Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i7.6969

"OUTCOMES OF NASAL PRONGS IN INFANTS WITH RESPIRATORY DISTRESS"

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ABSTRACT

INTRODUCTION: The World Health Organization recommends administering oxygen by nasopharyngeal catheter, nasal catheter, and nasal prongs as an essential therapeutic strategy. Non-invasive respiratory support, such as nasal continuous positive airway pressure (nCPAP), can alleviate respiratory distress.

OBJECTIVE: To determine the outcomes of nasal prongs in infants with respiratory distress.

STUDY DESIGN AND SETTING: A cross-sectional study was conducted at Children's Hospital, SMBB Medical University, Larkana, Pakistan from *June 2022* to *September 2023*.

MATERIALS AND METHODS: All patients who met the inclusion criteria and visited SMBBMU in Larkana were included in the research. Informed permission was obtained after discussing the technique, hazards, and advantages of the study. Using the proper-sized Hudson RCI Infant Nasal Prong CPAP cannula system (sizes 0 and 1), nasal prongs were applied to all newborns in our research. The Hudson Nasal prong CPAP cannula system's appropriate-sized bonnets were covered with rubber bands and pins to directly attach the prongs to the Fisher & Paykel "Bubble" CPAP system (BC151). The prongs were continued for 3 days and outcomes were measured on 3rd day. All the obtained data were put in the proforma and data was analyzed by using SPSS statistical package version 23 software.

RESULTS: The patients' ages varied from one to twelve months, with a median of 5. Of the total number of children, 36 (60%) were female and 24 (40%) were male. The patients' oxygenation levels varied between 93 and 101, with a median of 96.0. Additionally, their oxygen flow rates varied

between 1.7 and 3.5 liters per minute, with a median of 2.4, and their respiratory rate ranged from 14 to 28 per minute with a median of 21.0.
CONCLUSION: It may be concluded that an insignificant difference was observed in outcomes of nasal prongs in infants with respiratory distress with age group, gender, and gestational age. Further research is needed to evaluate the statistical significance using a larger sample size, and other parameters across numerous study locations in Pakistan are required to corroborate the current study's findings.

KEYWORDS: Infants, Nasal Prongs, Outcomes, Respiratory Distress

INTRODUCTION

Respiratory illnesses account for a significant percentage of ED (emergency department) visits [1]. In all, children between the ages of 0 and 17 make more than 9 million ED visits each year due to respiratory illnesses [2]. Pneumonia, asthma, and bronchiolitis collectively cause around 11% of pediatric emergency department visits each year and 25% of pediatric hospital hospitalizations. While most kids will recover without any problems, a small percentage may advance to respiratory distress and a smaller percentage will reach respiratory failure [3].

One of the most frequent issues that arise in the first few days of birth is respiratory distress. An infant experiencing respiratory distress may exhibit intercostal, subcostal, or supracostal recessions, apnoea, cyanosis, grunting, inspiratory stridor, nasal flaring, poor feeding, and tachypnea (> 60 breaths/minute) [4]. It affects around 7% of newborns. Respiratory distress is more likely in cases of decreased gestational age. At 37 weeks of gestation, there is a three-fold increased risk of respiratory distress compared to 39–40 weeks [5]. An increased frequency of cesarean sections, amniotic fluid stained with meconium, gestational hyperglycemia, maternal chorioamnionitis, or anomalies in the lungs or oligohydramnios seen on prenatal ultrasonography are additional risk factors [6].
Oxygen supplementation is suggested by the World Health Organization and the American Academy of Pediatrics (AAP) at an arterial pulse oximetry (SpO2) of less than 90% since it is linked to a decreased death rate in children suffering from acute lower respiratory tract infections [8].

There are several ways to supplement oxygen in children, and low-flow oxygen treatment tools include nasopharyngeal oxygen, nasal prongs, and simple facemasks. Research studiesResearch studies have reported that the most favored and secure way to provide oxygen to babies and kids is through nasal prongs [9]. A study was conducted by East wood, et al [10] to see the effectiveness of nasal prongs in an adult population with respiratory distress, in which it has been reported that NP was effective in maintaining the SpO2 >95% in all adults with mean 97.0±1.9, mean oxygen flow (liters per minute) was 2.6±1.0 and mean respiration rate (per minute) was 19.9±3.2. Although, there are few published studies on the use of NP therapy in children patients they have measured different outcomes than the outcome we are taking into account in our study except oxygen flow rate. In a study of Muhe L in 1998 [11], in which it was reported that the mean oxygen flow rate in children on day 3 was 0.95 ± 0.77. Similarly, another study conducted by Weber MW [12], in which it has been mentioned that the prongs needed, on average,26% higher oxygen flow rates than the NP catheter to obtain a SpO2 of 95%.To understand whether increased use of NP therapy in children is feasible, this prospective study is designed to determine the outcomes of nasal prongs in children with respiratory distress. These results will provide information regarding the outcomes of nasal prongs in children which will be certainly helpful in decision-making regarding its use in clinical practice. As in medical science, there is always a need for continued research for improved outcomes and to build up the decision so that the present standard of care may be enhanced accordingly.

ORIGINAL STUDY

OBJECTIVE

To determine the outcomes of nasal prongs in infants with respiratory distress

OPERATIONAL DEFINITION

RESPIRATORY DISTRESS

The presence of at least two out of three signs: tachypnea (respiratory rate > 60 breaths per min), grunting, moaning, lower chest in drawing, and nasal flaring was confirmed on laboratory criteria if ABGs with carbon dioxide > 50 mmHg.

OUTCOMES

• **Oxygenation (SpO2) %:** It was measured with the help of using pulse oximetry on the 3rd day after using nasal prongs.
• **Oxygen flow rate:** It was measured on the 3rd day after using nasal prongs.
• **Respiratory rate:** Respiration rate (per minute) was measured on the 3rd day after using nasal prongs.

METHODOLOGY

STUDY DESIGN AND SETTING

A descriptive cross-sectional study was carried out at Children's Hospital, SMBBMU, Larkana.

SAMPLE SIZE

Epi tool was applied for computation of sample size by considering the mean SpO2 after insertion of nasal prongs in infants i.e. 97.0±1.9, the margin of error = 0.5, level of confidence = 95%, then at least a sample of 60 was required. Since no statistics were available in infants, therefore, we were using the statistics in adults.

SAMPLING METHOD:

Consecutive Sampling (Non-Probability).

SAMPLE SELECTION

INCLUSION CRITERIA

- All infants diagnosed with respiratory distress as an operational definition age from birth to 1 year old.
- Either gender.
- Parents/guardians willing to make available informed consent.

EXCLUSION CRITERIA

Patients experiencing hemodynamic instability, cardiorespiratory arrest, neurological impairment impairing their ability to maintain airway patency, and incapacity to control secretions despite frequent suctioning, untrained pneumothorax, cyanotic congenital heart disease, severe pulmonary condition, and immune deficiencies were excluded.

DATA COLLECTION

To participate in the study, parents and guardians were invited, and they were informed of its procedure, goals, and advantages. If they agreed to have their kids included in the study, parents were required to sign a written informed consent form.

A total of sixty children admitted to the NICU meeting the eligibility criteria were included in the study. The data regarding the age, gestational age at the time of delivery (assessed from history), birth weight, height, gender, and mode of delivery. Using a Hudson RCI newborn Nasal Prong CPAP cannula system that had the proper size (sizes 0 and 1), a nasal prong was applied to every newborn. Using pins and rubber bands, the prongs were immediately attached to Fisher & Paykel's "Bubble CPAP system" (BC151) over appropriately sized bonnets that came with the Hudson Nasal prong CPAP cannula system. The prongs were continued for 3 days and outcomes were measured on the 3rd day as per operational definition. Biasness was controlled through the strict compliance of inclusion/exclusion criteria.

RESULTS

To evaluate the effectiveness of nasal prongs in newborns experiencing respiratory distress, this study included 60 patients. The following data were evaluated:

The Shapiro-Wilk test was used to evaluate the distribution of continuous data for age of the patient's mean and standard deviation was 5.63 ± 2.917, and age ranged from 1 to 12 months with a median of 5.0 with an interquartile range of 3 and confidence interval (4.88----6.39) and p-value 0.0001 as well as along with the weight of the patient's mean ± S.D 4.865±1.5912 while, weight ranged from 2.7 to 8.5 kg with a median of 4.850 with interquartile range 2.9 and C. I (4.45----5.27) and p-value 0.031 as shown in **TABLE 1**.

According to **Table 1**, the mean± S.D of the height of the patients36.07±5.505, height ranged from 26 to 47 cm with a median of 35.0 with an interquartile range of 7, C. I (34.64----37.49) and p-value 0.07.

The patients' mean and standard deviation of gestational age ranged from 25 to 39 weeks, with a median of 36.0 and an interquartile range of 4, C.I. (34.15 ----35.82), and p-value0.0001. Additionally, their mean and standard deviation of oxygenation ranged from 93 to 101, with a median of 96.0 and an interquartile range of 4, C.I. (96.04 ----97.26) and p-value0.001. **TABLE 1**

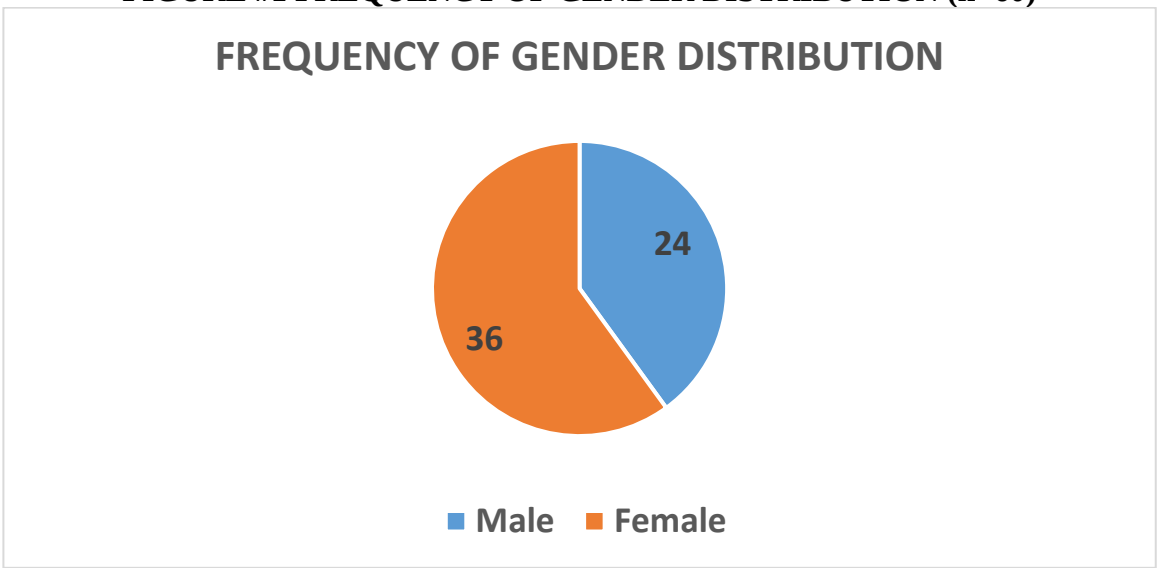
According to **Table 1**, the patients' mean oxygen flow rate (2.463±0.4940) ranged from 1.7 to 3.5 liters per minute, with a median of 2.4, an interquartile range of 0.7,C.I (2.33----2.59), and p-value 0.038. Additionally, their mean respiratory rate was 21.28±3.585, with a range of 14 to 28 per minute, a median of 21.0, an interquartile range of 6, C.I (20.36—-22.21) and p-value 0.044.

TABLE # 1 Descriptive Statistics Of Shapiro-Wilk Testn=60

Variable	Mean±SD	Std. Error	95% Confidence Interval for Mean		Range	Interquartile Range	P-Value
			L. border	U. Border			
Age (Months)	5.63±2.917	0.377	4.88	6.39	1-12	3	0.0001
Height (meter)	36.07±5.505	0.711	34.64	37.49	26-47	7	0.07
Weight (kg)	4.865±1.5912	0.2054	4.454	5.276	2.7-8.5	2.9	0.031
Gestational Age	34.98±3.223	0.416	34.15	35.82	25-39	4	0.0001
Oxygenation	96.65±2.357	0.304	97.26	96.61	93-101	4	0.001
Oxygen flow rate	2.463±0.494	0.0638	2.336	2.591	1.7 -3.5	0.7	0.038
Respiratory rate	21.28±3.585	0.463	20.36	22.21	13-28	6	0.044

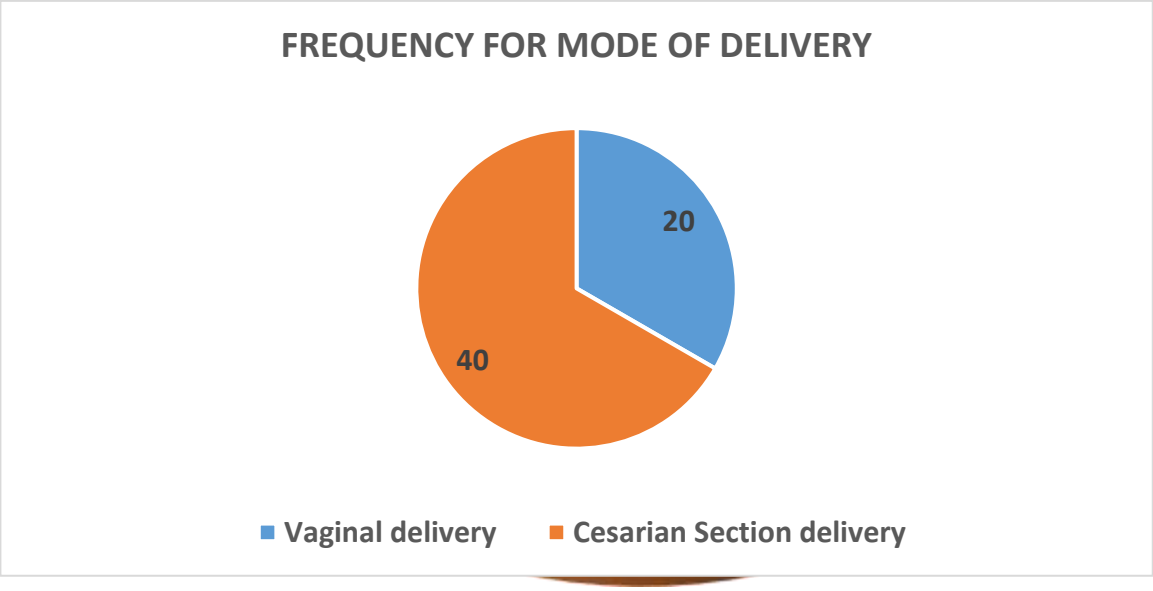
In the frequency distribution of gender, 24 (40.0%) were male while 36 (60.0%) were female children as shown in **FIGURE 1**.

FIGURE #1 FREQUENCY OF GENDER DISTRIBUTION (n=60)



Vaginal delivery was noted in 20 (33.3%) patients while cesarean section was noted in 40 (66.7%) patients as shown in **FIGURE 2.**

FIGURE # 2 FREQUENCY FOR MODE OF DELIVERY n=60



Stratification of age group, gender, and gestational age was done concerning outcomes of nasal prongs in infants in order to assess statistical differences from **TABLE 2-4.**

TAB**LE # 2 Stratification Of Different Variables With Oxygenation(N=60)**

VARIABLES		OXYGENATION [%]		P-VALUE
		Mean	±SD	
AGE GROUP **[In month]**	**1 – 6** (n=43)	96.70	2.41	0.806
	>6 (n=17)	96.53	2.26	
GENDER	**Male** (n=24)	96.50	2.28	0.691
	Female (n=36)	96.75	2.43	
GESTATIONAL AGE[In weeks]	**25–35** (n=27)	97.04	2.36	0.253
	>35 (n=33)	96.33	2.34	

TABLE # 3 Stratification Of Different Variables With Oxygen Flow Rate n=60

VARIABLES		**OXYGEN FLOW RATE [Liter/Min]**		**P-VALUE**
		Mean	**±SD**	
AGE GROUP **[In month]**	**1 – 6** (n=43)	2.40	0.48	**0.180**
	>6 (n=17)	2.60	0.49	
GENDER	**Male** (n=24)	2.31	0.46	**0.053**
	Female (n=36)	2.56	0.49	
GESTATIONALAGE**[I nweeks]**	**25–35**(n=27)	2.43	0.45	**0.674**
	>35 (n=33)	2.48	0.52	

TABLE # 4 Stratification Of Different Variables With Respiratory Rate (n=60)

VARIABLES		RESPIRATORY RATE **[/Min]**		P-VALUE
		Mean	±SD	
AGE GROUP **[In month]**	**1 – 6** (n=43)	21.44	3.69	0.590
	>6 (n=17)	20.88	3.37	
GENDER	**Male** (n=24)	21.04	3.49	0.674
	Female (n=36)	21.44	3.68	
GESTATIONAL AGE **[In weeks]**	**25 – 35** (n=27)	21.48	3.78	0.702
	>35 (n=33)	21.12	3.46	

DISCUSSION

For the majority of babies experiencing respiratory distress, nasal continuous positive airway pressure, or nCPAP, is the recommended breathing support. Whatever the reason, most infants would gain from this efficient treatment. When nCPAP is started early in the delivery room or during the first hour of respiratory distress, it can lessen the requirement for surfactant administration and mechanical ventilation in extremely premature newborns. On the other hand, CPAP is linked to nasal damage, frequent prong displacement, longer nursing times, and a requirement for highly qualified nursing personnel [13]. nCPAP failures occur in around 15-25% of babies who use it [14,15]. High-flow nasal cannula (HFNC), an alternate means of respiratory support, is becoming more widely acknowledged in the management of preterm newborns [16–18]. The advantages of this device over nCPAP include a decreased incidence of nasal trauma, patient and parent-friendly nasal prongs, and ease of use [19, 20]. HFNC is not less effective than nCPAP in babies who have been extubated from artificial ventilation [21,22]. To ascertain HFNC's place in the primary treatment of newborns experiencing respiratory distress, more information is required.

Ventilating a sick newborn using nasal continuous positive airway pressure is an easy, affordable, and noninvasive method [68]. The most popular way to administer NCPAP is via bubble CPAP.[24, 25].

For a long time, short bi-nasal prongs have been the recommended method of delivering NCPAP. The disadvantages of using nasal prongs for NCPAP include septal anomalies, columella injury, poor infant tolerance to the device, difficulties situating the neonate, and mechanical issues with maintaining the nasal prongs [26–28].

Because they are so simple to use, nasal masks are being used to administer CPAP more and more these days [29]. A randomized experiment comparing nasal masks with binasal prongs in newborns <31 weeks gestation revealed a lower intubation rate using a nasal mask within 72 hours for the treatment of respiratory distress syndrome (RDS) or in a post-extubation environment [30]. A recent randomized controlled trial (RCT) in India discovered that nasal continuous positive airway pressure using a mask as the interface is equally as effective as prongs while causing less pulmonary interstitial emphysema and nose damage. Two hours after initiating CPAP, employing a nasal mask required 6% less oxygen than nasal prongs [31]. Both nasal masks and nasal prongs have been shown to cause nasal damage, which happens equally with either interface [32, 33]. Before nasal masks may take the role of short binasal prongs, additional research is required.

In the neonatal intensive care unit, a heated, humidified high-flow nasal cannula (HHFNC) is now commonly employed as an alternate noninvasive respiratory support method. HHFNC is thought to be easier to use, more pleasant for the baby, and beneficial for mother-infant bonding since it has a simpler interface with the newborn and smaller prongs than nCPAP [34].

According to a recent Cochrane analysis [35], HHFNC is just as effective as other non-invasive respiratory support methods in reducing treatment failure, mortality, and chronic lung disease in preterm newborns. These outcomes, however, came from the data supporting the use of HHFNC as post-extubation support. The data supporting the use of HHFNC as the primary therapy for respiratory distress syndrome in infants (RDS) is currently lacking, despite several randomized studies [36.37] providing support for the idea that HHFNC is equally efficacious as nCPAP in the early stages of RDS.

The results of our research are consistent with those of several other investigations carried out globally. Here, a handful of these are covered.

In this study, 24 (40%) were male while 36 (60%) were female children. Eastwood GM, et al noted to have 65% males and 35% females [10]. Another study reported to have 55.8% males and 44.2% females [38] whereas the study of Goel S, et al stated to have 47% males and 53% females [39]. There were 55% males and 45% females in the study of Murki S, et al [40].

In the present study, the oxygenation of the patients ranged from 93 to101 percent with a median of 96.0, the oxygen flow rate ranged from 1.7 to 3.5 liter per minute with a median of 2.4 and the respiratory rate ranged from 14 to 28 per minute with a median of 21.0. A study that was conducted by East Wood GM, et al reported SpO2 > 95% with a mean of 97.0±1.9, mean oxygen flow 2.6±1.0,

and mean respiration rate of 19.9±3.2 [10]. In the study of Muhe L, et al, it has been reported that the mean oxygen flow rate in children on day 3 was 0.95±0.77 [11].

A recent research that stratified confounders and impact modifiers according to oxygenation revealed that age group (P=0.806), gender (P=0.691), and gestational age (P=0.253) did not significantly vary from one other.

Age group (P=0.180), gender (P=0.053), and gestational age (P=0.674) showed a negligible difference in our classification of confounders/effect modifiers with regard to oxygen flow rate.

When confounders and effect modifiers were stratified according to respiratory rate in this study, age group (P=0.590), gender (P=0.674), and gestational age (P=0.702) showed negligible differences.

CONCLUSION

It is to be concluded that an insignificant difference was observed in outcomes of nasal prongs in infants with respiratory distress with age group, gender, and gestational age. Further research is required to assess the statistical significance using a larger sample size, and other parameters across various study locations in Pakistan are required to corroborate the current study's findings.

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