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CLINICAL CHARACTERISTICS AND OUTCOME OF PATIENTS ON NON-INVASIVE VENTILATION VIA NASAL PRONGS IN PEDIATRIC INTENSIVE CARE UNIT

Paediatrics

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ABSTRACT

Background: Non-invasive ventilation (NIV) has become an essential tool in the treatment of both acute and chronic respiratory failure in children. This study aimed to determine the efficacy of NIV usage via si in pediatric patients who were admitted to the Pediatric Intensive Care Unit (PICU) with respiratory failure. **Design -**Prospective observational study. **Participants and Methods:** The data were collected from the PICU patients at our hospital in a predesigned proforma from july 2020 to December 2020. The inclusion criteria were all patients aged one month to 14 years old. This research data included a primary characteristic of the subject such as age, gender, nutritional status, diagnosis, the Pediatric risk of mortality score (PRISM), interface, duration of usage, and mortality incidence. The data was analyzed and presented descriptively using Microsoft Excel 2017 software tool. **Outcome: -** Successful NIV was defined as patients who survived without intubation. Failure was defined as worsened patients and needed intubation for the rescue. **Results:** The total subjects of this study were 108 patients. The most common indication for NIV was encephalopathy (57%). The data shows that the NIV was commonly used after extubation (49%) than for the first-time rescue (51%). The success rate of NIV after extubation were 84% and 16% failed and shifted to mechanical ventilation. The duration of NIV usage was less than two days (58%). **Conclusion:** NIV is a useful tool for the treatment of respiratory failure in pediatrics. The use of post-extubation NIV may be a valuable tool to prevent reintubation.

KEYWORDS

NIV, non-invasive ventilation, PICU, CPAP

INTRODUCTION

Non-invasive ventilation (NIV) refers to the use of non-invasive techniques to deliver artificial respiration to the lungs without the need for endotracheal intubation. As NIV has proven beneficial in comparison to invasive mechanical ventilation, it has become the optimal modality for initial respiratory support among children with respiratory distress. The first use of non-invasive techniques in the adult population was in the late 1980s.1

NIV is primarily used to avoid the need for endotracheal intubation in patients with early-stage acute respiratory failure and post-extubation respiratory failure. By definition, it is a non-invasive technique, which can be applied on demand, causing less morbidity, and discomfort. It also allows preserving essential functions such as swallowing, feeding, speaking, and coughing. Heating and humidification of the inspired air are greatly respected. The primary goal of using NIV is to improve oxygenation by improving functional residual capacity and lung inflation in patients with an adequate respiratory drive.2

Techniques for NIV include continuous positive airway pressure (CPAP), bilevel positive airway pressure (BPAP), and more recently, a high-flow nasal cannula (HFNC). NIV improves the effective minute ventilation enhancing CO2 elimination by augmenting inspiration in patients with respiratory failure or impending respiratory failure without the use of an artificial airway.3

The majority of NIV in pediatric patients is utilized for the treatment of imminent respiratory failure associated with acute or chronic respiratory insufficiency secondary to pulmonary disease, neuromuscular disease, airway obstruction, infectious processes, or post-extubation management or to avoid intubation or reintubation. NIV is not appropriate for patients with respiratory arrest, hemodynamic instability, multiple organ failure, recent upper airway or upper gastrointestinal surgery or bleeding, excessive sputum production or a diminished cough reflex or swallowing impairment. As mentioned above, uncooperative or agitated patients are also not eligible for using NIV.4

The advantages of NIV are widely reported in the scientific literature. It is much safer than invasive mechanical ventilation. Compared to invasive ventilation, NIV lowers the risk of laryngeal swelling, post-extubation vocal cord dysfunction, barotrauma, and ventilator-associated pneumonia. One can communicate with the patient and does not require deep sedation.5 Complications of NIV include skin breakdown, gastric distention, interface discomfort, and nasal injury.6 On the other hand, the successful of NIV is determined by the selection of interfaces, good trained medical teams, and observation.

This study aimed to determine the efficacy of NIV in pediatric patients who admitted to PICU with respiratory failure since the study of using NIV in Indonesia has not been widely studied.

PATIENTS AND METHODS

The data were collected from the PICU patients at our hospital in a predesigned proforma from july 2020 to December 2020. The inclusion criteria were all patients aged one month to 14 years old. This research data included a primary characteristic of the subject such as age, gender, nutritional status, diagnosis, the Pediatric risk of mortality score (PRISM) score at admission, interface(which is being made with nasal prongs connected to ventilator with ET adopter) duration of usage, and mortality incidence. The data was analyzed and presented descriptively using Microsoft Excel 2017 software tool.

Outcome: - Successful NIV was defined as patients who survived without intubation. Failure was defined as worsened patients and needed intubation for the rescue.

RESULTS

The most common age group used the NIV was below two years old. The male-to-female ratio was 1.7:1. The characteristics of the study subjects are presented in Table 1. In our hospital, we have introduced the HFNC since a few years ago. It is a relatively new, non-invasive ventilation therapy that seems to be well-tolerated in children.

In this study, the most common conditions that needed NIV was post-extubation patients. There were, however, some patients required re-intubation after using the NIV.

Table 1 Characteristics of the study

Variable	n = 108
Age, n (%)	
0-2 years	41 (37.9)
2-5 years	39 (36.1)
6-13 years	28 (25.9)
Sex, n (%)	
Male	68(62.9)
Female	40 (37)
Nutritional status, n (%)	

Well-nourished	50 (46,29)
Mod Malnourished	48(44.4)
Severe malnutrition	20 (18.5)
The presence of ARDS, n (%)	
Present	20 (18.21)
Absent	88(81.48)
PRISM Score , n (%)	
< 10	75 (69.44)
≥ 10	33 (30.55)
The background of NIV application, n (%)	
Successful NIV	90 (83.33)
NIV failure	18(16.6)
The duration of NIV, n (%)	
≥ 48 hours	45 (41.6)
< 48 hours	63 (58.33)
Mortality	
No	80(74.07)
Yes	28 (25.92)

Table 2 The clinical diagnosis of pediatric patients who used NIV

Variable	n = 108
Respiratory diagnoses, n (%)	
Pneumonia	28 (25.9)
Aspiration pneumonia	2 (1.8)
Non-Respiratory diagnoses, n (%)	
Neurology	62(57.4)
CVS	10 (9.2)
Gastrohepatoenterology	2 (1.8)
Hematology	6 (5.5)

DISCUSSION

In this study, we found that the almost equal number of patients were well-nourished and malnourished. Schleder et al.8 had concluded that nutritional status was not related to the time of permanence under invasive mechanical ventilation.

In this study, it showed that the majority of respondents were developing ARDS. The use of NIV for the treatment of ARDS remains controversial. A previous study has demonstrated that approximately half of their patients were spared adjusted. from endotracheal intubation through the application of NIV. The result was similar to the meta-analysis reported by Agarwal et al., that the severity of the disease was significantly higher in patients who received invasive ventilation only compared to NIV only, although there were no significant differences in the PICU's length of stay. Patel et al. evaluated ARDS patients submitted to NIV and drew attention to the importance of the NIV interface. They discussed their interesting findings focusing also on the ventilator settings and the current barriers to lung protective ventilation in ARDS patients during NIV.9
Table 2 showed that Neurological diseases was the most typical disease that required NIV.

In this study, the most frequent causes used NIV was neurology disease. According to previous journals and literature, the causes of respiratory failure in the children supported by NIV were chronic diseases-infection, neuromuscular diseases, renal transplantations-immunosuppression, leukemias, and respiratory infections.11 In the previous study, they found a few types of the underlying malignancy (leukemia, lymphoma, solid tumor) that did not associate with NIV success or failure.12 Piastra et al. had found that organ cancers were determinant evident for NIV failure in critically care children.13

In this study, the PRISM score was calculated on the first day the patients used NIV. The most frequent values of PRISM score in this study was <10. Bernet et al.14 similarly did not find differences in PRISM between patients managed successfully and unsuccessfully on NIV, whereas Essouri et al. using PELOD and Paediatric Risk of Mortality (PRISM) scores have shown a correlation between these prognostic severity scores and prediction of NIV success.15

In this study, although there are several subjects that demonstrated failure from the NIV, the number of successes from using the NIV is also significant. This is certainly in accordance the to another report that studied the early use of NIV on the PICU may serve as a first line interventional tool to prevent intubation.16

In this study, there was the commonest used NIV for less than two days. NIV support median duration was 48 hours and in the successful group (no reintubation), the average NIV duration was 48 hours while this was 20 hours in the unsuccessful group (with re-intubation). Besides that, in this study, there was 25% death after used NIV.

The limitation of this study is related to its limited number of subjects. Also, there are no description of the NIV setting, patients' and ventilator-free day outcomes. A further study is needed to describe the utilization of NIV in children, determinate the efficacy of NIV, and describe its safety profile in PICU patients.

CONCLUSION

NIV is a useful tool for the treatment of respiratory failure in pediatrics. The use of post-extubation NIV may be a valuable tool to prevent reintubation.

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