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ORIGINAL ARTICLE

EFFICACY OF CPAP IN DELIVERING BRONCHODILATORS SOLUTIONS TO THE AIRWAYS OF PATIENTS WITH BRONCHIAL ASTHMA & COPD

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Background: ***Bronchial asthma is characterized by reversible air way obstruction caused by a triad of bronchial smooth muscle contraction, air way inflammation and increased secretions. The episodes are usually associated with widespread but variable airflow obstruction that is often partially reversible either spontaneously or with treatment .***

COPD is a preventable and treatable disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases, primarily caused by cigarette smoking.

CPAP – Continuous Positive Airway Pressure – therapy uses a machine to regulate air flow to an individual suffering from obstructive sleep apnea, CPAP acts as a pneumatic splint and physical stent that increases the airway pressure in the throat so the airways do not collapse during inhalation.

The aim of this work is to evaluate the efficacy of CPAP in delivering nebulised bronchodilators to the airways of patients with bronchial asthma & COPD during exacerbation in comparison with the conventional nebulizer.

Methods: ***The present study included 50 patients with COPD diagnosed according to the criteria of GOLD 2010 and 50 patients with bronchial asthma diagnosed according to the criteria of GINA 2010. The patients in the study were classified into 2 groups: Group A: included 50 patients with acute attack of bronchial asthma who were subdivided into two equal groups 1 and 2 Group A 1: received bronchodilator solutions by the nebulizer alone. Group A 2; received nebulized bronchodilator solutions with application of CPAP.***

Group B: included 50 patients with exacerbation of COPD who were also subdivided into two groups 1 and 2 Group B 1; received bronchodilator solutions by the nebulizer alone Group B2: received nebulized bronchodilator solutions with application of CPAP.

The current study showed improvement both clinically and in the oxygenation, reduction in PaCO2, improvement of PH increase in the peak flow rate and significant reduction in the number of cases requiring endotracheal intubation in patients treated with CPAP and nebulizer in comparison with patients treated with nebulizer alone in moderate and severe cases of asthma and COPD.

Conclusion: ***CPAP is not only effective in cases of obstructive sleep apnea but also can be used with the nebulizer to dispel prescribed drug used in relieving symptoms of asthma and COPD depending on the physical principle that positive airway pressure can disperse the bronchodilators to more peripheral airways. Adding CPAP to the nebulizer is more beneficial in moderate and severe cases of asthma and COPD than in mild cases. In the current study CPAP application to the***

nebulizer showed significant improvement both clinically and in the oxygenation, reduction in PaCO2, improvement of PH, increase in the peak flow rate, and significant reduction in the number of cases requiring endotracheal intubation.

Keywords: ***CPAP–Continuous Positive Airway, Pressure, COPD-Chronic obstructive pulmonary disease, Bronchial asthma.***

INTRODUCTION

There is no universally accepted terminology or definition for the group characterized by conations airway obstruction that is incompletely reversible.(1) Asthma and COPD are characterized by an underlying airway inflammation. The underlying chronic airway inflammation is very different in these two diseases. However, individuals with asthma who are exposed to noxious agents, particularly cigarette smoke, may also develop fixed airflow limitation and mixture of “asthma-like” and “COPD-like” inflammation.(2) Bronchial asthma is characterized by reversible air way obstruction caused by a triad of bronchial smooth muscle contraction, air way inflammation and increased secretions. In most patients, control of disease activity is easily achieved.(3) However, in a small minority, asthma may be fatal.(4) This definition would combine the central roles of inflammation and bronchial hyper responsiveness with the characteristic clinical symptoms. As an example, asthma may be defined as "a chronic inflammatory disorder of the airways in which many cell types play a role, in particular mast cells, eosinophils, and T lymphocytes. In susceptible individuals, this inflammation causes recurrent episodes of wheezing, breathlessness, chest tightness, and cough particularly at night and/or in the early morning. These symptoms are usually associated with widespread but variable airflow limitation that is at least partly reversible either spontaneously or with treatment. The inflammation also causes an associated increase in airway responsiveness to a variety of stimuli.(5) COPD “chronic obstructive pulmonary disease” is a preventable and treatable disease with some significant extra pulmonary effects. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with abnormal inflammatory response of the lungs to noxious particles or gases. Patients usually present with cough, breathlessness, wheezing and excess respiratory secretions.(6) CPAP – Continuous Positive Airway Pressure – therapy uses a machine to regulate air flow to an individual suffering from obstructive sleep apnea, A CPAP machine acts as a pneumatic splint and a physical stent that increases the airway pressure in the throat so the airways don't collapse during inhalation.(7) The CPAP can also be used with a nebulizer, in order to dispel prescribed drug used in relieving symptoms of asthma, COPD or congestive heart failure.(8) CPAP application will result in bronchial dilatation by mechanical effect thus decreasing airway resistance, expanding atelectatic regions and facilitating clearance of secretions.(9) The benefit of CPAP is supported by evidence that PPV may have a direct bronchodilator effect, offset intrinsic PEEP, and recruit collapsed alveoli, improve ventilation/perfusion mismatch and reduce the work of breathing. NPPV should probably be applied in selected patients who have or at risk for severe asthma attacks.(10) The most common conditions for which PAP ventilation is used in hospital are congestive cardiac failure and acute exacerbation of obstructive airway disease, most notably exacerbations of COPD and asthma. It is not used in cases where the airway may be compromised, or consciousness is impaired. CPAP is also used to assist premature babies with breathing in the NICU setting.(11)

Aim of the work: The aim of this work is to evaluate the efficacy of CPAP in delivering nebulized bronchodilators to the airways of patients with bronchial asthma & COPD during exacerbation in comparison with the conventional nebulizer alone.

PATIENTS AND METHODS

Subjects: Fifty patients with chronic obstructive pulmonary disease and fifty patients with bronchial asthma were included in the present study. Patients with chronic obstructive pulmonary disease were diagnosed according to the criteria of GOLD, 2010.Patients with bronchial asthma were diagnosed according to the criteria of GINA, 2010.All patients included in the present study were selected from COPD and asthma patients admitted to the chest department in Kobri El Kobba Military Chest Hospital in the period between April 2010 to April 2011.

The following patients were excluded from the study:

1. Need for immediate endotracheal intubation & mechanical ventilation.
2. Decreased level of consciousness.
3. Patients with emphysematous bullae.
4. Excess respiratory secretions & risk of aspiration.
5. Maxillo-facial deformities precluding mask fitting.
6. Hemodynamic instability with or without cardiac angina.
7. Severe hypoxia and / or hypercapnia.

8. PaO_2 / FiO_2 ratio of 200, $PaCo_2$ > 60 mm Hg.
9. Severe gastro-intestinal tract bleeding.
10. Upper airway obstruction
11. Recent esophageal anastomosis.
12. Poor patient co-operation.
13. Severe agitation.

Patients in the study were classified into 2 groups:

Group A:

Consists of 50 patients with acute attack of bronchial asthma, subdivided into two groups 1 and 2. Group A 1: received bronchodilator solutions by the nebulizer alone. Group A 2: received nebulized bronchodilator solutions using CPAP.

Group B:

Consists of 50 patients with exacerbation of COPD who were also subdivided into two groups 1 and 2 Group B 1: received bronchodilator solutions by the nebulizer alone. Group B 2; received nebulized bronchodilator solutions using CPAP.

All patients will be monitored before and after the test by clinical examination and recording the vital data, and during the test using the pulse oximeter. The CPAP pressure used ranged from 7 to 10 Cm H_2O according to the patients tolerance. Fixed dose combination will be used as recommended in the acute attacks of bronchospasm: Short acting beta 2 agonist (aerosolized salbutamol) 2.5 to5 mg by continuous flow (also called "hand-held" or "updraft") nebulization every 20 minutes for three doses , then 2.5 to 10 mg every one to four hours as needed .[12] And anticholinergic agent (ipratropium) 500 mcg by nebulizer every four hours as needed.[6] With equal volume of normal saline 0.9% as a mechanical agonist .[13]The CPAP device used was Zzz – PAP CPAP machine with heated humidifier. The Face mask CPAP was used, not the nasal one to prevent leakage and help delivery of the bronchodilators as far as possible to the peripheral airways.[14]

Spirometric lung functions (PFTs) in the form of:

1. FVC.
2. FEV1.
3. FEV1 / FVC.

It is done using the ZAN-100 spirometer which is a completely self-contained automated spirometer. It combines a micro-computer, an integral printer, a calendar clock, a temperature sensor and an optimal serial communication capability into a single well-designed unit.

Statistical Analysis: Statistical analyses were performed utilizing Statistical Package for Social Sciences (SPSS for Windows, version 17.0; SPSS Inc, Chicago, IL). Descriptive statistics were presented as mean ± standard deviation (SD). Correlation co-efficient test: Was used to rank different variables positively or inversely versus each other P value > 0.05 insignificant P value < 0.05 significant P value < 0.01 highly significant.

RESULTS

The current study included 50 patients with chronic obstructive pulmonary disease and 50 patients with bronchial asthma .The patients in the study were classified into 2 groups.

Group A: Included 50 patients with acute attack of bronchial asthma who will be subdivided into two groups 1 and 2 Group A 1: received bronchodilator solutions by the nebulizer alone. Group A 2: received nebulized bronchodilator solutions using CPAP.

Group B: Consists of 50 patients with exacerbation of COPD who were also subdivided into two groups 1 and 2.

Group B 1: Received bronchodilator solutions by the nebulizer alone.

Group B 2: Received nebulized bronchodilator solutions with CPAP.

1. Cases with bronchial asthma

Cases were classified into mild, moderate and severe, the study included 10 cases with mild asthma, 20 cases with moderate asthma and 20 cases with severe asthma and all were classified into the two previously mentioned groups (Groups A1 and A2) .The mean ages were 42±5 yrs and 44±5 yrs, respectively (p>0.05).There is no statistical significant difference between both studied groups as regard age by using unpaired t-test.

Comparison between the studied groups regarding PFTs; ABG; the peak flow meter and the clinical improvement: The current study showed significant improvement in patients treated with Nebulized CPAP in comparison with patients treated with Nebulizer only, in moderate and severe cases of acute asthma regarding PFTs; (P=0.03)ABG (P<0.05and=0.01in moderate / severe asthma, respectively); the peak flow meter (P<0.001), and the clinical improvement (P=0.003 and <0.001 in moderate / severe asthma, respectively). On comparing both groups in mild asthma despite improvement in all cases did not reach statistical significance. The data of the different parameters among patients are shown in Table 1, (Fig. 1–9).

Table 1. Comparative Statistics between group A1 & A2 in mild, moderate and severe cases of asthma regarding PFTS, Peak flow meter, ABG and clinical improvement.

Parameters	Grades	Nebulized (Group A1)		Nebulized CPAP (Group A2)		P
		Before	After	Before	After	
FEV1	mild	3.1±.0.3	3.4±.0.1	3.2±.0.4	3.5±.0.3	>0.05
	moderate	2.2±0.4	2.5±.0.3	2.3±.0.3	2.7±.0.2	0.03
	severe	1.9±.0.2	2±.0.4	1.85±.0.3	2.1±0.2	0.03
FEV1%	mild	77.5±4%	85±3%	80±10%	87.5±6%	>0.05
	moderate	55±3%	62.5±3.5%	57.5±7.5%	67±6%	0.03
	sever	48±5%	50.5±2.5%	46±4%	53±3%	0.03
FEV1/ FVC	mild	69±3%	72±2%	70.5±2%	73.5±2.5%	>0.05
	moderate	53±2%	55.5±3%	54±3%	61±2%	0.03
	severe	44±4%	49±3%	43.5±3.5%	51±1.5%	0.03
Peak flow meter	mild	400±20	440±10	410±10	450±10	>0.05
	moderate	250±30	300±20	150±10	330±20	<0.001
	severe	150±20	240±10	160±10	280±20	<0.001
PaO2	mild	84±3	84±4	82±2	83±2	>0.05
	moderate	72±2	73±3	70±3	74±2	<0.05
	severe	60±4	63±3	59±3	67±4	0.01
PaCO2	mild	37±3	37±4	38±2	38.5±1	>0.05
	moderate	40±3	38±2	41±2	37±3	<0.05
	severe	46±5	43±2	48±2	43±3	0.01
PH	mild	7.39±0.05	7.41±0.06	7.37±0.03	7.38±0.02	>0.05
	moderate	7.35±0.01	7.36±0.02	7.35±0.02	7.40±0.04	<0.05
	severe	7.32±0.06	7.35±0.02	7.31±0.04	7.38±0.02	0.01
Clinical improvement	mild	5	5	5	5	
	moderate	10	6	10	8	0.003
	severe	10	4	10	7	<0.001

PFTS pulmonary function tests, ABG arterial blood gases, FEV_1 (%), forced expiratory volume in one second percent predicted; FVC (%) forced vital capacity, PaO2partial pressure of oxygen, Paco2partial pressure of Carbon dioxide.

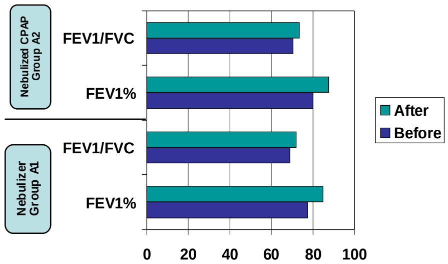

Fig 1. Comparison between mild cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard PFTs.

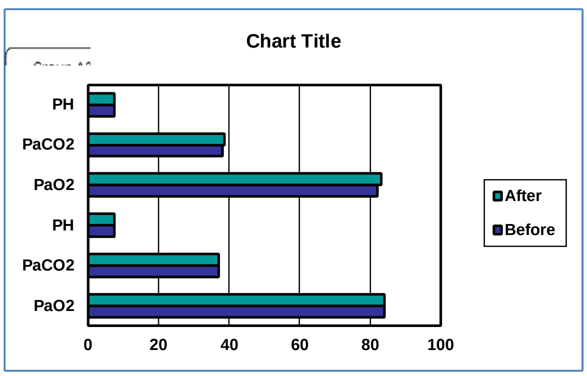

Fig 2. Comparison between mild cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard ABG.

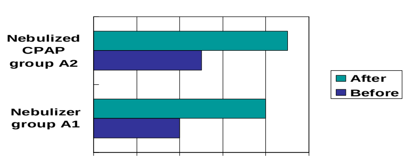

Fig 3. Comparison between mild cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard the peak flow meter.

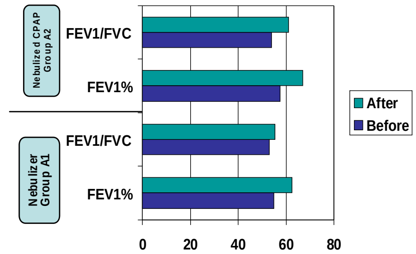

Fig 4. Comparison between moderate cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard PFTs.

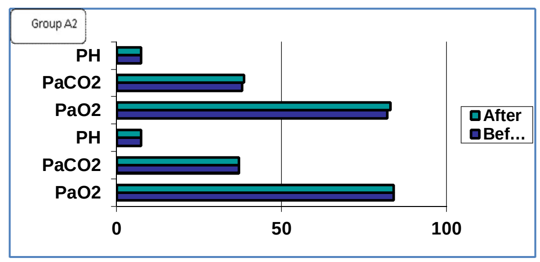

Fig 5. Comparison between moderate cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard ABG.

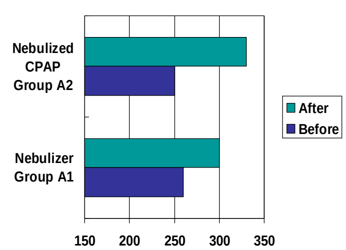

Fig 6. Comparison between moderate cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard the peak flow meter.

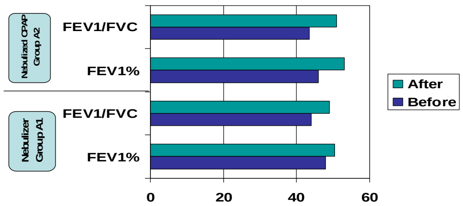

Fig 7. Comparison between severe cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard PFTs.

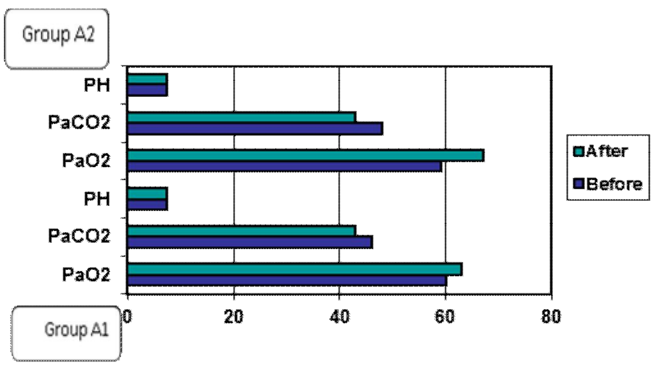

Fig 8. Comparison between severe cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard ABG.

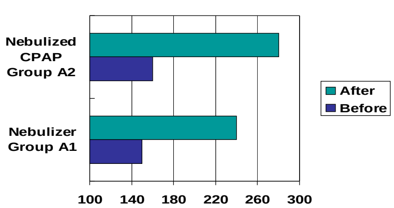

Fig 9. Comparison between severe cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard the peak flow meter.

The current study showed significant improvement (p<0.001) in patients treated by Nebulizer with CPAP(80%) in comparison with patients treated with Nebulizer only (60%) in cases of acute asthma with significant reduction in the number of cases required endotracheal intubation .There were 20% of asthma cases treated with nebulizer required endotracheal intubation while only 8% of asthma cases treated with nebulized CPAP required intubation with significant difference between both groups (P < 0.05),as shown in Table 2,3 & (Fig. 10).

Table 2. Comparison between asthma cases treated with nebulizer (group A1) and cases treated with nebulized CPAP (group A2) as regard the number of cases required endotracheal intubation.

	Group A1	Group A2	P value
Total no.	25	25	
Cases required intubation	5	2	<0.05
Percent	20٪	8٪	

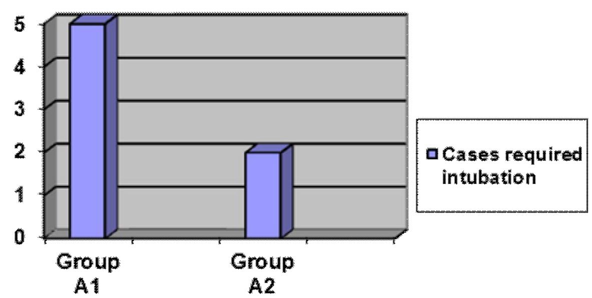

Fig 10. Comparison between cases treated with nebulizer (group A1) and cases treated with nebulized CPAP (group A2) as regard the number of cases required endotracheal intubation.

Table 3. Comparison between the whole studied cases of asthma treated with Nebulizer only (group A1) and those treated with Nebulized CPAP (group A2) as regard the overall improvement.

	Nebulizer Group A1	Nebulized CPAP Group A2	P value
Total No. of cases	25	25	
Improved	15	20	<0.001
Percent	60%	80%	

2. Cases of COPD:

Cases were classified into mild, moderate and severe, the study included 10 cases with mild COPD, 20 cases with moderate COPD and 20 cases with severe COPD and all were classified into the two previously mentioned groups (Groups B1 and B2). The mean ages were 52±3 yrs and 51±3 yrs, in the COPD (Groups B1 and B2), respectively (p>0.05). No statistical significant difference could be detected between both studied groups as regard age by using unpaired t-test.

Comparison between the studied groups regarding PFTs; ABG; the peak flow rate and the clinical improvement*:* The current study showed significant difference in improvement in patients treated with Nebulized CPAP in comparison with patients treated with Nebulizer only in moderate and severe cases of acute COPD regarding PFTs;.(P=0.007and <0.05 in moderate / severe COPD, respectively), ABG (P< 0.05and = 0.008 in moderate / severe COPD respectively), the peak flow meter (P<0.001), and the clinical improvement.(P=0.005and <0.001 in moderate/ severe COPD, respectively)).Comparing the both groups in mild COPD although there was significant improvement in all cases but there was no statistically significant difference between both groups (P>0.05)in PFTs&ABG. With statistically significant difference between both group (P<0.05) as regard the peak flow meter. The data of the different parameters among patients are shown In [Table 4 & Figure 11–17]. The current study showed highly significant improvement (P < 0.001), in patients treated with Nebulized CPAP (72%) in comparison with patients treated with Nebulizer only (52%)in cases of acute COPD ,there were significant reduction in the number of cases requiring endotracheal intubation that led to limitation of nosocomial infections. As there were 24% of COPD cases treated with nebulizer requiring endotracheal intubation while only 4% of COPD cases treated with nebulized CPAP required intubation with highly significant difference between both groups (P < 0.005), as shown in Table 5,6 & (Fig. 18).

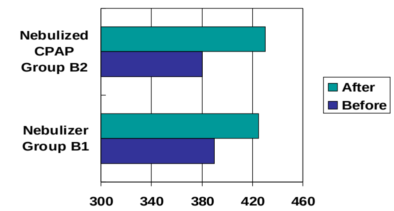

Fig 11. Comparison between mild cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard the peak flow meter.

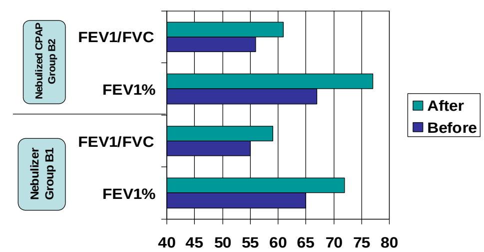

Fig 12. Comparison between moderate cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard PFTs.

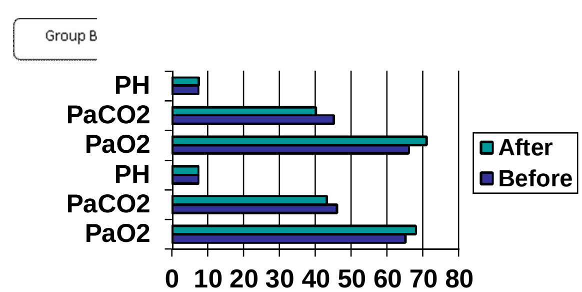

Fig 13. Comparison between moderate cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard ABG.

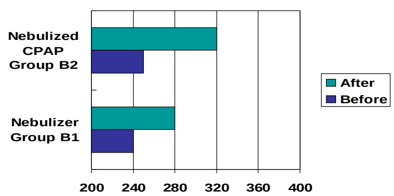

Fig 14. Comparison between moderate cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group groupB2) as regard the peak flow meter.

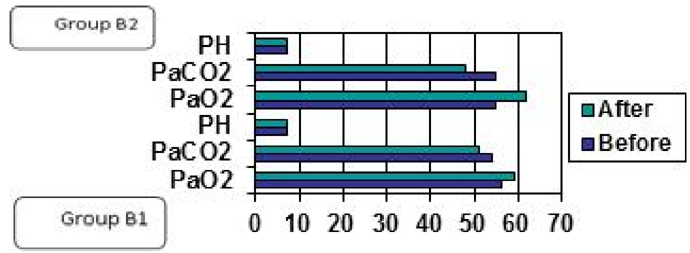

Fig 16. Comparison between severe cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard ABG.

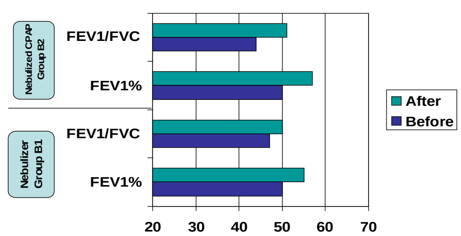

Fig 15. Comparison between severe cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard PFTs.

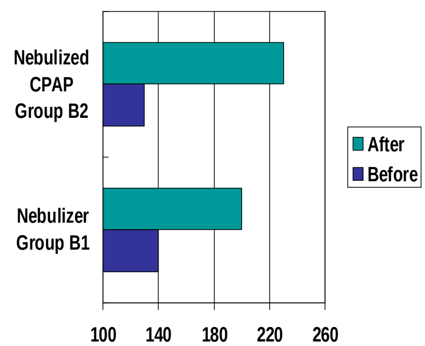

Fig 17. Comparison between severe cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulized CPAP (group B2) as regard the peak flow meter.

Table 4. Comparative Statistics between group B1&B2 in mild, moderate and severe COPD regarding PFTS, Peak flow meter, ABG and clinical improvement.

Parameters	Grades	Nebulized (GroupB1)		Nebulized CPAP (GroupB2)		P
		Before	After	Before	After	
FEV1	mild	3.2±0.2	3.3.±0.3	3.3±0.3	3.5±0.2	>0.05
	moderate	2.6±0.3	2.9±0.3	2.7±0.3	3.1±0.3	0.007
	severe	2±0.2	2.2±0.3	2±0.3	2.3±0.4	<0.05
FEV1%	mild	80±3%	83±3.5%	83±2%	87±2.5%	>0.05
	moderate	65±3.5%	72±2.5%	67±3.5%	77±4.5%	0.007
	sever	50±5%	55±3%	50±4%	57±4%	<0.05
FEV1/ FVC	mild	65±2	66±3	66±2	67±4	>0.05
	moderate	55±5	59±4	56±4	61±3	0.007
	severe	47±3	50±2	44±4	51±3	<0.05
Peak flow meter	mild	390±20	425±15	380±15	430±25	<0.05
	moderate	240±20	280±30	250±10	320±20	<0.001
	severe	140±20	200±20	130±15	230±25	<0.001
PaO2	mild	80±2	80±2	82±3	82±2	>0.05
	moderate	65±5	68±2	66±2	71±3	0.009
	severe	56±3	59±2	55±2	62±2	0.008
PaCO2	mild	41±3	40±2	40±4	40±2	>0.05
	moderate	46±2	43±1	45±3	40±2	0.003
	severe	54±3	51±2	55±2	48±4	0.008
PH	mild	7.38±0.02	7.39±0.01	7.37±0.03	7.40±0.01	>0.05
	moderate	7.33±0.01	7.34±0.02	7.32±0.02	7.38±0.02	0.005
	severe	7.30±0.03	7.34±0.03	7.29±0.04	7.38±0.05	0.008
Clinical improvement	mild	5	5	5	5	
	moderate	10	5	10	7	0.005
	severe	10	3	10	6	<0.001

PFTS pulmonary function tests, ABG arterial blood gases, FEV_1 (%), forced expiratory volume in one second percent predicted; FVC (%) forced vital capacity, PaO2 partial pressure of oxygen, Paco2 partial pressure of Carbon dioxide.

Table 5. Comparison between COPD cases treated with nebulizer (group B1) and cases treated with nebulized CPAP (group B2) as regard the number of cases required endotracheal intubation.

	Group B1	Group B2	P value
Total no	25	25	
Cases required intubation	6	1	< 0.005
Percent	24 %	4 %	

Table 6. Comparison between the whole studied cases of COPD treated with Nebulizer only (group B1) and those treated with Nebulizer + CPAP (group B2) as regard the overall improvement.

	Nebulizer Group B1	Nebulizer + CPAP Group B2	P value
Total No. of cases	25	25	
Improved	13	18	<0.001
Percent	52٪	72٪	

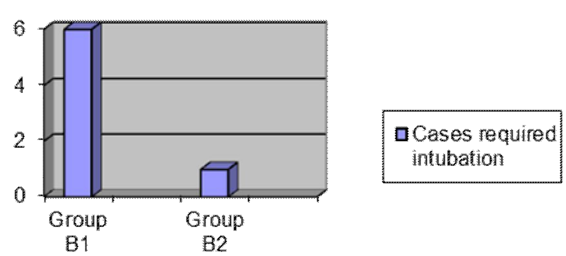

Fig 18. Comparison between cases treated with nebulizer (group B1) and cases treated with nebulizer + CPAP (group B2) as regard the number of cases required endotracheal intubation.

DISCUSSION

Bronchial asthma is a chronic inflammatory disorder of the airways in which many cells and cellular element play a role. The chronic inflammation causes an associated increase in airway hyper responsiveness that lead to recurrent episodes of wheezing, breathlessness tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread but variable airflow obstruction that is often partially reversible either spontaneously or with treatment.[5] COPD is a preventable and treatable disease with some significant extra pulmonary effect. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with abnormal inflammatory response of the lungs to noxious particles or gases. Patients usually present with cough, breathlessness wheezing and excess respiratory secretions.[6] CPAP Continuous Positive Airway Pressure therapy uses a machine to regulate airflow to an individual suffering from obstructive sleep apnea, A CPAP machine acts as a pneumatic splint and a physical stent that increases the airway pressure in the throat so the airways do not collapse during inhalation.[7] The CPAP can also be used with nebulizer, in order to dispel prescribed drug used in relieving symptoms of asthma , COPD or congestive heart failure.[8] As early as 1939 Barach and Swenson[15] showed that gas under positive pressure (CPAP of 7 Cm H2O) can dilate small to moderate sized bronchi, furthermore, aerosolised bronchodilator delivered through a bi_ level positive air way pressure [Bi PAP] circuit resulted in improved FEV1 and expiratory flow rate suggesting that positive.airway pressure can disperse the bronchodilators to more peripheral airways.[16] Positive pressure application also prevents bronchospasm induced by different stimuli. Prior reports showed that methacholine & histamine - induced bronchospasm could averted by application of CPAP.[17] Wilson and his group in1981,[9] have demonstrated that externally applied PEEP prevents exercise induced asthma and in addition to the pharmacological effect of the bronchodilators used in the nebulizer, CPAP application will result in bronchial dilatation by mechanical effect thus decreasing airway resistance, expanding atelectatic regions and facilitating clearance of secretions.[9]

The current study included 50 patients with acute attack of bronchial asthma who were subdivided into two groups A1 and A2 Goup A 1: 25 patients treated by the nebulizer alone .Group A 2: 25 patients treated by the CPAP using nebulized bronchodilator solutions. The study also included 50 patients with exacerbation of COPD who were subdivided into two groups 1 and 2. Group B 1; 25 patients treated by the nebulizer alone. Group B 2; 25

patients relieved by the CPAP applied to the nebulized bronchodilator solutions. The CPAP pressure which was used from 7 to 10 Cm H_2O and according to the patient tolerance. Fixed dose combination was used as recommended in the acute attacks of bronchospasm: Short acting beta 2 agonist (aerosolized salbutamol) 2.5 to 5 mg by continuous flow (also called "hand-held" or "updraft"). nebulization every 20 minutes for three doses, then 2.5 to 10 mg every one to four hours as needed.[12] And anticholinergic agent (ipratropium) 500 mcg by nebulizer every four hours as needed.[6] With equal volume of normal saline 0.9 % as a mechanical agonist. This is based on several studies that found that combination therapy produces bronchodilation in excess of that achieved by either agent alone in patients with a COPD exacerbation , an asthma exacerbation, or stable COPD.[13] The Face mask of the CPAP was used, not the nasal one to ensure no leakage and delivery of the bronchodilators as deep as possible to the peripheral airways.[14] Cases in both groups were classified according to the results into mild, moderate and severe cases according to GINA 2010[5] and GOLD 2010.[6] Over the last 10 yrs NPPV has gained wide acceptance for various indications. With the increased use of NPPV we gained new knowledge and experience. Therefore, we believe that under appropriate circumstances and experienced respiratory teams; NPPV use can now be extended to new diseases, such as asthma, and can be used in conditions that were previously considered as contraindications.[18] As regards asthma groups, the current study showed significant improvement in oxygenation (PaO_2 from 59±3 to 67±4 mmHg), increase in the peak flow (from 160 to 280L/min), significant reduction in $PaCO_2$ (from 48 to 42mmHg) and only two cases with severe asthma required endotracheal intubation and this was in agreement with MEDURI and his group in 1996,[18] that described a series.Of 17 asthmatic patients treated with NPPV. They used a CPAP face mask with pressure support. Their main finding was that NPPV improved gas exchange in status asthmatics. A statistically significant reduction in arterial carbon dioxide tension ($PaCO_2$) was observed. A concomitant improvement in oxygenation was also observed, with an increase in the arterial oxygen tension. Two out of 17 patients (12%) required intubation and there were no complications with NPPV use.

FERNANDEZ et al in 2001,[19] reported 33 patients with acute asthmatic attack. 22 patients received NPPV (with CPAP) and were compared to a group of 11 patients treated with invasive mechanical ventilation, three out of 22 (14%) patient in the non-invasive group were eventually intubated, on initiation of invasive and noninvasive ventilation, $PaCO_2$ decreased similarly in both groups. A similar improvement in $PaO_2$was noted in both groups and these results are in agreement with the current study and encourage and reassure the feasibility of NPPV application in severe asthmatic attacks. In the present study there were no reported complications with the use of NPPV occurred in cases with bronchial asthma and also the time of hospital admission decreases significantly and this was in agreement with GEHLBACH and coworkers in 2002,[20] which reported their experience on 78 patients admitted to their ICU with status asthmatic. 56 patients were endotracheal intubated and 22 were ventilated with NPPV. Endotracheal intubation was associated with a prolonged hospital stay and an increased rate of complications, such as barotraumas, muscle weakness, organ failure and hospital acquired infections. The current study showed significant difference in improvement in patients treated with Nebulized CPAP in comparison with patients treated with Nebulizer only in moderate and severe cases of asthma but there was no significant difference between both groups in mild asthma, and this could be partially explained on the assumption that; besides being mild, patients present early in the attack and might have received their usual rescue medications before attending the emergency unit. The key to successful NPPV application is choosing the right patient. Patients with easily controlled disease are too easy and probably do not need any respiratory support. At the other extreme are patients with severe status asthmaticus with pending respiratory failure, and who are on the verge of endotracheal intubation.[20] A trial of NPPV in these patients might delay an inevitable endotracheal intubation and subject them to unnecessary risks. Therefore, these patients should be considered for endotracheal intubation sooner rather than later. Between these two groups are patients with severe asthmatic attack which, if not treated aggressively, may progress to respiratory failure. These are the patients that could benefit from a closely monitored trial of NPPV.[20]

As regards the COPD groups, Patients with underlying chronic obstructive pulmonary disease (COPD) who present with an exacerbation of their COPD and hypercapnic respiratory distress or respiratory failure are the group most likely to be successfully treated with non-invasive ventilation (NIV). Exacerbations increase the respiratory load in these patients, exceeding their ability to adequately ventilate through a variety of mechanisms including increasing hyperinflation with decrease diaphragmatic excursion and strength, increasing intrinsic positive end-expiratory pressure (PEEP), ineffective or inadequate tidal volume generation, respiratory patterns, and increased respiratory frequency. Non-invasive ventilation effectively unloads the respiratory muscles, increasing tidal volume, decreasing the respiratory rate, and decreasing the diaphragmatic work of breathing, which translates to an improvement in oxygenation, a reduction in hypercapnia, and an improvement in dyspnea.[21] Noninvasive ventilation is an important adjunct to other conventional therapy (eg, bronchodilators corticosteroids, antibiotics). COPD is an ideal condition for noninvasive ventilation, given the rapid reversibility with treatment and added support that can be provided by non-invasive ventilation.[22] The current study showed significant improvement in patients treated with Nebulized CPAP in comparison with patients treated with Nebulizer only in moderate and severe cases of COPD but there was no significant difference between both groups in mild COPD . Again, this could be partially explained on the assumption that; besides being mild, patients present early in the attack and might have received their usual rescue medications before attending the emergency unit. The current study showed significant improvement in oxygenation (PaO2 from 55±2 to 62±2mmHg), increase in the peak flow (from 130 to 230 L/min), significant reduction in PCO2 (from 55±2 to 48±4mmHg) and only one case with severe COPD required endotracheal intubation and this was in agreement with Lightowler and his group in 2003,[23] that reported a recent meta- analysis of eight studies showed that, compared with usual care alone, this therapy was associated with lower mortality rate (relative risk 0.41; 95% confidence interval [CI] 0.26–0.64), Less need for end tracheal intubation (relative risk 0.42; 95% CI 0.31–0.59), lower rate of treatment failure (relative risk 0.51; 95% CI 0.38–0.67), greater improvement in the 1-hour post-treatment pH and PaCO2 levels, lower respiratory rate and a shorter length of stay in the hospital. Therefore, our results are in agreement with Lightowler and coworkers (23) as there were improvement in PaO2, PaCO2, PH and less need for endotracheal intubation.

The mode of non-invasive ventilation used in the current study was CPAP, in contrast, Plant et al in 2003(24), reported most experience with noninvasive ventilation has accrued with either bilevel positive airway pressure (Bi PAP) or pressure support ventilation, less so with volume ventilation and continuous positive airway pressure (CPAP). Keenan and colleagues in 2003,[25] showed that the benefit was most pronounced in patients with more severe COPD exacerbations, defined by an initial pH of less than 7.30. The magnitude of effect was even more pronounced in this group, with intubation rates decreased by 34% (95% CI, 22-46%), mortality reduction of 12% (95% CI, 6-18%), and absolute reduction in the length of stay by 5.59 days (95% CI, 3.66-7.52 d) and this was in agreement with the current study in reduction of the number of cases required endo-tracheal intubation. Noteworthy, the present study did not include the length of hospital stay and the mortality rate. Being a preliminary study all our study subjects were managed for the acute attack as emergency cases in the emergency unit. In some centers, patients with an initial pH of less than 7.25 and a Glasgow Coma Scale score of less than 11 had noninvasive ventilation failure rates of 70% or greater.[26]

Previous studies reported successful application of non-invasive ventilation in patients with a Glasgow Coma Scale score less than 8 and an average pH of 7.13 ± 0.06 (mean ± standard deviation), with 76 (80%) of 95 patients responding to treatment with noninvasive ventilation.[27] Our results are in agreement with the results of Diaz and coworkers[27] in the improvement of PH (from 7.29±0.04 to 7.38±0.05) and add further support that CPAP application could be used safely and effectively to improve PH, PaO2 and PaCO2 as previously mentioned. Nevertheless, local experience and expertise also play significant roles in determining the successful limits of noninvasive ventilation in COPD patients. Patients who are not cooperative and have a pH that approaches 7.20 must be evaluated with caution because they have a higher risk of failure with noninvasive ventilation and would therefore benefit from earlier intubation (if an option), especially if they do not respond to a short trial of noninvasive ventilation[28] Another benefit with noninvasive ventilation may be a reduction in nosocomial infections associated with its application. This was a finding suggested by earlier investigations, because averting endotracheal intubation also avoids a major risk factor for ventilator-associated pneumonia. Experience in a case-control study suggests a reduction in nosocomial pneumonia from 22% to 8%, with fewer days in the ICU and lower mortality (26% down to >4%) in those treated with noninvasive ventilation as opposed to those who received endotracheal intubation.[28] Although this issue was not considered in our present study, yet the less need for endotracheal intubation in our study population might have an impact on minimizing the risk of nosocomial lower respiratory tract infections.

CONCLUSION

CPAP is not only effective in cases of obstructive sleep apnea but also can be used with the nebulizer to dispel prescribed drug used in relieving symptoms of asthma and COPD depending on the physical principle that positive airway pressure can disperse the bronchodilators to more peripheral airways. Adding CPAP to the nebulizer is more beneficial in moderate and severe cases of asthma and COPD than in mild cases. In the current study CPAP application to the nebulizer showed significant improvement both clinically and in the oxygenation, reduction in PaCO2, improvement of PH increase in the peak flow rate, and significant reduction in the number of cases requiring endotracheal intubation.

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