



# Outcomes in Super Obese Patients Undergoing One Anastomosis Gastric Bypass or Laparoscopic Sleeve Gastrectomy

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## Abstract

**Introduction** The data on the role of OAGB in super obese patients and its direct comparison with LSG in super obese patients is scarce.

**Objectives** To compare weight loss, impact on comorbidities and nutritional parameters between LSG and OAGB in super obese patients.

**Methods** Prospectively collected data of 75 matched patients with BMI > 50, who underwent either laparoscopic sleeve gastrectomy (LSG) or one anastomosis gastric bypass (OAGB), was analyzed retrospectively. Percentage excess weight loss at 1 year and impact on comorbidities were compared in both the groups.

**Results** Both the groups were comparable for age, sex, BMI, and presence or absence of diabetes mellitus. Mean TWL% ± 2SD at 1 year was 30.09% ± 19.76 in patients undergoing LSG, while it was 39.9% ± 12.78 in patients undergoing OAGB ( $p < 0.001$ ). In the LSG group, 85.7% and 66.67% of patients had remission of diabetes mellitus and hypertension, respectively, as compared to 77.77% and 78.5%, respectively, in the OAGB group. All the patients with OSA had a resolution of their symptoms in both the groups. Patients in the OAGB group became more folate deficient despite regular supplementation.

**Conclusion** Weight loss following OAGB was found to be better than LSG in the super obese patients in our study. There was a similar resolution of comorbidities and a lesser rate of major complications in the OAGB group.

**Keywords** Outcomes · Super obese · Sleeve gastrectomy · One anastomosis gastric bypass

## Introduction

Super obese patients have been a challenge for management because of their associated comorbidities and large

liver size resulting in decreased workspace [1]. Laparoscopic sleeve gastrectomy (LSG) has been a preferred bariatric surgical option due to its ease and low morbidity in morbidly obese patients [2, 3]. However, there has been a concern regarding weight regain following LSG [4, 5]. One anastomosis gastric bypass (OAGB) is an upcoming and safe weight loss surgical option with reliable weight loss [6–8]. OAGB is a technically easier procedure with results comparable to Roux en Y gastric bypass (RYGB) [9, 10]. There have been only a few studies among super obese patients especially comparing outcomes among sleeve gastrectomy and OAGB, with no such study in Indian population [11–13].

## Objectives

To compare weight loss, impact on comorbidities and nutritional parameters between LSG and OAGB in super obese patients.

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## Materials and Methods

Data of all the super obese patients (body mass index > 50) who underwent either LSG or OAGB, at our tertiary care academic institution, from January 2008 until December 2016 was collected. We started to do OAGB only recently since 2015 in the super obese patients. Detailed counseling of the patients was done regarding all the three surgical procedures. Patients who had gastroesophageal reflux or severe T2DM were advised to undergo RYGB. The final decision was left with the patient. All the patients in the OAGB group who had completed 1 year of follow-up were included. For each of the 25 OAGB cases, 2 LSG cases, matched on age, sex, BMI, presence of T2DM were selected using fuzzy case control matching using IBM SPSS Statistics for Windows, Version 20.0. IBM Corp, Armonk, NY, USA. A single surgeon performed all the procedures according to the standardized technique. All the patients were kept on a very low-calorie diet for 2 weeks before the surgery.

## Surgical Procedure

Cefuroxime was used as a prophylactic antibiotic. Pneumatic compression devices were used for perioperative venous thromboembolism prophylaxis. Two 12-mm and two 5-mm ports were used and an intraoperative leak test was done for both the procedures. Postoperatively, patients were given heparin 5000 international units subcutaneously twice a day. Patients were allowed orally on postoperative day 1 and discharged by the third post-operative day.

## Laparoscopic Sleeve Gastrectomy

Greater omentum was divided at a point 4 cm from the pylorus to the angle of His using bipolar vessel sealing device. The sleeve was created over 36 French gastric bougie using a three-row endostapler. Staple line reinforcement was not used.

## One Anastomosis Gastric Bypass

Dissection and opening of gastrophrenic ligament were done using ultrasonic shears. The stomach was divided 4 cm proximal to the pylorus and a gastric pouch was created along the lesser curvature using a 36 French bougie with the help of three-row endostapler. A jejunal loop, 200 cm distal to the ligament of Treitz, was brought up in an ante colic fashion. Gastrojejunostomy was done using a 60-mm white cartridge and the common opening was closed using 2–0 polydioxanone suture.

## Weight Loss

Weight loss was reported as total weight loss percent (TWL%) at 1 year of follow-up. TWL% was calculated as preoperative weight minus the follow-up weight at 1 year, divided by preoperative weight, and multiplied by 100. Total weight loss was considered inadequate when it was less than 20% at 1 year of follow-up. Percentage excess weight loss (%EWL) was calculated as preoperative weight minus the follow-up weight at 1 year, divided by excess weight. Excess weight was calculated taking a body mass index (BMI) of 25 kg/m<sup>2</sup> [14, 15].

## Comorbidity Outcome

### Type 2 Diabetes Mellitus

DM was defined as glycated hemoglobin, HbA1c > 6.5 or fasting blood sugar more than 126 mg/dl. Remission was considered if the patient had euglycemia without insulin or oral hypoglycemic agents (OHA). An improvement was considered if there was a decrease in the dose of OHA. HbA1c could not be used to define remission as it was not available for all patients postoperatively.

### Hypertension

HTN was defined as a blood pressure greater than 140/90 mmHg. Remission was considered if the blood pressure was less than 120/80 mmHg without any anti-hypertensive medications. An improvement was defined if the patient required a decrease in the dose of anti-hypertensive medications to maintain normal blood pressure.

### Obstructive Sleep Apnea

OSA was defined as apnea-hypopnea index (AHI) > 14 or AHI > 4 with typical symptoms [16]. Polysomnography could not be done for all patients, so remission was not defined in the study. An improvement was considered if there was a resolution or decrease in symptoms of OSA and the patient did not require continuous airway positive pressure (CPAP) postoperatively.

### Hypothyroidism

Hypothyroidism was considered if the patients had abnormal thyroid function tests (TFT) before surgery. Remission was considered if the patients had normal TFT or did not require thyroxine postoperatively. A decreased requirement of thyroxine was considered as an improvement in the hypothyroid status.

## Nutritional Parameters

Nutritional parameters were assessed in both the groups at baseline and at 1 year. WHO defines anemia as a hemoglobin (Hb) < 13 g/dl in males and < 12 g/dl in females. A Hb < 8 is considered as severe anemia and 8–11 g/dl as moderate anemia. Serum folate (5–20 ng/ml), total iron binding capacity (TIBC) (250–370 µg/dl), ferritin (15–300 µg/l), vitamin B12 (180–914 ng/l), and vitamin D (10–50 ng/ml) were assessed at baseline and at 1 year. Values out of the range mentioned were considered to be abnormal.

## Statistical Analysis

The analysis was done using SPSS 20.0. Continuous variables were presented as mean with standard deviation and compared using non-parametric Mann-Whitney *U* test or *t* test. Categorical variables were compared using Chi-square test. Statistical significance was considered for *p* value less than 0.05.

## Results

A total of 143 super obese patients underwent LSG, and 25 super obese patients underwent OAGB between January 2008 and December 2016 at our Centre. All of these patients completed at least 1 year of follow-up in December 2017. Twenty-five patients who underwent OAGB were case matched with 50 patients undergoing LSG. As shown in Table 1, both the groups were comparable for age, sex, body mass index (BMI), and presence or absence of T2DM.

## Impact on Weight Loss

In patients who underwent LSG, the mean TWL% at 1 year was 30.09% [standard deviation (SD)—9.88%], while it was 39.9% (SD—6.39%) in patients undergoing

OAGB. The difference was found to be statistically significant with a *p* value < 0.001. The EWL% at 1 year was also better in the OAGB group. There was inadequate total weight loss in 14% of the patients in the LSG group. All the patients in the OAGB group had an adequate total weight loss. The details are shown in Table 2. Data regarding weight loss was available for all the patients at 1 year of follow-up.

## Impact on Comorbidities

At 1 year of follow-up, 85.7% and 77.7% of the patients in the LSG and the OAGB groups, respectively, had a remission of T2DM. Similarly, 66.6% and 78.5% of the patients in the LSG and the OAGB groups, respectively, had a resolution of hypertension. All the patients with OSA in both the groups (13 in the LSG group and 14 in the OAGB group) had improvement of their symptoms. Of these, eight patients in the OAGB group and four patients in the LSG group required CPAP preoperatively. None of the patients required CPAP at 1 year of follow-up. The impact on comorbidities is summarized in Table 3. There was no loss to follow-up.

## Nutrition

At 1 year of follow-up, 22 patients in the LSG group developed mild anemia, whereas, in the OAGB group, 14 patients developed mild anemia and 4 patients developed moderate anemia. Preoperatively, the mean Hb was  $11.87 \pm 2.36$  (2SD) in the LSG group and  $12.28 \pm 3.9$  in the OAGB group (*p* value 0.52). At 1 year of follow-up, mean Hb was  $12.49 \pm 2.86$  and  $11.27 \pm 3.14$  in the LSG and OAGB groups, respectively. The difference was statistically significant (*p* value 0.05). Other nutritional parameters are shown in Table 4. The 1-year follow-up nutritional data was available for 78% of the patients in the LSG group and for all the patients in the OAGB group.

## Complications

Bleeding occurred in one patient in the LSG group requiring re-exploration. In the LSG group, one patient was readmitted 2 weeks after discharge with a staple line leak which was managed conservatively. There was no case of deep venous thrombosis or mortality in the LSG group till 1 year of follow-up. There was no staple line leak, bleeding, deep venous thrombosis, or mortality in the OAGB group till 1 year of follow-up.

**Table 1** Preoperative characteristics of both the patient groups

	LSG ( <i>n</i> = 50)	OAGB ( <i>n</i> = 25)	<i>p</i> value
Age (years)	40.95 ± 9.77 <sup>a</sup>	39.56 ± 10.09 <sup>a</sup>	0.56
Sex (females)	37	21	0.95
BMI (kg/m <sup>2</sup> )	54.18 ± 4.06 <sup>a</sup>	53.76 ± 3.28 <sup>a</sup>	0.65
T2DM (present)	21	9	0.08

<sup>a</sup> Mean ± standard deviation

LSG laparoscopic sleeve gastrectomy, OAGB one anastomosis gastric bypass, BMI body mass index, T2DM type 2 diabetes mellitus

**Table 2** Weight loss in both the groups

	LSG		OAGB		Standard error	95% Confidence interval	p value
	Mean	Standard deviation	Mean	Standard deviation			
TWL% 1 year	30.09	9.88	39.90	6.39	2.17	5.47–14.14	< 0.01
EWL% 1 year	56.20	18.92	74.57	13.24	4.22	9.94–26.79	< 0.01
Inadequate total weight loss at 1 year	7/50 (14%)		0/25 (0%)		NA	NA	0.08

No loss to follow-up

NA not applicable, LSG laparoscopic sleeve gastrectomy, OAGB one anastomosis gastric bypass, TWL % 1 year percentage total weight loss at 1 year, EWL % 1 year percentage excess weight loss at 1 year

## Discussion

LSG has been a popular weight loss surgical option due to its technical ease and patient preference [2, 3]. It was initially proposed as a part of a staged procedure in high-risk patients including super obese patients to reduce the risk of complications and mortality [17]. It has been seen that operating in super obese patients is technically difficult due to the large liver size and decreased working space. LSG is easier to perform in these patients as compared to laparoscopic Roux en Y gastric bypass (LRYGB) [10]. However, the question remains regarding the long-term durability of weight loss following sleeve gastrectomy [4, 5, 18]. OAGB has also been found to be a technically easier procedure in super obese patients [9]. Studies have shown similar or even better weight loss following OAGB as compared to LRYGB [19–21]. OAGB is comparable to RYGB in regards to weight loss with a less complex procedure as seen in a systemic review [22]. Parmar et al. found significantly better weight loss following OAGB as compared to LRYGB in super–super obese patients [11]. The data on the comparison of OAGB with LSG in super obese patients is scarce [12, 13].

In our study, we compared the outcomes following LSG and OAGB in a matched super obese patient population. We found better excess weight loss in patients undergoing OAGB, as compared to those who underwent LSG at 1 year of follow-up. The impact on comorbidities was similar in both the

groups. Till date, only a few studies have compared LSG and OAGB in super obese patients. Madhok et al. in a study 19 super–super obese patients, found an EWL% of 58% in the OAGB group which was significantly higher as compared to an EWL of 45% in the LSG group [13]. Similarly, Plamper et al. found a mean EWL% of 66.2% in 169 super obese patients at 1 year of follow-up after OAGB. The mean EWL% in 118 super obese patients at 1 year of follow-up after LSG was found to be 57.3% in their study [12]. Madhok et al. used a biliopancreatic limb length of 200 cm in all of their patients, while Plamper et al. used a limb length of 250 cm for patients with BMI 50–60 and 300 cm for patients with BMI > 60. The weight loss was significantly better in both the studies following OAGB [12, 13]. In our study, we used a constant biliopancreatic limb length of 200 cm. Peraglie et al. in their study on 16 super–super obese patients found a mean EWL of 65% at 2 years of follow-up, after OAGB [9]. Other studies have also shown better EWL following OAGB as compared to LSG at short to mid-term of follow-up; however, these studies did not focus on super obese patients as such [21, 23, 24].

We found a similar resolution of T2DM in the LSG and the OAGB groups despite the fact that the weight loss was better in the patients undergoing OAGB. Weight independent factors like increased gastric emptying and increase in Glucagon like peptide 1 might have played a role in T2DM resolution following LSG [25]. A similar resolution of comorbidities was

**Table 3** Impact on comorbidities

	LSG (n = 50)			OAGB (n = 25)			p value
	Total	Resolved	Improved	Total	Resolved	Improved	
Type 2 diabetes mellitus	21	18 (85.7%)	3 (14.2%)	9	7 (77.77%)	2 (22.22%)	0.59
Hypertension	15	10 (66.67%)	5 (33.33%)	14	11 (78.57%)	3 (21.42%)	0.76
Obstructive sleep apnea	13	–	13 (100%)	14	–	14 (100%)	–
Hypothyroidism	11	2 (18.18%)	4 (36.3%)	8	2 (25%)	6 (75%)	0.09

No loss to follow up

LSG laparoscopic sleeve gastrectomy, OAGB one anastomosis gastric bypass

**Table 4** Nutritional parameters in both the groups preoperatively and at 1 year of follow-up

	LSG <sup>a</sup>			OAGB <sup>b</sup>		
	Preoperative <sup>c</sup>	At 1 year <sup>c</sup>	<i>p</i> value	Preoperative <sup>c</sup>	At 1 year <sup>c</sup>	<i>p</i> value
Iron	42.05 (32.2–69.5)	57 (33.5–99.5)	< 0.01	48 (35–62)	50 (43–61)	0.02
Ferritin	60 (35.2–95)	80 (37.75–106)	0.23	26.6 (19.2–57)	57 (31.2–90)	0.02
TIBC	318 (288–349)	318.5 (286.7–348)	0.49	363 (330–396)	299 (258–335)	< 0.01
Vitamin D	14 (10–27.6)	26 (17.5–35.6)	< 0.01	11.7 (7.7–23)	31.41 (20–36.2)	< 0.01
Vitamin B12	230 (154–411.2)	270.5 (193–444.5)	0.36	225 (182–312)	366 (284–490)	< 0.01
Folate	8.5 (5.4–13.1)	10.3 (7.9–17.1)	0.13	7.4 (5.2–9.8)	6.15 (4.9–7.2)	0.25

<sup>a</sup> Loss to follow up 22%

<sup>b</sup> No loss to follow-up

<sup>c</sup> Values reported as median (interquartile range)

LSG laparoscopic sleeve gastrectomy, OAGB one anastomosis gastric bypass, TIBC total iron binding capacity

also seen following OAGB and LSG in super obese patients in a study by Madhok et al. [13]. Lee et al. in their study found a better resolution of T2DM following OAGB as compared to LSG in 60 patients. However, the BMI of all the patients in their study was less than 35 kg/m<sup>2</sup>. They attributed it to the better incretin effect following OAGB as compared to LSG [26]. Musella et al. in a study in 206 patients with a mean BMI of 48 and found a better resolution of T2DM following OAGB (85%) as compared to LSG (60%). It was seen that the resolution of T2DM was dependent upon the type of procedure rather than the decrease in BMI postoperatively [21]. Other authors also found a better resolution of T2DM following OAGB as compared to LSG. They found a better resolution of T2DM in patients with a BMI > 35 as compared to patients with a lower BMI [27, 28]. However, these studies were done in patients with BMI < 50 kg/m<sup>2</sup> [21, 26–29].

We had staple line leak and bleeding in one patient each in LSG group, with no such complication in the OAGB group. Plamper et al. also reported a higher rate of a leak in patients undergoing LSG (5%) as compared to OAGB (0.6%) [12]. Madhok et al. did not report any leak, bleed, or deep venous thrombosis in either group in super obese patients [13]. Eisenberg et al. also reported bleed and leak in 1.4% and 2.8% of the patients, respectively, undergoing LSG [30]. Thus, OAGB is a safe procedure among super obese patients as compared to sleeve gastrectomy.

The incidence of anemia in both the groups was comparable preoperatively. However, the mean Hb was lower in the OAGB group at 1 year. Strikingly, the iron and vitamin B12 deficiency improved at 1 year of follow-up in the OAGB group. However, the folate levels were significantly low at 1 year in the OAGB group which could be due to exclusion of a large segment of jejunum from absorption. Madhok et al. also found a significant increase in anemia and folate deficiency following OAGB [31]. Thus, anemia is a known problem after OAGB and factors apart from folate might also play a

role. Surprisingly, vitamin B12 levels were lower in the LSG group as compared to the OAGB group. This can be partly explained by the reduced acidity and intrinsic factor deficiency in sleeve patients [32]. We had a more robust nutritional supplementation in the recent years and we also started to do OAGB in the same time period. This might have led to a systematic difference in nutritional supplementation between the two groups and might have acted as a confounding factor and is a limitation of our study. This could also be the reason for the patients in the OAGB group becoming less iron, vitamin B12, and vitamin D deficient at 1 year of follow-up (Table 4).

There are certain limitations to our study. The data were analyzed retrospectively and we are currently able to present the short-term results (at 1 year of follow-up) and waiting for the long-term results, especially in the OAGB group. However, we are presenting the preliminary results comparing OAGB and LSG in a mainly super obese patient population.

## Conclusion

Weight loss following OAGB was found to be better than LSG in the super obese patients in our study, with a similar resolution of comorbidities and lesser rates of major complications. There was no significant decline in the nutritional parameters in the OAGB group. Therefore, OAGB may be a preferred weight loss surgical option in super obese patients.

## Compliance with Ethical Standards

Since this is a retrospective study, there was no commission or omission of intervention for the study purpose and all the interventions were done in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

For this type of study, formal consent is not required; however, a written informed consent was taken from each patient for the surgical procedure.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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