

Influence of ozonotherapy on the functional status and medical aspects of quality of life in patients with bronchial asthma

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Accepted 17 February, 2015

ABSTRACT

The objective of this study is the assessment of interrelations of the structurally-functional condition of cardio-pulmonary system with medical aspects of quality of life and effects of ozonotherapy in patients suffered from cor pulmonale secondary to bronchial asthma. This randomized, quasi-experimental interventional study was conducted on 55 participants. 22 patients suffered from cor pulmonale secondary to bronchial asthma and 30 healthy persons (HP) were studied. Depending on methods of intervention, participants were divided into the 2 groups: 1st group (12) and 2nd group (10) received routine basic therapy (BT) combined with ozonotherapy as intravenous introduction Ozonized saline, 1000 mg/L. In cor pulmonale patients secondary to bronchial asthma with Right Ventricular Enlargement is more expressed in the reduction of quality of life on a physical condition and satisfaction by the intervention, in CP patients secondary to BA with pulmonary hypertension on an emotional condition and occupational suitability that is necessary to note during the adequate treatment. Infringements of respiratory system and quality of life are positively correlate pulmonary ventilation ability, average of pulmonary arterial pressure condition and remodeling of the right ventricle of hearts; ozonotherapy on the combined with the routine standard therapy can improve the above stated pathogenicity interconnected infringements. It seems that combination of ozonotherapy along with routine modality can lead to improve pulmonary function of CP secondary to BA, reduction of preload of right heart as well as improvement of RV structure. Also application of this combined method of therapy can lead to efficacy of treatment and better quality of life and reduced the use of urgent healthcare in CP secondary to BA patient.

Keywords: Pulmonary rehabilitation, pulmonary hypertension, chronic obstructive pulmonary disease, pulmonary function test, combination therapy, complex therapy.

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INTRODUCTION

Asthma among chronic obstructive pulmonary diseases (COPD) has become a grave public health problem with a significant effect on health economics (Jansson et al., 2007; Van Den Akker-van Marle et al., 2005). The medico-social importance of the bronchial asthma (BA) issue steadily grew in recent years (Ubaidullaev and Uzakova, 2002; Chuchalin, 2001). The prevalence of asthma has increased since the 1950s (Umławska, 2015; Namdar et al., 1998; Peat et al., 1994), and it has been

estimated that today more than 300 million people are affected worldwide (Bjerg et al., 2015). 7.2% (20*10⁶) of the US population suffered from asthma, however this prevalence in countries of the European Union near to 2 to 7% (Ubaidullaev and Uzakova, 2002). United Kingdom and Australia has high prevalence while Germany and Norway are countries with moderate prevalence (McGarvey et al., 2015). Cor pulmonale, secondary to COPD, is the heaviest complication of lung diseases

(Hosseini et al., 1999). This sequela affects many aspects of the patient's life particularly causing low quality of life (QL) (Karoli and Rebrov, 2005; Fabbri et al., 2004). Due to hypodiagnosis and late detection of CP secondary to BA, morbidity and mortality rate of this disease were raised in Uzbekistan (Rakhimova et al., 2012).

To adjust the early diagnosis, adequate preventive maintenance and treatment of CP, it is necessary to specify pathogenicity of this disease and its contributing factors (Rebrov and Karoli, 2002). At the same time, there is still an obscure mechanism of remodeling development heart right ventricle (RV) in patients with cor pulmonale.

With this relationship, the complex estimation of the broad audience parameters of the structurally-functional condition of cardiopulmonary system represents interest. These parameters determine the functional status and medical aspects of quality of life in patients with cor pulmonale (Ubaidullaev and Uzakova, 2002).

In Bronchial asthma (BA), special interest represents studying changes in the vegetative and microcirculation link level of blood circulation in various stages of the illness development, and it is important not only for more full disclosing of the pathogenesis mechanisms of this disease, but also for the development of widespread adequate treatment (Rakhimova et al., 2012). It seems that ozonotherapy may be effective to cure of cor pulmonale secondary to BA.

The objective of this study is the assessment of the interrelations of the structurally-functional condition of cardiopulmonary system with medical aspects of quality life and effects of ozonotherapy in bronchial asthma patients complicated CP.

MATERIALS AND METHODS

This randomized, quasi-experimental interventional study was conducted on 55 participants. 22 cor pulmonale patients secondary to BA and 30 healthy persons (HP) were selected. The ethical committee of the Centre of Therapy and Medical rehabilitations approved the study. Written informed consent was obtained for each participant.

Patients with BA, complicated pulmonary hypertension were randomized into two groups as the 1st group cor pulmonale patients secondary to BA patients, with Right Ventricular enlargement (RVE) as 2nd group were surveyed. Depending on methods of intervention, the subjects were divided into the following 2 groups: 1st group (12) and 2nd group (10) received basic therapy (BT) on (GINA, 2006) (Koshak, 2007; Seraji et al., 2011) and ozonotherapy (OT) (OT as intravenous introduction Ozonated saline, 1000 mg/L) (Volkhovskaya et al., 2008).

Besides specific methods of treatment, all patients received the following general medical measures: respiratory gymnastics, hydroaeroionization with iodine (Skromulis and Noviks, 2012; Umarova, 1980), herbal tea drinks remedy (expectorant), circular shower, massage of the thorax as pulmonary rehabilitation (Roosta and Koohestani, 2008) and a session of psychotherapy (Brennan, 2014).

Ozonized saline was delivered by clinical ozonizer "Asian", "Uzbekistan" (Fujishima et al., 2014). Ozone was released, by passing medical oxygen through the digit chamber of the ozonizer,

at 8 g/h. This gas was bubbled in 400 ml of physiological solution before reaching the concentration of ozone at 1000 mg/L. Concentration of ozone in a solution, defined titrating the delivered solution, according to the technique definition of residual ozone established in water and beforehand made calibration curve (Von Gunten and Oliveras, 1998). The subjects were studied and data were gathered in admission day and 10th intervention. Subject's data of the quality of life were gathered by specialized Seattle questionnaire and collected by marking system (Cline et al., 1999). This instrument helps to assess the level of a physical, emotional conditional, occupational suitability and satisfaction treatment of the participants (Spertus et al., 1995; Koohestani et al., 2011).

According to the guideline of the American Echocardiography Society (Schiller et al., 1988), the following parameters of a diastolic fillings spectrum of diastolic function (DF) RV were calculated using Doppler echocardiography: E/A-ratio of early and auricular fillings' speed; TF (m/s) - time of early filling delay; TIR (m/s) - time of isovolumic relaxation and auricular filling's fraction (AFF, %) and the level of pulmonary arterial pressure were analyzed.

Pulmonary Function Test (PFT) defined by *Medicor* (Hungary) device, with the calculation of forced expiratory volume in 1st second) (FEV1, %), forced vital capacity (FVC, %) and Tiffeneau-Pinelli index (FEV1/FVC, %) were used.

Findings were analyzed by SPSS v.16, using T-Student Test. All data are expressed as means \pm SD. P-values less than 0.05 were considered statistically significant and where appropriate were adjusted for multiple comparisons.

RESULTS

In the patients involved with pulmonary hypertension (PH) without RVE - mean pulmonary artery pressure (mPAP) more than 25 mmHg (Colledge et al., 2010) on Doppler echocardiography parameters and with RVE (thickness of forward wall of RV is less than 5 mm, in front-back size RV is more than 2.5 cm) were estimated (Schoepf et al., 2004).

Results of research before intervention in CP patients secondary to BA - PH and RVE, parameters of quality life and also expressiveness of changes in the specified groups were reduced ambiguously. So dilatation of right ventricle in CP patients secondary to BA was worsening adapted in all fields of activity. The analysis of results has shown the decrease in score on physical condition scale and software on 1.9 ± 0.08 and 3.16 ± 0.04 that was lower in 2.7 and 2.2 times than the greatest possible point (5.2 and 7 points), and emotional condition and estimated by treatment have been reduced to 2.87 ± 0.05 and 2.32 ± 0.06 points, in the greatest possible estimation in 5.2; 7; 7 and 5.3 points ($p < 0.05$). Patients of this group had fear of physical activity, to carry out usual occupational duties and dissatisfaction with treatment.

In bronchial asthma patients complicated with CP pulmonale hypertension parameters of FC, EC, PS and ET have been reduced to 2.96 ± 0.09 , 2.57 ± 0.05 , 3.09 ± 0.05 and 2.59 ± 0.04 respectively ($p < 0.05$). It must be noted that in BA patients complicated PH with RVE, the tendency of QL reduction was more expressed on a physical condition and satisfaction by treatment, in BA patients complicated CP with PH on emotional condition

Table 1. Parameters of the right chamber of heart and ventilating ability easy in dynamics of various modes of therapy in CP secondary to BA, (M ± SD).

Indicators	HP (n = 30)	1st group (n = 12)	2nd group (n = 10)
FVC. %	94.3 ± 0.7	56.8 ± 1.2** 63.7 ± 1.7	<u>52.3 ± 1.5**</u> 58.1 ± 1.1
FEV1	85.5 ± 1.8	<u>44.6 ± 0.5**</u> 50.1 ± 1.3	<u>39.4 ± 1.3**</u> 44.1 ± 0.8
FEV1/FVC. %	97.9 ± 0.91	<u>49.5 ± 0.3**</u> 55.1 ± 1.6*	<u>44.3 ± 2.1**</u> 49.1 ± 2.6*
FC. ball	5.20 ± 0.10	3.38 ± 0.31* 3.42 ± 0.20	2.63 ± 0.13* 2.69 ± 0.31
EC, ball	7.3 ± 0.28	3.08 ± 0.29* 3.14 ± 0.19	2.98 ± 0.16** 3.05 ± 0.24
ET, ball	5.0 ± 0.27	2.02 ± 0.16** 2.07 ± 0.19	2.28 ± 0.20** 2.34 ± 0.20
mPAP, mmHg	14.0 ± 2.0	<u>28.9 ± 0.5</u> 23.9 ± 0.9**	<u>32.1 ± 0.9</u> 28.8 ± 0.5**
E/A	1.61 ± 0.02	<u>1.34 ± 0.03</u> 1.46 ± 0.04*	<u>1.18 ± 0.02</u> 1.25 ± 0.03*
TIR, m/s	55.4 ± 1.5	<u>82.7 ± 1.9</u> 75.8 ± 1.3*	<u>87.6 ± 1.1</u> 82.4 ± 1.3*
TF, m/s	168.5 ± 1.7	<u>187.5 ± 2.2</u> 176.4 ± 2.3*	<u>202.1 ± 1.8</u> 192.7 ± 1.9*
AFF, %	23.5 ± 0.6	<u>28.8 ± 0.5</u> 25.5 ± 0.5*	<u>35.7 ± 0.6</u> 32.7 ± 1.1*

Note: in numerator parameters - before treatment (reliability of distinction with parameters HP), in a denominator - after treatment (reliability of distinction with parameters before treatment): **p < 0.005; *p < 0.05. AFF, Auricular filling's fraction; BA, Bronchial asthma; BT, Basic therapy; CP, Cor pulmonale; DF, Diastolic function; EC, Emotional condition; ET, Estimated by treatment; FC, Physical condition; FEV1, forced expiratory volume in 1st second; FEV1/FVC, Tiffeneau-Pinelli index; FVC, Forced vital capacity; GINA, Global initiative for asthma; HP, Healthy persons; OT, Ozonotherapy; mPAP, mean pulmonary artery pressure; PH, Pulmonary hypertension; PS, Professional (occupational) suitability; QL, Quality of life; RV, Right ventricle; TF, Time of early filling delay (m/s); TIR, Time of isovolumic relaxations (m/s); VAP, Ventilating ability pulmonary; E/A, Ratio of early and auricular fillings' speed; RVE, Right Ventricular Enlargement.

and occupational suitability in restriction of ability to live were observed (p < 0.05).

Before treatment in parallel with pulmonary ventilating ability dysfunction, was observed the infringements of lung hemodynamics and quality of life patients. So, the increasing of mPAP, FEV1 were observed and Tiffeneau-Pinelli index were reduced in comparison with similar

parameters of HP (p < 0.005).

In treatment dynamics in BA patients complicated PH parameters of the quality of life: FC, EC, PS and ET were the best in comparison by patients CP with RVE, reliability of parameters after treatment (p < 0.05).

According to the findings, it seems that quality of life parameters in therapy dynamics in all group adaptation to

active physical activity was significantly improved and increased (Sanchez et al., 2015). Also, improvement of the psychological condition was expressed in authentic reduction of depression and disturbing, improvement of the emotional control and memory, and satisfaction by life, improvement of social adaptation of patients were established. Comparing the dynamics of QL parameters in 1st group, increasing of the physical, emotional status parameters and occupational suitability appeared a little significant improvement than in the 2nd group.

According to Table 1, it is shown that instead of the complex treatment beside sick BA complicated by CP with PH and RVE, all groups observed the positive shift in indices of Doppler echocardiography and pulmonary function test.

Parameters of the right chamber of the heart and ventilating ability easy in dynamics of various modes of therapy in CP secondary to BA

Reduction of TF, TIR, AFF and mPAP, and also increase of E/A ($p < 0.05$, pretest) were observed. The findings show that in the study group, pressure reduction in lung arteries conducts to the reduction of pressure in RV hearts. As shown in result, there is a reduction of TIR, TF and AFF duration and the gradient reduction of pressure between the ventricles (Alagha et al., 2015). From this, positive shifts in RV essentially influence to the activity of heart and remodeling of the cardiovascular system endothelium.

According to findings of correlation analysis between QL, PFT indices (Tiffeneau-Pinelli index $r = 0.31$) and remodeling of heart RV, it seems that with the improvement of FEV1 bronchial possibility, FC, EC, PU and ET parameters improved ($r = 0.64$, FC, EC; 0.45; 0.26 and 0.21, $p < 0.03$). Reduction of mPAP leads to the improvement of FC, EC, PU and ET ($r = -0.74$; -0.65; -0.58 and -0.27, $p < 0.01$). The correlation between the increasing of E/A and FC, EC, PU and ET ($r = -0.57$; -0.49; -0.38 and -0.19, $p < 0.05$) was established. No any adverse effects were seen in the participants in study period.

DISCUSSION

It seems that combined (complex) therapy reduced the use of urgent healthcare in adults with asthma by 21% (Blakemore et al., 2015). In this manner, the results of our study showed also that combination of ozonotherapy as a significant intervention along with routine modality can lead to improve pulmonary function of CP secondary to BA, reduction of preload of right heart as well as improvement of RV structure. Also according to the results of our study, it can argued that remodeling of RV after intervention leads to improvement of the quality of life of participants that this result interrelated to

improvement in pulmonary function indices that is confirmed by other studies (Borrelli and Bocci, 2009; Hernández et al., 1995; Peretyagin et al., 2012).

It must be noted that changing of the quality of life patients curvature before treatment are parallel to infringements of bronchial function possibility, pulmonary perfusion and DF of right ventricle. Developing of pulmonary hypertension and development of cor pulmonale in BA suffered patients are closely related to the development of psycho-vegetative factors' dysfunction of regulation, and it is necessary to note that producing the plan of treatment patients of this category (Spertus et al., 1995; Weintraub et al., 2008). Mutual burdening and progressing of DF RV infringements and pulmonary hemodynamic are based on a generality of some parts of pathogenesis: development of hypoxia, infringements of cardio pulmonary microcirculation and pulmonary hypertension (Delgado et al., 2005). It was marked collaterally improvement QL and PFT, mPAP levels, and also DF RV conditions in CP secondary to BA, coming after routine treatment adjunct with ozonotherapy.

Conclusions

It seems that our intervention can improve infringements of respiratory system and quality of life are positively correlate between pulmonary function indices, average of pulmonary arterial pressure condition and remodeling of the right ventricle of hearts. On the other hand, in patients that suffer from CP secondary to BA with dilatation of right ventricle can be effective more expressed the reduction of quality of life on a physical condition and satisfaction by the treatment, in CP secondary to BA with pulmonary hypertension on an emotional condition and occupational suitability, that is necessary to note during the adequate treatment. As a final result, ozonotherapy combined with routine standard medications or procedures, can improve efficacy of treatment and better quality of life in CP secondary to BA patient.

ACKNOWLEDGMENTS

We would like to thank all participants for their cooperation in this study. Many thanks also go to the Centre of Therapy and Medical rehabilitations management for their trustworthiness concerning the research and the great access to collect data.

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Citation: Rakhimova DA, Sabirjanova Zulfiya Talgatovna SZ, Abedi A, 2015. Influence of ozonotherapy on the functional status and medical aspects of quality of life in patients with bronchial asthma. *Biochem Biotechnol Res*, 3(1): 17-21.
