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Retrospective analysis of the use of high-flow nasal cannula in pediatric emergency patients

Análise retrospectiva do uso de cânula nasal de alto fluxo em pacientes da emergência pediátrica

Análisis retrospectivo del uso de cánulas nasales de alto flujo en pacientes de urgencias pediátricas

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Abstract
Objective: to analyze the clinical outcome of patients admitted to a pediatric emergency unit after using a high-flow nasal cannula. **Methods:** this was a quantitative, retrospective, descriptive study with medical record analysis. Data on age, sex, diagnosis, comorbidities, length of hospital stay, and clinical outcome were collected and organized and analyzed using descriptive statistics, with calculation of means and frequencies. **Results:** of 94 children, 28 used a high-flow nasal cannula; 71.4% were male, with a mean age of 12.6 months. Most were previously healthy (67.9%). The most common diagnosis was acute viral bronchiolitis (92.9%). The mean length of hospital stay was 7.9 days, and three children required mechanical ventilation, having previously used a high-flow nasal cannula. **Conclusion:** the high-flow nasal cannula was effective in stabilizing respiratory distress in most cases, especially in infants with acute viral bronchiolitis. New studies are needed to improve indication criteria and identify factors for failure.
Keywords: Cannula; Oxygen Inhalation Therapy; Child.

Resumo
Objetivo: analisar o desfecho clínico de pacientes admitidos em uma unidade de emergência pediátrica após uso do cânula nasal de alto fluxo. **Método**: estudo quantitativo, retrospectivo e descritivo com análise de prontuário. Foram coletados dados de idade, sexo, diagnóstico, comorbidades, dias de internação e desfecho clínico, organizados e analisados por estatística descritiva, com cálculo de médias e frequências. **Resultados**: das 94 crianças, 28 fizeram uso do cateter nasal de alto fluxo; 71,4% eram do sexo masculino, com média de idade de 12,6 meses. A maioria era previamente hígida (67,9%). O diagnóstico mais comum foi bronquiolite viral aguda (92,9%). O tempo médio de internação foi 7,9 dias, e três crianças necessitaram ventilação mecânica, com uso prévio de cânula nasal de alto fluxo. **Conclusão**: o cateter nasal de alto fluxo foi eficaz na estabilização do desconforto respiratório na maioria dos casos, principalmente em lactentes com bronquiolite viral aguda. Novos estudos são necessários para aprimorar os critérios de indicação e identificar fatores de insucesso.
Palavras-chave: Cânula; Oxigenoterapia; Criança.

Resumen
Objetivo: analizar el desenlace clínico de los pacientes ingresados en una unidad de urgencias pediátricas tras el uso de una cánula nasal de alto flujo. **Método**: estudio cuantitativo, retrospectivo y descriptivo con análisis de historias clínicas. Se recopilaron datos sobre edad, sexo, diagnóstico, comorbilidades, días de hospitalización y resultado clínico, que se organizaron y analizaron mediante estadística descriptiva, con cálculo de medias y frecuencias. **Resultados**: de los 94 niños, 28 utilizaron el catéter nasal de alto flujo; el 71,4 % eran de sexo masculino, con una edad media de 12,6 meses. La mayoría estaban previamente sanos (67,9 %). El diagnóstico más común fue bronquiolitis viral aguda (92,9 %). La estancia media fue de 7,9 días, y tres niños necesitaron ventilación mecánica, con uso previo de cánula nasal de alto flujo. **Conclusión**: el catéter nasal de alto flujo fue eficaz para estabilizar la dificultad respiratoria en la mayoría de los casos, especialmente en lactantes con bronquiolitis viral aguda. Se necesitan nuevos estudios para mejorar los criterios de indicación e identificar los factores de fracaso.
Palabras-clave: Cánula; Terapia por Inhalación de Oxígeno; Niño.

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INTRODUCTION

A high-flow nasal cannula (HFNC) is a device that delivers heated and humidified air at high flow rates. The fraction of inspired oxygen (FIO_2) is adjusted to adapt oxygen levels[1]. The high flow generates a certain level of airway pressure, in addition to flushing out dead space in the upper airways, reducing the work of breathing, and improving gas exchange[2].

In the last decade, HFNC has been gaining increasing acceptance and being adopted in the treatment of patients of all ages[3]. Its installation is simple and quick, and the heating and humidification of the gas promotes better patient tolerance of the cannula and comfort for children[4]. Initially, among the pediatric population, it was used to treat infants with viral bronchiolitis. Over time, based on its efficacy, the device has also been used to treat children with pneumonia and asthma[5].

To date, there are no guidelines demonstrating which patients should receive HFNC; the indications are similar to those for Continuous Positive Airway Pressure (CPAP). The choice of HFNC may affect the prognosis of patients whose true indication is invasive respiratory support, so the indication must be as precise as possible[6]. Therefore, there is a need to identify the patient population that will benefit from HFNC, compared to other respiratory support modalities[7].

Recent studies indicate that HFNC improves oxygenation and reduces the need for mechanical ventilation in neonates and children[8]. However, it is important to conduct larger, randomized clinical trials to determine the exact role of HFNC in the various subgroups of patients with respiratory failure[3]. Therefore, this study aimed to analyze the clinical outcomes of patients admitted to a pediatric emergency unit after use of a high-flow nasal cannula.

METHODS

This is a quantitative, retrospective, descriptive study analyzing the medical records of patients admitted to the pediatric emergency department of a leading university hospital. Data were collected from participants' medical record numbers, obtained through a multidisciplinary census generated daily in the hospital system from Monday to Friday in April, May, and June 2023.

Patients prescribed physical therapy and who used HFNC were included. Sociodemographic variables such as age and sex, the child's diagnosis upon hospitalization, and whether the child had any comorbidities or was previously healthy were collected. Data were

collected on the number of days of hospitalization, and whether oxygen therapy, noninvasive ventilation (NIV), or invasive mechanical ventilation were required after use.

The collected data were organized in a Microsoft Excel® spreadsheet and analyzed using descriptive statistics. Numerical variables, such as age and length of hospital stay, were expressed using simple arithmetic means. Categorical variables were presented in absolute numbers and percentages, allowing for the characterization of the patients' clinical profile.

The study was approved by the Research Ethics Committee of the Faculdade de Medicina de São José do Rio Preto (FAMERP) under protocol number 6,635,104.

RESULTS

Of the 94 children admitted to the emergency department with a prescription for respiratory therapy, 66 (69.9%) did not require HFNC. Therefore, 28 children (30.1%) who used the device were included. The mean age was 12.6 months, and the mean length of hospital stay was 7.9 days. The sociodemographic data, comorbidities, and diagnoses upon hospitalization of the analyzed children are presented in Table 1.

Table 1. Sociodemographic data, comorbidities, and hospitalization diagnoses of Pediatric Emergency patients using high-flow nasal cannula (N=28). São José do Rio Preto/SP, Brazil, 2023.

Variable		n	%
Sex	Female	9	28.6
	Male	19	71.4
Age	12 months	14	50.0
	9 months	7	25.0
	8 months	1	3.6
	10 months	2	7.1
	11 months	2	7.1
	24 months	1	3.6
	48 months	1	3.6
Comorbidity	None	19	67.9
	Premature	6	21.4
	Cardiopathy	2	7.1
	Trisomy 21	1	3.6
Hospitalization diagnosis	Acute viral bronchiolitis (AVB)	26	92.9
	Pneumonia	2	7.1

Of the 28 children considered, three progressed to mechanical ventilation, two were previously healthy and one had trisomy 21. The clinical outcome, with data regarding the child's progress in relation to the use of HFNC with oxygen support and the percentage of inspired

fraction used or orotracheal intubation (OTI) with mechanical ventilation (MV) are presented in Table 2.

Table 2. Clinical outcome of Pediatric Emergency patients previously using high-flow nasal cannula (N=28). São José do Rio Preto/SP, Brazil, 2023.

Outcomes		n	%
Spontaneous breathing		23	82.1
Nasal catheter		2	7.1
Mechanical ventilation		3	10.7
HFNC O^2 levels	FiO_2: 40%	1	3.6
	FiO_2: 35%	1	3.6
	FiO_2: 30%	10	35.7
	FiO_2: 28%	2	7.1
	FiO_2: 25%	7	25.0
	No O^2	7	25.0

*O^2: Oxygen; HFNC: High-flow nasal cannula.

DISCUSSION

The results of this study showed a higher number of hospitalizations of male patients and infants up to 24 months old, similar to a study that analyzed the profile of hospitalizations for respiratory causes, of which 55.2% of patients were male and 55.8% were infants[9].

Regarding the diagnosis, of the 28 children, 26 had AVB and two had pneumonia. Acute bronchiolitis is the most common infection in infants and is one of the main causes of hospitalization in children under 6 months old, with a higher incidence in the fall and winter months[10]. The months in which data collection occurred (April to June) corresponded to a period with a high number of admissions for this diagnosis at the hospital studied.

The main comorbidity observed was prematurity, with six individuals (21.4%). Premature infants, with a gestational age of less than 36 weeks, have a high risk of developing severe bronchiolitis, requiring prolonged hospitalizations and intensive care unit stays[11]. Despite this, none of the three infants who progressed to mechanical ventilation were premature. Two of them were previously healthy, one had trisomy 21 (Down syndrome), and no deaths occurred.

It is known that respiratory syncytial virus (RSV) bronchiolitis has a high prevalence and severity rate in patients with Down syndrome, usually requiring prolonged hospitalization[12].

A retrospective study of 243 hospitalized children with respiratory distress and treated with HFNC found a failure rate of 11.9%, and observed that failure rates and their predictors differ between studies, likely due to methodological differences[6].

Despite the need for HFNC, seven infants (25%) did not require it. Oxygen, that is, HFNC was used with an oxygen concentration of 21%. Data indicate that in the case of acute

bronchiolitis, there is no need for oxygen therapy if blood oxygen saturation is greater than 90%[13].

A systematic review that analyzed eight clinical trials with 654 full-term newborns compared HFNC with CPAP and low-flow nasal cannula. Regarding CPAP, there were no significant differences in treatment failure, duration of support, or length of ICU stay, although HFNC may reduce nasal trauma and abdominal distension, with limited evidence. Compared to low-flow cannula, it showed a slight reduction in treatment failure, with no impact on other outcomes. The quality of the evidence ranged from moderate to very low, limiting the development of definitive guidelines[15].

CONCLUSION

It was observed that most children who used HFNC in the pediatric emergency room were male, and the average age was 12.6 months. The primary diagnosis was AVB, and there was a low rate of need for other ventilatory support and invasive mechanical ventilation.

The rate of need for invasive mechanical ventilation was low, suggesting that, in the context studied, HFNC may have contributed to stabilizing respiratory distress. HFNC tends to be more effective in less severe clinical conditions. Therefore, the adoption of instruments that allow for a more accurate assessment of disease severity may favor the definition of more appropriate criteria for the use of the device.

This study has limitations, such as the small sample size and the short time allotted for data collection. Patients with a prescription for respiratory therapy were included, although most children using HFNC had physical therapy prescribed by their physician. There was no guarantee that all children admitted during the study period were included in the study.

Nevertheless, it can provide data on the characteristics of pediatric patients who used HFNC in pediatric emergencies and contribute to the future development of guidelines and care protocols. Further research is needed to more accurately determine the indications for its use and the predictors of failure of this treatment.

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