Sleeve Gastrectomy and Left Ventricular Assist Device for Heart Transplant

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ABSTRACT

Background and Objectives: Heart failure (HF) is a severe obesity-related comorbidity. Many patients with end-stage HF eventually require cardiac transplantation for long-term survival. These patients may be precluded from enrollment in heart transplant programs secondary to morbid obesity. We propose a pathway involving sleeve gastrectomy (SG) for patients with morbid obesity and HF to afford cardiac transplantation eligibility.

Methods: Three patients with HF and morbid obesity underwent implantation of a left ventricular assist device (LVAD) and SG at an academic tertiary care institution in Washington, DC. This retrospective review from April 2012 through January 2017 examines the perioperative course of these 3 patients with regard to bariatric and cardiac indices, including ejection fraction (EF), HF classification, comorbid diseases, and percentages of total weight loss (%TWL) and excess weight loss (%EWL).

Results: All three patients underwent LVAD placement as a bridge to transplant but were excluded from cardiac transplantation secondary to body mass index (BMI) and were referred for bariatric surgery. All have demonstrated considerable weight loss, with average decrease in BMI of 19 points, 39% TWL, and 81% EWL at a mean of 44 months after SG. Two patients have gone on to receive heart transplants, with near normalization of their EF.

Conclusion: LVAD and SG constitute a feasible pathway to cardiac transplantation in morbidly obese patients with end-stage HF. LVAD permits temporary cardiac support, whereas SG assists in efficacious weight loss. We explore SG as a durable weight loss option in patients with HF, with LVAD to improve eligibility for orthotopic cardiac transplantation.

Key Words: Bariatric surgery, Gastrectomy, Heart failure, Heart transplantation, Obesity.

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INTRODUCTION

The ongoing epidemic of obesity in the United States and the world is becoming more prevalent, increasing healthcare costs as well as morbidity and mortality in patients with morbid obesity.[1] Furthermore, the incidence of obesity-related comorbid conditions is increasing; dyslipidemia, hypertension, and diabetes mellitus are all known precipitants of cardiac disease. The end stage of such cardiac dysfunction, as assessed by the American College of Cardiology and American Heart Association (ACC/AHA) staging system, is stage D, where patients have severe lifestyle-limiting symptoms of heart failure (HF) with minimal exertion and at rest. At this stage, patients become dependent upon adjunctive measures, such as the left ventricular assist device (LVAD), either as destination therapy or as a bridge to transplantation.

Transplantable organs are becoming an increasingly scarce resource.[2] Because of their weight and comorbidities, patients with morbid obesity may be excluded from the transplant list in their regional transplant network, or at individual institutions.[3] The United Network for Organ Sharing (UNOS) does not prescribe a specific body mass index (BMI) limit for a patient to undergo orthotopic heart transplantation (OHT). Several series have, however, retrospectively analyzed UNOS OHT data over periods from 1995 through 2012, and identified lower posttransplantation survival in patients with BMI >35 when compared with lower BMI groups, especially in younger patients with BMI > 35.[4,5] Moreover, Young et al[6] demonstrated a 2-fold increased risk of coronary allograft vasculopathy after transplantation in patients with BMI >30 in their cohort. Based on the increase morbidity and mortality of performing OHT in patients with BMI >35, the International Society for Heart and Lung Transplantation 2016 guidelines recommend weight loss to a BMI <35 before

listing patients to receive a transplant.[7] Providing a durable weight loss solution for patients with morbid obesity after LVAD implantation is difficult but achievable by surgical intervention.

Bariatric surgery has been demonstrated to result in decreased BMI, improved symptoms of HF, and increased quality of life (QOL) when compared to nonsurgical treatment options.[8] In addition, with the widespread use of LVADs in the treatment of HF, there is increasing evidence for the success of bariatric surgery in patients with severe HF and LVAD.[9] These patients experienced stabilization of their deteriorating cardiac function status post LVAD implantation. Furthermore, LVAD implantation for HF destination therapy in patients with morbid obesity who have other contraindications to cardiac transplantation has improved survival.[10,11] Notwithstanding the safety of elective noncardiac surgery in patients with LVAD,[12] severe HF places these patients at a small but acceptable risk of complications following bariatric surgery.[13] This review serves as a feasibility analysis of bariatric surgery in recipients of LVAD at our institution.

MATERIALS AND METHODS

From the study period of April 2012 through January 2017, a retrospective review of 3 patients was performed under a protocol approved by the Institutional Review Board of our hospital. Patients status post LVAD implantation for end stage HF were included in the study after being referred for weight loss surgery, to qualify for heart transplantation.

We collected data regarding patient demographics, etiology of HF, and EF. The severity and functional implications of the patients' HF was also classified according to the ACC/AHA and New York Heart Association (NYHA) stage. Pre- and postoperative weights were recorded, as were medical comorbidities, BMI, and postoperative percentage of total weight lost (%TWL). Operative details, length of stay, occurrence of postoperative complications, and current status of transplantation candidacy were also recorded. Because of the size of our cohort, statistical methods were limited to ranges and simple means.

To facilitate transition from the outpatient to the inpatient setting, 2 patients were admitted for preoperative cardiac optimization before SG, and 1 presented as an outpatient on the day of surgery. All patients were observed by the advanced HF service for management of LVAD pumps during surgery. Standard anticoagulation with warfarin was held 1 week before surgery and transitioned to low-molecular-weight heparin. All patients underwent LVAD driveline mapping by ultrasound or fluoroscopy before surgery, to avoid damaging the hardware during surgery.

All 3 patients underwent laparoscopic SG by a single surgeon from our bariatric surgery service (TS). Abdominal access was obtained via an optical trocar technique. The placement of the standard 4 working ports was modified as necessary, taking great care to avoid the previously mapped LVAD driveline. A Nathanson retractor placed through a fifth port in the epigastrium was used to retract the left lobe of the liver. Harmonic ACE (Ethicon Endosurgery, Cincinnati, Ohio, USA) was used to enter the lesser sac at a point 6 cm proximal to the pylorus on the greater curvature of the stomach and to dissect the greater omentum from the greater curvature proceeding cephalad before ligating the short gastric vessels. The gastric sleeve was created over a 36-French bougie, using sequential firings of a powered Echelon Endopath stapler (Ethicon Endosurgery), and the staple line was reinforced with Peri-Strips (Baxter International, Deerfield, Illinois, USA). Intraoperative endoscopy was subsequently performed to test for defects in the staple line and inspect the gastric sleeve before completion of the procedure.

All three procedures were performed without complication, and all three patients were admitted to the HF unit after surgery. A standard bariatric enhanced recovery protocol was used, including sugar-free liquid diet and early ambulation. Anticoagulation with intravenous heparin infusion was used after surgery, while the patients were transitioned back to warfarin before discharge.

RESULTS

All patients included in the study were men between the ages of 42 and 54 at the time of presentation for bariatric surgery. All had ACC/AHA stage D and NYHA class I or II HF, 2 of which were ischemic and 1 of which was non-ischemic cardiomyopathy, with EFs between 15 and 20% at the time of presentation. On initial consultation, the average BMI was 49 (range, 42–55), and average weight was 148 kg (range, 130–158). Data for each patient are presented in **Table 1**. The most common medical comorbidities of the cohort were HF, hypertension, and anemia (hemoglobin <12.5 g/dL) in all 3 patients, followed by diabetes mellitus type II, gout, sleep apnea, and musculoskeletal joint pain in 2 of 3 patients.

There were no intraoperative adverse events experienced by patients in this series. Average length of stay was 7 days (range, 5–9). One of the 3 patients experienced an imme-

Table 1.
Preoperative Patient Clinical Condition

Pt	Age	HF Type	ACC/AHA Stage	NYHA Class	EF (%)	BMI (kg/m^2)	Wt (kg)
1	42M	ICM	D	II	15	50	157
2	50M	NICM	D	II	20	55	158
3	54M	ICM	D	I	20	42	130

Pt, Patient; M, Male; HF, heart failure; ICM, ischemic cardiomyopathy; NICM, nonischemic cardiomyopathy; AHA/ACC, American Heart Association American College of Cardiology; NYHA, New York Heart Association; EF, ejection fraction; BMI, body mass index; Wt, Weight.

diate postoperative complication related to the SG. This patient readmitted with fever and tachycardia. Contrast fluoroscopy demonstrated a staple line leak requiring endoluminal stenting and a percutaneous drain. He subsequently recovered, and the drain was removed on postoperative day 86. This patient was the only one who was readmitted within the first 30 days of surgery.

A second patient experienced postoperative reflux >30 days after surgery and, on postoperative day 35, underwent outpatient endoscopic balloon dilatation of a midsleeve stricture to 15 mm with successful resolution of his symptoms. This patient also presented at late follow-up complaining of right upper quadrant postprandial discomfort. Technetium-99m hepatobiliary iminodiacetic acid cholescintigraphy confirmed biliary dyskinesia, and the patient underwent an uneventful laparoscopic cholecystectomy at 7 months status post SG.

After weight loss surgery, all 3 patients were promptly listed for cardiac transplantation. At present follow-up, an average of 44 months status post SG (range, 32–56), the cohort has achieved an average reduction in BMI of 19 (range, 16–22) per patient, to reach an average BMI of 30 (range, 26–32). The group has had an average 39% TWL (range, 37–41%), and an average 81% excess

weight loss (EWL; range, 75–92%). These data are summarized in **Table 2**.

Two patients successfully underwent explantation of their LVADs and OHT at 17 and 24 months after SG. One patient's immediate posttransplantation course was prolonged by wound complications for which he underwent operative debridement. He also experienced an episode of acute rejection managed medically without long-term EF compromise. The second patient who underwent transplantation had a relatively uneventful postoperative course. The third patient, who has not undergone the operation, experienced a 36-kg weight loss in the 5 months after SG, causing a shift in the location of his LVAD secondary to changes in his body habitus. He required repositioning of the inflow cannula to the LVAD to prevent recurrent inflow obstruction, and two subsequent LVAD pump exchanges for thrombosis. He has since withdrawn himself from the transplant list for personal reasons, and his EF remains <20%, despite his successful weight loss. The 2 patients who underwent OHT were noted to have a left ventricular EF of 60–65% and 50% on echocardiogram within the month before this writing.

Table 2.
Current Patient Status

Pt	Follow-up (mo)	Wt (kg)	%TWL	%EWL	BMI	BMI change	EF %	Transplant Status
1	56	98	37	75	31	19	<20	Withdrew from transplant list for personal reasons
2	43	94	41	75	32	22	60–65	S/p OHT, one episode of acute rejection
3	32	81	38	92	26	26	50	S/p OHT

Pt, Patient; TWL, total weight lost; EWL, excess weight lost; BMI, body mass index; Wt, Weight; EF, ejection fraction; s/p: status post; OHT, orthotopic heart transplant.

DISCUSSION

LVAD placement is becoming an increasingly common therapy for patients with advanced HF. The technical challenges of bariatric surgery, including modifications to cardiac risk preparation and anesthetic techniques, in patients with LVAD, have also been brought to light in this environment as more cases arise.[14] Various bariatric operations in patients with HF have been described, including laparoscopic adjustable gastric banding (LAGB), SG, and Roux-en-Y gastric bypass (RYGB).[15–17]

Subsequent OHT has been described infrequently in a small number of these case reports, and a few have attempted to standardize a surgical approach for weight loss surgery. In addition, the reported experience with such a clinical pathway to concurrently treat HF and morbid obesity is limited. In one series, Wikiel et al[18] reported 4 patients who underwent weight loss surgery, 2 with SG and 2 with RYGB, in an attempt to lose weight and become eligible for heart transplantation. Of those, 3 patients went on to receive a heart transplant after successful weight loss, although there were 2 mortalities by the conclusion of the study. The series by Chaudhry et al[19] included 3 patients with LVAD in place and 3 patients with medically managed advanced HF undergoing SG for the purpose of cardiac transplantation. Similar to our results, 1 patient from this series achieved weight loss sufficient to qualify for OHT and successfully underwent surgery. In that series, 1 patient had LVAD pump dysfunction, requiring replacement of the device. In another series, Shah et al[20] demonstrated the feasibility of simultaneous LVAD placement and SG; however, these patients did not undergo subsequent heart transplantation.[20] In a series from Australia, Lim et al[21] reported on 7 patients with NYHA class 2 or 3 HF managed medically without LVAD, 3 of whom underwent LAGB and 4 of whom underwent SG. Of this cohort, 2 received a heart transplant, 1 ultimately received an LVAD, and the remaining 4 lost sufficient weight to be eligible for transplantation. This series is noteworthy, because it exhibits the preference for restrictive over malabsorptive operations in a pretransplant population, and demonstrates the perioperative anesthetic and hemodynamic management in patients with HF who undergo surgery without mechanical circulatory support. It should be emphasized that the high-risk nature of this patient population led to abnormally high complication rates in the aforementioned series, as well as ours, which are not generally seen when performing bariatric surgery in the general population. Given the high-risk nature of this patient population, ambulatory bariatric surgery should be avoided.[22]

SG has become an increasingly popular operation in the armamentarium of the bariatric surgeon.[23] With increasing years of experience, SG has been shown to have a long-term weight loss profile similar to that of laparoscopic RYGB.[24] SG has also been shown to have similar rates of perioperative morbidity and mortality, with a trend toward higher leak rates but lower mortality when compared to RYGB.[25] However, the true benefit of SG for a patient with a high potential for future organ transplantation is secondary to the effect of the altered gastrointestinal anatomy present after RYGB with regard to immunosuppressive medications. Increasingly, mycophenolate mofetil, steroids, and cyclosporine or tacrolimus, with some patient-specific modifications, are being used for immunosuppression by patients after receiving a heart transplant.[26] Analysis of the pharmacokinetics of these drugs in patients with altered gastrointestinal anatomy status after gastric bypass show greater interpatient variability in the plasma concentrations of these drugs and the time required to reach that concentration.[27] Evidence demonstrating the importance of the proximal gastrointestinal organs in the absorption and metabolism of these drugs suggests that higher and more variable doses would be required in a patient who undergo RYGB than in a patient with normal gastrointestinal continuity, as is retained with SG. We propose that in patients with LVAD seeking bariatric surgery in anticipation of eligibility for OHT, SG is a superior option to RYGB, with regard to the future need for immunosuppressive medications.

Therefore, SG may be offered to patients with LVAD as an avenue to heart transplantation, given that it has been shown to be more effectual than clinical weight loss support alone.[28,29] Because the cardiac output of a patient with an LVAD cannot be readily increased in an effort to burn calories and participate in medical weight loss programs, surgical weight loss is indicated. In our cohort, SG offered to patients with LVAD assisted them in achieving sufficient weight loss to become eligible for heart transplantation. We acknowledge the limitation of a small sample size in our study population. Larger studies including more patients are necessary before more definitive conclusions can be drawn. At our institution, the number of patients who undergo both of these operations is small at present, but is expected to grow with the expansion of both the bariatric surgery service and advanced HF service. Our pathway demonstrates how collaboration across disciplines yielded satisfactory bariatric outcomes for all 3 patients and afforded heart transplantation for 2 patients

who would otherwise have been ineligible. The high-risk nature of this population necessitates this collaboration for optimal coordination of care. Further areas for investigation include long-term outcomes of these patients and assessment of outcomes such as comorbidity resolution and durable weight loss over time.

CONCLUSION

SG represents a feasible, durable, and effective pathway to heart transplantation for patients with advanced HF and an LVAD who are restricted by morbid obesity. Taken together, LVAD and SG have the potential to increase survival and improve quality of life for this high-risk population. Large multidisciplinary cardiac and bariatric surgical services should continue to collaborate on expanding the infrastructure to serve an increasing population of patients with advanced HF and morbid obesity.

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