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Evaluation of the Maximal Respiratory Pressure in Children and Adolescents with Asthma between 7 and 14 Years Old

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Abstract

Objectives: To evaluate the respiratory muscle strength among children (<10 years old) and adolescents with asthma.

Methods: This is a cross-sectional, retrospective study, among children and adolescents (7 years to 14 years of age) with asthma. Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) [in cmH_2O] were measured through digital manometer. The variables evaluated were: gender, age, BMI (body mass index), severity of asthma, use of inhaled corticosteroid (IC).

Results: A total of 48 individuals were studied. MIP values were according: a) normal weight=69.5 ± 22.6; overweight=81.6 ± 25.4 (p<0.088); b) use of inhaled corticosteroid=70.5 ± 23.0; no use=25.1 ± 86.3 (p<0.045). MEP values according: a) ages 7-9 years=78.8 ± 19.4; 10-14 years=68.1 ± 22.7 (p<0.097); b) normal weight=66.1 ± 18.9; overweight=80.3 ± 23.3 (p<0.024); c) use of inhaled corticosteroid=68.3 ± 18.3; no use=83.1 ± 27.5 (p<0.036); d) with bronchiectasis=61.8 ± 19.2; without bronchiectasis=83.1 ± 27.5 (p<0.069).

Conclusions: Patients who used inhaled corticosteroid had MIP and MEP lower than the others; patients with normal BMI tended to have lower MEP than the overweight group and lower MIP in the group of normal weight. There was a tendency of adolescents to present lower MEP than children.

Keywords: Respiratory muscle strength; Asthma; Bronchial asthma; Respiratory muscles; Breathing exercises; Child; Adolescents

Introduction

There is a high prevalence of asthma in Brazil, getting up to 20% in children and adolescents [1]. The disease progresses with lung hyperinflation affecting the action of the respiratory muscles. It can lead to diaphragm flatness due to its insertion into the inner surface of the xiphoid process and vertebral bodies of the second and third lumbar vertebrae, leaving it at a mechanical disadvantage, which results in a limitation of inspiratory muscles [2].

The measurement of respiratory muscle strength (RMS) through the maximal respiratory pressures (MRP) is performed through a simple, non-invasive mechanism which allows estimating lung function [3]. The measurement of RMS in adults shows a strong correlation between quality of life, dyspnea and respiratory muscle weakness in patients with COPD [4]. In Brazil there are few studies on RMS in children with asthma.

The evaluation of MRP by measuring the maximal inspiratory pressure (MIP) and the maximal expiratory pressure (MEP) may be applied in the differential diagnosis of dyspnea, a response evaluation to the training of the respiratory muscles, the preoperative evaluation of respiratory muscle function, the evaluation of the possibility of weaning from mechanical ventilation and the evaluation of the capacity of the respiratory muscles in different disorders (chronic obstructive pulmonary disease, asthma, respiratory failure, malnutrition, neuromuscular diseases and disorders of the chest) [5].

Until 2010, there were three articles on children which evaluated the relationship between respiratory muscle training and MIP, the relationship between MIP and nutritional status and reproducibility of MIP, respectively. Although difficult for children, RMS measurement is simpler to be performed than spirometry [6]. Previously, in 1980´s, Wilson et al. [7] had studied 235 children and adolescents between 7 years to 17 years old and 135 adults between 18 years to 70 years old and showed that MEP and MIP had significant correlation with age in men and height in women. In both sexes MIP was related to weight and MEP to age.

In 2013 a systematic review of the training of the inspiratory muscles in asthmatics was not conclusive to support or refute the inspiratory muscle training in patients with asthma due to the small number of trials and the methodological pattern variability [8].

The present study aimed to describe demographic, clinical and RMS aspects of children and adolescents with asthma, treated at an outpatient clinic.

Method

Cross-sectional, descriptive and analytical study with prospective data collection among children and adolescents aged 7 to 14 years old, treated in a pediatric pulmonology service from January 2010 to July 2014.

Patients with intermittent, mild persistent, moderate persistent and severe persistent asthma that were controlled or partially controlled

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were included, according to GINA 2014 [1]. The following patients were excluded: those who failed to undergo the examination due to lack of cooperation, with bronchospasm at the time of the examination, those who were part of a respiratory therapy program or whose parents refused to sign the Informed Consent.

The variables studied were sex, age, asthma classification [1], body mass index (BMI), current use of inhaled corticosteroids (IC), and presence of bronchiectasis. The BMI was calculated according to the formula of Lambert Quételet: weight (kg)/height (meters) and adapted to the World Health Organization (2013) table for childhood obesity [2].

The current use of IC was considered when used for more than three months and the controlled asthma for more than two months, according to notes from medical records and verbal confirmation of its leaders; the existence of bronchiectasis was confirmed by chest computed tomography.

Patients underwent a medical examination, anthropometric measurements at the time of evaluation, O_2 saturation and their parents signed the informed consent and performed the measurement of RMS by digital manometer. Digital manometer MVD 300 (Globalmed®, Porto Alegre-RS, Brazil) calibrated from -300 to +300 cmH_2O was used, with a precision of 1 cmH_2O connected to a computer that provided the participant with a visual and auditory feedback. The digital manometer was attached to a disposable biofilter of individual use.

The tests were made in the sitting position, with maximal sustained voluntary ventilation technique (MVV). A nose clip to prevent leakage and a whole diameter of 2 mm between the connector and the nozzle were used [9].

Each patient was evaluated in five tests, at least three of them reproducible lasting two continuous seconds each, in 1-minute interval between them. The highest value was utilized for the test, being reproduced at peak pressure. MIP was measure during maximal inspiratory after full expiration, at which time the residual volume is nearly minimal. MEP was measured during maximal expiration after full inspiration, at which time the lung is nearly full. The different results of up to 10% more or less than the other values were discarded [10]. Wilson et al. [7] standards were used for the predicted values of RMS, as it is the only reference for children and adolescents in medical literature. Descriptive statistical analysis was presented in the form of tables of the observed data, expressed by mean, standard deviation, median, interquartile range (IQR), minimum and maximum for numeric data, frequency (n), percentage (%) for categorical data and interquartile range. The inferential analysis, on an exploratory basis, consisted of the following methods: the comparison of MEP and MIP between subgroups of clinical variables and asthma was analyzed by Student's t test for independent samples. The conformity between observation and prediction of MIP and MEP was measured by the interclass correlation coefficient (ICC). The normal distribution was assessed by the Shapiro-Wilks test. The significance determination criterion adopted was the level of 5%. Statistical analysis was performed with SAS® statistical software, version 6.11 (SAS Institute, Inc., Cary, North Carolina) [11].

Project approved by the Research Ethics Committee (CEP) of UFRJ- IPPMG # 63/09- on December 22nd, 2009.

Results

Sixty children were evaluated and 48 were included, out of which 31 (64.6%) were male and 17 (35.4%) were female. The reasons for exclusion were differences in MRP values by more than 10% between them, unreliable tests due to uncooperative patients.

They were classified as intermittent asthma (N=8), mild persistent (N=13), moderate persistent (N=17) and severe persistent (N=10). All had controlled or partially controlled asthma.

Tables 1 and 2 describe MIP and MEP values, means and standard deviation.

Discussion

This paper described the RMS in asthma patients between 7 and 14 years old, ideal stage to make stress-dependent examination, as the exhalation and inhalation movements are perfectly understandable by the tested individuals. Our sample was relatively higher than those presented in the literature on the role of MIPs in the evaluation of RMS in asthmatic children [6].

There was a higher prevalence of adolescents with moderate to severe asthma, around 78% of the total. Although controlled, they showed decreased RMS, especially in the group using IC. Perhaps this is due to the fact that bronchial obstruction and lung hyperinflation lead to increased resistance to air flow, which can hamper the respiratory muscles in performing their function in more severe cases [12].

Solé et al. [13] in Brazil, evaluated RMS in children and adolescents between 6 and 16 years old with mild to moderate asthma and concluded that in their sample there was no significant difference between normal and asthmatic subjects. Mild and moderate asthmatics may not have significant lung hyperinflation that results in a change in position of the diaphragm and therefore not affecting the RMS (Figure 1) [14].

Variable	Subgroup	n	Mean	±	DP	p value[a]
Age (years)	7 to 9	19	77.6	±	24.1	0.52
	10 to 14	29	73	±	24.8	
Sex	Female	17	73.5	±	23.3	0.78
	Male	31	75.5	±	25.3	
Body mass index	Normal	27	69.5	±	22.6	0.088
	Overweight	21	81.6	±	25.4	
Asthma classification	Intermittent/light	21	79.4	±	23.5	0.25
	Moderate/severe	27	71.2	±	24.9	
Inhaled corticosteroids	Yes	35	70.5	±	23	0.045
	No	13	86.3	±	25.1	
Bronchiectasis	Yes	11	68.1	±	27.4	0.3
	No	37	76.8	±	23.5	

[a]Student's t test for independent samples

Table 1: MIP values (cmH_2O) in children and adolescents with asthma.

Variable	Subgroup	n	Mean	±	DP	P value[a]
Age (years)	7 to 9	19	78.8	±	19.4	0.097
	10 to 14	29	68.1	±	22.7	
Sex	Female	17	67.4	±	16.8	0.25
	Male	31	75	±	24.1	
Body mass index	Normal	27	66.1	±	18.9	0.024
	Overweight	21	80.3	±	23.3	
Asthma classification	Intermittent/light	21	77.6	±	23.9	0.14
	Moderate/severe	27	68.2	±	19.7	
Inhaled corticosteroids	Yes	35	68.3	±	18.3	0.036
	No	13	83.1	±	27.5	
Bronchiectasis	Yes	11	61.8	±	19.2	0.069
	No	37	75.4	±	21.9	
[a]Student's t test for independent samples						

Table 2: MEP values (cmH2O) in children and adolescents with asthma.

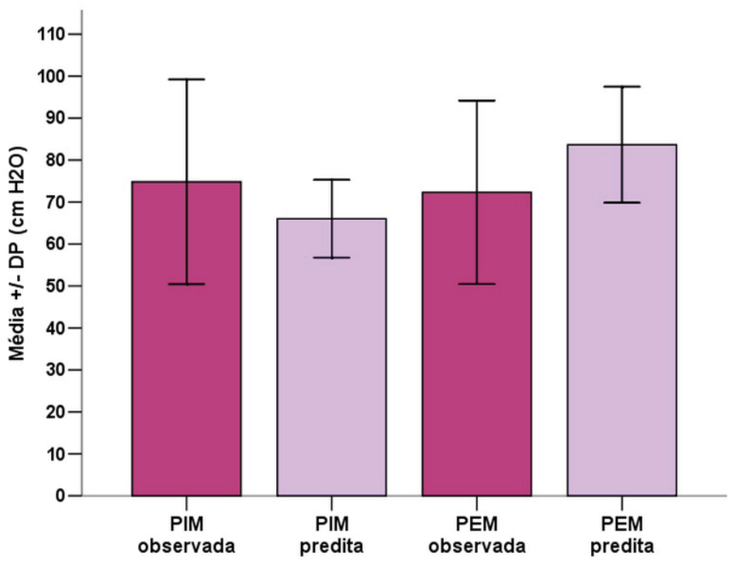

Figure 1: Mean values (cmH_2O) of MEP and MIP (predicted and patients) of 48 patients with asthma.

Conclusion

In our study, we observed decreased RMS (MIP and MEP) in patients using IC for more than three months (n=35) compared to those who did not use it (n=13). There were no patients using IC for less than three months. However, as the sample is not homogeneous, it would be incorrect to say that the use of IC influenced directly the RMS or was influenced by the severity of the disease.

In our study the group of children with normal BMI had significantly lower MEP values than the overweight group (p=0.024). The obesity impacts on RMS have been much discussed in the literature, especially regarding effects on the MIP. It is believed that obese people may show changes in the distribution of ventilation and gas exchange abnormalities. There is a decreased lung compliance which implies damage to mechanical ventilation with increased respiratory effort, in addition to potential inefficiency and decreased ability to generate strength for ventilation [15].

In Santa Catarina, Brazil, Rosa and Schivinski [16] observed healthy and normal school children, and identified a strong relationship among obesity, overweight and RMS. In asthmatic obese adults, Mosen et al. [17] observed that it is related to reduced quality of life, lack of control and increased hospitalization in obese patients if compared to non-obese asthmatics.

Among the limitations of our study, we compared only patients with asthma among each other, and not with healthy and overweight/obese children. Further study of RMS with reference values for Brazilian children may complement our work. Furthermore, future studies on intervention in RMS of asthmatic children and adolescents through low cost and good acceptance practices, in addition to the specific treatment of the disease, may show improvement in their quality of life.

References

1. Beasley R (2014) The global burden of asthma report. GINA pocket 2014.
2. Hill AR (1991) Respiratory muscle function in asthma. J Assoc Acad Minor Phys 2: 100-108.
3. Weiner P, Suo TJ, Fernandez E, Cherniack RM (1990) Hiperinsuflation is assossiated with reduced strengh and efficiency of the respiratory muscle in asthmatic and normal subjects. Chest 97: 69S-70S.
4. Weiner P, Magadle R, Beckerman M, Berar-Yanay N (2012) The relationship among inspiratory muscle strength, the perception of dyspnea and inhaled beta2-agonist use in patients with asthma. Can Resp J 9: 307.

5. Arora NS, Rochester DF (1982) Respiratory muscle strength and maximal voluntary ventilation in undernounrished patients. Am Rev Dis 126: 5-8.
6. Cavalcante AMFM, Silva HJ (2010) Role of maximal inspiratory presure in the evaluetion of respiratory muscle strengh in asthmatics: Systematic review. Rev Portuguesa Pneumol 16: 463-470.
7. Wilson SH, Cooke NT, Edwards RHT, Spiro SG (1984) Predicted normal values for maximal respiratory pressures in caucasian adults and children. Thorax 39: 535-538.
8. Silva IS, Fregonezi GA, Dias FA, Ribeiro CT, Guerra RO, et al. (2013) Inspiratory muscle training in asthma. Syst Rev CD: 003792.
9. Wagener JS, Hibbert ME, Landau LI (1984) Maximal respiratory pressures in children. Am Rev Respir Dis 129: 873-875.
10. American Thoracic Society/European Respiratory Society (2002) ATS/ERS Statement on respiratory muscle testing. Am J Respir Crit Care Med 166: 518-624.
11. Bartko JJ, Carpenter WT (1976) On the methods and theory of reliability. J Nervous Mental Dis 163: 307-316.
12. How SC, Romer LM, MC Connell AK (2009) Acute effects of inspiratory pressure threshold loading upon airway resistence in people with asthma. Respir Phisiol Neurobiol 166: 159-163.
13. Weiner P, Mc Connell A (2005). Respiratory muscle training in chronic obstructive pulmonary disease: Inspiratory, expiratory or both? Curr Opin Pulm Med 11: 140-144.
14. Santiago SQ, Silva ML, Davidson J, Aristóteles LR (2008) Evaluation of respiratory muscle strengh in overweight/ obese children and adolescents. Rev Paul Pediatr. 26: 146-150.
15. Lazarus R, Colditz G, Berkey CS, Speizer FE (1997) Effects of body fat on ventilator function in children and adolescents: Cross- sectional findings from a random population sample of schoolchildren. Pediatr pulmonol 24: 187-194.
16. Rosa GJ, Schivinski CIS (2014) Assessment of respiratory muscle strength in children according to the classification of body mass index. Rev paul Pediatr 32: 250-255.
17. Mosen DM, Shatz M, Magrid DJ, Camargo CA Jr (2008) The relationship between obesity and asthma severity and control in adults. J Allergy Clin Immunol 122: 507-511.