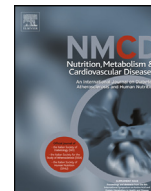


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Impact of weight loss on epicardial fat and carotid intima media thickness after laparoscopic sleeve gastrectomy: A prospective study

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Abstract *Background and aims:* Cardiovascular disease (CVD) is one of the leading causes of mortality in obese patients. We aimed to investigate the influence of significant weight loss following laparoscopic sleeve gastrectomy (LSG) on carotid intima media thickness (CIMT) and epicardial fat thickness (EFT) which are the independent predictors of subclinical atherosclerosis. *Methods and results:* Patients were recruited for standard indications. A total of 105 patients (79 women and 26 men) with the mean age of 43.61 ± 12.42 were prospectively enrolled. On B-mode duplex ultrasound; the mean CIMT at the far wall of both left and right common carotid arteries were measured. EFT was measured on the free wall of the right ventricle at end-diastole from the parasternal long-axis view by standard transthoracic 2D echocardiography. Delta (Δ) values were obtained by subtracting sixth month values from the baseline values. Body mass index (BMI) was significantly reduced from 46.95 ± 7.54 to 33.54 ± 6.41 kg/m² ($p < 0.001$) in sixth months after LSG. Both EFT and CIMT were significantly decreased after surgery (8.68 ± 1.95 mm vs. 7.41 ± 1.87 mm; $p < 0.001$ and 0.74 ± 0.13 mm vs. 0.67 ± 0.11 mm; $p < 0.001$ respectively). A significant correlation between Δ EFT and Δ BMI ($r = 0.431$, $p < 0.001$) was shown. Δ CIMT is significantly correlated with Δ EFT, Δ BMI and Δ systolic blood pressure ($r = 0.310$, $r = 0.285$ and $r = 0.231$ respectively, $p < 0.05$ for all). In multivariate stepwise linear regression analysis; among variables only Δ BMI was the independent predictor of Δ EFT ($\beta = 153$, $p = 0.001$).

Conclusion: Early atherosclerotic structural changes may be reversed or improved by sustained weight loss after LSG in asymptomatic obese patients.

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Introduction

Obesity is one of the greatest public health challenges. Individuals with obesity have increased mortality related to cardiovascular disease (CVD) throughout in their life. Long-term results of pharmacological and non-pharmacological approaches against morbid obesity are not generally satisfactory. Bariatric surgery is an option when all these approaches fail to provide desired results. Laparoscopic sleeve gastrectomy (LSG) is one of the popular restrictive bariatric surgery procedure in which the stomach is reduced to about 15–20% of its original size, by surgical removal of large portion of greater curvature and after which the stomach takes the form of a tube. Technical simplicity, favorable outcomes and low complication rates make this procedure widely preferred [1,2].

Carotid intima media thickness (CIMT) is a well-known independent predictor of future cardiovascular event [3]. Epicardial fat thickness (EFT) which reflects visceral fat tissue, has been suggested as a new cardio-metabolic risk factor [4–8]. There is not enough data showing the effect of bariatric surgery on CIMT and EFT which are early structural markers of subclinical atherosclerosis. We aimed to investigate the influence of significant weight loss following LSG on EFT and CIMT in a prospective study design.

Methods

Study population

We prospectively collected the data of severe obese subjects who underwent LSG between February 2015 and February 2017. Patients were recruited for standard bariatric surgical indications according to obesity diagnosis and treatment guidelines [1,2]; body mass index (BMI) $>40 \text{ kg/m}^2$, BMI $>35 \text{ kg/m}^2$ and additional co-morbidities associated with obesity such as type 2 Diabetes Mellitus (DM), severe hypertension, obstructive sleep apnea. LSG was offered when all non-surgical methods including life style modifications, diets, exercise programs and pharmacological therapy were tried but failed.

Uncontrolled overt diabetes mellitus, atherosclerotic vascular diseases (CVD, cerebrovascular disease, and peripheral artery disease), advanced heart failure or valve disease, malignancy, presence of active infection, chronic renal, liver and lung diseases, severe coagulopathy, drug or alcohol addiction, binge eating disorder, lack of mental competence, untreatable major depression and psychosis were exclusion criteria of our study. Patients who do not want to participate in the study and have low imaging quality were also excluded. Patients were defined as having no CVD if none of the followings were present: Angina pectoris, ST-T waves changes, Q waves, left bundle branch block on electrocardiogram, regional wall motion abnormalities on echocardiogram, ischemia detected by non-invasive stress tests, history of myocardial infarction, coronary artery stenosis $\geq 50\%$ on coronary angiography or history of coronary revascularization.

The total number of patients undergoing LSG during the recruitment period was 149; of whom 5 patients decided not to have the operation and 24 patients were excluded due to low imaging quality. In total; 120 subjects were eligible for the study. Written informed consent for was given by 117 of them but 12 patients did not come to follow-up visits after the operation. Prospective data of the remaining 105 subjects (79 female, 26 male) were recorded for analysis.

All participants underwent a complete physical and standard two-dimensional (2D) echocardiographic examination including EFT, and CIMT pre and post-operatively in sixth months after the operation. Delta (Δ) values were obtained by subtracting sixth month values from the baseline values. Blood pressures (BP) were measured in the sitting position by standard sphygmomanometer after 5 min rest. Anthropometric measurements (height, weight) were made by the same operator, using the same instruments for each individual. Body mass index (BMI) was calculated as weight (kg)/height (m)². Homeostasis model assessment index for insulin resistance (HOMA-IR) was calculated by using Matthew's equation which is fasting plasma insulin level (mu/L) x fasting glucose level (mg/dl)/405 [9]. Hypertension was defined as having an elevated BP ($>140/90 \text{ mmHg}$) on two occasions and/or use of antihypertensive medications [10]. Diagnosis of DM was based on current criteria established by American Diabetes Association [11]. Hyperlipidemia was described as having an elevated fasting total cholesterol (Total-C) $> 200 \text{ mg/dl}$ and/or triglycerides $> 150 \text{ mg/dl}$ and/or use of antihyperlipidemic agents.

Carotid ultrasonography

An ultrasound machine (Hitachi Arietta V70, Japan), equipped with a 2–12 MHz linear probe was used. Participants were examined in supine position with a 45° head rotation toward the opposite side. CIMT was defined as the distance between the leading edge of the first and the second echogenic lines. After digitally stored, off-line measurements were performed by the same investigator who was blinded to all clinical data of the patients. Measurements were performed from the far walls of left and right common carotid arteries on B-mode duplex ultrasound in longitudinal plane at a region 20 mm below the carotid bifurcation in a plaque-free arterial segment, and each measurement represented an average of four measurements for both sides (Fig. 1).

Routine two dimensional (2D) echocardiography and epicardial fat thickness (EFT)

Standard parasternal and apical views were obtained in the left lateral decubitus position by using Vivid S5 ultrasound machine (GE, Healthcare, Horten, Norway), equipped with a 3SRS broadband transducer. All participants underwent standard 2D and Doppler echocardiography conforming to the American Society of Echocardiography and European Association of Cardiovascular Imaging (EACVI) recommendations [12]. Ejection Fraction (EF) was

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