82 - EFFECT OF POSITIVE EXPIRATORY PRESSURE ON THE VITAL SIGNS IN PATIENTS WITH COPD

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INTRODUCTION

The chronic obstructive pulmonary disease (COPD) is considered a public health problem, currently the twelfth most prevalent disease in the world. According to estimates by the World Health Organization, in 2020 this disease will occupy the fifth position among the world's most devastating diseases (AQUINO, 2010; FERREIRA, 2012). COPD is characterized by progressive airflow limitation that is not fully reversible and is associated with an abnormal inflammatory response of the lungs to particles or noxious gases, disturbances of pulmonary gas exchange and airway obstruction, causing air trapping distal. Such changes cause dyspnea on small and medium effort, which may become increasingly limiting with advancing disease (GOLD, 2001).

One of the features that can be employed to minimize the complications caused by COPD is the positive expiratory pressure (EPAP - Expiratory Positive Airway Pressure) which main statement is the reducing of air trapping, in the reversal of atelectasis and optimization of capture to bronchodilators (MONTEIRO, et al. 2012).

Furthermore, the EPAP is considered an effective technique for lung re-expansion, because of the ease of generation and supply of the positive expiratory pressure (PEP) during spontaneous breathing. According to Pissinato et al. (2012) and Silva et al. (2009), this treatment promotes alveolar recruitment, increased of functional residual capacity, improved lung compliance, improved of ventilation / perfusion ratio, reduction of intrapulmonary shunt, redistribution of extravascular fluid and removal of pulmonary secretions.

On breathing with implementation of EPAP, the expiration is performed against linear pressure resistance generated by Valve Spring Load. The depth of the inspiration relates to the level of expiratory effort in view of the need for increased pulmonary insufflation (AQUINO, 2010).

The mechanical effects generated during EPAP on the cardiovascular system and thoracic cage are mediated by pulmonary stretch receptors, cardiopulmonary mechano receptors, arterial baroreceptors and chemoreceptors. Thus, responses mediated by chemical and mechanical receptors are integrated in the central nervous system (CNS) triggering activation of sympathetic and parasympathetic systems, major modulators of cardiovascular responses, in particular to heart rate (HR) and blood pressure (BP) (FREITAS et al. 2009).

Whilst it is true that there are very few contraindications for using EPAP in clinical practice, it is known that an expiratory effort against any resistance exerts effects on vital signs. Thus, it was aimed to examine in the present study, the possible changes in vital signs during and after the implementation of EPAP.

METHODOLOGY

The study consisted of a group called Control Group, which included healthy individuals and another called COPD Group, comprising patients with COPD, with clinical diagnosis and stage II or III according to the classification of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) aged between 40 and 70 years. The healthy individuals were nonsmokers and had normal lung function to spirometry exams. There were excluded those COPD patients with hemodynamic instability, clinical signs of acute exacerbation, with use of artificial airway or those who do not tolerate the use of EPAP mask. As for healthy individuals, there were excluded those with respiratory symptoms in the 30 days prior to inclusion in the study, with chronic lung disease, claustrophobia or hemodynamic instability.

This study was approved by the Ethics Committee in Research of the Universidade de Santa Cruz do Sul, which was also obtained from all study participants in writing the term of free and informed consent.

On the first day it was assessed anthropometry and lung function. on the second day these same participants returned for measuring HR, respiratory rate (RR), diastolic blood pressure (DBP), systolic blood pressure (SBP), oxygen saturation (SpO2) under the application of EPAP with level of positive expiratory pressure (PEP) of 15 cmH2O. The record of these variables was conducted with individuals under spontaneous breathing (Pre-EPAP), and at 15 and 25 minutes of application of positive pressure. Two researchers were responsible for implementing the interventions, which were blinded to study outcome.

To assess lung function it was used a portable spirometer (EasyOne®, Model 2001 Diagnostic Spirometer, Zurich, Switzerland), following the recommendations set out in the protocol of the American Thoracic Society (Miller, Hankinson et al. 2005). The evaluated variables were: forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), relation FEV1/FVC and peak expiratory flow (PEF). The curve that showed the best performance was compared with the predicted values in the literature and described in percentage of predicted (Pereira Barreto et al. 1992).

The HR and SpO2 evaluation was obtained by pulse oximetry (Nonin® Medical, Plymouth, MN, USA), SBP and SBP was measured using a semiautomatic sphygmomanometer (model BP3ABO-H, G-tech, SP, Brazil) and FR was obtained by counting the breaths in one minute. These variables were measured at baseline with the individual during spontaneous breathing, ie, before the implementation of EPAP (Pre-EPAP), and at 15 and 25 minutes of application.

The application of EPAP was performed using a flexible face mask (Vital Signs® RHDSON, Totowa, NJ, USA) connected to a headgear to avoid air leakage which had in its expiratory limb, a system that generates positive pressure containing one-way valve and a mechanism of respiratory resistance Spring Load (Vital Signs®, Totowa, NJ, USA). The procedure lasted 25 minutes, in which the first five minutes it was used the level of 5 cmH2O only for adaptation of the individual, after being raised to 15 cmH2O. To measure the intra-mask pressure level and ensure that this does not exceed 15 cm H2O, it was connected to the mask one digital vacuum manometer (MDI® model MVD300, Porto Alegre, Brazil). If individuals manifested any discomfort, applying the mask was interrupted.

STATISTICAL ANALYSIS

The statistical package SPSS (Statistical Package for the Social Sciences, version 20.0) was used for processing the

results, which were presented as mean and standard deviation and normality of the data was assessed by the Shapiro-Wilk test. Data regarding age, BMI and lung function were tested for heterogeneity by F test, and compared in groups using the Student t test for independent samples. The chi-square test was used to compare gender ratios among the groups. To compare the vital signs obtained in these three test there was used two-way ANOVA followed by post hoc Tukey. For purposes of statistical significance It was adopted a $p < 0.05$.

RESULTS

The sample consisted of 25 participants, the Control Group consisted of 13 individuals and the COPD Group consists of 12 individuals having homogeneous distribution by gender and average age of the subjects allocated. However there were differences between the groups regarding BMI, showing that the Control Group was in overweight. Regarding lung function, it showed apparent losses caused by COPD, with a reduction in all analyzed variables (Table 1).

Table 1 - Baseline characteristics of the two groups.

Characteristics	Control Group (n= 13)	COPD Group (n= 12)	p-value*
Male gender, n (%)	7 (53,8)	4 (33,3)	0,302
Age (years)	57,1 ± 7,1	57,2 ± 8,3	0,997
BMI (Kg/m²)	27,1 ± 3,0	22,5 ± 5,9	0,020
Lung function			
FVC (%pred)	87,8 ± 9,6	63,7 ± 19,5	0,001
FEV_1 (%pred)	86,8 ± 14,3	44,0 ± 20,0	<0,001
FEV_1/FVC (%pred)	99,0 ± 9,3	66,8 ± 17,4	<0,001
PEF (%pred)	79,0 ± 35,4	40,7 ± 21,8	0,004
$FEF_{25\%-75\%}$ (%pred)	90,6 ± 31,5	23,3 ± 14,9	<0,001

* Values expressed as mean ± SD, except for gender.

By comparing the data of RR and SpO2 between the Control Group and the COPD Group it can be observed that, in the first one there was a significant increase in SpO2 and also significant decrease of RR at 15 and 25 minutes compared to the first assessment (baseline). Observing the Group COPD it can be seen that there was a similar increase in relation to SpO2 and decrease in RR at 15 and 25 minutes compared to baseline. Comparing the drop in RR among the groups it was observed that this was not different in these three conditions analyzed (Table 2).

Table 2 - Presentation of the collected data between the study groups.

	Control Group (n= 13)				COPD Group (n= 12)				p-value
	Baseline	15min	25min	p-valor	Baseline	15min	25min	p-value	
HR (bpm)	72,4 ± 10,8	78,2 ± 13,9	82,1 ± 12,4	0,150	74,5 ± 13,9	80,6 ± 12,3	79,6 ± 11,9	0,464	0,742
RR (irpm)	17,4 ± 4,6[a]	9,2 ± 3,1[b,c]	10,5 ± 4,7[b,c]	<0,001*	18,3 ± 4,1[a]	11,4 ± 3,1[b,c]	11,6 ± 3,8[b,c]	<0,001*	0,830
SBP (mmHg)	125,5 ± 9,4	121,5 ± 15,7	121,7 ± 20,3	0,762	121,3 ± 18,5	132,9 ± 14,5	130,9 ± 17,2	0,207	0,189
DBP (mmHg)	76,9 ± 7,3	79,2 ± 10,3	80,5 ± 15,5	0,724	75,9 ± 10,7	80,4 ± 9,2	79,8 ± 7,7	0,447	0,089
SpO_2 (%)	96,5 ± 1,3[a]	97,8 ± 1,3[b,c]	98,4 ± 0,8[b,c]	<0,001*	93,6 ± 5,1	95,4 ± 4,2	95,4 ± 3,2	0,480	0,002*

* Comparison between groups. HR: heart rate, RR: respiratory rate, SBP: systolic blood pressure, DBP: diastolic blood pressure, SpO2: oxygen saturation. Statistical significance: $p < 0.05$.

DISCUSSION

The main finding of this study was to reduce the respiratory rate in both groups with no alteration of the other vital signs, ie, we find that the EPAP of 15 cmH20 resulted in reduction of respiratory muscle work during and after the application of such a feature. The same results were observed in the study of Nava et al. (1993), which have established a significant decrease in HR and parallel increase in tidal volume (TV) when applied IPAP of 10 cmH2O or 20 cmH2O, associated with an EPAP of 5 cm H2O also in patients with COPD, however it is noteworthy that in this study, patients with COPD were classified as serious.

In a study of mountaineers with high-altitude pulmonary edema the implementation of EPAP (5 and 10 cm H2O) produced increased SpO2 as well as TV and the reduction of RR, which is in line with our findings that demonstrate statistical significance for both increased SpO2 and for reduction of RF after application of 15 cmH2O EPAP. The authors reported the hypothesis that EPAP can cause an increase in ventilation / perfusion through the reversal of microatelectasis (SCHONE et al. 1985).

Agreeing with the results of Schoene et al., Andersen et al. (1979) describes in his study that the implementation of EPAP provides recruitment of collapsed alveoli by positive pressure generated at the end of expiration, these events being sustained based on collateral ventilation through the pores of Kohn and canals of Lambert. Also according to Andersen et al, pressure produced by EPAP also promotes the increased of efficiency of the forced expiration technique promoting the

displacement of secretions more effectively. For this reason, it is emphasized that the use of EPAP assists in reducing the mechanism for lung hyperinflation in COPD patients.

Regarding blood pressure, our study found no significant change in the levels of both SBP and DBP pressure before and during the implementation of EPAP. This finding was also demonstrated by Barros et al. who observed the effects of different levels of EPAP (5 cm H2O, 10 cm H2O and 15 cm H2O), applied in the form of non-invasive ventilation, DBP and HR in 14 patients with cardiogenic pulmonary edema. The results of this study did not show any change in hemodynamic variables of the sample. This same behavior on these variables was also found by Sant'Anna et al., who analyzed the acute cardiovascular responses of PEP 8 and 15 cmH2O in modality EPAP and the impact in double product (DP) in young adults. The authors concluded that the HR, BP and DP did not present significant change for both PEP 8 cmH2O as for the 15 cmH2O.

According Sant'Anna, et al., (2006), with the implementation of EPAP in healthy subjects, there is a decrease in DC, and consequently the decrease in vascular resistance (VR), as by the application of this feature, there is an increased of intrathoracic pressure which at the same time reduces the venous return leading to a reduction of preload. However, in our sample this effect was not found, both in healthy individuals as in patients with COPD. This fact can be explained by the possibility that these individuals had some degree of cardiac involvement inherent in COPD.

It is important to mention some limitations of this study that require discussion, being the main, the small sample size that may have been responsible for not encountered significant differences in hemodynamic variables such as SBP and DBP in the control group. However, this study becomes relevant in helping to deepen the knowledge of a widely used resource in the clinical field which is the expiratory positive airway pressure by mask.

CONCLUSION

Through the results obtained in this study, it was possible to observe that 15 cmH2O EPAP produces decrease in RR without changing other vital signs such as SpO2, HR, DBP and SBP. The reduction of RF can be attributed to the possible reduction of air trapping caused by positive expiratory pressure in patients with COPD.

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BEHAVIOR OF VITAL SIGNS IN PATIENTS WITH COPD IN THE USE OF POSITIVE PRESSURE EXPIRATORY

ABSTRACT

Evaluate the effects of Positive Expiratory Pressure (EPAP) on vital signs (VS) in patients with COPD. This is a clinical trial single blinded, comprising patients with COPD (n=12) treatment group (WG) with a clinical diagnosis and staging II and III GOLD (Global Initiative for Chronic Obstructive Lung Disease), and healthy subjects (n=13) Control Group (CG) both genders, age between 40 - 70 years. Initially to characterize the groups were evaluated by spirometry lung volumes, the VS as respiratory rate (RR), blood pressure (BP) and heart rate (HR) and oxygen saturation (SpO2) at baseline (Pre-EPAP). It was later applied to EPAP (15 cmH2O) by mask for 25 min, with data logging (VS and SpO2) in the fifteenth and twenty-fifth minute of application of positive pressure. A média de idade dos indivíduos do GC foi de 57,1 ± 7,1 anos e no GT, 57,2 ± 8,3 anos. The values obtained in spirometry demonstrated normal lung function in CG (FVC: 87.8 ± 9.6%pred, FEV1 86.8 ± 14.3%pred and FEV1/FVC: 99.0 ± 9.3%pred), and airflow limitation in TG (FVC: 63.7 ± 19.5%pred, FEV1: 44.0 ± 20.0%pred and FEV1/FVC: 66.8 ± 17.4%pred).

With the implementation of EPAP increased SpO2 (p <0,001), with reduced FR (p <0,001) at 15 and 25 min of application compared to baseline in the GC. With the implementation of EPAP increased SpO2 (p <0.001), with reduced FR (p <0.001) at 15 and 25 min of application compared to baseline in the GC. TG showed significant reduction in RR (p <0.001) at 15 and 25 min of application during Pre-EPAP. Our results suggest a possible benefit of the EPAP in reducing RR in COPD patients without causing alteration of the other SV.

COMPORTEMENT DES SIGNAUX VITAUX CHEZ LES PATIENTS PORTEURS DE LA BPCO SOUS L'UTILISATION DE LA PRESSION POSITIVE EXPIRATOIRE

RÉSUMÉ

Évaluer les effets de la pression expiratoire positive (PEP) sur les signaux vitaux (SV) chez les patients atteints de la BPCO. Il s'agit d'un essai clinique “uni aveugle”, comprenant les patients atteints de la BPCO - Groupe de Traitement (GT) (n=12) avec le diagnostic clinique et la évaluation GOLD II et III (Global Initiative for Chronic Obstructive Lung Disease), et par des individus en bonne santé - Groupe de Contrôle (GC) (n=13) des deux sexes et âgés entre 40-70 ans. Ont été évalués les volumes pulmonaires par spirométrie, les SV comme la fréquence respiratoire (FR), la pression artérielle (PA) et la fréquence cardiaque (FC) et la saturation périphérique en oxygène (SpO2) dans les conditions basales (Pré-EPAP). Il a ensuite été appliqué l'EPAP (15 cmH2O) au masque d'oxygène pendant 25min, avec l' enregistrement des données (SV et SpO2) dans le quinzième et vingt-cinquième minute d'application de la pression positive. L'âge moyen des individus dans le GC était de 57,1±7,1, et dans le GT, 57,2±8,3. Les valeurs obtenues dans la spirométrie ont démontré une fonction pulmonaire normale dans le GC (CVF: 87,8 ± 9,6%pred, VEF1 86,8 ± 14,3%pred et VEF1/CVF: 99,0 ± 9,3%pred), et la limitation du débit aérien dans le GT (CVF: 63,7±19,5% pred, VEF1: 44,0±20,0%pred et VEF1/CVF: 66,8 ± 17,4%pred). Avec l'application de l'EPAP il y a eu une augentation de la SpO2 (p<0,001) et une diminution de la FR (p<0,001) dans le 15 et 25 minutes d'application par rapport à la période pré-EPAP dans le GC. Le GT a montré une réduction significative de la FR (p<0,001) à 15 et 25min de l'application par rapport à la période pré-EPAP. Nos résultats suggèrent un bénéfice possible de l'EPAP à réduire FR chez les patients atteints de la BPCO sans provoquer l'altération des autres signaux vitaux.

COMPORTAMIENTO DE LOS SIGNOS VITALES EN PACIENTES CON EPOC EN EL USO DE PRESIÓN ESPIRATORIA POSITIVA

RESUMEN

Observar los posibles efectos de la Presión Esíratória Positiva (EPAP) sobre los signos vitales (SV) en pacientes con EPOC. Es un ensayo clínico uni-ciego, que incluye pacientes con EPOC - Grupo de Tratamiento (GT) (n=12) con un diagnóstico clínico y estadiamiento GOLD II y III (Global Initiative for Chronic Obstructive Lung Disease), e individuos sanos - del grupo control (GC) (n=13) ambos géneros, con edades comprendidas entre 40 y 70 años. Primero, para la caracterización de los grupos fueron evaluados los volúmenes pulmonares por la espirometría, los SV como la frecuencia respiratoria (FR), la presión arterial (PA) y la frecuencia cardíaca (FC) y la saturación de oxígeno (SpO2) en la línea base. Se aplicó posteriormente a EPAP 15 cm H2O) con mascarilla durante 25 minutos, con el registro de datos (SV y SpO2) en el decimoquinto y vigésimo quinto minuto de aplicación de presión positiva. La media de edad de los individuos en el GC fue 57,1 ± 7,1 años y en GT, 57,2 ± 8,3 años. Los valores obtenidos en la espirometría demostraron la función pulmonar normal en el grupo de control (CVF: 87,8 ± 9,6 %prev, VEF1 86,8 ± 14,3 %prev e VEF1/CVF: 99,0 ± 9,3 %prev), y la limitación del flujo aéreo en GT (CVF: 63,7 ± 19,5 %prev, VEF1: 44,0 ± 20,0 %prev e VEF1/CVF: 66,8 ± 17,4 %prev). Con la implementación de EPAP, hubo um aumento en SpO2 (p<0,001), con la reducción de la FR (p<0,001) a los 15 y 25 min de la aplicación relativo en la línea base. Nuestros resultados sugieren un posible beneficio de la EPAP en la reducción de FR en pacientes con EPOC sin causar alteración de la otra SV.

COMPORTAMENTO DOS SINAIS VITAIS EM PORTADORES DE DPOC SOB O USO DA PRESSÃO POSITIVA EXPIRATÓRIA

RESUMO

Avaliar os efeitos da Pressão Positiva Expiratória (EPAP) sobre os sinais vitais (SV) em portadores de DPOC. Trata-se de um ensaio clínico uni-cego, composto por portadores de DPOC - Grupo Tratamento (GT) (n=12) com diagnóstico clínico e estadiamentos GOLD II e III (Global Initiative for Chronic Obstructive Lung Disease), e por indivíduos hígidos - Grupo Controle (GC) (n=13) de ambos os gêneros e com idade entre 40 a 70 anos. Foram avaliados os volumes pulmonares através da espirometria, os SV como frequência respiratória (FR), a pressão arterial (PA) e frequência cardíaca (FC) e saturação periférica de oxigênio (SpO2) em condições basais (Pré-EPAP). Posteriormente, foi aplicada EPAP (15 cmH2O) através de máscara facial por 25 min, havendo o registro dos dados (SV e SpO2) no décimo quinto e vigésimo quinto minuto de aplicação da pressão positiva. A média de idade dos indivíduos do GC foi de 57,1 ± 7,1 anos e no GT, 57,2 ± 8,3 anos. Os valores obtidos na espirometria demonstraram a normalidade da função pulmonar no GC (CVF: 87,8 ± 9,6 %pred, VEF1 86,8 ± 14,3 %pred e VEF1/CVF: 99,0 ± 9,3 %pred), e limitação ao fluxo aéreo no GT (CVF: 63,7 ± 19,5 %pred, VEF1: 44,0 ± 20,0 %pred e VEF1/CVF: 66,8 ± 17,4 %pred). Com a aplicação da EPAP, houve aumento da SpO2 (p<0,001) e redução da FR (p<0,001) nos 15 e 25 min de aplicação em relação ao período pré-EPAP no GC. O GT apresentou redução significativa da FR (p<0,001) aos 15 e 25 min de aplicação em relação ao período Pré-EPAP. Nossos resultados apontam para um possível benefício da EPAP em reduzir a FR nos indivíduos portadores de DPOC, sem provocar alteração dos demais sinais vitais.