
7. Simonson DC, Halperin F, Foster K, Vernon A, Goldfine AB. Clinical and patient - centered outcomes in obese patients with type 2 diabetes 3 years after randomization to Roux-en-Y gastric

bypass surgery versus intensive lifestyle management: The SLIMM-T2D study. Diabetes Care 2018;41:670-9.

8. Ahmed B, King WC, Gourash W, Belle SH, Hinerman A, Pomp A, *et al*. Long-term weight change and health outcomes for sleeve gastrectomy (SG) and matched Roux-en-Y gastric bypass (RYGB) participants in the longitudinal assessment of bariatric surgery (LABS) study. Surgery 2018;164:774-83.
9. Gloy VL, Briel M, Bhatt DL, Kashyap SR, Schauer PR, Mingrone G, *et al*. Bariatric surgery versus non-surgical treatment for obesity: A systematic review and meta-analysis of randomised controlled trials. BMJ 2013;347:f5934.
10. Arterburn DE, Courcoulas AP. Bariatric surgery for obesity and metabolic conditions in adults. BMJ 2014;349:g3961.
11. Trastulli S, Desiderio J, Guarino S, Cirocchi R, Scalercio V, Noya G, *et al*. Laparoscopic sleeve gastrectomy compared with other bariatric surgical procedures: A systematic review of randomized trials. Surg Obes Relat Dis 2013;9:816-29.
12. Kim SH, Chun HJ, Choi HS, Kim ES, Keum B, Jeen YT. Current status of intragastric balloon for obesity treatment. World J Gastroenterol 2016;22:5495-504.
13. Lee WJ, Ser KH, Lee YC, Tsou JJ, Chen SC, Chen JC. Laparoscopic Roux-en-Y vs. mini -gastric bypass for the treatment of morbid obesity: A 10-year experience. Obes Surg 2012;22:1827-34.
14. Lee WJ, Yu PJ, Wang W, Chen TC, Wei PL, Huang MT. Laparoscopic Roux-en-Y versus mini-gastric bypass for the treatment of morbid obesity: A prospective randomized controlled clinical trial. Ann Surg 2005;242:20-8.
15. Lee WJ, Chong K, Lin YH, Wei JH, Chen SC. Laparoscopic sleeve gastrectomy versus single anastomosis (mini-) gastric bypass for the treatment of type 2 diabetes mellitus: 5-year results of a randomized trial and study of incretin effect. Obes Surg 201;24:1552 -62.
16. Jammu GS, Sharma R. A 7-year clinical audit of 1107 cases comparing sleeve gastrectomy, Roux-En-Y gastric bypass, and mini-gastric bypass, to determine an effective and safe bariatric and metabolic PROCEDURE. Obes Surg 2016;26:926-32.
17. Garg H, Aggarwal S, Misra MC, Priyadarshini P, Swami A, Kashyap L, *et al*. Mid to long term outcomes of laparoscopic sleeve gastrectomy in Indian population: 3-7 year results-A retrospective cohort study. Int J Surg 2017;48:201-9.
18. Kular KS, Manchanda N, Rutledge R. Analysis of the five-year outcomes of sleeve gastrectomy and mini gastric bypass: A report from the Indian sub-continent. Obes Surg 2014;24:1724-8.
19. Jammu GS, Sharma R. An eight-year experience with 189 Type 2 diabetic patients after mini-gastric bypass. Integr Obes Diabetes 2016;2:246-9.
20. Nasta AM, Goel R, Dharia S, Goel M, Hamrapurkar S. Weight loss and comorbidity resolution 3 years after bariatric surgery-an Indianperspective. Obes Surg 2018;28 :27 12-9.
21. Graefen M. Low quality of evidence for robot-assisted laparoscopic prostatectomy: A problem not only in the robotic literature. Eur Urol 2010;57:938-44.
22. Puzziferri N, Roshek TB 3rd, Mayo HG, Gallagher R, Belle SH, Livingston EH. Long -term follow-up after bariatric surgery: A systematic review. JAMA 2014;312:934-42.
23. Benotti P, Wood GC, Winegar DA, Petrick AT, Still CD, Argyropoulos G,*et al*. Risk factors associated with mortality after Roux-en-Y gastric bypass surgery. Ann Surg 2014;259:123-30.
24. Ross DS, Burch HB, Cooper DS, Greenlee MC, Laurberg P, Maia AL, *et al*. 2016 American thyroid association guidelines for diagnosis andmanagement of hyperthyroidism and other causes of thyrotoxicosis.Thyroid 2016;26:1343-421.
25. Brethauer SA, Kim J, el Chaar M, Papasavas P, Eisenberg D, Rogers A, *et al*. Standardized outcomes reporting in metabolic and bariatric surgery. Surg Obes Relat Dis 2015;11:489-506.
26. Sjöström L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlsson B, *et al*. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med 2004;351:2683-93.
27. Schauer PR, Burguera B, Ikramuddin S, Cottam D, Gourash W, Hamad G, *et al*. Effect of laparoscopic Roux-en Y gastric

bypass on type 2 diabetes mellitus. Ann Surg 2003;238:467-84.

28. Shen R, Dugay G, Rajaram K, Cabrera I, Siegel N, Ren CJ. Impact of patient follow-up on weight loss after bariatric surgery. Obes Surg 2004;14:514-9.
29. Compher CW, Hanlon A, Kang Y, Elkin L, Williams NN. Attendance at clinical visits predicts weight loss after gastric bypass surgery. Obes Surg 2012;22:927-34.
30. Gould JC, Beverstein G, Reinhardt S, Garren MJ. Impact of routine and long-term follow-up on weight loss after laparoscopic gastric bypass. Surg Obes Relat Dis 2007;3:627-30.
31. MBSAQIP: Resources for Optimal Care of the Metabolic and Bariatric Surgery Patient. American College of Surgeons, Chicago, IL; 2014. Available from: https://www.facs.org/quality-programs/mbsaqip/ standards. [Last accessed on 2021 Jan 08].
32. te Riele WW, Boerma D, Wiezer MJ, Borel Rinkes IH, van Ramshorst B. Long-term results of laparoscopic adjustable gastric banding in patients lost to follow-up. Br J Surg 2010;97:1535-40.
33. Fewtrell MS, Kennedy K, Singhal A, Martin RM, Ness A, Hadders-Algra M, *et al*. How much loss to follow-up is acceptable in long-term randomised trials and prospective studies? Arch Dis Child 2008;93:458-61.
34. Kristman V, Manno M, Côté P. Loss to follow-up in cohort studies: How much is too much? Eur J Epidemiol 2004;19:751-60.