



Case Study

High Flow Nasal Cannula Oxygen Therapy in Long Hauler Covid-19 Patients

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Article Info

Article History:

Submit Feb 5th, 2021

Accepted March 1st, 2021

Published March 28th 2021

Keywords:

Long Hauler Covid-19;
ARDS; High Flow Nasal
Canul; Critical Care

Abstract

Long Hauler Covid-19 is a condition that describes a person who has recovered from Covid-19 and is declared with a negative PCR smear 2 times but still feels signs and symptoms for a longer period of time, even severe and critical symptoms. Most cases complicate Acute Respiratory Disorder Syndrome (ARDS), which can lead to death. Fulfilment of non-invasive high concentration oxygenation requirements as an intervention modality in this case. The purpose of this case study was to determine the effect of giving oxygen therapy through the High Flow Nasal Cannula (HFNC) on the respiratory function of Covid-19 long haulier patients. The method of nursing care was a case study on 2 respondents with a descriptive approach method. There were 2 cases of Long haulier Covid-19 patients with comorbid smokers, Diabetes Mellitus, experiencing moderate ARDS complications, desaturation, and tachypnea. Patients received oxygen therapy intervention through HFNC while being treated in the critical care room, and after being given HFNC oxygen therapy for 5 days there was a decrease in respiratory frequency, a change in breathing pattern from shortness of breath to shortness of breath, an increase in oxygen saturation, an increase in the ROX Index, an increase in PO₂ and blood pH in normal limit. Nursing care that focuses on respiratory management in covid-19 long haulier patients improves patient outcomes in particular, namely decreased respiratory rate, changes in the respiratory pattern of shortness of breath, increased oxygen saturation, increased ROX index, increased PO₂ and blood pH within normal limits.

INTRODUCTION

Long hauler Covid-19 is a term that describes the phenomenon of symptoms experienced by patients after being infected with COVID-19.¹ Someone who has recovered from Covid-19 and tested negative but still feels signs and symptoms for longer.² The symptoms felt by sufferers of Covid-19 vary. About 80% of people with

Covid-19 experience mild symptoms and can recover in just two weeks. However, there are also those who experience a severe response that takes three to six weeks. A person is said to have a Covid-19 long hauler if he is infected with the corona virus and experiences symptoms for 28 days or more after being infected. A research and survey published in August 2020 showed that 50-80% of sufferers still

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South East Asia Nursing Research, Vol 3 No 1, March 2021

ISSN:2685-032X

DOI: <https://doi.org/10.26714/seanr.3.1.2021.33-39>

experience disturbing symptoms within 3 months of recovering from COVID-19.³

Health workers and researchers have focused on the acute phase of Covid-19, but follow-up monitoring after discharge for long-term effects (long hauler Covid-19) is needed. Of the patients recovering from COVID-19, around 87.4% said that there was at least one persistent symptom, especially fatigue and dyspnea. The most common symptoms are fatigue, shortness of breath, cough, joint pain, and chest pain.⁴ While long-term symptoms include difficulty thinking and concentration, depression, muscle aches, headaches, chest pain, intermittent fever, tachycardia.^{3,5}

The phenomenon of Covid-19 long hauler patients at Tugurejo Hospital who have severe symptoms is treated in the Covid-19 ICU room, but if the results of PCR swabs that have been carried out 2 times in a row are negative and require critical care 19. This patient who has tested negative for Covid-19 still feels symptoms of dyspnea, fatigue, joint pain, reduced muscle function, impaired ability to perform daily activities, and mental health problems such as post-traumatic stress disorder, anxiety, and depression. The number of long hauler cases covid-19 in December 2020-February 2021 was 30 patients. There were 15 patients given oxygen therapy through HFNC, 5 patients received oxygen therapy through mechanical ventilation, 7 patients received oxygen through a non-rebreathing mask, 3 patients received oxygen therapy through a nasal cannula and 1 patient experienced worsening conditions from HFNC oxygen therapy to a mechanic ventilator. The duration of using HFNC and the length of stay of these patients varied between 5-14 days.

The main life-threatening problem for Covid-19 long hauler patients is a problem attacking the respiratory system and some patients in the course of the disease will develop insufficient refractory hypoxemic breathing which requires mechanical

ventilation. Currently, the non-invasive method of giving high concentration oxygen through HFNC is a modality in Long hauler Covid-19 patients, especially those who experience moderate and severe ARDS failure.^{6, 7} Delaying or preventing mechanical ventilation procedures can reduce the need for a ventilator.⁸ Nasal high-flow oxygen therapy (HFNC) allows the delivery of warm and humidified gases at a high flow rate and the appropriate fraction of inspired oxygen (FiO₂), is currently frequently used in patients with hypoxemic acute respiratory failure (HARF).⁹

A 2020 study showed that 28 patients with severe COVID-19 symptoms, 67.8% of patients with HFNC improved, 32.2% of patients failed using HFNC and needed NIV, 17.8% required intubation.¹⁰ HFNC also plays an important role in correcting hypoxemia in about two-thirds of patients with Covid-19. From previous studies, there has been no specific study for Covid-19 long hauler patients. This case study aims to determine the effect of oxygen therapy through HFNC on specific patient outcomes, namely improving breathing patterns, lowering respiratory frequency, increasing oxygen saturation and increasing blood oxygen pressure (PaO₂) of Covid-19 long hauler patients in critical care rooms.

METHODS

This study is a case study of nursing care using pre and post test conducted on 2 respondents with a descriptive approach method. The variable of this study was HFNC oxygen therapy on the respiratory function of Covid-19 long hauler patients. This study was conducted in the critical care room of Tugurejo Hospital on February 4-February 15, 2021.

Covid-19 patients whose PCR results were 2 times negative and/or patients who had a history of Covid-19 in the past were the population of this study. The subjects of this study consisted of 2 patients obtained by

purposive sampling. Sampling according to the inclusion criteria, namely long hauler Covid-19 patients with comorbid Diabetes Mellitus who had severe breathing problems, the patient was conscious and able to communicate. Exclusion criteria of the patient were no longer able to continue the study because of severe breathlessness, worsening of the condition and requiring mechanical ventilation.

The instruments in this case study were the HFNC machine, bed side monitor, oximetry, and blood gas analysis results. Data collection procedures: a) Determine the patient according to the criteria. b) Provide informed consent to prospective respondents. c) After the prospective respondent agrees to become a respondent, the researcher contracts the time to do the research. d) Record the breath pattern, measure the respiratory frequency, oxygen saturation, and record the measurement results in the respiratory function status column before being given intervention. d) Researchers provide intervention to respondents in the form of HFNC oxygen therapy with a flow of 60 L/minute and 90% FiO₂. e) Every day the patient is re-measured the respiratory function status until day 5. f) Record the measurement results in the respiratory function status column after the intervention. g) Give HFNC oxygen therapy in accordance with the development of the patient's condition every day.

RESULTS

The subjects of this case study were 2 people, consisting of male and female patients. Patient characteristics in both cases can be seen in Table 1 and the assessment results in both cases are shown in Table 2.

First case; A 52 years old male was admitted to the critical care room with complaints of severe shortness of breath, cough, swallowing pain, weakness, lack of appetite, desaturation and compos mentis

awareness. The patient had a history of diabetes mellitus with his blood sugar currently under control. The patient did not have fever, blood pressure and pulse rate were within normal limits. The results of laboratory tests of blood gas analysis obtained data on oxygen levels in the blood (PO₂) 45 mmHg, the P/F ratio of the results was 50 (severe ARDS), the D-dimer test was 2030 ug/L, the blood sugar when the results were 146 g/dl and X-rays. the result typically viral pneumonia. Physical examination obtained data on complaints of severe shortness of breath, respiratory rate 31 times per minute, 88% oxygen saturation, blood pressure 126/92 mmHg, pulse 100 times per minute and temperature 36.5 ° C. Diet Low in sugar and carbohydrates. The patient experienced major nursing problems as ineffective breathing patterns and impaired gas exchange. Patients received oxygen therapy through HFNC flow of 60 liters per minute and a concentration of 90%, ROX 3.19, heparin syringe pump 10,000 IU per 24 hours, meropenem injection therapy 500 mg per 8 hours, Novorapid 0-0-10 IU (SC) and bricasma inhalation therapy combined with heparin 25,000 IU every 6 hours. Acetyl cysteine oral therapy 3 times per day. The patient received RL/Tutofusin infusion therapy 30 drops per minute.

Second case; A 58 years old woman was admitted to the critical care room with complaints of severe shortness of breath, cough, swallowing pain, weakness, lack of appetite, desaturation, restlessness and compos mentis awareness. The patient had a history of diabetes mellitus with his blood sugar currently under control. The patient did not have fever, blood pressure and pulse rate were within normal limits. The results of laboratory examination of blood gas analysis obtained data on oxygen levels in the blood (PO₂) 45 mmHg, the P/F ratio was 50 (severe ARDS), ROX 2.95, the D-dimer examination was 2100 ug/L, blood sugar at 170 gr/dl and Chest X-ray results typically viral bilateral pneumonia. Physical examination obtained data on complaints of

severe shortness of breath, respiratory rate of 35 times per minute, oxygen saturation of 93%, blood pressure of 126/85 mmHg, pulse 80 times per minute and temperature of 36.3 ° C. Diet low in sugar and carbohydrates. The patient experienced major nursing problems as ineffective breathing patterns and impaired gas exchange. Patients received oxygen therapy through HFNC flow 60 liters per minute and a concentration of 90%, heparin syringe pump 10,000 iu per 24 hours, meropenem injection therapy 1 gram per 8 hours, Novorapid 14 IU per 8 hours (SC) and bricasma inhalation therapy combined with heparin 25,000 IU every 6 hours. Acetyl cysteine oral therapy 1 tablet per 8 hours. The patient received infusion therapy of RL/Tutofusin 20 drops per minute.

The nursing diagnoses that occurred in these 2 patients were ineffective breathing patterns and impaired gas exchange. Nursing problems that occur in physiological subcategory disorders are gas exchange disorders associated with increased airway resistance and decreased pulmonary complaints, hyperthermia associated with lung virus infections.^{11, 12} Nursing intervention given is to measure the frequency of breathing, increase oxygen saturation and increase oxygen pressure in the blood (PaO₂). Then the patient is given HFNC oxygen therapy according to the patient's needs.

Implementation of nursing measures: the patient's respiratory status is measured and

the results of laboratory tests. Then the patient was given HFNC oxygen therapy with initial parameters of flow 60 and FiO₂ 90% for 5 days. Evaluations are carried out every day to determine the progress of the patient's condition so that oxygen administration is tailored to the patient's needs.

Table 2 shows that 2 patients after being given HFNC oxygen therapy for 5 days experienced an improvement in the respiratory frequency of patient 1, namely from 26 times/ minute to 22 times/minute and patient 2 the frequency of breathing on the first day 35 times/ minute after day 5 to 19 times/minute. The breathing patterns of patients 1 and 2 on days 1 and 5 also experienced a change from shortness of breath to not shortness of breath. The oxygen saturation in patient 1 on the first day was 94% after day 5 to 97% and patient 2 on the first day 92% after day 5 to 99%. Laboratory results PO₂ of patient 1 first day 45 after day 5 to 99 and patient 2 on day 45 after day 5 to 164. Blood pH was within normal limits. The ROX index on day 5 in patient 1 became 8.82 and 10.42 in patient 2. The HFNC oxygen parameter decreased according to the development of the patient's condition each day. HFNC oxygen flow and FiO₂ in patients 1 and 2 on the first day were 60 L/min and 90% after day 5 the HFNC flow and FiO₂ oxygen in patient 1 were 40 L/min and 50%, the second patients were 30 and 50%.

Table 1
Patient characteristics

Indicators	Case 1	Case 2
Gender	Male	Female
Age	52 years old	58 years old
Comorbid	Diabetes Mellitus	Diabetes Mellitus
ROX	3.19	2.95

Table 2
Hemodynamic parameters and laboratory test results

Day	Case 1					Case 2				
	1	2	3	4	5	1	2	3	4	5
Parameter										
HFNC Flow	60	55	55	50	40	60	60	50	40	30
FiO ₂	90	80	70	60	50	90	90	80	60	50
pH	7.45	7.47	7.45	7.45	7.46	7.46	7.46	7.45	7.46	7.47
PO ₂	45	46	51	67	99	45	51	71	80	164
P/F ratio	50	57.5	72.8	111.6	198	50	56	88	133	328
Breathing pattern (dyspnea)	+	+	-	-	-	+	+	-	-	-
RR	26	26	21	26	22	35	26	24	22	19
SpO ₂	94	94	94	95	97	92	95	97	98	99
ROX index	4.02	4.52	6.39	6.09	8.82	2.92	4.06	5.05	7.42	10.42

DISCUSSION

The results of this case study indicate that after maximal administration of HFNC oxygen at the start of each day of administration it can be reduced according to the patient's oxygen requirements. After giving HFNC oxygen therapy to this Covid-19 long hauler patient also showed a decrease in breathing frequency, changes in breathing patterns from shortness to shortness of breath, increased oxygen saturation, and an increase in the ROX index, an increase in PO₂ and blood pH within normal limits.

Severe, progressive shortness of breath and complications of ARDS often experience a happy hypoxic condition characterized by compos mentis awareness, shortness of breath, desaturation and severe hypoxemia are symptoms that often occur in Long Hauler Covid-19 patients.¹³ This is in accordance with the conditions that occurred in this case study. The patient characteristics in this case study were diabetes mellitus patients. The phenomenon of Covid-19 and long hauler covid-19 patients requires intensive care and occurs in patients who have a history of diabetes mellitus because they have a very severe inflammatory response.¹⁴ The special surface glycoproteins in ACE2 are the entry port for the Covid-19 virus. ACE2 is abundant in the alveolar type II cells of the lungs. If the amount of ACE2 in excess can worsen the patient's condition. This can

lead to ARDS, damage to the liver, heart, kidneys, and even death. Patients with comorbid diabetes mellitus tend to be twice as likely to suffer from severe symptoms of COVID-19 and two times more likely to die from these symptoms.¹⁵

The principle of oxygen therapy with HFNC is based on a device capable of providing a high flow of oxygen demand through a warm and moist nasal cannula. This cannula can provide flows of up to 60 L/minute at a temperature of 31-37°C with an absolute humidity of 44 mg H₂O/L; FiO₂ varies between 21-100%. The advantages of HFNC include clearing the pharyngeal dead space, reducing respiratory effort, the effect of PEEP (Positive End-Expiratory Pressure), providing a constant fraction of inspired oxygen, patient comfort and improved muco-ciliary clearance. HFNC is also known to provide a low PEEP, which can improve the condition of patients with mild-to-moderate respiratory failure. In addition, by providing a warm, humidified gas, HFNC reduces the metabolic effort required to condition the air. HFNC is more tolerable than other ventilatory supports and reduces the incidence of intubation thus providing a good clinical prognosis in patients with acute respiratory failure.¹⁶

HFNC was also studied to have an important role in correcting hypoxemia in about two-thirds of patients with COVID-19 with severe hypoxemic respiratory failure who were unable to achieve SatO₂ ≥ 92% with

standard oxygen therapy. A study showed 28 patients with severe COVID-19 symptoms, about 67.8% of patients with HFNC improved and could be transferred to a normal room, 32.2% of patients failed using HFNC and needed NIV, 17.8% required intubation.¹⁰ This improvement in oxygenation is related to air flow that is in accordance with ventilation requirements, high and stable FiO₂, cleaning of the upper airways, the presence of positive pressure (PEEP), and providing warm and humid air. Patients with a PaO₂/FiO₂ ≤ 100 mmHg are at risk of failing HFNC therapy.¹⁰

This case study was the initial administration of HFNC oxygen therapy with a flow of 60 L/min and a FiO₂ of 90%. Every day the patient's condition shows an improvement in the status of respiratory function so that the HFNC oxygen therapy is gradually reduced. Until day 5, the HFNC oxygen therapy given was a flow of 40 L/min and FiO₂ of 50% in patient 1, flow of 30 L/min and FiO₂ of 50% in patient 2. A study also showed about 61.9% (65 subjects) patients show improved oxygenation and can be removed from HFNC.¹⁷ Assessment of the ROX index at 6 hours of HFNC administration provides a predictive value for the patient's oxygenation status and a predictor of the success of HFNC therapy.¹⁸ An ROX index of more than 5.55 at 6 hours of HFNC administration was associated with HFNC success (sensitivity 61.1% specificity 84.6%). This assessment can help the clinician to prevent a late intubation that will lead to a poor prognosis. An ROX index below 2.85 at 2 hours, below 3.47 at 6 hours and below 3.85 at 12 hours is a predictor of failure of HFNC therapy.¹⁹ In this case study, the ROX index results after administration of HFNC oxygen therapy on day 5 were 8.82 in patients and 10.42 in patients 2. The effectiveness and comfort of HFNC needed to be evaluated every 2 and 48 hours. Thrombocytopenia, increased IL-6 upon initiation of HFNC, ROX index <5.31 in the first 4 hours of HFNC therapy were independent predictors of failure of HFNC

therapy. Prolonged use of HFNC is not associated with a poor prognosis. APACHE II and PSI scores can be used to determine when intubation is needed so that it is not late.²⁰

CONCLUSION

Nasal high-flow oxygen therapy is proven to be an additional option and alternative method of respiratory support in Long Hauler Covid-19 patients. This is evidenced by an improvement in the respiratory function of Covid-19 long hauler patients in critical rooms after being given HFNC oxygen therapy. This case report shows the results of improvement in respiratory function while being treated in the critical care room receiving oxygen therapy through HFNC.

ACKNOWLEDGMENTS

We would like to express our gratitude to the director of the Tugurejo Hospital for giving permission to carry out this case study. Thanks also to the head of the nursing department who supported this case study, as well as the respondents who participated.

CONFLICTS OF INTEREST

Neither of the authors has any conflicts of interest that would bias the findings presented here.

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