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A Study on Chronic Obstructive Pulmonary Disease with Acute Respiratory Failure: Evaluating the Predictors Indicating the Need of Invasive Mechanical Ventilation

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I. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a one of the leading causes of morbidity and mortality all over the world and also imparts an expanding social burden that is both substantial and increasing.[1]Patients affected by COPD undergo recurrent episodes of acute exacerbations and associated respiratory failure often requiring intense medical therapy and mechanical ventilation.[2] Exacerbation of COPD is defined as acute worsening of respiratory symptoms that results in additional therapy.[3] Symptoms include increase in cough, breathlessness, sputum volume and purulence.[4] Exacerbations are important events in management of COPD as they have a negative impact on health status, rate of hospitalization, readmission and disease progression.[5] Previous data suggests that 50-70% of exacerbations are due to respiratory infections,[6] 10% are due to environmental pollutants [7] and 30% are of unknown etiology.[8] COPD is a common disease in older adults affecting 14.2% of elderly population.[9] It is responsible for 19.9% of all hospitalization in adults between 65-75 years.[10] It is also the fourth leading cause of death in world.[11]The course of COPD is punctuated by decline in lung functions and exacerbations which has a negative impact on patients life.[12] The clinical course of patients with acute exacerbations of COPD and acute respiratory failure (ARF) has not fully characterized. Reported mortality of COPD with ARF varies between 6-24% and increases to 14-57% with ventilator support.[13] However invasive mechanical ventilation (IMV) has its complications too.[14]Review of 11 studies of COPD with AHRF found a combined mortality of 20.3% and mechanical ventilation rate of 9.8%-67.6%.[15]

Determining the factors predicting poor outcomes and need for IMV is of interest to intensivists as it helps to tailor monitoring,therapy, and counseling families.Delaying IMV is associated with higher rates of mortality. Many prognostic systems are available for intensive care unit (ICU), but their accuracy is debatable. Therefore, development of disease specific scoring system is needed that can predict IMV requirement at time of admission and serve in appropriate care of these patients.[16]This study is therefore designed to determine the predictors of IMV in patients of AECOPD.

AIMS AND OBJECTIVES

1. To identify COPD patients with acute exacerbations.
2. To identify predictors for need of IMV in these patients.

II. MATERIAL AND METHODS

This study was conducted as a cross sectional observational study in the department of pulmonary medicine in ICU of Ispat General Hospital, Odisha. The study population included all patients of known COPD admitted to ICU and patients with provisional diagnosis of COPD shifted to ICU.

By Previous records in IGH Rourkela and previous prevalence of IMV in COPD as 73% and by applying sample size calculator and keeping confidence level of 95% and margin of error as 10% the sample size was 36. The study period was from June 2016 to May 2017.

All patients of COPD exacerbations were selected. Patients had to have a prior confirmed diagnosis of COPD by spirometry with FEV1/FVC < 70% or were clinically diagnosed by clinical features and hyperinflation on CXR.All COPD patients admitted due to other causes were excluded.

Clinical and demographic profile including name, age, sex, occupation were documented. History of any organ insufficiency or immune compromised state along with history of hypertension (HTn) and diabetes (DM) were noted.

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Probable cause of exacerbation was noted. Activity limitation was noted using modified Menzies criteria.[17] Acute physiology and chronic health evaluation APACHE 2[18] was recorded at time of admission which included Glasgow coma scale (GCS), temperature, heart rate (HR), respiratory rate (RR), mean arterial pressure (MAP) and lab parameters e.g.arterial blood gas analysis (ABG), serum electrolytes, serum creatinine, hematocrit, total leucocyte count (TLC). All patients were managed, and treatment tailored according to clinical status. Pharmacologic therapy was given to all patients in view of exacerbation. Noninvasive mechanical ventilation (NIV) was used as Initial strategy where patients had respiratory failure. Change to IMV was done for indications like respiratory failure, deteriorating level of consciousness, exhaustion, progressive hypoxemia and acidemia.

Informed consent was taken from patients or the attendants.

Statistical method

Descriptive analysis was used for frequency and %age and Chi-square test was used to find association among variables.Analysis was done using statistical software "SPSS version 17.0"

Descriptive analysis was presented on mean +_ SD (min-max) and results on categorical measurements are presented as number %. Significance was assessed at 5% level of significance.

The study group was divided on basis of primary outcome of study. Various parameters were compared between groups to identify the predictors of intubation.Paired proportional test has been used to find significance of proportion of paired data.Pearson's correlation between study variables is performed to find the degree of relationship.

Significant figures:

Suggestive significance 0.05< p value <0.01

Moderately significant 0.01 <pvalue ≤0.05

Strongly significant p value ≤0.01

Microsoft Word and excel has been used to generate graphs and tables.

RESULTS

Out of 36 the patients studied 28 (77.8%)patients were males and 8 (22.2%) were females. Major patients were above age 55 years (96%). All patients had chronic health point of 5.The cause of exacerbation was lower respiratory tract infections in 21 patients (58.3%) noncompliance with medications in 5 patients (13.9%) and uncertain reasons in 10 patients (27.8%).

38.9% patients had no history of comorbidities, 30.6 % had history of hypertension and diabetes.

Majority of patients (55.6%) were placed in grade 3 according to modified Menzies score. 63.9% of patients were afebrile at presentation. 66.7% had MAP within normal range. Majority of them (72.2%) had heart rate of 55-69/min. 75% had respiratory rates of 25-32/min. 55.6% had hypoxemia.5.6% had severe acidosis pH < 7.15. Nearly 58% had hyponatremia on presentation and 52 % had hypokalemia .Majority patients had normal renal functions.

58.3% had raised TLC .44.4% had GCS <8. APACHE 2 score of 28 patients was more than 25 (77.8%). IMV was required by 47.2% patients. Rest patients were managed on NIMV.

Details of baseline characteristics of 36 patients have been elaborated in Table 1.

Table 1:

Variable		IMV no	IMV Yes	x^2 value	P value
Sex	Male	13	15	2.038	0.153^{NS}
	Female	6	2		
Risk Factors	LRTI	11	10	0.538	0.764^{NS}
	NC	2	3		
	UC	6	4		
Co-Morbidity	None	9	5	1.327	0.723^{NS}
	DM	2	3		
	Htn	3	3		
	Htn& DM	5	6		
Menzies Score	Grade 2	11	2	8.279	0.016*
	Grade 3	7	13		

	Grade 4	1	2		
Temperature	0	11	12	2.273	0.321^{NS}
	1	8	4		
	2	0	1		
MAP	0	15	9	2.731	0.098^{NS}
	2	4	8		
Heart Rate	0	4	0	4.724	0.193^{NS}
	1	2	1		
	2	12	14		
	3	1	2		
Respiratory rate	0	4	3	2.372	0.499^{NS}
	1	15	12		
	2	0	1		
	3	0	1		
Oxygenation	0	2	0	3.919	0.417^{NS}
	1	11	9		
	2	1	1		
	3	4	7		
	4	1	0		
Ph	0	1	0	6.478	0.091^{NS}
	2	10	3		
	3	7	13		
	4	1	1		
S. Sodium	0	11	4	7.178	0.066^{NS}
	1	4	4		
	2	3	9		
	3	1	0		
S.Potassium	0	12	4	7.731	0.052^{NS}
	1	4	7		
	2	2	6		
	3	1	0		
S. Creatinine	0	11	8	1.653	0.647^{NS}
	1	1	1		
	2	6	8		
	3	1	0		
Hematocrit	0	13	7	3.299	0.192^{NS}
	1	6	9		
	2	0	1		
WBC	0	11	4	5.952	0.051^{NS}
	1	6	6		
	2	2	7		

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GCS Score	<=8	11	5	2.948	0.086[NS]
	>8	8	12		
Age Pts	2	1	0	1.618	0.445[NS]
	3	11	8		
	5	7	9		
CHP	5	19	17	-	-
APACHE Score	<25	8	0	9.203	0.002*
	>=25	11	17		

III. DISCUSSION

Chronic obstructive pulmonary disease is a leading cause of morbidity and mortality requiring hospitalization and intensive care management. The course of COPD is marked by episodic exacerbation. This study identifies predictors for need of invasive mechanical ventilation in these patients, thus helping in framing management and ICU care, especially in resource limited setting in Indian hospital setup. This study was done taking a small sample size (n 36) for one year period.All patients with prior confirmed diagnosis of COPD were included, also those new admissions with only clinical and radiological evidence of COPD.Here history of smoking or occupational exposure were not taken as individual variable.This study shows the predictive capability of IMV using variables of APACHE 2 score which includes simple physiological measurements among patients with the most severe forms of COPD exacerbation.

All patients had history of Non operative organ insufficiency in form of chronic lung disease, therefore 100% patients had chronic health point score of 5.This study included 77.8% men 22.2% females with ratio of 3:1. Mean age of patients was 64 years(p value 0.445) which is in close correlation with study done by Breen et al.[(19)]Majority of patients had exposure to risk factors e.g.lower respiratory tract infection (58.3%) in both patient group requiring IMV and NIMV (p value 0.764) which is in accordance with study done by Kumar et al.[(20)] where LRTI occupies 44 % of cases.61.2% patients had associated comorbidities of diabetes and hypertension.

Premorbid functional status indicates the condition of the patient in terms of severity of dyspnea, level of independence in doing activities of daily living reflecting severity of underlying COPD and other associated conditions. In this study Menzies score was significant with p value 0.016. Nearly 63% patients had score >3 accompanied to study done by Kumar et al.

Mean APACHE 2 score was 29. Higher score is an independent predictor of need of IMV with 77.8% having score >25 (p value < 0.01). This is in accordance with the study done by Breen et al. with higher APACHE 2 score of 22 and Ucgun et al.[(21)]with score of 23.7.

Mean GCS score in this study was 8.8 (p value 0.016) which is significant and associated with higher intubation rates. Study done by Ucgun et al. is in accordance with this study.

Among APACHE 2 variables, no individual variable like MAP, HR,RR, serum electrolytes, hematocrit, TLC count were noted but were not independently significant.

Only a few percentageof patients were febrile on admission (36.1%), with 33.3% having low mean arterial pressure, more in patients requiring IMV.55.6% patients had mild hypoxemia with PaO2 in range of 61- 70 mmHg (p value 0.41). This was not much a difference in patients requiring NIMV and IMV.Most patients had tachypnea (80.16%) and tachycardia (88.8%) on admission, which was comparable in both groups requiring IMV and NIMV.

Majority of patients had low serum sodium and deranged potassium on admission but was not comparable in the two groups. Serum creatinine was deranged in 47.2%, probably due to old age andalsoindicating a spectrum of sepsis. Hematocrit was high in 44.5 % but is not significant (p value 0.19). TLC count was high in 58.3% indicating lowered respiratory tract infection as possible cause of exacerbation.pH< 7.24 was associated with higher rates of intubation (55.6%) but was not significant with p values of 0.091. In this study absolute value of pCO2 was not included because clinical states are more dependent on level of compensation of acidemia by the body. However, in other studies arterial pCO2 was an independent predictor of requirements IMV.

In other studies by Hoo et al.[13] association with worse acidemia with higher intubation rates is noted with threshold of 7.25. Rates of intubation was higher with pH < 7.20.

The incidence of need of IMV in acute exacerbation if COPD has varied from 9.8% to 67.6% according to previous studies, which is in accordance with the present study with 47.2% and is also comparable with study done by Ucgun et al. with 57.6% requiring IMV. This high percentage is attributed to worse premorbid functional status and higher APACHE 2 scores.

The following are the limitations of this study:

A relatively low number of patients and exclusion of absolute values of pCO2 .

IV. CONCLUSION

COPD exacerbation remains one of the serious health problems requiring hospitalization.ICU admission is common among these patients. Because of perennial short fall of critical facility beds, some indicators need to be assessed during admission to predict need of IMV so that patients can be managed appropriately. The present study focuses on these aspects.In conclusion worse premorbid functional status , more severe acute acidemia without compensation, higher APACHE 2 scores lower GCS are independent predictors of need of IMV.

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