Bariatric Surgery as the One Route to Achieving Donor Heart Transplantation in a Patient with a Left-Ventricular Assist Device

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Keywords

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Abstract

Bariatric and metabolic surgery is currently the most effective procedure of achieving and maintaining weight loss. In the case under discussion, a 48-year-old male patient with heart insufficiency and an implanted left-ventricular assist device (LVAD) wanted to reduce his high BMI (48.6 kg/m²), so as to qualify for the heart transplant waiting list. According to the guidelines, he underwent all the required preoperative testing, which included psychosomatic clarifications, determination of endocrinological causes, and a nutritional consultation. During laparoscopic sleeve gastrectomy, a cardiac technician was present to support the anesthetist. After inserting 3 trocars with no complications, the greater curvature was mobilized using Medtronic's bipolar electrothermal vessel-sealing instrument, LigaSure™. The resection was performed with an Ethicon™ endostapler. Postoperative monitoring showed no signs of hemorrhage. The patient's BMI on the day of surgery was 46.8 kg/m² and consecutively fell to 26.7 kg/m² 1 year after the procedure. Follow-up appoint-

ments revealed that the patient was fit and in good health. Thus, the patient's aim of being listed on the transplant list was fulfilled, and at the time of this writing, he is ready to be matched with an organ donor. Because high-BMI patients with inserted LVADs are less likely to receive a donor graft and must remain longer on transplant waiting lists than normal-weight patients, bariatric and metabolic weight loss surgery may lead to a speedier resolution for these high-risk patients.

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Introduction

Over the last 20 years, bariatric and metabolic surgery (BMS) has proved to be the most effective way to reduce weight as compared to nonoperative conservative treatment [1, 2]. It reduces the danger of the metabolic syndrome, such as type 2 diabetes, hypertension, dyslipidemia, sleep apnea, and other weight-related diseases [1, 2].

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Fig. 1. Marked driveline location.

Yet, there is a lack of data on the safety of BMS performed for patients who are at high risk due to severe heart insufficiency or previous heart transplantation, or those who have an implanted left-ventricular assist device (LVAD). According to the European guidelines for organ transplant recipients, patients with a BMI above 34 kg/m² are not considered for the waiting list for heart transplantation [3, 4]. Because attending a weight loss program may be difficult for these patients and because physical exercise is practically impossible for heart-insufficient people, a surgical solution to pretransplantation weight loss may be the most likely option.

Case Report

The authors are reporting on their own experiences concerning a 48-year-old male patient who had an Abbott HeartMate 3TM LVAD implanted in 2017, 2 years before his bariatric surgery. Written informed consent was obtained from the patient for publication of this case report and accompanying images. The patient underwent LVAD surgery due to bacteroides myocarditis, which caused extensive myocardial heart insufficiency leading to grade 4 irreversible heart failure. Other relevant comorbidities documented at the time of surgery included hypertension and a history of deep venous thrombosis. Furthermore, a defibrillation device was implanted in the patient in 2014.

Prior to surgery, the patient underwent a thorough preoperative workup including psychosomatic and endocrinological investigations to rule out contraindications. Nutritional consultation and medical records for this patient revealed that he was a high-

Fig. 2. Trocar placement.

volume eater with no history of diabetes mellitus. All these examinations led to our decision to perform laparoscopic sleeve gastrectomy (LSG). A preoperative endoscopy was also performed to identify any abnormalities like gastroesophageal reflux-related findings or esophagogastric tumors like GIST.

The patient's oral anticoagulants were stopped 2 days before surgery, and unfractionated heparin was given intravenously with an aPTT goal of 50–60 s. The BMI of the patient on the day of surgery was 46.8 kg/m² (height: 173 cm/weight: 140 kg). Furthermore, a preoperative X-ray and ultrasound were performed to define the driveline position so as to avoid injury during trocar positioning (shown in Fig. 1, 2). Following this assessment, the position of the driveline was marked on the patient's abdomen.

During the surgical procedure, a cardiac technician was present to support the anesthetists. Three trocars were inserted without complications, and there was no need to divide adhesions. The greater curvature was mobilized using a 10-mm bipolar electrothermal vessel-sealing instrument (Medtronic LigaSureTM). The resection was performed from the antrum to the angle of His using the endostapler EchelonTM Flex 60 (Ethicon Endo-Surgery[®]) after a 40Ch nasogastric tube had been positioned in the stomach. The cranial half of the staple line was oversewn to prevent bleeding. Also, a Robinson drain was placed next to the staple line for drainage and for monitoring postoperative bleeding and early leakage. The postoperative examination showed no signs of hemorrhage. On postoperative day 2, a regular swallow test with toluidine blue did not indicate any sign of staple-line leakage; therefore, the Robinson drain was removed. The patient was allowed to drink water and tea only for 1 week. Soup was allowed in week 2 and puréed meals in week 3, followed by well-chewed solid meals in week 4. Oral route anticoagulation was re-induced with warfarin, and as soon as an international normalized ratio (INR) of <2.8 was reached, continuous heparinization was stopped. The hospital stay was prolonged due to a transient rise in inflammatory markers so that the patient was discharged on postoperative day 10. A CT scan did not indicate any sign of leakage or intra-abdominal abscess. During the first fol-

low-up visit, 4 weeks after surgery, the patient's BMI had dropped to 42 kg/m². He also experienced fatigue and dyspnea and was transferred to the transplantation center in order to exclude thrombosis of the LVAD. During the next follow-up visit 2 months postoperative, he reported that both his physical health and his mental condition had improved, and his BMI had dropped still further to 40.1 kg/m² (120 kg). On the third follow-up visit, 5 months postoperative, his BMI had dropped to 35.8 kg/m² (107 kg), and his vitamin D and protein deficiency were treated with adjusted supplementation. As recorded on further visits, the patient's BMI reportedly had dropped to 32.4 kg/m² (97 kg) and 30.4 kg/m² (91 kg) after 8 and 12 months, respectively, after surgery. One year after surgery, he had to undergo inpatient treatment for a driveline infection; this included wound cleansing and vacuum therapy for 8 weeks. At the present time, his BMI has been as low as 26.7 kg/m² (80 kg), and he still reports good health and physical fitness. He can easily cope with the routines of daily living, and even bicycling and walking are feasible for him now. Therefore, the aim of adding his name to the transplant list has been fulfilled, and he is now in line for a donor organ.

Discussion

Comorbidity of obesity is rather high [1, 2]. Nevertheless, an acceptable morbidity and mortality of BMS could be shown in previous studies [5]. The benefits of BMS for high-risk patients, who suffer from diseases like end-stage heart failure, have to be discussed. According to Albert [6], while morbidity and mortality rates following cardiac surgery or heart transplantation are increased in obese subjects, BMS has been shown to reduce cardiovascular risk factors including diabetes, hypertension, and dyslipidemia. In addition, BMS may even prevent the need for LVAD implantation or a heart transplantation and may serve as a bridging treatment offering heart transplant eligibility in patients with advanced heart failure [6–9]. In the present case, our patient suffered from grade 4 heart insufficiency. Due to his high BMI of 48 kg/m², among other reasons, the patient did not meet the criteria for high-urgency transplantation, as the European guidelines require a BMI of <34 kg/m² for organ transplant recipients [3]. Under these circumstances, his option was implantation of the LVAD. But unfortunately, patients with LVAD implantation usually gain even more weight after this surgery because the possibility of losing weight through a restricted diet plus calorie-burning activities is naturally limited. Therefore, some institutions favor a simultaneous LVAD implantation and gastric sleeve resection [10]. Overweight and obese patients on the organ transplant list have been shown to wait twice as long as normal-weight individuals and

are as much as 46% less likely to receive a donor graft than patients of normal weight [11, 12]. For those with an implanted LVAD, a longer waiting time on the transplant list may diminish their chances for a lifesaving heart transplantation and survival. Based on their own 7 cases of patients who underwent LSG after LVAD implantation and on other 19 cases reported in the literature, Punchai et al. [13] concluded that bariatric surgery might be advantageous, considering the pitfalls of perioperative management for high-risk patients, which may include preventing damage to the LVAD components, fluid volume management, and invasive hemodynamic monitoring supervised by a specialized anesthetist.

daSilva-deAbreu et al. [14] studied 8 patients at a single heart transplant center and described LSG as an effective intervention to help obese LVAD-implanted individuals who wished to become candidates for heart transplantation. Furthermore, they point out that the low sample size for each center treating obese patients with LVADs demonstrates the need for creating a prospective multicenter registry to unify criteria for therapy [15]. The present case showed that bariatric surgery is feasible and safe in obese patients with implanted LVADs, if certain key points are considered: these patients must undergo surgery in a specialized bariatric surgery center with an experienced anesthesiological and surgical team. The bridging from oral anticoagulation to heparinization is critical, so as not to endanger the function of the LVAD and to keep the risk of postoperative hemorrhage low. Therefore, preoperative heparinization as well as induction of oral anticoagulation postoperatively should be done during the hospital stay. In addition, the surgeon must be aware of the driveline location, especially during trocar insertion into the abdomen, because injury of the driveline would lead to possibly fatal complications. Therefore, driveline location should be marked after X-ray and sonographic investigation. A cardiac technician familiar with the patient's implanted LVAD must be available during the day of surgery and also in the days that follow, so as to support the anesthesiological team. The LVAD counts for 80–90% of cardiac-pump function [16, 17]. Arterial blood pressure curve is continuous rather than pulsatile; therefore, the medium arterial pressure is the important parameter for controlling blood pressure. Because the LVAD runs a washout every 2 s, there is a dip in blood pressure; for this reason, the anesthetist must ensure a sufficient cardiac preload. Of note is the fact that blood pressure cannot be controlled with arterenol; initiating a rise in blood pressure to control bleeding

at the end of the procedure, as is usually done in our department, is not possible because the pump itself takes control of the blood pressure. As an additional factor, these patients are at high risk of infection, and so a peri-operative antibiotic regimen should be discussed with a microbiologist and antibiotic supervisor based on the medication and infection history of the patient, in order to avoid LVAD site infection, which occurs in up to 32% of these patients [18]. We also recommend a swab test from the site the driveline perforates the skin at the beginning of surgery to identify any infectious bacteria (shown in Fig. 1). Last, the procedure should only be performed by a highly experienced and specialized surgical team to minimize the operation time and risk of complications.

Conclusions

Our patient underwent successful bariatric surgery and still enjoys good health and fitness. The aim of reducing BMI so that the patient might find a place on the transplant list was realized. By achieving weight loss and reducing strain on the heart, bariatric surgery may preclude the need for LVAD implantation or a heart transplantation, but may also act as a bridging treatment to heart transplant eligibility in patients with advanced heart failure.

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References

- 1 Angrisani L, Santonicola A, Iovino P, Formisano G, Buchwald H, Scopinaro N. Reply to letter to the editor: bariatric surgery worldwide 2013 reveals a rise in mini-gastric bypass. *Obes Surg*. 2015;25:2166–8.
- 2 Svane MS, Madsbad S. Bariatric surgery: effects on obesity and related co-morbidities. *Curr Diabetes Rev*. 2014;10:208–14.
- 3 Mehra MR, Canter CE, Hannan MM, Semigran MJ, Uber PA, Baran DA, et al.; International Society for Heart Lung Transplantation (ISHLT) Infectious Diseases, Pediatric and Heart Failure and Transplantation Councils. The 2016 International Society for Heart Lung Transplantation listing criteria for heart transplantation: a 10-year update. *J Heart Lung Transplant*. 2016; 35(1):1–23.
- 4 De Jonge N, Kirkels JH, Klöpping C, Lahpor JR, Caliskan K, Maat AP, et al. Guidelines for heart transplantation. *Neth Heart J*. 2008;16(3):79–87.
- 5 Schauer PR, Mingrone G, Ikramuddin S, Wolfe B. Clinical outcomes of metabolic surgery: efficacy of glycemic control, weight loss, and remission of diabetes. *Diabetes Care*. 2016;39:902–11.
- 6 Albert CL. Morbid obesity as a therapeutic target for heart failure. *Curr Treat Options Cardiovasc Med*. 2019;21(10):52.
- 7 Alba AC, Bain E, Ng N, Stein M, Brien KO, Ross H. Complications after heart transplantation: hope for the best, but prepare for the worst. *Int J Transplant Res Med*. 2016; 2(2):2.
- 8 Elagizi A, Carbone S, Lavie CJ, Mehra MR, Ventura HO. Implications of obesity across the heart failure continuum. *Prog Cardiovasc Dis*. 2020;63(5):561–9.
- 9 Gadela NV, Umashanker D, Scatola A, Jaiswal A. Clinical outcomes, trends in weight, and weight loss strategies in patients with obesity after durable ventricular assist device implantation. *Curr Heart Fail Rep*. 2021;18(2):52–63.

Statement of Ethics

This study protocol was reviewed and the need for approval was waived by the local ethics committee (Ärztchamber Niedersachsen). Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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Author Contributions

Clara Boeker contributed to data acquisition, drafting of the manuscript, and literature research. Julian Mall contributed to drafting of the manuscript. Christian Reetz contributed to critical revision of the manuscript. Kamil Yamac contributed to critical revision of the manuscript. Ibrahim A. Hakami contributed to drafting of the manuscript and literature research. Hinrich Koehler contributed to drafting of the manuscript and literature research. The authors confirm that the final version of this manuscript was read and approved by all of the authors.

Data Availability Statement

All data generated or analyzed during this case report are included in this article. Further enquiries can be directed to the corresponding author.

- 10 Challapalli J, Maynes EJ, O'Malley TJ, Cross DE, Weber MP, Choi JH, et al. Sleeve gastrectomy in patients with continuous-flow left ventricular assist devices: a systematic review and meta-analysis. *Obes Surg*. 2020; 30(11):4437–45.
- 11 De Santo LS, Moscariello C, Zebele C. Implications of obesity in cardiac surgery: pattern of referral, physiopathology, complications, prognosis. *J Thorac Dis*. 2018;10(7):4532–9.
- 12 Weiss ES, Allen JG, Russell SD, Shah AS, Conte JV. Impact of recipient body mass index on organ allocation and mortality in orthotopic heart transplantation. *J Heart Lung Transplant*. 2009;28(11):1150–7.
- 13 Punchai S, Nor Hanipah Z, Sharma G, Aminian A, Steckner K, Cywinski J, et al. Laparoscopic sleeve gastrectomy in heart failure patients with left ventricular assist device. *Obes Surg*. 2019;29:1122–9.
- 14 daSilva-deAbreu A, Garikapati K, Alhafez BA, Desai S, Eiswirth C, Krim S, et al. Laparoscopic sleeve gastrectomy in patients with obesity and ventricular assist devices: a comprehensive outcome analysis. *Obes Surg*. 2021;31(2):884–90.
- 15 daSilva-deAbreu A, Alhafez BA, Patel H, Lloro-Ferrer JF, Ventura HO, Lavie CJ, et al. Laparoscopic sleeve gastrectomy in patients with ventricular assist devices, beyond just bridging to heart transplantation. *Obes Surg*. 2020;30(12):5123–4.
- 16 Ahn HC, Holm J, Najjar A, Hellers G, Szab Z. A new total artificial heart concept allowing replacement or support of the native heart. *J Clin Exp Cardiol*. 2018;9(2):569.
- 17 Lund LH, Matthews J, Aaronson K. Patient selection for left ventricular assist devices. *Eur J Heart Fail*. 2010;12(5):434–43.
- 18 Hernandez GA, Breton JDN, Chaparro SV. Driveline infection in ventricular assist devices and its implication in the present era of destination therapy. *Open J Cardiovasc Surg*. 2017;9:1179065217714216.