

Can High-Flow Nasal Cannula Oxygen Therapy Improve Respiratory Status in Hospitalized Patients With COVID-19?

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Abstract

Introduction: High-flow nasal cannula (HFNC) is an oxygen delivery procedure for patients with respiratory disorders. The role of this oxygen therapy system in the treatment of patients with COVID-19 has not been conclusively proven. The present study evaluated the efficacy and success of HFNC in improving the clinical condition of patients with COVID-19.

Methods: The statistical population of this cross-sectional study was hypoxemic patients with the COVID-19 disease. The findings of the study were obtained by reviewing patients' records and extracting information from the hospital information system.

Results: A total of 29 patients with moderate to severe COVID-19 were analyzed. Comparison of the results of blood gas analysis of these patients showed that the use of HFNC did not make a significant difference in pH ($P=0.063$), PaCO_2 ($P=0.135$), O_2sat ($P=0.999$), and HCO_3^- ($P=0.717$).

Conclusion: Our study showed that the use of HFNC did not make a significant difference in respiratory parameters and the results of blood gas analysis in patients with COVID-19.

Keywords: COVID-19, High-flow nasal cannula (HFNC), Oxygen therapy

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Introduction

The COVID-19 pandemic has greatly affected the global health system. The disease is transmitted through contaminated droplets, and patients show different manifestations based on the dose and duration of exposure to the virus.^{1,2} Patients with COVID-19 are classified into four categories: mild, moderate, severe, and critical.³ Many patients with respiratory symptoms go to medical centers, and only a small percentage of them experience severe pneumonia. Except for mild cases treated on an outpatient basis, other cases of COVID-19 that need hospitalization impose unprecedented pressure on the health care system and highlight the need for choosing the best and most effective treatment modalities.³

Patients with COVID-19 and acute hypoxemic respiratory failure require highly concentrated oxygen inhalation and a non-invasive ventilation (NIV) strategy as a viable option.^{4,5} The use of high-flow oxygen therapy

through the high-flow nasal cannula (HFNC) is another non-invasive strategy that can provide warm and humid air to provide the patient with good breathing and improve carbon dioxide clearance by providing 60 L/min flow and FIO_2 up to 1.0.^{6,7} Studies have shown that HFNC reduces the need for invasive ventilation or intensifies oxygen therapy compared to conventional oxygen therapy (COT) but does not make much difference in mortality rates.⁸

Also, studies have shown that HFNC alone can reduce the need for aggressive mechanical ventilation in severe cases of respiratory failure ($\text{PaO}_2/\text{FiO}_2$ 200 mm Hg) compared to COT or NIV combined with HFNC.⁹

Therefore, the role of respiratory support is very important to maintain adequate oxygen supply or ventilation to reduce respiratory performance and to prevent lung damage. According to the guidelines of the World Health Organization (WHO), patients with moderate to severe COVID-19 need to receive oxygen in



the hospital.¹⁰

Some respiratory indicators such as oxygen saturation, PaCO₂, and PaO₂ are effective in monitoring the oxygen delivery efficiency in the patients undergoing HFNC and predicting the outcome of this type of oxygen delivery.¹¹ In the present study, we retrospectively investigated the effects of HFNC on the respiratory status of COVID-19 patients with hypoxemic respiratory failure.

Materials and Methods

The present study was performed as a cross-sectional retrospective experiment from March to August 2020 and obtained the approval of the institutional ethics committee (IR.SBMU.NIRTL.D.REC.1399.229). The study population included patients with moderate to severe COVID-19 hospitalized in Masih Daneshvari hospital, Tehran, Iran.

Among hospitalized patients with COVID-19, 29 patients meeting the inclusion criteria, including decreased oxygen saturation and age over 18 years, were included in the study. Patients with chronic renal or pulmonary insufficiency, pregnant or lactating women, and patients with acute heart failure were excluded from the study.

For oxygen therapy, high-flow oxygen delivery through a nasal cannula (HFNC) was used. The flow and temperature of the device were adjusted individually and according to the needs of each patient. During the use of HFNC, the patient's clinical condition was closely monitored by the treatment team to allow patients to desirably breathe. Patients' information before and after the intervention was extracted from the hospital information system and recorded in a pre-designed checklist. Then the collected information was analyzed by SPSS software version 22. The results of blood gas analysis before and after oxygen therapy through HFNC were compared using the Wilcoxon signed-rank test at a significant level of 0.05

Results

Among 35 patients with COVID-19 admitted to the hospital from March to August 2021, 29 patients (including 18 men) with a mean age of 57.65 ± 14.66 years were evaluated (Table 1).

The results obtained from blood gas analysis (Table 2) showed that the mean pH before HFNC oxygen therapy was 7.465 ± 0.042 , and after oxygen therapy, it was 7.396 ± 0.147 , showing no significant increase after oxygen therapy ($P=0.063$). Also, the comparison of PaCO₂ between the two time periods showed that the mean of this factor after using HFNC (47.17 ± 18.27 mm Hg) did not increase significantly compared to the pre-oxygen therapy condition (37.64 ± 7.23 mm Hg, $P=0.135$).

The results showed that the patients' oxygen saturation before starting oxygen therapy was 88.82 ± 4.19 % and

Table 1. Patients' Characteristics

Variables	Mean \pm Standard Deviation
Age (y)	57.655 ± 14.668
Weight (kg)	87.000 ± 28.962
Height (cm)	167.035 ± 17.006
Hospital stay (days)	17.103 ± 14.028

Table 2. Comparison of Blood Gas Parameters Before and After High-flow Nasal Cannula Oxygen Therapy

Parameters	Groups		P Value
	Before HFNC (Mean \pm SD)	After HFNC (Mean \pm SD)	
PH	7.465 ± 0.042	7.396 ± 0.147	0.063
PaCO ₂ (mm Hg)	37.64 ± 7.23	47.17 ± 18.27	0.135
O ₂ sat (%)	88.82 ± 4.19	90.04 ± 5.68	0.999
HCO ₃ (mmol/L)	35.37 ± 10.37	33.43 ± 7.66	0.717

after that, it was $90.04 \pm 5.68\%$, showing no significant difference ($P=0.999$). Also, the average level of bicarbonate after using HFNC did not significantly change compared to before the intervention ($P=0.717$, Table 2).

Discussion

The present study showed that HFNC, although considered a treatment option for patients with moderate to severe COVID-19, could not significantly improve the respiratory status. Our results showed that the patients receiving oxygen therapy with HFNC did not have significant changes in PH, HCO₃, PaCO₂, and O₂sat. The mean hospital stay of our patients was 17.10 ± 14.02 days. Therefore, the ineffectiveness of HFNC in improving blood gas indices in these patients can be influenced by the therapeutic interventions such as corticosteroids administered during this period. Here, HFNC started at 30 L/min, but FiO₂ was adjusted to suit the patient's needs. A previous study investigated the role of the flow rate in improving the respiratory workload.¹² Rittayamai et al found that a flow of 30 L/min was associated with the best results,¹³ while other studies have confirmed that a gradual increase in the flow rate would improve patients' blood gas indicators. However, due to the retrospective nature of the present study, it was not possible to investigate the effects of different flow rates on the outcomes of our study. However, some studies had different results from our study. A meta-analysis on 1084 patients with COVID-19 showed that HFNC significantly reduced the rate of intubation and mortality compared to NIV and COT. Şancı et al also demonstrated that HFNC could improve blood gases in people with acute respiratory failure.¹⁴ Rorat et al also showed that HFNC is a safe method for the treatment of acute hypoxemia respiratory failure, with an effectiveness of up to 50%.¹⁵ We found that oxygen therapy with HFNC did not

significantly alter O₂sat; however, the mean O₂sat showed a relative improvement during treatment with HFNC.

Our study had some limitations. This was a retrospective study without a control group. The sample size was very small, and the population studied was not homogeneous. The reason for the small sample size was that this study was performed in a selected section of a medical center and over a very limited period. Also, during the first months of the COVID-19 pandemic, the experience of HFNC treatment teams was limited, and few data had been reported. In addition, at the beginning of the pandemic, a comprehensive protocol for the use of HFNC was not available. Despite these limitations, the role of HFNC in the improvement of respiratory condition in COVID-19 patients cannot be definitively ruled out. Achieving more accurate clinical results requires further research comparing other oxygen therapy methods. Prospective and multicenter studies with a larger statistical population can result in more accurate conclusions.

Conclusion

According to our observation, HFNC did not improve blood gas parameters in hospitalized patients with moderate to severe COVID-19. Randomized studies with a control group and a larger sample size can be useful in achieving more accurate results.

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Authors' Contribution

TKH presented the idea. MSM, AF, and RZ performed the literature search and developed the initial draft. MNA, TKH and ML carried out formatting and editing, and AF reviewed and approved the final version.

Competing Interests

None.

Ethical Approval

This study was approved as a research project with the code of IR.SBMU.NIRTL.DREC.1399.229 by the Ethics Committee of Masih Daneshvari Hospital, Tehran, Iran.

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