



Comparison between non-invasive ventilatory support nasal CPAP versus high-flow nasal cannula in neonates with respiratory distress syndrome. A single-center observational study.

Joseline Deyanire Triviño Carranza ¹ , Limberg Steven Vera Vera ¹ , Carlos Alfredo Venegas Arteaga ¹ 
1. School of Medicine, Faculty of Sciences Medical, Catholic University of Santiago de Guayaquil, Ecuador.

Abstract

Introduction: Respiratory distress syndrome in newborns is an acute respiratory condition that frequently affects premature and preterm infants, with increasing severity as gestational age decreases. Currently, treatment options exist, including nasal CPAP and high-flow nasal cannula (HFNC). The objective of this study was to compare nasal CPAP with high-flow nasal cannula as initial methods of non-invasive ventilatory support in premature infants with respiratory distress syndrome.

Methodology: A quantitative, cross-sectional, retrospective analytical study that analyzed the medical records of 162 neonatal patients treated at the Guasmo Sur General Hospital during the period 2017-2019.

Results: Complications were evaluated in the patients in the sample. The most frequent complications were abdominal distension and nasal injuries, occurring in 27.8% (n=45) and 27.2% (n=44) of the sample, respectively. More serious complications, such as pneumothorax, occurred in 2.5% of cases (n=4). It is important to note that 42.6% of cases did not develop ventilation-related complications (n=69).

Conclusions: The type of ventilatory support is directly associated with PaO₂/FiO₂ control in premature infants with Respiratory Distress Syndrome, with CPAP showing the most significant increase in this parameter, whereas HFNC is associated with fewer complications.

Keywords :

CPAP, FHNC, Neonatal, Ventilatory, Non-invasive, Prematurity, Respiratory Distress Syndrome.

Abbreviations

CPAP: stands for "continuous positive airway pressure".
HFNC: High-flow nasal cannula.

Supplementary information

No supplementary materials are declared.

Acknowledgments

We thank the administrative staff of the Guasmo Sur General Hospital, where the study was conducted.

Authors' contributions

Luz Pilar Alcívar Solórzano: Conceptualization, Research, Writing – original draft, Resources, Software, Supervision.

Patricia Geoconda Álava Moreira: Methodology, Data Curation, Formal Analysis, Fundraising, Project Management, Validation, Visualization, Writing – Review and Editing.

Financing

The authors funded this research.

Availability of data and materials

The datasets used and analyzed during this study are available to the corresponding author upon reasonable request.

Introduction

Respiratory distress syndrome is an acute respiratory condition that primarily affects preterm infants [1]. Its occurrence and severity increase as gestational age decreases; it mainly affects infants born before 32 weeks' gestation, with 50% of cases happening between 26 and 28 weeks' gestation. The condition is more common in males, infants born via cesarean section, and second twins [1].

Non-invasive mechanical ventilation (NIMV) is currently the preferred treatment for most patients with acute respiratory failure [2]. Therefore, oxygen therapy is indicated when acute or chronic hypoxemia occurs, with a pO_2 below 55–60 mmHg, which corresponds to a hemoglobin saturation of 90%. Below these levels, hemoglobin's affinity for O_2 decreases rapidly, reducing the total O_2 content and its delivery to tissues [3].

High-flow nasal cannula (HFNC) is increasingly used and accepted as a respiratory support method in the pediatric population because of its benefits for oxygenation, ventilation, and patient comfort [4]. Continuous positive airway pressure (CPAP) has shown effectiveness in neonatal respiratory distress, apnea, bronchiolitis, and pulmonary edema [5]. This study raises the following research question: Is HFNC more effective than the standard of care for non-invasive ventilation (conventional nasal CPAP) in newborns with respiratory distress syndrome at birth? We conducted an observational study to answer this question.

Materials and methods

Studio design

This study is observational. The source is retrospective.

Scenery

The study was conducted in the Statistics Department of Guasmo Sur General Hospital, a facility of the Ministry of Public Health of Ecuador, located in Guayaquil, Guayas Province, Ecuador. The research period ran from January 1, 2017, to December 31, 2019.

Participants

Records of neonatal patients aged 27 to 37 weeks of gestation with respiratory distress syndrome and an indication for non-invasive ventilation, admitted to the Neonatal Intensive Care Unit, were included. Records of incomplete cases were excluded.

Variables

The variables included age, sex, birth weight, clinical manifestations, Downes scale, arterial oxygenation, oxygen saturation, PAFI measurement, and ventilation complications in both modalities (CNAAF and HFNC).

Data sources/measurements

The source was indirect; an electronic form was completed using data from the institutional medical record. For the case search, multiple searches were conducted for patients diagnosed with respiratory distress syndrome, utilizing the following ICD-10 codes and diagnoses derived from J80: P22.0 (Respiratory distress syndrome of the newborn [RDN]), P22.1 (transient tachypnea of the newborn), P22.8 (other respiratory distress of the newborn), and R06.03 (Acute respiratory distress [unspecified]).

Biases

Observation and selection bias were avoided by applying participant selection criteria. To prevent potential interviewer, information, and memory biases, the principal investigator adhered to guidelines during data collection and maintained records in accordance with the research protocol. Two researchers independently analyzed each record twice, and variables were entered into the database after confirming their consistency.

Study size

The sample was probabilistic. In 2024, among the 215,714 live births in Ecuador, 43,436 occurred in Guayaquil. With a rate of 5.1 preterm infants per 1,000 live births, the study population had 221 preterm infants annually, totaling 663 over the 3 years. Using a 95% confidence level, a 5% margin of error, and an expected NICU admission rate of 16.3%, the calculated sample size was 159. Data collection was conducted using Epi Info™ version 7.2 (CDC, Atlanta, March 9, 2025).

Quantitative variables

The variables were treated as continuous, using their full original distributions; for example, age was modeled as a continuous variable in a regression. No mathematical transformations (such as logarithms or square roots) were applied. Outliers were identified with a Tukey diagram, and extreme values were checked against primary sources. Missing data was handled by excluding those cases. No dichotomization or categorization of the continuous variables was performed.

Statistical analysis

Qualitative variables were analyzed using frequencies and percentages. The statistical software used was IBM SPSS Statistics for Windows, Version 26.0, released in 2018 by IBM Corp., Armonk, NY.

Results

Participants

A total of 162 patients who met the inclusion criteria were analyzed, allowing us to achieve 100% of the sample size calculation.

Characteristics of the study group

There were 97 patients in the CPAP group and 65 in the HFNC group. Sixty cases in the CPAP group (61.9%) and 39 in the HFNC group (60%) were male (Table 1). The largest proportion of patients weighed <2.5 kg (68.5%).

Table 1. Description general of patients.

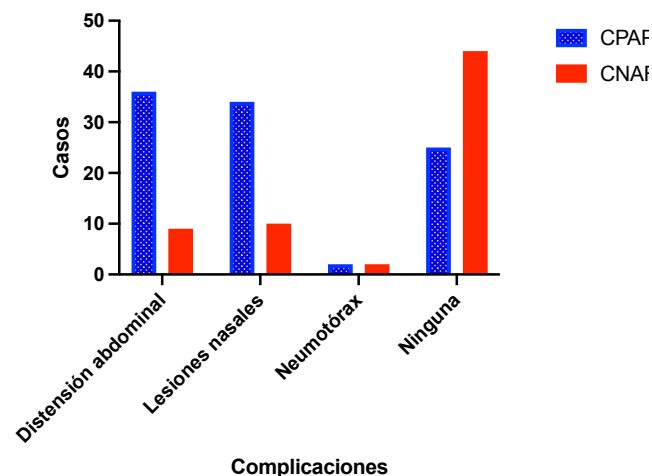
	CPAP N=97	HFNC N=65	Total n=162
Man	60 (61.9%)	39 (60.0%)	99 (61.1%)
Gestational Age	33.9 ± 1.4	32 ± 1.2	33.6 ± 1.3
Weight 2.5 to 4 Kg	30 (30.9%)	21 (32.3%)	51 (31.5%)
Weight < 2.5 kg	67 (69.1%)	44 (67.7%)	111 (68.5%)
Mild Downes	33 (34.0%)	22 (33.8%)	55 (34.0%)
Moderate Downes	22 (22.7%)	14 (21.5%)	36 (22.2%)
Severe Downes	42 (43.3%)	29 (44.6%)	71 (43.8%)

X², HFNC: High-flow nasal cannula.

Clinic

The distribution of Downes scale scores for respiratory distress severity was severe in 43.8%, moderate in 22.2%, and mild in 34% of cases (Table 1). The most common symptoms and signs were intercostal retractions (78.5%), tachypnea (69.1%), nasal flaring (44.6%), and cyanosis (34%) (Table 2). The PAFI of 400–500 was higher in the CPAP group (63.9%) than in the HFCN group (15.4%; P<0.001) (Table 2).

Figure 1. Incidence of complications..



Complications.

The High Flow Nasal Cannula group had the fewest complications (67%) compared with 25.8% in the CPAP group (P<0.001) (Figure 1 and Table 3).

Table 2. Clinical description of patients with respiratory distress.

	CPAP N=97	HFNC N=65	P
Intercostal retraction	76 (78.4%)	51 (78.5%)	1.0
Nasal flaring	43 (44.3%)	29 (44.6%)	1.0
Tachypnea	67 (69.1%)	45 (69.2%)	1.0
Cyanosis	33 (34.0%)	23 (35.4%)	1.0
PAFI 400-500	62 (63.9%)	10 (15.4%)	P<0.001
PAFI 300-399	35 (47.4%)	42 (64.6%)	
PAFI 200-299	0 (0%)	13 (20.0%)	

X², P=0.69

Table 3. Description general of the complications in the study groups.

	CPAP N=97	HFNC N=65	P
Abdominal distension	36 (37.1%)	9 (13.8%)	0.0013
Nasal injuries	34 (35.1%)	10 (15.4%)	0.0058
Pneumothorax	2 (2.1%)	2 (3.1%)	0.6832
None	25 (25.8%)	44 (67.8%)	<0.0001

X², P=0.69

Discussion

This research was conducted with the primary objective of comparing CPAP and HFNC ventilation in premature infants with respiratory distress syndrome. To this end, a comparison was made between the results obtained and those reported in recent studies with similar characteristics. Beginning with the epidemiological characterization of the evaluated patients, it was observed that males were the most prevalent sex, accounting for 61.1% of cases, and that the gestational age of 33-34 weeks had the highest incidence [6]. This study highlights males as the most frequently affected sex, indicating a slightly higher prevalence of 68.3% of cases. Regarding age, the author stratified by age group, highlighting those under 34 weeks as the most frequent, consistent with prior reports [7].

Regarding the patients' clinical characteristics, birth weight below 2.5 kg was the most prevalent, affecting 68.5% of the sample, and a Downes score indicative of severe respiratory distress syndrome was present in 43.8% of cases. Cárdenas [8], in his study conducted in Central America, highlighted premature infants with low birth weight as one of the most frequent factors in the development of acute respiratory distress syndrome, accounting for 74.2% of cases. In terms of severity, moderate cases were the most frequent, at 49.3%, according to reports [9].

A key advantage of this study is its representative sample size, which provides a larger confidence interval for the results. Furthermore, the case evaluation extends beyond a simple description of the clinical and epidemiological factors of patients requiring ventilatory support. It also compares improvements in clinical condition, assessed by the PaO₂/FiO₂ ratio, with the development of complications. This provides valuable information that informs updates to management protocols for patients with respiratory distress.

However, a limitation of the study is that it did not account for other variables that could affect comparisons between these types of ventilatory management, such as patient comorbidities or surfactant use during hospitalization. These factors can influence the patient's outcome and discharge status. Therefore, it is recommended that this study be replicated in other hospitals nationwide and that these variables be further evaluated.

Finally, in comparison, it was determined that the type of ventilation is indeed associated with the PaO₂/FiO₂ ratio, as 86% of cases with a PaO₂/FiO₂ ratio greater than 400 corresponded to patients using nasal CPAP. In terms of complications, high-flow nasal cannula (HFNC) was associated with a lower rate of complications. Llumiguano and Guairacaja [10] report complications associated with ventilatory support,

which they estimate to be frequent, consistent with the findings in this study. Quimi [9], in a study conducted in Ecuador, concurs that the use of HFNC is associated with fewer complications in patients. No studies were found that establish an association between these variables and the type of ventilation [9, 10].

Based on the study carried out on 162 neonatal patients between 27 and 37 weeks of gestational age with a diagnosis of respiratory distress syndrome treated in the NICU department of the Guasmo Sur General Hospital, the hypothesis was confirmed because the use of the non-invasive ventilatory device High flow nasal cannula (HFNC) produces fewer complications compared to nasal CPAP, which is more effective in relation to PAFI.

Conclusions

It is concluded that male sex and gestational age between 33 and 34 weeks are the epidemiological factors most strongly associated with the development of respiratory distress syndrome requiring ventilatory support. Birth weight below 2.5 kg and high severity of the condition, according to the Downes Scale, are the most prevalent clinical factors in cases of respiratory distress syndrome in premature infants. The type of ventilatory support is directly associated with PaO₂/FiO₂ control in premature infants with respiratory distress syndrome, with CPAP producing the greatest increase in this parameter. The use of high-flow nasal cannula (HFNC) is associated with fewer complications in premature infants with respiratory distress syndrome.

References

1. Luo J, Chen J, Li Q, Feng Z. Differences in Clinical Characteristics and Therapy of Neonatal Acute Respiratory Distress Syndrome (ARDS) and Respiratory Distress Syndrome (RDS): A Retrospective Analysis of 925 Cases. *Med Sci Monit.* 2019 Jul 6;25:4992-4998. doi: [10.12659/MSM.915213](https://doi.org/10.12659/MSM.915213). PMID: 31278248; PMCID: PMC6636403.
2. Reuter S, Moser C, Baack M. Respiratory distress in the newborn. *Pediatr Rev.* 2014 Oct;35(10):417-28; quiz 429. doi: [10.1542/pir.35-10-417](https://doi.org/10.1542/pir.35-10-417). PMID: 25274969; PMCID: PMC4533247.
3. Condò V, Cipriani S, Colnaghi M, Bellù R, Zanini R, Bulfoni C, Parazzini F, Mosca F. Neonatal respiratory distress syndrome: are risk factors the same in preterm and term infants? *J Matern Fetal Neonatal Med.* 2017 Jun;30(11):1267-1272. doi:

- [10.1080/14767058.2016.1210597](https://doi.org/10.1080/14767058.2016.1210597). Epub 2016 Aug 2. PMID: 27399933.
4. Sweet DG, Carnielli V, Greisen G, Hallman M, Ozek E, Te Pas A, Plavka R, Roehr CC, Saugstad OD, Simeoni U, Speer CP, Vento M, Visser GHA, Halliday HL. European Consensus Guidelines on the Management of Respiratory Distress Syndrome - 2019 Update. *Neonatology*. 2019;115(4):432-450. doi: [10.1159/000499361](https://doi.org/10.1159/000499361). Epub 2019 Apr 11. PMID: 30974433; PMCID: PMC6604659.
 5. Gallacher DJ, Hart K, Kotecha S. Common respiratory conditions of the newborn. *Breathe (Sheff)*. 2016 Mar;12(1):30-42. doi: [10.1183/20734735.000716](https://doi.org/10.1183/20734735.000716). PMID: 27064402; PMCID: PMC4818233.
 6. Yadav S, Lee B. Neonatal Respiratory Distress Syndrome. [Updated 2023 Jul 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK560779/>.
 7. Cárdenas W. Comportamiento clínico y terapéutico del Síndrome de Distrés Respiratorio Agudo en recién nacidos atendidos en el hospital Fernando Vélez Paiz, Enero 2019 a Diciembre 2020. Tesis-Especialista en Pediatría. Managua: Universidad Nacional Autónoma de Nicaragua, Departamento de Ciencias de la Salud; 2021. [unan.ni/16624/](https://uman.ni/16624/)
 8. Llumiguano JM, Guairacaja MV. Prevención de complicaciones en el síndrome de distrés respiratorio en neonatos. Riobamba 2019. Tesis-Medicina. Riobamba: Universidad Nacional de Chimborazo, Facultad de Ciencias de la Salud; 2020. unach.ec/6764
 9. Quimí Ramos FL. Ventilación mecánica y sus complicaciones por el uso de surfactante en niños prematuros. Estudio realizado en UCIN del Hospital Gineco- Obstétrico Enrique C. Sotomayor enero del 2013 a junio 2013. Tesis de Grado. Guayaquil: Universidad de Guayaquil, Facultad de Ciencias Médicas; 2014. redi.cedia.edu.ec/495022
 10. Gregoraci A. Papel de las cánulas nasales de alto flujo en el destete de CPAP-N en prematuros con riesgo de patología pulmonar crónica. Tesis Doctoral. Barcelona: Universitat Autònoma de Barcelona, Departament de Pediatria, d'Obstetrícia i Ginecologia i de Medicina Preventiva; 2019. [Tesisred.net/668011](https://tesisred.net/668011)

Statements

Ethics committee approval and consent to participate

The study was approved by the bioethics committee of the Faculty of Medical Sciences, of the Catholic University of Santiago de Guayaquil.

Publication consent

It was not required, as the present study does not publish images, radiographs, or specific patient studies.

Conflicts of interest

The research has no financial interests or conflicts of interest.

Author information

Joseline Deyanire Triviño Carranza, physician from the Catholic University of Santiago de Guayaquil (Guayaquil, 2022).
Email: j_dtricar2@hotmail.com

ORCID <https://orcid.org/0009-0003-4323-7702>

Limberg Steven Vera Vera, physician from the Catholic University of Santiago de Guayaquil (Guayaquil, 2022).
Email: limbergxd@gmail.com

ORCID <https://orcid.org/0009-0002-7168-4334>

Editor's Note

The journal *Actas Médicas* (Ecuador) remains neutral with respect to jurisdictional claims in published maps and institutional affiliations.

Received: July 6, 2025.

Accepted: September 1, 2025.

Published: September 9, 2025.

Editor : Dr. Mayra Ordoñez Martínez.

How to cite:

Triviño J, Vera L, Venegas C. Comparison between non-invasive ventilatory support nasal CPAP versus high-flow nasal cannula in neonates with respiratory distress syndrome. A single-center observational study. *Actas Médicas (Ecuador)* 2025;35(2):133-138.

© **Copyright 2025**, Joseline Deyanire Triviño Carranza, Limberg Steven Vera Vera , Carlos Alfredo Venegas Arteaga . article es distributed under the terms of the [Creative Commons CC BY-NC-SA 4.0 Attribution License](https://creativecommons.org/licenses/by-nc-sa/4.0/) , which permits non- commercial use and redistribution provided the source and the original author es cited .

Correspondence: Joseline Deyanire Triviño Carranza, Email : j_dtricar2@hotmail.com

Address: Av. Pdte. Carlos Julio Arosemena Tola Km 1.5, Vía a Daule, Guayaquil. Faculty of Medical Sciences. Guayaquil, Ecuador.
Telephone: [593] 04 220 6950