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Original Article

The effect of bariatric surgery on pulmonary function in the morbidly obese patients: A prospective before-after study

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Abstract

Background and aims: Obesity is one of the challenging public health issues which can increase the risk of different morbidities like respiratory disorders. Some studies suggested that significant weight loss may be associated with the improvement of pulmonary function in morbid obese patients. Bariatric surgeries are the most effective was for significant weight loss in morbid obese patient. The aim of this study was to determine the effects of bariatric surgery on the pulmonary function in the morbid obese patients.

Methods: This prospective, before-after study was conducted on morbid obese patients who underwent bariatric surgery in Loghman Hakim hospital during 2019. All morbid obese patient (BMI ≥ 40) who presented to the hospital in the study period were included in the study by convenience sampling. Patient's demographics and results of spirometry test variables were recorded in a questionnaire before the surgery and three months after the surgery. SPSS software version 25 was used for data analysis.

Results: Thirty-eight patients were entered in the final analysis. The mean age of patients was 39.2±11.6 (range: 15-65). Fifteen patients in this study were male (39.5%). There were significant relations in the values of BMI, FEV_1, FEV_1/FVC before and after the surgery. In addition, there were significant negative correlation between FEV_1 and BMI. Furthermore, functional dyspnea and obstructive sleep apnea were seen in 50% and 21% of patients which completely improved after the study.

Conclusion: Bariatric surgery has significant effects on the improvement of pulmonary function in morbid obese patients.

Keywords: Bariatric Surgery, Obesity, Pulmonary Function Test, Spirometry

Introduction

Obesity is a multifactorial metabolic disorder which is an important public health issue related to different morbidities (1–3). The prevalence of obesity has increased globally in the last decades and represents a major health issue by through the increasing of type 2 diabetes mellitus, fatty liver disease, cardiovascular disease including hypertension, myocardial infarction and stroke, in addition to cancers and pulmonary disorders like obstructive sleep apnea (4). Various studies suggested that obesity has a significant impact on pulmonary function (5–7). In fact, obesity may be associated with the development and deterioration of respiratory disease including asthma, COPD and infectious pneumonia (8–10).

Life style modification including increasing physical activity, changing diet to reduced-calorie diet is the primary approach for the treatment of overweight; although, these measures are not enough for the treatment of morbid obesity (BMI ≥ 40) and surgery may needed in these cases especially in the cases of comorbidities (11). Bariatric surgeries are the most effective treatments for morbid obesity which is able to decrease the majority of obesity associated morbidities in the first year after the surgery (12). Laparoscopic Roux-en-Y gastric bypass (LRYGB), laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) are some of the common types of bariatric surgery (12, 13).

Previous studies suggested that body mass index (BMI) is associated with airway obstruction and spirometry findings (14, 15); however, results are limited and conflict. Furthermore, there are few studies in the context of the effect of bariatric surgery on the lung function in Iran. This study was aimed to evaluate the effect of bariatric surgery on the spirometry tests among the obese patients.

Methods

Study design: This prospective, before-after study was conducted on patients who referred to Loghman Hakim hospital during 2019. Inclusion criteria in this study was assumed as morbid obesity (BMI ≥ 40) and patients who did not consent to enrolled in the study or patients who did not complete the follow-up were excluded from the study. Convenience sampling was used for patient selection. Considering this issue that almost 1000 patients underwent bariatric surgery in Loghman Hakim hospital annually, the sample size was calculated to be 40 patients based on 10% margin of error and 80% of confidence level by assuming 50% of response distribution based on the Cochran formula.

Data collection: Some information including age, gender, BMI in addition to the spirometry test variables including forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1), peak expiratory flow

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(PEF), estimated lung age (ELA), forced expiratory flow 25-75% (FEF_{25-75}), forced expiratory time (FET) and forced inspiratory vital capacity (FIVC) was recorded in a questionnaire before the surgery and three months after the surgery.

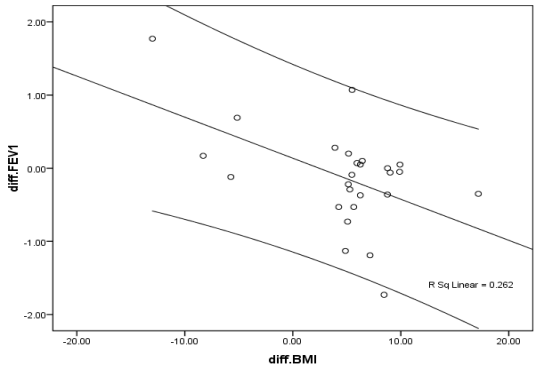
Statistical analysis: All data were entered into SPSS software version 25 for the final analysis. The normality of the data was evaluated by Kolmogorov-Smirnov test, and due to the normality of data, parametric tests were used for data analysis. Quantitative data were reported as mean ±SD and qualitative data were reported as percentage statistics. Paired t-test was used for the comparison of quantitative data. Furthermore, Pearson correlation tests were used for assessing the correlation between the data. The P values < 0.05 were considered significant.

Ethical consideration: All stages of the study were conducted after obtaining the permission from Ethics Committee of Shahid Beheshti University of Medical Sciences. In addition, informed consent was received from all patients. This study was extracted from the medical thesis of Dr. Yasaman Sadeghian with registration number: 164.

Results

In this study, 38 patients were entered in the final analysis. The mean age of patients was 39.2±11.6 with a range of 15-65 years. Fifteen patients in this study were male (39.5%) and 23 patients (60.5%) were female. The results of BMI and spirometry tests are presented in Table 1. As seen in Table 1, there were a significant relation in the values of BMI, FEV_1, FEV_1/FVC before and after the surgery.

In the context of spirometry variables correlation with BMI, the results are presented in Table 2. As seen in Table 2, there were significant negative correlation between FEV_1 and BMI (Fig. 1).



A: Pearson correlation coefficient

Fig. 1. The correlation between BMI and FEV_1

In addition, 19 patients (50%) had functional dyspnea and 8 patients (21%) had obstructive sleep apnea. All patients with this morbidity were improved after the operation.

Discussion

Patients with morbid obesity are exposed to respiratory system disorders with various causes including increasing the respiratory work and decreasing the respiratory volume (16). Significant weight loss in the obese patient can have a significant effect on the lung function (17). Considering spirometry parameters as one of the best indicators of lung function which can alter in the obesity (18), bariatric surgery, which is the most proven ways of morbid obesity treatment, can have positive effects on the

Table 1. Results of BMI and spirometry tests before and after the surgery

Variables	Before the surgery	Three months after the surgery	P value [A]
BMI	45.8 ± 6.3	41.2 ± 5.45	0.001
FVC	2.92 ± 0.88	2.92 ± 0.47	0.961
FEV_1	2.61 ± 0.74	2.74 ± 0.34	0.013
FEV_1/FVC	90.06 ± 9.43	95.3 ± 4.9	0.006
PEF	4.89 ± 2.24	4.94 ± 1.03	0.92
ELA	65.62 ± 31.22	60 ± 20.6	0.360
FEF_{25-75}	3.26 ± 1	3.66 ± 0.61	0.097
FET	1.92 ± 1.24	1.8 ± 1.99	0.798
FIVC	2.68 ± 0.91	2.7 ± 0.64	0.863

A: Paired t-test

Table 2. Spirometry variables correlation with BMI

Variables	BMI	
	Correlation coefficient [A]	P value [A]
FVC	-0.487	0.01
FEV_1	-0.511	0.008
FEV_1/FVC	-0.223	0.274
PEF	-0.532	0.004
ELA	0.388	0.061
FEF_{25-75}	-0.439	0.022
FET	0.144	0.474
FIVC	-0.267	0.178

respiratory function through reducing the fat deposition of the chest wall which can influence the function of respiratory muscles and spirometry parameters (19).

In the present study we evaluate the effects of bariatric surgery on spirometry parameters and respiratory symptoms including functional dyspnea and obstructive sleep apnea in obese patients. In this study, the improvement of respiratory function was assessed by two major spirometry parameters: FEV_1 and FEV_1/FVC. It was concluded that FEV_1 parameter improved significantly after the bariatric surgery which has an inverse significant correlation with BMI. Furthermore, the values of FEV_1/FVC, which is an important parameter for assessing the obstructive and restrictive pulmonary disease (20), was significantly improved after the surgery but it does not have significant correlation with BMI. In fact, we concluded that the effect of bariatric surgery on FEV_1 is higher than other spirometry parameters. In addition, functional dyspnea and obstructive sleep apnea which are common in obese patients (21) were completely relieved after the bariatric surgery.

The results of the current study were in association with previous studies. Alsumali et al., in a systematic review reported that bariatric surgery significantly improved pulmonary functions for morbid obesity (22). In the study of Santiago et al., the values of BMI, FEV_1, functional residual capacity (FRC) and expiratory reserve volume (ERV) was improved significantly; in addition, air way resistance was decreased significantly in this study; furthermore, bariatric surgery had a significant effect on obstructive sleep apnea which were in line with results of the current study (23). de Souza et al. observed that pulmonary function tests including FVC, FEV_1/FVC had a significant improvement 6 months and one year after bariatric surgery (24). Moreover, in the study of Boulet et al., FEV_1, FVC, total lung capacity (TLC) and FRC were improved significantly in asthmatic patients after bariatric surgery (25). All of the previous studies were in association with the current study. In contrast, in the study of Xavier et al., there were no significant improvement in the value of FEV_1/FVC after the bariatric surgery (26). In fact, they observed that only FRC and ERV improved significantly after bariatric surgery which was different from the results of this study. Some factors like differences in patient follow-up time, comorbidities and patient cooperation in spirometry test may be responsible for this difference.

Despite significant results, this study had some potential limitations. The sample size of the study was small and despite significant changes in some spirometry parameters, some others differences were not significant due to the volume of the study. In addition, because of the small ample size, it was not possible to assess these changes in different ages and sex subgroups. Furthermore, due to the mid-term follow-up of patients (only for three months) long-term changes in spirometry parameters were not assessed following bariatric surgery.

It is better for future study to assess the effects of comorbidities and habitual history in the respiratory function after bariatric surgeries; in addition, large sample studies with long term follow up may be needed for obtaining better results.

Conclusion

Bariatric surgery is effective for improvement of pulmonary function and respiratory symptoms in morbid obese patients. Spirometry parameters including FEV_1 and FEV_1/FVC had significant improvement after the surgery which is correlated with BMI changes in the post-operative period.

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