



Combined liver transplantation with sleeve gastrectomy: a pioneer case series from Brazil

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Abstract

The association of a bariatric operation during liver transplantation may benefit patients with liver failure and obesity and sleeve gastrectomy emerges as the procedure of choice. The aim of this study is to present our experience with combined liver transplantation and sleeve gastrectomy. During an 18-month period, seven patients were submitted to simultaneous liver transplant and sleeve gastrectomy (LTSG). There were four male and three female, and the mean recipient age was 60.5 years, mean BMI was 38.2 kg/m², and mean MELD score was 25 points. The indication for liver transplantation was nonalcoholic steatohepatitis (NASH) with hepatocellular carcinoma (HCC) in four cases, hepatitis C with HCC in one case, pure NASH in one case and alcoholic cirrhosis with HCC in one case. Six patients are alive with normal allograft function. There were no biliary complications.

Keywords Liver transplant · Sleeve gastrectomy · Obesity · Cirrhosis · NASH · Combined surgery

Introduction

Nonalcoholic fatty liver disease (NAFLD) follows the burden of obesity and its metabolic complications with a growing demand, approximately 170% more, for liver transplantation (LT) due to nonalcoholic steatohepatitis (NASH)-related cirrhosis [1, 2].

NASH is considered the progressive form of NAFLD, with a faster evolution when compared to fatty liver disease, and an increased risk of death linked to type 2 diabetes

(T2D) and cardiovascular risk factors. Likewise, with the increased prevalence of metabolic syndrome, triggered by insulin resistance, there will be a greater number of liver donors with NAFLD. Approximately, 12% of the NAFLD patients will develop severe liver disease, best treated with liver transplant (LT) [1]. LT has a 72% survival rate 5 years after the surgery, exposing the recipient to the incidence of a significant increase in obesity with de novo NAFLD and recurrence of NASH, all having an impact on morbidity and mortality. At the same time, metabolic effects of immunosuppressive agents all are implicated in new onset of diabetes after transplant [1–3]. A 10% weight reduction in NASH patients can improve liver fibrosis. Bariatric surgery (BS), with metabolic effects resulting not only from weight loss, but also from endocrine and neural changes, may be a safe alternative on this population [3, 4]. The possibility of treating the liver disease at the same time as obesity, while preventing the incidence of metabolic syndrome in the graft, can validate the joint indication of bariatric-metabolic surgery at the time of liver transplantation [5–7].

Sleeve gastrectomy (SG) is the most popular bariatric operation in the United States, with a low rate of complications, short operative time, and no gastrointestinal

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anastomosis. On the other hand, bile reflux in the esophagus may be a factor in the onset of both esophagitis and Barrett's esophagus, emerging as long-term complications [8, 9].

Biliary diversion during a combined SG and LT, with a Roux-en-Y biliary reconstruction, would relieve bile reflux into the stomach and may add a known mechanism of metabolic improvement, by delivering the bile to the distal gastrointestinal tract [10–13]. The aim of this study is to present our initial experience with simultaneous liver transplantation and sleeve gastrectomy.

Methods

Liver transplant combined with sleeve gastrectomy (LTSG) was performed using deceased donors, with six conventional (bicaval reconstruction) and one piggyback technique (preservation of the retro hepatic vena cava). Total hepatectomy was performed with hilum dissection followed by common bile duct transection and ligation of the right and left hepatic arteries. Portal vein (PV) identification and exposure of its full extension were done. In patients with PV thrombosis, thromboendovenectomy was done to restore PV patency.

Portal vein reconstruction was performed with a running 6.0 prolene suture followed by a classic reperfusion. Arterial anastomosis was done with end-to-end anastomosis with running 7.0 prolene suture, most of the times using a “carrel patch” at recipient hepatic artery and gastroduodenal artery confluence.

At this stage of the procedure, patient stabilization and metabolic status were determinants in the decision to proceed or not with the SG. If we decide not to do the SG and the native bile duct is good enough to make a duct-to-duct anastomosis, we do not perform the Roux-en-Y anastomosis. In the probably unlikely case of a severe complication during the SG, the biliary reconstruction is safe using the Roux-in-Y limb. SG was performed by mobilizing gastric greater curvature starting 2–4 cm from the pylorus. The stomach was stapled with linear staplers around a 36-Fr bougie. The staple line was over sewn with a running 3–0 PDS suture.

The jejunal Roux limb started 50–60 cm from Treitz's ligament using a regular trilinear suture staple and a side-to-side enteric anastomosis with hand sewed 4.0 prolene. Hepaticojejunostomy was done with an interrupted 6.0 prolene suture without protecting drainage into the anastomosis (Figs 1, 2, 3, 4).

Results

During an 18-month period, seven patients, four male (57.1%) and three females, were submitted to a combined LTSG with a Roux-en-Y biliary reconstruction. All patients

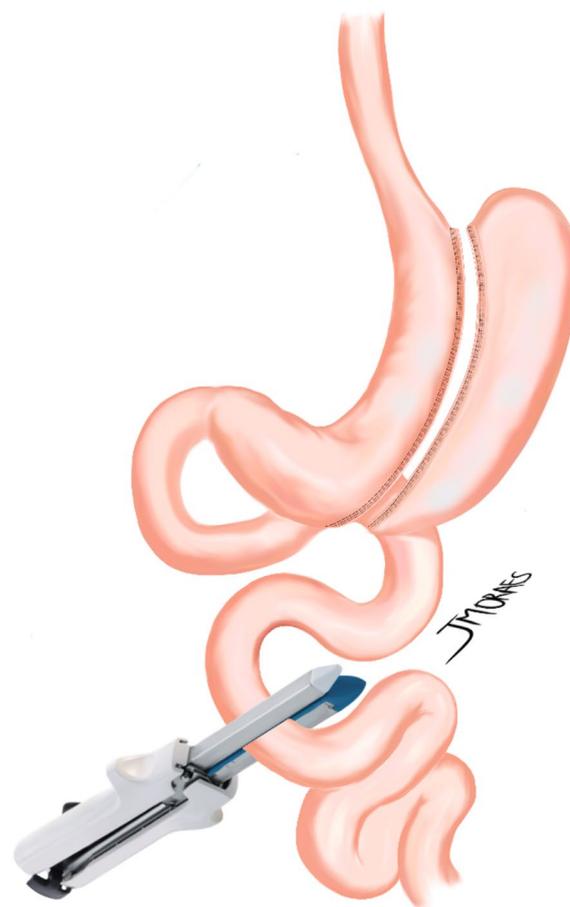


Fig. 1 Sleeve gastrectomy and sectioning of the jejunal Roux limb starting 50–60 cm from Treitz's ligament

had an informed consent document signed, together with one family member. In the same period, we have done 328 LT.

Mean recipient age was 60.5 years, body mass index (BMI) ranged from 33.4 to 45.6 kg/m² (mean 38.2 kg/m²), MELD (model for end-stage liver disease) score ranged from 18 to 29 points (mean 25 points). The indication for LT was NASH with hepatocellular carcinoma (HCC) in four cases, hepatitis C with HCC in one case, pure NASH in one case and alcoholic liver cirrhosis with HCC in one case. Donor age ranged from 34 to 78 years (mean 57.5 y), 57.1% were obese, with a BMI ranging from 23.4 to 39 kg/m² (mean 30 kg/m²) (Table 1).

Six patients are alive with normal allograft function. One patient had a perforated diverticulitis resulting in a prolonged hospital stay. One case had a leak on the stapler line of the sleeve gastrectomy. Endoscopic treatment was successful, but this patient was reoperated because of a perforation of the splenic flexure of the colon and died. This patient also had a preoperative diagnosis of colonic diverticulosis, but we could not assure if it was an iatrogenic perforation, triggered by insufflation of air.

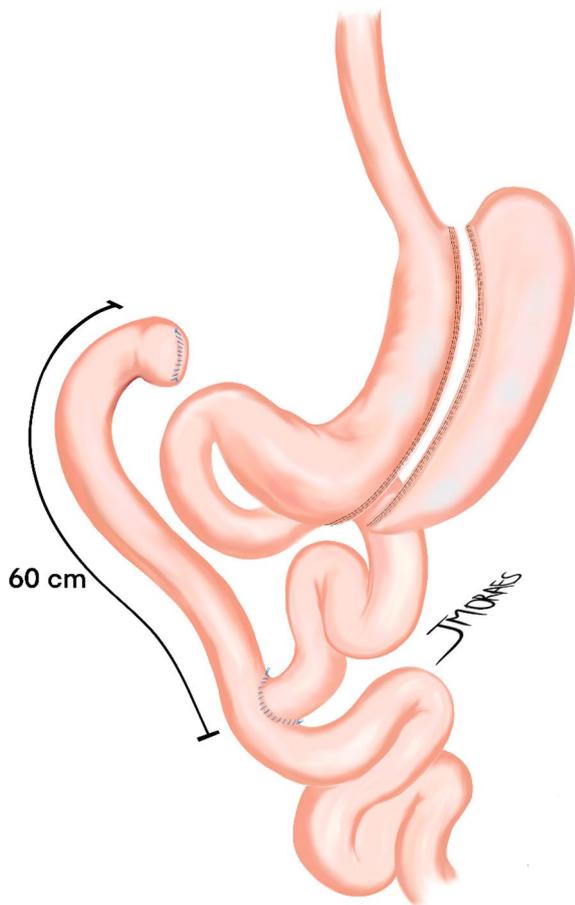


Fig. 2 Roux-en-Y anastomosis

Discussion

Patients with high BMI ($> 40 \text{ kg/m}^2$) have a high risk of primary liver dysfunction after liver transplant. Weight control of patients with morbid obesity and high MELD score with indication of liver transplant is important to minimize the risk after liver transplant [6, 7, 14, 15].

The cirrhotic patient has a variable degree of disease and sometimes it is difficult to manage during abdominal surgery. Preoperatively, Child–Turcot–Pugh (CTP) and MELD scores should be calculated for predicting mortality. CTP A patients are suggested as acceptable candidates for elective abdominal procedures. MELD score is the most significant predictor of postoperative mortality which include albumin $< 3.0 \text{ mg/dL}$, portal hypertension, ascites, and intraoperative transfusion. A common recommendation is that elective abdominal surgery should be postponed until liver transplantation for patients with MELD score above 20, as the mortality rate is up to 50%. Scores from 12 to 19 liver transplantation should be considered. Meld score less than or equal to 10 is acceptable for elective abdominal procedures.

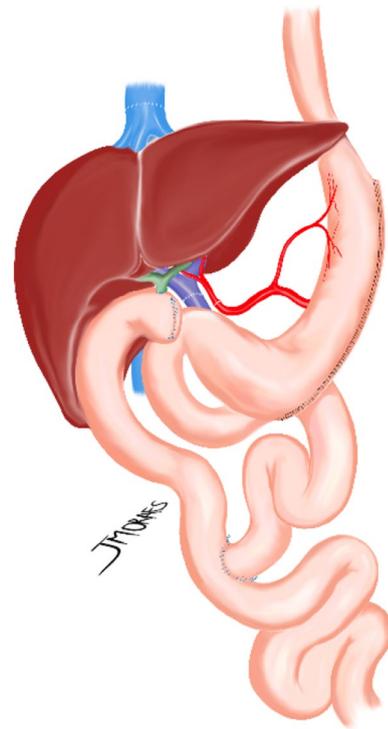
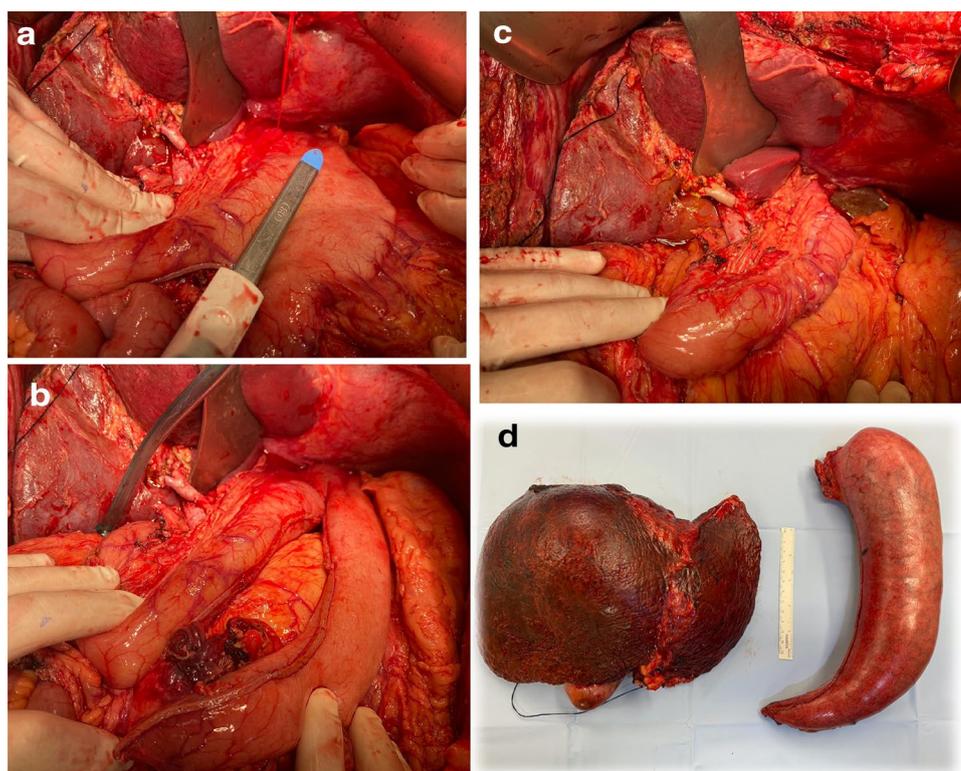


Fig. 3 Sleeve gastrectomy with a Roux-en-Y biliary reconstruction

The most common complications associated with abdominal procedures in cirrhotic patients are bleeding, renal dysfunction, infection, worsening encephalopathy, increased ascites, and liver failure. Higher length of stay, hospital cost, and mortality has been observed after elective abdominal procedure in cirrhotic patients [16–18]. In the present study, only one patient had a MELD score below 20.

Obesity pre-liver transplantation is associated with increased waitlist mortality and an increased risk for portal vein thrombosis. At the liver transplant, the obesity probably increased morbidity and mortality, and longer hospital and ICU stay [7, 8, 19, 20]. After liver transplant, the obesity is associated with cardiovascular events, metabolic syndrome, new onset diabetes, recurrent de novo NAFLD, and HCC recurrence. Nowadays, bariatric surgery is the only therapy for severe obesity that has demonstrated significantly affect weight loss. Guidelines for cirrhotic patients and high BMI with indication for bariatric surgery is lacking. Bariatric surgery in cirrhotic patients and high MELD score before or after liver transplant is associated with major complication rate up to 17% and 26%, respectively. Moreover, the use of immunosuppressors and the presence of abdominal adhesions increase the risk of the procedure. Simultaneous liver transplant and sleeve gastrectomy is a safe and effective method for patients with obesity and high MELD score. In the present study, seven patients with high BMI underwent simultaneous sleeve gastrectomy and liver transplant from

Fig. 4 a–d Technical aspects of the operation



different etiologies. The patient who had sleeve gastrectomy leakage and colonic perforation died at the 17th postoperative day (14.2% mortality) [9, 14, 19, 20].

The outcomes of simultaneous LT and SG have already been addressed, and this report is intended to present our experience and propose a Roux-en-Y biliary reconstruction as an alternative during a combined LTSG [7, 8, 19]. The possibility of diverting the bile could prevent the bile reflux, influence glucose homeostasis, and avoid de novo NAFLD and NASH recurrence. SG was done to treat obesity, occurring in 100% of the LT recipients in this series, while addresses gastric varices [10–13]. Likewise, the proposed approach may benefit an immunosuppressed patient, in the case of a leak from the sleeve. It is recommended that the decision to proceed with SG should be made only after hepatic reperfusion and arterial reconstruction. Aspects of good liver perfusion associated with liver function were analyzed and included absence of liver reperfusion syndrome and hemodynamics instability, normalized bile output, graft consistency, lactate in normal range, and bleeding under control.

We aborted the SG in four cases who presented with clinical and metabolic abnormalities. Case 1, a 29-year-old female patient, BMI 42, adjusted MELD of 29, developed coagulopathy intraoperatively followed by primary non-function. She was retransplanted 3 days later. Case 2, a 49-year-old female patient, BMI 44, MELD 31, portal hypertension, type 2 portal vein thrombosis. After reperfusion,

the patient required high doses of vasopressors, the lactate increased, without urine output. She was discharged after 42 days. Case 3, a 60-year-old male patient, BMI 47, adjusted MELD of 29, previous liver resection. During the total hepatectomy, the patient required multiple transfusion and developed severe coagulopathy. Case 4, a 24-year-old female patient, BMI 37, adjusted MELD of 24, two previous liver resections. The patient developed coagulopathy and primary non-function.

The benefits of bile flow alteration are not hypothetical. Bile acids came out as signaling molecules with a central role in modulating, through farnesoid nuclear receptor and G-protein-coupled bile acid receptor membrane, many of the physiological effects seen after bariatric surgery [10, 11]. The advantage of diverting the bile may compensate the loss of endoscopic access to the biliary tree and the possible occurrence of an internal hernia. A Roux-en-Y hepaticojejunostomy may not compromise patient or graft survival and has a lower incidence of biliary anastomotic structuring. In the present study, there was no biliary complications.

Conclusion

Simultaneous LTSG was an attractive and effective strategy to treat patients with end-stage liver disease associated with morbid obesity. However, other studies with more patients and longer follow-up are needed to achieve evidence-based

Table 1 Characteristics of seven patients who underwent combined liver transplant with a Roux-en-Y biliary reconstruction plus sleeve gastrectomy

Gender	BMI at TX (kg/m ²)	Comorbidities	Age	MELD	TX indication	Donor age	Donor BMI (kg/m ²)	operative time	Hospital stay (days)	Surgical complication	BMI after surgery
Male	45.6	T2D, SAH, OBESITY	51	18	NASH	78	31	8:10	20	None	34 at 6 months
Male	41.9	OBESITY, SAH	61	24	NASH, HCC	34	25.9	5:25	63	Perforated diverticulitis	27.7 at 9 months
Female	37.3	SAH, OBESITY	61	29	NASH, HCC	63	39	5:10	8	None	26 at 7 months
Female	37.2	T2D, SAH, OBESITY	60	29	NASH, HCC	64	35	4:45	17	None	25 at 11 months
Male	35	T2D, CKD, SAH, OBESITY	61	29	HCC, VIRUS C	54	31	4:55	9	None	25 at 12 months
Male	33.4	T2D, SAH, CAD, OBESITY	74	29	ALD, HCC	55	23.4	5:15	17	Sleeve leak Colonic perforation	
Female	37	OBESITY	56	20	NASH, HCC	49	24	6:00	10	Death	29 at 3 months

BMI body mass index, *T2D* type 2 diabetes, *SAH* systemic arterial hypertension, *CKD* chronic kidney disease, *CAD* coronary artery disease, *NASH* Nonalcoholic Steatohepatitis, *HCC* Hepatocellular Carcinoma, *ALD* Alcoholic liver disease

data. The Roux-en-Y biliary reconstruction is a remarkably interesting alternative during the combined procedure.

Declarations

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

Informed consent This is a retrospective study that used data from the database, the informed consent was waived.

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