

Coronary Artery Bypass Surgery Performed after Laparoscopic Sleeve Gastrectomy in A Patient with Severe Obese of Severe Coronary Artery Stenosis

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Abstract *Introduction:* Obesity is a significant risk factor for cardiovascular disease and causes obesity-related disorders (ORD), which are risks for surgery. Metabolic and bariatric surgery (MBS) improve ORDs, reducing preoperative risk. We report the case of a patient with severe obese of severe coronary artery stenosis who underwent laparoscopic sleeve gastrectomy (LSG) prior to coronary artery bypass grafting (CABG) to reduce the risks associated with latter surgery. *Case presentation:* The 53-year-old (body mass index, BMI 43.2 kg/m²) male patient's comorbidities included obstructive sleep apnea, hypertension, dyslipidemia, and osteoarthritis of the knee, all on treatment. Sufficient weight loss was not achieved, so LSG was planned. Preoperatively, three-vessel coronary artery disease indicated the need for CABG. Six months post-LSG, the excess and total weight losses were 36.8% and 19.1%, respectively. He continued to lose weight successfully and underwent CABG 8 months post-LSG. The postoperative course was favorable; he was discharged on postoperative day 13. Sixteen months post-CABG, there are no complications and his progress remains stable. *Clinical discussion:* Reports of two-stage cardiovascular surgery with preceding MBS are rare. However, MBS reduces visceral fat and improves several ORDs, thereby decreasing perioperative risks for CABG and potentially improving postoperative outcomes. While the "obesity paradox" occurs in cardiovascular surgery, the benefits of prior MBS outweigh this effect. *Conclusion:* MBS preceded CABG in this case, reduced the associated risks, and is likely to improve postoperative outcomes. Moving forward, the waiting period post-MBS, and the severity of the cardiovascular disease, require further investigation.

Keywords: Case report, coronary artery disease, preoperative risk reduction, metabolic and bariatric surgery, second stage surgery, severe obesity

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1. Introduction

Severe obesity and a high body mass index (BMI), as a weight-related factor, are among the most significant risk factors for coronary artery disease, and the proportion of obese patients among those undergoing coronary artery bypass grafting (CABG) is high [1]. Severe obesity itself poses surgical risks, which are exacerbated by numerous obesity-related disorders (ORDs). Metabolic and bariatric surgery (MBS) has been shown to improve ORDs. For instance, our department has reported cases in which MBS was performed prior to laparoscopic spleen-preserving distal pancreatectomy with bifurcated graft replacement to reduce preoperative risk [2,3].

Additionally, epicardial adipose tissue (EAT) and mediastinal fat (MF) contribute to left ventricular diastolic dysfunction in obese patients⁴. Moreover, EAT is known

to increase the incidence of atrial fibrillation (Af) [5]. Both EAT and MF have been found to decrease after MBS, which highlights the potential benefits of performing MBS prior to cardiovascular surgery [4,6]. By contrast, in the field of cardiovascular surgery, there have been reports of an "obesity paradox," whereby obese or overweight patients exhibit better prognoses when compared with patients of normal weight [7].

Herein, we report the case of a severely obese patient with severe coronary artery stenosis who underwent laparoscopic sleeve gastrectomy (LSG) prior to CABG to reduce the risks associated with latter surgery.

We have revised the manuscript according to the CARE guidelines.

2. Case Presentation

The patient is a 53-year-old male diagnosed with severe

obesity (height: 165 cm, weight: 117.8 kg, BMI: 43.2 kg/m²), and comorbidities including obstructive sleep apnea syndrome (OSAS), hypertension, dyslipidemia, and osteoarthritis of the knee, for which he was receiving medical treatment. Based on the insurance eligibility criteria for MBS in Japan, the decision was made to perform MBS [8]. Preoperative electrocardiography revealed abnormal Q waves in leads II, III, and aVf, while transthoracic echocardiography showed reduced wall motion. Additional questioning of the patients highlighted symptoms of angina during exertion. Based on these findings, coronary computed tomography (CT) angiography was performed. It revealed complete occlusions in the right coronary artery at #1, #2, and #3 (Figure 1a), severe stenosis in the left anterior descending artery at #7 (Figure 1b), and complete occlusion in the left circumflex artery at #11 (Figure 1b), leading to a diagnosis of effort angina. The predicted operative mortality for isolated CABG was 1.16% according to the Society of Thoracic Surgeons Adult Cardiac Surgery Database Operative Risk Calculator, while the predicted risk of major morbidity or mortality was 8.0%. The estimated risks of stroke, renal failure, reoperation, and prolonged ventilation were 0.67%, 0.76%, 2.91%, and 5.11%, respectively. The predicted operative mortality according to EuroSCORE II was approximately 0.9%. CABG was deemed necessary, although the test results indicated that the heart's capacity to tolerate surgery was sufficient. The surgical plan, which was to perform LSG first, followed by coronary angiography (CAG) was discussed in consultation with the cardiology and cardiovascular surgery teams.

The patient's postoperative course after LSG was favorable, and was discharged on postoperative day 6. The changes in the patient's body weight, lung volume, and visceral fat in various organs over the 6 months following LSG, when compared with the preoperative values, are shown in Table 1. Postoperatively, the patient's weight decreased steadily, with an excess weight loss (EWL) of 36.8% and a total weight loss (TWL) of 19.1%. The visceral fat in all the assessed organs decreased, and lung volume increased.

Table 1. Changes in BMI, lung volume, and visceral fat after MBS

	Before treatment	6 months post-MBS
Body mass index (kg/m ²)	42.2	34.8
Visceral fat area (cm ²)	264	117
Lung volume (mL)	3,006	5,615
Epicardial adipose tissue (mL)	98	87
Mediastinal fat (mL)	264	117

Furthermore, 6 months post-LSG, CAG revealed complete occlusions in the right coronary artery at #1, #2, and #3 (Figure 2a), severe stenosis in the left anterior descending artery at #7 (Figure 2b), and complete occlusion in the left circumflex artery at #11 (Figure 2c).

Based on these findings, the decision was made to proceed with CABG. Thus, 8 months post-LSG, the patient underwent off-pump coronary artery bypass grafting, left internal thoracic artery to left anterior descending artery grafting, and Y-composite free right internal thoracic artery to posterolateral and four posterior

descending branches grafting (Figure 3a and Figure 3b). The patient's postoperative course was again uneventful and was discharged on postoperative day 13. To date, the patient has experienced no complications related to LSG or CABG.

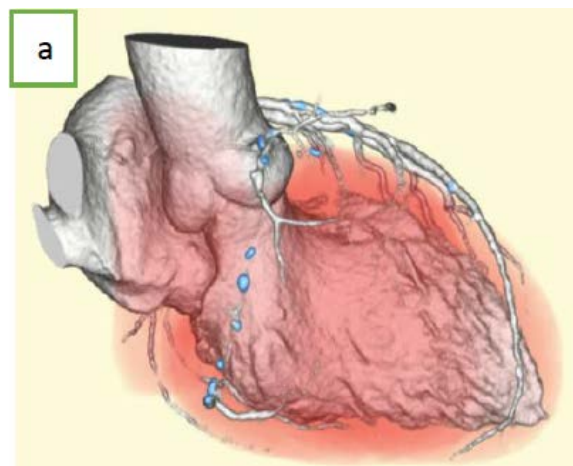


Figure 1a. Complete occlusions in the right coronary artery at #1, #2, and #3

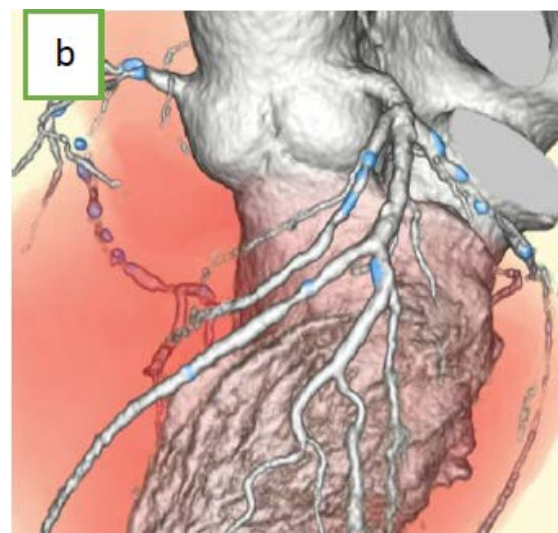


Figure 1b. Severe stenosis in the left anterior descending artery at #7 and complete occlusion in the left circumflex artery at #11

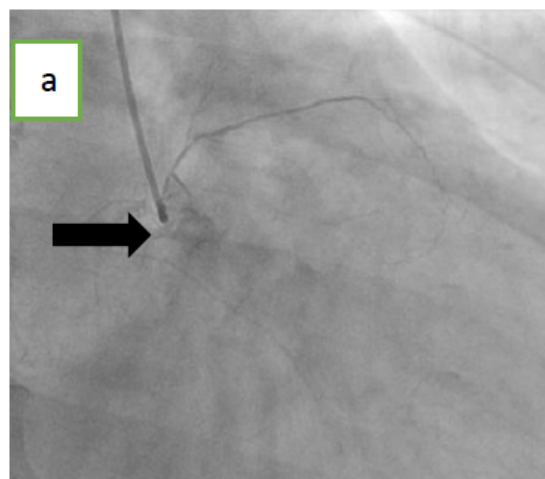


Figure 2a. Complete occlusions in the right coronary artery at #1, #2, and #3

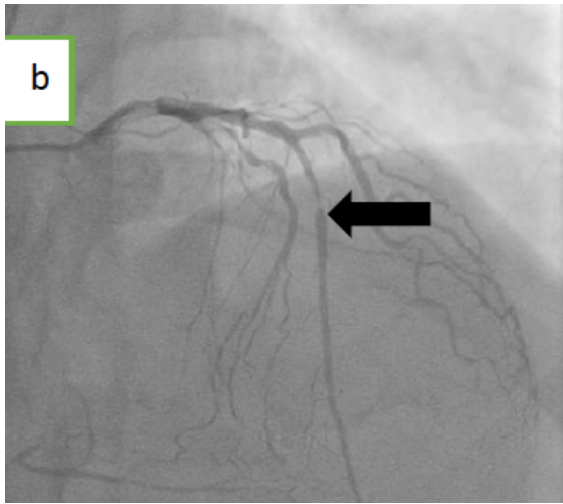


Figure 2b. Severe stenosis in the left anterior descending artery at #7

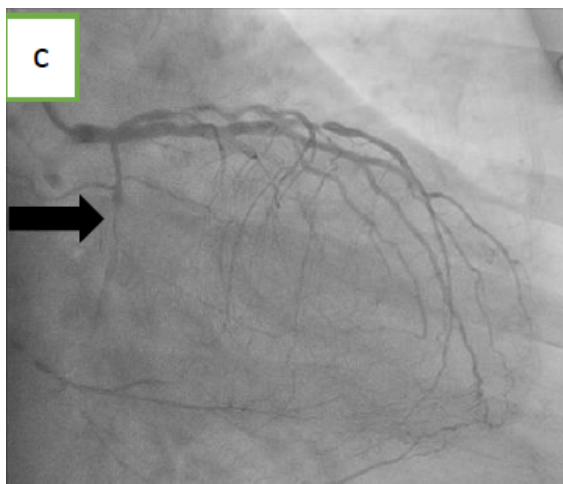


Figure 2c. Complete occlusion in the left circumflex artery at #11

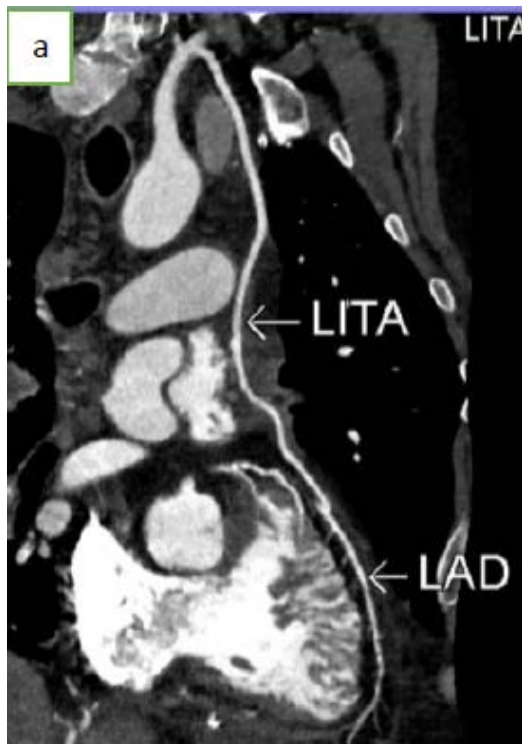


Figure 3a. Left internal thoracic artery to left anterior descending artery grafting

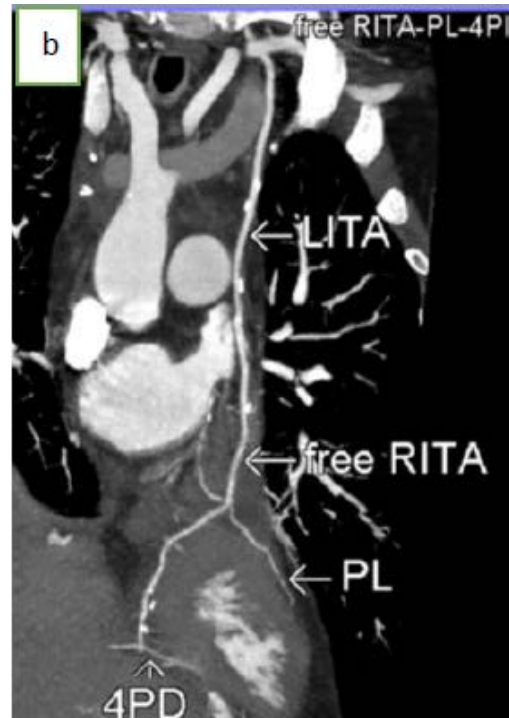


Figure 3b. Y-composite free right internal thoracic artery to posterolateral and four posterior descending branches grafting

LITA: Left internal thoracic artery, LAD: left anterior descending artery, RITA: Right internal thoracic artery, PL: posterolateral branches, 4PD: four posterior descending branches.

3. Discussion

The reported case involved performing MBS prior to CABG to address lesions identified during the preoperative evaluation concerning MBS, wherein CABG was performed after confirming the patient's weight loss. Favorable weight loss was observed by 6 months post-LSG, with an EWL of 36.8% and a TWL of 19.1%. There was a noticeable increase in the patient's lung volume, and the visceral fat volumes of various organs decreased, indicating a favorable therapeutic effect. CABG was performed 8 months post-MBS without perioperative complications. The patient continued to do well, did not experience any complications even after discharge.

Severe obesity increases the difficulty of surgery, and is known to reduce respiratory function. It has been reported that MBS can increase patient's lung volume and improve their respiratory function, and leading to MBS being considered useful in preventing postoperative respiratory failure [9]. In cardiovascular surgeries involving sternotomy, the risk of postoperative respiratory failure is increased due to factors such as postoperative pain, making the utility of MBS particularly valuable. In the reported case, an increase in the patient's lung volume was observed after LSG, which is believed to have contributed to the prevention of postoperative respiratory failure. Additionally, OSAS, a known the ORD, significantly increases the risk of post-CABG Af, although improvements have been reported following MBS, which indicates that MBS prior to required surgery may also reduce the risk of postoperative Af [10,11].

EAT and MF are known to contribute to diastolic dysfunction in the heart, with EAT having been also reported to significantly increase the risk of postoperative Af [4]. Additionally, both EAT and MF make it more difficult to secure the surgical field in CABG. In the reported case, it is possible that the reduction in EAT and MF brought about by the MBS contributed to reducing the risks associated with the patient's later surgery, such as the development of postoperative Af, and to improving the therapeutic effect of CABG.

Patients with severe obesity often have multiple ORDs, which increase surgical risk. For instance, in case of CABG, patients with diabetes have a mortality rate that is twice as high as that of patients without diabetes, both within 30 days and from 30 days to 2 years [12].

Additionally, obesity-related kidney disease can lead to chronic kidney disease, which influences the early and long-term outcomes of revascularization. The preoperative estimated glomerular filtration rate in case of CABG is closely associated with perioperative mortality [13]. Performing MBS prior to CABG is considered a strategy that, in addition to reducing the perioperative risks, may also improve ORD in the long term and extend patient's life prognosis.

An "obesity paradox," in which overweight or mildly obese patients demonstrate better outcomes after cardiovascular surgery, has been reported. Previous studies suggest that the obesity paradox is mainly observed in patients who are overweight or have mild obesity, whereas its applicability to patients with severe obesity remains controversial. Furthermore, many of these findings are derived from observational studies and may be influenced by confounding factors such as age, comorbidities, sarcopenia, smoking status, and selection bias. Therefore, excessive generalization of the obesity paradox to all obese populations should be avoided.

Studies comparing cardiovascular outcomes after MBS and GLP-1 receptor agonists in patients with obesity have demonstrated that MBS is associated with a significantly lower risk of cardiovascular adverse events, including coronary artery disease. Based on these findings, MBS

was considered an appropriate treatment option in the present case [14].

Reports concerning two-stage cardiovascular surgery following MBS are shown in Table 2. Severe obesity has been found to be a high-risk factor in heart transplant surgery. For example, in the United States, a BMI of 36 kg/m² or higher is considered a relative contraindication for such surgery, which is why three cases of MBS performed prior to heart transplant surgery have been reported [15]. However, while such cases exist, there remain few reports of MBS being performed prior to cardiovascular surgery. The four cases included in the table, namely, the three mentioned above and the case reported here, all underwent second-stage surgery without postoperative mortality.

While MBS prior to cardiovascular surgery is considered useful, malignant diseases and cardiovascular surgeries may cause a delay in the timing of such surgery due to the progression or deterioration of the underlying illness, making it necessary to carefully consider the required waiting period. At our facility, preoperative cardiac evaluation is mandatory, and cases discovered during the pre-MBS assessment, such as the reported one, are considered good candidates. However, such cases are limited. In general, the effects of MBS are reported to become clear at approximately 6 months postoperatively, and this time point may be considered one practical benchmark when planning second stage surgery, however, the status of the underlying disease varies among patients and therefore the timing should be individualized [16]. Moreover, for planned CABG, it is important to discuss the patient's condition and the reduction in the surgical risks that can be achieved via MBS with the cardiology and cardiovascular surgery teams, which this ultimately leads to second-stage surgery. Additionally, in LSG, the right gastroepiploic artery is divided, which may result in limitations in terms of the graft selection for CABG, presenting a disadvantage. Moving forward, it will be necessary to accumulate more cases reports and further evaluate the indications for performing MBS prior to surgery.

Table 2. Cases of post-MBS second stage cardiovascular surgery

Age	Weight (kg)	BMI (kg/m ²)	%EWL	Second stage surgery	MBS procedure	Months after MBS	Outcomes
29	156→126	52→39	38	Heart transplant surgeries	LSG	17	28 months after transplant, doing well
43	127→109	43→36	32	Heart transplant surgeries	LSG	8	Died 101 months after transplant (chronic renal failure.)
56	147→94	42→29	77	Heart transplant surgeries	LRYGB	15	Died 9 months after transplant (cerebrovascular accident.)
53	118→106.5	42→35	37	CABG	LSG	6	16 months after CABG, doing well

LRYGB: laparoscopic Roux-en-Y gastric bypass

4. Conclusion

Here, we report on the case of a patient with severe obesity and severe coronary artery stenosis who underwent CABG following LSG. Reports of patients undergoing MBS prior to cardiovascular surgery are extremely rare, although the improvement of ORDs by means of MBS contributes to reducing the perioperative risks associated with such surgery, demonstrating

significant utility. However, it is necessary to accumulate more case reports favorable on MBS performed prior to surgery and to reach a consensus regarding the appropriate indications and waiting periods for such cases.

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