

# Successful Outcome of Bariatric Surgery in Living Donor Liver Transplant Recipients With Multidisciplinary Approach: A Preliminary Experience

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**Introduction:** Liver transplant recipients may develop weight gain, metabolic syndrome, and subsequent nonalcoholic steatohepatitis of the transplanted liver which impairs graft function. Bariatric surgery is an effective modality for management of morbid obesity and metabolic syndrome. Our aim is to review the role of bariatric surgery in such high-risk posttransplant patients not responding to medical management and highlight the important considerations. **Methodology:** We review the management of two cases with posttransplant metabolic syndrome not responding to medical management and discuss the literature available on bariatric surgery in organ transplant patients. **Results:** The first patient was a 51-year-old man who underwent living donor liver transplantation 3 years prior, and follow-up ultrasound and fibroscan was suggestive of steatohepatitis of the graft. After liver transplantation, he had gained 30 Kg weight and was on oral hypoglycemic agents with HbA1c of 8%. The second patient was a 65-year-old man, who gained 30 Kg weight with risk of graft impairment 4 years after of combined liver and kidney transplant. Both patients were evaluated thoroughly preoperatively for risk stratification including an upper gastro-intestinal (GI) endoscopy. The immunosuppression was reduced and monitored closely perioperatively. Both patients underwent laparoscopic sleeve gastrectomy (LSG) and were discharged on postoperative day 3. The first patient was evaluated a year after surgery with body mass index (BMI) reduction from 42 to 34 and second at 2 months with BMI reduction from 38 to 33; both patients were free of diabetes and had stable graft functions. **Conclusion:** Bariatric surgery in liver transplant recipients has significant challenges with higher complication rates as patients are on immunosuppression which often impairs wound healing. LSG is safe and effective in such patients which often requires good coordination between the bariatric team and liver transplant team. (J CLIN EXP HEPATOL xxxx;xxx:xxx)

Liver transplant recipients are prone to weight gain and metabolic syndrome. This is due to several reasons such as improvement in diet, immunosuppression, and reduced stress with improvement of the catabolic state. Calcineurin inhibitors increase posttransplant hypertension and dyslipidemia while corticosteroids increase all components of metabolic syndrome.<sup>1</sup> Heimbach et al<sup>2</sup> showed in their series that more than 50% patients who had undergone liver transplantation (LT) for nonalcoholic

steatohepatitis (NASH) had post-LT weight gain with a body mass index (BMI) > 35 kg/m<sup>2</sup>, posttransplant diabetic mellitus, and recurrence of NASH in the allograft. Patients often try weight reduction by diet and exercise programs. However, for several patients, this may not be adequate as they usually struggle with maintaining the weight loss.

Bariatric surgery has been shown to be the most effective long-term treatment for morbid obesity with improvement of metabolic syndrome. The rates of resolution of type 2 diabetes mellitus after bariatric or metabolic surgery have been reported to be generally from 60% to 80%. Studies have also shown significant improvement in steatosis of the transplanted liver including resolution of NASH on histology, at time of bariatric surgery and subsequently few months later.<sup>3</sup> Bariatric surgery in postsolid organ transplant recipients does have a higher risk of complications as patients are on immunosuppression and hence needs several considerations.<sup>4</sup> Our aim is to review the management of this high-risk group of patients for bariatric surgery and highlight the important considerations.

**Keywords:** bariatric surgery, laparoscopic sleeve gastrectomy (LSG), liver transplantation (LT), metabolic syndrome, obesity

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**Abbreviations:** BMI: Body Mass Index; LDLT: Living Donor Liver Transplantation; LSG: Laparoscopic Sleeve Gastrectomy; LT: Liver Transplantation; NAFLD: Nonalcoholic Fatty Liver Disease; NASH: Nonalcoholic Steatohepatitis

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**Table 1** Baseline and Posttransplant Characteristics of Two Patients.

Characteristic	Case 1	Case 2
Baseline characteristics		
Age/Sex	51/M	65/M
Transplant	LDLT	SLKT
Etiology of liver disease	Ethanol and HCV/Cryptogenic, CKD	
Weight (kg)	100	87
BMI	31.1	28.4
CTP	9	9
MELD	17	27
HTN	Yes	No
Type 2 DM	Yes	Yes
Postliver transplant characteristics		
Posttransplant weight gain (kg)	35	30
BMI at LSG (kg/m <sup>2</sup> )	41.7	38.2
Dyslipidemia at LSG	Yes	Yes
USG at LSG	Fatty liver	Fatty liver
Posttransplant metabolic syndrome	Yes	Yes
Immunosuppression	TAC + MMF	TAC + MMF + PRED
Transplant to LSG interval (months)	43	36
Improved control of T2DM and HTN	Yes	Yes
Follow-up after LSG (month)	20	2
% Excess weight loss (EWL) at 240% months		41.25%

LSG, laparoscopic sleeve gastrectomy; BMI, body mass index; SLKT, simultaneous liver kidney transplant; CKD, chronic kidney disease; LDLT, living donor liver transplantation; HCV, Hepatitis C virus; CTP, Child-Pugh Score; MELD, Model for end stage liver disease score; HTN, Hypertension; DM, Diabetes mellitus; USG, ultrasonography; TAC, Tacrolimus; MMF, Mycophenolate mofetil; PRED, Prednisolone; T2DM, type 2 diabetes mellitus.

## METHODOLOGY

From June 2010 to October 2019, 2779 liver transplants were performed at our center. During this period, 710 bariatric surgeries were performed. We present two patients who underwent laparoscopic sleeve gastrectomy (LSG) for morbid obesity and metabolic syndrome after living donor liver transplantation (LDLT). We review the management of these patients and discuss the literature available on bariatric surgery in organ transplant patients.

## RESULTS

The first patient was a 51-year-old man, who underwent LDLT 3 years prior for ethanol and hepatitis C virus-

related cirrhosis. After the liver transplant, he had gained 35 Kg weight and developed the metabolic syndrome with BMI of 42 kg/m<sup>2</sup>, type 2 diabetes mellitus, and dyslipidemia (Table 1). He was started on oral hypoglycemic agents with HbA1c of 8% and remained on immunosuppression. On evaluation by the hepatologist, he had an ultrasound and fibroscan study which was suggestive of steatosis of the graft.

The second patient was a 65-year-old man, 4 years post simultaneous liver kidney transplant for cryptogenic cirrhosis and chronic kidney disease stage 4 (Table 1). He gained 30 Kg weight in the posttransplant period and also developed type 2 diabetes and dyslipidemia with risk of graft impairment.

Both patients were evaluated thoroughly for risk stratification preoperatively including an upper GI endoscopy apart from complete laboratory evaluation. Immunosuppression was reduced and monitored perioperatively by the transplant hepatologist. Both patients underwent LSG and were discharged on postoperative day 3. Neither patient had any postoperative complication. The first patient was evaluated a year after surgery with BMI reduction from 42 to 34 and second at 2 months with BMI reduction from 38 to 33 (Table 2). Reduction of BMI of these two cases after surgery has been shown in Figure 1a and b, and comparison of BMIs over the first two months is shown in Figure 2. Both were free of diabetes and able to stop oral hypoglycemic agents. Both patients were continuing their immunosuppression and had stable graft functions.

## DISCUSSION

Nonalcoholic fatty liver disease (NAFLD) has a significant impact on LT, as there are unique problems in context to LT. NAFLD is the most common cause of donor rejection in LDLT. Grafts with biopsy proven-NASH are usually not accepted. Grafts with moderate to severe steatosis have increased ischemia reperfusion injury in the posttransplant period which can contribute to graft dysfunction. Long-term outcomes with such grafts are not clear. In addition, there is no consensus on whether donor steatosis should be evaluated differently in recipients with NASH.

As the prevalence of NAFLD is increasing worldwide, it has become the leading cause of LT. These patients require detailed evaluation of nutritional and cardiovascular status. Nutritional interventions include lifestyle modifications with tailored weight reduction programs and resistance training exercises to increase muscle mass. As there is an increased predisposition to cardiovascular complications before and after transplant, careful screening with institution of therapeutic interventions including addition of statins or cardioselective beta blockers as per child status is often needed.<sup>5</sup>

**Table 2 Series of Patients Who Underwent Laparoscopic Sleeve Gastrectomy (LSG) After Liver Transplantation.**

Case series	Number of LSG of total SG	Complication rate	Follow-up (months)	% of excess weight loss (EWL at time point)	Improvement of comorbidities (%)
Lin et al <sup>13</sup> 2013, USA	8/9	3 (33.3%)	5 (3–12)	38% (3 months)	T2DM
Pajecki et al <sup>16</sup> 2014, Brazil	1	0	10	75% (5 months)	HTN (100%), T2DM (100%)
Elli et al <sup>10</sup> 2016, USA	2/2	0	12	42.2% (12 months)	T2DM
Khoraki et al <sup>14</sup> 2016, USA	5/5	1 (20%)	33.7 (13–79)	46% (12 months)	T2DM (100%)
Osseis et al <sup>4</sup> 2017, France	3/6	2 (33.3%)	41 (12–94.4)	76% (24 months)	HTN (50%)
Tsamalaidze et al <sup>15</sup> 2018, USA	12/12	4 (33.3%)	25.3	50% (12 months)	HTN (27%), T2DM (44%)
*Present study, 2020, India	2/2	0	11 (6.5–15.5)	41.3% (2 months)	HTN (100%), T2DM (100%)

SG, Sleeve gastrectomy; T2DM, type 2 diabetes mellitus; HTN, hypertension.

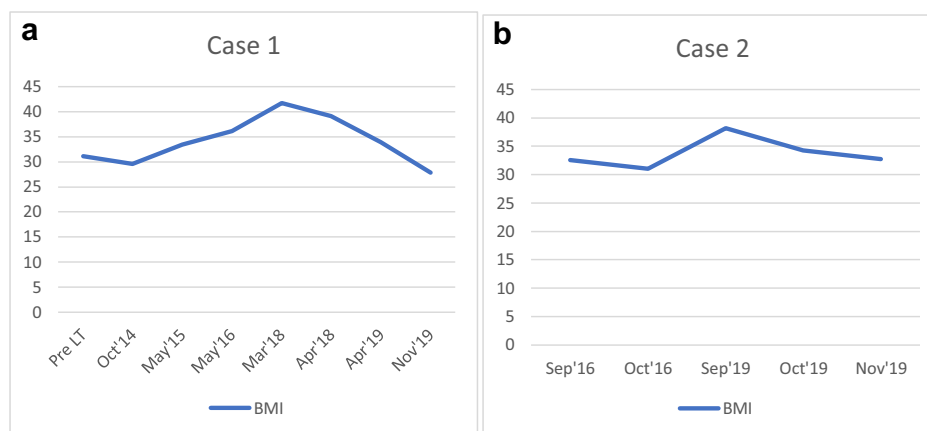
Outcomes of LT in patients with NASH-related cirrhosis are not different as compared with other etiologies. However, morbid obesity (BMI > 35 kg/m<sup>2</sup>) is a relative contraindication for LT as it is associated with poor outcomes. It is the common cause of rejection in LDLT as the graft-to-recipient weight ratio (a measure to predict adequate graft volume to sustain metabolic demands) is compromised. Preoperative management of such patients includes lifestyle modification, endotherapy, and bariatric surgery. We have previously described the role of intragastric balloons as minimally invasive modality in morbidly obese patients with Child B cirrhosis awaiting LT. Five of eight such patients underwent successful LT after weight loss.<sup>6</sup> However, finding the suitable candidate for endotherapy is not always easy. Bariatric surgery often comes to the rescue in the setting of LT as it achieves the intended weight loss and addresses the metabolic syndrome. Sleeve gastrectomy is the commonly performed procedure; however, there is no consensus regarding its timing, that is, before, simultaneous, or after LT.

In the posttransplant period, excess weight gain is common and maximum weight gain occurs in the first 6 months after LT. Usually patients gain about 5 kg of weight within the first year and 10 kg by the end of 3 years

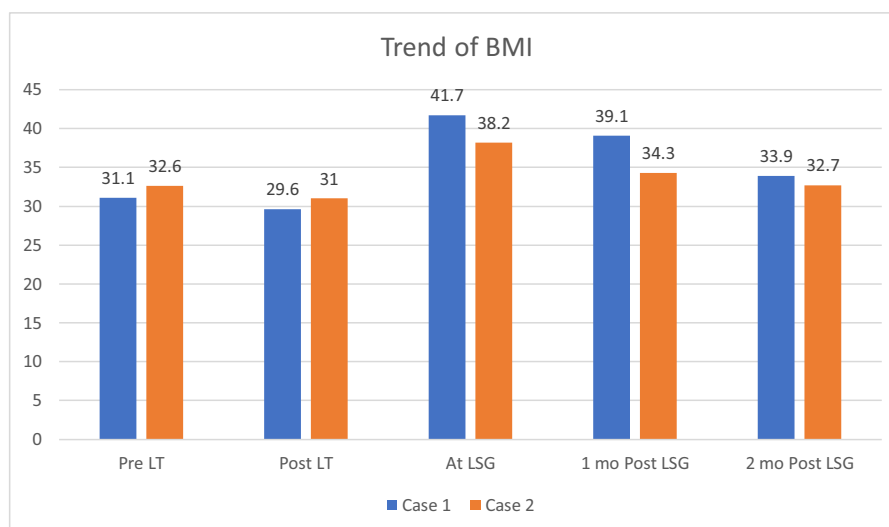
after LT. About 30% patients may become obese along with development of metabolic syndrome.<sup>7</sup> Preexisting metabolic syndrome can worsen, or patients may develop de novo metabolic syndrome after LT with incidence of de novo metabolic syndrome reported to be 33%, 27%, and 40% at 3, 6, and 12 months after LT, respectively.<sup>8</sup>

Management of posttransplant obesity and metabolic syndrome frequently involves lifestyle interventions including structured exercise programs and dietary modifications. Weight loss on these programs should have similar benefits as compared with the nontransplant population, that is, reversal of steatosis, inflammation, and fibrosis. However, few patients can achieve this objective weight loss as immunosuppression often increases components of metabolic syndrome. Bariatric surgery is often effective in selected patients with morbid obesity and metabolic syndrome.

Generally, LSG has been the preferred bariatric surgery in liver transplant recipients as it is primarily restrictive, apart from the metabolic effects. It does not carry the risk of malabsorption of immune suppressant medication which is especially important in this group of patients. Sleeve gastrectomy also preserves the endoscopic access to the stomach and biliary tree. Al-Nowaylati et al<sup>9</sup> in their



**Figure 1** (a) Trend of BMI of case 1 over 20 months and (b) trend of BMI of case 2 over 2 months. BMI, body mass index.



**Figure 2** Comparison of BMI of two cases over 2 months. BMI, body mass index.

case series of Roux-en-Y gastric bypass procedure after liver transplant reported great weight reduction and improvement in comorbidities but a higher complication risk. In contrast, several case reports have demonstrated the safety of sleeve gastrectomy in postorgan transplant patients,<sup>10</sup> apart from significant improvement in NASH of the graft.<sup>11</sup> In terms of regression of steatohepatitis, a study comparing sleeve gastrectomy and Roux-en-Y gastric bypass showed no significant difference.<sup>12</sup>

In a series of 9 sleeve gastrectomies (8 laparoscopic) in 2013, Lin et al<sup>13</sup> have metabolic benefits of sleeve gastrectomy without adversely affecting graft function and immunosuppression with acceptable early complication rate (33%). Elli et al.<sup>10</sup> reported similar efficacy of LSG in achieving weight loss in organ transplant recipients (2 of 10 had LT) as compared with the nontransplant population. Khoraki et al<sup>14</sup> reported similar outcomes of LSG along with improvement of graft function and type 2 diabetes mellitus on transplant recipients (5 of 10 had LT). In the largest reported series, Tsamalaidze et al<sup>15</sup> have reported similar outcomes of LSG in 12 LT recipients as compared with the non-LT population with resolution of comorbid conditions and complication rate of 33%. Summary of patients who underwent LSG after LT has been shown in Table 2.

Although small in number, we report our experience of LSG in two living donor liver transplant recipients. Previously, Kumar et al<sup>17</sup> reported the first case of simultaneous LDLT and sleeve gastrectomy in a patient with NASH-related cirrhosis and metabolic syndrome from India. To the best of our knowledge, we report first case series of LSG after LDLT from India. Both the patients did not have any postoperative complications and had improvement of graft functions along with comorbid conditions.

There are several considerations in liver transplant recipients. Reported complication rates are higher because of patients being on steroids and impaired healing due to immunosuppression. Safe surgery of this subgroup of patients requires a multidisciplinary approach with good coordination between the liver transplant and bariatric team.

## GRANTS

None.

## CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

**Vikas Singhal:** Writing - original draft, Visualization, Validation. **Swapnil Dhampalwar:** Data curation, Formal analysis, Visualization, Validation, Writing - review & editing. **Sanjiv Saigal:** Conceptualization, Writing - review & editing, Visualization, Validation, Supervision. **Narendra Choudhary:** Writing - review & editing, Supervision. **Neeraj Saraf:** Writing - review & editing, Supervision. **Adarsh Chaudhary:** Writing - review & editing, Supervision. **Arvinder Sooin:** Writing - review & editing, Supervision.

## CONFLICTS OF INTEREST

The authors have none to declare.

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