

Left Ventricular Assist Device Support and Longitudinal Sleeve Gastrectomy Combined With Diet in Bridge to Heart Transplant

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Combining left ventricular assist device (LVAD) implantation and longitudinal sleeve gastrectomy may enable patients with morbid obesity to lose enough weight for heart transplant eligibility. In a retrospective study, we evaluated long-term outcomes of patients with body mass indexes ≥ 35 who underwent LVAD implantation and longitudinal sleeve gastrectomy during the same hospitalization (from January 2013 through July 2018) and then adhered to a dietary protocol. We included 22 patients (mean age, 49.9 ± 12.5 yr; mean preoperative body mass index, 43.3 ± 6.2). Eighteen months after gastrectomy, all 22 patients were alive, and 16 (73%) achieved a body mass index of less than 35. Myocardial recovery in 2 patients enabled LVAD removal. As of October 2020, 10 patients (45.5%) had undergone heart transplantation, 5 (22.3%) were waitlisted, 5 (22.3%) still had a body mass index ≥ 35 , and 2 (9%) had died.

With LVAD support, longitudinal sleeve gastrectomy, and dietary protocols, most of our patients with morbid obesity and advanced heart failure lost enough weight for transplant eligibility. Support from physicians and dietitians can maximize positive results in these patients. (Tex Heart Inst J 2022;49(1):e207521)

Heat transplantation (HT) has substantially improved outcomes in patients with end-stage heart failure (HF). However, not all patients are ideal candidates. Although eligibility requirements vary by center, it is widely accepted that a body mass index (BMI) of 35 or higher contraindicates HT, because obesity is associated with higher risks of postoperative morbidity and death.^{1,2}

In patients with obesity and end-stage HF who are not eligible for HT, a left ventricular assist device (LVAD) can be used as a bridge to transplant (BTT). However, these patients are often unable to lose enough weight because poor cardiac function limits their ability to exercise; many die of HF before they are eligible for HT.³ Therefore, clinicians must consider alternatives, such as bariatric surgery, to improve outcomes. Longitudinal sleeve gastrectomy (LSG) after LVAD placement⁴⁻⁶ has shown promise in BTT therapy.

Few articles in the literature beyond case reports⁴⁻¹¹ have focused on LVAD placement and bariatric surgery as combination BTT therapy in patients with HF and morbid obesity. Therefore, we decided to perform a study of our patients to determine how much weight they lost, how many reduced their BMI to below 35, and how many underwent successful BTT.

Patients and Methods

Our retrospective, single-center cohort analysis included 22 patients with a BMI of 35 or higher and end-stage HF (Table I). From January 2013 through July 2018, the patients underwent LVAD placement and LSG during

the same hospitalization as BTT therapy. From chart reviews, we collected baseline data on age, sex, height, date of LVAD placement, date of LSG, and body weight before LSG. Body mass index was calculated as weight in kilograms divided by height in meters squared. Follow-up data were collected on body weight after

TABLE I. Body Mass Index and Percentage of Weight Loss in the 22 Patients Over 18 Months

Variable	Eligible for Transplant or LVAD Removed* (n=13)	Not Listed for Transplant or Explanted (n=9)	Total (N=22)
Baseline			
Age (yr)			
Mean	49.3 ± 13.5	51.9 ± 9.3	49.9 ± 12.5
Median	48.2 (41.1–60.0)	53.5 (46.9–56.6)	50.9 (41.9–59.4)
Sex			
Male (n=14)	10 (71.4)	4 (28.6)	14 (63.6)
Female (n=8)	3 (37.5)	5 (62.5)	8 (36.4)
Weight (kg)			
Mean	135.7 ± 34.7	126.3 (112.1–171.2)	132 ± 29.5
Median	125.9 ± 20.4	122.0 (117.5–127.6)	126.0 (115.0–133.0)
BMI			
Mean	42.8 ± 6.6	45.1 ± 4.4	43.3 ± 6.2
Median	41.4 (36.9–45.7)	44.3 (42.4–46.2)	41.9 (40.2–46.1)
3 Months after LSG			
BMI			
Mean	35.6 ± 5.3	38.6 ± 3.3	36.2 ± 5.0
Median	34.7 (32.7–37.0)	36.8 (36.4–40.3)	35.1 (33.1–38.1)
Weight loss (%)			
Mean	16.7 ± 4.5	14.6 ± 2.8	16.2 ± 4.2
Median	16.1 (15.0–19.6)	16.3 (12.8–16.4)	16.2 (13.4–17.6)
6 Months after LSG			
BMI			
Mean	33.0 ± 5.3	36.8 ± 2.1	33.8 ± 5.0
Median	32.1 (29.6–34.8)	36 (35.3–37.8)	33.6 (30.3–37.3)
Weight loss (%)			
Mean	22.8 ± 5.6	18.3 ± 4.3	21.7 ± 5.6
Median	23.1 (20.9–27.5)	18.3 (17.5–20.3)	21.8 (18.5–25.3)
12 Months after LSG			
BMI			
Mean	30.5 ± 4.6	36.9 ± 2.6	31.9 ± 5.3
Median	29.5 (26.7–33.1)	37.8 (35.5–38.1)	31.4 (28.1–36.8)
Weight loss (%)			
Mean	28.5 ± 8.2	17.7 ± 7.2	26.1 ± 9.1
Median	27.9 (23.0–37.0)	19.6 (15.1–19.9)	25.1 (19.7–32.3)
18 Months after LSG			
BMI			
Mean	29.8 ± 4.2	37.2 ± 4	31.5 ± 5.3
Median	29.7 (26.6–32.7)	38.1 (37.5–38.8)	31.9 (27.9–35.3)
Weight loss (%)			
Mean	29.6 ± 9.7	17.2 ± 7.4	26.8 ± 10.5
Median	28.1 (22.4–39.0)	16.0 (15.4–22.9)	24.9 (20.3–36.1)

BMI = body mass index (calculated as weight in kilograms divided by height in meters squared); LSG = longitudinal sleeve gastrectomy; LVAD = left ventricular assist device

*Patients who achieved a BMI of less than 35 were listed for heart transplantation or underwent left ventricular assist device explantation after myocardial recovery.

Data are presented as mean ± SD, median and interquartile range, or number and percentage.

LSG, as well as the date of HT listing or LVAD explantation, when applicable. Listing status and deaths were monitored for 18 months, and in one case, through October 2020. Records were given study numbers for privacy, and our local institutional review board waived the need for written informed consent.

Surgical Protocol

Every patient underwent the same prebariatric screening. The LVAD was implanted first, as described previously,⁶ immediately after which the LSG was performed with use of a standard 4-port technique.

Dietary Protocol

After LSG and while still hospitalized, the patients were introduced to the 4-stage dietary protocol developed at our institution (Table II). The weight-loss diet progresses from clear liquids to solid food and ultimately ends with a low-fat, low-carbohydrate plan. The multidisciplinary HF team encouraged patients to drink 48 to 64 ounces of water daily, to avoid using straws, and to limit alcohol and caffeine intake, as well as to eat small, frequent meals at a slow pace. After discharge from the hospital, the patients had follow-up appointments in our outpatient clinic. Our HF dietitians continued the diet education process, monitored compliance with the protocol, and provided ongoing weight-loss counseling. Depending on specific requests from the patients' physicians, the dietitians continued to monitor weight loss and provide medical nutrition therapy as needed.

Data Analysis

Quantitative data are reported as mean \pm SD or as median and interquartile range (IQR); qualitative data are reported as number and percentage.

Results

Before LSG, 5 patients (22.7%) were in obesity class 2 (BMI 35 to <40), and 17 (77.3%) were in class 3 (BMI \geq 40). Two of the class 3 patients had a BMI of greater than 50.

Fourteen patients (63.6%) achieved a BMI of less than 35 at 12 months, as did 16 patients (72.7%) at 18 months (Fig. 1). Of note, both patients with baseline BMIs greater than 50 reduced their BMIs to below 35.

Two patients experienced myocardial recovery, and their devices were explanted. One, whose LVAD was explanted at 16 months, had lost 58.4% of body weight (BMI, 34.1); the other, explanted at 25 months, had lost 42.3% of body weight (BMI, 29.7).

Weight loss was not the sole factor affecting transplant eligibility in many cases. Each patient's clinical and social status was reviewed to determine access to postoperative care and support, as well as other medical conditions that could affect their clinical outcome.

Ultimately, 11 patients (50%) were either listed for HT (n=10) or underwent LVAD removal (n=1) within 18 months (Fig. 2).

All patients were alive at 18 months. Two patients died later. One, waitlisted at 12 months, underwent HT at 17 months and died 7 months later (24 mo after LVAD + LSG). His posttransplant course was complicated by primary graft dysfunction that necessitated venoarterial extracorporeal membrane oxygenation. Subsequent sepsis led to multiorgan failure, and the family decided to withdraw care. The other patient never achieved a BMI of less than 35 and died 40 months after LSG.

TABLE II. Dietary Protocol After Longitudinal Sleeve Gastrectomy

Stage	Duration	Diet
1	Days 1–3	Clear liquids only
2	Days 4–14	Full liquids; includes protein drinks, multivitamin, calcium citrate with vitamin D supplement, 60 g/d protein
3	Weeks 3–6	Puree; includes multivitamin, calcium citrate with vitamin D supplement, 60 g/d protein
4	Week 7 (maintenance)	Solid low-fat, low-carbohydrate; includes multivitamin, calcium citrate with vitamin D supplement, vitamin B12 supplement, 60 g/d protein

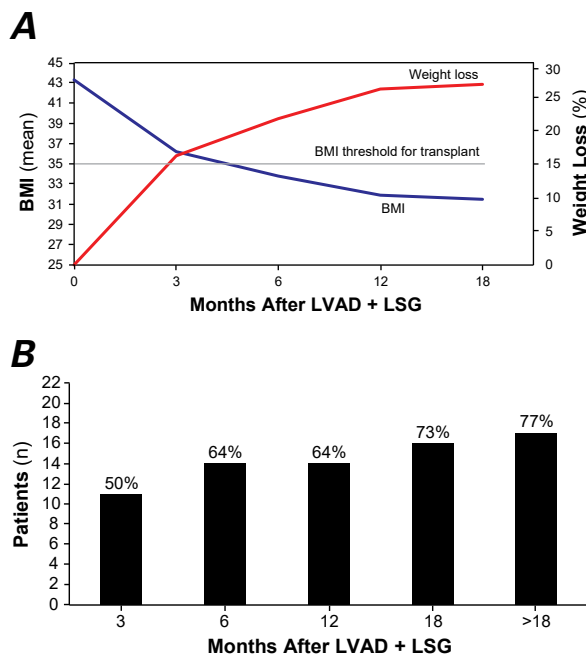


Fig. 1 Graphs show **A**) mean body mass index (BMI) and percentage of weight loss over 18 months, and **B**) cumulative total of patients who achieved a BMI of less than 35 over 18 months.

LSG = longitudinal sleeve gastrectomy; LVAD = left ventricular assist device

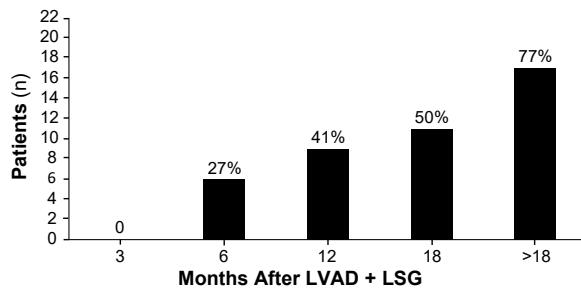


Fig. 2 Graph shows the cumulative number of patients who were listed for heart transplantation or underwent left ventricular assist device (LVAD) explantation.

LSG = longitudinal sleeve gastrectomy

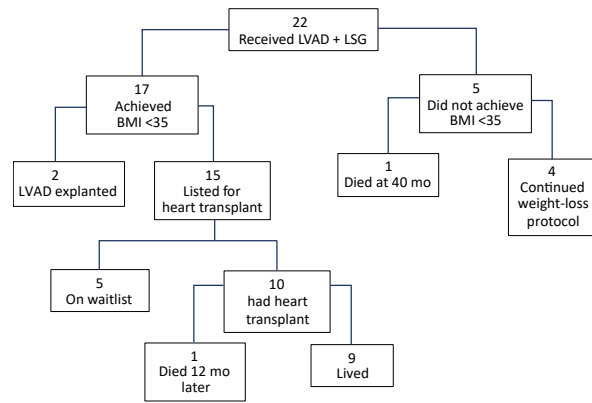


Fig. 3 Flow chart shows outcomes in the 22 patients who underwent left ventricular assist device (LVAD) implantation and longitudinal sleeve gastrectomy (LSG) as of October 2020.

BMI = body mass index

Toxic metabolic encephalopathy of unknown cause was complicated by sepsis and retroperitoneal bleeding. The poor prognosis led the family to withdraw care.

As of October 2020, 10 patients (45.5%) had undergone HT, 5 (22.3%) were listed for HT, 2 (9%) had undergone LVAD explantation, and 5 still had a BMI ≥ 35 (Fig. 3). Seventeen of the 22 patients (77.3%) either were listed for HT or underwent successful LVAD removal. Their median time from LSG to listing or explantation was 362 days (IQR, 172–831 d). In the 10 transplanted patients, the median time from LSG to HT was 352 days (IQR, 225–496 d).

Discussion

Our results show that LVAD support, LSG, and a dietary protocol with ongoing encouragement can enable patients to reduce their BMI. Most in our cohort achieved a BMI of less than 35 at 12 months, and more than half were either listed for HT or had recovered myocardial function at 18 months. Substantial weight loss improved their likelihood of HT and their chances of survival.

Of note, the therapy was not effective in all patients. Six of the 22 did not achieve a BMI of less than 35 in 18 months and, as of October 2020, 5 still struggled to lose weight.

Study Limitations. This retrospective review is limited in its application scope. The small sample size and single-center approach may have introduced bias. The data are accurate; however, conclusions must remain tentative until verification in a larger cohort. Regardless, the number of patients and duration of follow-up add to the relevant literature and can inform future studies. Prospective studies with larger sample sizes are needed.

Conclusion

Our data support LVAD placement and LSG for BTT in patients with morbid obesity and advanced HF. Ad-

herence to a dietary protocol after LSG, with encouragement from physicians and dietitians, further aids long-term weight loss in this vulnerable patient population.

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