The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 5, 2025

OUTCOMES OF NONINVASIVE VENTILATION USE IN PATIENTS WITH INTERSTITIAL LUNG DISEASE: A CROSS-SECTIONAL STUDY

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DOI: https://doi.org/10.5281/zenodo.16869970

Keywords
Interstitial lung disease, Noninvasive ventilation, Respiratory failure, Clinical outcomes.

Article History
Received on 28 February 2025
Accepted on 03 May 2025
Published on 28 May 2025

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Abstract

Background: *ILD is a progressive disease that results in scarring of the lungs, impaired oxygen supply, and failure to breathe effectively. The noninvasive ventilation (NIV) consists of no intubated ventilatory support. Though it has found application in the treatment of acute respiratory distress, its effects in patients with ILD have not been well studied.*

Objectives*: To assess the prevalence of NIV utilization among ILD-patients and evaluate its impact on clinical outcome, and to determine the predictive variables impacting oxygenation, discharge status, quality of life, and short-term prognosis.*

Study Design: *A Cross-Sectional Study.*

Place and Duration of Study. Department of Pulmonology at Jinnah Postgraduate Medical Center from Sep 2024 to March 2025

Methods: *The study included ILD patients who were accessioned to or followed up with NIV as a supportive therapy. Structured interviews and hospital records were used to collect data on demographics, NIV utilization, comorbidities, and outcomes. Prevalence, outcomes, and predictive factors of a favorable response to NIV therapy were determined using descriptive statistics, chi-square tests, and logistic regression.*

Results: *There were 92 ILD patients enrolled; the average age was 64.7 9.8. Fifty-eight percent of patients were treated using NIV. Users of NIV were significantly better in aspects of oxygenation ($p = 0.032$) and discharges ($p = 0.021$) than non-users. The duration of using NIV was associated with improved symptom control by patients receiving >72 hours of NIV. Logistic regression analyses revealed that a geek <65 ($p = 0.015$) and a lack of comorbid COPD ($p = 0.004$) were found to predict a positive answer as well. The NIV group showed improved quality-of-life scores ($p = 0.027$), and the severity of invasive ventilation use was reduced ($p = 0.018$).*

Conclusion: *NIV has an important clinical role in the treatment of ILD patients, exhibiting significant effects on the outcomes of oxygenation, symptom palliation, and hospital discharge. There was a better response in younger patients and those with no severe comorbidities. The results confirm that NIV should become a routine intervention in the care of selected ILD patients with dyspnea. There is a need for large-scale research to develop guidelines and to enhance positive patient outcomes in the long term based on evidence-based ventilation strategies.*

INTRODUCTION

Interstitial lung disease (ILD) is a generic term used to identify more than 200 chronic lung diseases that feature progressive fibrosis of the interstitium of the lung and subsequent abnormality in gas exchange, persistent hypoxemia, and eventual respiratory failure [1]. Idiopathic pulmonary fibrosis (IPF), hypersensitivity pneumonitis, and connective tissue-related ILD are some of the most common ones. They are the causes of high morbidity and mortality, especially in older adults [2].Chronic respiratory failure (CRF) and acute exacerbations are frequent in patients with ILD and mainly in the advanced stages. Such incidences are characterized by escalated dyspnea, hypoxemia, and radiologic deterioration, which usually necessitates instant ventilatory care [3]. Despite the invasive mechanical ventilation (IMV) being one of the standards in severe cases, its use in ILD is linked to a poor prognosis, extensive mortality during hospital stay, and ventilator-associated pneumonia and barotrauma [4].Conversely, noninvasive ventilation (NIV) has been described as one of the possible supportive interventions that can support patients without intubation and offer adequate ventilatory support. NIV provides the positive airway pressure to the face or nose using a mask to create better gas exchange and a decrease in the effort of the respiratory muscles [5]. It has wide use in diseases such as cardiogenic pulmonary edema and chronic obstructive pulmonary disease (COPD) [6]. Nonetheless, its application in ILD is under-assessed, and there is too little evidence regarding effectiveness, safety, and factors predicting outcomes.Past researches provide ambivalent pieces of advice. As an example, Kumar et al. showed that oxygenation was improved, and there was a shorter hospitalization using NIV in patients with ILD [7]. Short-term survival benefit and better patient comfort were also reported in another prospective cohort analysis by Rocha et al. [8]. However, such results need more solidification because of low sample sizes, retrospective study designs, and the use of heterogeneous populations of patients.Further, ILD patients tend to possess stiff, non-compliant lungs that will affect the effectiveness of NIV. Interface intolerance, mask leak, and low tidal volumes are some of the factors that present a clinical challenge [9]. In this way, the selection of an ILD subgroup of patients who might at least theoretically respond to NIV and in which situation it might help them is vital.The study aims to address this gap by analyzing the usage and short-term clinical outcomes of NIV as applied to patients with ILD in a tertiary care center. It is also aimed at discovering the predictors of positive response, including age, comorbidity burden, and the duration of NIV application. A cross-sectional approach will enable us to address guidelines on NIV implementation in respiratory failure related to ILD and assist in evidence-based, optimal interventions in Management.

METHODS

This study was a cross-sectional study Conducted in Department of Pulmonology at Jinnah Postgraduate Medical Center from Sep 2024 to March 2025. Patients With A History Of ILD Who Were Treated With Noninvasive Ventilation (NIV) As Inpatients Or Outpatients Were Considered The Target Population. Demographic, Clinical, And Outcome Data Were Collected By Using A Structured Questionnaire And A Standardised Data Abstraction Form. The Method Of Selection Of Patients Was Purposive Sampling, Starting With A Review Of The Hospital Records.The key variables were these: age, gender, smoking or not, NIV indication, duration,

settings, and complications. The outcome variables consisted of oxygenation measures (SpO2 2 / ABG), hospital discharge, the requirement of intubation, and self-reported improvement of symptoms. The authorisation of the institutional review board was received before it was started. Patients gave informed consent in writing during the interview phase.

Ethical Approval Statement:
This study, titled Outcome of Noninvasive Ventilation in Interstitial Lung Disease A Cross-Sectional Study was approved by the CPSP Research Evaluation Unit under reference number CPSP/REU/PUL-2022-786-746, dated July 24, 2024. All procedures followed institutional ethical guidelines. Informed consent was obtained from participants prior to data collection.

Inclusion Criteria
Patients aged 50 years or older diagnosed with ILD (as defined by the following International Labor Organization definition: ILD=33/11/51+00) and with noninvasive ventilation used at the time of inpatient admission or during follow-up, with complete medical records, and who were capable of giving informed consent.

Exclusion Criteria
The study excluded patients with incomplete hospital documentation, on invasive mechanical ventilation, or with known neuromuscular disease, recent facial surgical intervention, and patients who refused participation.

Data Collection
Electronic medical records of the hospital and face-to-face interviews were used to gather data. The demographic data, clinical background, NIV settings, and outcomes were collected using a structured questionnaire. The quality assurance procedures ensured that things were complete and accurate. NIV tolerance, subjective reporting improvement of breathing, and changes in quality of life after therapy were discussed with the interviewed patients.

Statistical Analysis
The analysis of the data was performed with the help of SPSS version 24.0. Demographics and clinical features were summarized in terms of descriptive statistics. Associations between categorical and continuous variables were evaluated using a chi-square and independent t-tests. The logistic regression determined predictors of good outcomes. The Sampling interval was p-value <0.05.

Results
Ninety-two patients with interstitial lung disease (ILD) were incorporated into the analysis. The average age is 64.7 +/- 9.8 years old, with a male distribution of 60.9 percent and a female distribution of 39.1 percent. Fifty-four (58.7%) of the patients were put on noninvasive ventilation. Most of the NIV users were acutely exacerbated (66.7 percent), and most of the others experienced chronic respiratory failure (25.9 percent).The percentage of NIV users showing significant improvement in oxygenation, even after oxygenation (74.1 percent), in terms of being successfully discharged without intubation (68.5 percent) was also graded with p = 0.032 and p = 0.021, respectively. The mean time of application of NIV was 49.3 +/- 16.2 hours. Patients who were younger than 65 years and did not have COPD comorbidity reported much better outcomes (p = 0.015 and p = 0.004, respectively).Relevant complications were few in NIV, as characterized by only five patients who complained of pressure sores or discomfort (9.3%). Also, 70.4 percent of patients reported satisfaction or high satisfaction ratings. Logistic regression analysis demonstrated that younger patient age, shorter comorbidity index, and NIV use of 48 hours or more were the predictors of responding to clinical trials (p < 0.05).This evidence points to the fact that NIV is an effective intervention in preselected ILD and that it adds to better control of symptoms, oxygenation, and discharge status.

Table 1: Demographic and Clinical Characteristics of ILD Patients (n = 92)

Variable	Frequency (%)	Mean ± SD
Age (years)		64.7 ± 9.8
Gender		
- Male	56 (60.9%)	
- Female	36 (39.1%)	
Smoking Status		
- Current/Former Smoker	48 (52.2%)	
- Never Smoked	44 (47.8%)	
Comorbidities (≥1 condition)	67 (72.8%)	
- Hypertension	42 (45.7%)	
- Diabetes Mellitus	38 (41.3%)	
- COPD	20 (21.7%)	

Table 2: NIV Usage and Related Clinical Indicators (n = 54 NIV Users)

Parameter	Frequency (%)
Indication for NIV	
- Acute Exacerbation	36 (66.7%)
- Chronic Respiratory Failure	14 (25.9%)
- Post-Procedural Support	4 (7.4%)
Location of NIV Initiation	
- Inpatient	34 (63.0%)
- Emergency Department	12 (22.2%)
- Outpatient Clinic/Home	8 (14.8%)
Duration of NIV Use	
- <24 hours	10 (18.5%)
- 24–72 hours	28 (51.9%)
- >72 hours	16 (29.6%)

Table 3: Comparison of Clinical Outcomes in NIV Users vs. Non-Users

Outcome	NIV Users (n=54)	Non-Users (n=38)	p-value
Improved Oxygenation	40 (74.1%)	18 (47.4%)	0.032
Discharged without Intubation	37 (68.5%)	19 (50.0%)	0.021
Need for Invasive Ventilation	6 (11.1%)	10 (26.3%)	0.018

Symptom Improvement Reported	43 (79.6%)	17 (44.7%)	0.007
Hospital Stay > 7 days	19 (35.2%)	14 (36.8%)	0.861

Table 4: Predictors of Positive Response to NIV (Logistic Regression Analysis)

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Age < 65 years	2.76	1.23–6.19	0.015
Absence of COPD	3.12	1.43–7.63	0.004
NIV Duration > 48 hours	2.45	1.08–5.52	0.038
Female Gender	1.39	0.61–3.19	0.420
≥2 Comorbidities	0.79	0.35–1.78	0.567

Discussion

This analysis indicates the importance of noninvasive ventilation (NIV) use and clinical outcomes of patients with interstitial lung disease (ILD) that showed a positive value in influencing their oxygenation and limiting the invasive mechanical ventilation incidence to a lower portion of the patients selected. The findings are in line with the possible usefulness of NIV as an assistant therapy in ILD-related respiratory distress and correspond with the results of international research. Out of them 74.1% improved in oxygenation, and 68.5% left without intubation. These results are in line with a systematic review by GlBer et al. that showed clinical benefit and transient survival advantage in ILD patients that were treated with NIV [10]. Likewise, Rocha et al. noted that, in a randomized controlled trial, NIV greatly improved respiratory parameters and comfort without augmenting adverse effects [11].In our study, the average age of the patients was 64.7 years, which is close to the age minus 27 years mentioned by Kumar et al. who found that older patients with ILD tend to respond well to early NIV intervention when it comes to the prevention of complications related to invasive ventilation [12]. Nevertheless, their cohort showed worse outcomes with age 70 and more, similarly to our logistic regression, where patients below 65 provided a significantly better response (p = 0.015).Another interesting fact presented by Bendstrup et al. was the heterogeneity of the ILD pathophysiology that needs to be addressed by accordance of ventilatory support to the severity of the disease and the patient profile [13]. COPD comorbidity was another variable that significantly influenced NIV success in our study (p = 0.004) which serves to prove earlier arguments about crossing obstructive disorders hindering the effectiveness of the NIV because of dynamic hyperinflation and air-trapping [14].The use of duration of NIV was another factor; it was found that those greater than 48 hours improved after the NIV. This is in line with the prospective study conducted by Yamamoto et al., which reported that a long-term maintenance of NIV lasting at least 48 hours to 72 hours led to an increase in symptom relief reported by the patients and a reduction in the number of ICU transfers [15].Albeit with encouraging findings, certain studies have mentioned restraint. According to reports by Papiris et al., NIV might provide temporary benefits, but this does not seem to change the long-term deaths in progressive fibrosing ILD [16]. Moreover, Ciftci et al. issued warnings concerning possible problems such as pressure sores and intolerance to masks, but our research registered few

NIV related complications [17].Notably, our results confirm recent changes in the recommendations provided in the American Thoracic Society regarding the use of NIV with ILD patients, as it can be a supportive intervention at best, and the patient selection has become the most important factor [18].In short, the presented study forms part of the evidences which demonstrate that, properly applied, NIV can be used in ILD patients with notable clinical benefit. Nonetheless, additional larger metacentric trials are required in order to standardize the guidelines of NIV application among such a complicated group of patients.

Conclusion

In carefully chosen patients with ILD, noninvasive ventilation (NIV) has a clinical benefit in terms of oxygenation, a decrease in the use of invasive ventilation, and short-term prognostic improvements. NIV can be a useful supportive measure with suitable selection of the patient. These results support the position of NIV in the treatment of ILD-related respiratory failure in tertiary medical care institutions.

Limitations

Limitations topography of the study are exclusively dogmatic, grounded primarily on its single-centered course and a small sampling of its domain, as well as on the cross-sectional nature that does not allow for any causal interpretation. The way the data was collected was also based partially on retrospective records, which is questionable given its capacity to bring about bias. Another limitation is the absence of in-depth follow-up, which restricts the value of studies involving NIV in evaluating its long-efficacy on chronic disease duration and patient survival.

Future Findings

Multicenter, longitudinal, studies with higher sample sizes are needed in future research to back our results and determine any long-term complications. Exploring the biomarkers, lung scans, and assessing the quality-of-life indicators can improve NIV procedures. Donovan et al. (2017) indicate that additional efforts must be established to determine the subgroups of ILD that respond best to NIV and in what clinical conditions.

Acknowledgements

The authors gratefully acknowledge the dedicated support of the hospital staff and doctors at Mardan Medical Complex for their valuable assistance and contributions throughout the course of this study.

Disclaimer: Nil
Conflict of Interest: Nil
Funding Disclosure: Nil

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