Available online at http://www.journalijdr.com

IJDR

ISSN: 2230-9926

International Journal of Development Research
Vol. 09, Issue, 11, pp. 32107-32110, November, 2019

RESEARCH ARTICLE OPEN ACCESS

RELATIONSHIP BETWEEN SPIROMETRIC AND MANOVACUOMETRIC PARAMETERS IN ASTHMATIC PATIENTS NOT SUBJECT TO REHABILITATION PROGRAMS

*[1]COUTINHO, Augusta Adna Souza, [2]CARVALHO, Amanda Ferraz, [3]MOREIRA, Mariana Aparecida Oliveira, [4]SILVA, Rodrigo Nascimento, [5]LIMA, Leonardo da Silva and [6]CARACAS, Danilo Rocha Santos

Docente da Faculdade Independente do Nordeste – FAINOR. Vitória da Conquista, Bahia, Brazil

ARTICLE INFO

Article History:
Received 17th August, 2019
Received in revised form
26th September, 2019
Accepted 03rd October, 2019
Published online 30th November, 2019

Key Words:
Asthma. Spirometry.
Respiratory muscles.

Corresponding author:
COUTINHO, Augusta Adna Sousa

ABSTRACT

Asthma severity and response to treatment can be assessed by monitoring clinical and functional respiratory parameters obtained by spirometry. The study aims to relate spirometric variables to maximal inspiratory and expiratory pressures in asthmatic patients not undergoing rehabilitation programs. This is a cross-sectional and analytical study composed of 16 asthmatic individuals submitted to anamnesis and physical examination followed by spirometry and manovacuometry. It is observed that in the present sample there is a positive linear correlation of the reduction in expiratory muscle contraction force (maximal expiratory pressure) considering the final expiratory volume 1 and functional vital capacity spirometric values, but there was no significant correlation in the other variables studied. It is important that the person with asthma is aware of the severity of the crises and the care to be taken, which facilitates the control of the disease, as it helps in the management of treatment, consequently improving the quality of life. This is possible due to the ability to accurately measure the lung capacity and ventilatory muscle of individuals.

Citation: COUTINHO, Augusta Adna Souza, CARVALHO, Amanda Ferraz, MOREIRA, Mariana Aparecida Oliveira, SILVA, Rodrigo Nascimento, LIMA, Leonardo da Silva and CARACAS, Danilo Rocha Santos. 2019. "Relationship between spirometric and manovacuometric parameters in asthmatic patients not subject to rehabilitation programs", *International Journal of Development Research*, 09, (11), 32107-32110.

INTRODUCTION

Asthma is a chronic inflammatory airway disease characterized by recurrent episodes of dyspnea, chest oppression, wheezing, and dry cough that vary over time and in intensity, may occur persistently mild, moderate, severe or intermittent, with varying expiratory airflow limitation. The level of control is based on clinical parameters, according to which it is classified as controlled, partially controlled or uncontrolled, and functional parameters that objectively evaluate airflow limitation and contribute to the most appropriate treatment (GINA, 2019). It is estimated that a disease affects approximately 235 million people worldwide, according to the World Health Organization (OMS, 2017). In Brazil, there is a prevalence of over 6 million adults, according to the National Health Survey (PNS) of the Ministry of Health (MS) and the Brazilian Institute of Geography and Statistics (IBGE) (CANÇADO *et al*., 2018). Asthmatic individuals suffer impairment of respiratory muscle function due to changes in ventilatory mechanics. Muscle weakness can reduce lung flow and volume and lead to exertion intolerance and dyspnea. Manovacuometry allows the measurement of the contraction force of the respiratory muscles plus the elastic withdrawal forces of the lung and ribcage using PIMáx, which is the measure of the contraction force of the inspiratory muscles, and the PEMáx measures the strength of the expiratory muscles. (CAVALCANTI, 2017; CARUSO *et al*., 2015; OLIVEIRA; LANZA; SOLÉ, 2012). The diagnosis should be based on clinical symptomatology and functional conditions, which is based on the presence of characteristic symptoms, and confirmed by the show of variable airflow limitation. Spirometry with the clinical picture confirms the diagnosis when reversible airflow obstruction is demonstrated. Asthma severity and response to treatment can be assessed by monitoring clinical and functional respiratory parameters: forced expiratory volume in one second (FEV1), FEV1 / forced vital capacity (FVC) ratio, slow vital capacity (FVL), peak expiratory flow (PEF), forced expiratory flow (FEF), obtained by pulmonary function test or spirometry. (SANTOS, 2018) The evaluation of pulmonary function and respiratory muscle strength becomes of great importance to identify the intensity of airflow limitation, its reversibility and variability. Seeking to associate functional parameters of respiratory muscles with clinical respiratory parameters, this study aims to relate spirometric variables with maximal inspiratory and expiratory pressures in asthmatic patients not undergoing rehabilitation programs.

MATERIALS AND METHODS

This is a cross-sectional, descriptive, analytical and quantitative study composed of 16 individuals. Held in the breathing practices laboratory of a higher education institution in the city of Vitória da Conquista, Bahia. A subproject of a study project entitled: "IMPACT OF INSPIRATORY MUSCLE TRAINING KINESIO VERSUS TAPE ON ASTHMATIC PATIENTS: A Randomized Clinical Trial", approved by the Research Ethics Committee of Faculdade Independente do Nordeste under No. 3,325,901.The patients were informed about the ethical precepts of the research in which the objectives were presented and signed the Termo de Consentimento Livre e Esclarecido(TCLE). The study included patients with a medical diagnosis of asthma aged ≥ 18 years who are undergoing pharmacological treatment to stabilize acute processes. Individuals with acute asthmatic processes (dyspnea, bronchospasm, oxygen desaturation less than 90%) at the time of collection were excluded.

All participants underwent a clinical evaluation of vital signs: blood pressure (BP), heart rate (HR), respiratory rate (RR), axillary temperature (TAX), peripheral oxygen saturation (SpO_2) and answered two questionnaires for define the sample profile. Subsequently, they underwent spirometric evaluation (DatoSpir Micro Digital Silbemed®), were positioned in sedation with trunk extension, lower limbs to ninety degrees and feet flat on the floor, each patient with the aid of a mouthpiece connected to the device and a nasal clip performed a maximal inspiration followed by an exhalation with the maximum possible force sustained for six seconds, each exam was repeated three times and the highest value between them was defined for analysis. All spirometric analyzes took into account Miller's criteria; *et al* (2005). Respiratory muscle pressures were measured using a digital manovacuometer (MVD 300, GlobalMed and MDI system), following the guidelines of the Brazilian Society of Pulmonology and Tisiology, 2002. With the subject still positioned, using a nasal clip and mouthpiece, the A PIMáx was obtained by a maximal inspiratory effort maneuver after a maximal expiration near the residual volume (RV).PEMáx was obtained by maximal expiratory effort after maximal inspiration, close to total lung capacity (TLC). The maneuvers were performed at least three and at most five times in cases of variation greater than 10% between the values obtained, and the effort was maintained by the individual for at least three seconds, adopting a 15-second interval between measurements, 30 seconds between maneuvers and 1 minute between tracheal changes.

The collected data were tabulated and analyzed using the Statistical Package for Social Sciences - SPSS 22.0, for Windows. The treatment performed was descriptive (prevalence, mean and dispersion measure) and analytical (Mann-Whitney U test and Student t test). In all tests the reliability was set at 95%. Charts and tables were plotted by Microsoft Excel 2013.

RESULTS

From a sample of 16 individuals, it was observed that in the profile given in table 1, the average age of 21.12 ± 2.39 years, with female predominance 12 (75.0%), non-practitioners of regular physical activity 9 (56.3%), who use continuous medication 8 (50.0%), whose asthma is considered moderate 8 (50.0%).

Table 1. Sociodemographic and clinical profile of the sample. Victória da Conquista - BA, 2019

Variables	Mean ± dp[1]	n	%
Age, *years*	21,12 ± 2,39	16	—
Sex			
Male		4	25,0
Female		12	75,0
Regular physical activitye			
Not		9	56,3
Yes		7	43,7
Continuous medication			
Not		8	50,0
Yes		8	50,0
Asthma Severity			
Intermittent		3	18,8
Mild		3	18,8
Moderate		8	50,0
Severe		2	12,4

[1] Sample standard deviation; Source: Research Data.

The comparison between the spirometric variables obtained with the predicted values, contained in table 2, revealed that all the obtained values are lower than the predicted ones, highlighting the PEMáx that has the largest difference and the FVC that has the lowest. Although this behavior is the same for all variables, no statistically significant difference was found for FVC and PIMáx (p = 0.167 and p = 0.129, respectively).

Table 2. Predicted comparison with obtaining. Vitória da Conquista - BA, 2019

Variables	Mean ± dp[1]		*p**
	Predicted	Obtained	
FEV1, *%*	3,55 ± 0,48	2,46 ± 0,71	≤ 0,001
FVC, *%*	4,13 ± 0,60	3,95 ± 0,87	0,167
FEV1 / FVC, *%*	86,39 ± 2,02	62,79 ± 15,21	≤ 0,001
PEF, *%*	8,25 ± 1,26	3,32 ± 1,22	≤ 0,001
PIMáx, *cmH20*	99,67 ± 62,53	76,97 ± 18,65	0,129
PEMáx, *cmH20*	117,71 ± 22,35	65,46 ± 14,77	≤ 0,001

[1]Sample standard deviation; * Paired student t-test; Source: Research Data.

The results shown in Table 3 indicate that for higher FEV1, FVC, and PEF values, PIMáx assumes higher values (r = 0.206, r = 0.451; r = 1.42, respectively).FVC is correlated inversely proportional (r = - 0.157). However, none of the variables has significant correlation.

Table 3. Correlation between spirometric variables and PImáx. Vitória da Conquista - BA, 2019

Variables	*r*[1]	*p-value*
FEV1	0,206	0,445
FVC	0,451	0,079
FEV1 / FVC	-0,157	0,561
PEF	1,420	0,601

[1]Pearson correlation; Source: Research Data.

The analysis of PEMáx with spirometric variables showed that there is a directly proportional behavior among all variables.

Table 4. Correlation between spirometric variables and PEMáx. Vitória da Conquista - BA, 2019

Variables	r[1]	*p-value*
FEV1	0,624	0,010
FVC	0,597	0,015
FEV1 / FVC	0,249	0,352
PEF	0,426	0,099

[1]Pearson correlation; Source: Research Data.

Table 5. Correlation between spirometric and manovacuometric variables with seizure severity.Vitória da Conquista - BA, 2019

Variables	Gravity(mean ± dp[1])				*p**
	Intermittent	Mild	Moderate	Severe	
FEV1, *%*	2,64 ± 0,70	2,17 ± 0,83	2,70 ± 0,58	1,65 ± 0,79	0,253
FVC, *%*	4,41 ± 1,05	3,70 ± 1,14	3,97 ± 0,87	3,57 ± 0,14	0,728
FEV1 / FVC, *%*	59,61 ± 3,04	58,23 ± 10,70	69,69 ± 15,38	46,82 ± 24,14	0,245
PEF, *%*	3,05 ± 0,60	2,79 ± 1,15	3,89 ± 1,32	2,24 ± 0,74	0,273
PIMáx, *cmH20*	77,7 ± 26,15	89,53 ± 13,35	73,41 ± 17,69	2,24 ± 0,74	0,650
PEMáx, *cmH20*	75,86 ± 26,10	64,53 ± 10,31	63,66 ± 12,96	71,15 ± 25,66	0,604

[1]Sample standard deviation; Pearson correlation; Source: Research Data.

Significant statistical correction was observed for FEV1 (p = 0.010) and FVC (p = 0.015), as shown in Table 4. Comparison between the variables and severity of asthma are summarized in Table 5. FEV1 has the highest mean for moderate asthma (2.70 ± 0.58), FVC for intermittent (4.41 ± 1.05), FEV1 / FVC to moderate (69.69 ± 15.38), as well as PEF (69.69 ± 15.38). PIMáx had the highest value for mild asthma (89.53 ± 13.35), while PEMáx had the highest value for intermittent asthma (75.86 ± 26.10). These results have no significant statistical correlation.

DISCUSSION

Regarding spirometric evaluation, pulmonary impairment was demonstrated, since patients have restrictive characteristics: decreased and obstructive FVC: reduced FEV1 and reduced FEV1 / FVC ratio. In fact, ventilatory function in asthmatic patients may be altered due to hyperresponsiveness and / or increased airway resistance as reported by Minatel *et al.* (2012). In addition, decreased PEF can also be considered an indirect indicator of airway obstruction (AGGARWAL *et al.*, 2005). According to Schultz *et al.* (2016), an obstructive pattern is often present due to the reduction in forced expiratory volume by 1 s (FEV 1) and FEV 1 to forced vital capacity (FEV 1 / FVC), according to the present study. Patients may have normal spirometry between asthma episodes. In some patients, FVC may be reduced due to air retention, resulting in pseudo-restriction on spirometry in the presence of normal or increased total lung capacity, increased residual volume (RV), and increased functional residual capacity (CRF). The IV Brazilian Guidelines for Asthma Management (2006) discuss the following criteria as one of the indicative of asthma: FEV1 below 80% of predicted and FEV1 / FVC below 75% in asthmatic adults. GINA (Global Asthma Initiative 2019) uses the FEV1 / FVC ratio as a parameter to assess the presence of airflow limitation. The Tiffeneau index below 0.75 to 0.80 in adults suggests the presence of lower airway obstruction. FEV1 or PFE below 80% of predicted is one of the criteria for classifying asthma as uncontrolled or partially controlled according to GOLD (Global Initiative for Chronic Obstructive Lung Disease, 2011). As for manovacuometry, in the presence of hyperinflation and possible diaphragm rectification, PIMáx and PEMáx measurements may be compromised due to mechanical disadvantage and reduced respiratory muscle strength in this population (SANTOS *et al.*, 2012; WORT, 2003; LOPES *et al.*, 2007; RICIERI *et al.*, 2008). On the other hand, at the moment of seizures, there is a greater respiratory effort, causing the accessory muscles of respiration to be recruited, which may undergo adaptations such as hypertrophy, which can lead to an increase in PIMáx (ANDRADE *et al.*, 2012). However, in the present study, only PEMáx showed a statistically significant correlation when compared to FEV1 and FVC, while PIMáx could not verify statistical significance, which can be justified, according to Oliveira, Lanza and Solé (2012) because Patients with mild or moderate obstructive ventilatory disorder may not have significant pulmonary hyperinflation to the point of altering the diaphragmatic position. Although the literature has shown correlations of diaphragmatic mobility with parameters such as pulmonary obstruction and hyperinflation (IWASAWA *et al.*, 2011; YAMAGUTI *et al.*, 2008), Davachi *et al.* (2014) did not find a relationship between diaphragmatic mobility and pulmonary hyperinflation, possibly because patients with COPD (Chronic Obstructive Pulmonary Disease) were included in the selection for milder stages of the disease, which may have persuaded this relationship due to the lower degree of obstruction to expiratory flow, causing less damage to the diaphragm. In the present study, there is no statistically significant correlation between spirometric and manovacuometric variables with the severity of asthma episodes. Salame, Moreira, Tesser (2017) found that despite presenting airflow obstruction, confirmed by reduced FEV1 levels, most asthmatic individuals do not have reduced respiratory muscle strength in studies without grouping by disease severity. However, studies with a larger number of patients are still needed to analyze the relationship of muscle strength in seizure severity. As a limitation of the study, we can highlight the number of individuals in the sample, which may generate biases of generalization of the results.

Conclusion

From the results found, it could be observed that there is a positive linear correlation of the reduction of expiratory muscle contraction force (PEMáx) with spirometric variables. Further research should be conducted to confirm possible hypotheses related to spirometry and manovacuometry. It is important that the person with asthma is aware of the severity of the crises and the care to be taken, which facilitates the control of the disease, as it helps in treatment procedures, consequently improving the quality of life. This is possible due to the possibility of accurately measuring the lung capacity and ventilatory muscle of individuals.

REFERENCES

Aggarwal A. N. *et al*. 2005. The Relationship Between FEV1 and Peak Expiratory Flow in Patients With Airways Obstruction Is Poor. CHEST, 130, (5);1454-1461.

Andrade TCQD *et al*. 2012. Influência dos corticosteroides inalatórios nas pressões respiratórias máximas de crianças escolares asmáticas. Fisioter. mov. 25(1);67-72.

Cançado JED; *et al*. 2019. Projeto Respira: Carga humanística e econômica da asma no Brasil, *Journal of Asthma,* 56: 3, 244-251.

Caruso PA; *et al*. 2015. Métodos diagnósticos para avaliação da força muscular inspiratória e expiratória. *Jornal Brasileiro de Pneumologia,* 41(2), 110-123.

Cavalcanti JD. 2017. Comportamento da atividade elétrica muscular e desempenho de asmáticos durante o Incremental Shuttle Walking Test e Teste Glittre-AVD. 2017. 54f. Dissertação (Mestrado em Fisioterapia) - Centro de Ciências da Saúde, Universidade Federal do Rio Grande do Norte, Natal, 2017.

Davachi, B. *et al*. 2014. A Relação entre Movimentos Diafragmáticos na Avaliação Sonográfica e Gravidade da Doença em Pacientes com Doença Pulmonar Obstrutiva Crônica Estável (DPOC). *Jornal de Medicina Cardio-Torácica*, 2 (3), 187-192.

Dos Santos Yamaguti WP, *et al*. 2008. Air trapping: The major factor limiting diaphragm mobility in chronic obstructive pulmonary disease patients. *Respirology.* 13(1):138-44.

Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2019. Available in: http://ginasthma.org/2019-gina-report-global-strategy-for-asthma-management-and-prevention/. Access in: Out 13, 2019.

Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2011. Disponível em http://www.goldcopd.org/. Accessed: 29/10/2019.

Iwasawa T, *et al* 2011. Influence of the distribution of emphysema on diaphragmatic motion in patients with chronic obstructive pulmonary disease. *Jpn J Radiol.* 29(4):256-64.

Lopes EA *et al*. 2007. Assessment of muscle shortening and static posture in children with persistent asthma. *Eur J Pediatr.*166(7);715-721.

Miller MR, *et al*. 2005. Standardisation of spirometry. *Eur Respir J.* 26(2):319-38.

Minatel V *et al* (2012). Avaliação da distância percorrida e velocidade média durante o TC6 em pacientes com diferentes doenças pulmonares. *J Health Sci Inst.,* 30(1); 281-286.

Ministério da Saúde MS , Instituto Brasileiro de Geografia e Estatística IBGE 2015. Pesquisa Nacional de Saúde (PNS).

Oliveira CMG, *et al* 2012. Força dos músculos respiratórios em crianças e adolescentes com asma: similar à de indivíduos saudáveis?. *J Bras Pneumol.* 38(3):308-314

Organização Mundial da Saúde OMS 2017. Ficha informativa sobre asma: OMS [Online].

Pereira CAC, *et al* 2002. Sociedade Brasileira de Pneumologia e Tisiologia (SBPT). Diretrizes para Testes de Função Pulmonar. *J Pneumol.* 28(Suppl 3):1-238

Ricieri DV; *et al* 2008. Razão entre diâmetros torácicos para detecção de hiperinsuflação estática em crianças pela biofotogrametria. *Jornal de Pediatria,* 84(5), 410-415.

Salame FM, *et al*. 2017. Correlação entre força muscular respiratória e gravidade clinica em adultos com asma brônquica. Revista de ciências da saúde da Amazônia. [S.l.] (1), 7-17.

Santos VCH. 2018. Qualidade de vida na asma: relação com tabagismo, controle da doença, função pulmonar, eosinofilia, atopia e comorbidades. Dissertação (Mestrado) -- Universidade Federal do Rio Grande do Sul, Faculdade de Medicina, Programa de Pós-Graduação em Ciências Pneumológicas, Poto Alegre.

Santos, MDS *et al*. 2012. Atividade mioelétrica dos músculos respiratórios em crianças asmáticas durante manobra inspiratória máxima. Rev. Bras. Saude Mater. Infant., 12, (3); 215-257.

Schultz, K., *et al*. 2016. Volumes pulmonares e resistência das vias aéreas em pacientes com possível padrão restritivo à espirometria. Jornal brasileiro de pneumologia: publicação oficial da Sociedade Brasileira de Pneumologia e Tisilogia , 42 (5), 341–347.

Sociedade Brasileira de Pneumologia e Tisiologia (2006). IV Diretrizes Brasileiras para o Manejo da Asma. J Bras Pneumol. 32(Supl 7):S 447-S 474.

Wort SJI. 2003. The management of acute severe asthma in adults. Anaesthesia and Critical Care, 14(2); 81-9.

****