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Predictors of Hospital Outcome and Intubation of Patients Hospitalized for Exacerbation of Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Exacerbations of COPD affect a significant number of patients. Severe exacerbations are linked to worse outcome.

Aim of The Work: To identify predictors of adverse outcomes in patients who were admitted to the hospital for exacerbation of COPD.

Patients and Methods: The present study was conducted on 120 patients with COPD at Chest diseases Departments and ICUs of Al Azhar University Hospitals in the period from March 2019 to March 2021.

Results: Patients need mechanical ventilation had ischemic heart disease with hypertension showed $p = 0.034$, old ischemic stroke with hypertension $p = 0.001$, old hemorrhagic stroke with hypertension $p = 0.001$, exposure to air pollution $p = 0.037$, exposure to pneumonia $p = 0.038$, increase previous exacerbations ($p = 0.001$), admission on exacerbation ($p = 0.001$) and intubation last 5 years ($p < 0.001$), dyspnea $p = 0.004$, increase respiratory rate $p = 0.001$ COPDSS $p = 0.028$ in patients needed ventilation. Also there was statistically significant increase PaCo₂ $p < 0.001$, HCO₃ $p = 0.005$, Left Pleural effusion $p = 0.022$, bronchiectasis $p = 0.022$, increase regarding readmission and death $p = 0.000$. There were 14 patients needed intubation. Indications of intubations were Low Glasgow coma score (35.7%), apnea (21.4%) and Failure of NIV with confusion (21.4%).

Conclusion: Comorbidities with Cardio vascular diseases, previous exacerbations, hospitalization for COPD exacerbation, intubation last 5 years, exposure to air pollution and pneumonia, dyspnea at time of admission, increase COPDSS, increase respiratory rate, pleural effusion, and bronchiectasis had highest risks to invasive ventilation.

Keywords: COPD exacerbations; Outcome; Intubation; Mechanical ventilation.

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is third cause of death in the world. Exacerbations of COPD affect a significant number of patients. Severe exacerbations are linked to worse outcome.¹

An adverse outcome of COPD exacerbation, characterized by the presence of at least one of the following items: mortality from a respiratory cause during hospitalization or within one month of follow-up; admission to Intensive care unit (ICU); mechanical ventilation, invasive or non-invasive; prolonged hospitalization, defined by the upper quartile of hospital stay distribution, and emergency room visit or readmission due to COPD during follow-up. Absence of all the above-mentioned problems considers good outcome.²

The need for invasive ventilation and complications due to mechanical ventilation (MV) are the most important predictors connected to hospital mortality

in COPD exacerbation. Adequate metabolic compensation for respiratory acidosis at admission is linked with better outcome.³

The aim of this study to identify predictors of adverse outcomes in patients who were admitted to the hospital for exacerbation of COPD.

PATIENTS AND METHODS

This study was done at Chest diseases Departments of Al Azhar University Hospitals at March 2019 to March 2021. This study included 120 hospitalized patients with COPD. The patients were divided to 3 groups: Group I: patients with no need for MV. Group II: patients needed noninvasive MV. Group III: patients needed invasive MV.

A written informed consent were obtained from all the studied patients. All patients were subjected to full medical history, full physical examinations, laboratory investigation, calculation of Chronic obstructive pulmonary disease severity score (COPDSS)⁴, calculation of the Glasgow Coma

Scale and spirometry including forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC) and FEV₁/FVC.

Data were analyzed by the Statistical Package for Social Science (IBM SPSS) version 20. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: Chi-

square test was used to compare between two groups with qualitative data. The comparison between more than two groups with quantitative data and parametric distribution were done by using One Way Analysis of Variance (ANOVA) test. The p-value was considered significant as the following : P > 0.05: Non-significant (NS), P < 0.05: Significant (S), P < 0.01: Highly significant (HS).

RESULTS

		Hospital course							
		Patients improved (No.=84)		Patients need noninvasive ventilation (No.=22)		Patients need invasive ventilation (No.=14)		Chi square test	
		No	%	No	%	No	%	x ²	p value
Sex	Female	6	7.1%	5	22.7%	6	42.9%	14.21	0.001
	Male	78	92.9%	17	77.3%	8	57.1%	1	
Smoking status	Non smoker	7	8.3%	4	18.2%	6	42.9%	12.12	0.002
	smoker	49	58.3%	12	54.5%	8	57.1%	0	0.950
	Ex-smoker	28	33.3%	6	27.3%	0	0.0%	6.581	0.037
Comorbidities	Ischemic heart disease with hypertension	1	1.2%	2	9.1%	2	14.3%	6.789	0.034
	Old ischemic stroke with hypertension	2	2.4%	1	4.5%	4	28.6%	15.06	0.001
	Old hemorrhagic stroke with hypertension	1	1.2%	0	0.0%	2	14.3%	9.133	0.001
	Hypertension	22	26.2%	3	13.6%	0	0%	5.837	0.054
	Diabetes mellitus	4	4.8%	1	4.5%	0	0%	0.691	0.708
	No comorbidities	11	13.1%	1	4.5%	1	7.1%	1.543	0.462
	Previous exacerbations	44	52.4%	13	59.1%	14	100%	11.26	0.001
	Hospitalizations for COPD exacerbation	42	50.0%	10	45.5%	14	100%	13.11	0.001
	Intubation last 5 years	6	7.1%	1	4.5%	6	42.9%	16.94	<0.001
	Risk factors	Air pollution	8	9.5%	6	27.3%	4	28.6%	6.597
Pneumonia		36	42.9%	3	13.6%	6	42.9%	6.545	0.038
Age		Mean	SD	Mean	SD	Mean	SD		
		64.02	6.31	64.64	6.51	66.57	9.92	0.843	0.433

Table 1: characteristics of patients according to hospital course.

This table shows that there was statistically significant increase male, non-smoker and ex-smoker in patients improved. There was statistically significant increase in ischemic heart disease with hypertension, old ischemic stroke and old hemorrhagic stroke with hypertension. There was statistically significant increase in previous

exacerbations, hospitalization for COPD exacerbation and intubation last 5 years in patients need invasive ventilation. There was statistically significant increase in air pollution and pneumonia in patients needed ventilation.

		Hospital course						Chi square test	
		Patients improved (No.=84)		Patients need noninvasive ventilation (No.=22)		Patients need invasive ventilation (No.=14)		x ²	p value
		No	%	No	%	No	%		
Clinical characters	Cough	52	61.9%	6	27.3%	12	58.3%	13.49	0.001
	Dyspnea	51	60.7%	6	27.3%	11	78.6%	11.037	0.004
	Fever	20	23.8%	11	50.0%	3	21.4%	6.261	0.044
Vital signs		Mean	SD	Mean	SD	Mean	SD		
	Respiratory Rate, breath/min	24.96	2.83	24.09	3.13	28.14	5.05	7.426	0.001
	Heart Rate, beat/min	92.00	11.39	91.86	8.81	98.64	14.49	2.129	0.124
	Systolic blood pressure, mmHg	132.98	16.13	128.64	17.26	110.71	22.00	10.227	<0.001
	Diastolic blood pressure, mmHg	83.69	8.92	81.82	10.97	72.14	13.11	8.238	<0.001
	Temperature, °C	36.71	0.74	36.81	0.98	36.87	0.92	0.312	0.733

Table 2: clinical characters and vital signs among studied groups.

There was statistically significant increase in dyspnea in patients needed ventilation. There was statistically significant increase respiratory rate in patients need invasive ventilation. There was statistically significant increase systolic blood pressure and diastolic blood pressure in patients improved.

This table shows that there was statistically significant increase COPDSS, PaCo₂, HCO₃ and respiratory rate in

		Patients improved (No.=84)		Patients need noninvasive ventilation (No.=22)		Patients need invasive ventilation (No.=14)		One way ANOVA	p value
		Mean	SD	Mean	SD	Mean	SD		
Glasgow Coma Score(GCS)		14.48	1.52	13.91	1.54	10.00	2.60	42.54	< 0.001
COPD Severity score (COPDSS)		13.00	2.08	13.45	2.06	14.57	1.70	3.675	0.028
ABG	Arterial pH	7.36	0.06	7.27	0.07	7.28	0.11	18.254	< 0.001
	PaO ₂ , mmHg	61.04	24.57	64.64	24.61	46.86	21.93	2.525	0.084
	PaCo ₂ , mmHg	50.09	9.87	76.18	16.22	65.50	16.69	44.516	< 0.001
	HCO ₃ , mEq/L	28.05	5.17	32.22	7.74	31.93	8.54	5.493	0.005
Spirometry	FEV/FVC	0.63	0.06	0.61	0.06	0.59	0.04	4.962	0.009
	FVC	73.45	6.62	72.41	3.89	68.29	2.46	4.669	0.011
	FEV1	46.37	5.42	44.32	4.65	40.07	3.45	9.587	< 0.001
Chest X-ray		No	%	No	%	No	%	Chi square test	p value
	Hyperinflation	58	69%	17	77.2%	8	57.1%	1.627	0.443
	Left Pleural effusion	0	0%	0	0%	1	7.1%	7.633	0.022
	Bronchiectasis	0	0%	0	0%	1	7.1%	7.635	0.022

Table 3: Glasgow Coma Score, COPD Severity score (COPDSS), ABG, spirometry & chest x ray findings among studied patients.

patients need invasive ventilation. Also there was statistically significant increase in left pleural effusion and bronchiectasis in patients need mechanical ventilation. While there was an increase in GSC, arterial pH and spirometry values in patients improved.

	Item	No.	%
Indications of intubations	Apnea	3	21.4
	Low Glasgow coma score	5	35.7
	Acute cardio vascular instability	2	14.3
	Failure of NIV with confusion	3	21.4
Indications of intubation at time of admission	Low Glasgow coma score	4	66
	Apnea	2	33
	Number of intubated patients at time of admission	6	42%

Table 4: Intubations among studied patients.

This table shows that most of studied patients were intubated due to low Glasgow coma score and 42% of the intubated patients were intubated at time of admission.

	Patients improved (No.=84)		Patients need noninvasive ventilation(No.=22)		Patients need invasive ventilation(No.=14)		Total		Test	p-value
	No.	%	No.	%	No.	%	No.	%		
Discharge	77	91.7	21	95.9	4	28.6	102	85	39.7	000
Readmission	7	8.3	1	4.5	6	42.9	14	11.7	15.2	000
Death	0	0	0	0	4	28.6	4	3.3	31.3	000

Table 5: Outcome among all studied groups.

This table shows that there was high significance increase regarding discharge in patients improved and there was high significance increase regarding readmission and death in patients needed ventilation.

DISCUSSION

We studied 120 patients with COPD. Their mean age is 64.43 ± 6.83 years old. This is correlating with reports from Ucgun et al in which mean age was 65.1 years.³ 85.8% of them were male. This result agrees with the results of several studies.^{3,5} the high prevalence of COPD in men is due to higher prevalence of smoking in this sex, and males are also more exposed to smoking than females.⁶

Regarding smoking status 57.5% of patients were smokers, 28.3% of them were ex-smoker which is coping with results of the study done by Said et al.⁷ Approximately 50% of smokers developing COPD during their lifetime.⁸

In the present study patients were divided according to hospital course to three groups group I including 84 (70%) of studied patients who were improved, group II including 22 (18.3%) of studied patients who needed noninvasive ventilation and group III including 14 (11.7%) of studied Patients who needed invasive ventilation.

Our results indicated that patients suffered from ischemic heart disease with hypertension, old ischemic stroke and old hemorrhagic stroke with hypertension had bad hospital course which is coping with several studies that showed that patients with bad outcome of COPD exacerbation had more than two comorbidities, mostly cardiovascular comorbidities.^{5,9} Anzueto et al reported that cardiovascular comorbidities are risk factors for bad outcome in COPD patients.⁹

Table 1 shows that there were statistically significant increase previous exacerbations (p value 0.001), hospitalization for COPD exacerbation (p value 0.001) and intubation last 5 years (p value <0.001) in patients need invasive ventilation. That is consistent with the results of Soler et al which shows increased risk of death with frequent exacerbations.¹⁰ These results can be explained by the increase of

severity of exacerbations over time, and also sputum purulence increases throughout the disease. This suggests that patients with more severe exacerbations have more inflammation.¹¹

56.6% of patients were presented with dyspnea at admission, this finding is similar to results from Mohan et al.¹² In this work most of patients were presented with cough and dyspnea, reports from Grolimund et al and roche et al agreed with these results.^{13,14}

Table 2 shows as regard to risk factors of COPD exacerbations among all studied groups there was statistically significant increase in air pollution and pneumonia in patients needed ventilation with p value of 0.037 and 0.038 respectively that may be due to complications of pneumonia and presence of air pollution that worsen the lung function.

As regard COPDSS there was statistically significant increase COPDSS in patients need invasive ventilation. Miravittles et al showed that COPDSS was found to be a predictor for failure of treatment in COPD exacerbation.⁴

In this study ABG was statistically significant in patients need MV as regard lower PH and higher CO_2 , this correlate with results from Matkovic et al that assumed that ABG analysis had a high predictive value for outcome for patients hospitalized for COPD exacerbation⁵, also this result is coping with several studies that shows that higher CO_2 was related to bad outcome of COPD patients.¹⁵

In the current study the mean of FEV_1/FVC was 0.62, mean of FVC was 72.66, mean of FEV_1 was 45.26. There was statistically significant increase in spirometry values in patients improved, that is consistent with study by Matkovic et al which shows there is increased spirometry values in patients with good outcome.⁵ Similar results have been found in many studies and may be explained by the degree of ventilatory impairment and also exposure to the risk

of colonization by aggressive bacteria which causes exacerbation.¹⁶

Our study shows that 14 patients needed intubation. 35.7% of them was intubated due to Low Glasgow coma score, while 21.4% of patients was intubated due to apnea and 21.4% was intubated due to Failure of NIV with confusion that is coping with.³ In this work 6 patients were intubated at time of admission. 66% was intubated due to low Glasgow coma score, 33% of them was intubated due to apnea.

Our results indicate that as regard outcome of all studied groups there was high significance increase regarding discharge in patients improved (p value 0.000) and there was high significance increase regarding readmission and death in patients needed ventilation (p value 0.000). That is coping with results of Mohan et al.¹² The lowest readmission rate (4.5%) was with patients needed NIV. this result is attributed to that NIV increases alveolar ventilation and improves gas exchanges. also NIV reduces the patients' effort, dyspnea, the need for intubation, length of stay in ICU and the mortality rate.¹⁷

CONCLUSION

The need for invasive ventilation and complications due to mechanical ventilation (MV) are the most important predictors connected to hospital mortality in COPD exacerbation. Comorbidities with Cardiovascular diseases, previous exacerbations, hospitalization for COPD exacerbation, intubation last 5 years, exposure to air pollution and pneumonia, dyspnea at time of admission, increase COPDSS and increase respiratory rate, pleural effusion, and bronchiectasis had highest risks to invasive ventilation. There was increase regarding readmission and death in patients needed ventilation.

Conflict of interest : none

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