

Respiratory muscles power reversibility test as a new test in asthma diagnosis

Abstract

Making diagnosis of asthma requires a critical evaluation of the patient's symptoms, medical history, physical examination and diagnostic tests. It is known that a reduction of respiratory muscle pressures (MIP and MEP) for assessment of respiratory muscles power has been associated with several neuromuscular diseases, but it is also possible to point out lower values in patients with chronic obstructive pulmonary diseases as in asthma. As asthma diagnosis by reversibility test is not very sensitive in intermittent and mild asthma and pulmonary function is related to respiratory muscle pressures (RMP), could we use the reversibility of RMP in the patients for asthma diagnosis is the main issue investigated in this research. The aim of the study to determine the validity of asthma diagnosis by reversibility testing of respiratory muscles power. A cross-sectional hospital based study carried out in Lung function tests clinic in Police and Alban Gadeed hospitals in Khartoum during the years 2010-2011 to determine the reversibility of the lung function (FEV1 and PEFR) and respiratory muscles power (MEP and MIP). Thirty five known asthmatic subjects attending the referred chest clinic for follow up, and 20 healthy non asthmatic controls were included in the study. FEV1, PEFR, MEP and MIP were measured for all subjects before and after bronchodilator. Reversibility test was considered positive assuming the cut-off point for FEV1, MEP and MIP is $\geq 12\%$ and for PEFR $\geq 20\%$. The results showed percent of change in asthmatic group before and after bronchodilator test for FEV1, PEFR, MEP, MIP were: 10.45, 11.84, 12.15 and 16.73 respectively. The difference was statistically significant. Sensitivity and specificity of reversibility testing for FEV1 (40%, 75%), for PEFR (31%, 65%), for MEP (49%, 70%) and for MIP (71%, 65%). In conclusion, the respiratory muscles power reversibility test could be a potentially sensitive diagnostic test for asthma

Keywords: pulmonary, lung function, respiratory muscles power, asthma

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Abbreviations: FVC, forced vital capacity; FEV1, forced expiratory volume in first second; PEFR, peak expiratory flow rate; RMP, respiratory muscle pressures; MEP, maximal expiratory pressure; MIP, maximal inspiratory pressure

Introduction

Making the diagnosis of asthma requires a critical evaluation of the patient's symptoms, medical history, physical examination and diagnostic tests.¹

In several diseases, the evaluation of respiratory muscles power can prove to be very useful. The measurement of the respiratory muscle pressures (MEP, maximal expiratory pressure; MIP, maximal inspiratory pressure) is the most widely used to assess respiratory muscles power.^{2,3} It is known that a reduction of MIP and MEP has been associated with several neuromuscular diseases, but it is also possible to point out lower values in patients with chronic obstructive pulmonary diseases as in asthma.⁴⁻⁶ Age and sex could influence MIP and MEP values; these are lower in females than in males and quite constant until seventy years of age when they start to decrease.⁷

Inspiratory muscle training (IMT) was studied in a group of 25 children with asthma and compared with another 25 asthmatic controls not subjected to the same IMT as the first ones. MIP, MEP and PEFR increased significantly in IMT group. MIP increased from 48.32 ± 5.70 to 109.92 ± 18.04 cm H₂O and MEP increased from 50.64 ± 6.55 to 82.04 ± 17.01 cm H₂O and PEFR increased from 173.60 ± 50.82 to 312.00 ± 54.85 . The study concluded that IMT can increase the efficiency of respiratory muscles, lung function and improve the clinical situation of the patients.⁸ This positive correlation

of IMT and improved pulmonary function indicate the important relation between respiratory muscle pressures (RMP) and the level of pulmonary function value.

Reversibility test is considered positive for asthma diagnosis if FEV1 is increased by 12-15%. Values more than 12% in FEV1 compared to baseline during a single testing session suggest significant bronchodilation.^{9,10} An improvement of more than 20% from baseline in PEFR is also considered positive response to bronchodilators as recommended by British Thoracic Society (BTS).¹¹

Low sensitivity of the reversibility test by pulmonary function may need to search for other tests to diagnose asthma as in mild & intermittent asthma types.

As asthma diagnosis by reversibility test is not very sensitive in intermittent and mild asthma, and pulmonary function is related to RMP, could we use the reversibility of RMP in the patients for asthma diagnosis is the main issue investigated in this research.

Objectives

General:

- To study the validity of asthma diagnosis by reversibility testing of respiratory muscles power.

Specific:

This study aim at the following:

- To perform the reversibility test by respiratory muscle pressures (RMP).

- To determine the sensitivity and specificity of lung function (FEV1 and PEFR) and RMP (MEP and MIP) reversibility testing in diagnosis of asthma.
- To determine the sensitivity of lung function and respiratory muscles power reversibility testing in diagnosing mild & intermittent asthma types.

Methods

This is a cross-sectional hospital based study carried out in Lung function tests clinic in Police and Alban Gadeed hospitals in Khartoum during the years 2010-2011 to determine the reversibility of the lung function (FEV1 and PEFR) and respiratory muscles power (MEP and MIP). Thirty five known asthmatic subjects (19 female, 16 males) attending the referred chest clinic for follow up, and 20 healthy non asthmatic controls (12 female, 8 males) were included in the study.

Following signed written consent, baseline test for FEV1, PEFR, MEP and MIP (before bronchodilator) were obtained for all subjects. Two to four puffs of salbutamol inhaler were given to all subjects through mouth via a spacer device and the same test was repeated for all subjects after 15 minutes of salbutamol inhaler (after bronchodilator). The % of change of each parameter was calculated.

Lung function (FVC, FEV1, PEFR) and respiratory muscle pressures (MEP, MIP) were measured using digital spirometer and respiratory pressure meter respectively. Paired t- test was used for comparing variables before and after the test. P value < 0.05 were considered to be significant. Reversibility test was considered positive assuming the cut-off point for FEV1, MEP and MIP is $\geq 12\%$ and for PEFR $\geq 20\%$.

Results

35 asthmatic subjects (19 females and 16 males) and 20 non asthmatic healthy controls (12 females and 8 males) were included in the study. The two groups were matched in terms of age, sex height (ht) and weight (wt). Mean, standard deviation (SD) before and after bronchodilator test in asthmatics were as follows: FVC (2.56±0.86, 2.83±0.90L), FEV1 (2.01±0.78, 2.22±0.80L), PEFR (291.77±127.87, 326.31±137.91 liter/sec), MEP (82.54±23.44, 92.57±26.90 cm H₂O) and MIP (65.37±26.92, 76.31±25.62 cm H₂O). The percent of change after bronchodilator test were: 10.54, 10.45, 11.84, 12.15 and 16.73 respectively (Table 1)(Figure 1). The difference was statistically significant. Mean, SD before and after bronchodilator test in control group were as follows: FVC (3.10±0.64, 3.15±0.61L), FEV1 (2.71±0.57, 2.79±0.59L), PEFR (329.45±120.71, 338.65±125.39L/sec), MEP (81.10±24.74, 84.75±27.15 cm H₂O) and MIP (72.60±24.05, 74.30±24.60 cm H₂O). The percent of change after bronchodilator test were: 1.61, 2.95, 2.79, 4.50 and 3.18 respectively. The difference was statistically insignificant. The total number of cases with positive MEP, MIP, FEV1 and PEFR reversibility testing in asthmatics was: 17, 25, 14 and 11 respectively. Sensitivity and specificity of reversibility testing in all asthmatic subjects for FEV1 (40%, 75%), for PEFR (31%, 65%), for MEP (49%, 70%) and for MIP (71%, 65%). Sensitivity of FEV1, PEFR, MEP and MIP reversibility testing in mild & intermittent asthma were 29%, 29%, 43% and 67% respectively and in severe & moderate asthma were 50%, 33%, 57% and 78% respectively (Table 2).

Table 1 Mean, SD, % change and P value before and after bronchodilator (BD) reversibility test of FVC, FEV1, PEFR, MEP and MIP of asthmatics (n=35)

Parameter	Asthmatics		P value
	mean±SD	% change	
FVC(L) before BD	2.56±0.86	10.54	0.007
FVC(L) after BD	2.83±0.90		
FEV1(L) before BD	2.01±0.78	10.45	0.000
FEV1(L) after BD	2.22±0.80		
PEFR(L/sec) before BD	291.77±127.87	11.84	0.001
PEFR(L/sec) after BD	326.31±137.91		
MEP(cmH ₂ O) before BD	82.54±23.44	12.15	0.002
MEP(cmH ₂ O) after BD	92.57±26.90		
MIP(cmH ₂ O) before BD	65.37±26.92	17.73	0.000
MIP(cmH ₂ O) after BD	76.31±25.62		

Table 2 Sensitivity of FEV1, PEFR, MEP and MIP reversibility testing in mild & intermittent asthma and moderate & severe asthma

Type of asthma	Sensitivity			
	FEV1	PEFR	MEP	MIP
Mild & intermittent	29%	29%	43%	67%
Moderate & severe	50%	33%	57%	78%

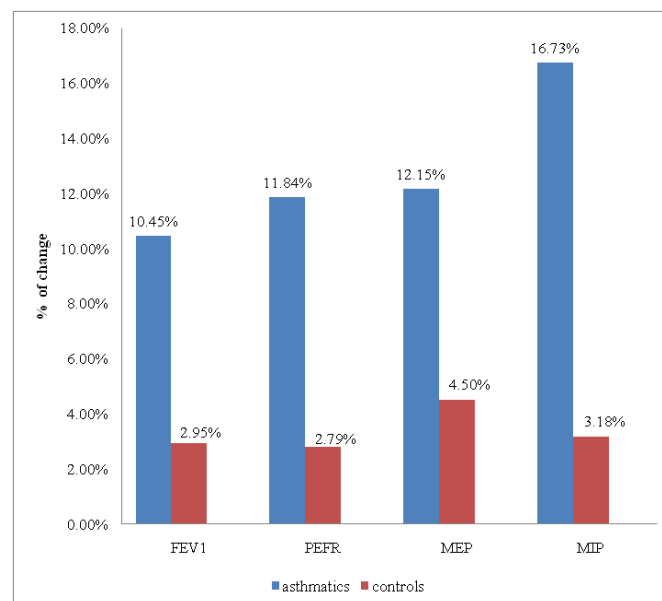


Figure 1 % of change in FEV1, PEFR, MEP and MIP after the bronchodilator in asthmatics and control subjects.

Discussion

The respiratory pressure meter measures the respiratory muscles power as a function of the air volume expired or inspired by effort.

In the present study of reversibility testing, significant increase was observed in lung function (FVC, FEV1 and PEFR) of asthmatic

subjects compared to controls (non asthmatic) after bronchodilator test. Similar results were also obtained for MEP and MIP where significant increase in these parameters was observed in asthmatics after bronchodilator test. The greater percent of change in asthmatic subjects after reversibility testing has occurred in respiratory muscle pressures (MEP & MIP) more than lung function parameters in the present study. Eleven cases with FEV1 negative reversibility testing were found to be MIP positive for reversibility testing, however, 9 of these 11 cases were classified as mild and intermittent asthmatics. This implies that patients with negative reversibility testing of lung function could be diagnosed by respiratory muscle pressures reversibility testing even those with mild and intermittent asthma. MEP and MIP were found to be lower in patients with severe airway impairment than normal healthy subjects in a study conducted by Claudio Terzano et al.,¹² The reduction in MEP and MIP was found to be lower in patients with slight reduction of FEV1.¹²

Asthma increases the work load on respiratory pump by causing increase in airway resistance, the inspiratory muscles bear the majority of this load whereas expiratory muscle recruitment is relatively minor.¹³ This may explain in part the result that MIP increased more than MEP after bronchodilator test. Higher sensitivity of MEP and MIP reversibility testing in asthmatic subjects compared to that of FEV1 and PEFr may imply that respiratory muscle pressures reversibility tests could be a potential sensitive test in diagnosis of asthma. Higher sensitivity of MEP and MIP reversibility test in intermittent and mild asthma may further imply that respiratory muscle pressures reversibility testing could be a better sensitive test in diagnosis of mild and intermittent asthma.

Further studies must also focus on broncho provocation tests of respiratory muscles power in asthmatics who had negative reversibility testing for further confirmation of the results obtained in our present study.

Conclusion

Respiratory muscles power reversibility test could be a potentially sensitive diagnostic test for asthma.

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Conflict of interest

The authors declare that there is no conflict of interest.

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