ORIGINAL ARTICLE

Carotid intima-media thickness and insulin resistance changes in patients who underwent sleeve gastrectomy: A prospective study

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Abstract

Objectives: Our aim was to examine changes in insulin resistance, Carotid Intima-Media Thickness (CIMT), in morbid obese patients without any known associated chronic diseases who underwent sleeve gastrectomy.

Materials and Methods: The subjects of this study were patients with minimum BMI of 40, who did not have any known chronic diseases. Sleeve gastrectomy was performed and perioperative control endoscopy was performed. The following values were measured before the operation and after follow-up period after the operation: Fasting blood glucose and insulin, lipid profile, BMI, liver function tests, right and left CIMT. Furthermore, the patients' insulin resistance was calculated by HOMA method, and the values of 2.7.

Participants: Six-teen patients (14 women and 2 men, average age: 39.12 ± 10.63 years), who did not have a known additional chronic disease, took part in the study.

Results: There was a significant difference between baseline and follow-up values of the patients, and the mean weight loss was 20.5%. Given the statistical evaluation of baseline and follow-up values, there was a significant difference in BMI, insulin resistance rates and right and left CIMT values.

Conclusions: Bariatric surgery may provide some additional advantages for the management of cardiovascular risks in obese patients. However, it should be kept in mind that the most important components of fight against obesity are appropriate diet and exercise programs.

Key words: Bariatric surgery, carotid intima-media thickness, morbid obese

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Introduction

Obesity is a multifactorial disease which is acknowledged to be a pandemic. For the treatment of this disease, various pharmacological, nonpharmacological, and surgical methods have been tried.[1-3] In obese patients, loss of weight is important since obesity poses certain health risks, including type 2 diabetes mellitus, hypertension, dyslipidemia, and

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coronary arterial disease. As body mass index (BMI) increases, the risk of mortality and morbidity increases.

In morbid obese patients, conservative methods such as dietary changes, pharmacological treatment, and modifications in lifestyle rarely produce considerable results and weight loss.[4] That is why, to ensure weight loss, the use of obesity surgery has increasingly become widespread in order to ensure healing in diseases associated with obesity and to reduce mortality in the long-term.[5,6]

Obesity surgery is particularly performed on patients with morbid obesity and/or patients with associated diseases such as diabetes, hypertension (HT) and hyperlipidemia, which cause serious cardiovascular diseases deteriorating quality of life and shortening lifetime. Laparoscopic sleeve gastrectomy is a bariatric surgical procedure which has widely been used because it is performed easily and produces good outcomes.[7]

Carotid intima-media thickness (CIMT), a measurement included in Framingham risk score, indicates the risk of cardiovascular diseases.[8] CIMT is a tool particularly used in the identification of asymptomatic atherosclerosis and determination of cardiovascular risk. It is a reliable, cost-effective, and widespread technique used to determine the risk of future cardiovascular disorders.

The purpose of this paper is to examine changes in insulin resistance, as measured by BMI, CIMT, cholesterol, and homeostatic model assessment insulin resistance (HOMA-IR) methods, in morbid obese patients without any known associated chronic diseases who underwent sleeve gastrectomy.

Materials and Methods

The subjects of this study were patients with minimum BMI of 40, who did not have any known chronic diseases. Bariatric surgical indications were planned according to obesity diagnosis and treatment guidelines of the Turkish Society of Endocrinology and Metabolism.[9] The study was designed in line with the principles in these guidelines. According to these guidelines, the indications of bariatric surgery are as follows:

- BMI >40 kg/m^2
- BMI >35 kg/m^2 and when comorbidities associated with obesity (e.g., type 2 diabetes, obstructive sleep apnea, and severe HT) cannot be controlled through the medical treatment and changes in lifestyl
- When nonsurgical methods were tried but failed.

According to the guidelines, the contraindications to bariatric surgery are as follows:

- Untreatable major depression and psychosis
- Drug and alcohol addiction
- Binge eating disorder
- Advanced heart failure
- Severe coagulopathy
- Lack of psychic and mental competence to carry out what is suggested for the postoperative period.

Sleeve gastrectomy is a type of partial gastrectomy where a large part of the curvature of the stomach is removed and after which the stomach takes the form of a tube. Procedure: Sleeve gastrectomy was performed, and perioperative control endoscopy was performed on patients to test whether there was any leakage. Mean time of operations was 115 min.

The age, gender, and educational status of the patients that consented to take part in the study were recorded. The following values were measured before the operation and after follow-up period after the operation, simultaneously: Fasting blood glucose and insulin, lipid profile, BMI, liver function tests, and right and left CIMT. Furthermore, the patients' insulin resistance was calculated by HOMA method, and the values of 2.7[10] and over were considered insulin resistance. CIMT measurement was performed by the same radiologist. The average period between follow-ups was 4.6 months (minimum 4 months, maximum 5 months).

This study was approved by a Local Ethical Committee according to the Helsinki Declaration. A written consent was obtained from the patients before the operation.

The patients underwent B-mode ultrasonography (Philips HD 12 Digital Ultrasound) for bilateral carotid Doppler ultrasound imaging with the linear probe by the same radiologist. The measurements, conducted at a stable ambient temperature and under appropriate conditions, were recorded in millimeters. CIMT was measured as follows: The intima-media thickness at proximal (1 cm proximal to bifurcation), middle (4 cm from bifurcation), and distal (the first 1 cm of bulbus) regions of the common carotid artery were measured, and the arithmetic mean of these three measurements was calculated. The measurements were performed in the existence of laminar flow in Doppler imaging, and careful attention was paid not to perform measurement in regions where large plaque and turbulent flow were detected. Measurements in right and left parts were recorded separately in the form of CIMT. The patients were examined by a dietician, a psychologist, and an anesthetist before the operation.

Statistical analysis

Continuous quantitative data are presented as *n*, mean and standard deviation, whereas qualitative data are presented as *n*, median and percentile values of 25 and 75. Paired *t*-test was used for the variables that consist of repeated measures and show normal distribution, and Wilcoxon signed-rank test was used for data sets that did not have a normal distribution. $P < 0.05$ are considered significant.

IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corporation was used for data analysis.

Results

It was initially planned to include 25 patients in this study. However, five patients decided not to have the operation, and four patients could not get approval from the Department of Anesthesia for the operation. Thus, 16 patients (14 women and 2 men, average age: 39.12 ± 10.63 years), who did not have a known additional chronic disease, took part in the study. There was a significant difference between baseline and follow-up values of the patients, and the mean weight loss was 20.5%. The average period of follow-up was 4.6 months. There was a significant decrease in weight in their follow-up compared to the baseline (117.188 ± 15.467 kg vs. 93.125 ± 18.554 kg, $P \leq 0.001$). Given the statistical evaluation of baseline and follow-u*P* values, there was a significant difference in BMI, alanine aminotransferase, HOMA-IR, and right and left CIMT values. With regard to BMI, 25th and 75th percentiles were taken into consideration, and they were significantly lower in the follow-up than the baseline (45.165 [42.22–50.54] vs. 34.560 [32.64–40.01]; $P < 0.001$). There was also a significant decrease in waist and hip measurements of the patients. There were six patients (37.5%) that were detected to have insulin resistance according to HOMA-IR value before the operation while only one patient (6.3%) had insulin resistance in the postoperative follow-up. The difference was significant ($P < 0.001$). With respect to lipid profiles of the patients, there was a significant decrease only in triglyceride values. Compared to the preoperative period, there was an insignificant decrease in low-density lipoprotein and total cholesterol values and an insignificant increase in high-density lipoprotein in the postoperative follow-up. [The findings are summarized in Table 1].

Table 1: Comparison of preoperative and postoperative results

	Preoperative baseline	Postoperative	*P*
Weight (kg)	117.19±15.47	93.12±18.55	<0.001
Waist (cm)	121.12±9.60	102.81±11.79	<0.001
Hip (cm)	138.31±11.52	121.87±12.54	<0.001
CIMT left (mm)	0.67±0.22	0.54±0.11	0.002
CIMT right (mm)	0.67±0.21	0.51±0.14	<0.001
HOMA-IR	2.45±1.30	1.43±0.88	<0.001
LDL (mg/dL)	209.12±48.71	131.44±37.70	0.844
Triglyceride (mg/dL)	153.00±61.05	114.25±25.40	0.008
HDL (mg/dL)	45.125±6.80	47.75±4.77	0.202
Total cholesterol (mg/dL)	209.12±48.71	201.56±39.44	0.409

CIMT=Carotid intima-media thickness; HOMA-IR=Homeostatic model assessment insulin resistance; LDL=Low density lipoprotein; HDL=High density lipoprotein

Discussion

Diet and exercise play an effective role in the treatment of obesity. However, surgery is also an option when drug therapies, diet, and exercise programs fail to provide desired results. Malabsorptive procedures are better than restrictive surgical techniques at ensuring expected results about weight loss; however, sleeve gastrectomy – a method where the stomach volume is reduced by resecting a large proportion of the stomach – has also proved to be as successful as gastric bypass surgery in ensuring weight loss.[11]

Sleeve gastrectomy is one of the surgeries used for reducing the volume of the stomach. After this operation, the rate of complications such as bleeding, organ injury, respiratory problems, and emboli, which are likely to occur as a result of all laparoscopic surgeries is quite low.[12] Furthermore, the reduced secretion of ghrelin after sleeve gastrectomy is also known to play a role in the loss of appetite. Additionally, the increased response to peptide YY after sleeve gastrectomy is effective in reducing appetite.[12-15] Loss of weight after sleeve gastrectomy occurs in the 1st couple of months following the operation.[16]

Rapid developments in bariatric surgery and positive outcomes obtained increase the tendency to adopt surgical approaches in the treatment of obese patients. This increase also suggests an increase in complications associated with surgical treatment.[17] Bariatric surgery poses some risks; however, these risks are significantly smaller than the risks caused by health problems associated with morbid obesity.[18]

Related to the surgery of patients included in this study, we were not faced with any complications. This is probably because the number of patients was restricted, and the patients with no comorbidity were selected for the study.

The most significant result obtained is that effective weight loss was achieved after the surgery. The advantages of bariatric surgery compared with medical treatment are considerable weight loss, reduction in comorbidity, and accordingly, a considerable improvement in the quality of life.[19]

According to the results of our study, there was a significant reduction in HOMA-IR values and CIMT in the patients who underwent sleeve gastrectomy.

Kotidis *et al*. found that adiponectin levels were increased after sleeve gastrectomy.[20] Saif *et al*. reported that the inverse relation between plasma adiponectin and CIMT in type 2 diabetes could be explained, at least partially, by obesity.[21] Obesity is an important disorder because it causes insulin resistance and atherosclerosis. The atherosclerosis increasing due to obesity affects all arteries in the body.

Impaired vasoreactivity also plays a role in this effect. The carotid wall was found thicker in Doppler ultrasonography in patients with no components of metabolic syndrome other than obesity.[22] That is why, it is of particular importance to examine carotid arteries and all peripheral arteries in obese patients. Losing weight is advised because it has positive effects on blood pressure and dyslipidemia, reduces the hemodynamic burden caused by obesity, and hence prevents or has positive effects on cardiovascular diseases.

The development of atherosclerosis is associated with insulin resistance rather than hyperinsulinemia. The fact that a correlation was found between insulin resistance and CIMT in an insulin resistance atherosclerosis study indicates that insulin resistance is an independent factor playing a role in atherosclerosis.[23] CIMT measurement is a simple and noninvasive procedure for the evaluation of future cardiovascular risks. CIMT is an indicator of atherosclerosis and is accepted as one of the first steps of the process leading to type 2 diabetes mellitus, coronary heart disease, and kidney failure.[24,25] CIMT is also associated with coronary arterial calcification. The importance of carotid intima thickness becomes more salient given that increased coronary arterial calcification is prospectively related to atherosclerotic alterations in coronary arteries.

In this study, we observed an insignificant reduction in total cholesterol values of the patients. No significance was found probably because of only a small number of patients was involved in the study. However, we found a significant decrease in triglyceride levels which were accepted as an independent risk factor of early atherosclerosis in type 2 diabetes. As we found significant decreases in CIMT values, decreases in triglyceride levels may be one of the reasons of such results.[26]

Preoperative assessment and consultation, perioperative care, and long-term management programs are required for patients that undergo a bariatric surgery. It is advised to draw up preoperative, intraoperative, and postoperative protocols for risk assessment and postoperative care planning of morbid obese patients that undergo a bariatric surgery. Postoperative follow-up should be multidisciplinary, as it is the case for preoperative follow-up. Patients that undergo an obesity surgery are required to receive preoperative and postoperative training and counseling to optimize weight management. This training and counseling service should include behavior change strategies whose aims are to increase the physical exercise of patients, improve the quality of their diet and decrease their energy intake. Today bariatric-metabolic surgery has been promoted in health policies of all developed countries because it causes psychological healing in addition to above mentioned positive outcomes and because the ratio of effectiveness and cost is high in surgery.[27-29]

As a result, sleeve gastrectomy is associated with weight loss as well as the healing of insulin resistance and reduction in CMIT. These data may indicate that cardiovascular risks decrease after sleeve gastrectomy.

It is proved by scientific research that obesity plays a role in the pathogenesis and progress of cardiovascular diseases. Cardiovascular diseases increase morbidity and mortality in obesity and may cause sudden death. Despite some proofs related to obesity paradox, the rate of mortality is lower in people with normal weight. There is a need to fight against and cure obesity in order to prevent the development of cardiovascular diseases. Bariatric surgery may provide some additional advantages for the management of cardiovascular risks in obese patients. However, it should be kept in mind that the most important components of the fight against obesity are appropriate diet and exercise programs.[30]

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Conflicts of interest

There are no conflicts of interest.

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