

# EFFICACY OF BIPAP IN PATIENTS ADMITTED WITH HYPERCAPNIC RESPIRATORY FAILURE; AN EXPERIENCE AT A TERTIARY CARE HOSPITAL

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## ABSTRACT

**OBJECTIVE:** To determine the efficacy of BiPAP in patients with Hypercapnic respiratory failure admitted at Pulmonology Unit Khyber Teaching Hospital (KTH), Peshawar.

**PATIENTS AND METHODS:** This was a quasi experimental study conducted at Pulmonology Unit KTH, Peshawar from 11th August 2011 till 10th August 2013. All patients with the diagnosis of Hypercapnic Respiratory Failure (HRF) were included. Information regarding primary diagnosis, duration and outcome of BiPAP, respiratory rate and ABGs (pH, PCO<sub>2</sub>) before, at 1-2 hours and 4-6 hours after BiPAP were recorded in a structured proforma and then entered into SPSS 16. Frequencies/percentages were calculated for qualitative variables (age, sex, primary diagnosis and Outcome of BiPAP), Mean and SD for quantitative variables (duration of BiPAP) and paired sample 't' test was applied for comparison of means of changes in Respiratory rate, pH and PCO<sub>2</sub>. P value of less than 0.05 with 95% confidence interval was taken as significant.

**RESULTS:** A total of 53 patients with mean age of 55.75 years were enrolled in the study. Of these, 62% were females while 37% were males. The underlying diagnosis was COPD in the majority (79.25%), Bronchiectasis in 13.21%, Muscular dystrophy in 3.77%, and chest deformity in 3.7%. The mean baseline respiratory rate was 28/min, arterial blood pH 7.23 and pCO<sub>2</sub> was 74.56 mm of Hg. There was statistically significant improvement in these parameters at 1-2 hours and 4-6 hours after applying BiPAP in conjunction with conventional treatment. BiPAP was tolerated by 90.57% of the patients and the average duration BiPAP applied was 3.38 days. BiPAP was successful in 77.36% while 13.21% failed to improve and were transferred to intensive care unit for invasive mechanical ventilation.

**CONCLUSION:** BiPAP in general respiratory ward is an effective adjunct in the management of patients admitted with Hypercapnic respiratory failure, and its use should be encouraged.

**KEY WORDS:** BiPAP, Respiratory failure, COPD, NIV, Hypercapnic respiratory failure, Bronchiectasis, Muscular dystrophy.

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## INTRODUCTION

Hypercapnic respiratory failure (type II) is a clinical condition in which the respiratory system fails to eliminate carbon dioxide (CO<sub>2</sub>) from the lungs resulting in a high arterial Pco<sub>2</sub> (>45mm Hg) with or without hypoxia. Chronic obstructive pulmonary disease (COPD) being the commonest cause, other etiologies include bronchiectasis, drug overdose, neuromuscular disease and chest wall deformities.<sup>1</sup> It is associated with a high

mortality (20-30%) despite treatment.<sup>2</sup>

The main pathophysiologic feature is the abnormalities in the respiratory mechanics resulting in inability of the respiratory system to maintain adequate alveolar ventilation leading to hypercapnia, acidosis, hypoxemia and clinical deterioration. The key element during decompensation seems to be shortening of the inspiratory time, inducing an increase in respiratory rate and decrease tidal volume. Because there is associ-

ated excessive load on respiratory muscles, treatment should be directed at reducing the loads imposed on the respiratory muscles in addition to standard medical therapy.<sup>2</sup>

The traditional way has been to use endotracheal intubation as a means of access to the lower airways and to deliver ventilation to the patient's lungs but at the cost of complications. A more recent approach, called non-invasive ventilation (NIV), has profoundly changed the management and outcome of these patients.<sup>3</sup>

Numerous randomized controlled trials (RCTs) and meta-analyses have shown that NIV in addition to conventional treatment of COPD exacerbations significantly reduces mortality and complications as compared to standard medical therapy alone.<sup>4</sup>

The success of this mode of assisted ventilation is based on the use of a face /nasal mask in place of an endotracheal tube, its intermittent mode, and the ability to improve alveolar ventilation by increasing tidal volume, subsequently unloading of the respiratory muscles.<sup>5</sup>

A systematic review has shown a clear benefit of NIV as an adjunct to usual medical care in the management of patients with respiratory failure secondary to acute exacerbations of COPD. NIV in addition to usual medical care significantly reduces mortality, the rate of invasive ventilation, complications and length of stay in hospital.<sup>6</sup>

There is growing evidence that BiPAP may be applicable in patients with severe acidaemia (pH<7.25) and hypercapnic coma, conditions previously considered as contraindications to its use.<sup>7</sup>

However, despite increasing interest in its use, Non invasive ventilation (NIV) should not be considered as a replacement for invasive mechanical ventilation and should not delay intubation in those patients who deserve because its inappropriate use may result in high inpatients mortality as evidenced by a large UK audit of BiPAP use in COPD.<sup>8</sup>

NIV should be tried early in the course of respiratory failure and before severe acidosis, to reduce mortality, avoid endotracheal intubation, and decrease treatment failure.<sup>9</sup>

Despite strong recommendations, the use of BiPAP is limited in our country for many reasons including its non availability and lack of expertise and hence very limited local research. Moreover, literature has focused on the use of BiPAP on patients with COPD and milder form of Hypercapnic respiratory failure. We conducted this study to share our local experience of BiPAP in patients admitted with Hypercapnic Respiratory Failure

due to variety of causes and with more severe form of the disease (HRF) in general respiratory ward.

## OBJECTIVE

To determine the efficacy of BiPAP in patients with Hypercapnic respiratory failure admitted at failure admitted at Pulmonology Unit KTH, Peshawar.

## PATIENTS AND METHODS

This was a quasi experimental study conducted at Pulmonology Unit Khyber Teaching Hospital, Peshawar from 11<sup>th</sup> august 2011 till 10<sup>th</sup> august 2013. A total of 53 patients (both genders) admitted with hypercapnic respiratory failure due to any etiology, presenting with moderate to severe dyspnoea, respiratory rate >23/min and arterial blood PH <7.35 along with high PCO<sub>2</sub> were included. Patients with hemodynamic instability, coma, near fatal asthma, life threatening hypoxemia requiring invasive mechanical ventilation or unwilling for application of BiPAP were excluded.

Hypercapnic Respiratory Failure was defined as any patient with arterial blood PH <7.35 and PCO<sub>2</sub> >45mm of Hg. The outcome of BiPAP was labeled as successful or failed depending on whether PH and respiratory rate returned to normal range or not.

After clinical assessment, patients with Hypercapnic Respiratory Failure were started on maximum treatment and were closely monitored. They were subjected to BiPAP if inclusion criteria were fulfilled. BiPAP machine (Respironics) was applied for most of the time per 24hours via face mask, with ST mode, EPAP 5 and IPAP 10 initially and then adjusted as per requirement. Information regarding primary diagnosis, main outcome variables like Respiratory rate, pH, PCO<sub>2</sub> before, 1-2 hours and 4-6hour after applying BiPAP, duration and outcome of BiPAP were collected and entered into a structured proforma.

Data analysis: Data was analyzed via SPSS 16. Frequencies and percentages were calculated for qualitative variables like age, sex, primary diagnosis and outcome of BiPAP. Mean and Std. deviation were calculated for quantitative variable like duration of BiPAP. Paired sample t test was applied for comparison of means of changes in Respiratory rate, pH and PCO<sub>2</sub> before and after the application of BiPAP. P value less than 0.05 with 95% confidence interval was taken as significant.

## RESULTS

A total of 53 patients with mean age of 55.75 (SD +\_

Table 1: Mean values of respiratory rate, pH and Pco2 before, 1-2hour and 4-6hour after applying BiPAP, and their level of significance with 95% confidence interval.

Parameter	Pre BiPAP (Mean and SD)	1-2hr post BiPAP (mean)	4-6hr post BiPAP (mean)	Sig.(2tailed) (p value)
Respiratory rate	28(SD +_10)	24	22	0.001
pH	7.23(SD +_0.063)	7.28	7.33	0.003
Pco2	74.56(SD+_10.37)	66.80	63.70	0.001

Paired sample Student t Test

Figure 1: Age distribution of patients with hypercapnic respiratory failure.

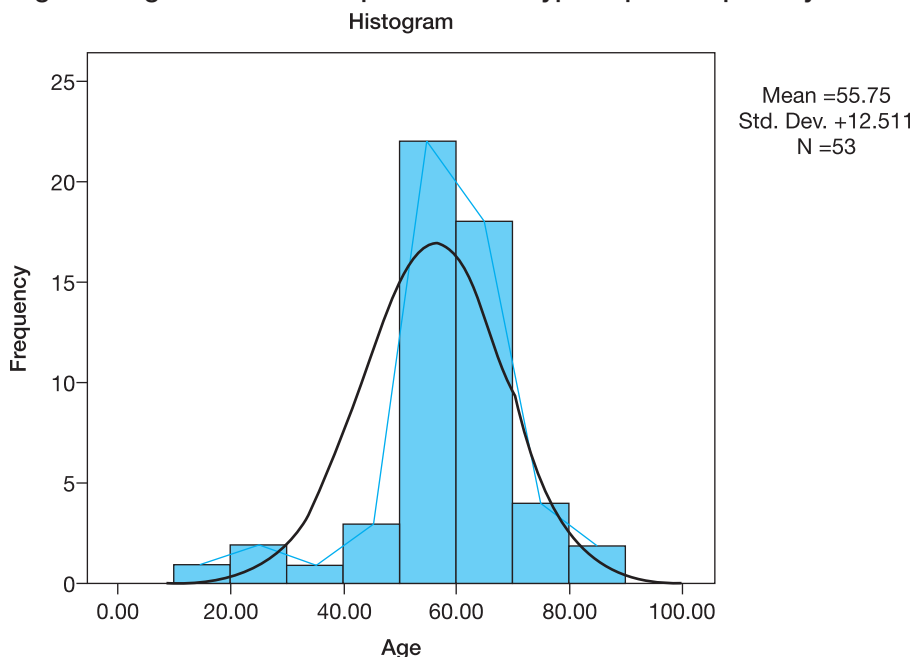


Figure 2: Gender of patients with Hypercapnic respiratory failure

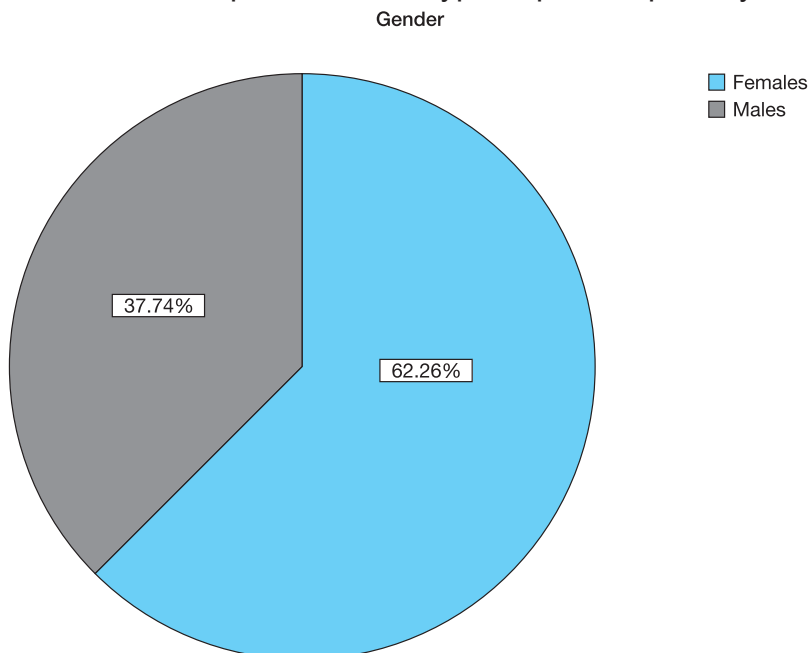


Figure 3: Underlying diagnoses of patients with Hypercapnic respiratory failure.

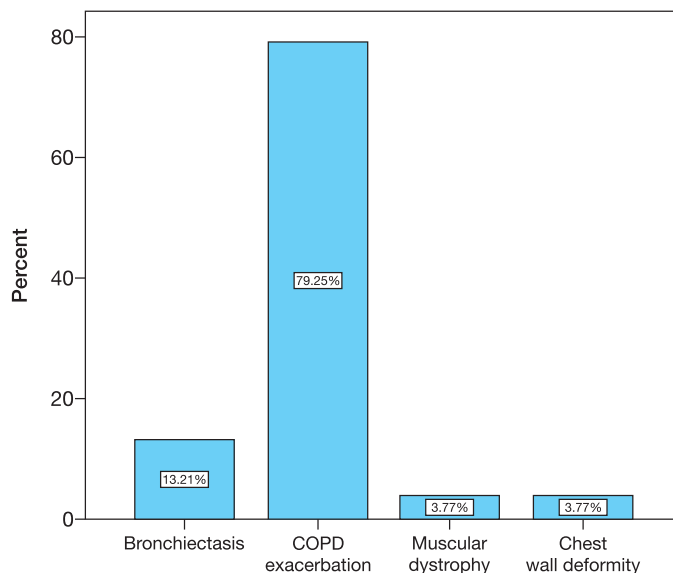
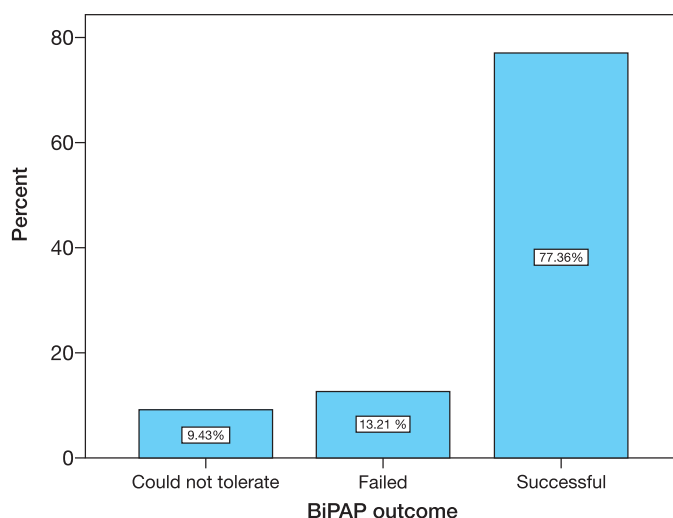


Figure 4: Outcome of patients with Hypercapnic Respiratory Failure with BiPAP



12.52) years were enrolled in the study. The age distribution has been shown in figure 01. Of these, 62% were females while 37% males as shown in figure 02. The underlying diagnosis was chronic obstructive pulmonary disease (COPD) in the majority (79.25%), Bronchiectasis in 13.21%, Muscular dystrophy in 3.77%, and chest deformity in 3.77% as shown in figure 03. The mean baseline respiratory rate was 28/min, arterial blood pH was 7.23 and pCO<sub>2</sub> was 74.56 mm of Hg (shown in table 01). There was statistically significant improvement (p value <0.05) in these parameters at 1-2hours and 4-6hours after applying BiPAP in conjunction with maximum medical treatment of the underlying conditions (table 01). BiPAP was tolerated by 90.57% of patients (Fig 04) and the average duration BiPAP applied was 3.38 (SD +\_ 2.87) days. BiPAP was

successful in 77.36% while 13.21% failed to improve and were transferred to intensive care unit for invasive mechanical ventilation (figure 04).

## DISCUSSION

This study showed that application of BiPAP in addition to the conventional treatment of patients admitted with Hypercapnic respiratory failure effectively improved the clinical outcome. Similar results have been shown by many studies.<sup>9</sup> In contrast, one randomized trial conducted by Barbe et al<sup>10</sup> has reported no benefit. This later contradiction could be due to the fact that the size of the study sample was very small (only 10/24 patients were put on BiPAP), the machine was applied

for a very little time (3hr/day) and the patients had milder form of the disease (the initial mean pH of 7.33 and Pco<sub>2</sub> of 7.9 kpa. A systemic review has confirmed little benefit of non invasive ventilation in patients with milder exacerbations of COPD with pH >7.30.<sup>9</sup>

BiPAP was tolerated by 90.57% of our patients whereas the same has been reported as 93%, and 87% by Plant pk et al, and Bott et al respectively.<sup>11, 12</sup>

Respiratory rate is an important clinical parameter predictive of the outcome, improved (decreased) significantly which is also reported in other trials.<sup>5,13</sup> The decrease in respiratory rate may be explained by the fact that BiPAP increases Minute ventilation by increasing tidal volume which allows respiratory rate to fall, off loading the respiratory muscles and hence improvement in patients clinical condition.

Biochemical parameters of prognostic interest include arterial blood pH and pCO<sub>2</sub>. BiPAP leads to CO<sub>2</sub> washout from the lungs, consequently reducing blood PCO<sub>2</sub> level and increasing the arterial blood pH. We found a significant improvement in both of these parameters (p value < 0.001). Similar improvement in biochemical parameters has been reported by many other trials.<sup>5,13,14</sup> BiPAP was successful in the majority of our patients (77.36%) while the success rate has been reported as 80% in a local study<sup>15</sup>. According to Brochad et al<sup>16</sup> and Anton<sup>17</sup> the success rate was 80% and 77% respectively.

The failure rate in our study was (13.21%) which is comparable with a national study (12.6%)<sup>18</sup> and international multi centre RCT (15%).<sup>19</sup> It is pertinent to note that even with BiPAP, 13.21% of our patients needed intubation, it is important that rapid access to Invasive Mechanical Ventilation should be available. Moreover, improper management of the machine (BiPAP) and uncontrolled oxygen can result in devastating outcomes.

## CONCLUSION

BiPAP in general respiratory ward is an effective adjunct in the management of patients admitted with Hypercapnic respiratory failure due to various etiologies, and its use should be encouraged.

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