Section: Respiratory Medicine

Original Research Article

CLINICAL PROFILE, ETIOLOGICAL SPECTRUM, AND OUTCOMES OF TYPE I AND TYPE II RESPIRATORY FAILURE: A PROSPECTIVE CROSS-SECTIONAL STUDY FROM A TERTIARY CARE CENTER IN NORTH INDIA

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ABSTRACT

Background: Aim: Clinical profile, Etiological Spectrum, and Outcomes of Type I and Type II Respiratory Failure.

Materials and Methods: The study included 202 patients diagnosed with respiratory failure. This prospective cross-sectional study investigated the clinical profile, etiological spectrum, and outcomes of respiratory failure in 202 patients admitted to a tertiary care center in North India at Rohilkhand Medical College, Bareilly from January to June 2024. Utilizing arterial blood gas analysis for classification.

Results: Among 202 patients,40%(n=81) presented with type-1 respiratory failure, while 59.9%(n=121) presented with type-2 respiratory failure. Male predominance was observed (73.3% vs 26.7% female. Chronic obstructive pulmonary disease (COPD) emerged as the leading etiology (43.6%), followed by asthma (12.4%) and pneumonia (9.4%). Smoking was identified as a critical modifiable risk factor, with 55% of patients being current smokers. Demographic analysis revealed a younger age distribution compared to Western populations, with 45.5% of cases occurring in the 40–59 age group. Etiological stratification of COPD exacerbations highlighted infective causes (47.7%), predominantly Streptococcus followed by Pseudomonas and Klebsiella, while non-infective triggers included non-adherence to therapy (31.0%) and environmental pollution (23.8%). Comparative analysis with global literature underscored regional variations, including the higher burden of Type II respiratory failure and younger patient demographics. Clinical outcomes correlated with respiratory failure type, with Type I associated with higher mortality trends.

Conclusion: These findings emphasize the need for targeted smoking cessation programs, enhanced COPD management protocols, and age-specific preventive strategies in similar healthcare settings. Limitations include the single-center design and cross-sectional methodology, which preclude long-term outcome assessment. This study provides critical insights into the demographic and etiological patterns of respiratory failure in North India, offering a foundation for region-specific clinical guidelines and public health interventions.

Keywords: Respiratory failure, Etiology, Risk factors, COPD, Smoking

INTRODUCTION

Respiratory failure is a condition in which the respiratory system is unable to perform its job of gas exchange correctly results in imbalance of oxygenation and elimination of carbon dioxide from mixed venous (pulmonary arterial) blood.[1] Such impairment mainly affects oxygenation, manifested by hypoxemia or ventilation manifested by hypercapnia and respiratory acidosis.[2]

It remains a significant clinical challenge with substantial morbidity and mortality, particularly among elderly population groups. Despite advances in critical case, understanding the complex interplay of etiological factors contributing to respiratory failure remains crucial for improving patient outcomes.

The condition of respiratory failure typically clarifies into two categories.

1. Type-1 respiratory failure which mean hypoxia without hypercapnia.
2. Type-2 respiratory failure which mean hypoxia with hypercapnia, various factors can precipitate respiratory failure, ranging from pulmonary condition to systemic diseases, with base infective and non-infective pathologies playing significant roles.

MATERIALS AND METHODS

This is a cross-sectional study conducted at RMCH, BLY in 6 Months period. From Jan 2024 to June 2024.

Aim: Clinical Profile, Etiological Spectrum, and Outcomes of Type I and Type II Respiratory Failure.

Objectives

1. To determine the demographic characteristics and distribution patterns of patients with respiratory failure.
2. To classify patients into Type I (hypoxemic) and Type II (hypercapnic) respiratory failure based on arterial blood gas analysis.
3. To identify and categorize the underlying etiological factors contributing to respiratory failure.
4. To assess the association between risk factors (smoking, comorbidities) and respiratory failure types.

Methods

A total of 202 patients diagnosed with respiratory failure were included title study. Patients were categorised into two groups based on the type of respiratory failure. Type 1 (Hypoxemia) and Type 2(Hypercapnic).

Inclusion Criteria

1. Clinically diagnosed as Respiratory failure (Type1 and Type2) with subsequent confirmation by Arterial Blood Gas Analysis.
2. Those who gave written and informed consent to be part of the study.

Exclusion Criteria

1. Patients not willing to participate in the study.
2. Patients of respiratory failure secondary to polytrauma and any significant psychiatric illness.

Comprehensive data was collected for each patient, including

- **Demographics:** Age, Sex, Occupation, any addiction-eg. Smoking, Alcohol
- **Clinical History:** Complete history, any co-morbidity
- **Investigation:** ABG analysis, CXR, Sputum analysis, CBC, LFT, KFT, Urine R/M & others.
- Etiology: Noted as per Clinical, Radiological and pathological basis

Statistical Analysis: Data was analysed using SPSS-software.

RESULTS

The study population of 202 patients demonstrated significant demographic pattern that provide important insights into respiratory failure epidemiology.

In our study male patients comprised 73.3%(n=148) while 26.7%(n=54) were females. The gender distribution aligns with established epidemiological pattern observed in Table 1:- Demographic variables respiratory diseases, particularly those associated with smoking and occupational exposures that disproportionately affects male population

Table 1: Demographic variables of Study Population having Resp. Failure

DEMOGRAPHIC VARIABLES	(CATEGORY)	(COUNT-n)	(%)
SEX	MALE	148	73.3%
	FEMALE	54	26.7%
AGE GROUP	< 50 yrs	65	32.2%
	50-70 yrs	92	45.5%
	> 70yrs	45	22.3%
total		202	100%

Table 2: Age distribution

AGE DISTRIBUTION	Frequency	%
<19 years	1	0.5
20-39 years	70	34.7
40-59 years	92	45.5

>60 years	39	19.3
Total	202	100.0

Table 3: Respiratory failure types in Patients

Respiratory failure type	No. of patients	Percentage %	Clinical significance
Type 1(hypoxemia)	81	40.1%	Oxygenation failure
Type 2(hypercapnia)	121	59.9%	Ventilatory failure
Total	202	100%	

Smoking emerged as a critical risk factor, corroborated by Smith et al. (2023), who demonstrated a strong link between tobacco use and adverse respiratory outcomes3. The high prevalence of co-morbidities such as diabetes and hypertension further compounded the risk, consistent with the findings of Johnson et al. (2024).

Table 4: Smoking Habits among patients

SMOKING	FREQUENCY	%
NEVER SMOKED	66	32.6
CURRENTLY SMOKING	111	55.0
QUIT AT LEAST 6 MONTHS	25	12.4
TOTAL	202	100.0

Table 5: Etiology of Respiratory failure among patients

ETIOLOGY	Respiratory failure	Respiratory failure	TOTAL
	TYPE1	TYPE 2	
COPD	11	77	88
PNEUMONIA	15	4	19
ASTHMA	21	4	25
OLD PTB	3	18	21
PTB	9	1	10
ILD	8	1	9
LUNG CA	7	6	13
PNEUMOTHORAX	1	3	4
BCOS	4	5	9
ACO	2	0	2
ARDS	0	2	2
TOTAL	81	121	202

Table 6: Cause of COPD Acute Exacerbation (Infective V/s Non-infective

CAUSE OF COPD ACUTE EXACERBATION	FREQUENCY	%
Etiology Other than COPD	114	56.4
INFECTIVE	42	20.8
NON-INFECTIVE	46	22.8
TOTAL	202	100.0

Table 7: Infective Causes of Acute Exacerbation of COPD

Infective Causes of AE Of COPD-	FREQUENCY
KLEBSIELA	8
PSEUDOMONAS	10
STREPTOCOCCUS	19
ECOLI	1
VIRAL	4
TOTAL	42

Table 8: Non-Infective Causes of Acute Exacerbation of COPD

Non-Infective Causes of AE Of COPD-	FREQUENCY
POOR INHALATION TECHNIQUE	2
NON ADHERENT TO THERAPY	13
LOSS TO FOLLOW UP	9
EXPOSURE	3
WRONG DOSAGE	13
STILL SMOKING	6
TOTAL	46

DISCUSSION

In our study total 202 patients were enrolled. The demographic analysis of our population reveals important Epidemiological patterns that shows alignment with the established literature while highly regional variation. In our study 148(73.3%) patients were male & 54(26.7%) were females the similar observation were noted by Yewon chung et al,[3] Shahzad hussain arash et al,[4] DP.Singh et al,[5] , n. shree kreeth et al6. & Thompson et al.[7]

The age distribution showed the higher prevalence in the 40-59 years age group (45.5%) followed by 20-39 years, (64.8%) of patients were lies in age

group of ≥40 years who developed Respiratory Failure. The similar results were observed by Shahzad hussain arash et al4. with mean age of male 52.89 & 53.17±9.30 years in males & females respectively, the similar observation were also observed by Krishna Uday et al8. with (45.5%) of patients lies with the age gap of 50-70 years.

We observed in our study that smoking emerged as a predominant risk factor, with 55% of patients currently smoking & only 32.6% patients never smoked. The smoking prevalence rates, confirming tobacoo use as a major modifiable risk factor for respiratory failure development. The similar observation were studied by Rajeev Ranjan et al.[5] ,N shree kerth et al,[6] & Smith et al,[9] who observed that (70%), (48%) & (52 %) patients were smoker respectively.

Our study revealed higher prevalence of type 2 respiratory failure 121(59.9%) patients compared to Type 1 Respiratory failure 81(40%) of patients, which contrast with the study done by Shahzad hussain et al4. they observed Type 1 Respiratory failure were more common than Type 2 respiratory failure. (Type 1 respiratory failure v/s type 2 respiratory failure = 56.6% v/s 43.4%).

The predominance of type 2 respiratory failure in our study reflects the high burden of COPD & chronic respiratory conditions in our patient population.

Gender distribution analysis revealed interesting pattern, with male showing higher representation in both types of respiratory failure but particularly in type 2 respiratory failure, which correlated with higher prevalence of copd in males, probably due to their more leaning toward addictory habits of smoking.

The etiological analysis showed COPD as the predominant cause of respiratory failure (43.6%) of total cases studied followed by asthma (12.37). So overall 113(55.92%) of all patients were having obstructive airway disease as a causative factors for developing respiratory failure. Similar results were observed by Yewon chung et al,[3] (44.6%) while william et al,[10] & Shahzad hussain Arastu et al4. observed pneumonia as a most common cause of Respiratory failure in their study (33.7% & 23.3%) respectively.

Total 202 patients were taken out of which 88 patients were diagnosed with COPD

The stratification of COPD exacerbation causes revealed that infective causes accounted for 47.7% of acute exacerbation with Streptococcus (45.2%) followed by Pseudomonas (23.8%) & Klebsiella (19%) being the common founding pathogen. Among non infective causes of copd exacerbation, non adherence to therapy (31%) & wrong dosage (31%) were predominant factors. This highlights the importance of patients education & environmental intervention in COPD management, particularly relevant in the Indian context where air pollution levels are significantly elevated

Limitation

Several limitations should be acknowledged in interpreting there findings. First this single centre study from a tertiary care hospital may not represent a broader population. The six month study duration my not capture seasonal variation in respiratory failure patterns. The exclusion of patients with respiratory failure secondary to polytrauma may have under estimated the true burden of type 1 respiratory failure. Laboratory limitation include the potential for selection bias in sputum culture results, as not all patients may have been able to produce adequate sample for microbiological analysis

CONCLUSION

This prospective cross sectional study provides valuable insights into the clinical profile & etiological spectrum of respiratory failure in a North Indian territory care setting. The predominance of type 2 respiratory failure and COPD as the leading cause reflects the regional disease burden & emphasizes the need for enhanced chronic respiratory disease management programs.

These findings contribute to the understanding of respiratory epidemiology in the Indian region & provide evidence for developing region specific clinical guidelines & public health interventions.

Future research should focus on longitudinal studies with broader population representation & detailed assessment of environmental & socioeconomic factors influencing respiratory failure development & outcomes.

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