A NEW SCORING SYSTEM FOR THE PREDICTION OF MECHANICAL VENTILATION IN ACUTE EXACERBATION OF COPD

Clinical Research

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ABSTRACT

Introduction: Acute exacerbations of COPD due to either pollution continued smoking, or infections are leading causes of hospital admission and need for mechanical ventilation. **AIM** This study aims to assess the predictors for the need of Mechanical ventilation in patients with acute exacerbation of COPD with respiratory failure and to propose a new scoring system as a predictor of mechanical ventilation. **Results-** Out of the 100 patients included in the study, 56 patients required mechanical ventilation. Of them, 41 were managed on NIV, while 15 patients needed invasive ventilation. The predictors for mechanical ventilation were PH, Pco2, heart rate, respiratory rate, age, and total APACHE 2 score. **Conclusion** Based on the findings of this study, a new scoring system has been proposed to predict the need for mechanical ventilation during the hospital stay. However, more stringent studies are needed to validate the scoring.

KEYWORDS

INTRODUCTION

COPD is the leading cause of death in the world and the third most common cause of hospitalization1. Approximately 85% of patients with COPD suffer from chronic bronchitis, and 15% suffer primarily from emphysema. Chronic bronchitis is the presence of chronic productive cough for three months in each of 2 successive years, where other causes of chronic cough have been excluded2. Emphysema results from progressive destruction of bronchioles and alveoli and limitation of elastic recoil. Chronic bronchitis is defined in clinical terms, and emphysema is characterized in terms of anatomic pathology, which limits the clinical utility of the definition. In contrast, the GOLD definition encompasses chronic bronchitis, emphysema, bronchiectasis, and to a lesser extent, asthma2.

In resource-limited settings in developing countries, there is a perennial shortage of health care resources. Well equipped critical care beds are at a premium and are in only limited numbers. In such a scenario, optimum utilization of resources, including the critical care beds, is imperative. It stands to reason to prioritize intensive care admission to the patients that are at higher risk of developing complications, including the need for a mechanical ventilator. The current study was aimed to identify independent predictors for the need for a mechanical ventilator in patients with exacerbation of COPD.

AIMS and OBJECTIVE:

This study aims to assess the predictors for the need of Mechanical ventilation in patients with acute exacerbation of COPD with respiratory failure and to propose a new scoring system as a predictor of mechanical ventilation.

Methods and materials-

The current study is a prospective study undertaken over one year. The patients who are already diagnosed as COPD and presented with an exacerbation are enrolled in the study. The spirometric diagnosis was omitted for the survey. Exacerbation of COPD was diagnosed based on at least one of the following respiratory symptom-Dyspnea, cough, and sputum production. The patients who were managed according to the standard guidelines and treating clinician discretion. Various parameters were recorded and compared between the Ventilatory and non-ventilatory group. Based on the findings, a scoring system was suggested. The analysis was done using SPSS software. All discrete data presented as mean and standard deviation. The correlation coefficient was calculated for variables that appeared to be predictors of mechanical ventilation. The student t-test was used to check statistical significance.

RESULTS :

The study included a total of 100 patients with respiratory failure secondary to acute exacerbation of COPD. Of the 100 patients,73 (73%) were male patients, and 27 (27%) were females. 56 (56%) patients required mechanical ventilation (invasive and non-invasive). All the 100 patients had worsening of dyspnea as a major complaint. Ninety-four patients had an accompanying cough. Only 67 patients had a change in sputum production, both quality and quantity (seropurulent to hemoptic).

Totally 18 patients had chronic organ dysfunction and ten patients had acute kidney injury. Of the 18 patients who had chronic organ dysfunction,17 patients needed mechanical ventilation. A Pearson correlation of 0.215 was found between chronic organ failure and invasive mechanical ventilation.

Of the 56 patients who required mechanical ventilation, 15(26.8%) patients required endotracheal intubation, and 41(73.2%) could be managed on NPPV alone. The primary indicator of invasive mechanical ventilation was found to be a reduced GCS score.

The main predictors of mechanical ventilation were first day Pco2, first day pH, heart rate, respiratory rate, GCS, and total APACHE II score. Any correlation of 0.010 was found between mechanical ventilation and age with a mean age of 70.17 +/- 12.31 in the ventilator group and 61+/-8.1 in the non-ventilator group.

A higher total APACHE score was found to be an essential predictor of mechanical ventilation. Other independent predictors of mechanical ventilation include the age of the patient, higher pco2 levels at presentation, pH, heart rate, respiratory rate, total WBC count, GCS, and overall APACHE II score.

Based on the observations, a new scoring system as a determinant of mechanical ventilation was proposed. The minimum possible score is one, and the maximum rating is 25. A score of 12 or more is an indication of NPPV. A score of 17 and above is definitive for resorting to intubated MV.

A marginal increase in total score possibly spells of NPPV failure, thereby need for ICU admission and invasive ventilation.

Discussion-

The current study has found a higher age of the patient as an independent predictor of mechanical ventilation. The average age of the ventilatory group is 70.18±12.31 vs. 61±8.90 in the ventilatory group. The p-value is 0.0001, indicating extreme statistical significance. The impact of age might be due to a longer duration of

disease, which causes more frequent exacerbations and progression of disease13. In the current study, 51(51%) patients presented with only hypercarbic failure.

Thirty-five patients had combined hypoxic, and hypercarbic failure, and 14 patients had a hypoxic failure. Overall, 86% of patients had type 2 respiratory failure, and only 14% of patients had type 1 respiratory failure.

The average first-day $PaCO_2$ was 60.80 ± 16.38 in the ventilatory group vs. 48 ± 10.25 in the non-ventilatory group with a Pearson correlation coefficient of 0.338, indicating a significant positive correlation. The p-value of 0.0001 was noted, indicating extreme statistical significance. Of the 56 patients, 41 were managed on non-invasive positive pressure ventilation. 15 patients required more invasive mechanical ventilation by endotracheal intubation. Many studies have proved that non-invasive ventilation decreases the length of hospital stay, morbidity, and mortality in COPD patients with type respiratory failure but not in other causes of type 2 respiratory failures 14, 15, 16. The main indications for intubation included reduced GCS, patient intolerance to NIV, and failure of NIV and also organ dysfunctions. Reduced GCS is also a contraindication for non-invasive ventilation because of the risk of aspiration7. The patients requiring mechanical ventilation had a pH of 7.30 ± 0.08 vs. 7.37 ± 0.08. PH levels correlated well with $PaCO_2$ levels. P-value is 0.0001, indicating extreme statistical significance. Pearson correlation coefficient was 0.13, indicating a positive correlation. One study conducted in Queen Elizabeth hospital has shown a 7.24 ± 0.11 as an indicator of mechanical ventilation. Another study conducted in north India7 also showed a pH of 7.26 as a cutoff for the need for mechanical ventilation. This fact has been proven by multiple earlier studies like Khilnani et al. .7, Hoo et al. .14, and Sluiter et al. 17. Khilnani et al. and Hoo et al. identified a threshold of 7.25. The group of patients needing mechanical ventilation had a significantly higher heart rate and respiratory rate. The patients requiring mechanical ventilation had a mean heart rate of 115.07 ± 18.73 vs. 103.11 ± 13.47. The P-value was 0.006, which signifies extreme statistical significance. A Pearson correlation of 0.534 was obtained, signifying an excellent positive relationship 18. A mean respiratory rate of 30.80 ± 5.90 in a ventilatory group vs. 25.68 ± 3.44 has been detected in the present study. There is an extreme statistical significance between the two groups with a P-value of 0.0001. The highest correlation has been noted between tachypnea and the need for mechanical ventilation with a correlation coefficient of 0.760. Generally agreed level of respiratory rate for mechanical ventilation was 25 20. Reduced GCS score is also found as an indicator of the need for mechanical ventilation. The current study has found a GCS of 14.46 ± 1.09 in a ventilatory group vs. 15/15 GCS in the non-ventilatory group. There is extreme statistical significance between the two groups with a P-value of 0.0014.

Reduction in GCS in COPD is caused by respiratory failure. In hypoxemic respiratory failure, a decreased supply of oxygen to the brain leads to obtundation. Increased carbon dioxide levels cause CO_2 narcosis, leading to a confusional state and coma.

CONCLUSIONS

The present study was conducted to identify the predictors of mechanical ventilation in acute exacerbation of COPD with acute respiratory failure.

This study has found that high first-day $Paco_2$, low arterial pH, elevated heart rate, high respiratory rate, low GCS are the predictors of mechanical ventilation. A high $Paco_2$, low pH, and higher respiratory rate had a more significant correlation with the need for mechanical ventilation. Those with more number of acute physiological disorders had a higher incidence of ventilation rates. Persistent organ failure, severe kidney injury, and reduced GCS are the predictors for early intubation. Endotracheal intubation increases the length of ICU stay, morbidity, and mortality in patients with COPD. Most COPD patients can be managed on NPPV without the need for intubation, and they can be treated in a High Dependency Unit without the need for ICU stay. NPPV decreased the length of hospital stay and the need for ICU admission.

Table1. Comparison between the ventilator and non-ventilator group :

Parmeter	Ventilatory group	Non-Ventilatory group
pCO2	60.80+16.38	48.36+10.28
Ph	7.30+0.08	7.37+0.08
Heart rate	115+18.73	103.11+13.47
Respiratory rate	30.80+5.90	25.68+3.44
WBC count	12.51+5.15	10.56+3.10
GCS	14.46+1.09	15+ 0
APACHE II Score	17.5+6.09	9.52+3.02

Table2. PES SCORING SYSTEM:

PARAMETER		SCORE POINTS	
History	Age	<40	0
		41-55	1
		56-65	2
		66-75	3
		>75	4
	Disease severity	Mild	1
		Moderate	2
		Severe	3
Clinical criteria	Heart rate	70-100	0
		100-120	1
		120-140	2
		>140	3
	Respiratory rate	12-20	0
		21-30	1
		31-40	2
		41-50	3
		>50	4
	GCS	15	0
		12-14	1
		10-12	2
		8-9	3
		<8	4
Laboratory	PaCO2	<35	0
		35-45	1
		46-55	2
		56-65	3
		>65	4
	pH	7.35-7.45	0
		7.25-7.34	1
		7.15-7.24	2
		7.0-7.14	3

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