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Outcome of Non-Invasive Ventilation for Acute Exacerbation of Chronic Obstructive Pulmonary Disease in Tertiary Level Hospital

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ABSTRACT

Background: Acute exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) complicated by acute hypercapnic respiratory failure frequently requires Intensive Care Unit (ICU) admission and is associated with significant mortality and morbidity. Non-Invasive Ventilation (NIV) is an established modality of treatment that reduces the need of mechanical ventilation and improves outcomes. This study aimed to evaluate the effectiveness of NIV use for AECOPD in a tertiary-level hospital in Nepal.

Methods: This observational study was conducted in the Department of Anesthesia and Critical Care in the College of Medical Sciences, Bharatpur, Chitwan, from June 2025 to May 2026. A total of 260 patients with AECOPD with Type II respiratory failure were included. Baseline demographic and clinical data were recorded. Arterial blood gas (ABG) was done before initiation of NIV and 4 hours after. NIV success, need for invasive ventilation, and clinical outcomes were analyzed.

Results: Out of 260 patients, 161(61.9%) were males, and 99 (38.1%) were females. The mean age of patients was 67.49 ± 12.49 years. NIV use improved ABG parameters significantly within 4 hours of use, with mean pH increasing from 7.24 ± 0.06 to 7.30 ± 0.07 and mean PaCO2 decreasing from 88.54 ± 14.31 mmHg to 75.68 ± 13.43 mmHg. NIV was successful in 229 (88.1%) patients, while 31(11.9%) required escalation of care. The mean duration of NIV use was 30.69 ± 5.38 hours.

Conclusion: NIV is an effective supportive modality in AECOPD with type II respiratory failure, resulting in higher successful treatment.

Keywords: AECOPD, critical care, ICU, NIV

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is one of the foremost causes of morbidity and mortality globally, often characterized by persistent respiratory symptoms and airflow limitation.[1] Acute exacerbation of COPD (AECOPD) is marked by worsening dyspnea, cough, and sputum production, often necessitating hospitalization. Both invasive and non-invasive ventilation (NIV) have been used to manage AECOPD in various studies.[2,3] Non-invasive ventilation (NIV) has emerged as a cornerstone in managing AECOPD, particularly in cases complicated by acute hypercapnic respiratory failure.[4-6] NIV has been shown to decrease mortality, hospital stay, and complications such as ventilator-associated pneumonia but its success mainly depends on patient selection, timely initiation, and use of appropriate settings.[6,7] It mainly improves gas exchange and reduces respiratory muscle fatigue which enhances survival in AECOPD patients with respiratory acidosis.[8,9] However, factors such as comorbidities, severity of exacerbation, and adherence to NIV protocols can influence treatment success.[7, 10] This study aims to evaluate the outcomes of NIV in patients with AECOPD admitted to a tertiary-level hospital, focusing on success rates and in-hospital mortality.

METHODS

This observational study was conducted in the Department of Anesthesiology and Critical Care at College of Medical Sciences Teaching Hospital at Bharatpur, Chitwan. We had conducted this study in our setting, as most of the existing meta-analyses on NIV use for COPD derive their data from high-income countries, with limited representation of tertiary-care settings in low- and middle-income countries. Our study was done over a period of 1 year, from June 2025 to May 2026, and included 260 patients on the basis of predefined inclusion and exclusion criteria after due approval from the College of Medical Sciences, Institutional Review Committee. (COMSTHIRC-IRC/2025-038). All the cases of AECOPD with type II respiratory failure with respiratory acidosis admitted to the ICU were included in our study. Patients less than 16 years, not willing to participate, patients unable to protect their airway (Glasgow coma scale of 8 or less), recent surgery of the upper airway or gastrointestinal system, pregnant patients, and patients having 2 or more organ dysfunctions were excluded. Sample size was calculated by the formula: $n=z^2pq/e^2$ Where, p =88, from a previous study by Agca et al.[11] e= 0.04.

A total of 260 patients were included in the study All patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) who visited the COMS Emergency Department received standard medical management. Arterial blood gas (ABG) analysis was performed at the time of presentation. Patients who failed to improve after medical treatment were shifted to the Intensive Care Unit (ICU). They were re-evaluated in the ICU, and their ABG reports were reviewed. Patients with type II respiratory failure (pH <7.35 and PCO_2 >45 mmHg) were included in the study. Non-invasive ventilation (NIV) was initiated for these patients, and the time of initiation was considered as hour zero. The initial NIV settings, including pressure support (PS), positive end-expiratory pressure (PEEP), and fraction of inspired oxygen (FiO_2), were recorded The patients were kept under continuous monitoring for clinical improvement. Repeat ABG analysis was performed 4 hours after the initiation of NIV. If improvement was observed in the ABG findings or clinical status, the same NIV settings were continued. For patients who failed to show improvement either clinically or in the ABG findings, the NIV settings were titrated accordingly. The changes in NIV settings were not included as part of the study. NIV was continued for the maximum possible duration on Day 1, followed by gradual weaning over the subsequent days based on clinical improvement and ABG findings. Patients who deteriorated at any point and required invasive mechanical ventilation were intubated according to clinical indications, and this information was recorded in the study proforma. Patients who did not require any form of ventilatory support (invasive or non-invasive) for 48 hours after discontinuation

of NIV or transfer out of the ICU were considered discharged. Patients who refused treatment at any point after the initiation of NIV were recorded as having left against medical advice (LAMA). All collected data were entered into a Microsoft Excel spreadsheet and subsequently transferred to SPSS software version 17 for statistical analysis. Qualitative variables were presented as frequencies and percentages, while quantitative variables were expressed as mean ± standard deviation. A p-value of <0.05 was considered statistically significant.

RESULTS

Out of 260 patients in the study, there were 161 males and 99 females. The mean age of the patient was 67.49 ±12.49 years. 213 patients were smokers. The distribution of age, gender and smokers is given in Table 1.

Table 1. Age-wise distribution of genders and smokers.

Age	Non smoker		Smoker		Total (%)
	Male (%)	Female (%)	Male (%)	Female (%)	
<50	5 (1.92)	0	11 (4.23)	5 (1.92)	21 (8.07)
51-60	4 (1.53)	7 (2.68)	26 (10)	12 (4.61)	49 (18.84)
61-70	6 (2.30)	8 (3.07)	45 (17.30)	29 (11.15)	88 (33.84)
71-80	5 (1.92)	8 (3.07)	44 (16.92)	15 (5.76)	72 (27.69)
>81	2 (0.76)	2 (0.76)	13 (5)	13 (5)	30 (11.53)

Among the study population, 76 patients had no other comorbidities, 130 had a single comorbidity, while 54 patients had 2 or more comorbidities. Hypertension was the leading comorbidity in 109 patients, followed by diabetes, ischemic heart disease, and thyroid among 104, 23, and 8 patients, respectively. The study showed significant improvement in the pH after 4 hours of NIV. The mean pH of patients before initiation of NIV was 7.24 ± 0.06 while 4 hours later it was 7.30 ± 0.07 ($p<0.001$). Similarly, $PaCO_2$ was also reduced from 88.54 ± 14.31 to 75.68 ± 13.43 which was statistically significant ($p<0.001$). Of 260 patients, 229 patients were successfully treated by NIV, while 31 patients required escalation of care. Out of these 31 patients, 13 went on LAMA, opting for do not intubate/Resucitate (DNI/DNR) order. 18 patients were intubated, of whom 11 cases survived. Table 2 shows the success and failure of the NIV in different age groups.

Table 2. Age wise distribution of success and failure of NIV

Age range	Success	Failure
<50	17	4
51-60	42	7
61-70	79	9
71-80	63	9
>81	28	2

DISCUSSION

Non-invasive ventilation has been a part of the treatment of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) for a long time and has shown promising results in reducing acidosis, hypercapnia, dyspnoea, and overall mortality of the patient.[12] It is effective particularly in patients with acute hypercapnic respiratory failure (AHRF) by improving the gas exchange, providing support during breathing, and effectively reducing mortality and hospitalization along with treatment costs.[13, 14] We had included 260 patients with AECOPD in Type II respiratory failure in our study out of which there were 161 males and 99 females. There was a male preponderance of COPD in our study, with a higher number of male patients being smokers. This was in contrast with study done by Sayami et al.[15] and Joshi et al.[17], where the incidence was more in females. This lower incidence of COPD in our study could be attributed to a higher smoking incidence among males and a trend towards declining reliance on biomass fuels for cooking, even in semi-urban and rural areas of Nepal. Our study demonstrated that non-invasive ventilation (NIV) was highly effective in managing acute exacerbations of chronic obstructive pulmonary disease (COPD) complicated by type 2 respiratory

failure, 229 patients experienced significant improvement with non-invasive ventilation and were successfully discharged from the ICU. This result was similar to studies done by Joshi et al.[16] and a study done in Pakistan by Ishfaq et al.[17] A study done by Md Motiul Islam et al.[18] from Bangladesh, where NIV was used for variable indications apart from AECOPD with Type II respiratory failure, yielded the best results only for AECOPD. A similar study was done in Australia by Korula et al.[19] where NIV was used for various indications except for AECOPD and yielded higher failure rates. The mean duration of NIV use in our study was 39.16±8.53 hours, which was in contrast to a study done by Joshi et al. where the mean duration of NIV use was 18.3±9.2 h. Although the outcomes were similar, the prolonged duration of NIV use in our study could be due to differences in institutional weaning practices and clinician preference rather than actual disease severity. NIV failure and in-hospital mortality were strongly associated with duration of NIV use as it reflected persistent respiratory failure and disease severity. Patients who were in NIV for a longer duration had poorer outcomes. Similar findings were noted in a study done by Steriade et al.[20] in Romania.

Our study highlighted the overall success of the use of NIV in patients with acute exacerbation of COPD in our population. It also provided a baseline for future research into the factors determining the success of NIV in AECOPD patients.

CONCLUSIONS

NIV is an effective supportive modality for patients with acute exacerbation of COPD admitted to the ICU. Longer duration of NIV was associated with poorer clinical outcomes, including mortality. Careful monitoring and early recognition of NIV failure are essential to optimize patient outcomes.

Limitations

This is a single-centre observational study conducted in a tertiary-level ICU, so the findings may not be generalizable to other healthcare settings with limited manpower and resources or to less severe populations. Additionally, certain clinically relevant confounders, such as severity scores (APACHE II or SOFA) and underlying organ dysfunction, were not taken into consideration.

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