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Laparoscopic gastric sleeve resection for metabolic syndrome (MS) with obstructive sleep apnea-hypopnea syndrome (OSAHS): Report of two cases

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Abbreviations: LGSR: Laparoscopic Gastric Sleeve Resection; OSAHS: Obstructive Sleep Apnea-Hypopnea Syndrome; AN: Acanthosis Nigricans; BMI: Body Mass Index; AHI: Apnea-Hypopnea Index; RDW: Red Blood Cell Distribution Width; FBG: Fast Blood Glucose; CR: C-Reactive Protein; MS: Metabolic Syndrome; DM: Diabetes Mellitus; DM2: Type 2 Diabetes Mellitus; PBG: Postprandial Blood Glucose; HDL: High Density Lipoprotein; γ-GT: γ-Glutamyl-Transferase; AKT: Alkaline Phosphatase; MBP: Mean Blood Pressure; ESR: Erythrocyte Sedimentation Rate; PRL: Prolactin; GIP: Gastric Inhibitory Peptide; GLP-1: Glucagon-Like Peptide-1; Ghrelin: Gastric Hormone Regulating Peptide; PYY: Peptide YY; ESR: Erythrocyte Sedimentation Rate; PCOS: Polycystic Ovarian Syndrome; MOSH: Male Obesity associated Secondary Hypogonadism; RYGB: Roux-En-Y Gastric Bypass.

Abstract

To evaluate the therapeutic efficacy of Laparoscopic Gastric Sleeve Resection (LGSR) for patients with metabolic syndrome and Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS). Two patients with metabolic syndrome and OSAHS received LGSR in our hospital in 2015 and were postoperatively followed up for 3 months to observe relief of the symptoms of Acanthosis Nigricans (AN) and snoring, and changes in metabolism-associated parameters, endocrine hormones and inflammatory factors. The results of 3-month postoperative follow-up observations showed that body weight was reduced and the associated symptoms of AN and snoring were relieved significantly in both patients. Body Mass Index (BMI) and neck and abdominal circumferences were also decreased significantly. Metabolism-related biochemical parameters, inflammatory factors and endocrine hormones including Apnea-Hypopnea Index (AHI), Red Blood Cell Distribution Width (RDW), Fast Blood Glucose (FBG), blood insulin, C-Reactive Protein (CRP), mean blood pressure and sex hormones all underwent favorable changes in both patients. The clinical outcome of the two patients in our series demonstrates that LGSR is a viable option for the treatment of patients with metabolic syndrome and OSAHS in that it can relieve the snoring symptoms of sleep apnea, improve lipid and glucose metabolisms and endocrine hormone levels in obese patients, and attenuate their chronic inflammation.

Keywords: laparoscopic gastric sleeve resection; obstructive sleep apnea-hypopnea syndrome (OSAHS); inflammation; sex hormone.

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Introduction

Metabolic Syndrome (MS) is a group of comprehensive diseases characterized by abdominal obesity or central obesity, hypertension, dyslipidemia, diabetes or abnormal glucose tolerance, and insulin resistance. MS is considered as a risk factor for Diabetes Mellitus (DM) and cardio-cerebrovascular diseases. It is currently believed that the common cause of all these diseases is insulin resistance and hyperinsulinemia caused by obesity, especially central obesity. 15 years ago, China's MS prevalence rate was 14%-18%, according to WHO standards. Most patients receive medication, and for the complications of MS, OSAHS, lack of effective treatments, leading to a vicious circle between hypoxia and MS. Now, in China and even around the world, the incidence of MS has increased. Obstructive Sleep Apnea-Hypopnea Syndrome (OHASH) is a clinical syndrome of complete or partial obstruction of the upper airway during sleep, resulting in repeated hypoventilation and/or interruption of breathing, causing intermittent hypoxemia with hypercapnia and disorder of the sleep structure, which leads to a series of pathophysiological changes. Most OHASH patients are obese or overweighed, with varying degrees of anatomical stenosis of the upper respiratory tract including the nasopharyngeal portion. The incidence of OHASH is also related to the reduced reactivity of the respiratory system, and neurological, humoral and endocrine factors as well. The morbidity of OSAHS is 2-4% in the general population [1] versus 42-48% in obese men and 8-38% in obese women [2]. Laparoscopic Gastric Sleeve Resection (LGSR) is defined as partial surgical resection of the stomach to reduce body weight by reducing the volume of the stomach and therefore the amount of food eaten. It is generally used for the treatment of obesity and obese DM2 patients. Obesity is the most important risk factor for OSAHS. An increase in body mass index (BMI) of 6 kg/m^2 increases the risk of OSAHS by 4 points [3], so weight loss therapy is recommended as the treatment of choice for obese patients with OSAHS [4]. Clinically, short-term weight loss can be achieved effectively through intensive lifestyle interventions including diet adjustment, physical activity, behavioral therapy, and drug weight-loss therapy, but the long-term outcome is usually unsatisfactory [5]. Weight loss surgery is a viable option to achieve a relatively stable and definitive weight loss effect and has been used for the treatment of obesity-associated comorbidities such as OSAHS [4].

Case presentation

Case 1 is a 43-year-old male patient and Case 2 is a 34-year-old female patient who received LGSR under general anesthesia in our center on November 16, 2015 and September 7, 2015 respectively. Informed consent was obtained from all individual participants included in the study.

Final diagnosis: Metabolic syndrome with obstructive sleep apnea-hypopnea syndrome.

Treament: Laparoscopic gastric sleeve resection.

Outcome and follow-up: Both patients were followed up for three months postoperatively, and the last follow-up checkup results showed that the male patient lost 35 Kg body weight and the female patient lost 25 Kg body weight after surgery. The symptoms of Acanthosis Nigricans (AN) and snoring were improved significantly in both patients. Changes in the other baseline data of the two OSAHS patients after surgery including the Body Mass Index (BMI), abdominal and neck circumferences, Apnea-Hypopnea Index (AHI), minimum SaO_2 and Red blood cell Distribution Width (RDW) are shown in Table 1.

Table 1: Changes in baseline data of the two OSAHS patients after surgery.

	BMI (kg/m^2)	Abdominal circumference (cm)	Neck circumference (cm)	AHI (times/h)	Minimum SaO_2 (%)	RDW (%)
Case report 1						
Preoperative	36.32	119	46	72	53	16.6
Postoperative	25.95	86	36	12	66	14.1
Case report 2						
Preoperative	43.75	131	48	86	48	17
Postoperative	33.56	100	40	16	60	15.3

Abbreviations: BMI: Body Mass Index; AHI: Apnea-Hypopnea Index; RDW: Red blood cell Distribution Width.

Table 2: Changes in metabolism-related biochemical data after surgery.

	FBG (mmol/L)	PBG (mmol/L)	Blood insulin (uU/ml)	C peptide (ng/ml)	HDL (mmol/L)	γ-GT (U/L)	AKT (U/L)	MBP (mmHg)
Case report 1								
Preoperative	7.6	13.8	42.62	4.62	0.93	22.7	78.2	168/92
Postoperative	5.0	6.2	36.84	4.25	1.07	9.8	59.3	136/86
Case report 2								
Preoperative	8.3	15.6	46.86	4.88	0.87	26.5	57.2	160/88
Postoperative	5.0	5.7	42.24	4.50	0.96	10.5	26.4	132/78

Abbreviations: FBG: Fasting Blood Glucose; PBG: Postprandial Blood Glucose; HDL: High Density Lipoprotein; γ -GT: γ -Glutamyl-Transferase; AKT: Alkaline Phosphatase; MBP: Mean Blood Pressure.

Table 3: Changes in inflammatory factor and endocrine hormone levels after surgery.

	ESR (mm/h)	CRP (mg/L)	IL-6 (pg/ml)	IL-8 (pg/ml)	Estradiol (pmol/L)	Testosterone (nmol/L)	Progesterone (nmol/L)	PRL (U/L)
Case report 1								
Preoperative	18	31.00	2.0	6.84	141.7	8.6	2.54	517.0
Postoperative	10	3.3	2.04	10.0	147.3	18.0	1.38	340.6
Case report 2								
Preoperative	42	11.9	3.39	14.6	96.91	0.44	0.41	651.3
Postoperative	54	11.8	3.51	16.8	130.30	1.01	0.82	672.7

Abbreviations: ESR: Erythrocyte Sedimentation Rate; CRP: C-Reactive Protein; IL: Interleukin; PRL: Prolactin.

Changes in metabolism-related biochemical parameters, inflammatory factors and endocrine hormones including Apnea-Hypopnea Index (AHI), minimum SaO_2, Fast Blood Glucose (FBG), Postprandial Blood Glucose (PBG), blood insulin, C peptide, High Density Lipoprotein (HDL), γ-Glutamyl-Transferase (γ-GT), Alkaline Phosphatase (AKT), Mean Blood Pressure (MBP), Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP), and Prolactin (PRL) are listed in Table 2 and 3.

Discussion

Weight loss surgery can improve both sleep and metabolic disorders. First, OSAHS is closely related to obesity [6]. Obese patients have increased abdominal fat and reduced abdominal space, which raises the diaphragm and reduces the lung capacity [7]. Patients with obesity and OSAHS have 42% more neck fat than average people, which can cause stenosis of the pharynx and increase the risk of OSAHS [8]. Weight loss surgery can improve the lung capacity, reduce neck fat, and increase the airway transverse diameter, thereby alleviating AHI [4]. The current study showed that the sleep quality and excessive daytime sleepiness of the two patients were improved remarkably even 6 months after LGSR [9]. As OSAHS responds early to gastric surgery, other weight independent factors may at least in part be responsible for early postoperative improvement in OSAHS. These data firmly support the inclusion of OSAHS as an indication for use of weight loss surgery for severely obese adolescents [10]. In addition, laparoscopic sleeve gastrectomy can improve lipid and carbohydrate metabolisms. At present, the intestinal-islet axis is the most widely accepted hypothesis for the mechanism underlying weight loss surgery for controlling blood sugar. It is believed that surgery induces changes in the secretion of various hormones in the gastrointestinal tract, including Gastric Inhibitory Peptide (GIP), Glucagon-Like Peptide-1 (GLP-1), Leptin, Gastric Hormone Regulating Peptide (Ghrelin), and Peptide YY (PYY), all of which can work together to reduce insulin resistance and improve blood sugar. In addition, surgery can also regulate the secretion of fat-adipokines [11]. OSAHS can also cause abnormalities in fat metabolism through the effect of chronic intermittent hypoxia and sleep fragmentation on the endocrine system, consisting of abnormal release of growth hormone and androgen, insulin resistance, impaired glucose tolerance, glucose metabolism disorders, and increased morbidity of DM2. The increased blood glucose concentration causes excessive energy to be converted into fat, resulting in elevated blood lipids; sympathetic nerve stimulation during sleep increases fat mobilization; daytime sleepiness plus obesity factors snubs the activity of the patient and therefore reduces energy expenditure, which increases the blood lipid level and body weight [12,13]. Therefore, LGSR can also improve metabolic disorders by improving sleep conditions.

The overall inflammatory index of the two patients in our series decreased markedly after surgery. Studies have shown that obesity/OSAHS is associated with inflammation [14]. Patients with OSAHS are often associated with the release of pro-inflammatory factors in their bodies [15], and may have elevated levels of IL-6, IL-8, ESR and serum CRP. Metabolic weight loss surgery can significantly reduce the release of these inflammatory factors [16], and significantly improve insulin resistance [17], there by achieving an anti-inflammatory state to relieve OSAHS.

Gender dimorphism is evident in obesity-related gonadal dysfunction [18]. Female obesity is often associated with Polycystic Ovarian Syndrome (PCOS) and hyperandrogenemia [19]. Male obesity is often associated with Male Obesity-Associated Secondary Hypogonadism (MOSH) and androgen deficiency [20]. Metabolic surgery can improve the hypothalamic pituitary-gonadal axis function in obese patients [20,21].

In addition, studies have shown that the gut microbiota composition undergoes significant changes after laparoscopic sleeve gastrectomy [22]. Zhang et al found that firmicute microflora was predominant in obese and normal-weight patients and decreased after Roux-En-Y Gastric Bypass (RYGB). Individuals after RYGB also had a large population of gammaproteobacteria, which were not found in them prior to surgery. It is possible that these altered microbiota populations could have a metabolic impact [23]. The mal-absorption status after bariatric surgery including changes in bile acid, gastric pH and hormones leads to gut microbiota changes [24]. Surgically induced alterations in gut microbial profiles are believed to be associated with weight loss and reduction in body fat mass. Surgically induced perturbations in the gut microbiota-brain interaction axis may play an important role as a mediator of the effect of bariatric surgery [22].

Conclusion

The clinical outcome of the two cases in our series indicates that LGSR has significant therapeutic efficacy for metabolic syndrome with OSAHS. However, the current weight loss metabolic surgery for obesity combined with OSAHS is still in its infancy and exploration stage in China, and no consensus guidelines and norms on obesity combined with OSAHS are available at present. Therefore, multidisciplinary collaborative treatment remains the main stay of treatment for metabolic syndrome or OSAHS.

Declarations

Ethics approval and informed consent: The trial has received ethics approval from the Ethics Committee of Shanghai 10th people's Hospital (SHSY-IEC-4.1/21-240/01). All participants provide full informed consent to participate in the trial.

All participants provide full informed consent to participate in the trial.

Consent for publication: Not applicable.

Data availability: Not applicable.

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Authors' contributions: CXS substantially contributed to the conception and design, ZQW wrote the manuscript, KS contributed to the acquisition of the data and made forms. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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