COMPARISON OF NIPPV WITH STANDARD TREATMENT IN PATIENTS WITH ACUTE EXACERBATIONS OF COPD IN TERMS OF IMPROVEMENT IN ABGs AND HOSPITAL STAY

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ABSTRACT

Objective: To compare non invasive positive pressure ventilation with standard treatment in patients with acute exacerbations of chronic obstructive pulmonary disease in terms of improvement in arterial blood gases and hospital stay.

Study Design: Randomized control trial.

Place and Duration of Study: This study was carried out at Military Hospital Rawalpindi for a period of six months (1st May 2009 to 30th Oct 2009).

Patients and Methods: A total of 78 patients with acute exacerbation of chronic obstructive pulmonary disease (COPD) were inducted into the study, the study compared non invasive positive pressure ventilation (NIPPV) with standard treatment in patients with COPD exacerbation. Patients were divided into two groups.

Group A: Received standard treatment of COPD

Group B: Received NIPPV in form of Bi- level positive airway pressure (BiPAP) along with standard treatment

The data was analyzed using SPSS version 17.0. Means and standard deviation were calculated for numerical variables, i.e, age, pH, PO_2, PCO_2, HCO_3 and length of hospital stay. Frequency and percentages were presented for categorical variables, i.e., gender student's. t-test was used to compare the means of the numerical data.

Results: The use of NIPPV significantly improved the arterial blood gases (ABGs) and hospital stay. In the group treated with NIPPV, significant improvement was noted in pH (7.25 ± 0.523 at base line and 7.28 ± 0.5340 at 24 hours, p=0.001), PO_2 (46.32 ± 2.0284 mm Hg at admission and 64.43 ± 4.025 after 24 hours, p=0.032) and PCO_2 (57.82 ± 5.93 at baseline and 52.17 ± 7.984 at 24 hours, p=0.001) while HCO_3 (32.78 ± 2.92 at presentation and 30.15 ± 2.90 at 24 hours, p=0.134) as well as hospital stay (p=0.001).

Conclusion: NIPPV is superior to standard treatment in patients with COPD exacerbation in terms of improvement in ABGs and reduction in hospital stay.

Keywords: Non Invasive Positive Pressure Ventilation (NIPPV), Chronic Obstructive Pulmonary Disease (COPD), Arterial Blood Gases (ABGs).

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a state characterized by air flow limitation that is not fully reversible[1]. COPD exacerbation is defined as an acute increase in cough, sputum production and shortness of breath beyond normal day to day variation[2]. In severe instances, an acute exacerbation can cause respiratory failure and death. Non invasive positive pressure ventilation (NIPPV) is the delivery of mechanically assisted breaths without placement of an artificial airway via tightly fitting nasal or facial mask. In long standing cases patients with COPD develop type 2 respiratory failure and cor pulmonale.

In patients with acute respiratory failure, NIPPV improves alveolar disease mortality, the occurrence of nosocomial infection, rates of ICU acquired pneumonia and hospital length of stay compared to invasive mechanical ventilation[4]. These improvements are greatest for patients with acute exacerbation of COPD complicated by hypercarbia[5].

Endotracheal intubation and mechanical ventilation can be a life saving procedure.

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However, their use is associated with complications. NIPPV is an alternative approach that was developed to avoid these complications. The need for an emergent intubation is an absolute contraindication to NIPPV but patients with hypercapnic encephalopathy may benefit from a brief, closely observed trial[6].

NIPPV is beneficial in patients with acute exacerbation of COPD, acute cardiogenic pulmonary edema and some types of hypoxaemic respiratory failure but it is most beneficial in patients with COPD complicated by hypercarbia[7]. It is a relatively newer treatment modality. It can be safely used in patients with type 2 respiratory failure[8,9]. We are using this therapeutic modality in our treatment regimen as very little work has been done on it particularly in our population. In our study, this therapeutic modality in conjunction with standard treatment was compared with standard treatment alone for patients with COPD exacerbation in terms of improvement in ABGs and length of hospital stay. It was helpful to guide treatment strategy in future so that patients with COPD can be saved from complications associated with endotracheal intubation and mechanical ventilation.

The objective of this study was to compare NIPPV with standard treatment in patients with acute exacerbation of chronic obstructive pulmonary disease in terms of improvement in arterial blood gases and hospital stay.

Operational Definitions

COPD exacerbation: Sustained worsening of the patient's condition from stable state beyond normal day to day variation which is acute in onset and warrants additional therapy in patients with underlying COPD. This is characterized by an increase in dyspnea, cough and sputum production. Patients with FEV1 less than 50% on spirometry and patients with respiratory rate greater than 30 per minute.

Arterial blood gases (ABGs) : Normal reference range for arterial blood gases are as follow: pH (7.35-7.45)

PCO2 (35-45 mm Hg)

PO_2 (80-100 mmhg)

HCO_3 (22-28 meq/l)

Standard Treatment

Oxygen inhalation at the rate of 2 liters per minute, intermittently, inhaled bronchodilators (β agonist and anticholinergics), systemic cortico-steroids and intravenous antibiotics.

Noninvasive Ventilation

Noninvasive positive pressure ventilation (NPPV) refers to Bi-level positive airway pressure (BIPAP) delivered through a noninvasive interface, such as a tight fitting which delivers both inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP) using a portable ventilator with a tight fitting mask.

MATERIAL AND METHODS

This randomized control trial was carried out at department of medicine, Military Hospital Rawalpindi for a period of 6 months (1st May 2009 to 30th Oct 2009). Military Hospital, Rawalpindi is a tertiary care hospital. The hospital deals with military as well as civilian patients.

Inclusion Criteria

Diagnosed cases of chronic obstructive pulmonary disease having respiratory rate greater than 30 and FEV1 less than 50% on spirometry. Exacerbation of dyspnea lasting less than two weeks. Arterial blood gases showing respiratory acidosis (arterial pH below 7.35), elevated bicarbonate level (greater than 28 meq /l), partial pressure of arterial oxygen below 60 mm Hg and partial pressure of arterial carbon dioxide above 50 mm Hg.

Exclusion Criteria

Administration of sedative drugs within previous 12 hours, central nervous system disorders unrelated to hypercapnic encephalopathy, cardiogenic pulmonary edema, kyphoscoliosis, upper airway obstruction,

asthma, pulmonary thromboembolism and pneumothorax.

Seventy eight patients with acute exacerbation of COPD were selected through non probability purposive sampling from the intensive care unit and medical wards of the hospital. They were divided into 2 groups by lottery method.

Group A - Standard treatment with oxygen inhalation at the rate of 2 liters per minute, inhaled bronchodilators and systemic corticosteroids

Group B - BiPAP for six hours a day along with standard treatment.

Patient fulfilling the inclusion criteria were inducted in the study after taking an informed consent from the patient or his relatives in case of encephalopathy. The interview covered the patients' symptoms, the time of onset of symptoms, the circumstances under which they appeared and the subsequent events till the time they reached the hospital. Past medical history was also inquired about. The patients' medical documents were used to note the demographic data. Spirometry in these patients was performed and vital signs were recorded. Then arterial blood gases at hospitalization, 2 hours after treatment and 24 hours after treatment were taken and recorded. Patients not improving with either treatment were intubated and mechanically ventilated. All the data including length of hospital stay was calculated through a carefully structured proforma.

All the data was analyzed using SPSS 17.0. Both numerical and categorical data was analyzed. Means and standard deviation for age, pH, PO_2, PCO_2, HCO_3 and length of hospital stay were calculated student's t-test was used to

Table-1: Comparison of age between the group A (standard treatment) and group B (non invasive positive pressure ventilation (NIPP)).

Demographic variables	Group A (n=39)	Group B (n=39)	*p* value
Age	61.2 ± 6.3	61.5 ± 4.9	0.8

Table-2: Comparison of pH, pO_2, pCO_2, and HCO_3 between the group A (standard treatment) and group B (non invasive positive pressure ventilation (NIPP).

Variable	Time	Group A (n=39)	Group B (n=39)	*p* value
pH	At admission	7.22 ± 0.05	7.25 ± 0.05	0.79
	2 hours after treatment	7.23 ± 0.04	7.26 ± 0.05	0.58
	24 hours after treatment	7.23 ± 0.04	7.28 ± 0.05	0.001
pO_2	At admission	44.43 ± 2.54	46.20 ± 2.0	0.001
	2 hours after treatment	49.61 ± 2.49	51.48 ± 2.42	0.001
	24 hours after treatment	62.35 ± 4.65	64.51 ± 4.02	0.03
pCO_2	At admission	61.17 ± 9.0	57.82 ± 5.93	0.56
	2 hours after treatment	59.15 ± 8.88	55.79 ± 7.11	0.069
	24 hours after treatment	60.05 ± 8.68	52.30 ± 7.98	0.001
HCO_3	At admission	34.58 ± 2.52	32.97 ± 2.92	0.011
	2 hours after treatment	33.61 ± 2.43	31.94 ± 2.82	0.007
	24 hours after treatment	31.15 ± 2.92	30.15 ± 2.90	0.134

Table-3: Comparison of stay in the hospital (days) between both the group A standard treatment and group B (non invasive positive pressure ventilation (NIPP).

Group A (n=39)	Group B (n=39)	*p*-value
11.9 ± 2.8	9.5641 ± 2.4	0.001

compare the numerical data. $p < 0.05$ was taken as significant.

RESULTS

A total number of 78 patients were included in the study. Patients were divided into two groups randomly by lottery method. There were 39 patients in each group. All patients who were given standard treatment were placed in group "A" and all those patients who were given NIPPV along with standard treatment were placed in group "B". In group A there were 86.7 % males and 13.3 % females. In group B there were 83.3 % males and 16.7 % female. Both the groups were comparable with respect to age (*p*-0.813) and gender (*p*-0.714). Patients in both the groups (100%) were married and all (100%) belonged to middle class socioeconomic group.

Age in both the groups is described in Table-1.

The comparison of pH, PO2, PCO2 and HCO_3 in both groups is summarized in Table-2.

The comparison of stay in hospital in both groups is summarized in Table-3.

DISCUSSION

In this study, NIPPV was used for patients with COPD exacerbation in conjunction with standard treatment. It is a new treatment modality in Pakistan and very little work had been done on it, particularly in our population.

NIPPV improves arterial blood gases, mortality, decreases the need for mechanical ventilation and shortens the hospital stay and is therefore the treatment of choice in appropriate patients. Most patients tolerated NIPPV very well as evidenced by improvement in ABGs and shorter hospital stay. NIPPV had been studied to produce better results in patients with hypercapnic respiratory failure, cardiogenic pulmonary edema, hypoxaemic respiratory failure and post extubation patients.

COPD is a common problem in our outpatient department and majority of the patients present with exacerbation and require indoor treatment as well. Patients under study were both males and females, age group selected was between 50-80 years, majority of them were smokers and had acute worsening of dyspnea, cough and sputum production.

The results of this study clearly support our hypothesis. Statistically significant results were seen in terms of improvement in pH, PO2, PCO2 and hospital stay. Despite the enormous economic and social burden of this disease, there are few studies in literature and even fewer in Pakistan that give us results to formulate clinical guidelines to treat COPD on cost effective basis.

Lightowler et al. carried out a systematic review of multiple randomized control trials and found that NIPPV improved pH in one hour, PaCO2 and respiratory rate and significantly reduced the length of hospital stay[10]. Moreover, it also reduced mortality, need for mechanical ventilation and likelihood of treatment failure.

Peter et al analyzed from a meta analysis that noninvasive ventilation appears to be beneficial in COPD exacerbations. A firm conclusion on milder exacerbations cannot be made with current data. On the basis of regression analysis, the American Association for Respiratory Care consensus statement could be modified to recommend the use of noninvasive ventilation in patients with COPD exacerbations who have a pH less than 7.37, a $PaCO_2$ greater than 55 mm Hg, or both[11].

Agarwal et al. carried out a prospective observational study to determine the effectiveness of NIPPV in acute respiratory failure due to COPD and other causes and found that NIPPV is more effective in preventing endotracheal intubation in acute respiratory failure due to COPD than other causes, and the etiology of acute respiratory failure is an important predictor of NIPPV failure[12].

In another study Khilnani et al, studied 40 patients with COPD exacerbation who were randomized to receive NIPPV with conventional therapy or conventional therapy alone. They found that after one hour treatment with NIPPV there was significant improvement in pH, $PaCO_2$.

Need for endotracheal intubation and hospital stay was reduced[13].

CONCLUSION

Our study concludes that non invasive positive pressure ventilation is superior to standard treatment in terms of improvement in arterial blood gases and reduction in hospital stay in selected patients with acute exacerbation of COPD as compared to the standard treatment.

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