Research Article

ASSESSMENT OF PULMONARY FUNCTIONS IN OBESE PATIENTS AFTER LAPAROSCOPIC GASTRIC SURGERY

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Abstract

Obesity is an important, worldwide public health problem. Obesity affects all body systems, but mainly cardiovascular and respiratory systems. We aimed to investigate the change in respiratory functions due to both the decrease in Body-Mass Index (BMI) and laparoscopic obesity surgery that is used in obesity treatment.

Patients were selected who applied to Ondokuz Mayıs University General Surgery Clinics and referred to pulmonary medicine clinics for preoperative evaluation. 32 patients applied for laparoscopic obesity surgery with BMI > 40 kg/m2 monitored. Pulmonary symptoms of patients were evaluated pre-operatively and post-operatively; their BMIs were calculated and pulmonary function tests, lung diffusion testing and 6 minutes walking test (6 MWT) were applied. The data obtained at the end of the study were assessed under computer setting by SPSS 15.0 program. Chi-Square, Mann Whitney U, WilcoxonSignedRanks, PairedT and StudentT tests were used in statistical analysis of data.

Average age of patients was 35.3 ± 9.3 and 28.1% of them (n=9) were men, 71.9% (n=23) of them were women. The fact that majority of patients who participated the study were women was related with more frequent morbid obesity in women in general; we also saw that women applied to hospital for obesity surgery at a higher ratio. When preoperative and post-operative data were compared, BMI of patients decreased by 28%; FEV_1 value, FEV_1 percentage, FVC value and FVC percentages increased by 11.9%,14.8%, 14.8% and 17.3%respectively, these results were statistically significant. Recovery in respiratory functions due to decrease in BMI was observed after laparoscopic sleeve gastrectomy in obesity.

Keywords:

Obesity; Pulmonary function tests; laparoscopic sleeve gastrectomy

Introduction

Obesity is a health problem whose prevalence gradually increases and which coexists with high mortality and morbidity compared with the normal population.

Obesity is one of the gradually increasing most important public health problems in adults and children of 21st century. It is known to be the most frequent, preventable death cause worldwide [1] .

Obesity related soft tissue increase creates a pressure effect on chest wall and leads to increase in pulmonary blood flow. Respiratory tracts are affected as a result of these two situations. The fall in lung compliance causes increased oxygen consumption during respiration and a subjective increase in dyspnea.

Respiratory functions can so much damage in obese individuals without a specific underlying lung disease that respiration and heart failure can occur .

Both Forced Expiratory Volume (FEV_1) at 1st second and Forced Vital Capacity (FVC) decrease with the decrease in respiratory tract airflow in obesity.

Respiration rates of obese people per minute are higher and their tidal volumes are lower. Airway, chest wall and the total respiration system resistance which is the addition of these two are higher in obese people.

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Obesity disrupts respiratory functions by causing an increase in chest wall compliance. Alveolar-arterial oxygen gradient increases with hypoxaemia in people with morbid obesity. The basic mechanism that is responsible from hypoxaemia is the ventilation-perfusion non-compliance. In obese people, the basal parts of lungs are well perfused while airway and alveoles badly perfused due to early closure.

We aimed to evaluate the positively change in respiratory functions, relieve in respiratory symptoms, spirometric Pulmonary Function Testing (PFT), Carbon Monoxide Diffusing Capacity (DLCO) and six Minute Walk Test (6 MWT) after laparoscopic sleeve gastrectomy due to the decrease in BMI.

Materials and Methods

Patients who applied and provided consent for obesity surgery were admitted to the study prospectively. Ondokuz Mayıs University Medical School Ethical Committee's approval numbered B.30.2.ODM.0.20.08/302 was received prior to the study.

The study was written in accordance with the Declaration of Helsinki. Patients who applied for obesity surgery with a BMI above 40 kg/m2 were randomly selected. Before and more than 12 weeks after the obesity surgery (between 12-20 weeks; averagely at 16th week) history, physical examination, BMI, pulmonary function testing, pulmonary function testing with diffusion and 6 minute walk distance were evaluated [2]. The patients who had chronic lung diseases like chronic obstructive lung disease, chronic heart diseases, uncontrolled diabetes, chronic renal diseases, severe anaemia, joint diseases that prevent walking; who define a lung disease previously; who are younger than 18 year-old and who did not consent were not included in the study.

Respiration symptoms of patients were questioned post-operatively and their physical examinations were performed. Their weights are measured and BMIs were recorded. Pulmonary function testing (Cosmed Quarkspiro, Roma/ Italy) was performed according to the American Thoracic Society (ATS) 2005 standards . The FVC, FEV_1, FEV_1/FVC, FEF25-75 values were measured at pulmonary function testing. Values were recorded as millilitres (ml) and percentage (%). Carbon Monoxide Diffusing Capacity (DLCO) value was recorded as percentage in all patients by using the same device (ZAN 300 Oberthulba/Germany). For measurement of six Minute Walk Distances (6 MWT), the maximum distance walked within 6 minutes at thirty-metres corridor was measured. Heart rate, blood pressure, dyspnea level and oxyhaemoglobin saturation and the highest walk distance were considered and recorded before and after the test [3] . Patients were approved for pre-operative chest diseases consultation. Doctors of general surgery clinic applied sleeve gastrectomy surgery which is also known as "tube stomach" to the patients. Patients were requestioned on averagely 16th week after obesity surgery and FVC, FEV_1, FEV_1/FVC, FEF25-75, DLCO and 6 MWT were recorded. The study plan is summarised in (Table 1).

Table 1: Study Plan.

	Pre-operative	Post-operative 16th Week
Consent	+	
History	+	
Physical examination	+	+
BMI	+	+
PFT	+	+
DLCO	+	+
6 MWM	+	+

The data obtained at the end of the study were assessed under computer setting by SPSS 15.0 program. Chi-Square, Mann Whitney U, Wilcoxon Signed Ranks, Paired T and Student T tests were used in statistical analysis of data. As a result of data analysis, $p < 0.05$ value is accepted as significant.

Results

Fifty one patients were examined pre-operatively for the study. 2 of the patients were excluded due to asthma; 1, for operated knee and could not perform 6 MWT; 5 for inability to apply DLCO due to technical reasons and the fact that they were coming from other cities; 11, for their unavailability at post-operative control visit. Data of totally 32 patients was analysed. 28.1% of 32 patients who participated the study (n=9) were male; 71.9% (n=23) were female; the age distribution was normal and the average age was 35.3 ± 9.3. The average age of the female patients was 33.9 ± 9.4 years and the average age of the male patients was 39.1 ± 9.3 years. Totally 12 patients (37.5%) were smoking with a ratio of 7 women (30.4%) and 5 men (55.6%). The gender and smoking rate relationship was statistically insignificant (p=0.240).

Pre-operative average BMI of patients was 44.7 ± 4.3 kg/m2 and average BMI at the 4th month was 32.1 ± 4.6 kg/m2 (Table 2). Pre-operative average BMI of female patients was 44.9 ± 4.7 kg/m2 and average post-operative BMI was 32.6 ± 4.5 kg/m2. Pre-operative average BMI of male patients was 44.3 ± 3.5 kg/m2 and average post-operative BMI was 31.0 ±

4.8 kg/m2. Post-operative 16th week average BMIs decreased as 12.6 kg/m2 compared with average ratio of pre-operative BMIs and it was statistically significant ($p < 0.001$). BMI decrease was average 12.3 kg/m2 ($p < 0.001$) in women and 13.3 kg/m2 in men (p=0.008). BMI decrease in both genders was statistically significant.

Table 2:Characteristics of patients at baseline and after surgery.

Variable	Pre-operative (n=32)	Post-operative 16th week (n=32)	Difference	P
BMI (kg/m2)	44.7 ± 4.3	32.1 ± 4.6	-12.6	0
FVC (ml)	3609 ± 826	4144 ± 1089	535	0
FVC (%)	91.3 ± 10.5	108.6 ± 16.1	0.173	0.05
FEV1 (ml)	3164 ± 703	3543 ± 923	379	0
FEV1 %	95.0 ± 10.6	109.8 ± 16.6	0.148	0
FEV1/FVC	87.5 ± 4.2	85.1 ± 5.6	-	0.17
FEF25-75 (ml)	3917 ± 998	4116 ± 1256	-	0.09
FEF25-75 %	103.5 ± 23.0	105.2 ± 25.8	-	0,610
PEF (ml)	7217 ± 1670	7083 ± 2372	-	0.64
PEF %	99.4 ± 19.9	96.0 ± 22.7	-	0,352
DLCO %	97.7 ± 19.1	103.5 ± 21.8	-	0.21
6 MWT	520 ± 67	666 ± 74	141	0

Patients' PFT values, DLCO and 6 MWT pre-operatively and post-operatively are given in Table 2. Pre-operative average FVC of patients was measured in millilitres and found as 3609 ± 826 ml; the same value was found as 4144 ± 1089 ml at post-operative 16th week. Increase in FVC was statistically significant ($p < 0.001$). average FVC of patients at post-operative 16th week increased as 535 ml compared to means of pre-operative weeks and this value was statistically significant ($p < 0.001$).

Pre-operative average FVC % of patients was measured as 91.3 ± 10.5; the same value was found as 108.6 ± 16.1 at post-operative 16th week. Increase in FVC percentage was statistically significant ($p < 0.001$). average FVC of patients at post-operative 16th week increased as 17.3% compared to means of pre-operative weeks and this value was statistically significant ($p < 0.05$).

Pre-operative FEV_1 was measured as 3164 ± 703 ml while at post-operative 16th week, it was Measured as 3543 ± 923 ml. Increase in FEV_1 was statistically significant ($p < 0.001$). average FVC of patients at post-operative 16th week increased as 379 ml compared to means of pre-operative weeks and this value was statistically significant ($p < 0.001$). Average FEV_1 of patients at post-operative 16th week increased as 14.8% compared to means of pre-operative weeks and this value was statistically significant ($p < 0.001$).

Pre-operative FEV_1/FVC of patients was measured as 87.5 ± 4.2; the same value was found as 85.1 ± 5.6 at post-operative 16th week. Change in FEV_1/FVC was statistically insignificant (p=0.17).

Pre-operative average FEF25-75 of patients was 3917 ± 998 ml while it was measured as 4116 ± 1256 ml at post-operative 16th week. Change in FEF25-75 as millilitres was statistically insignificant (p=0.094). Average pre-operative FEF25-75 was measured as %103.5 ± 23.0 while at post-operative 16th week, it was measured as %105.2 ± 25.8. Change in FEF25-75 percentage was statistically insignificant (p=0.610). Pre-operative PEF of patients was measured as 7217±1670 ml while at post-operative 16th week, it was measured as 7083 ± 2372 ml. Change in PEF was statistically insignificant (p=0.643). Average pre-operative PEF of patients was measured as 99.4±19.9 ml while at post-operative 16th week, it was measured as %96.0 ± 22.7. Change in PEF percentage was statistically insignificant (p=0.352).

Pre-operative average DLCO of patients was 97.7 ± 19.1 while it was measured as 103.5 ± 21.8 at post-operative 16th week. Change in DLCO was statistically insignificant (p=0.210).

The average pre-operative 6 MWT was 520 ± 67 metres while it was 661 ± 74 metres at post-operative evaluation. The distance measured at post-operative 16th week and the pre-operatively measured distance increased as 141 metres and this was statistically significant ($p < 0.001$).

DISCUSSION

Lung diseases are roughly divided into two groups as restrictive and obstructive diseases. Limitation is present at expansion of thorax cavity and lung in restrictive diseases. In obstructive diseases, airway obstruction, prolonged expiration and air trap are observed. Respiration difficulty is observed in both restrictive and obstructive patterns in morbid obese patients [4]. The fat accumulated in thoracic region decreases the compliance whereas the fat accumulated in upper respiratory tract causes airway obstruction; and therefore, obstructive respiration difficulty. In addition, the bronchodilation mechanism is disrupted and increased airway sensitivity develops .

Morbid obesity is more frequently observed in women. Majority of patients in our study were women. Also showed that women are more frequent among patients who undergo obesity surgery. This finding reminds that women apply to surgical methods at a higher rate or that morbid obesity is seen at a higher frequency in women . in their study that all of the patients whose BMIs were > 40 kg/m2 and underwent obesity surgery were all women. Also, their BMI dropped from pre-operative 42 kg/m2 to 31 kg/m2 at post-operative 1st year and this result was statistically significant. The pre-operative and post-operative FVC % of the 1st year increased from 101 to 111 and change in FEV_1/FVC percentage was not statistically significant. This result supports our study.

The popularity of obesity surgery has increased in the last 10 years by development of laparoscopic gastric bypass method and by proving the benefit patients had after surgery. It is known that comorbidities related with obesity like hypertension, diabetes mellitus, sleep apnoea, dyslipidaemia improve after surgery. However, very few studies dealt with relationship of respiration mechanics and obesity surgery so far. Increased BMI causes pulmonary function defects in both restrictive and obstructive patterns. It is thought that respiration mechanics recover after obesity surgery by increase in chest wall compliance and decrease in airway obstruction; however, very few studies report this result via long-term follow-up.

Performed a study in California and checked pulmonary function tests of 104 obese patients with BMI > 40 kg/m2 at post-operative 3rd, 6th, 9th and 12th months and pre-operatively, after laparoscopic sleeve gastrectomy operation. They found that, at 12th month, patients lost %54 ± 23 of their excess weights. The FEV_1 value was more than the basal value at post-operative 3rd month and it was measured as % 112 ± 16 of the basal value at post-operative 12th month. The FVC value was more than the basal value at post-operative 3rd month and it was measured as % 109 ± 16 of the basal value at post-operative 12th month. These results support our study. The PEF value was more than the basal value at post-operative 1st month and it was measured as % 115 ± 25 of the basal value at post-operative 12th month. The FEF25-75 value was more than the basal value at post-operative 1st month and it was measured as % 130 ± 27 of the basal value at post-operative 12th month. These results do not overlap with our study. The change in measured PEF and FEF25-75 in our study was statistically insignificant. However, in Nguyen and his colleagues' study, it is seen that PEF and FEF25-75 values gradually increase in periods of 3 months. We checked post-operatively and averagely at 16th week in our study, so we were not able to see the possible increase at the period up to 12th month. Similarly to the study performed by we also saw recovery in both restrictive and obstructive respiration patterns by losing weight after surgery .

In the comparative FVC, FEV_1 and FEV_1/FVC study at post-operative 1st year and pre-operatively, performed on 30 morbid obese patients (BMI > 40 kg/m2), it was shown that FVC increased, average FEV1 increased and this finding was statistically significant. On the other side, the increase in average FEV_1/FVC was statistically insignificant . Also in a meta-analysis of published studies performed reported that a statistically significant increase in FEV1 and FVC was observed after bariatric surgery . Again similarly, performed a comparative, pre-operative and 6th month post-operative FVC, FEV_1, FEV_1/FVC and FEF25-75 study on 25 morbid obese women in 2014 and showed that average FVC and FEV1 increased in a similar way to our study, and this finding was statistically significant. Differently from our study, average FEF25-75 was found as higher and statistical significance was shown . The post-operative period was 16 weeks in our study, and 6 months in study performed and the finding might be related with this reason [5].

Found increases in total lung capacity, FEV1 and FVC at the 6th month in 36 morbid obese patients. Yet, this study included only patients with pre-operative restriction . We think that showing a recovery even within respiratory functions at normal ranges is considerable by means of the negative effects that obesity exerts on respiratory functions.

In the study respiratory functions of 21 obese patients (BMI > 40 kg/m2) pre-operatively and at the 3rd month after sleeve gastrectomy were examined and it was shown that FEV_1 and FVC values increased. This result was statistically significant but FEV_1/FVC %, PEF value and change in FEF25-75 were statistically insignificant . We see that results obtained at the ends study totally overlapped with results of our study. The pre-operative and 3rd month post-operative DLCO changes were examined in the same study, too and the change in DLCO was not found as statistically significant as we did in our study. One study has shown, contradictory to data in both ours studies, DLCO is higher as 8% in morbid obese patients . More specific tests are required in evaluation of alveolar membrane's diffusion capacity in addition to DLCO. In a study, researchers investigated diffusion Capacity Of Alveolar Membrane For Nitric Oxide (DLNO) and found that though DLCO was normal, alveolar membrane conductance was lower than predicted. This finding reminds that the sensitivity in determining change in DLNO can be better than the one in DLCO .

The pre-operative 6 MWT increased from average pre-operative 475 metres to 626 metres at post-operative 1st year and the increase of 151 metres was found as statistically significant in a prospective study 15 female patients having BMI > 40 kg/m2 during 1 year In our study, pre-operative 6 MWT increased from average 520 metres to average 661 metres at post-operative 16th week; and the 141 metres of increase was statistically significant.

Limitations of our study were the less number of cases and unevaluated effectiveness at post-operative long-term. Treating obesity by surgical methods carries many post-operative risks; however, it exerts a positive contribution on respiratory functions.

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