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Original Article

The effect of laparoscopic sleeve gastrectomy on echocardiographic factors in patients with morbid obesity

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Abstract

Background and Aims: Cardiac remodeling and functions are affected after laparoscopic sleeve gastrectomy (LSG); although, the degree of the LSG impression on cardiac function is unclear. The purpose of this study was to determine the effect of LSG on echocardiographic factors in morbidly obese patients.

Materials and Methods: In this prospective study, patients with morbid obesity who underwent LSG in Loghman Hakim Hospital, Tehran, Iran in 2017 were evaluated. Echocardiographic parameters such as ejection fraction (EF), left ventricle (LV) diastolic function, LV mass, LV mass index, epicardial fat (EPF), and valvular heart disease including mitral regurgitation (MR), mitral stenosis (MS), aortic regurgitation (AR) and aortic stenosis (AS) were evaluated before and after LSG. All of the data were entered into SPSS software and were analyzed by statistical tests. P values of less than 0.05 was considered significant.

Results: Ninty (90) patients were enrolled in this study. The EF (P=0.012), LV diastolic function (P=0.0001), valvular heart disease (P=0.0001), and LV mass (P=0.002) were significantly improved after LSG. The EPF (P = 0.42) and LV mass index (P = 0.06) had no significant difference before and after surgery.

Conclusion: LSG would have significant effects on echocardiographic factors and cardiac remodeling in patients with morbid obesity.

Keywords: SleeveGastrectomy,Echocardiography,Morbidobesity,BariatricSurgery, Overweight

Introduction

Obesity is one of the most common results of the urbanization and stationary lifestyle with a prevalence rate of 22-40% in Iran (1). This condition is associated with multiple co-morbidity such as hypertension, hyperlipidemia, diabetes mellitus, and metabolic syndrome (2-4). In addition, morbid obesity is considered as a major risk factor for the cardiovascular related mortality (5).

Surgical approaches for morbid obesity would decrease the relative risk of death by 89% (6). In addition, bariatic surgery reduce obesity related morbidity such as type 2 diabetes and cardiovascular disease (7, 8). Laparoscopic sleeve gastrectomy (LSG) is a routine surgical option for the treatment of morbid obesity (9-13). Cardiac alterations are one of the postoperative outcomes that may affect the prognosis via cardiac remodeling (14). Ventricular and atrial functions are affected by the weight loss (15). Moreover, epicardial fat (EPF) which reflect visceral fat is one of the new cardiac risk factor which can be effected by significant weight loss (16).

The purpose of current study was to determine the effect of sleeve gastrectomy on echocardiographic parameters including valvular heart disease, ejection fraction, left ventricle factors and epicardial fat tissue in patients with morbid obesity.

Methods

Study Design: This prospective study was conducted on patients who underwent LSG in Loghman Hakim Hospital, Tehran, Iran in 2017. The inclusion criteria were morbid obesity, LSG as the surgical approche, ejection fraction (EF) above 40% and mild valvular heart disease including mitral stenosis, mitral regurgitation, aortic stenosis and aortic regurgitation. The exclusion criteria were the history of other cardiac diseases including heart failure (EF below 40%), congenital heart disease and myocardial infarction in the medical history, abnormal EKG regarding ischemic heart disease, and moderate to severe valvular heart disease.

Echocardiographic Assessment: A primary transthoracic echocardiography was done for all patients to detecting the valvular disease before surgery. All of the echocardiographic assessments were done by the same cardiologist. Furthermore, 6 months after surgery, a transthoracic echocardiography was conducted for following up the patients. The echocardiographic indices including ejection fraction (EF), left ventricular diastolic function (LVDF), LV mass, LV Mass index, EPF, and valvular heart diseases including mitral stenosis, mitral regurgitation, aortic stenosis and aortic regurgitation were determined and recorded in the quesionaarie and were compared preoperatively and six months after the LSG in all patients.

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Data Analysis: Data analysis was performed by SPSS software version 24 (Statistical Procedures for Social Sciences; Chicago, Illinois, USA). Considering the lack of normality in the study variables (P value of Kolmogorov Simonov test < 0.05). Mann-Whitney-U test and chai-square test were used for analyzing the data. P values less than 0.05 were considered statistically significant.

Ethical Consideration: This study was approved by ethical committee of Shahid Beheshti University of Medical Sciences (Registration No: IR.SBMU.MSP.REC.1397.45). In addition, Helsinki declaration was respected across the study. Moreover, informed consent form was received from all of the patients.

Results

Thirty patients were entered into final analysis. As seen in table 1, seven patients were male (23.3%); in addition, the mean age of the patient was 38.97 ± 11.8 years. The mean body mass index was 45.58 ± 5.4 and 33.77 ± 5.7 kg/m² before and after LSG respectively which was significantly different (P=0.0001). The mean EF was 57.33 ± 2.85 and 58.33 ± 2.73 percent before and after the surgical procedure respectively. The mean EF was significantly higher in the post-operative (P=0.034).

In the exploration of the diastolic function, 10 patients had grade 1 of diastolic dysfunction who 6 of them became normal after LSG. Furthermore, 8 patients had grade 2 of diastolic dysfunction that 2 of them were in normal status after surgery (Table 2). It was concluded LSG has a significant effect on the diastolic function (P=0.008).

In the field of valvular heart disease, 17 patients had valvular heart diseases including mitral stenosis, mitral regurgitation, aortic stenosis and aortic regurgitation before surgery that two of them (11.8%) were treated after surgery (Table 2). In fact, LSG had a sifnificant effect on the valvular heart disease (P=0.001).

As shown in Table 3, the EPF and LV mass index had no significant difference (P > 0.05); however, the LV mass (P=0.002) was significantly improved after LSG.

Table 1. Demographics of the patients

Variable	Values		P value[a]
Age	38.97 ± 11.8		-
Gender	Male	7 (23.3%)	0.003
	Female	23 (76.7%)	
Body mass unit (kg/m^2)	Before LSG	45.58 ± 5.4	0.0001
	After LSG	33.77 ± 5.7	
Ejection fraction (%)	Before LSG	57.33 ± 2.85	0.034
	After LSG	58.33 ± 2.73	

a. **Mann-Whitney-U test**

Table 1. Diastolic function and valvular disease before and after LSG

Variable	Status	Before LSG	After LSG	P value[a]
Diastolic Function (n)	**Normal**	12 (40%)	20 (66.7%)	0.04
	Grade 1	10 (33.3%)	8 (26.7%)	
	Grade 2	8 (26.7%)	2 (6.6%)	
Valvular Heart Disease (n)	**Positive**	17 (56.6%)	15 (50%)	0.75

	Negative	13 (43.4%)	15 (50%)	

a. Chai-square test

Table 2. LV mass, LV mass index, and EPF before and after operation

Index	Before	After	P value[a]
LV mass	179.03 ± 48.48	169.31 ± 46.89	0.002
EFP	6.18 ± 2.03	5.8 ± 1.46	0.42
LV Mass Index	100.75 ± 150.42	81.34 ± 18.56	0.068

a. Mann-Whitney-U test

Discussion

Obesity is one of the major problems of the public health which its prevalence is increasing during last decades (17). Increasing physical activity and modified nutritional diet are two of the non-surgical treatment of the obesity (18); although, surgery would prefer in the case of BMI ≥ 40 or BMI ≥ 35 with at least one comorbidity (19). Bariatric surgery is one of the beneficial and prolonged treatment for the morbid obesity (20). LSG is one of the popular types of bariatric surgery which is used in case of morbid obesity and cusses significant weight loss in the first year of post-operative period (12, 21, 22).

It has been shown that bariatric surgery has beneficial effect on the cardiovascular function with the alteration of echocardiographic parameters such as LV mass (23, 24). In this study the echocardiographic and functional factors in patients under laparoscopic sleeve gastrectomy were assessed before and after the surgery and it was revealed that the EF, diastolic function, valvular heart disease, and LV mass were significantly improved after LSG but the EPF and LV mass index had no significant difference.

In a cohort study by Navarrete et al, 16 patients who underwent LSG were assessed. In this study, interventricular septum and posterior wall thickness were reduced after the surgery; moreover, left ventricular mass was significantly decreased after LSG (23). These results are associated with the findings of the current study. In addition, Leung et al suggested that ejection fraction would increase by 10% after LSG; also, the left ventricular global longitudinal strain was improved up to 50% (25). In our study, majority of left ventricle indices were improved after operation. Furthermore, Shabbir et al reported significant improvement in echocardiographic indices after LSG leading to significant alterations in left ventricular ejection fraction and function as well as our study (26). Moreover, Le Jemtel et al reported in their review study that echocardiographic indices especially left ventricular mass would be improved after sleeve gastrectomy (27). This issue is similar to the current study.

It has been observed that the reduction in arterial pressure after LSG is the main mechanism fot the cardiac remodeling after bariatric Surgery (23). In addition, the positive effect of the LSG on the systolic function which is observed in the animal studies may be another mechanism for the cardiac remodeling (14).

In this study, bariatric surgery did not have significant effect on the epicardial fat. Epicardial fat is one of the indicators of the visceral fat which is associated with cardio-metabolic risk factor (28, 29). In the of Kokkinos et al., it was suggested that bariatric surgery has a significant effect on reduction of epicardial fat tissue (30). In addition, Wu et al suggested the same result in the field of epicardial fat reduction after bariatric surgery (31). Moreover, Altin et al. reported that bariatric surgery may have negative effect on the atherosclerosis process and can be effective in the reduction of epicardial fat (32). In contrast, in the current study, LSG did not have significant effect on the epicardial fat reduction which is associated with the study of Fops et al. (33).

Our study had some limitation. At first, the sample size was small. Only 90 patients were explored which 30 of them entered in the final analysis. It is suggested to conduct future studies with larger population. Poor quality echocardiographic image was another limitation of this study. It would be better to conduct feature studies with the aid of MRI and CT scan for better exploration of the fat tissue. In addition, this study was conducted by the aid of 2D echocardiography. It can be better for the other study to use 3D echocardiography for accurate assessment of the cardiac function.

Conclusion

Laparoscopic sleeve gastrectomy has positive effects on echocardiographic indices in patients with morbid obesity. However, further studies with larger sample size are required to obtain these results.

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