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Assessment of High-Flow Nasal Cannula Therapy for Primary form of Respiratory Support: A Cross-Sectional Study

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Dr Udarapu Sambasiva Rao
Resident, Dept of Paediatrics, Krishna Institute of Medical Sciences, Karad, Maharashtra, India

Key words:
Oxygenation, Respiratory support, Cross-sectional study, Hypoxemic respiratory failure, High-flow nasal cannula therapy

Abstract:
Background: "High-Flow Nasal Cannula (HFNC)" therapy using a nasal cannula using heated and humidified air is a non-invasive respiratory support technique. It is increasingly being used as the main method of respiratory assistance for critically unwell patients. However, there is still disagreement regarding the efficacy of HFNC therapy as a primary method of respiratory support. The motive of this research was to assess the efficacy of HFNC treatment as the main method of respiratory support in critically ill patients.
Methods: In a hospital providing tertiary care, a cross-sectional study was carried out. The study comprised 100 critically ill patients who began using HFNC treatment as their primary method of respiratory support. Data on demographics, medical conditions, and lab results were gathered. The necessity for intubation within the first 48 hours of beginning HFNC therapy served as the key outcome indicator. Death rate, hospital stay, and HFNC therapy-related problems were considered secondary outcomes.
Results: 100 subjects were considered for the study. The patients were on average 62 years old, and 60% of them were men. COPD was the most prevalent underlying medical condition (36%). Within the first 48 hours of beginning HFNC therapy, 26 (or 26%) of the 100 patients needed to be intubated. The sole independent predictor of the need for intubation was the PaO2/FiO2 ratio at the beginning of HFNC therapy (OR=0.96, 95% CI: 0.94-0.98, p0.001). The median length of stay in the ICU was 5 days, and the death rate was 22%. HFNC therapy-related complications were extremely uncommon.
Conclusion: In critically sick patients, HFNC treatment has the potential to be an effective primary method of respiratory support. Close observation is required, nevertheless, and early intubation should be taken into consideration in patients who do not improve after the first 48 hours of HFNC therapy.

1. Introduction:

A non-invasive respiratory support technique that has gained favour recently is "*High-Flow Nasal Cannula* (HFNC)" therapy [1]. A nasal cannula is used in HFNC therapy to supply heated and humidified oxygen at high flow rates. Numerous advantages result from the high flow rates of HFNC therapy, including reduced work of breathing, increased oxygenation, and reduced dead space [2]. In critically ill patients, particularly those who have hypoxemic respiratory failure, HFNC treatment has been employed as the major method of respiratory support [3].

When used as the primary method of respiratory support, HFNC therapy provides a number of advantages over more conventional methods like "*Non-Invasive Positive Pressure Ventilation* (NIPPV)" and "*Invasive Mechanical Ventilation* (IMV)". In addition to making patients feel more at ease, HFNC therapy may lower the risk of NIPPV and IMV-related complications like ventilator-associated pneumonia and barotrauma [4].

The efficacy of HFNC therapy as a major method of respiratory support is still up for dispute despite its rising popularity. In some individuals, HFNC therapy may be a useful substitute for NIPPV and IMV, according to a number of studies [5-7]. However, in patients receiving HFNC therapy as their primary method of respiratory support, other studies have

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found a higher rate of treatment failure and the requirement for intubation [8,9].

The usefulness of HFNC as a major method of respiratory support needs to be investigated further in light of the contradictory findings of earlier trials. The motive of this research was to assess the efficacy of HFNC treatment as the main method of respiratory support in critically ill patients.

2. Materials and Methods:

Study design and samples: In a tertiary care center, this cross-sectional study was conducted. Critically ill patients who began using HFNC therapy as their primary method of respiratory support in the hospital's medical ICU made up the study population.

Data collection: From the patients' electronic medical records, demographic, clinical, and laboratory data were gathered. Age, sex, "*Body Mass Index* (BMI)", underlying medical disorders like asthma, heart failure, and "*Chronic Obstructive Pulmonary Disease* (COPD)", as well as laboratory values like arterial blood gases and respiratory rate, were all gathered. The requirement for intubation within the first 48 hours of beginning HFNC therapy was the primary outcome.

Secondary outcomes: The secondary outcomes included death, ICU duration of stay, and HFNC therapy-related side effects like bleeding, pain, and nasal damage.

Descriptive statistics were utilised to compile the demographic, clinical, and laboratory data for this statistical study. Frequencies and percentages were used to report categorical variables. To determine the variables connected to the requirement for intubation during the first 48 hours of beginning HFNC therapy, a univariate analysis was carried out. Statistical significance was kept at p-value less than .05.

3. Results:

The research involved 100 patients in all. The patients were on average 62 years old, and 60% of them were men. COPD (36%) was the most prevalent underlying medical condition. At the beginning of HFNC therapy, the median PaO2/FiO2 ratio was 200 mmHg (IQR: 160-250). **Table 1**

26 (26%) of the 100 patients who were a part of the trial needed intubation within the first 48 hours after beginning HFNC medication. According to a univariate analysis, age (p=0.02), BMI (p=0.01), and the PaO2/FiO2 ratio at the beginning of HFNC therapy (p<0.001) were all linked with the requirement for intubation. The PaO2/FiO2 ratio at the start of HFNC therapy was the only independent predictor of the requirement for intubation, according to logistic regression (OR=0.96, 95% CI: 0.94-0.98, p<0.001). The median length of stay in the ICU was five days, and the death rate was 22%. There were very few HFNC therapy-related complications, and no significant adverse events were documented. **Table 2**

Table 1: Clinical and Demographic features

Characteristic	**Value**
Sample size (N)	100
Age (years)	62 ± 8.6
Male sex, n (%)	60 (60%)
Underlying medical condition, n (%)	
COPD	36 (36%)
Asthma	15 (15%)
Interstitial lung disease	12 (12%)

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Other	37 (37%)
PaO2/FiO2 ratio at start of HFNC therapy, median (IQR)	200 (160-250)

Table 2: Univariate Analysis of Factors Associated with Need for Intubation

Characteristic	**Univariate Analysis**
Age (years)	p = .02
BMI (kg/m²)	p = .01
PaO2/FiO2 ratio at start of HFNC therapy	p < .001

4. Discussion:

This research evaluated the efficacy of HFNC therapy when used as the main form of respiratory support in critically sick patients. The results suggest that for some people, HFNC treatment may be an effective primary source of respiratory support. Close monitoring is needed and fast intubation should be a treatment option for individuals who do not respond to HFNC therapy within the first 48 hours of treatment.

A significant incidence of treatment effectiveness with HFNC therapy in a subset of patients with hypoxemic respiratory failure has been shown in earlier trials [5-7]. The results of this study support and are consistent with those of the other studies. The advantages of HFNC therapy, such as reduced work of breathing, enhanced oxygenation, and reduced dead space, may contribute to its effectiveness as a primary source of respiratory support [2].

The PaO2/FiO2 ratio at the start of HFNC treatment was the only variable in this study that could independently predict whether or not the patient would need to be intubated. This conclusion is consistent with earlier studies' findings [10,11] that showed the degree of respiratory failure at the start of HFNC therapy is a good indicator of how effective the therapy will be. These findings and this one are consistent. As a result, extremely careful patient selection is necessary when using HFNC treatment as a primary form of respiratory support, in addition to regular monitoring of the patient's oxygenation level.

This study's findings that HFNC therapy-related issues were rare are consistent with those of other investigations [12–16]. The low frequency of problems may be attributed to the careful observation of patients for symptoms of nasal damage and pain, the use of appropriate humidification and flow rates, and these factors together. The fact that patients are continuously followed may also be responsible for the low occurrence of problems.

The findings of this study are in line with earlier research that revealed a range of intubation rates among patients receiving HFNC therapy [17,18]. The rate of intubation in patients receiving HFNC therapy was 12% in a retrospective research by Roca et al., which is lower than the rate found in our study [17]. The study by Roca et al., however, focused on individuals with acute hypoxemic respiratory failure and had a very small sample size of 52 patients [17].

The rate of intubation in patients undergoing HFNC therapy was 34% in a multicenter randomised controlled trial by Hernandez et al., which is higher than the rate found in our study [18]. The study by Hernandez et al. focused on patients with acute respiratory failure of varied aetiologies and used a larger sample size of 310 participants.

It is in line with earlier studies' findings that the PaO2/FiO2 ratio at the beginning of HFNC therapy is a significant predictor of the need for intubation. The PaO2/FiO2 ratio was found to be an independent predictor of intubation in patients receiving HFNC therapy in a retrospective analysis by Xu et al. [19]. The PaO2/FiO2 ratio was also discovered to be a

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significant predictor of intubation in patients with acute hypoxemic respiratory failure in a prospective trial by Frat et al. [1].

Age and BMI were linked to intubation necessity in univariate analysis, which is consistent with some prior research but not all. Age and BMI were found to be independent predictors of intubation in patients undergoing HFNC therapy in a retrospective analysis by Fernandez et al. [20]. Age and BMI, however, were not found to be reliable indicators of intubation in patients with acute hypoxemic respiratory failure in a prospective trial by Frat et al. [1].

Overall, this study's findings reflect the expanding body of research on the efficacy of HFNC treatment as a major method of respiratory support and are consistent with those of other studies. However, more research is required to confirm these results in larger, multicenter studies and to pinpoint additional variables that might be linked to the requirement for intubation in patients receiving HFNC therapy.

There are a few limitations with this study. First, because this was a cross-sectional study, the findings need to be interpreted with a certain degree of caution. Second, the sample size was not very large, and additional research with larger samples is required to validate these results. Third, the research was only carried out at one location, therefore it is possible that the findings cannot be generalised to a wider population. HFNC therapy was not compared with any other kind of respiratory support in this trial; therefore, additional research is required to assess the relative efficacy and safety of the other types of respiratory support.

5. Conclusion:

In conclusion, HFNC therapy may be an effective primary mode of respiratory support in some seriously ill patients. However, in patients who do not improve during the first 48 hours of HFNC therapy, close surveillance is necessary, and early intubation should be considered. Thorough patient selection and monitoring are required in order to employ HFNC treatment as a primary way of respiratory support. The PaO2/FiO2 ratio at the start of HFNC therapy is a good indicator of how well the therapy will work. More research is needed to compare the relative effectiveness and safety of different respiratory support techniques..

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