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EFFECT OF OBESITY ON PULMONARY FUNCTIONS AND DISEASE CONTROL IN ASTHMA

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ABSTARCT

Objectives and Background: Recent data shows a growing evidence about a parallel increase in asthma and obesity prevalence and a negative relationship between obesity and some clinical properties of asthma as control status, pulmonary functions and some other parameters. We aimed to evaluate the effect of obesity on asthma control, asthma control status, asthma severity and pulmonary function tests of asthma patients in order to have a reliable data to offer weight loss for obese asthmatics and to achieve a better asthma control and diminished asthma related health-costs.

Methods: This is a cross-sectional descriptive study. 104 adjacent adult patients diagnosed as asthma enrolled in the study after assignment of the written informed consent. A detailed demographic and clinical settings including asthma control status and severity, the number of attacks in the last year was recorded. Asthma control test is applied to all participants. Pulmonary function test (PFTs) and skin test were recorded.

Results: 79 (70,5%) of study population was female. Mean age of participants was 43,5. Intermittent asthma was diagnosed only in 6.7% of patients. 31.73% of participants were well-controlled. 44,2% were obese. The mean FEV1 of obese and nonobese asthmatics were $2{,}15 \pm 0{,}68$ and $2{,}94 \pm 0{,}8$ respectively ($p < 0.001$). The mean FVC of obese and nonobese asthmatics were $2{,}64 \pm 0{,}67$ and $3{,}36 \pm 1{,}03$ respectively ($p < 0.001$). The mean asthma control test point was lower in obese asthmatics than nonobese ($17{,}39 \pm 5{,}06, 19{,}03 \pm 5{,}45$ respectively $p: 0.045$).

Conclusions: Obesity is associated with a worse asthma control and lower pulmonary functions. In addition to standard medical treatments, weight loss may be advised as an alternative strategy for achieving asthma control and better pulmonary functions in asthma.

Key Words: Asthma, Obesity, Pulmonary Function, Asthma Control.

INTRODUCTION

Asthma is a chronic respiratory disorder characterized by variable air flow limitation and symptoms as dyspnea, chest tightness, wheezing and cough. These symptoms generally increase with a trigger/ exposure. Risk factors of asthma are well described, obesity is one of the probable risk factors and a contributor for loss of asthma control. Asthma is more common in obese than in non-obese, but also the obesity related respiratory symptoms as exertional

dyspnea may mimic asthmatic symptoms (1). Since there has been growing evidence about similar racial and ethnic disparities that exist with obesity prevalence and a parallel increase in asthma and obesity prevalence, several studies examining the possible relationship between these two conditions have been started to be conducted recently (2-7). Obese asthmatics generally resist in response to therapy and have an increased risk of hospitalizations due to exacerbations (3). In addition, obese asthmatics have a decreased quality of life and increased utilization of resources compared to their non-obese counterparts (4). Factors that could contribute to the pathogenesis of asthma in the obese include both mechanical factors and altered inflammation and immune responses related to the obese state.

Adipose tissue produces various types of cytokines and adipokines which may have adverse effects on lung tissue. Cytokines of adipose tissue include plasminogen activator inhibitor-1, monocyte chemotactic factor-1, interleukins 6 (IL-6) and 8, and adipokines such as leptin and adiponectin. The exact mechanism of these mediators in the pathogenesis of asthma is not certain yet; however, the potential roles of adiponectin and leptin in asthma is blamed substantially in some studies. (5, 6,7).

The mechanical linkage between obesity and asthma is thought to be related to restrictive physiology (8). Breathing at the low lung volumes seen with a restrictive pulmonary respiration pattern leads to increased airway hyperresponsiveness (9) and smooth muscle hyperreactivity (10).

In the light of these recent studies, we aimed to evaluate the effect of obesity on asthma control, asthma control status, asthma severity and pulmonary function tests of asthma patients. To offer weight loss for obese asthmatics shall led to achieve a better asthma control and diminished asthma related health-costs.

MATERIAL AND METHOD

Study Population, Protocol & Design

This is a cross-sectional descriptive study. We enrolled 104 adjacent adult patients who admitted to Cukurova University Faculty of Medicine, Department of Chest Diseases between 1 July 2011 - 1 September 2011 and diagnosed as asthma according to GINA report . All of them were enrolled in the study after assignment of the written informed consent. The institutional ethics committee approved the study (2015/48) and written informed consents were obtained from all of the participants.

Diagnosis is based on a detailed medical/symptomatic history, physical examination and pulmonary function tests by a pulmonary specialist.

Their demographic information, comorbid disorders diagnosed by the doctor and the treatment they received and also the medication prescribed for asthma were recorded.

A detailed anamnesis including the control status and severity of asthma in the previous year and the number of attacks in the last year was recorded. Asthma control test is applied to all participants (11,12).

Body mass index (BMI), defined as the weight in kilograms divided by the square of the height in meters, is commonly used to classify overweight and obesity. In adults, a BMI between 25 and 29.9 is defined as overweight and a BMI of 30 or higher is considered obese (13).

Pulmonary function test (spirometry) and skin test were performed on each patient.

Pulmonary function tests (PFTs) were performed by using a calibrated Sensor Medics V-Max 20 Spirometer. None of the patients were receiving oral or inhaled short acting beta 2 agonists 8h before testing. Baseline forced expiratory volume in first second (FEV1) and forced vital capacity (FVC) was measured 3 times and the best of three measurements was recorded. Total lung capacity was measured using the helium dilution technique (Jaeger MS-PFT Analyser Unit). The transfer factor of the lung for carbon monoxide (TLCO) was measured using the single breath method and the data was presented as the percentages of predicted.

Skin prick test performed on the volar or inner aspect of the forearm avoiding the flexures and the wrist areas. The skin should be clean and free of lotions or creams. A drop of the allergen (extract) solution was placed by each code. A lancet with 1 mm point was used to prick the skin through the drop. A fresh lancet was used for each allergen. The solutions were blotted off the test site. The patient warned not to wipe down the arm to prevent cross contamination. Skin reactions assessed 10-15 minutes after allergen placement. Antihistamines was avoided 48 to 72 hours before the test. Other medication needed to be avoided for example, tricyclic antidepressants and phenothiazines as that may lead to false negative results. A positive and negative control included in each series of tests. The negative control solution was the diluent used to preserve the allergen extract. Any reading 2 mm larger than the negative control will then be read as positive. The positive control solution, a 1 mg/ml histamine hydrochloride solution, was used. The reaction graded by measuring the wheal and flare or it was expressed as a percentage of the positive histamine control.

STATISTİCAL ANALYSIS

All analyses were performed using SPSS 18.0 statistical software package. Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as mean and standard deviation and as median and minimum-maximum where appropriate. Chi-square test was used to compare categorical variables between the groups. The normality of distribution for continuous variables was confirmed with the Kolmogorov-Smirnov test. For comparison of continuous variables between two groups, the Student's t-test was used. For comparison of more than two groups, One-way ANOVA was used. To evaluate the correlations between measurements, Pearson Correlation Coefficient was used. The statistical level of significance for all tests was considered to be 0.05.

RESULTS

79 (70,5%) of study population was female. Mean age of participants was 43,5. Basic characteristics were similar between male and female except FEV1 and FVC as expected. Detailed clinical characteristics of study group is listed in Table1.

Table 1. Clinical characteristics of study population.

Characteristics	Female (n:79)	Male (n:25)	p
Age	43,41±14,93	43,8±12,12	0,90
FEV1%	2.15±0.68	2,94±0.80	<0.001
FVC%	2,73±0,7	4,03±0,99	<0.001
FEV1/FVC	77,37±11,07	71,69±8,61	0.02
BMI	29,74±6,42	27,58±4,82	0.12

Asthma severity, control status, BMI and obesity prevalence were similar in females and males. Smoking was more prevalent in males. Detailed data is given in Table 2.

Table 2. Asthma characteristics of study population

	Female (n:79)	Male (n:25)	p
Severity of asthma			
Intermittent	7(%8,9)	0(%0)	
Mild persistent	25(%31,6)	8(%32)	0,22
Moderate persistent	34(%43)	15(%60)	
Severe persistent	13(%16,5)	2(%8)	
Asthma control			
Well-controlled	22(%27,8)	11(%44)	
Partial control	30(%38)	8(%32)	
Poor control	11(%13,9)	2(%8)	0.48
Acute exacerbation	16(%20,3)	4(%16)	
Never smoked	61(%77,2)	9(%36)	
Quitted	14(%17,7)	8(%32)	**<0,001**

Still smoking	4(%5,1)	8(%32)	
BMI			
<18.5	2(%2,5)	1(%4)	
18,5-25	19(%24,1)	5(%20)	
25-30	19(%24,1)	12(%48)	0,17
30-35	24(%30,4)	6(%24)	
35-40	11(%13,9)	0(%0)	
>40	4(%5,1)	1(%4)	
BMI			
≤ 30	40(%50,6)	18(%72)	0.06
>30	39(%49,4)	7(%28)	

Pulmonary function tests were lower in obese asthmatics than non-obese. Other demographic data is seen on Table 3.

Table 3. Demographic data and pulmonary function tests of study population according to obesity

BMI	Study Population (n:104)		
	≤ 30 (n:58)	>30 (n:46)	p
Gender			
Female	18(%72)	7(%28)	0,06
Male	40(%50,6)	39(%49,4)	
Age	38,33±14,43	50,02±11,13	<**0,001**
Exacerbation in previous year	1,17±1,14	2,02±1,35	0,2
FEV1 (L)	2,94±0,80	2,15±0,68	<**0,001**
FVC (L)	3,36±1,03	2,64±0,67	<**0,001**
FEV1/FVC	76,58±11,86	75,27±9,29	0,53

Asthma control test points were lower in obese asthmatics than non-obese asthmatics. Asthma control status, severity and asthma medications were similar in terms of statistics as seen in Table 4.

Table 4. Asthma severity, control and medications according to obesity

BMI	Study Population (n:104)		
	≤ 30 (n:58)	>30 (n:46)	p
Asthma control test point	19,03±5,45	17,39±5,06	**0,045**
Severity of asthma			
Intermittent	5(%71,4)	2(%28,6)	
Mild persistent	20(%60,6)	13(%39,4)	0,56
Moderate persistent	24(%49)	25(%51)	
Severe persistent	9(%60)	6(%40)	

Asthma control			
Well-controlled	23(%69,7)	10(%30,3)	
Partial control	18(%47,4)	20(%52,6)	0,26
Poor control	7(%53,8)	6(%46,2)	
Acute exacerbation	10(%50)	10(%50)	
Asthma medications			
SABA	35(%60,3)	32(%69,6)	0,411
SABA+SAMA	1(%1,7)	2(%4,3)	0,58
ICS+LABA	36(%62,1)	35(%76,1)	0,14
LAMA	2(%3,4)	0(%0)	0,5
LABA	0(%0)	0(%0)	0
ICS	6(%10,3)	0(%0)	**0,03**
Oral steroid	2(%3,4)	0(%0)	0,50
LTRA	15(%25,9)	12(%26,1)	1,0
Teofilin	2(%3,4)	3(%6,5)	0,65
Asthma control test point			
<20	29(%47,5)	32(%52,5)	
≥20	29(%67,4)	14(%32,6)	**0,048**

DISCUSSION

It is demonstrated in this study that obese asthmatic patients have lower asthma control test points than non-obese, poorer asthma control and decreased pulmonary function test parameters.

It is already known that the risk of asthma increases in parallel to BMI and is strongly associated with weight gain after age 18 years (14), but the relationship between asthma and obesity is not clear of doubt because although BMI is an appropriate and widely accepted measure of adipose tissue amount, it may not be the best measurement of the effect of obesity on the lung and obesity can induce respiratory symptoms in patients without obstructive pulmonary diseases (15,16).

As poor asthma control can increase the expected future risks of asthma, including exacerbation, accelerated decrease in lung function, and side effects of treatment, asthma control test is an essential tool in assessment of asthma in the initial visit and during follow-up (17). The overall management of asthma is based on asthma control so it is useful to define obesity as a risk factor for loss of asthma control. In our study, obese asthmatic patients have lower asthma control test points than non-obese and a poorer asthma control. Generally, all obese people have a decreased exercise tolerance and they perceive dyspnea more severe so they generally assume their asthma control is worse. There are numerous studies indicating that

obese asthmatics usually have difficult-to-control asthma and the prevalence of obesity is high in asthma patients that have uncontrolled asthma (18,19). In addition, when patients with asthma and obesity manage to reduce their weight, there is a decrease in both symptoms and airway hyperresponsiveness, along with an improvement in asthma control (20,21).

The mechanics of breathing alters in obesity, especially due to excess fat deposition in mediastinum and the abdomen. The main difference in obesity is the reduction in compliance. Another important issue is the different breathing pattern in obesity. Obesity increases the negative pleural pressure and intraabdominal pressure, so the flow of air diminishes. As a result, the functional residual capacity (FRC) and the expiratory reserve volume (ERV) decreases (22). In some limited studies, it is demonstrated that obese subjects with asthma have a lower FEV_1 compared with normal-weight subjects with asthma. Our study has shown that obese asthmatics have worse FEV1 and FVC results than nonobese asthmatics.

The main limitation of our study is the lack of prospective design to evaluate the effect of weight loss on asthma control and pulmonary functions. Asthma control test may be an inappropriate or misleading in evaluation of obese asthmatics with regard to marked perception of dyspnea and so vulnerability to use rescue medication than nonobese.

In conclusion, obesity is associated with a worse asthma control and lower pulmonary functions. In addition to standard medical treatments, weight loss may be an alternative strategy for achieving asthma control and better pulmonary functions in asthma.

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