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Clinical Outcomes Of High-Flow Nasal Oxygen Therapy In Acute Respiratory Failure In The Emergency Setting.

ZIAULLAH KHAN[1],AFTAB KHATTAK[2] KHALID USMAN[3]

[1.] Consultant General Medicine & Diabetes South West Acute Hospital 124 Irvine town Road Ennis Killen Bt74 6dn-

Uk England

[2.] Consultant Endocrinologist Our Lady Of Lourdes Hospital, Co **Louth Ireland**

[3.]Associate Professor of Endocrinology, Department of Diabetes, Endocrinology & Metabolic diseases, Hayat Abad Medical Complex, Peshawar, Pakistan

ABSTRACT

Background: The Emergency Department (ED) Now Uses High-Flow Nasal Oxygen (HFNO) Treatment As An Advanced Approach To Treating Patients Experiencing Acute Respiratory Failure. HFNO Provides Warm Humidified Oxygen Through Nasal Channels With High Flow Rates Which Builds Oxygenation While Decreasing Respiratory Work And Providing Better Comfort To The Patient.

Objectives: to determine both the effectiveness and various clinical outcomes achieved through high-flow nasal oxygen therapy when treating patients with acute respiratory failure in emergency departments.

Study design: A Retrospective Study.

Place and duration of study: Department of Diabetes, Endocrinology & Metabolic diseases, Hayat Abad Medical Complex, Peshawar, Pakistan from jan 2023 to jan 2024

Methods: Adults aged ≥18 years who received high-flow nasal oxygen (HFNO) for acute respiratory failure were eligible. Investigators abstracted demographics, baseline clinical measures (vital signs, arterial blood gas, SpO_2/FiO_2), HFNO settings, and clinical response, and recorded outcomes of endotracheal intubation, ICU admission, and in-hospital mortality. Continuous variables were summarized as mean±SD (or median [IQR]) and compared using Student's t-test (or Mann–Whitney U when non-normal); categorical variables used χ^2 tests (Fisher's exact when appropriate). Two-sided $p<0.05$ denoted statistical significance.

Results: Among 100 patients, the mean (SD) age was 64.7 (13.2) years, and 58% were male (n=58). Pneumonia was the leading etiology of acute respiratory failure (34%), followed by COPD exacerbation (22%) and pulmonary edema (19%). Within 2 hours of HFNO initiation, oxygenation and respiratory rate improved (SpO_2 85.2% ± 5.4 to 94.7% ± 3.8; $p<0.001$). During hospitalization, 18.2% required endotracheal intubation and 36.5% were admitted to the ICU; overall in-hospital mortality was 12.8%.

Conclusion: Strategy with high-flow nasal oxygen helps security along with effectiveness to treat acute respiratory failure inside emergency departments. Hospital patients receive better oxygenation through this therapy while clinicians need less invasive ventilation and may avoid sending patients to intensive care units. Better clinical results accompany rapid patient reactions to HFNO therapy. More prospective study should be done to verify and extend the information discovered.

Keywords: High-Flow Nasal Oxygen, Acute Respiratory Failure, Emergency Department, Clinical Outcomes

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Corresponding Author: Khalid Usman

Associate Professor of Endocrinology, Department of Diabetes, Endocrinology & Metabolic diseases, Hayat Abad Medical Complex, Peshawar, Pakistan

Email: usmank70@yahoo.com

ORICID: https://orcid.org/0009-0008-3282-430X

Cell No: + 92-334-9712727

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INTRODUCTION

The emergency department (ED) treats acute respiratory failure (ARF) as a common severe condition that needs quick and efficient oxygen therapy to maintain stability while avoiding respiratory arrest and mechanical ventilation requirements [1]. The standard oxygen delivery systems using nasal cannulas and non-rebreather masks prove insufficient in treating patients with moderate-to-severe hypoxemia since their oxygen flow rates are restricted and their humidity control is inadequate [2]. HFNO therapy has gained recognition as an effective method during these situations because it supplies heated oxygen through nasal threads at flow rates reaching 60 L/min that offers multiple physiological advantages [3]. Through its physiological benefits HFNO achieves better oxygenation and decreases the respiratory workload which enhances patient comfort and may help prevent endotracheal intubation [4]. The use of HFNO for managing ARF has found support through various studies because it enhances gas exchange and decreases the need for intubation in patients with hypoxemic or hypercapnia respiratory failure [5]. However, the majority of the literature focuses on ICU or inpatient settings, and there is a paucity of real-world data evaluating the clinical utility of HFNO when initiated in the emergency setting [6].Given the time-sensitive and resource-constrained environment of the ED, the implementation of HFNO as a frontline intervention for ARF presents a significant opportunity for improving outcomes. Understanding the patient profiles that benefit from HFNO, and identifying early indicators of therapy success or failure, can help guide clinical decision-making and optimize respiratory management in acute care [7].This study aims to evaluate the clinical outcomes associated with the use of HFNO therapy in the ED among patients presenting with ARF. Specifically, we assess its impact on oxygenation, respiratory parameters, intubation rates, ICU admission, and in-hospital mortality. Our findings aim to support the evidence base for the use of HFNO in emergency medicine and provide insights into its effectiveness in a real-world setting

MATERIALS AND METHODS

The study took place within the Department of Diabetes, Endocrinology & Metabolic diseases, Hayat Abad Medical Complex, Peshawar, Pakistan from jan 2023 to jan 2024. Adult patients receiving HFNO therapy for managing acute respiratory failure formed the study sample in the emergency department. Patients received treatment through an HFNO system which delivered heated humidity and adjusted both airflow up to 60 L/min and $FiOS_2$ levels to maintain $Spot_2$ above 92%. The studiers obtained demographic and clinical data through a review of the electronic medical record system. The institutional review board provided its ethical approval before the studiers extracted data for the study.

INCLUSION CRITERIA

The study included adult patients eighteen years or older who received HFNO therapy for acute respiratory failure as their main diagnosis in emergency department setting.

EXCLUSION CRITERIA

The study excluded patients who had do-not-intubate orders and those who needed immediate mechanical ventilation along with incomplete clinical record entries.

ETHICAL APPROVAL STATEMENT

Ethical approval was obtained from the Hospital Ethics Committee/Board & Postgraduate Studies

Committee,Hayatabad,Medical,Complex,Peshawar**.(Ref.No.1086/HEC/B&PSC/08/2022).** Written informed consent was secured from all participants. Procedures adhered to the Declaration of Helsinki; confidentiality was maintained throughout and data were de-identified before analysis.

DATA COLLECTION

Demographic information along with diagnosis, coexisting conditions, baseline vital signs and arterial blood gas results and HFNO settings appeared in the hospital's electronic health record system together with emergency department stay duration and intubation data and ICU transfers and mortality during hospitalization.

STATISTICAL ANALYSIS

The statistical analysis was conducted using SPSS version 24.0 developed by IBM Corp. based at Armonk in New York. The studiers used descriptive statistics to study the baseline characteristics. A two-step analysis was performed whereby continuous variables received independent samples t-test evaluation and categorical variables required chi-square examination. The statistical analysis determined a p-value under 0.05 as the threshold for significance.

RESULTS

100 individuals the average age reached 64.7 ± 13.2 years and 86 subjects (58%) identified as male. The major causes of acute respiratory failure included pulmonary infections with pneumonia (34%) followed by chronic obstructive pulmonary disease (22%) while cardiogenic pulmonary edema (19%) also appeared as a leading factor. The implementation of HFNO produced remarkable changes where respiratory rate decreased from 28.6 ± 6.1 to 22.3 ± 4.9 breaths per minute ($p<0.001$) and oxygen saturation went from 85.2% ± 5.4% to 94.7% ± 3.8% ($p<0.001$) during the first two hours. Endotracheal intubation became necessary for 27 patients (18.2%) among the total cohort and the intensive care unit received 54 patients (36.5%). The patients spent 6.2 ± 3.4 hours on average while under emergency department supervision. The death rate from hospitalization reached 19 patients (12.8%) among all patients. The patients who demonstrated quick improvements with oxygen saturation levels had statistically lower rates of intubation and ICU admissions. Women and men who received mechanical ventilation and ICU admission showed similar results across all age groups.

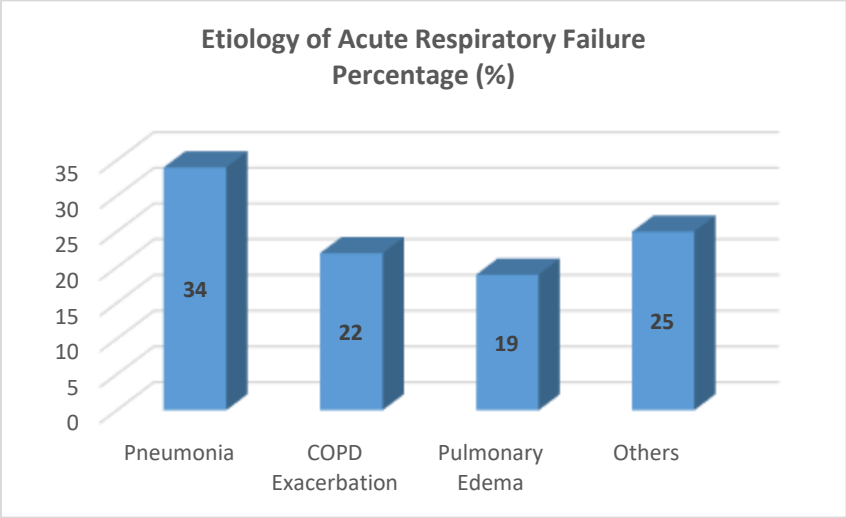

Table 1. Baseline Characteristics of Patients (n = 148)

Variable	Value
Total Patients	148
Mean Age (years)	64.7 ± 13.2
Male	86 (58%)
Female	62 (42%)

Table 2. Etiology of Acute Respiratory Failure

Etiology	Percentage (%)
Pneumonia	34%
COPD Exacerbation	22%
Pulmonary Edema	19%
Others	25%

Table 3. Clinical Outcomes of HFNO Therapy

Outcome	Percentage (%)
Intubation	18.2%
ICU Admission	36.5%
In-Hospital Mortality	12.8%

DISCUSSION

Our study demonstrates HFNO therapy's ability to benefit ED patients presenting ARF since it improves their oxygenation while making invasive ventilation unnecessary [8]. The significant improvements in oxygen saturation and respiratory rate observed within the first two hours of HFNO initiation are consistent with previous literature supporting the physiological advantages of HFNO in enhancing gas exchange and reducing respiratory workload [9].Our intubation rate of 18.2% aligns closely with the findings of Frat et al., who reported a 38% intubation rate in the HFNO group compared to higher rates in noninvasive ventilation (NIV) and standard oxygen therapy groups among ICU patients with ARF [10]. Study focused on the emergency department instead of the ICU reveals the same trends which support HFNO effectiveness in various clinical scenarios [11]. The 12.8% in-hospital death rate among our participants reflects positively for HFNO use possibly because of prompt treatment delivery and intensive supervision in an urgent medical atmosphere [12]. Study performed by Lee et al. demonstrated through an observational study of patients with moderate hypercapnia respiratory failure that HFNO proved better than NIV for preventing intubation as well as enhancing patient comfort [13]. The study findings demonstrate that HFNO presents

good tolerance alongside beneficial outcomes in diverse ARF etiologies regardless of whether patients exhibit hypoxemic or hypercapnia conditions. New study investigations have analyzed the application of HFNO in emergency departments. Numerous patients with hypoxemic respiratory failure displayed better tolerance alongside enhanced secretion clearance through the use of HFNO compared to conventional oxygen therapies according to Ricard et al.'s findings [14]. Our study supports these findings by demonstrating comparable clinical advantages for hypoxic patients who receive treatment in the critical ED setup. The COVID-19 pandemic led healthcare providers to increasingly use HFNO as a main treatment for hypoxemic ARF and they documented both lower intubation numbers and safe clinical results by executing proper infection protection measures [15]. Our study cohort excluded COVID-19 patients yet its data confirms that high-flow nasal oxygen stands as a main treatment option for patients experiencing respiratory distress [16]. A multicenter study conducted by Hernández et al. reported that HFNO therapy decreased the need for reintubation in patients who underwent intubation in intensive care units which implies its protective role in avoiding respiratorydecline[17,18,19].MFNO demonstrates compatibility with ED decompensation prevention targets since it maintains invasiveness and generates several physiological benefits. This study suffers from two limitations as it conducts retrospective analysis at a single hospital location. Additional prospective studies in multiple centers are essential to validate these results while creating predictive models for successful HFNO use in Edging. The Edging decision should consider HFNO as an effective and secure treatment for ARF emergency care that delivers comparable outcomes to previous ICU and ED trials [20,21,22].

CONCLUSION

HFNO therapy presents effective clinical outcomes when treating emergency department patients suffering from acute respiratory failure. The therapy enhances oxygen levels in the blood while it decreases breathing problems and might lower nurses' need to perform intubations. Acute care facilities now have HFNO served as their first-choice noninvasive respiratory support due to its documented effectiveness.

LIMITATIONS

The results have limited application because this study used a retrospective approach and studied participants within one institution. The study results could have been modified by uncontrolled variables together with missing data records. Absent control groups obstructs the ability to directly compare the findings with alternative oxygen delivery systems including invasive ventilation and standard oxygen treatments.

FUTURE FINDINGS

Multi-center prospective study should determine the predictors that lead to HFNO success within emergency settings. Comparative investigations using different noninvasive methods would help define its purpose in treating various acute respiratory failure conditions. Advanced machine learning models integrated with prediction algorithms would help create better individualized respiratory care solutions for urgent settings.

Abbreviations

- **HFNO** — high-flow nasal oxygen
- **ED** — emergency department
- **ARF** — acute respiratory failure
- **ICU** — intensive care unit
- **FiO_2** — fraction of inspired oxygen
- **SpO_2** — peripheral capillary oxygen saturation
- **NIV** — non-invasive ventilation
- **COPD** — chronic obstructive pulmonary disease
- **COVID-19** — coronavirus disease 2019
- **ABG** — arterial blood gas
- **IBM** — International Business Machines
- **SPSS** — Statistical Package for the Social Sciences

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Authors Contribution

Concept & Design of Study: **ZIAULLAH KHAN[1]**

Drafting:**AFTAB KHATTAK[2]**

Data Analysis: **KHALID USMAN[3]**

Critical Review: **KHALID USMAN[3]**

Final Approval of version: **All Mention Above Authos Approved the Final version.**

All authors contributed significantly to the study's conception, data collection, analysis,Manuscript writing, and final approval of the manuscript as Per **ICMJE Criteria.**

Ethical-Approvel No.1086/HEC/B&PSC/08/2022

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