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Original research article

Comparative Study Between Modes of Non-Invasive Ventilation for The Management of Type 2 Respiratory Failure in Acute Exacerbation of COPD Patient at National Institute of Medical Sciences, Jaipur

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Abstract

INTRODUCTION: Chronic respiratory failure due to chronic obstructive pulmonary disease (COPD) contributes a significant social and economic burden to individuals, families and the healthcare system. One of the limitations of traditional NIV is altered levels of consciousness. However, under certain circumstances, especially those produced by hypercapnic conditions, traditional NIV has produced very favorable results, even in patients with hypercapnic coma.

METHODOLOGY: A hospital based, prospective, observational study done on 176 patients of AECOPD with type 2 respiratory failure admitted at Institute of Respiratory Diseases, National Institute of Medical sciences, Jaipur. Necessary permission was taken from Ethical Committee and Research Review Board of National Institute of Medical science, Jaipur.

RESULTS: Our study showed that the comparison of mean age was statistically non-significant (=0.5979 NS) and duration of disease was statistically significant (P=0.0004*). Our study showed that the mean value of pH, PaCO2, PaO2 and SaO2 was statistically non-significant at admission and after 3 hours in between groups, but HCO3- & Respiratory Rate was statistically significant at admission and after 3 hours in between groups. pH and PaCO2 was statistically significant after 6 hours in between groups.

CONCLUSION: We concluded that NPPV should be the first line intervention in addition to usual medical care to manage respiratory failure secondary to an acute exacerbation of chronic obstructive pulmonary disease in all suitable patients. NPPV should be tried early in the course of respiratory failure and before severe acidosis, to reduce mortality, avoid endo-tracheal intubation, and decrease treatment.

Keyword: type 2 respiratory failure, Chronic respiratory failure, Noninvasive mechanical ventilation (NIV)

Introduction

Chronic respiratory failure due to chronic obstructive pulmonary disease (COPD) contributes a significant social and economic burden to individuals, families and the healthcare system.

The incidences of COPD, in terms of its combined mortality and disability, was the 12th highest for diseases worldwide in 1990 and is expected to become the fifth highest by 2020, with

mortality expected to increase fivefold by 2015. Reduced alveolar ventilation in chronic respiratory failure due to COPD results in nocturnal and daytime gas exchange abnormalities, sleep-disordered breathing, dyspnea and increased work of breathing, which in turn lead to significant functional impairment, morbidity and mortality.

The eventual development of chronic respiratory failure is characterized by varying degrees of ventilation–perfusion mismatch, hypoxia and hypercapnia. Noninvasive mechanical ventilation (NIV) is used in patients with acute respiratory failure for several different etiologies. The heterogeneity of different patient groups leads to varying levels of success, with the best results produced in patients with infectious exacerbations of COPD and congestive heart failure. When NIV is initiated in patients with acute respiratory failure due to infectious exacerbations of COPD, ventilator parameters are typically determined based on clinical assessment and changes in blood gases.

One of the limitations of traditional NIV is altered levels of consciousness. However, under certain circumstances, especially those produced by hypercapnic conditions, traditional NIV has produced very favorable results, even in patients with hypercapnic coma.

MATERIAL & METHODS:
A hospital based, prospective, observational study done on 176 patients of AECOPD with type 2 respiratory failure admitted at Institute of Respiratory Diseases, National Institute of Medical sciences, Jaipur. Necessary permission was taken from Ethical Committee and Research Review Board of National Institute of Medical science, Jaipur.

INCLUSION CRITERIA:
1. All cases of acute exacerbation of COPD with type 2 respiratory failure as per GOLD guidelines 2018.
Respiratory acidosis ($PaCO_2$ > 45 mm of Hg and arterial pH < 7.35).
Severe dyspnea with clinical signs suggesting of respiratory muscle fatigue, increased work of breathing, or both, such as use of respiratory accessory muscles, paradoxical motion of abdomen, or retraction of costal spaces.
Persistent hypoxemia despite supplemental oxygen therapy.
2. Those who give written informed consent.

EXCLUSION CRITERIA:
1. Indication for endotracheal intubation,
2. Hypotension defines systolic blood pressure <90 and diastolic blood pressure <60 mm of Hg,
3. Presence of ventricular or atrial arrhythmia 4. Inability to co-operate with the fitting and wearing of the face mask, 5. Presence of upper airway obstruction or facial trauma or presence of tracheostomy 6. Unconscious patient, 7.Un-drained pneumothorax, 8. Vomiting, 9. Patient declines treatment,10. Severe co-morbidities.

PROCEDURE:

Patients were classified into 2 groups:

1. Group 1 – S/T Mode BiPAP group

2. Group 2 – AVAPS Mode group
Arterial blood gases were measured at admission, 3 hours and 6 hours after applying NIV; the

patient was assessed by a respiratory therapist under close supervision of a physician trained in NIV. Mask use, complications, and tolerance were also assessed.

Disease severity was assessed using the Encephalopathy Score (EC) to determine the patient's level of consciousness.

Respiratory rate, heart rate, systolic blood pressure, diastolic blood pressure were measured upon hospitalization, 3 hours, and 6 hours during NIV.

OUTCOME VARIABLES:
Comparison of pH, PaO2, PaCO2, HCO3, SaO2, Respiratory rate and Consciousness Level (ENCEPHALOPATHY SCORE) on admission and after 3 and 6 hour of applying Non Invasive Ventilation (NIV).

STATISTICAL ANALYSIS:
The mean values were compared using Student's t-test. For categorical variables $\chi 2$ or fisher's exact tests were used as appropriate. We used student paired t- test to compare the ability of different variables to predict the outcome of therapy in experimental and control patients.

A P-value < .05 was considered statistically significant.

RESULTS:
Our study showed that the comparison of mean age was statistically non-significant (=0.5979 NS) and duration of disease was statistically significant (P=0.0004***) shown in table 1 and table 2 respectively.

The comparison of mean value of pH, PaCO2, PaO2, SaO2, HCO3- & Respiratory Rate at admission, after 3 hours and after 6 hours was shown in table 3, 4 & 5 respectively.

Our study showed that the mean value of pH, PaCO2, PaO2 and SaO2 was statistically non-significant at admission and after 3 hours in between groups, but HCO3- & Respiratory Rate was statistically significant at admission and after 3 hours in between groups. pH and PaCO2 was statistically significant after 6 hours in between groups.

Our study showed that the mean value of consciousness level according to ES score was 1.609 ± 0.6534 in group 1 & 1.552 ± 0.6779 in group 2 at admission, after 3 hours was 0.5930 ± 0.6576 in group 1 & 0.5647 ± 0.6805 in group 2 and after 6 hours was 0.1149 ± 0.3552 in group 1 & 0.2529 ± 0.487 in group 2.

The comparison of mean value of consciousness level was statistically non-significant at admission and after 3 hours (P=0.5698 & P=0.7823 respectively), but statistically significant after 6 hours (P=0.0343*) in between groups (table 6).

Table 1: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding age

Age (yrs)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P- value
Mean	59.78 yrs	58.90 yrs	0.5979
SD	10.81	11.28	
Range	40-86 yrs	39-83 yrs	

Table 2: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding duration of disease

Duration of disease (yrs)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P- value
Mean	6.011 yrs	7.540 yrs	0.0004***
SD	2.197	3.298	
Range	3.0-14.0 yrs	3.0-17 yrs	

Table 3: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding arterial blood gas analysis at admission of patients

Arterial blood gas analysis (ABG)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P-value
pH	7.309±0.03395	7.311±0.04060	0.7173
PaCO2	72.83±53.69	65.01±12.63	0.1877
PaO2	58.74±9.952	60.57±9.273	0.2113
SaO2	68.44±10.31	70.93±9.214	0.0943
HCO3-	27.02±5.774	25.21±4.607	0.0235*
Respiratory Rate	34.10±4.327	32.52±4.234	0.0155*

Table 4: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding arterial blood gas analysis after 3 hours

Arterial blood gas analysis (ABG)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P-value
pH	7.345±0.04851	7.338±0.04367	0.3099
PaCO2	56.36±8.363	56.77±9.836	0.7698
PaO2	68.52±9.876	66.60±10.75	0.2217
SaO2	80.09±7.80	78.31±9.817	0.1885
HCO3-	26.92±5.648	25.34±4.526	0.0432*
Respiratory Rate	24.92±3.807	23.20±4.326	0.0059**

Table 5: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding arterial blood gas analysis after 6 hours

Arterial blood gas analysis (ABG)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P-value
pH	7.370±0.04861	7.355±0.03950	0.0311*
PaCO2	46.03±7.163	50.05±8.543	0.0010***
PaO2	76.09±10.73	73.54±11.96	0.1403
SaO2	101.9±9.639	87.53±8.356	0.1669
HCO3-	26.41±5.310	25.26±4.811	0.1372
Respiratory Rate	16.09±2.165	16.29±2.282	0.5631

Table 6: Comparison between Group 1 (S/T Mode Bi PAP) & Group 2 (AVAPS Mode) regarding Consciousness level at various interval

Consciousness level (GLASGOW COMA SCALE)	Group 1 (S/T Mode Bi PAP)	Group 2 (AVAPS Mode)	P-value
At admission	1.609±0.6534	1.552±0.6779	0.5698
After 3 hours	0.5930±0.6576	0.5647±0.6805	0.7823
After 6 hours	0.1149±0.3552	0.2529±0.487	0.0343*

DISCUSSION:

Non invasive ventilation (NIV) is the first option for ventilatory support in acute respiratory failure of COPD exacerbations or acute cardiogenic pulmonary edema and should be considered in immunocompromised patients, prevention of post extubation failure and in difficult weaning. It can also be used in the postoperative period and in cases of pneumonia and asthma or as a palliative treatment. NIV is currently used in a wide range of settings, from the ICU to home care.

CONCLUSION:

We concluded that NPPV should be the first line intervention in addition to usual medical care to manage respiratory failure secondary to an acute exacerbation of chronic obstructive pulmonary disease in all suitable patients. NPPV should be tried early in the course of respiratory failure and before severe acidosis, to reduce mortality, avoid endo-tracheal intubation, and decrease treatment.

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