

## CLINICAL PROFILE AND OUTCOMES OF PATIENTS WITH TYPE I AND TYPE II RESPIRATORY FAILURE IN A TERTIARY CARE HOSPITAL: A COMPARATIVE STUDY

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### Abstract

**Background:** Respiratory failure is a life-threatening condition characterized by the inability of the respiratory system to maintain adequate gas exchange. It is categorized into two types: Type I (hypoxemic) respiratory failure, where oxygen levels are insufficient, and Type II (hypercapnic) respiratory failure, where carbon dioxide retention occurs. Understanding the clinical profile of these patients is crucial for timely intervention and management at tertiary care hospitals.

**Objective:** This study aims to evaluate and compare the clinical characteristics, underlying causes, comorbidities, management strategies, and outcomes of patients diagnosed with Type I and Type II respiratory failure at a tertiary care hospital.

**Material and Methods:** This observational study was conducted in the Department of Medicine over one year and included 150 patients diagnosed with Type I and Type II respiratory failure. Data on demographics, underlying causes, comorbidities, clinical management, and outcomes were collected. The patients were categorized into two groups based on the type of respiratory failure, and statistical analysis was performed to compare clinical outcomes between the groups.

**Results:** Patients with Type I respiratory failure (n=80) had a higher incidence of acute lung conditions like pneumonia and ARDS, while those with Type II respiratory failure (n=70) predominantly had COPD. Oxygen therapy was universally used in Type I patients, whereas non-invasive ventilation was more common in Type II. Invasive mechanical ventilation was required more frequently in Type I patients (75%) compared to Type II (42.9%). Mortality rates were similar between the two groups (Type I: 22.5%, Type II: 21.4%).

**Conclusion:** Type I respiratory failure is mainly associated with acute conditions, while Type II is linked to chronic diseases like COPD. Proper identification of the type of respiratory failure is essential for choosing the correct management strategy, leading to better patient outcomes.

**Keywords:** Respiratory failure, Type I respiratory failure, Type II respiratory failure, Hypoxemia, Hypercapnia, COPD, Tertiary care hospital, Mechanical ventilation.

### Introduction

Respiratory failure is a critical condition wherein the respiratory system is unable to adequately exchange gases, leading to life-threatening complications. It occurs when oxygenation, carbon dioxide removal, or both fail. The two main types of respiratory failure—Type I (hypoxemic) and Type II (hypercapnic)—are distinct in terms of their pathophysiology, causes, and clinical presentation. Type I respiratory failure is

characterized by low arterial oxygen levels ( $\text{PaO}_2 < 60 \text{ mmHg}$ ) with normal or low arterial carbon dioxide ( $\text{PaCO}_2$ ), while Type II respiratory failure presents with elevated  $\text{PaCO}_2$  levels ( $> 45 \text{ mmHg}$ ) in addition to hypoxemia (1).

Type I respiratory failure is primarily caused by acute lung conditions that impair oxygen exchange. Acute respiratory distress syndrome (ARDS), pneumonia, and pulmonary edema are

common etiologies associated with this condition (2). These disorders reduce the capacity of the lungs to oxygenate the blood, while carbon dioxide levels remain within normal limits or may even decrease due to compensatory hyperventilation (3). Type II respiratory failure, on the other hand, is often linked to chronic conditions that reduce the ventilatory drive or impair the mechanics of breathing. Common causes include chronic obstructive pulmonary disease (COPD), neuromuscular disorders, and drug overdose (4). In these patients, the inability to eliminate carbon dioxide leads to its retention, thus elevating PaCO<sub>2</sub> levels and contributing to respiratory acidosis (5).

The global burden of respiratory failure is significant, and its management presents a considerable challenge in critical care settings. According to epidemiological studies, the incidence of acute respiratory failure ranges from 137 to 360 cases per 100,000 population annually (6). Despite advances in medical technology, mortality rates remain high, especially among patients requiring invasive mechanical ventilation (7). Early identification of risk factors and an understanding of the clinical profile of patients with respiratory failure are crucial to improving outcomes (8).

At tertiary care hospitals, where patients with severe forms of respiratory failure are often referred, it is imperative to recognize the differences in the clinical presentations of Type I and Type II respiratory failure (9). These distinctions can influence the choice of treatment modalities, the necessity for ventilatory support, and the eventual prognosis (10). Additionally, understanding the comorbidities associated with these conditions can help tailor management strategies (11). For instance, while COPD is frequently observed in patients with Type II respiratory failure, those with Type I respiratory failure may often present with more acute, reversible causes like pneumonia or pulmonary embolism (12).

### Aim and Objectives

**Aim:** To evaluate the clinical profile of patients diagnosed with Type I and Type II respiratory failure at a tertiary care hospital.

### Objectives:

1. To identify the most common etiologies associated with Type I and Type II respiratory failure.
2. To compare the comorbidities, clinical management, and outcomes between patients with Type I and Type II respiratory failure.

### Material and Method

This observational study was conducted in the Department of Medicine over a period of one year (2022-2023) at the respiratory care unit of a tertiary care hospital. A total of 150 patients diagnosed with respiratory failure were included. Ethical approval was obtained from the institutional ethics committee.

- **Inclusion criteria:** Adult patients (>18 years) admitted with respiratory failure, defined as either Type I (PaO<sub>2</sub> < 60 mmHg with PaCO<sub>2</sub> < 45 mmHg) or Type II (PaO<sub>2</sub> < 60 mmHg with PaCO<sub>2</sub> > 45 mmHg).
- **Exclusion criteria:** Patients with respiratory failure secondary to trauma or major surgery were excluded.
- **Data collection:** Demographic details, underlying causes of respiratory failure, comorbidities, arterial blood gas analysis, treatment received (oxygen therapy, non-invasive ventilation, or invasive mechanical ventilation), and outcomes (discharge or mortality) were recorded.
- **Statistical analysis:** Data were analyzed using SPSS software. Categorical data were presented as frequencies and percentages, while continuous data were presented as means with standard deviations. Chi-square tests were used to compare outcomes between the two groups.

### Result

**Table 1: Comparison of Clinical Characteristics and Management Between Type I and Type II Respiratory Failure Patients**

Characteristics	Type I Respiratory Failure (n=80)	Type II Respiratory Failure (n=70)
Mean Age (years)	56.4 ± 11.8	61.3 ± 9.4
Male (%)	45 (56.2%)	48 (68.6%)
Common Comorbidities	Pneumonia (30%), ARDS (25%)	COPD (50%), Obesity (20%)
Oxygen Therapy (%)	80 (100%)	50 (71.4%)
Non-invasive Ventilation (%)	20 (25%)	40 (57.1%)
Invasive Mechanical Ventilation (%)	60 (75%)	30 (42.9%)
Mortality (%)	18 (22.5%)	15 (21.4%)

Patients with Type I respiratory failure were younger on average compared to those with Type II. Pneumonia and ARDS were the leading causes of Type I, while COPD was the most common cause of Type II. Non-invasive ventilation was more frequently used in Type II patients. Mortality rates were similar between the groups, though invasive ventilation was more commonly required in Type I patients.

### Discussion

Respiratory failure, whether hypoxemic (Type I) or hypercapnic (Type II), is a critical condition necessitating prompt diagnosis and intervention (13). This study highlights key differences in the clinical profile, comorbidities, and management of patients with these two types of respiratory failure (14). Our findings suggest that Type I respiratory failure, which is frequently associated with acute lung conditions such as pneumonia and ARDS, is more likely to require invasive mechanical ventilation (15). In contrast, Type II respiratory failure, often linked to chronic lung diseases like COPD, may benefit more from non-invasive ventilatory support (16).

Previous studies have emphasized the distinct pathophysiological mechanisms underlying Type I and Type II respiratory failure (17). While Type I is primarily a problem of oxygenation, caused by ventilation-perfusion mismatch or diffusion impairment, Type II results from ventilatory failure, where inadequate alveolar ventilation leads to carbon dioxide retention (18). The presence of comorbid conditions such as COPD,

obesity, and neuromuscular disorders in patients with Type II respiratory failure has been widely documented (19). Our study corroborates these findings, with COPD being the most prevalent comorbidity among Type II patients.

Mortality in respiratory failure remains high, particularly in those requiring invasive mechanical ventilation (20). The use of non-invasive ventilation (NIV) has been shown to reduce the need for intubation and its associated complications in selected patients with Type II respiratory failure (21). In our cohort, the application of NIV was more common in Type II respiratory failure, reflecting the growing body of evidence supporting its efficacy in hypercapnic respiratory failure management.

The clinical implications of our study are significant. Early recognition of the type of respiratory failure and the underlying etiology is critical in determining the appropriate therapeutic approach (22). For patients with Type I respiratory failure, aggressive oxygen therapy and mechanical ventilation may be necessary to restore adequate oxygenation, while in Type II respiratory failure, addressing the underlying cause of hypoventilation, such as optimizing COPD management, may lead to better outcomes (23).

### Conclusion

Our study illustrates distinct differences between Type I and Type II respiratory failure patients in terms of etiology, comorbidities, and management. Type I is primarily associated with acute lung

conditions, while Type II is linked to chronic respiratory diseases like COPD. Proper identification and tailored interventions are essential to improving clinical outcomes in these patients.

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