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The Effect of Positions on Spirometric Values in Obese Asthmatic Patients

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ABSTRACT

Obesity as a common health risk is increasing all over the world. The aim of this study was evaluation of standing and sitting positions on spirometric values in obese asthmatic patients, in comparison with normal obese subjects.

The study included 49 obese asthmatic patients with mean age of 42.63 years and body mass index of 36.06 kg/m², and 51 control obese normal subjects with mean age of 39.86 years and body mass index of 36.69 kg/m². Subjects with body mass index of (BMI) ≥30 kg/m² were enrolled in the study. Spirometric values were measured according to American Thoracic Society (ATS) recommendation. In both groups forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) were measured in sitting and standing positions, and the results were compared.

The mean±SD of FVC in sitting and standing positions in obese asthmatic patients were: 3.04±0.93 lit and 3.03±0.96lit, p=0.37; and in control group: 3.68±1.12 lit and 3.72± 1.11 lit, p=0.39, respectively. The mean±SD of FEV1 in the sitting position and standing positions in obese asthmatic patients were: 2.38± 0.75 lit and 2.40± 0.81 lit, p=0.20; and in control subjects: 3.17± 0.92 lit and 3.21± 0.93 lit, p=0.07.

This study showed that spirometric values in obese asthmatic patients with BMI≥30 are not affected by the standing and sitting positions.

Key Words: Body mass index; Lung volumes; Obesity; Pulmonary function test

INTRODUCTION

Obesity is a major health problem which seems to be increasing all around the world.[1] Body mass index (BMI)has significant effects on all of the lung volumes, particularly functional residual capacity (FRC) and expiratory reserve volume.[2]

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In normal subjects, lung volumes are slightly but significantly higher in standing position.[3,4] American Thoracic Society (ATS) and European guidelines have recommended that lung volumes and forced ventilatory flows to be measured in seated upright body position.[5,6] In one study no differences were detected between spirometric values obtained in sitting and standing positions.[7] Lalloo *et al*, reported that in healthy subjects spirometric indices were higher in the standing in comparison with the sitting position.[8] Gudmundsson *et al,* showed that body position is not important when

performing spirometry in obese subjects with BMI ≥ 30 kg/m^2. [9] In both groups of obese and non-obese individuals maximum inspiratory and expiratory pressures (PImax and PEmax) values decreased in the supine posture with respect to upright and sitting positions.[10] Differences between pressures in the various postures were similar for both groups with the exception of PEmax in obese females.[10] The aim of this study was to determine if spirometric values of obese asthmatic individuals are different in the standing versus sitting positions, and to compare the results of changes with normal obese subjects.

MATERIALS AND METHODS

The study was conducted in the department of internal medicine of Kashan University of Medical Sciences, Kashan, Iran. Obese asthmatic patients (case group) requiring spirometric testing were invited to participate, and the results were compared with obese normal subjects (control group). BMI (in kg/m^2) was calculated for each participant. Obesity was defined as BMI ≥ 30 kg/m^2.

Spirometry was done using a spirometer (Fukuda Spiroanalyser ST 95), according to ATS recommendations.[5] A minimum of three forced expiratory maneuvers were performed at each session, and the two best were reproducible. The test result with the highest sum of the forced vital capacities (FVC) and forced expiratory volume in 1 second (FEV1) from individual maneuvers was included in the data analysis. Forced vital capacities (FVC), forced expiratory volume in 1 second (FEV1), forced expiratory flow at 25 to 75% of vital capacity (FEF25–75) were measured and the FEV1/FVC ratio was calculated. The diagnosis of asthma was made on clinical grounds and required objective criteria of reversible airway obstruction as [an improvement in FEV1 ≥ 15% (and ≥ 200 ml) after inhalation of a short-acting β2-agonist] defined by the American Thoracic Society.11 In both groups the spirometry maneuvers were performed alternately in sitting and standing positions with an interval of 15 minutes between the positions.

Parameters are expressed as mean±SD. The groups were compared by the Mann-Whitney U-test and by the Wilcoxon signed-rank tests, when appropriate. Differences between postures and groups were assessed by paired and unpaired *t*-tests, respectively. A P-value of less than 0.05 was considered statistically significant. Statistical analysis was performed by means of statistical software package (SPSS version 10.0 for windows). Changes of spirometric values for both obese asthmatic and obese normal subjects in sitting and standing positions were calculated as percentage of change relative to baseline FVC, FEV1 and $FEF_{25–75}$ by the following equation: Percentage of change = [(observed- base) / base] × 100 were base a on the first spirometric value that was obtained in either standing or supine positions, and observed is the second value of this measurement.

RESULTS

In this study, 49 obese asthmatic patients (mean age 42.63 ± 11.76 years, body mass indices 36.06 ±5.06kg/m^2), were evaluated with spirometric assessment of FVC, FEV_1 and $FEF_{25–75}$ in the sitting and standing positions, and the results were compared with 51 control obese normal subjects (mean age 39.86 ± 10.09 years, BMI 36.69±4.06 kg/m^2). Age range was between 18 and 50 years. The characteristics of both groups are shown in Table 1.

Table 2 gives the results of the spirometric values performed in sitting and standing positions. The differences between the different rates were not significant for the positions chosen.

Table 3 shows that percentage change of spirometric values (FVC, FEV1, and $FEF_{25–75}$) between standing and sitting positions in the two groups are not statistically significant (p=0.72, 0.11, and 0.13, respectively).

In obese asthmatic patients FVC was higher in the standing position in 19 individuals compared to sitting in 26 individuals, and in 4 patients was equal. Whereas, in normal subjects FVC was higher in the standing position in 28 individuals compared to sitting in 19 individuals, and in 4 subjects was equal.

DISCUSSION

Our results do not show significant differences between the standing and sitting positions for measurements of spirometric values. The measurements of FEV1 in both groups of patients, and for FVC in obese normal subjects in standing position were slightly higher than sitting position, but for FVC in obese normal subjects in sitting position were slightly lower than standing (Table 2).

Table 1. Characteristics of subjects.

Characteristics	Obese asthmatic patients (no=49)		Obese normal subjects (no=51)	
Male / Female	Mean±SD	95% CI	Mean±SD	95% CI
	24/25		20/31	
Age, yr	42.63±11.76	39.34-45.92	39.86±10.09	37.09-42.63
Weight, kg	94.10±11.12	90.99-97.21	98.14±12.03	94.84-101.44
Height, cm	162.02±9.23	159.44-164.60	163.47±10.53	160.58-166.36
BMI	36.06±5.06	34.64-37.48	36.69±4.06	35.58-37.80

Table 2. Spirometric values in sitting and standing positions of two groups of obese asthmatic and obese normal subjects.

Parameters	Obese asthmatic patients (n=49)		P-value	Obese normal subjects (no=51)		P-value
	Mean±SD	95% CI		Mean±SD	95% CI	
FVC, lit						
Sitting	3.04± 0.93	2.78 - 3.30	0.37	3.68 ± 1.12	3.37 - 3.99	0.39
Standing	3.03± 0.96	2.76 - 3.30		3.72 ± 1.11	3.42 - 4.02	
FVC, % pred						
Sitting	86.49± 16.54	81.86 - 100.38	0.95	100.37 ± 14.12	96.49 - 104.25	0.37
Standing	86.22± 17.50	81.32 - 91.12		101.24± 14.65	97.22 - 105.26	
FEV1, lit						
Sitting	2.38± 0.75	2.17 - 2.59	0.20	3.17± 0.92	2.92 - 3.42	0.07
Standing	2.40± 0.81	2.17 - 2.63		3.21±0.93	2.95 - 3.47	
FEV1, % pred						
Sitting	80.86±17.73	75.9 - 85.82	0.74	101.76±13.86	97.96 - 105.56	0.09
Standing	80.61± 18.56	75.41 -85.81		103.02±14.51	99.02 - 106.98	
FEF 25-75%, lit/sec						
Sitting	2.92± 1.33	2.55 - 3.29	0.44	4.50±1.59	4.06 - 4.94	0.85
Standing	2.89±1.33	2.52 - 3.26		4.42±1.47	4.02 - 4.82	
FEF 25-75 %, % pred						
Sitting	77.67±33	68.43 - 86.91	0.95	116.49±31.29	107.90 - 125.08	0.33
Standing	77.61± 33.77	68.15 - 87.07		115±27.86	107.35 - 122.65	
FEV1 / FVC						
Sitting	79.10± 9.02	76.57 - 81.63	0.46	86.45±4.78	85.14 - 87.76	0.85
Standing	78.63± 8.53	76.24 - 81.02		86.51±4.90	85.16 - 87.86	

Table 3. Spirometric values changes of obese asthmatic and obese normal subjects in sitting and standing positions.

Variables	Obese asthmatic patients (n = 49)		Obese normal subjects (no = 51)		P-value
	Mean±SD	95% CI	Mean±SD	95% CI	
FVC values	4.59±4.65	3.29-5.89	5.05±4.86	3.72-6.38	0.720
FEV1 values	5.14±5.49	3.60-6.68	3.63±3.62	2.64-4.62	0.110
FEF 25-75 % values	6.70±7.70	4.54-8.86	8.11±10.90	5.12-11.10	0.132

CI= confidence interval

When we compared the results of percentage change of spirometric values among obese asthmatic patients with those obese normal subjects, it was not significant (Table 3).

In a study, conducted by Townsend on 90 middle-aged male subjects with alternated sitting-standing and standing-sitting testing sequences between subjects, FEV1 and FVC were significantly larger (p less than 0.001) in the standing position.[3] Gudmundsson *et al*, reported the results of study in 50 obese subjects, and found that there was a small but statistically significant difference between forced vital capacity (FVC) in the standing versus sitting positions, but there was no significant difference in FEV1 between sitting and standing positions.[9]

In another study that was conducted by Fiz *et al,* on ten obese patients, and ten normal control subjects, in both groups maximum inspiratory and expiratory pressures values decreased in the supine posture with respect to standing and sitting positions.[10] In healthy men with BMI < 30 kg/m^2, changing from the sitting to supine or prone positions resulted in statistically significant change in respiratory pattern. However, all spirometry values in each position were normal according to American Thoracic Society definitions.[12]

Obesity is a serious health-nutritional problem, which is increasing in the entire world. It is well known that obesity causes decreased lung volumes, and functional residual capacity (FRC) and expiratory reserve volume (ERV) decreases exponentially with increasing BMI.[2] Total respiratory system resistance is elevated in obese subjects. The increase in respiratory system resistance in obese people is likely related to increased resistance at the level of the small, rather than large, airways (due to reduced lung volume), and so the FEV_1 /FVC ratio remains normal (in the absence of concomitant obstructive lung disease).[13] Respiratory resistance increases in the supine position, as compared to upright body position, possibly due to mass loading of the supralaryngeal airways by fat and increased intrapulmonary blood flow leading to further airway narrowing.[13-15] Reduced functional residual capacity (FRC) may also contribute to the increased resistance in the supine position.[13]

In another study on obese subjects, spirometric values decreased only in supine position compared with sitting and standing positions.[7] Spirometric values in obese asthmatic patients with BMI≥30 seems to not be affected by the positions of the standing and sitting.

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