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Perioperative Nutritional Therapy in Bariatric Surgery: A Case Report

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ABSTRACT:

Background: Metabolic and bariatric surgery, such as laparoscopic sleeve gastrectomy (LSG), is effective for obese patients with type 2 diabetes mellitus (DM), proven to improve metabolic profiles, control hyperglycemia, and provide DM remission in 55-85% of patients, as well as reducing medication use and body weight (BW) within one year after surgery. **Case Report**: A 23-year-old female patient with grade II obesity (BMI 31.42 kg/m²), DM, and cholecystolithiasis underwent laparoscopic cholecystectomy and LSG. Perioperative clinical nutrition therapy was performed to support the success of the surgery, including BW management, a preoperative diet through the Enhanced Recovery After Surgery (ERAS) protocol, and a gradual postoperative diet from liquid consistency. Evaluation 5 days after surgery showed decreased BW, waist circumference, body fat mass, visceral fat, and HbA1C without complications. The patient was discharged on the 6th day and was advised to adopt a transitional diet, multivitamins, and calcium supplementation. The mechanism of LSG involves calorie restriction, early satiety due to decreased gastric volume, and faster gastric emptying time. **Conclusion**: Short-term perioperative LSG nutrition therapy aims to meet nutritional needs, support weight loss, and improve metabolic profiles, thus contributing to clinical success for patients with obesity, type 2 diabetes, and metabolic syndrome.

Keywords: Bariatric, laparoscopic sleeve gastrectomy, perioperative nutrition, weight loss, metabolic profile

ABSTRAK:

Latar Belakang: Bedah metabolik dan bariatrik, seperti laparascopic sleeve gastrectomy (LSG), efektif bagi pasien obesitas dengan diabetes mellitus (DM) tipe 2, terbukti memperbaiki profil metabolik, mengontrol hiperglikemia, dan memberikan remisi DM pada 55-85% pasien, serta menurunkan penggunaan obat-obatan dan berat badan (BW) dalam 1 tahun pasca operasi. **Laporan Kasus:** Pasien perempuan, 23 tahun, dengan obesitas grade II (IMT 31,42 kg/m²), DM, dan kolesistolithiasis menjalani laparoscopic cholecystectomy dan LSG. Terapi gizi klinis perioperatif dilakukan untuk menunjang keberhasilan operasi, meliputi manajemen BW, diet preoperatif melalui protokol Enhanced Recovery After Surgery (ERAS), serta diet pasca operasi yang bertahap dari konsistensi cair. Evaluasi 5 hari pasca operasi menunjukkan penurunan BW, lingkar pinggang, massa lemak tubuh, lemak viseral, serta HbA1C tanpa komplikasi. Pasien dipulangkan pada hari ke-6 dan dianjurkan diet peralihan serta suplementasi multivitamin dan kalsium. Mekanisme LSG melibatkan restriksi kalori, rasa cepat kenyang akibat penurunan volume lambung, serta waktu pengosongan lambung yang lebih cepat. **Kesimpulan:** Terapi gizi perioperatif LSG jangka pendek bertujuan memenuhi kebutuhan nutrisi, mendukung penurunan BW, serta perbaikan profil metabolik, sehingga berkontribusi pada keberhasilan klinis bagi pasien obesitas, DM tipe 2, dan sindroma metabolik.

Kata Kunci: Bariatrik, laparoscopic sleeve gastrectomy, gizi perioperatif, penurunan berat badan, profil metabolik

1. Introduction

Metabolic and bariatric surgery is currently an effective modality for obese patients with diabetes that has been shown to improve metabolic profile, control hyperglycemia, remission 55-85% Diabetes Mellitus (DM) type 2, reduce the use of medications, and lose weight (BW) more effectively in 1 year after surgery.[1,2] The recommended bariatric surgery procedure is laparoscopic sleeve gastrectomy (LSG). Perioperative clinical nutrition therapy is needed for the success of LSG.[3]

The quick effects of LSG are calorie restriction, a feeling of satiety quickly due to reduced gastric volume, and faster gastric emptying time. The therapeutic mechanism of LSG against obesity and diabetes is the role of glucoregulators of the gastrointestinal tract.[4] Short-term LSG perioperative nutrition therapy aims to provide a perioperative diet, prevent gastrointestinal complaints, meet macronutrient needs, micronutrients, and fluids, support decreased body weight, and improve the metabolic profile.[3]

Obesity and type 2 diabetes mellitus (DM) increasingly dominate the epidemic proportions and have evolved into one of the most severe health problems of the 21st century. DM type 2 is one of the fast-growing non-communicable diseases and reaches 300 million sufferers worldwide and is estimated to reach 450 million sufferers by 2030. In addition, obesity is the leading cause of death in the world, with an ever-increasing prevalence in adults and children. It results in adverse effects on health status and a significant increase in health burden. Obese individuals have 36% higher annual healthcare costs. Patients who are *obese* pay 42% more health costs than normal-weight (BW) individuals, while patients with diabetes pay twice as much health costs as patients without diabetes.[5–7]

Nonsurgical management of obesity and its comorbidities includes lifestyle changes (diet, exercise) and pharmacological interventions. Medical management can lower BMI by 5-10% but is not long-term. Type 2 DM is treated medically, including dietary restrictions, physical exercise, oral hypoglycemic drugs (OHO), and insulin injections. However, in the long term, patients' compliance with lifestyle improvements, medication, and insulin injections is relatively low. If nonsurgical management fails, patients with obesity-related morbidity and those who meet the criteria are advised to consider bariatric surgery. Bariatric surgery has recently been included in the most effective treatment modalities for the treatment of obesity and diabetes when compared to nonsurgical interventions.[3,8] Reports from the International Diabetes Federation (IDF) and other organizations, comprising 200 national diabetes associations from 160 countries, show that surgical interventions prevent progressive complications of diabetes and reduce spending on healthcare systems. [9] Clinical nutrition plays an essential role in multidisciplinary teams before and after bariatric surgery, such as lowering BW before and after surgery, preventing BW from rising and controlling glycemic status before and after surgery, and improving metabolic profiles.[3]

2. Case Report and Case Management

2.1 Case Report

Ms. L came with a state of class II obesity based on the Asia Pacific criteria (BMI 31.04 kg/m^2) with comorbidities of DM and *multiple cholecystolithiasis*. The patient was diagnosed with multiple cholecystolithiasis in April 2019 but only found out that he had DM when he was first treated at dr. Kariadi Semarang Hospital will undergo various examinations in June 2019. Ms. L also suffers from metabolic syndrome with ATP criteria in 2001, where 3 out of 5 criteria are met, namely waist circumference of the Asian population > 80 cm (110 cm), HDL < 50 mg/dl (37 mg/dl), and diabetes. Based on the IDF criteria in 2005, the same criteria were also met: an increase in LP and a decrease in HDL and diabetes.[10] Ms. L has been suffering from obesity since the 6th grade of elementary school. Where since junior high school, the patient has undergone various diets to lose weight, but nothing has succeeded, coupled with the new patient finding out that he has had DM and gallstones in the last few months. Mrs. L is planning to undergo bariatric surgery and removal of the gallbladder in July 2019.

Figure 1 shows two key components of the procedures performed on Ms. L during the laparoscopic sleeve gastrectomy (LSG) and cholecystectomy. Figure A **d**isplays Ms. L's stomach after being partially resected during the LSG procedure. The resected portion of the stomach is removed to significantly reduce its size, aiming to limit food intake and accelerate weight loss as part of the treatment for Grade II obesity**.** Figure B shows Ms. L's gallbladder, which was removed along with several visible gallstones. Cholecystectomy, or the removal of the gallbladder, was performed to treat cholelithiasis, a condition where gallstones form in the gallbladder and can cause pain and other health complications. Both procedures aim to improve the patient's quality of life by enhancing metabolic health and reducing the risks associated with obesity and gallstones.

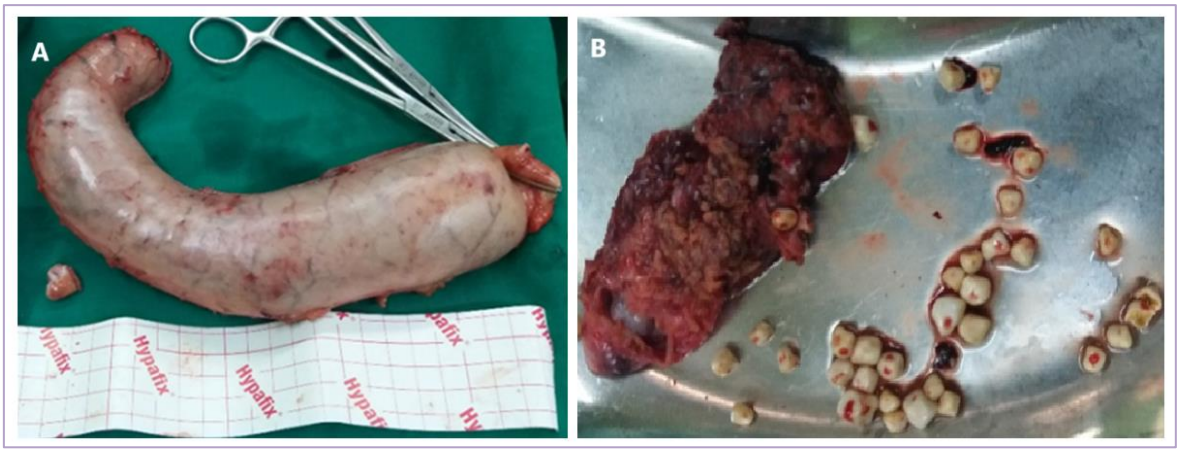

Figure 1. Laparoscopic sleeve gastrectomy (A) Ms. L's stomach was cut during LSG. (B) Ms. L's gallbladder and gallstones.

2.2 Case Management

2.2.1 Physical and Metabolic Parameters

In terms of long-term nutritional therapy, uncomplicated postoperative reduction in BMI is the primary goal of postoperative in obese patients. A situation with a small amount of nutrition can be considered to optimize body weight reduction. However, considering the risk of malnutrition, patients can tolerate energy reduction but still need enough protein to maintain *lean body mass.* A decrease in body weight of 0.23-0.45 kg/day or 18-45 kg within three months can be achieved postoperatively. This is based on a lack of less than 500-1000 kcal/day intake.[17] Some patients undergoing LSG can achieve the BW target within 1-2 years and maintain BW with an intake of around 1000-1200 kcal/day without increasing complications.[15,19,20] BW Nn. L experienced a significant decrease within six months after surgery. The initial weight was 83 kg, and the weight at the end of the monitoring was 68.65 kg.

Weight Loss

Weight loss (BW) Ms. L. after laparoscopic sleeve gastrectomy (LSG) surgery. On the 31st day (D+31) postoperatively, BW Nn. L experienced an increase of 0.8 kg, different from the previous downward trend. Some factors that may influence this increase include Patient non-adherence to dietary advice: Ms. L may not fully comply with the postoperative dietary guidelines that have been given, such as consuming foods that exceed calorie restrictions or choosing inappropriate types of foods. Different types of scales: Using different scales when measuring BW can lead to inconsistent results due to variations in accuracy between tools. Differences in body composition: In addition to fat, changes in muscle mass, body fluids, or other factors such as fluid retention can cause weight fluctuations, although there is a decrease in overall fat Mass.

Decrease in Body Mass Index

Decrease in Body Mass Index (BMI) of Mrs. L after undergoing laparoscopic sleeve gastrectomy (LSG) surgery. Nn. L's BMI decreased from 31.05 kg/m² (before surgery, classified as grade II obesity) to 25.68 kg/m² on the 161st day postoperatively. According to the Asia Pacific criteria, this decrease indicates that Ms. L's BMI has shifted from a grade II obesity group to a grade I obesity. With a significant reduction in BMI, patients are expected to experience improvements in various aspects of metabolic health associated with obesity, such as blood glucose control and the risk of metabolic syndrome-related complications. Although there was slight fluctuation on day 31, the general trend continued to show a steady decline, indicating a recovery and long-term effects of this bariatric procedure.

Laparoscopic sleeve gastrectomy (LSG) is essential in accelerating gastric emptying so food reaches the small intestine distal more quickly, as described in Figure 6. The procedure involves resectioning about 75% of the stomach, including the part where the hormone ghrelin is produced. Ghrelin is a hormone that stimulates appetite, so its level decreases after LSG, which contributes to a reduction in appetite and can maintain body weight (BW). The decrease in ghrelin production is caused by the reduced number of oxyntic cells in the stomach after the LSG procedure. This

mechanism significantly decreases calorie intake, leading to a progressive decrease in body weight after surgery. In addition, the metabolic changes that occur increase insulin sensitivity, which plays a role in regulating blood sugar levels and supporting diabetes control in obese patients with type 2 diabetes. The mechanism of LSG is not only limited to a reduction in gastric volume but also in hormonal changes, significantly a decrease in ghrelin, which results in a reduction of appetite and an overall improvement in metabolic profile. Thus, LSG is an effective solution in reducing long-term BMI and improving patients' metabolic health. [21]

Waist Circumference

Significant decrease in waist circumference (LP) of Nn. L for six months after laparoscopic sleeve gastrectomy (LSG) surgery. At the beginning of the measurement, Nn. L's waist circumference was recorded at 110 cm, and at the end of the monitoring, which was the 161st day after surgery, the waist circumference dropped to 80 cm. This decrease in LP reflects the positive impact of LSG surgery in reducing visceral fat, which is closely related to the risk of metabolic diseases, such as type 2 diabetes mellitus and cardiovascular disease. Reduced visceral fat is also associated with increased insulin sensitivity and a reduced risk of metabolic complications. The success of this decrease in LP can be justified by the mechanism of action of LSG, which reduces gastric volume and affects appetite-regulating hormones, such as ghrelin so that patients experience a decrease in calorie intake. In the long run, this reduces overall body fat, including in the abdominal area. A reduction in waist circumference by 30 cm within six months indicates the success of bariatric therapy in obese patients.

Excess Weight Loss

Percentage of Excess Weight Loss (%EWL) of Nn. L patients in 6 months after laparoscopic sleeve gastrectomy (LSG) surgery. %EWL is one of the critical parameters for assessing the success of bariatric surgery by calculating the percentage of excess weight that has been successfully reduced. Based on the data in the figure, the patient's %EWL increased gradually: 37.1% in the first month, 74.5% in the third month, and 88.74% in the sixth month postoperatively. Bariatric surgery success is generally defined as an EWL of over 50% in individuals under 40 with an initial BMI below 50 kg/m². Based on the theory, the average %EWL after LSG is 18-30% in the first month, 37-41% in the third month, and 54-61% in the sixth month. In Mrs. L's case, the results exceeded the average target with an EWL of 88.74% in the sixth month. This shows that the LSG surgery performed on Ms. L was very successful, with significant weight loss and following theoretical predictions. [19,20] This success reflects the effectiveness of LSG in significantly reducing excess weight, which is supported by patients' adherence to dietary programs and postoperative lifestyle changes.

Glucose Ad Random Parameters

Changes in Glucose Ad Random (GAR) of Nn. L patients at several time points, before and after laparoscopic sleeve gastrectomy (LSG) surgery. At one month of preoperative, the patient's GDS was recorded to be very high, at 273 mg/dl, which indicates uncontrolled hyperglycemia. After the patient received insulin and oral hypoglycemic medication (OHO), the GAR dropped significantly to 93 mg/dl three days before surgery (preoperative H-3), indicating an improvement in blood glucose control. After surgery, GAR improved, with the lowest value recorded at 70 mg/dl on the 3rd day after LSG. On the 31st day postoperatively, although there was a slight increase to 120 mg/dl, this was still within the standard limit. In response, the medical team decided to stop giving OHO because the patient's glucose control was judged to be quite good without the help of medication. On the 161st monitoring day, the patient's GAR was at 102 mg/dl, which is still considered normal. Overall, this figure shows a significant improvement in patients' blood glucose control after LSG surgery, which not only aids in weight loss but also improves metabolic status, particularly regarding type 2 diabetes control.

Changes in Prandial Blood Sugar (GDP) and Post Prandial 2-Hour Blood Sugar (GD2PP) before and after laparoscopic sleeve gastrectomy (LSG) surgery showed significant improvements in blood sugar control. In the first month before surgery, GDP was recorded at 130 mg/dL, and GD2PP reached 150 mg/dl, indicating high blood sugar levels, especially after meals. However, on the 5th-day post-LSG, there was a drastic decrease, with GDP dropping to 90 mg/dl and GD2PP to 80 mg/dl, showing a significant improvement in blood sugar control. On the 31st day postoperatively, GDP increased slightly to 103 mg/dl and GD2PP to 140 mg/dl. Although there was

a slight improvement, these two values were still better than blood sugar levels before surgery. In conclusion, LSG surgery effectively lowered blood sugar in the early postoperative phase. Although there was a slight improvement the following month, the patient's blood sugar control was still better than the preoperative condition.

HbA1C

Before surgery, the patient's HbA1C was recorded to be very high, at 9.8%, indicating poor blood sugar control and uncontrolled hyperglycemia. However, just five days after surgery, HbA1C levels dropped to 8.1%, indicating an early improvement in glycemic control. On the 31st day postoperatively, the patient's HbA1C dropped further to 6.7%, close to the standard value for diabetic patients, which is below 7%. This decrease indicates that LSG surgery is effective in weight loss and improving type 2 diabetes control. This improvement is likely due to decreased insulin resistance, reduced calorie intake, and changes in hormones such as ghrelin that regulate appetite. With a lower HbA1C, the risk of diabetes complications such as cardiovascular disease and organ damage can be minimized, making LSG an effective solution for managing obesity and type 2 diabetes simultaneously.

HbA1C is showing improvement over time. Another parameter is HOMA-IR, where HOMA IR has improved, whereas, on D+5 after LSG, it was 2.0 and became 0.6 on D+62 after LSG. Based on objective criteria, diabetes in Mrs. L has improved but has not yet been remissioned, where there has been a decrease in GDP, but HbA1C has not met the remission criteria. It's good follow-up continued for up to 5 years, considering that this criterion is used to *follow up* for a Minimum of 3 years.[22] In fact, each piece of literature defines diabetes improvement differently. The target of therapy based on Perkeni is HbA1C <7%.[23] The LSG mechanism accelerates gastric emptying so food reaches the small intestine distal faster. Sugar levels will rise rapidly, peaking quickly and then falling due to increased GLP1 and insulin response. On the other hand, the hormone ghrelin will decrease. Ghrelin has obesogenic and diabetogenic properties.[4]

2.2.2. Fat Parameter

Changes in the patient's total cholesterol levels before and after laparoscopic sleeve gastrectomy (LSG) show a notable improvement. One month before surgery, the patient's total cholesterol level was 125 mg/dl, within the normal range. However, one day before surgery, the cholesterol level slightly increased to 133 mg/dl. After the surgery, by day 31, the cholesterol level had decreased to 131 mg/dl, indicating stability in the postoperative phase. By day 105, a further decrease to 129 mg/dl was observed, and on day 161, the cholesterol level dropped more significantly to 120 mg/dl. This downward trend highlights the long-term positive effects of LSG on the patient's lipid profile, suggesting that the surgery not only aids in weight loss but also contributes to improving metabolic health, particularly cholesterol management.

Regarding the patient's triglyceride levels, one month before surgery, the triglyceride level was 81 mg/dl, which is within normal limits. One day before surgery, the level rose slightly to 82 mg/dl but remained within a healthy range. By day 31, after surgery, the triglyceride level increased to 97 mg/dl, and by day 105, it reached 127 mg/dl. This triglyceride increase could be attributed to dietary or metabolic changes following the surgery. Although these levels remain within tolerable limits, regular monitoring is essential to prevent the risk of dyslipidemia or other metabolic disorders.

As for HDL (High-Density Lipoprotein), the patient's levels before surgery were 37 mg/dl, considered low and suboptimal for heart protection. One day before surgery, the HDL level rose slightly to 39 mg/dl. However, by day 31 postoperatively, the HDL level dropped to 35 mg/dl; by day 105, it further decreased to 31 mg/dl. This decline suggests that while LSG is effective for weight loss, it may lead to undesirable changes in lipid profiles, especially concerning HDL levels. Since HDL is "good cholesterol" that helps protect against cardiovascular diseases, the low levels post-surgery are concerning and highlight the need for further lifestyle or nutritional interventions to improve HDL levels.

In terms of LDL (Low-Density Lipoprotein), the patient's LDL level was 76 mg/dl one month before surgery, which is within the normal range. One day before surgery, the LDL level slightly decreased to 73 mg/dl. However, the LDL level increased by day 31 after surgery to 82 mg/dl. Despite this rise, by day 105, the LDL level had dropped to 77 mg/dl, nearing the initial pre-surgery

level. LDL is known as "bad cholesterol," which can increase the risk of heart disease if elevated. Although there were minor fluctuations, the patient's overall LDL levels remained within a safe range, posing no significant cardiovascular risk. Nevertheless, continuous monitoring is necessary to ensure LDL levels stay within optimal limits.

2.2.3. *Bioelectrical Impedance Analysis* of Body Parameters

Table 1 shows the changes in the patient's body composition before and after undergoing laparoscopic sleeve gastrectomy (LSG), which was analyzed using Bioelectrical Impedance Analysis (BIA). The patient's weight decreased significantly from 83 kg to 68.65 kg on the 161st day postoperatively. The Body Mass Index (BMI) also reduced from 31.05 kg/m² to 25.68 kg/m², and the waist circumference decreased from 110 cm to 80 cm, indicating a substantial decrease in visceral fat. Fat Mass decreased from 37.28 kg to 26.54 kg, while Fat Mass Index (FMI) also reduced from 13.9 kg/m² to 9.9 kg/m².

Initially, the fat-free Mass decreased from 45.72 kg to 39.72 kg. Still, it began to recover to 42.11 kg by day 161, indicating a recovery of fat-free Mass after an initial period of decline. Skeletal Muscle Mass tends to decrease, from 20.6 kg to 15.77 kg, because the patient only starts exercising after four months postoperatively. Visceral fat (VAT) dropped significantly from 3.4 L to 1.1 L, indicating a reduced risk associated with visceral obesity. The percentage of total body water (TBW) and extracellular water (ECW) fluctuated, with TBW reaching 43.6% and ECW reaching 22.2% on day 161. The phase angle, an indicator of cellular health, dropped from 5.00 to 3.3, signaling postoperative metabolic changes. Overall, LSG surgery significantly lowered fat Mass, while fat-free Mass began to recover in the postoperative period.

Table 1. Bioelectrical Impedance Analysis (BIA) of changes in the patient's body composition before and after laparoscopic sleeve gastrectomy (LSG)

Variables analyzed	Pre-operation (Days)		Postoperative (Days)					
	2 weeks	D-1	D+5	D+11	D+31	D+62	D+ 105	D+161
BW, kg	83	82	80,5	76.2	77	73.45	70.95	68.65
IMT, kg/m2	31.05	30.67	30.11	28.5	28.8	27.48	26.54	25.68
WC, cm	110	103	102	98	90	87	85	80
FFM, kg	45.72	46.68	47.31	39.72	40.79	40.33	41,95	42.11
FFMI, kg/m2	17.1	17.4	17.7	14.9	15.3	15.1	15.7	15.8
Fat Mass, kg	37.28	35.52	33.19	36.48	36.21	33.12	29	26.54
Fat Mass Index, kg/m2	13.9	13.3	12.4	13.6	13.5	12.4	10.8	9.9
Skeletal Muscle Mass, kg	20.6	20.8	20.5	17.6	16.8	15.9	15.99	15.77
TBW, %	41.5	42.5	44.3	39	40.2	39.3	42	43.6
ECW, %	19.8	19.8	21.3	17.9	20.3	19.5	21.3	22.2
ECW/TBW, %	47.9	46.6	48.1	45.8	50.4	49.7	50.7	50.9
Phase angle	5,00	5,50	4.8	5.4	4	3.6	3.4	3.3
VAT, L	3.4	2.7	2.4	2.6	1.6	1.8	1.5	1.1

BW = body weight; BMI = body mass index; LP = waist circumference, FFM = fat-free mass; FFMI = fat-free mass index; SMM = skeletal muscle mass; VAT = visceral adipose tissuel ECW/TBW= ratio of Extracellular Water to Total Body Water

2.2.4. Complications, allergies, drug-food interactions

Common complications that can occur after a laparoscopic sleeve gastrectomy (LSG) procedure include bleeding, stenosis of the gaster outlet, leakage, and gastroesophageal reflux disease (GERD). However, in Nn. L's patients, no complications were reported during the recovery period. In addition, the patient did not experience any allergic reactions, drug interactions, or foods that could interfere with their recovery process, indicating the procedure's success without significant side effects.

Regarding physical activity, the patient's mobility after LSG went well. On the third day after surgery, Ms. L was able to sit down and showed significant progress because when it was time to discharge, the patient could walk independently without assistance. This indicates a rapid recovery of mobility after surgery. Even so, in the second month after LSG, patients are advised to start exercising by walking. However, Ms. L's adherence to physical activity is relatively low during this period, which may impact long-term weight loss and fitness outcomes. The patient only started to return to exercise in the fourth month after LSG. This delay in starting physical activity can affect muscle recovery and overall fitness. Consistency in physical activity, such as light exercise, is vital to support the long-term success of these bariatric procedures, including increased muscle mass, metabolic recovery, and prevention of postoperative complications.

2.2.5. Prognosis

Mortality after bariatric surgery is relatively low, with an incidence of < 1% perioperative mortality. Similar to other surgical procedures, patient selection is essential to minimize risks and optimize post-surgical outcomes. Risk factors for death include men, super obesity (BMI ≥50 kg/m^2) and diabetes. In this, the patient has a prognosis *ad vitam ad bonam* because The condition does not threaten the patient's survival, and the patient is clinically improving. This patient has a prognosis *ad vitam* because LSG significantly reduces fasting plasma glucose, HbA1C, and BW in type 2 DM patients.[1] The decrease in BW in LSG was 61.5% in 2 years after LSG.[15] Failure to reduce body weight after surgery is multifactorial and involves psychological factors, poor lifestyle, eating disorders, and support from family or others.[24] In the ad function, the patient has a prognosis of Dubia AD Vitim because the stomach functions functionally, and only a decrease in restriction capacity is experienced due to LSG.

3. Discussion

Metabolic and bariatric surgery is currently an effective modality for obese patients with diabetes that has been shown to improve metabolic profile, control hyperglycemia, lower drug use, and lower BMI, and thus reduce the complications caused by this metabolic syndrome.[11–13] The currently recommended bariatric surgery procedure is LSG. Ms. L meets the indications of bariatric surgery, and there are no contraindications to LSG for this patient. For patients with a BMI of 30-35 kg/m^2 who cannot achieve a decrease in BW and cannot achieve a comorbidity improvement with nonsurgical methods, bariatric surgery is the right choice. Comorbidities in these patients are type 2 DM and, multiple cholecystolithiasis and metabolic syndrome.[14] Contraindications to LSG include severe mental disorders, severe mental retardation, severe GERD, severe inflammation of the esophagus or gastric tract or ulcers located in the minor curvature, active cancer, and pregnancy.[15] After expressing consent, informed consent patients undergoing LSG and cholecystectomy on July 29, 2019.

LSG is a bariatric surgery in which 60-80% of the stomach is removed longitudinally, causing the stomach to become smaller and shaped like a sleeve, as shown in Figure 1. The mechanism of LSG in reducing BW is the restriction of the gaster, where the capacity of the gaster shrinks to 300 ml, and the presence of several neurohormonal changes, such as low ghrelin levels as a consequence of the loss or reduction of the gaster fundus when LSG is performed. Perioperative nutrition therapy plays an essential role in LSG patients. Nutritional treatment is provided by Clinical Nutrition Specialists who are involved in a multidisciplinary team consisting of Digestive Consultant Surgeons, Anesthesiologists, Internal Medicine Specialists, Metabolic Endocrine Consultants, Heart and Blood Vessel Specialists, Pulmonary Specialists, Clinical Nutrition Specialists, Mental Health Specialists, Physical Medicine and Rehabilitation Specialists. Perioperative nutrition therapy includes preoperative nutrition therapy, short-term nutritional therapy after bariatric surgery, and long-term nutritional therapy after bariatric surgery. Patients should make a routine schedule for *follow up* Usually 1-2 weeks after surgery, in months 1,2,3, 6, and 9 postoperatively, and then annually.[3,15]

Preoperative nutrition therapy includes nutritional evaluation, management of preoperative BW, and carbohydrate *Loading*. In May 2019, Mr. L was first examined in the eagle ward 2A. From the results of the interview and a complete physical examination, Nn L was diagnosed with obesity *Grade* II, DM, and *multiple cholecystolithiasis*. Obesity patients suffer from childhood. From the surgical Ts, the patient is advised to undergo LSG. Patients and families were given a detailed explanation of obesity, LSG, and the existing risks. Micronutrient deficiencies are widespread in obese patients, even before bariatric surgery is performed. This is caused by excess calories consumed but low in nutrients.[3,15] In this patient, no micronutrient examination is performed.

The patient decided to go home first because he would undergo a thesis hearing and return to undergo hospitalization on July 27, 2019. A nutritional assessment was carried out on July 28, 2019, and then an LSG was carried out the next day on July 29, 2019. When at home, Ms. was given a diet menu for 14 days and controlled every day. Ideally, patients are given a low-fat, low-calorie diet. The pre-bariatric diet gives the patient 1500 kcal/80 g of protein in solid/regular food. The calories given are gradually reduced until the D-1 day when the patient gets liquid food or a completely liquid diet. Patients are also helped to change their lifestyle. Preoperative BW management aims to accelerate the decline in BW and reduce liver volume in patients with

hepatomegaly or abundant central adipose tissue that interferes with the operator's field of vision. When she was about to undergo surgery the next day, Mrs. L was also given *loading* carbohydrates according to ERAS. *Loading* KH will minimize postoperative insulin resistance and hyperglycemia, protein loss, FFM, and muscle function and reduce anxiety and postoperative nausea and vomiting.[15,16]

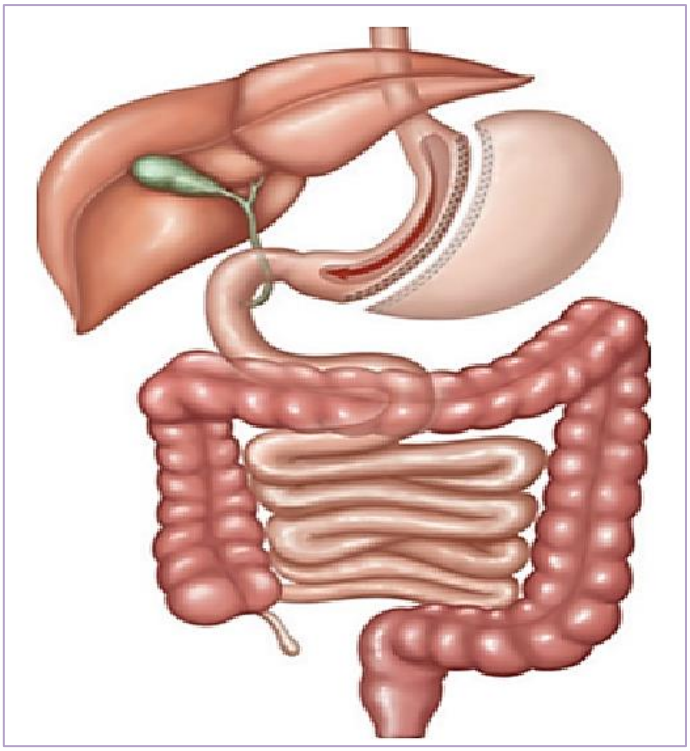

Figure 2. Sleeve-like hull shape on LSG [15]

Short-term nutritional therapy after bariatric surgery includes postoperative diet stages, improving eating behavior, and nutritional therapy related to common gastrointestinal symptoms. Purpose of nutritional treatment after bariatric surgery in people *obese* In contrast to non-obese. Several things need to be avoided, such as overfeeding and its harmful effects such as increased CO2 production, which will increase respiration effort, and lipogenesis, which will increase hepatic dysfunction and insulin resistance. In addition, maintaining lean body mass And speeding up healing is also essential so patients do not fall into malnutrition. ASPEN guidelines recommend nutritional therapy starting with hypokalemic and high protein levels for patients with obesity and critical illness, assuming normal kidney and liver function to prevent overfeeding, hyperglycemia, and protein catabolism. [3,17]

Nutritional therapy should be started when the patient cannot meet oral intake adequately or intake is predicted to be inadequate within 7-14 days or 5-7 days in the ICU. The risk of malnutrition is screened using validated methods such as NRS 2002 or NRI.[18] Mrs. L was still examined using SGA. Hipokaloric feeding is recommended to start from 50-70% of the energy requirement. The calorie requirement is 11-14 kcal/kg BW or 22-25 kg/BWI. The recommended postoperative protein requirement is 60-80 g/day or 1-1.5 g/kgBWI/day. Postoperative diet recommendations are based on the gradual development of consistency and texture over 1-2 months. Patients are given *clear liquid* 24-48 hours postoperative, gradually increasing the food's volume, type, and consistency. In addition, patients are required to drink small portions according to tolerance. [3,17–19]

The oral route remains the first line of nutritional therapy. *Enteral nutrition* (EN) is still given if the need for it through the oral cannot be met because it stimulates the gastrointestinal tract, and the physiological effects obtained resemble the physiological effects through the oral. *Parenteral nutrition* (PN) should only be used when the patient has a dysfunctional gastrointestinal tract or an unusable enteral tract, such as severe nausea and vomiting, severe diarrhea, or poor enteral tolerance.[18] Mrs. L can use the oral route during postoperative care at the hospital.

On the first day after LSG, Mrs. L was given water 6 hours post-surgery, and the first two days were given clear soup without solid/soft foods, juice without sugar, or mung bean juice. On the 3rd day, a menu is in the shape of a thick liquid, like steamed eggs. Patients are added liquid foods such as milk, soy milk, or yogurt postoperative on days 3-7 in small amounts according to the remaining gastric capacity. The stomach taken at Nn L is about 75%, so the gastric capacity is only about 75 ml, as seen in Figure 2**.** In addition, the selection of foods that reduce gastrointestinal symptoms is also a concern.[15]

Protein is essential for maintaining lean body mass and achieving a positive nitrogen balance after a rapid decrease in body weight due to a rapid drop in fat Mass. The quality of the protein source is also essential, especially the quantity of leucine, which helps maintain muscle tissue. Some food sources rich in leucine levels are soy products, eggs, meat, nuts, and cheese. Protein supplements are recommended until the patient can consume protein sources as per daily needs. If protein supplements are needed, the best option is protein *Whey*.[3,17–19] Mrs. L does not need protein supplements because until she returns home, she has managed to consume protein according to the guidelines. The recommended carbohydrate is 130 g/day to maintain adequate glucose for the central nervous system (CNS). Avoid simple carbohydrates as they will cause *dumping syndrome*. After surgery, patients are instructed to follow a low-fat diet and calorie restriction. The maximum allowable fat requirement is 20 g/day. The recommended types of fats are unsaturated fats and essential fatty acids. [3,15,18] Mrs. L is given complex carbohydrates and a good source of fat.

Mrs. L was allowed to go home on the 5th day until she was finally given a regular diet in stages according to the tolerance of quantity and texture. In weeks 1-2 postoperative, patients are advised to switch to pureed foods. After two weeks of postoperative, patients can add soft foods to their diet, such as meatballs, omelets or hard-boiled eggs, soft fruits that have been peeled, and biscuits. After one month postoperative, the patient can change the diet to solid foods such as legumes or nuts, fresh vegetables, fresh fruit, and bread. After two months of postoperative, patients can consume regular solid foods because solid foods can accelerate greater satiety and are rich in nutritional composition.[16,18] Entering the 3rd month after LSG, the patient has started to try to eat normally, but the number of calories is adjusted to the calories needed. Food remains perfectly chewed.

Fluid requirements are calculated based on several formulas that mostly match calorie needs to prevent dehydration. After bariatric surgery, patients are at risk of intake-related dehydration, vomiting, or diarrhea. Pasen is recommended to drink 30 minutes after meals to avoid gastrointestinal upset and leave room for food.[18] Mrs. L had been dehydrated on the 7th day after LSG. The patient entered the emergency room complaining of dizziness and had time to go to the outpatient clinic. The tension dropped by 50/could not be read. Clinically in the emergency room, the patient is conscious and cheerful, and dizziness is reduced. The patient admitted to drinking less.

Patients undergoing LSG are at high risk of developing nutrient deficiencies due to several reasons, such as insufficient intake, reduced HCL and intrinsic factors, nausea and vomiting after LSG, and avoiding food due to intolerance. Therefore, LSG patients are recommended to take micronutrient supplements to prevent deficiency.[15] Mrs. L was given a multivitamin and mineral in a chewable preparation on the 4th day before returning from the hospital. His clinical condition was good when he returned home, and there were no gastrointestinal complaints. Wound healing looks good, but delayed wound healing is absent.

4. Conclusion

This study shows the laparoscopic sleeve gastrectomy (LSG) procedure in Nn. L patients are significantly successful in weight loss, reduced fat Mass, and improved body composition and metabolic profile. The patient's body weight dropped from 83 kg to 68.65 kg in 6 months, accompanied by a decrease in Body Mass Index (BMI) and waist circumference, which showed a reduction in visceral fat. In addition, the patient's total blood sugar and cholesterol levels improved, including a decrease in HbA1C and the stability of the lipid profile. The patient did not experience serious complications such as bleeding, gaster outlet stenosis, leakage, or GERD, and recovery to mobility went well. Although adherence to physical activity was initially low, patients began exercising again postoperatively in the fourth month, which is expected to support long-term fitness and recovery. Overall, LSG is effective in weight loss and improving metabolic health parameters in obese patients, with positive outcomes in fat loss, diabetes control, and cardiovascular health. At the same time, postoperative physical activity is an essential factor for long-term success.

5. Conflict of Interest

There were no reported conflicts of interest that are pertinent to this article.

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Authors Contribution

Contribution	Amelia FD	Cristianto F
Concepts or ideas	√	
Design	√	
Definition of intellectual content	√	√
Literature search	√	
Experimental studies	√	√
Data acquisition	√	
Data analysis	√	√
Statistical analysis		
Manuscript preparation	√	√
Manuscript editing	√	
Manuscript review	√	√

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