

To Compare the Effect of Oxygen Therapy Via Face Mask With Bi-Level Positive Airway Pressure Ventilation (Bipap) In Managing Patients with Acute Cardiogenic Pulmonary Edema in Al-Nafees Medical College and Hospital, Islamabad

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ABSTRACT

Objective: To compare the effect of oxygen therapy via face mask with bi-level positive airway pressure ventilation (BiPAP) in managing patients with acute cardiogenic pulmonary edema in Al-Nafees Medical College and Hospital, Islamabad.

Study Design: Interventional study

Place and Duration of Study: This study was conducted at the Intensive Care Unit (ICU), Department of Medicine, AL- Nafees Medical College and Hospital, Islamabad from 1st March 2019 – 1st March 2020.

Materials and Methods: The study was conducted after the approval of the synopsis. All the patients were educated and informed consent was taken. 154 Patients were selected according to the inclusion criteria 77 in each group and randomly assorted into two groups. Group A: those getting oxygen therapy by face mask and Group B: those getting oxygen by BiPAP. Clinical improvement was observed in Respiratory rate, Pulse rate, Oxygen Saturation on pulse oximeter (SPO₂), Partial Pressure of Oxygen (po₂) on Arterial Blood Gases (ABGs), and Echocardiography. All these parameters were observed and duly documented at zero 0 minutes, 30 minutes, 60 minutes and 180 minutes (3 hours). The collected data were analyzed by using SPSS 23 version.

Results: We enrolled 154 patients, 77 in each group in our study. The mean age of patients in Group A (Face Mask) was 64.69±8.93 years and in Group B (BiPAP) was 65.34±9.17. In Group A (Face Mask) 44(57.1%) patients were male and 33(42.9%) patients were female. Similarly in Group B (BiPAP), 48(62.3%) patients were male and 29(37.7%) patients were In our study we find BiPAP has better outcome results in the improvement of respiratory rate, pulse rate, oxygen saturation, partial pressure of oxygen in ABGs, and less need of mechanical ventilation than oxygen therapy with the face mask.

Conclusion: In our study, we concluded that BiPAP has significant clinical benefits and cost-effectiveness over oxygen therapy with face mask in patients with ACPE management.

Key Words: BiPAP, ACPE, Oxygen Therapy, Comparison, Face Mask

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INTRODUCTION

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Acute cardiogenic pulmonary edema (ACPE), which is a subset of acute pulmonary edema (APE), is a common symptom of acute heart failure and often results in acute decompensated heart failure (ADHF). ACPE was defined as the presence of pulmonary alveolar/ interstitial congestion on chest X-ray and/or CT with at least two of the following: 1) severe respiratory distress or worsening respiratory distress or persistent severe dyspnea, orthopnea 2) rales in lungs 3) high jugular venous pressure.¹

ACPE is the general cause of respiratory failure that requires mechanical ventilation.² Patients with CPE that need mechanical ventilation constitute a subgroup with significant mortality.³ Acute cardiogenic pulmonary edema is one commonest causes of hospitalization in 65

years or over the age of patients, in Europe and USA, with mortality of 20–30% within 6 months after discharge.⁴

In the hospital mortality from ACPE is high (10-20%),⁽⁶⁾ while the majority of the patients with pulmonary edema respond to the conventional therapy, including use of the supplemental oxygen, nitrates, opiates, diuretics and few patients need the support of a ventilator.⁵

Mechanical ventilation in the acute care setting has been found to be associated with complications that include larynx trauma, pneumonia, sinusitis, contents of gastric aspiration, hypotension, arrhythmia, trachea, pharynx and loss of ability to communicate verbally and eat.⁶

Though not a form of mechanical ventilator assistance as per Bilevel Positive Airway Pressure Ventilation (BiPAP) is commonly used to treat ACPE. By avoiding those complications BiPAP can, in some groups of the patient, reduce hospital morbidity, hospital stay shorten, lower the costs, and improve the patient comfort.⁷

BiPAP possible benefits on the ACPE include the capacity of functional residual increased, reduced atelectasis, reduced intrapulmonary shunt right-to-left, better pulmonary compliance decreased breathing work and by decreased afterload and preload left ventricular increased output of cardiac and provide assistance of inspiratory to unload respiratory muscles and lessens the distress of respiratory quickly and efficiently.⁸

The studies conducted in the past showed that the intubation rate was significantly reduced along with improved physiological variables and gas exchange.⁹ In this study, we aim to determine the outcome of using BiPAP as compared to oxygen therapy via face mask in managing ACPE.

MATERIALS AND METHODS

This interventional study was conducted at intensive care unit (ICU) department, Department of Medicine, AL- Nafees Medical College and Hospital Islamabad for one year from 1st March 2019 – 1st March 2020 after approval from hospital ethical committee. The sample size was calculated (n=154) with anticipated population proportion of 14.7%, a significance Level of 5% and with the precision of 6%. Nonprobability purposive sampling technique was employed.

Patients who fulfilled the criteria was included with a clinical diagnosis of ACPE, confirmed by ECG, chest radiograph and Echocardiography findings and divided in two groups with 77 patients in each group. Patients were excluded who presented in the ER with altered sensorium, inability to protect the airway, hemodynamic instability, or need for immediate intubation.

Detailed history regarding the illness was obtained from each patient. Complete clinical examination was performed. Informed consent was taken from the

patients. After collecting the data, it was entered in a specially designed performa. Data were analyzed by the SPSS version 23. Different variables like respiratory rate, pulse rate, oxygen saturation (spo2) and partial pressure of oxygen (po2) was followed and compared in both Groups. Results were calculated using modalities like chi-square, p-value and standard deviation.

P value of less than or equal to 0.05 was considered statistically significant. Effect modifiers like age and gender was controlled by stratification, Post stratification chi-square test for qualitative and t-test for quantitative variables was applied.

RESULTS

We enrolled 154 patients 77 in each group in our study. The mean age of patients in Group A (Face Mask) was 64.69±8.93 years and in Group B (BiPAP) was 65.34±9.17. In Group A (Face Mask) 44(57.1%) patients were male and 33(42.9%) patients were female. Similarly in Group B (BiPAP) 48(62.3%) patients were male and 29(37.7%) patients were female as shown in Figure-1.

The finding of ACEP showed in Group A (Face Mask) 6(7.8%) in ECG, 36(46.8%) in chest x-ray and 35(45.5%) in echocardiography. Similarly in Group B (BiPAP) 13(16.9%) in ECG, 33(42.9%) in chest x-ray and 31(40.3%) in echocardiography as shown in Figure-2.

In Group A (Face Mask) the respiratory rate at zero minute was 31.44±1.82, at 30 minute was 31.62±1.99, at 60 minute was 31.60±1.17 and at 180 minute was 28.86±1.35. Similarly in Group B (BiPAP) at zero minute was 46.35±1.59, at 30 minute was 32.69±1.35, at 60 minute was 27.62±1.84 and at 180 minute was 22.48±1.71. The p value was significant for respiratory rate in both groups as shown in Table-1.

In Group A (Face Mask) the pulse rate at zero minute was 124.38±3.49, at 30 minute was 118.10±2.02, at 60 minute was 111.43±2.24 and at 180 minute was 99.68±3.30. Similarly in Group B (BiPAP) at zero minute was 101.99±4.68, at 30 minute was 100.19±3.04, at 60 minute was 97.06±1.65 and at 180 minute was 84.79±3.27. The p value was significant for pulse rate in both groups.

In Group A (Face Mask) the oxygen saturation at zero minute was 74.95±1.62, at 30 minute was 78.64±1.11, at 60 minute was 82.36±1.75 and at 180 minute was 87.61±1.64. Similarly in Group B (BiPAP) at zero minute was 72.32±1.60, at 30 minute was 81.25±2.47, at 60 minute was 87.17±1.77 and at 180 minute was 94.68±2.65. The p value was significant for oxygen saturation in both groups as shown in Table-2.

In Group A (Face Mask) the partial pressure of oxygen at zero minute was 44.78±3.11, at 30 minute was 65.36±3.03, at 60 minute was 72.55±1.71 and at 180 minute was 80.64±3.02. Similarly in Group B (BiPAP)

at zero minute was 54.84 ± 3.26 , at 30 minute was 70.84 ± 5.84 , at 60 minute was 85.01 ± 3.11 and at 180 minute was 93.83 ± 2.38 . The p value was significant for partial pressure of oxygen in both groups as shown in Table No.3.

The need of mechanical ventilation in Group A (Face Mask) was 10(13.0%) Group B (BiPAP) was 4(5.2%) as shown in Figure-3.

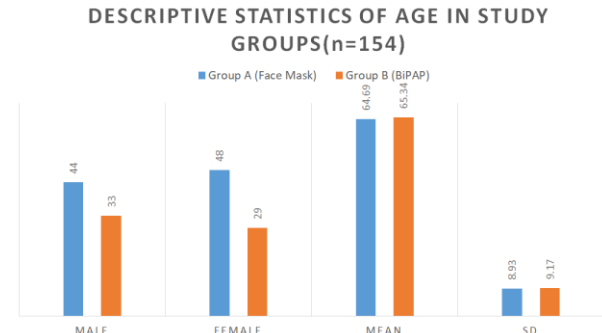


Figure No.1: Descriptive statistics of age in study groups (n=154)

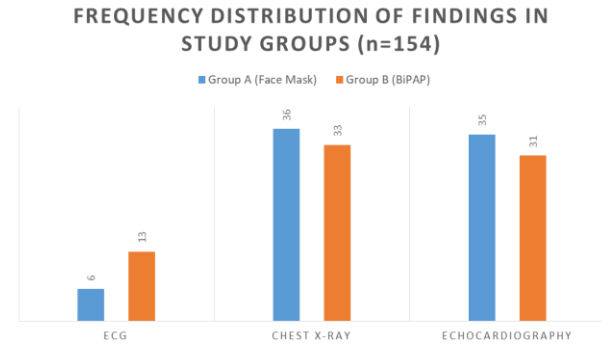


Figure No.2: Frequency distribution of findings in ACPE patients in study groups (n=154)

Table No.1: Results of respiration rate in study groups (n=154)

Respiratory rate	Groups	N	Mean	SD	p value
Respiratory Rate at 0 minute	Group A (Face Mask)	77.00	31.44	1.82	0.000
	Group B (BiPAP)	77.00	46.35	1.59	
Respiratory Rate at 30 minute	Group A (Face Mask)	77.00	31.62	1.99	0.000
	Group B (BiPAP)	77.00	32.69	1.35	
Respiratory Rate at 60 minute	Group A (Face Mask)	77.00	31.60	1.17	0.000
	Group B (BiPAP)	77.00	27.62	1.84	
Respiratory Rate at 180 minute	Group A (Face Mask)	77.00	28.86	1.35	0.000
	Group B (BiPAP)	77.00	22.48	1.71	

Table No.2: Results of oxygen saturation in study groups (n=154)

Oxygen Saturation	Groups	N	Mean	SD	p value
Oxygen saturation (SPO2) at 0 minute	Group A (Face Mask)	77.00	74.95	1.62	0.000
	Group B (BiPAP)	77.00	72.32	1.60	
Oxygen saturation (SPO2) at 30 minute	Group A (Face Mask)	77.00	78.64	1.11	0.000
	Group B (BiPAP)	77.00	81.25	2.47	
Oxygen saturation (SPO2) at 60 minute	Group A (Face Mask)	77.00	82.36	1.75	0.000
	Group B (BiPAP)	77.00	87.17	1.77	
Oxygen saturation (SPO2) at 180 minute	Group A (Face Mask)	77.00	87.61	1.64	0.000
	Group B (BiPAP)	77.00	94.68	2.65	

Table No.3: Results of partial pressure of oxygen in study groups (n=154)

Partial pressure of oxygen	Groups	N	Mean	SD	p value
Partial Pressure of Oxygen (PO2) in ABGs at 0 minute	Group A (Face Mask)	77.00	44.78	3.11	0.000
	Group B (BiPAP)	77.00	54.84	3.26	
Partial Pressure of Oxygen (PO2) in ABGs at 30 minute	Group A (Face Mask)	77.00	65.36	3.03	0.000
	Group B (BiPAP)	77.00	70.84	5.84	
Partial Pressure of Oxygen (PO2) in ABGs at 60 minute	Group A (Face Mask)	77.00	72.55	1.71	0.000
	Group B (BiPAP)	77.00	85.01	3.11	
Partial Pressure of Oxygen (PO2) in ABGs at 180 minute	Group A (Face Mask)	77.00	80.64	3.02	0.000
	Group B (BiPAP)	77.00	93.83	2.38	

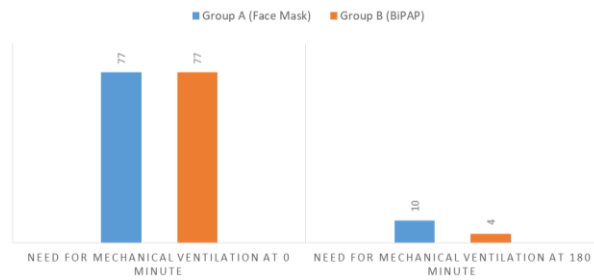


Figure No.3: Results of need for mechanical ventilation in study groups (n=154)

DISCUSSION

Positive pressure ventilation using face mask has been proposed as successful therapeutic approach in the ACPE when used in conjunction with conventional medication. When compared to the traditional therapy with oxygen via face mask, it allows for a faster recovery of the blood gas and vital signs parameters.¹⁰ A decrease in the requirement for mechanical ventilation and tracheal intubation has also been shown in few studies.¹¹ Improvement of the hypoxemia, reduction in the left ventricular afterload and preload, and increase in the pulmonary compliance due to recruitment of previously collapsed alveolar units are some of mechanisms involved in using the positive pressure to alleviate respiratory discomfort in patients with the acute pulmonary edema.¹²

The noninvasive way for delivering positive breathing pressure is ventilation with two pressure levels “bilevel positive pressure ventilation”. Bilevel pressure ventilation has a greater pressure during inspiration and a lower pressure during expiration. It is a technique that promotes inspiration and thereby minimizes the patient's breathing effort.¹³

Even though there is evidence in the literature about the benefits of using a face mask with positive pressure in airways to treat patients with acute cardiogenic pulmonary edema, there are still questions about the best ventilator modality because most studies have only looked at the effects of using this method.¹⁴

The most common source of question about the need for noninvasive ventilatory assistance is acute ischemic heart disease. Noninvasive ventilation can be harmful in this circumstance, according to evidence.¹⁵ The respiratory effort of patients with the acute pulmonary edema is enhanced. Bilevel positive pressure ventilation, we reasoned, is a superior ventilatory modality than oxygen therapy with face mask because it combines the benefits of expiratory positive pressure with a reduction in respiratory labour afforded by inspiratory support.

In our study we find BiPAP has better outcome results in the improvement of respiratory rate, pulse rate, oxygen saturation, partial pressure of oxygen in ABGs

and need for mechanical ventilation than oxygen therapy with a face mask.

BiPAP has received limited research as a therapy for acute pulmonary edema. In the literature, there is a study that compares effects of the continuous positive airway pressure with BiPAP in the treatment of acute pulmonary edema in a prospective and randomized manner. Patients who received bi-level positive pressure breathing improved significantly more than those who received continuous positive airway pressure, according to this research.¹⁶

Noninvasive ventilation (NIV) has been associated with a lower death rate without raising the risk of myocardial infarction in ACPE patients. It speeds up symptom remission and normalization of blood gas parameters, reduces the need for endotracheal intubation, and reduces the need for endotracheal intubation. The patient's prognosis is unaffected by the type of ventilation used in ACPE.¹⁷

Early prehospital use of CPAP and BiPAP can be considered to reduce intubation rates. Noninvasive ventilation (NIV) was found it to be effective in reducing mortality with no significance in the length of hospital stay.¹⁸

CONCLUSION

In our study we concluded that BiPAP has significant clinical benefits and cost effectiveness over oxygen therapy with face mask in patients with ACPE. BiPAP improves respiratory distress, metabolic disruption, blood gas parameter normalization, and reduces need for the endotracheal intubation more quickly than regular oxygen therapy, but has no influence on short-term mortality.

Limitations and Recommendations:

Our study has following limitations

1. The duration of our study was short
2. The study was single center study
3. Sample size limited

We recommend a longer study may be conducted to at multiple centers to briefly address the efficacy of BiPAP in clinical use.

Author's Contribution:

Concept & Design of Study: Syed Saif Ur Rehman
 Drafting: M. Amir Majeed, Yasir Mumtaz
 Data Analysis: Jahanzeb Maqsood
 Revisiting Critically: Safdar Hussain, Saad Hameed Khan
 Final Approval of version: Syed Saif Ur Rehman

Conflict of Interest: The study has no conflict of interest to declare by any author.

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