

A Prospective Study on Effectiveness of Non-invasive Positive Pressure Ventilation in Acute Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. The chronic and progressive course of COPD is often punctuated by "exacerbations", defined clinically as episodes of increasing respiratory symptoms, particularly dyspnoea, cough and sputum production, and increased sputum purulence. **AIM:** To study the effectiveness of non-invasive positive pressure ventilation in the management of acute exacerbation of chronic obstructive pulmonary disease.

Methods: Our study included 63 patients of acute exacerbation of COPD admitted in the intensive care unit of Shri Aurobindo Medical College and Post Graduate Institute, Indore, India.

Results: The maximum numbers of patients (46.03%) were in the age group between 61 to 70 years. In our study, the overall success rate in patients given noninvasive ventilation along with standard therapy was higher (95.2%) compared to patients given standard therapy alone (60.3%).

Conclusions: This proves that non-invasive ventilatory support is an effective tool in the management of acute exacerbation of COPD.

Keywords: Positive Pressure Ventilation, COPD

Available Online: 24th December 2019

Received: 15.10.19

Accepted: 02.11.19

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INTRODUCTION


Patients with COPD are prone to respiratory failure, often resulting in admission to hospital.¹⁻⁵ Conventional treatment aims to ensure adequate continuous oxygenation and to treat the cause of exacerbation - usually achieved through treatment with bronchodilators, corticosteroids, antibiotics and controlled oxygen therapy. Traditionally, patients who do not respond to conventional treatment require endotracheal intubation and mechanical ventilation, both to restore adequate gas exchange and to alleviate respiratory muscle fatigue.⁶ The procedure of tracheal intubation and assisted ventilation is associated with high morbidity, and it may be difficult to wean these patients from ventilation.^{7,8} Furthermore, although it is a common practice to give intubation and mechanical ventilation, complications can

result from the intubation process (damage to local tissue) and during the course of ventilation (pneumonia and sinusitis associated with ventilators), prolonging stay in intensive care.⁹⁻¹²

Hence, there is a need for methods of ventilator assistance that could obviate the necessity for intubation in patients with acute respiratory failure.

In chronic respiratory insufficiency, ventilation has been assisted non-invasively by means of external negative pressure¹³, chest-wall oscillations¹⁴, and positive pressure ventilation administered through a mouth piece¹⁵ or through the nose.⁶ Intermittent positive pressure through a nasal mask has also been used to treat some patients with acute respiratory failure.^{16,17}

Access this article online

Website: www.iabcr.org	Quick Response code 
DOI: 10.21276/iabcr.2019.5.4.14	

How to cite this article: Jain R, Nagar D. A Prospective Study on Effectiveness of Non-invasive Positive Pressure Ventilation in Acute Chronic Obstructive Pulmonary Disease. Int Arch BioMed Clin Res. 2019;5(4):PM1-PM3.

Source of Support: Nil, **Conflict of Interest:** None

Non-invasive positive pressure ventilation (NIPPV) is an alternative treatment for patients admitted to hospital with acute exacerbation of COPD.¹⁸ Inspiratory-pressure support is a new method of partial ventilatory assistance in which constant positive pressure is applied during the patient's spontaneous inspiration. In NPPV the patient receives air or a mixture of air and oxygen from a flow generator through a full facial or nasal mask, and thus ventilation is enhanced by the unloading of fatigued ventilatory muscles.

METHODS

Our study included 63 patients of acute exacerbation of COPD admitted in the intensive care unit of Shri Aurobindo Medical College and Post Graduate Institute, Indore, India.

Study period

The duration of study was 18 months i.e. January 2016 to June 2017

Study Design

Prospective-observational cohort study

Sample size

All cases of acute exacerbation of COPD admitted to Shri Aurobindo Medical College and Post Graduate Institute, Indore, India during the study period on the basis of inclusion and exclusion criteria.

Indications for non-invasive positive pressure ventilation.

- RR > 25/min
- Use of acc muscles of respiration
- PaCO₂ > 45mmHg with pH < 7.35
- Proper mask fit

Statistical Methods

Data was entered in Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) software, version 21. We calculated the means and standard deviations for the linear variables, and proportions for the categorical variables. The means between two groups were compared using Chi square test. The means across more than two groups were compared using the Analysis of Variance (ANOVA).

Significant figures:

P value of <0.05 is considered to be statistically significant.

RESULTS

In our study the maximum numbers of patients (46.03%) were in the age group of 61 to 70 years. (Table 1)

The mean age in standard therapy (ST) group for male was 69.45 (SD 9.2) years, whereas for female was 66.72 (SD 12.71) years. (Table 2)

In our study the total number of male patients were 32(50.8%) in number whereas females were 31(49.2%).

The male to female ratio in standard therapy group was 20/18, in standard therapy + noninvasive ventilation group was 09/13 whereas in patients who were invasively ventilated was 3/0.

Mean age in standard therapy + noninvasive ventilation (NIV) group in male was 62.67 (SD 12.75) years, whereas for female was 66.07 (SD 9.48) years.

In patients who were invasively ventilated (IV) the mean age in male was 61 (SD 17.34) years, whereas there were no females in this group.

Table 1: Age Wise Distribution of Patients.

Age (Years)	Frequency (n)	Percentage (%)
41-60	15	23.82
61-70	29	46.03
71-80	12	19.04
>80	7	11.11
Total	63	100

Table 2: Sex Distribution

Sex	Frequency (n)	Percentage (%)
Male	32	50.8
Female	31	49.2
Total	63	100

Out of the total 63 patients admitted with acute exacerbation of COPD, 38 patients (60.32%) were given only standard treatment. 22 patients (34.92%) received noninvasive ventilation in addition to standard therapy, whereas 3 patients (4.76%) required invasive ventilation after a trial of noninvasive ventilation along with standard therapy.

Table 3: Type of Treatment

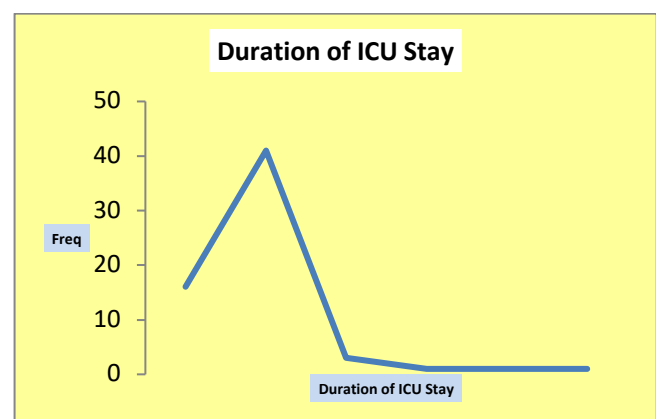
Treatment	Frequency(n)	Percentage (%)
Standard Treatment	38	60.32
Standard Treatment + Non-Invasive Ventilation	22	34.92
Standard Treatment + Non-Invasive Ventilation + Invasive Ventilation	3	4.76
Total	63	100

In standard therapy group, the mean respiratory rate was 26 ± 2.64 breaths/min on admission and 20.92 ± 2.12 breaths/min after 5 hours of treatment.

In non-invasive ventilation + standard therapy groups the mean respiratory rate was 32 ± 3.38 breaths/min on admission and 30.54 ± 2.82 breaths /min after 5 hours of treatment.

In patients requiring invasive ventilation the mean respiratory on admission was 30 ± 0 breaths/min.

In our study maximum number of patients required ICU stay for 2 days (65.07%) and maximum number of days for a patient in ICU was 10 days and minimum was 1 day.



Graph 1: Duration of ICU Stay

DISCUSSION

63 patients of acute exacerbation of COPD fitting in the inclusion criteria were included in this study and the effectiveness of non-invasive positive pressure ventilation in their management was studied.

In 2 randomized prospective controlled studies done by Ali O. Abdel Aziz et al¹⁹, Osadnik CR et al²⁰ the mean age in standard therapy + non-invasive ventilation group was 62.2 (SD 9.64), 66.8 years respectively.

The mean age in our study is in concordance with the above mentioned randomized controlled studies.

In a randomized controlled study conducted by Schirnhofner L et al²¹ data showed that 59.9% male patients are smokers. Our study also points out to the fact that smoking continues to be an important risk factor in the development of COPD among males.

In a randomized controlled study conducted by Plant PK et al²² 118 patients were allocated to standard treatment and 118 to NIV. 32 of the 118 patients (27.1%) in the standard treatment group met the primary end point "need for intubation" compared with 18 of the 118 (15.3%) in the NIV group. In-hospital mortality was also reduced: 24/118 (20.3%) of the standard group died compared with 12/118 in the NIV group (10.2%).

In a randomized controlled study conducted by R. Prasad et al²³ 9 patients were allocated to standard treatment and 10 to NIV. 2 of the 9 patients (20%) in the standard treatment group met the primary end point "need for intubation" compared with 1 of the 10 (12.5%) in the NIV group.

In our study 63 patients with a diagnosis of acute exacerbation of COPD were given standard therapy. 38(60.3%) patients showed significant improvement in terms of clinical and arterial blood gas parameters and required no further intervention. But 25(39.6%) patients failed to improve at the end of 1 hour of standard therapy. Of these 25, 3 patients failed to improve after 1 hour and developed impending respiratory failure.

These 3 patients had to be invasively ventilated. Out of these 3 patients, 2 patients had uncontrolled diabetes, hypertension and ischemic heart disease. These 2 patients developed cardiac arrest and expired during their course in hospital. Remaining 1 patient had no associated comorbidities, but developed ventilator associated pneumonia with septicemia and succumbed to his illness.

Remaining 22(34.9%) patients who were given a trial of non-invasive ventilation showed significant improvement in terms of clinical and arterial blood gas parameters after 4 hours of non-invasive ventilation trial. Subsequently these patients were successfully discharged along with 38 other patients who improved with standard therapy alone.

In our study the rate of improvement with NIV was 34.9% which was more than the studies done by Plant PK et al²² and R. Prasad et al.²³

In our study hospital stay with standard therapy + non-invasive ventilation was reduced compared to standard therapy group alone but it is statistically not significant ($p=0.28$).

The success rate in the present study was about 95.2%, which is comparable to that reported in two previous studies, which is in accordance with the similar studies conducted by Ali O. Abdel Aziz et al¹⁹ in 2016 and Turgay Celikel et al.²⁴

CONCLUSION

- We conclude that non-invasive ventilation is an effective tool in acute exacerbation of COPD and its early initiation would improve the clinical status, respiratory acidosis and reduce the length of hospital stay.
- This increase in the use of NIPPV was associated with declines in the number of patients requiring invasive mechanical ventilation and mortality.

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