**ORIGINAL ARTICLE**

# The effect of Noninvasive Ventilation in the form of Bi-level Positive Airway Pressure (BiPAP) on the outcome in patients of Chronic Obstructive Pulmonary Disease (COPD) presenting with Hypercapnic Respiratory Failure

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## ABSTRACT

**Aim:** To compare the effectiveness of BiPAP in patients with normal Glassgow Coma Scale (GCS) to those having impaired consciousness (GCS in between 10-14) in COPD exacerbation with hypercapnic encephalopathy**.**

**Methods:** This comparative study was conducted in a Medical Intensive Care Unit of Ittefaq Hospital Model Town Lahore from 1st June 2015 to 30th November 2015. Ninety patients admitted with acute exacerbation of COPD were studied. Base line reading of arterial blood gas (ABGs) was taken in all patients. Level of consciousness was assessed by GCS. Patients with GCS above 10 were put on BiPAP ventilation. Arterial blood gas analysis was repeated at 2 hours. Patients were divided in to two groups. One group with normal GCS (15/15) and other with GCS 10-14. Effectiveness of BiPAP was compared in both groups in term of improvement in ABGs.

**Results:** ABG readings improved in both groups at 2 h. Success rate with noninvasive positive pressure ventilation in the form of BiPAP was up to 98.5% in group with normal GCS compared to 37.5% in low GCS group.

**Conclusion:** If medical therapy fails in acute exacerbation of COPD, the Non Invasive mechanical ventilation in the form of BiPAP should be applied even in low GCS settings in patients with hypercapnic encephalopathy prior to deciding about conventional invasive ventilation.

**Keywords:** Acute respiratory failure (ARF), Chronic obstructive pulmonary disease, Noninvasive positive pressure ventilation (NPPV), BiPAP, Hypercapnic encephalopathy syndrome (HES), Glasgow Coma Scale

## INTRODUCTION

Respiratory failure (RF) occurs when lungs are unable to meet the metabolic demand in the form of oxygen delivery to tissue and carbon dioxide exhalation. This may be due to hypoventilation or hypo perfusion of lungs during normal respiration resulting in the disturbance of partial pressure of oxygen and carbon dioxide in arterial blood[1]. Acute exacerbations of chronic obstructive pulmonary disease area major burden on Medical Intensive Care Units (ICU). Non-invasive ventilation using bi-level positive airway pressure (BiPAP) has an important role in the management of acute hypercapnic (type 2) respiratory failure as conventional invasive mechanical ventilation is associated with many complications including difficulties in weaning in COPD patients[2]. Non-invasive positive pressure ventilation gives the patients ventilator support in the form of positive air way pressure during inspiration and expiration by using pressure cycled machine known as BiPAP. This can be achieved by applying the BiPAP through face or nasal mask[3]. Acute hypercapnic respiratory failure is associated with broad range of potentially reversible neurological features ranging from mild cognitive impairment and stupor to coma[4].

There has been lately a debate regarding the mode of ventilation in patients with hypercapnic encephalopathy. Noninvasive positive pressure ventilation (NPPV) is considered a relative contra- indication due to risk of aspiration pneumonia and mischance ventilation. According to international guidelines the conventional invasive mechanical ventilation (IPPV) is the best option for patients with impaired conscious state[5]. However, IPPV is associated with many complications and difficulty in weaning in COPD patients.

In this study NPPV in the form of BiPAP was given to COPD patients with type-2 respiratory failure and GCS between 10 and 15 and efficacy of BiPAP was monitored. The outcome of BiPAP in patients with normal GCS was compared to patients with low level of consciousness[6].

## PATIENTS AND METHODS

This comparative study was conducted in a Medical Intensive Care Unit of Ittefaq Hospital Model Town Lahore from 1st June 2015 to 30th November 2015. During study period COPD patients presenting with shortness of breath with or without impaired conscious state admitted to Medical Intensive Care Unit of Ittefaq Hospital Model Town Lahore in age group of 40-80 years were included. First arterial blood gases were done in Emergency Department. Patients were started on medical treatment in the form of oxygen therapy, nebulization and antibiotics. The level of consciousness was evaluated by using Glasgow Coma Scale (GCS). Computed tomographic (CT) scan brain and other metabolic profiles were performed to rule out other possible etiologies of encephalopathy. These patients were divided in two groups: Group one (normal conscious level with GCS 15/15) and group two (patients with impaired conscious state GCS between 10-14). Respiratory failure

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was defined as follow: acute hypercapnic respiratory failure was characterized by arterial PaO<60mm Hg,$PaCO_2$ values >55 mm Hg and an arterial pH <7.35 on room air. Patients with PH <7.20 or hemodynamically unstable patients were excluded from the study. The recommended settings of BiPAP were: (1) 2cm H2O for IPAP and (2) 5-6cm H2O for EPAP. If a patient had low saturation during this ventilation, then oxygen was attached to BiPAP circuit. Also we adjusted the pressures during inspiration and expiration to maintain the saturation within required limits. If we increased the EPAP, then the IPAP was also increased. EPAP was increased up to 8 cm of $H_2O$, if needed. BiPAP ventilation may be discontinued at time with clinical evidence of deteriorating conscious level or hemodynamic instability.

**Data Collection:** Demographic and baseline clinical data was collected from patients before being put on BiPAP. The information was obtained about age, gender, pH, GCS, $PaO_2$, $PaCO_2$, respiratory rate, bicarbonate etc. The information about arterial blood gases were again taken from patients two hour after receiving ventilation with BiPAP. The data was recorded in a structured Performa and then entered into SPSS 16. Arterial blood gases were compared before and after BiPAP ventilation in both Groups with reference to their Glasgow Coma Scale (GCS). Mean and SD were calculated for quantitative variables. Paired 't' test and Chi-Square test were applied for comparison of relevant parameters.

## RESULTS

A total of 90 patients were included in this study. The mean age of study cohort was 63.7±8.3 years with an age range of 40-80 years. The present study cohort has a male preponderance. On admission, out of total 90 patients,24patients were in hypercapnic encephalopathy with GCS in between 10-14 & 66 patients were having GCS of 15/15 (Table 1).

**Table 1:** Demographic and Baseline characteristics of study population in relation to their level of consciousness

| Variables | Glasgow Coma Scale Normal 15/15 (n = 66) | Glasgow Coma Scale in between 10-14 (n = 24) |
|---|---|---|
| Age (years) | 63.4±8.42 | 64.7±8.04 |
| Sex | Male = 56<br>Female = 10 | Male = 19<br>Female = 05 |
| Respiratory rate/mints | 63.4±8.42 | 64.7±8.04 |
| Respiratory rate/mints | 30.06±4.56 | 28.9±3.57 |
| PH baseline | 7.29±0.03 | 7.22±0.02 |
| PaCO2 baseline (mmHg) | 68.8±5.59 | 66.0±7.46 |
| PaO2 baseline (mmHg) | 54.2±4.37 | 54.9.8±5.92 |
| Bicarbonate base line | 34.03±2.97 | 33.7±2.79 |

All patients tolerated the BiPAP well. Arterial blood gases were repeated again in all patients after two hours (Table 2). In group with normal GCS, ABG improved significantly after 2 hours. Out of 66 patients with normal GCS, 65(98.5%) showed improvement in the form of pH,$PO_2$ and $PCO_2$. In one (1.5%) patient ABG did not improve, rather patient showed deterioration in the respiratory rate, $PaCO_2$, $PaO_2$ and GCS after 2hrs. This patient was put on Invasive mechanical ventilation. In group with GCS in between 10-14, out of 24 patients, ABG significantly improved in 9 patients after 2 hrs (Table 3).

Table 2: Comparison of pertinent clinical parameters before and after the use of BiPAP in both groups (n=90)

| Clinical Parameter | Before BiPAP | After BiPAP | P value |
|---|---|---|---|
| Respiratory Rate | 29.7±4.33 | 21.2±6.99 | .0001 |
| pH value | 7.26±0.03 | 7.36±0.06 | |
| PCo2 (mmHg) | 68.1±6.23 | 43.4±14.7 | |
| PO2 (mmHg) | 54.4±4.81 | 82.2±13.3 | |
| Serum Bicarbonate mg/dl | 33.8±2.93 | 32.2±2.87 | |

*Paired t test with level of significance at P<05*

Table 3: Relationship between of level consciousness and outcome of BiPAP

| GCS | Post BiPAP | | P value |
|---|---|---|---|
| | Normal Parameter | Abnormal parameter | |
| **pH value** | | | .0001 |
| ≤14 | 9 | 15 | |
| 15 | 65 | 1 | |
| **PCO2** | | | |
| ≤14 | 10 | 14 | |
| 15 | 58 | 6 | |
| **PO2** | | | |
| ≤14 | 9 | 15 | |
| 15 | 65 | 1 | |
| **Bicarbonate** | | | **.450** |
| ≤14 | 6 | 18 | |
| 15 | 22 | 44 | |

*Fishers exact test and $X^2$ test with level of significance at* <.05

## DISCUSSION

In our study we observed that COPD patients with type-2 respiratory failure not responding to medical therapy can be treated effectively by using noninvasive mechanical ventilation (BiPAP) especially if their level of consciousness is normal (15/15) and arterial blood gases pH in-between 7.20-7.35. Out of 66 patients with normal GCS, 65 patients responded to BiPAP therapy. Previous recommendation for noninvasive therapy in COPD with type-2 respiratory failure is: Failure of medical therapy in hypercapnic respiratory failure with PH in between 7.35-7.25. Many studies have been done on efficacy of BiPAP. All studies have shown excellent results with BiPAP therapy if GCS is normal. In one study published in British Medical Journal in 2003 Lightowler et al[7] have shown effectiveness up to 90% in acute exacerbation of COPD treated by BiPAP therapy. In our study success rate if BIPAP was about 98% in patient with normal conscious level. In many studies the same has been reported as 93% and 87% by Plant et al[8] and Bott et al[9] respectively. So in our study the efficacy of BiPAP in patients with normal GCS was comparable with studies in Pakistan and elsewhere.

Since our objective was to monitor the efficacy of BiPAP in acute exacerbation of COPD in patients having GCS in between 10-14.There has been a debate regarding

the mode of ventilation in patients with hypercapnic encephalopathy. Noninvasive positive pressure ventilation (NPPV) is considered as a relative contraindication due to risk of aspiration pneumonia and mischance ventilation. According to international guidelines, the conventional invasive mechanical ventilation (IPPV) is the best option for patients with impaired conscious state[10].

We observed that, out of 24 patients with GCS in between 10-14, 9 patients (37.5%) responded favorably to BiPAP therapy. These patients showed improvement in the form of pH, $PaO_2$, $PaCO_2$ and respiratory rate. 15 patients (62.50%) with low GCS did not show improvement and were put on invasive mechanical ventilation.

A study was conducted by Corrado et al[11], studied 150 patients and their success rate was 73%. They showed that success rate was low as the GCS went down from 14 to 3, being worse in GCS ≤5. In their study 5 patients developed aspiration pneumonia, the different outcome of our study may be due to trained staff in applying the BiPAP therapy.

In a South-American study conducted by Claudett et al[12], 44% improvement was seen in patients with hypercapnic encephalopathy syndrome (HES) treated with BiPAP. These results are comparable to results obtained in our study, however slight difference can be explained because they included all patients with acute respiratory failure and hypercapnic encephalopathy whatever the etiology. But we included only COPD patients with HES. The difference in the clinical outcome observed in other studies can also be explained by different clinical criteria like, (GCS,ES,KMS), selected to assess the level of consciousness[11]. Another important contributing factor for relatively low response to NPPV in HES patients may be inability to clear airways due to respiratory secretions[13].

## CONCLUSION

Non Invasive Mechanical Ventilation in the form of BiPAP should be applied even in low GCS patients with hypercapnic encephalopathy. Although it is not the gold standard therapy in these patients but as Invasive Mechanical Ventilation is associated with many risks, BiPAP therapy is good initial option with close monitoring of patients.

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