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ORIGINAL PAPER

What Happens with Airway Resistance (RAW) in Asthma and COPD exacerbation

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Background: To show that during the exarcerbration of asthma and COPD, increased airway resistance is accompanied with decreased spirometry values (FVC, FEV1, FEF50, and PEF) also comes increasing of airway resistance (RAW). **Patients and methods:** This research included 74 patients, in exacerbation phase of disease. All the patients got spirometry and plethysmography measurements, including adequate therapy, and after at least one month on control examination they repeated spirometry and plethysmography and answered a short life questionnaire. **Results:** The mean value of RAW after therapy in asthma is decreased for -17. 68% and in COPD for -15. 44%. The mean value of RAW in all levels of obstruction is higher in COPD than in asthma, before and after therapy. After therapy spirometry values (FVC, FEV1, FEF50, and PEF) were significantly increased in asthma than in COPD. From questionnaire analyses 78.37 %(58) of patients felt well, 17.57 %(13) felt the same like before therapy and 4.05 %(3) of them felt worst. All the patients who felt worst were in COPD group of patients. All of them had increased RAW, almost all felt better (96. 43%) had decreased RAW. In asthma nobody felt worst. In most of the patients (76.67%) who felt better RAW was decreased. **Conclusion:** Adequate therapy during exacerbation of asthma and COPD decreases value of RAW and increases spirometry values. Increase in spirometry values in asthma is much higher than in COPD. Mean values of resistance in COPD are higher before and after therapy than in asthma. There is a negative relationship between subjective experience of illness and the level of resistance. Measuring of RAW can be a good parameter for monitoring COPD and asthma control. **Key words:** exacerbation of asthma or COPD, spirometry, airway resistance - Raw.

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1. INTRODUCTION

Pulmonary function tests are vastly under used yet they can provide important clinical information. They are designed to identify and quantify defects and abnormalities in the function of respiratory system, and answer questions about how serious obstruction is, does it respond on bronchodilators, and is the treatment helping the patient (1).

Chronic obstructive pulmonary disease (COPD) is leading cause of morbidity and mortality worldwide. Current definition of COPD is a disease state characterized by airflow limitation and is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles of gasses (2). COPD is progressive disease characterized by worsening pulmonary function.

Asthma is a serious global health problem. It is a chronic inflammatory disorder of the airways. Chronically inflamed airways are hyper responsive, they become obstructed and airflow is limited (by bronchoconstriction, mucus plugs, and increased inflammation) when airways are exposed to various risk factors (3).

When COPD and asthma are in question most common test is spirometry (flow-volume-curve). It is a gold standard for asthma and COPD diagnosis. Body plethysmography test is not as common. One of reasons for sure is that plethysmography is not available as spirometry. If we include plethysmography we get much more of data. One of data we can get is airway resistance (RAW). It is used for evaluation of airway responsiveness, provocation testing characterization of various types of obstructive lung disease, localization of the primary site of flow limitation and evaluation of localized obstruction (4).

The clinical measurement of plethysmographic airflow resistance is also considered to be a gold standard. Measurement of resistance as a function of lung volume provides a useful extension of currently utilized methodology (5).

When the airways are narrow resistance is increased. Narrowing may be due to bronchoconstriction of inflamed airways in asthma, mucus and thickened bronchi in chronic bronchitis or floppy airways in emphysema (1). Airway resistance (RAW) is defined as difference between pressures in alveolus and in examinee mouth necessary for flow of 1 liter of air per second. If increasing is more than 0.3 kPa/l/s, it is sign that resistance is increased

and flow rate in the big airway is decreased (6).

The main point of this research is:

- To show that airway resistance (RAW) is a changing variable in exacerbation of asthma and COPD.
- That therapy at exacerbation of COPD and asthma works not only on improvement of spirometry values as well as decreasing of airway resistance (RAW).
- To show relation between subjective experience of illness (questionnaire) and the level of airway resistance (RAW).

2. PATIENTS AND METHODS

2.1. Research design

Patients with COPD and asthma which were assigned by their doctor on examination because of exacerbation of sickness were included in this research. History of sickness and finding from functional lab were used in examination. They came with reference for examination and lung function in regular ambulance during the morning. They were also regular patients of practice for asthma and COPD. Patients are included in research if this criteria is satisfied: (a) patients of both gender who have a diagnose of COPD or asthma, (b) patients which had higher parameters of inflammation, and/or decreasing of spirometry values compared to last check up, and/or retrogression of subjective parameters which complicates breath taking, and/or higher need for short term bronchodilatators, enhanced cough and expectoration. Actually asthma patients get included compare to GINA guidelines for uncontrolled or bad controlled asthma (3). The severity of COPD was classified according to Global initiative for Obstructive Lung Disease (GOLD) stages (7).

2.2. Patients

This research includes 74 patients, between 23-80 years of age, 40 female (54.05%) and 34 male (45.95%). From that 36 of patients were with asthma diagnosis and with COPD 38 patients. Characteristic of patients are presented in Table 1.

2.3. Methods

Before intensive therapy all the patients made spirometry and plethysmography and after at least 1 month of recommended therapy they repeated spirometry and plethysmography and answer questionnaire. Questionnaire was really simple, they got only one question to answer, do them subjective feel better, worst or the same. Spirometry and plethysmography were carried out according to ERS/ATS pointers (8, 9). All the patients measured: airway resistance (RAW), forced expiratory volume in 1 second (FEV1), forced expiratory vital capacity (FVC), forced expiratory flow after 50% VC (FEV50), peak expiratory flow (PEF). All the measurements were done on Sensor Medics Vmax device.

	All the patients	Asthma	COPD
Number of patients, N %	74 (100%)	36 (48.65%)	38 (51.35%)
Female (%)	40 (54.05%)	25 (62.50%)	15 (37.50%)
Male (%)	34 (45.95%)	11 (32.35%)	23 (67.65%)
Age, mean value (year)	56.48	49.45	63.5
Mean value. female (year)	57.55	52.7	62.4
Mean value, male (year)	55.4	46.2	64.6

Table 1. Characteristic of all the patients

	Number of patients with increased values(COPD)	Number of patients with decreased values (COPD)	Number of patients with increased values(ASTHMA)	Number of patients with decreased values (ASTHMA)
FEV 1 (L)	20 (52.63%)	18 (47.37%)	34 (94.44%)	2 (5.56 %)
FVC (L)	22 (57.90%)	16 (42.10%)	30 (83.33%)	6 (16.67%)
FEF 50 (L/s)	26 (68.42%)	12 (31.58%)	33 (91.66%)	3 (8.67%)
PEF (L/s)	28 (73.68%)	10 (26.32%)	30 (83.33%)	6 (16.67%)
Raw (kPa/l/s)	8 (21.05%)	30 (78.95%)	10 (27.78%)	26 (72.22%)

Table 2. Number of patients with increased and decreased spirometry values and airway resistance (RAW) after therapy in asthma and COPD

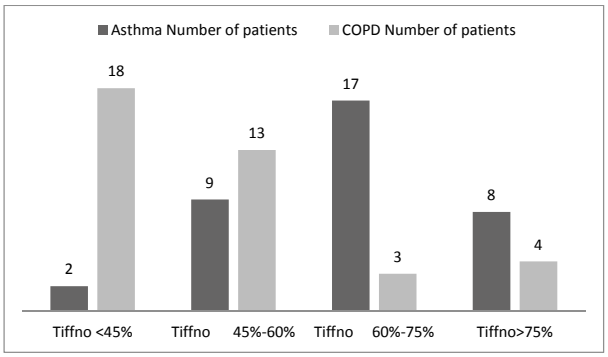

Figure 1 . Connection between number of patients with asthma and COPD with level of obstruction (Tiffno index)

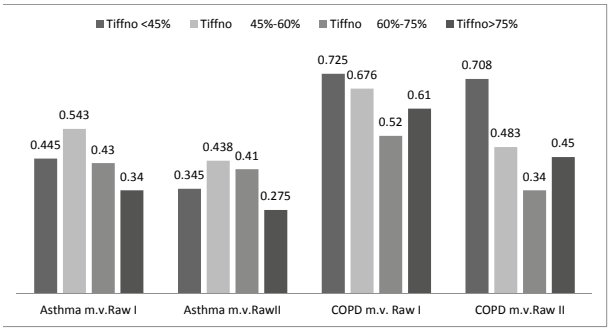

Figure 2 Connection of mean value of RAW from the level of obstruction before(I) and after (I) therapy in asthma and COPD m.v.mean value

3. RESULTS

In Figure 1 number of all patients (asthma and COPD) is divided according to level of obstruction (ratio FEV1/ FVC- Tiffno index). If level of obstruction is higher (Tiffno index lower) we have bigger number of patients with COPD than with asthma.

At 78. 95% of patients with COPD and 72. 22% of patients with asthma come to decreasing of RAW; number of patients with increased spirometry values is higher at asthma than in COPD (Table 2).

Figure 2 is showing us the mean value of RAW (before therapy- RAW I and after therapy - RAW II) at asthma and COPD according to level

of obstruction. Value of RAW in all the levels of obstruction is bigger in COPD than in asthma, before and after therapy.

The mean value of RAW I in asthma before therapy is 0.40794 kPa/l/s and after therapy RAW II is 0.33581 kPa/l/s. The mean value of RAW I in COPD before therapy is 0.68 kPa/l/s and after therapy RAW II is 0.575 kPa/l/s (Figure 3).

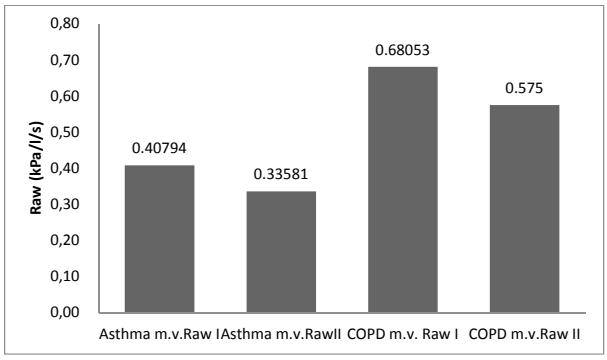

Figure 3. Mean value of RAW before (I) and after (II) therapy in asthma and COPD m.v. mean value

The mean value of RAW in asthma is decreased for -17.68% and for COPD for -15.44 % (Figure 4).

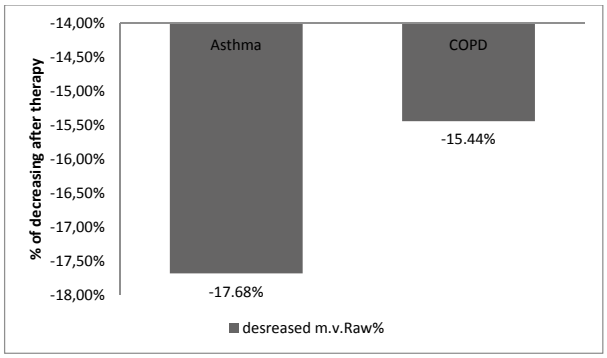

Figure 4. Decreasing of mean value in asthma and COPD after therapy m.v. mean value

RAW according to level of 0. 3 kPa/l/s have a bigger number of patients which value in asthma is lower from 0.3 kPa/l/s than in COPD also before and after therapy. There are 30.56% (11) of patients with asthma before therapy and 50 % (18) of patients after therapy. The number of COPD patients is 5. 26% (2) before therapy and 13. 16 %(5) after therapy (Figure 5).

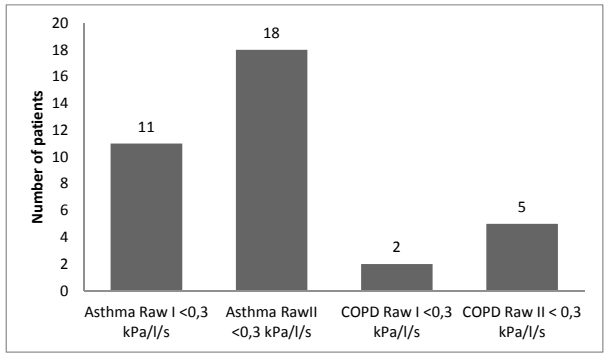

Figure 5. Number of patients with resistance (RAW) under 0, 3 kpa/l/s before(I) and after (II) therapy in asthma and COPD

After therapy spirometry values (FVC, FEV1, FEF50, and PEF) are much more increased in asthma than in COPD. There are slightly increased values in COPD according to increased values in asthma (Figure 6).

From questionnaire analyses 78.37%(58) of patients felt well, 17.57% (13) felt the same like before therapy and 4.05%(3) of them felt worst.

All the patients who felt worst were in COPD group of patients, all of them had increased RAW. 96. 43% of COPD patients who felt better had decreased RAW. In asthma nobody felt worst. 76. 67% of them who felt better had decreased RAW (Figure 7). Comparing together RAW I and RAW II from all the patients in asthma and COPD it is obvious existence of decreasing of values of RAW after therapy (Figure 8).

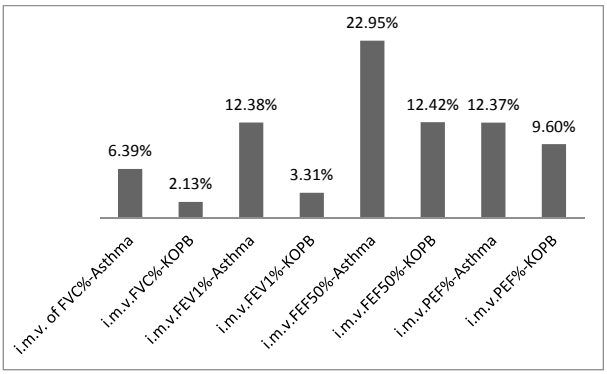

Figure 6. Increasing in mean spirometry values in asthma and COPD after therapy i.m.v. -increase of mean value

4. DISCUSSION

This research involves 74 patients, average age 56-48 years, who have asthma or COPD. From the level of obstruction they are divided in 4 groups of patients.

They are divided according to Tiffno index (ratio FEV1/FVC). It is better indicator of obstruction than FEV1 (10). Because this parameter involves restriction and shows us the real obstruction (11). Many lung diseases may result in reduced FEV1, because of that a useful assessment of airflow limitation is the ratio FEV1/FVC (Tiffno index). The ratio is normally bigger than 0.75 (75%) (12). According to level of obstruction there is a bigger number of COPD patients (81.56%) with Tiffno index which is lower than 0.60 apropos number of patients with asthma (69.44%) where Tiffno index is higher than 0.60. COPD patients have bigger level of obstruction and higher mean values of RAW than patients with asthma. In all four groups of patients mean values of RAW in COPD are higher than in asthma. After therapy there is expected improvement of parameters of lung function in asthma patients and slightly improvement of values in COPD patients. Mean values of RAW get decreased both in asthma and COPD, but mean values are still higher in COPD than in asthma.

According to Lall and associates even by kids variability of resistance is noticed. It is answer to bronchodilator therapy. Values of RAW are decreasing, so there is possibility that value of RAW can be used as parameter for monitoring of answer to therapy, but that needs to be investigated (13).

Morice and associates were monitoring the values of complains (Gaw) which is reciprocal value of RAW, and they came to conclusion that value of Gaw is rising (mathematically that means that RAW is decreasing) after broncho-

dilatators which is applied by different types of devices for inhalation usage (14).

Therefore value of resistance is a variant variable influenced by exacerbation of asthma and COPD. It is obviously existence of decreasing of value of RAW after therapy in asthma and in COPD. Undoubtedly the values of RAW variants depending on level of obstruction. Value of RAW is higher with higher obstruction. After therapy in COPD response is better to RAW than to spirometry value. RAW decreased much more than spirometry values increased. The plethysmography should be considered the preferred technique for measuring bronchodilation in COPD clinical trials (15). In asthma response to spirometry values and RAW are similar.

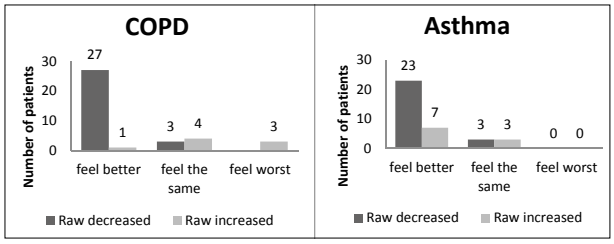

Figure 7. Connection between level of airway resistance (RAW) and subjective experience of illness in COPD and asthma patients

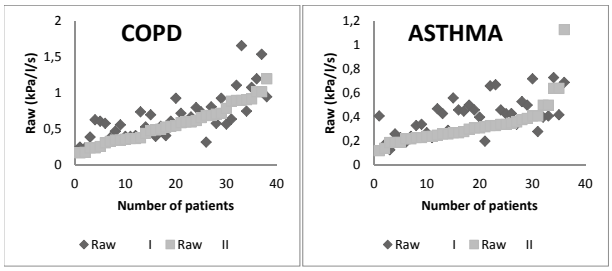

Figure 8. Decreasing of airway resistance (RAW) of all patients (COPD and asthma) after therapy RAW I - before therapy, RAW II- after therapy

There is very good negative connection between subjective experience of illness (questionnaire) and the level of airway resistance (the patients which felt worst had increased RAW and the ones which felt better had decreased RAW).

As we see research answered to the appointed objectives.

5. CONCLUSION

This research shows that adequate therapy in exacerbation of asthma and COPD decreases value of RAW and increases spirometry values. Increasing of spirometry values in asthma is much higher than in COPD. Mean values of resistance in COPD are higher before and after therapy than in asthma. There is a negative connection between subjective experience of illness and the level of resistance. It makes us possible to conclude that measuring of RAW can be a good parameter for monitoring COPD and asthma control.

Spirometry and plethysmography are both a gold standard for diagnosing and controlling the asthma and COPD. With bigger obstruction resistance in airways is higher.

REFERENCES

1. Hyatt RE, Scanlon PD, Nakamura M. *Interpretation of Pulmonary Function Tests - A practical guide.* 2nd ed. Philadelphia: Lippincot Williams and Wilkins; 2003.
2. Tazaki G, Kondo S, Tajiri S, Tsuji C,Shiya S, Tamgaki T. *Functional residual capacity and airway resistance in rats of COPD model induced by systemic hyaluronidase.* Tokai J Exp Clin Med.2006; 3l(3): 125-127.
3. Pocket guide for Asthma management and prevention. Updated 2010.Availabile from http://www.ginasthma.org. Accessed July 1.2011.
4. Airway resistance (By Plethysmography). Avaible from http://www.morgansci.com/choose-your-pft-solution/. Accessed July 4,2011.
5. Gosselnik R,Stam H. *Lung function testing.* European Respiratory Society Monograph.. 2005; 31:15-43.
6. Vrhovac B, Bakran I, Granic M, Jaksic B, Labar B, Vucelic B. *Interna medicina 1.* Naprijed, Zagreb, 1991.
7. Global initiative for Obstructive Lung Diseases. Global strategy for the diagnosis management and prevention of chronic obstructive pulmonary diseases. Updated 2010. Available from http://www.goldcopd.com.. Accessed July 28, 2011.
8. Miller MR, Hankinson J, Brusasco V, et al. *ATS/ERS Task Force.Standartisation of spirometry.* Eur Resp J. 2005; Aug; 26(2): 319-338.
9. Wanger J, Clausen JL, Coates A, et al. *ATS/ERS Task Force.Standartisation of measurement of lung volumes.* Eur Resp J. 2005 ; Aug; 26: 511-522.
10. Gidikova P, Prakova G,Sandeva G. *Pulmonary function test in workers exposed to asbestos dust in relation to smoking and body mass index.* Trakia Journal of Science.2010; (2): 279-285.
11. Pellegrino R, Viegi G, Brusasco V, et al. *ATS/ERS Task Force.Interpretative strategies for lung function tests.* Eur Resp J. 2005; 26: 948-968.
12. Bateman ED, Hurd SS, Barnes BJ, et al. *Global strategy for asthma management and preventin: GINA executive summary.* Eur Respir J. 2008; Jan; 31(1): 143-178.
13. Lall CA, Cheng N, Hernandez P, et al. *Airway resistance variability and response to bronhodilatator in children with asthma.* Eur Resp J. 2007; Aug; 30(2): 260-268.
14. Morice AH, Waterhouse JC, Peers EM, Parry-Billings M. *Use of Whole-Body Plethysmofigurey to Compare Bronchodilator Inhaler Efficacy .Respiration.* 1998; 65: 120-124.
15. Borrrill ZL,Honghton CM, Woodcock AA, Vestbo J, Sing D. *Measuring bronhodilation in COPD clinical trials.* J Clinical Pharmacol. 2005 April; 59(4): 379-384.