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ROX Index Assessment of Success use of High Flow Nasal Cannula (HFNC) in Patients With Covid-19 at Haji Adam Malik Hospital Medan

Syahrir Supratman Hutabarat
Resident of the Department of Anesthesiology and Intensive Therapy, Faculty of Medicine, University of North Sumatra

Bastian Lubis, Dadik Wijaya
Department of Anesthesiology and Intensive Therapy, Faculty of Medicine, University of North Sumatra

Abstract:-
Introduction: The high incidence of COVID-19, the progressive nature of SARS-CoV-2 infection which can cause acute respiratory distress syndrome that affects the outcome of the disease, there is no effective management guide for COVID-19 especially for oxygenation therapy, and there is still controversy about use of high flow nasal cannula in COVID-19 patients.
Methods: This study is an observational analytic study with a retrospective cohort study design to assess the ROX index on the success of using a high flow nasal canule (HFNC) in COVID-19 patients treated at H Adam Malik Hospital Medan based on data from medical records of 70 people. This research was conducted in October-November 2021 at RSUP H Adam Malik Medan using data from April 2020-April 2021.
Results: In this study, the characteristics of the sample in this study had a mean age of 47 years. Based on gender, 35 men were found to be the most and based on comorbidities found in the most samples were DM and hypertension, 9 people with a length of stay of 6 days. In this study, the ROX index before the installation of HFNC obtained an average of 3.12 and after the installation of HFNC there was an increase in the average ROX index of 4.48. In this study, the successful installation of HFNC was 61 people out of a total of 70 samples.
Discussion: The ROX index can be helpful in identifying subjects who are more at risk for poorer outcomes. Therefore, early invasive mechanical ventilation can be used to prevent worse outcomes in patients with COVID-19-associated AHRF.

Keywords:- *ROX index, high flow nasal canule, NIV, ventilator, COVID-19.*

I. INTRODUCTION

At the end of 2019 the world was shocked by a new case of pneumonia with a rapidly increasing incidence, starting from China and then spreading to various regions in the world including Indonesia and especially in Medan. After some time it was discovered that the cause of the pneumonia was a new variant of the beta corona virus type corona virus which was later named Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) and the disease it caused was called Corona virus disease 2019 (COVID-19) (Sharma et al. al, 2020). Molecular detection examinations such as real time reverse transcriptase polymerase chain reaction with nasopharyngeal swab samples, sputum, tracheal aspirates, or bronchoalveolar lavage have become the standard for diagnosis of SARS-CoV-2 infection (Harapan et al, 2020).

Approximately 5% of patients with COVID-19 fall into a critical condition where there is respiratory failure requiring assisted ventilation in the intensive care unit. The need for intubation and mechanical ventilation in these patients is high, ranging from 71-90% while the number of COVID-19 patients is increasing very rapidly in a short time so that it can have an impact on the lack of required health facilities (Raoof et al, 2020). Therefore, the use of non-invasive ventilation techniques is an important requirement, one of which is the use of HFNC. However, the use of HFNC in the management of critically symptomatic COVID-19 patients is still controversial, some support its use as a first-line approach while some support early intubation (Procopio et al, 2020, Raoof et al, 2020).

A meta-analysis found that HFNC reduced the need for intubation without reducing mortality and length of stay in the intensive care unit (Karamouzos et al, 2020). HFNC is thought to play a role in improving hypoxemic conditions in 2/3 of severe COVID-19 patients. The use of HFNC does not appear to be inferior to noninvasive ventilators or intubation in critically ill patients and its use is more comfortable (Wang et al, 2020, Gurun et al, 2020).

Another study also found a positive response to HFNC in moderately hypoxemic patients while the failure rate increased as Pa02/Fi02 decreased (Montiel et al, 2020). However, some parties do not support the use of HFNC in COVID-19 because it is believed that non-invasive ventilation measures are associated with a high failure rate with aerosolization which increases the risk of virus transmission (Procopio et al, 2020). Another study stated that the use of HFNC was associated with further damage to the lung parenchyma compared to mechanical ventilation due to high oxygen fraction values without end-expiratory positive pressure (Setiawan et al, 2019). In China, experts recommend the use of HFNC in patients with Pa02/Fi02 150 mmHg (Duan et al, 2020). The ROX index was used to assess the success of HFNC use (Blez et al, 2020). Assessment of the ROX index at 6 hours of HFNC administration provides predictive value on the patient's oxygenation status and predicts the success of HFNC therapy (Panadero et al, 2020).

The high incidence of COVID-19, the progressive nature of SARS-CoV-2 infection which can cause acute respiratory distress syndrome that affects the outcome of the disease, there is no effective management guide for COVID-19 especially for oxygenation therapy, and there is still

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controversy about the use of high blood pressure, flow nasal canules in COVID-19 patients stated to be the actual interest in researching the success of using HFNC in COVID-19 patients, especially in patients treated at H. Adam Malik General Hospital, Medan.

II. METHODS

This study is an observational analytic study with a retrospective cohort study design to assess the ROX index on the success of using a high flow nasal canule (HFNC) in COVID-19 patients treated at H. Adam Malik Hospital Medan based on data from medical records of 70 people. This research was conducted in October-November 2021 at RSUP H Adam Malik Medan using data from April 2020-April 2021.

The inclusion criteria used in this study were patients diagnosed with COVID-19 who were treated in the Intensive Care Room at Adam Malik General Hospital Medan from April 2020 to April 2021 with a diagnosis of respiratory failure (PaO_2<55mmHg in free air) and received HFNC therapy. The decision to use HFNC was made by an Anesthesiologist who is a subspecialist in Intensive Therapy and aged 18 years. Exclusion criteria in this study were patients who were forced to go home or go home at their own request, incomplete medical records and have a history of chronic lung disease (lung tumors, COPD, and pulmonary TB).

The procedure of this research is in this study are as follows. This research was conducted after obtaining approval from the Health Research Medical Committee, Faculty of Medicine, Universitas Sumatera Utara/ RSUP H. Adam Malik Medan. Medical records of patients diagnosed with COVID-19 with respiratory failure who were admitted to the ICU/RITN RSUP H Adam Malik Medan from April 2020 to April 2021 were recorded and analyzed retrospectively, the data recorded included age, gender, comorbid factors, duration of treatment, HFNC therapy success, and ROX index value. The data were then collected and analyzed statistically.

Statistical analysis was performed using SPSS software. Data were normally distributed or not tested using the Kolmogorov-Smirnov test. Qualitative or categorical variables are described by frequency and percentage while quantitative or continuous variables are described by mean±standard deviation. For categorical variables, Chi-square and Fisher's exact tests were used. To assess the comparison of parameters used independent t-test or Mann-Whitney U'test. Pearson correlation analysis was used to assess the strength of the relationship between parameters and mortality. Receiver operating characteristic curves (ROC curve) and area under the curve (AUC) were calculated for parameters that were statistically significant correlated with outcomes. P value <0.05 is said to be statistically significant.

III. RESULTS

This study is an observational analytical study with a retrospective cohort study design to assess the ROX index on the success of using a high flow nasal canule (HFNC) in COVID-19 patients treated at H. Adam Malik Hospital Medan based on data from medical records.

Characteristics	Frequencies n 70 / %	P value
Age		
< 45 year	23 (32,9)	
– 59 year	34 (48,6)	0,01
> 60 year	23 (18,6)	
Gender,n (%)		
Male	44 (62,9)	
Female	26 (37,1)	0,01
Race,n (%)		
Acehnese	4 (5,7)	
Bataknese	24 (34,3)	
Javanese	27 (38,6)	
Malay	15 (21,4)	
Comorbidities, n (%)		
Absent	42 (60)	
DM	10 (14.3)	
Hypertension	10 (14.3)	
AKI + DM	1(1.4)	
AKI + Hypertension	1(1.4)	
AKI + CHF	1(1.4)	0,60
CKD	1(1.4)	
Hypertension + CHF	1(1.4)	
Hypertension + DM	3(4.3)	
Length of stay	6 ± 3.51	0,59

Table 1: Sample Characteristics

*Kolmogorov-Smirnov

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Based on Table 1 shows that the distribution of the characteristics of the sample in this study has a mean age of 47 ± 14.27 years and gender is mostly found in male as many as 44 people (62.9%) and female 26 people (37.1%) with a p value < 0.05 on the age and gender variables which means the data is not normally distributed. Based on the race, the highest number was found in the Javanese race of 27 (38.6%) and the Acehnese 4 (5.7%). Based on the comorbidities found in the sample the most were DM and hypertension 10 (14.3) people, while those who did not have comorbidities were 42 (60%). Based on the length of stay of the sample, it was found that the mean of the sample being treated was 6 ± 3.51 days. P value > 0.05 on the variables of race, comorbidities and length of stay which means that the data is normally distributed.

Characteristics	Frequencies n 70	P value
Flow	57.71 ± 6.40	[a]0,53
FiO2	92,17 ± 2.64	[a]0,43
ROX Index Before HFNC	3,12 ± 0,30	[a]0,09
ROX index 4 hours	4.48 ± 0,59	
HFNC Success		
Succeed	61 (87,1)	[b]0,01
Not successful	9 (12,9)	

Table 2: Characteristics Sample

[a]Kolmogorov-Smirnov, [b]Spearman

Based on Table 2 shows that the distribution of the characteristics of the sample in this study has a mean Flow value of 57.71 ± 6.40 HFNC installation while the FiO2 mean value of 92.17 ± 2.64 p value > 0.05 then the sample is normally distributed. Based on the characteristics of the sample in this study, the average ROX index was 3.12 ± 0.30 before HFNC installation, while the average ROX index was 4.48 ± 0.59 with a value of p = 0.09 (p> 0.05), which means that the data is normally distributed. Based on the success of HFNC, it was found that the successful sample was about 61 (87.1%) people while those who were not around 9 (12.9%) with a p value = 0.01 (p <0.05) which means that there is an effect of using HFNC in patients COVID-19 on the ROX index rating increase.

IV. DISCUSSIONS

In this study, the average ROX index was 3.12 ± 0.30 before HFNC applications, while the average ROX index was 4.48 ± 0.59. This is in line with previous studies that used ROX values in a group of patients who were successful using HFNC therapy and the group that was not successful found that at 24 hours of treatment a significant increase in ROX values was found in the successful group. However, no significant increase in ROX values was found at two hours post-treatment. This study concludes that HFNC therapy can be a modality of oxygen therapy in the management of respiratory failure. In this study, it was found that if the ROX value at the beginning of HFNC therapy was above 4.88, it had a better success rate. (Setiawan I, et al 2019).

Previous studies have shown that HFNC is a useful therapy for the management of patients with ARDS secondary to COVID-19. The main finding was that HFNC allowed us to treat ARDS successfully in the majority of patients (47.5%) without requiring invasive ventilation support and with low mortality. Therefore, the use of HFNC may be the first choice of treatment for ARDS because of its efficacy in avoiding intubation and associated complications. In addition, we have observed that the ROX index performs well in determining which patients require intubation after initiating HFNC. An ROX index of less than 4.94 measured 2 to 6 hours after initiation of therapy was associated with an increased risk of intubation (HR 4.03 [95% CI 1.18-13.7]; p=0.026). Therefore, it is a good tool for identifying patients whose therapy may fail and therefore are at high risk of requiring intubation(Panadero C, et. al 2020).

Research conducted by Roca et al. in 2019 showed that the ROX index in the first hours of assisted breathing was a predictor of the success of HFNC in avoiding intubation. In their study, an index higher than 4.88 after 12 hours of treatment predicted a lower risk of intubation. (Roussos C, et.al 2003) Another observational study with HFNC has shown an intubation rate of 40% in ARDS treatment, as well as better tolerance than NIV. Patients in this study underwent an average of three days of treatment (six in the group that did not require intubation, and two in the patients who were eventually intubated), suggesting that one of the success factors of this therapy is good patient tolerance. When compared with standard oxygen therapy and NIV, HFNC showed better results for the intubation rate of patients with PaO2/FiO2 of 200 mmHg. (Panadero C, et.al 2020 and Messika J, et.al 2015).

The results of the Ferrer S study in 2021 showed that the ROX index predicts the success of HFNC in patients suffering from severe pneumonia associated with SARS-CoV-2 with a score of 5.35 or under 24 hours after HFNC initiation. In addition, sequential respiratory support with HFNC and NIV as salvage therapy in failed HFNC to avoid endotracheal intubation or death in 58.82% of patients with COVID-19. (Ferrer S, 2021).

Recent studies have analyzed the performance of the ROX index for detecting HFNC failure in SARS-CoV-2-induced ARF, which shows a high discriminatory value for predicting HFNC failure within 24 hours after HFNC initiation, although this study was limited mainly by its retrospective design. Previous studies reported HFNC failure rates in SARS Fig CoV-2 patients between 38 and 55%, while NIV failure rates ranged from 44 to 72%. In

addition, our noninvasive strategy (HFNC-NIV) avoided the need for endotracheal intubation in 58.82% of patients. Wang et al. avoid ETI in 55% of patients with severe ARF. (K.Wang, 2020).

In this study, the success of HFNC was obtained in the successful sample of about 61 (87.1%) people while those who did not were around 9 (12.9%) with a p value of 0.01 (p <0.05). Whereas another study demonstrated the ROX index cut-off to predict the success of HFNC therapy in COVID-19, it was found that 6 hours after the onset of HFNC with a cut-off point of 5.55 was the most suitable predictor of HFNC success, although with a relatively low sensitivity (61.1%) and relatively high specificity (84.6%); in contrast, in this study, the best predictor of HFNC success was the ROX index 24 hours after the onset of therapy, with a cut-off point of 5.35, which resulted in a sensitivity of 91%, specificity of 79%, PPV of 0.92, and NPV of 0.79 (Zucman 2020, M.Hu 2020, and Panadero 2020).

A meta-analysis study showed that the ROX index has good discriminatory power for the prediction of HFNC failure in COVID-19 patients with acute hypoxemic respiratory failure. This meta-analysis also showed that the ROX index was able to differentiate with an sAUC value of 0.81 (95% CI, 0.77-0.84) with a sensitivity of 0.70 (95% CI, 0.59-0.80) and specificity. 0.79 (95% CI, 0.67–0.88) to predict HFNC failure in COVID-19 patients. Based on the studies included in the meta-analysis, the optimal threshold value may be close to 5 ROX indices within 24 hours of admission to predict HNFC failure. The ROX index measurement time between included studies ranged from 2 hours to 12 hours. Only two studies reported data for prognostic accuracy of the ROX index at 12 hours. (Prakash J, et.al 2021).

A study published by Lemiale et al. also observed that the maximum diagnostic accuracy and static measurement of the ROX index was at 6 hours. The findings of this study suggest that the ROX index can be helpful in identifying subjects who are more at risk for poorer outcomes. Therefore, early invasive mechanical ventilation can be used to prevent worse outcomes in patients with COVID-19-associated AHRF.

V. CONCLUSIONS

In this study, the characteristics of the sample in this study had an average age of 47 years. Based on gender, the most found male as many as 35 people and based on comorbidities found in the sample the most were DM and Hypertension 9 people with a length of stay of 6 days. In this study, the ROX index before the installation of HFNC obtained an average of 3.12 and after the installation of HFNC there was an increase in the average ROX index of 4.48. In this study, the successful installation of HFNC was 61 people from a total of 70 samples.

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