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Original Research Paper

Respiratory Medicine

EVALUATION OF RESPIRATORY FAILURE IN PATIENTS WITH ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE: A CROSS-SECTIONAL STUDY.

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ABSTRACT Chronic Obstructive Pulmonary Disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms due to abnormalities of the airways and/or alveoli that cause persistent, often progressive, airflow obstruction. This study was conducted to detect, evaluate and generate baseline data on the respiratory failure in patients with COPD who came with acute exacerbation, which will help in management and future implications. **Materials and Methods:** A total of 280 COPD patients admitted in the Dept of Respiratory Medicine ward, AGMC Agartala with acute exacerbation were selected. They underwent complete clinical evaluation and Spirometry was done when the patient became hemodynamically stable or could follow the instructions., **Results:** In the present study, most of the patients were in the age group of 61-70 years (38.9%), dyspnoea was the most common presentation, 42.80% of the patients had co-morbidity and 22.90% of patients had low anion gap. **Conclusion:** In this study, dyspnoea and cough with expectoration emerged as the most common clinical presentations. A significant proportion of patients had comorbidities, predominantly hypertension and diabetes mellitus, with many exhibiting multiple comorbid conditions. Radiological evaluation revealed emphysema as the predominant phenotype, which showed a strong association with both Type 1 and Type 2 respiratory failure

KEYWORDS :

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnea, cough, sputum production and /or exacerbations) due to abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction. About 3 million people died of COPD in 2012 accounting for 6% of all death Globally. The Global prevalence of COPD is estimated to be 10.3%. The BOLD (Burden of obstructive Lung Disease) reported prevalence of COPD is 11.8% for men and 8.5% for women and 3 to 11% among never smokers. COPD results from gene (G)-environment (E)-interaction occurring over the life time (T) of the individual (GETomics) that damages the lungs/alter normal development or aging processes. The genetic causes include mutation of SERPINA1 gene, leading to deficiency of alpha1-antitrypsin deficiency. The environmental exposures are tobacco smoking and inhalation of toxic particles/gases from household and outdoor air pollution.[1]

The pathology of COPD comprises of a variety of lesions involving airways, parenchyma, pulmonary vasculature. The mechanism involved are complex leading to airflow obstruction due to increase in airway resistance secondary to structural abnormalities of airways.[2] The inhalational stressors induce 4 key pathologic processes involving small airway disease, mucus hypersecretion, emphysema, and vascular dysfunction. Small airways are those which have internal diameter of <2mm.

Small airways dysfunction can be inferred from air trapping on expiratory CT scans. [3,4]The management of COPD includes proper education about the disease and its progression, managing comorbidities and prevention of future exacerbations. The pharmacological therapy which includes bronchodilators and anti-inflammatory medications in the form of MDI, DPI and nebulization, theophylline, PDE4, long term macrolide therapy, alpha1 antitrypsin, mucolytics and vaccinations. Once Acute Exacerbation of COPD (AECOPD) develops, early recovery is crucial in determining prognosis of patients with COPD and as well as prevention of AECOPD. Many patients admit in Respiratory Medicine department with acute exacerbation of COPD, and some of them with suspected Respiratory failure. This study was conducted to detect, evaluate and generate baseline data on the respiratory failure in patients with COPD who came with acute exacerbation, which will help in management and future implications.

Objectives

1). To estimate the proportion of respiratory failure in patients with acute exacerbation of COPD, who gets admitted in the Respiratory Medicine ward.
2). To determine the association between the clinical phenotypes and arterial blood gas.

MATERIALS & METHODS

A hospital based Observational, Cross sectional study was conducted in the Department of Respiratory Medicine, Agartala Government Medical College and GB Pant Hospital for a period of one and half years (from October 2022 to March 2024). The study included all the COPD patients who are admitted with acute exacerbation. Sample size was calculated using the Kish and Leslie formula [5] of 1965 for cross sectional studies was used. Total sample size= 280. The sampling technique used was census sampling technique was followed until the desired sample size was reached.

Study Tools: 1) Case record proforma 2) Pulse Oximeter 13 3) Arterial blood gas analyser-EDAN-i 15 blood gas and

chemistry analyser and BG10 / BG8 Cartridge. 4) Spirometer—SPIROWIN

Inclusion Criteria:

1. All cases of COPD who presented with Acute exacerbation with respiratory failure.

Exclusion Criteria:

1. Patients who refused to give consent
2. Patients with major cardiac problem /or recent MI
3. Patients with known psychiatric disorder
4. Patients with end-stage renal disease/ on haemodialysis
5. Patients with history of recent cerebrovascular accidents
6. Patients who could not perform spirometry
7. Patients with active pulmonary tuberculosis

Data Collection and Methodology

COPD patients who got admitted with acute exacerbation in Respiratory Medicine Department, at Agartala Government Medical College and GBP Hospital and gave consent was included in this study. All these patients underwent detail clinical evaluation that include history taking, general physical examination, systemic examination, 12-lead ECG, pulse oximetry, routine blood tests, and chest radiography. They are then prepared for taking arterial blood samples. Spirometry was done, when the patient became hemodynamically stable or could follow the instructions.

RESULTS & OBSERVATIONS

Table 1: Age Group Distribution (N=280)

Age group	Frequency	Percent
31—40	1	0.35
41--50 years	20	7.14
51 – 60 years	69	24.6
61 – 70 years	109	38.9
71 – 80 years	56	20.0
>80 years	25	8.9

Table 1 shows the age distribution of the participants where majority of the patients were in the age group of 61-70 years old.

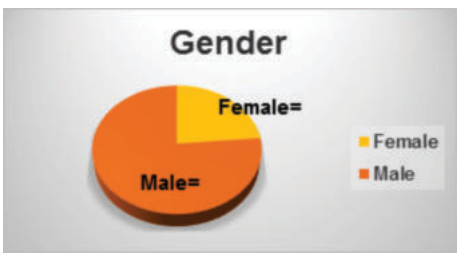

Figure 1: Gender Distribution (N=280)

Pie chart (Figure 1) shows most of the patients were male [214 (76.40%)].

Table 2: Clinical Features at Initial Presentation Among Study Participants Among Study Participants

CLINICAL FEATURES	COUNTS
Dyspnea	253 (90.3%)
Cough with expectoration	226 (80.7%)
Fever	66 (23.5%)
Fatigue	45 (16.07%)
Altered sensorium	39 (13.9%)

Table 2 shows, dyspnea was the most common presentation (253 in numbers), followed by cough with expectoration (226 in number).

Table 3: Distribution of Comorbidities Among Study Participants Having Comorbidity (N=120)

Co-morbidities	Frequency	Percent
Hypertension	89	74.10
Diabetes mellitus	32	26.70
Coronary artery disease	15	12.50
Kidney disease	6	5.0
Ischemic heart disease	6	5.0
Chronic heart failure	1	0.80
Pulmonary Tuberculosis	1	0.80

Table 3 shows the proportion of patients having comorbidities, in which hypertension (74.10%) followed by diabetes mellitus (26.70%) and coronary artery disease (12.5%). One patient was diagnosed as Respiratory failure, however subsequently pulmonary Tb was also detected.

Table 4: Total Leukocyte Count (TLC) Profile

Variable	Mean (SD) / frequency/ median	Ranges/ percent
Total Leukocyte count (TLC)	9900	3900 to 32000
Leucopenia (11000)	1	0.32
Normal TLC (4000 to 11000)	164	52.73
Leukocytosis (>11000)	146	46.95

Table 4 shows, 52.73% (164) had normal TLC count and 46.95% (146) had leucocytosis.

Table 5: Distribution of C-reactive Protein (CRP)

CRP (<1mg/dl)	FREQUENCY	PERCENT
NORMAL	98	35
ELEVATED	182	65

Table 5 shows distribution of C Reactive protein levels among the participants. One hundred eighty two (182) participants (65%) had elevated levels of C reactive protein levels.

Table 6: Serum Electrolyte Profile in Study Cases (N=280)

Serum electrolyte	Mean (SD)	Mean	Range
Sodium (Na+)	134.64 ± 7.57	136	106-156
Potassium (K+)	3.96 ± 2.54	3.9	1.7 to 44
Chloride (Cl)	96.9 ± 8.2	97	16 to 110

Table 6 shows that, the mean serum sodium was 134.64± 7.57 and potassium was 3.96±2.54 and chloride was 96.9±8.2.

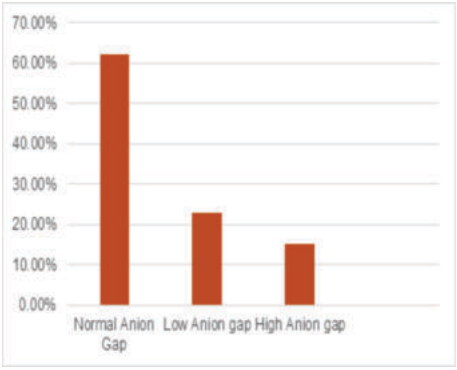

Figure 2: Distribution of Anion Gap Among the Study Participants (N=280)

Bar diagram (Figure 2) shows that, 62.10% of the patients showed normal anion gap (8 to 12).

Table 7: Distribution of Arterial Blood Gas Profile Among the Study Participants (N=280)

Arterial blood gas	Mean ± SD	Median	Ranges
pH	7.30 ± 0.14	7.33	6.73 to 7.60
PaCO2	63.9± 29.2	51.0	23.1 to 160.0
PaO2	68.2 ± 30.9	57.5	29.0 to 228.0
H+	49.6 ± 32.8	43.3	21.4 to 498.5
HCO3-	34.2 ± 11.6	30.4	15.3 to 88.3
SO2	88.7 ± 11.7	91.0	33 to 136

Table 7 shows that, the mean ± SD of Ph was 7.30± 0.14, PCo2 was 63.9± 29.2, PO2 was 68.2±30.9 H+ was 49.6±32.8, HCO3- was 34.2±11.6, SO2 was 88.7±11.7.

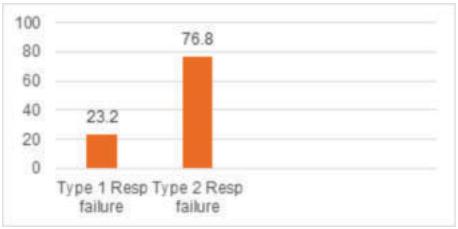

Figure 3: Proportion of Resp. Failure Among Study Population(N=280)

Figure 3: shows that the proportion of type 1 and type 2 respiratory failure among the study participants were 23.2% and 76.80% respectively

Table 8: Association Between Clinical Phenotypes of COPD and Types of Respiratory Failure (N=280)

Types of respiratory failure		Phenotypes		P value
		Bronchitis	Emphysema	
Type 1 resp. failure	Present (67)	8 (11.9)	59 (88.1)	0.42
	Absent (221)	22 (10.3)	191(88.1)	
Type 2 resp. failure	Present (221)	22 (10.3)	191 (89.7)	0.42
	Absent (67)	8 (11.9)	59 (88.1)	

Table 8 shows, In type 1 respiratory failure, Emphysema accounts for 88.10% of cases, while chronic bronchitis accounts for only 11.90%. Similarly in type 2 respiratory failure, Emphysema accounts for 89.70% of cases, whereas bronchitis accounts for 10.30%. The result is not statistically significant with p value of 0.42.

Table 9: Short-time Outcome Among Study Cases (N= 280)

Outcome	Frequency	Percentage
Treatment offered:		
Conservative	134	47.9
Non-invasive ventilation(NIV)	118	42.1
Invasive mechanical ventilation(IMV)	28	10.0
Duration of hospital stay:		
≤ 3 days	71	25.4
>3 to ≥5 days	91	32.5
>5 to ≤10 days	100	35.7
>10 days	18	6.4
Outcome:		
Discharge(Improved or relieved)	262	93.6
Death	18	6.4

Table 9 shows that, most of the patients was managed conservatively about 47.9%(134), and with NIV for about 42.1%(118) and IMV for about 10%(28),also indicated that 93.6% of the patients were discharged after improvement and 6.4% of the patients died.

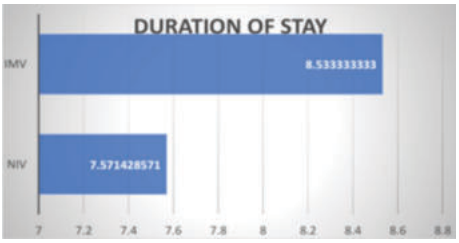

Figure 4: Mean Duration of Hospital Stay Among Patients Managed with NIV and IMV

Figure 4 shows that, mean duration of hospital stay which managed with NIV was 7.571 days and with IMV was 8.533 days

DISCUSSION

This Cross-sectional Observational study was conducted during the period of One and half years at Department of Respiratory Medicine, AGMC & GBP Hospital, Agartala, Tripura. During the study period, a total of 1331 patients attended with AECOPD in Department of Respiratory Medicine, out of which 280 patients who fulfilled the inclusion and exclusion criteria were included in this study.

In this study, most of the patients were in the age group of 61-70 years (38.9%), followed by 51-60 years (24.6%) and most of the patients were male [214 (76.40%)] [Table 1 and Figure 1] which is similar to a study done by Rycroft C, Heyes A, Lanza L et al. where they had reported that prevalence was greatest among men than women, and in patients with age 75 years and above. [5]

Dyspnea was the most common presentation (253 in numbers), followed by cough with expectoration (226 in number) [Table 2]. Similar findings were also reported by Pratt AJ, Prussell A, Zhang T et al. where they reported that 96.5% patients had dyspnea, followed by cough (67.9%), increased sputum (57.5%).[6]

In all patients(no) with co-morbidities, hypertension constitutes around 74.1% and diabetes mellitus 26.7% [Table 3]. Among those who have comorbidity, multiple comorbidities were found in 76.70% of patients, which is comparable to a study done by Mannino DM, Thorn D, Swensen A et al. where they showed that 40.1% had hypertension, 12.7% of patients had Diabetes and 15.2% had cardiovascular disease.[7]

In our study, about 52.73% (164) had normal TLC count and 46.95% (146) had increased TLC(Leucocytosis) [Table 4], and 29% of the patients had elevated C-reactive protein levels [Table 5]. These findings suggest that majority (52.73%) of the patients had normal TLC, indicated that exacerbation probably of non-infectious origin; and 29% of patients had raised C-reactive protein [Table 5], indicated inflammatory reaction, may be infectious or non-infectious origin. Singh B, Kampani G, Lall B et al. reported that the level of NLR, hsCRP, and procalcitonin were significantly higher in exacerbation cases compared to stable COPD cases.[8]

We found that, the mean serum sodium was 134.64±7.57 and potassium was 3.96±2.54 and chloride was 96.9±8.2 [Table 6]. These findings are similar to a study conducted by SYED UA. where he reported that AECOPD cases, had low serum sodium with mean of 132.02±9.20, mean serum potassium was normal and mean serum chloride was 94.76±8.20 when compared to stable COPD cases.[9] In this study, 62.10% of the patients showed normal anion gap which may be due to renal tubular acidosis caused by many drugs (e.g. ACE inhibitors, Angiotensin receptor blockers, diuretics) used by many of the study participants because of co-morbidities [Table 3] .

It is seen that 22.90% of patients had low anion gap indicating the albumin deficiency, which may be due to inadequate food intake and administration of parenteral nutrition; and 15% had high anion gap, indicated concomitant metabolic component due to comorbidities like diabetes, kidney disease [Figure 2].

From this study [Table 7] it is found that, the mean ± SD of pH was 7.30± 0.14, PaCO2 was 63.9± 29.2, PaO2 was 68.2±30.9. H+ was 49.6±32.8, SO2 was 88.7±11.7 which is comparable to a study conducted by Kumar A and his team, where they reported that, patients with COPD exacerbation had mean pH of 7.248, mean PCO2 of 69.7mm Hg, mean PO2 of 55 mmHg, mean HCO3- of 40.78 mmol/L and mean SO2 of 83.0%. [10]

The proportion of type 1 and type 2 respiratory failure among the study participants were 23.2% and 76.80% respectively,

indicated that majority of the patients had type 2 respiratory failure, in other way type 2 respiratory failure is more common in patients presented with AECOPD [Figure 3]. This finding is similar to a prospective study done by Khilnani GC, Banga A, Sharma SK with 82 COPD patients with acute exacerbation, where they reported that 90.2% of the patients had type 2 respiratory failure. [11]

Emphysema is more associated with both types of respiratory failure compared to chronic bronchitis [Figure 3]. In type 1 respiratory failure, Emphysema accounts for 88% of cases, whereas chronic bronchitis accounts for only 12%. Similarly in type 2 respiratory failure, Emphysema accounts for 89.70% of cases, whereas bronchitis accounts for 10.30%.

We observed that, most of the patients were managed conservatively [Table 9] i.e. 47.9% (134), and NIV for about 42.1% (118) and IMV for about 10% (28) which is similar to a study done by Gadre SK, Duggal A, Cabodevila ME, et al. where they reported that only 11.8% patients needed invasive mechanical ventilation16.[12] The average duration of hospital stay was 5.66 days [Figure 4}. and the mean duration of hospital stay managed with NIV alone is 7.57 days and with IMV alone was 8.53 days which is comparable to a study done by Fermont JM, Bolton CE, Fisk M, et al. where they reported that average stay duration of 1 to 7 days during AECOPD24.[13]

CONCLUSION

In this study, dyspnoea and cough with expectoration emerged as the most common clinical presentations. A significant proportion of patients had comorbidities, predominantly hypertension and diabetes mellitus, with many exhibiting multiple comorbid conditions. Radiological evaluation revealed emphysema as the predominant phenotype, which showed a strong association with both Type 1 and Type 2 respiratory failure. Most patients were managed conservatively or with non-invasive ventilation (NIV). NIV demonstrated clear clinical benefits, including a shorter duration of hospital stay and a substantial reduction in mortality compared to invasive mechanical ventilation (IMV). Overall, the short-term outcomes were favourable, with a high discharge rate of 93.6%. These findings emphasize the importance of early identification of comorbidities, timely radiological assessment, and the effective use of NIV in improving patient outcomes in respiratory failure.

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