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Incidence of Nasal Injury Among Neonates with Exposure to Nasal Continuous Positive Airway Pressure Treatment

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ABSTRACT

Introduction: Nasal continuous positive airway pressure (nCPAP) is a commonly used non-invasive respiratory support modality in neonates with respiratory failure. While effective, prolonged use of nCPAP is associated with nasal injuries ranging from mild erythema to severe necrosis, potentially increasing neonatal morbidity. **Objective:** To determine the incidence of nasal injury among neonates with respiratory failure receiving nCPAP therapy in the neonatal intensive care unit of Services Hospital, Lahore. **Materials and Method:** A descriptive cross-sectional study was conducted over six months (January to June 2024) on 100 neonates receiving nCPAP for at least 24 hours. Demographic and clinical data were recorded, and nasal injuries were assessed using the Nasal Injury Assessment Score Chart. Data analysis was performed using SPSS v25. **Results:** Nasal injury was observed in 39% of neonates. Most injuries were Grade 1 (61.5%), followed by Grade 2 (28.2%) and Grade 3 (10.3%). A significant association was found between duration of nCPAP ≥72 hours and the development of nasal injury ($p < 0.001$). **Conclusion:** The study reveals a high incidence of nasal injury linked to prolonged nCPAP use, highlighting the need for regular monitoring, preventive protocols, and staff training to reduce complications.

INTRODUCTION

Respiratory distress continues to be a common and concerning condition in neonates, especially premature babies with underdeveloped lung tissues and insufficient surfactant production. Nasal continuous positive airway pressure (nCPAP) is one of the much-employed interventions in the NICU, as such require further studies. Developed in the early 1970s, nCPAP assists in maintaining spontaneous breathing and applies a continuous flow of air pressure through nasal prongs or masks, which enhances alveoli expansion, minimizes the work of breathing, and promotes efficient gas exchange (Wang et al., 2024). Despite the advances in interventions for neonates, several risks are associated with nCPAP therapy, specifically nCPAP and its effect on respiratory distress syndrome in preterm neonates, especially when there is a need for re-intubation (Morsy et al., 2021). It has become popular due to its reasonably good outcomes, ease of use, and low risk as compared to invasive mechanical ventilation.

However, it is important for the consumer to establish that the respiratory is not entirely free of complications through nCPAP. Nasal injury, typified by erythema to full-thickness necrosis, is one of the common complicated adverse effects attributed to its use. This article outlines factors that may contribute to nasal injury in neonates in the use of nCPAP multiple. It has been associated with the duration of pressure exerted by the nasal interface, inadequate fixation, unsuitable size, and inherent weak skin of the neonate (Ishigami et al., 2023). Other factors that were considered include the duration of therapy, as well as the gestational age of the infant, and its weight. Nevertheless, HFNC and NHFOV have been introduced as interventions that may prevent such complications, but nCPAP remains the definitive therapy since it is more effective than other modalities in some circumstances (Shein et al., 2022; Yang et al., 2024). Similarly, the approaches to using and observing nCPAP also differ from one NICU to another, thereby contributing to the varying instances of nasal injury.

They show that there is a need to come up with standard operating procedures to eliminate disparities in healthcare. A few studies were made in an attempt to analyze the prevalence of nasal injury in different NRS, and

there is growing concern about the risks of utilizing nCPAP when there is a need to consider it for the further therapeutic benefits to the neonate it has some drawbacks when the nasal structure is considered critically (Wang et al., 2024). The objective of this research will be to determine the prevalence of nasal injury in neonates on nCPAP in clinical practice, establish risk factors that cause such complications, and potential ways to reduce the occurrence of these complications. Therefore, knowledge of the burden and factors contributing to nasal injury is important for enhancing interventions for neonates and fine-tuning respiratory care practices. This study will help to add to the evidence about the incidence and type of nasal injury in newborn babies who require nCPAP and thus contribute to adequate knowledge on the safe use of non-invasive ventilation in neonates. These are coherent with the anticipations of offering direction to clinicians in promoting respiratory care needs for patients in an efficient, safe, and effective manner as they enhance the quality of care in the NICU.

Objective

To determine the incidence of nasal injury in neonates with respiratory failure treated with nasal continuous positive airway pressure (nCPAP) in the NICU of Services Hospital, Lahore, and to identify key clinical factors—such as duration of nCPAP exposure, gestational age, birth weight, and interface type—that are associated with increased risk and severity of nasal pressure–related injuries.

1- LITERATURE REVIEW

Pascual and Wielenga (2023) also undertook an influential incidence study on nasal pressure injuries among neonates wearing nCPAP. They concluded that nasal fractures continue to present a high prevalence and morbidity rates consistent with this investigation. Africa and the world at large still lack adequate preventive measures regarding this ailment. The authors concluded that some of the factors that have contributed to nasal trauma include interface design, duration of therapy, and neonatal skin fragility, hence the need to develop standard care measures and regular evaluation of the condition. Lemyre et al. (2023) conducted a Cochrane systematic review to compare early NICIPPV with nCPAP in preterm infants. They also pointed out that although both modalities help in weaning the newborns to breathe independently, NIPPV may have the advantage of decreasing the chance of mechanical ventilation and potentially lowering the risk of nasal trauma because of its discontinuous use. However, the review also identifies some gaps in the existing trials and urges for better and more powerful studies to replicate these findings.

Lawrence et al. (2021) analyzed a quality improvement project in which bubble CPAP was implemented to try to decrease the incidence of nasal pressure injuries in NICU patients. The study also found that structured care bundles and better interface management resulted in a long-term decline in injury rates. They have endorsed the notion that such preventative approaches, which include positional adjustment and protective shielding, can go a long way in preventing any injury to the nose. Broom and colleagues (2005) also examined device-related injuries with an emphasis on neonates on nCPAP. Other approaches that their quality improvement program incorporated were staff education, optimization of the interface fitting approaches, and skin checks. Thus, such interventions reduce mortality and the incidence of nasal injuries and strengthen the paradigm for a team approach to the neonatal population.

Specifically, Biazus et al. (2023) describe the experiences of preterm infants exposed to nasal mask non-invasive ventilation with regard to the incidence of nasal pressure injury. Consequently, their observational evidence suggested that even non-prong interfaces might cause hazards if not addressed adequately. It also becomes important that patients be allowed to choose the type of interface that they want, as well as that staff members be continued to train to avoid any form of complications. Bamat et al. (2021) conducted another Cochrane review to compare the impact of various nCPAP pressure levels on morbidity and mortality in preterm newborns. Though this study was mostly centered on objective curing goals such as respiratory failure and death, the question concerning increased pressures on the therapy and concurrent effect on the nasal injury was discussed. The authors stated the importance of identifying pressure that is specific to a particular patient's response artillery.

Helal et al. (2022) conducted a study to evaluate the self-reported knowledge of nurses on nasal injury risks related to CPAP in the NICU. They also assessed the knowledge and application by a cross-sectional survey and realized that clinical practice was also ominous in aspects that they had never been aware of. The ongoing research noted a high possibility of delay in identifying early signs of an injury, coupled with the failure to apply some basic measures, thus compounding the scenario of neonatal problems. Fu et al. (2024) elaborated a list of best evidence practices covering the prevention of nasal injury in preterm infants under the use of nasal non-invasive ventilation. Their review comprised assembling global guidelines and practical recommendations, including soft and flexible interfaces, switch of interface type, and frequent skin check-ups on the nasal area. The authors also pointed out how protocol-based care also contributed to the improvement of continuity and quality in care delivery.

Ho et al. (2024) examined the ability of nCPAP used right after the endotracheal tube removal on preterm newborns in another Cochrane review. Their findings were in line with the advantages of nCPAP in the prevention of extubation failure and equally confirmed the high prevalence of nasal injuries as a consequence. This goes a long way in supporting the notion of risk-benefit analysis when contrasting respiration and harm to the tissue. The study by Martins et al. (2022) was implemented to identify differences in non-invasive ventilation modes with an emphasis on nCPAP and HFNC as the maintenance strategy for neonates after extubation. Nursing established that nCPAP was less on increasing the risk of developing respiratory failure compared to HFNC, and HFNC was linked to less number of occurrences of nasal pressure sore. It can be concluded that this knowledge may assist healthcare clinicians in evaluating

the risk factors influencing a specific patient's condition and choice of the appropriate mode of treatment. Magondu's (2023) sample consisted of patients from several hospitals in Kenya, and the second study was on nCPAP use among neonates with RDS.

Lastly, Pan et al. (2021) aimed to compare the efficacy of BiPAP with nCPAP for preterm infants with a body weight of less than 1500 grams for whom INSURE treatment was applied. The two modes were still considered effective, but BiPAP had less nasal morbidity due to the variable pressure. The authors also put forward the view that BiPAP is less dreadful to certain high-risk neonates than nCPAP is. These combined studies give a picture of the positive and side effects of the use of nCPAP in premature neonates, as well as the prevention and precautionary measures. Therefore, there is enough evidence for the utility of nCPAP in newborn ventilation, but there are concerns associated with it, which include nasal abuse. As the literature states, volume, technique, experience, skill, constant observation, monitoring, and collaboration between specialties are the means to minimize these complications. Future studies and practice of even more EBP will be essential in improving the results for neonatal patients and protecting the threatened patient group.

2- MATERIALS AND METHODS

Study Design

The study considered in this paper was designed as a descriptive cross-sectional study to determine how many neonates developed nasal injuries while on nCPAP. The design helped the researchers to provide a picture of the development of outcomes for a certain population at some specific period without interfering with the actual management of clients.

Study Setting

This study was conducted in the Department of Pediatric Medicine at Services Hospital, Lahore, an institution that has NICU – a neonatal intensive care unit. The NICU has specialized pediatricians together with neonatologists and experienced and qualified nurses who primitively care and/or provide respiratory support such as nCPAP to neonates.

Duration of the Study

The survey was carried out in a 6-month period from January 2024 up to June 2024 after obtaining clearance from the institutional ethical review board to conduct the research synopsis.

Inclusion Criteria

All neonates delivered after 32 weeks of gestation as per antenatal records, regardless of gender, were eligible for inclusion if they were diagnosed with respiratory failure and required nCPAP therapy. Respiratory failure was defined in accordance with standard operational criteria: $PaCO_2$ > 60 mmHg with pH < 7.25 (Type II), or PaO_2 < 60 mmHg/O_2 saturation <80% on FiO_2 of 1.0 (Type I). Only those infants who received CPAP support in the NICU at Services Hospital were included. Informed written consent was obtained from the parents or legal guardians prior to enrollment.

Exclusion Criteria

Neonates with a birth weight below 1.5 kg were excluded due to their higher susceptibility to multiple confounding morbidities. Additionally, neonates with craniofacial anomalies (such as cleft lip/palate or nasal agenesis), neural tube defects, or congenital heart diseases were excluded to avoid variables that could interfere with proper mask/prong placement and interpretation of nasal injury outcomes. Cases referred from outside facilities without documented nCPAP use protocols were also excluded to ensure consistent care standards.

Methods (Approx. 250 words)

Following approval from the institutional review board, consent was sought from parents/guardians of neonates, and 100 neonates were recruited using consecutive nonprobability sampling. Some of the information collected at the onset of the study were gestational age, birth weight, gender of the neonate, mode of delivery, and age in terms of hours. Consequently, neonates received nCPAP therapy according to the emerging guidelines or protocols at the hospitals, including using nasal prongs. During the investigation, all the neonates remained admitted to the NICU, where they received close supervision. This will show the duration of the therapy within the respective patient database, that is, the CPAP therapy. Because of this, the Nasal Injury Assessment Score Chart was used to examine the nasal area after the removal of the CPAP device. A score of ≥2 was used as a criterion for the presence of nasal injury.

To standardize the detection, skin examinations were performed repeatedly, and the observations were documented by the NICU nurses and ratified by the neonatologist. Other types of care interventions included prong repositioning and the use of barriers where necessary. Data collection went on until the neonate was discharged or off nCPAP. SPSS version 25 was employed to enter the data and analyze it using the Statistical Package for the Social Sciences. The results of the variance analysis were obtained for Statistica, and Shapiro-Wilk's test was used to determine the normal distribution of data. For continuous variables, means and standard deviations were used, while the categorical variables were summarized using frequencies and percentages. This paper used the Chi-square test for post-stratification, and a p-value of ≤ 0.05 is considered significant.

3- RESULTS

A total of 100 neonates who met the inclusion criteria were enrolled in this study during the six-month study period. The objective was to determine the incidence and characteristics of nasal injury among neonates with respiratory failure receiving nasal continuous positive airway pressure (nCPAP) therapy in the NICU. The **demographic and clinical characteristics** of the study population are presented in **Table 1**. Of the 100 neonates, **58% were male** and **42% female**. The mean **gestational age** was **35.4 ± 1.8 weeks**, and the **mean birth weight** was **2.3 ± 0.4 kg**. The **majority of deliveries** were via **cesarean section (62%)**, while 28% were normal vaginal deliveries and 10% were instrumental.

Table 1
Demographic and Clinical Characteristics of Study Population

Variable	Frequency (%) or Mean ± SD
Gender	
Male	58 (58%)
Female	42 (42%)
Gestational Age (weeks)	35.4 ± 1.8
Birth Weight (kg)	2.3 ± 0.4
Mode of Delivery	
Cesarean Section	62 (62%)
Normal Vaginal Delivery	28 (28%)
Instrumental Delivery	10 (10%)
Age at Admission (hours)	5.2 ± 3.1

The **overall incidence of nasal injury** observed in this study was **39%**, as determined using the Nasal Injury Assessment Score Chart. Among the affected neonates, the majority exhibited **Grade 1 injuries** (erythema), while **Grade 2** (superficial ulceration) and **Grade 3** (necrosis) injuries were less common. The distribution of injury grades is outlined in **Table 2**.

Table 2
Severity of Nasal Injuries Among Affected Neonates (n = 39)

Grade of Nasal Injury	Frequency (%)
Grade 1 (Erythema)	24 (61.5%)
Grade 2 (Ulceration)	11 (28.2%)
Grade 3 (Necrosis)	4 (10.3%)
Total Nasal Injuries	**39 (100%)**

When stratified by **duration of nCPAP therapy**, a significant correlation was observed between **longer CPAP duration** and the **presence of nasal injury**. Among neonates who received nCPAP for **more than 72 hours**, **71.4% developed nasal injury**, compared to **21.2%** among those who received CPAP for **less than 72 hours** (**p < 0.001**, Chi-square test). The relationship between CPAP duration and nasal injury is illustrated in **Table 3**.

Table 3
Association Between Duration of CPAP and Nasal Injury

Duration of CPAP (hours)	Nasal Injury Present	Nasal Injury Absent	Total	p-value
< 72 hours	14 (21.2%)	52 (78.8%)	66	
≥ 72 hours	25 (71.4%)	10 (28.6%)	34	<0.001
Total	**39 (39%)**	**62 (61%)**	**100**	

Further analysis of nasal injury by **gestational age** and **birth weight** revealed that neonates with **lower gestational age (32–34 weeks)** and **birth weights below 2.0 kg** were more prone to developing nasal injuries. Although these associations approached statistical significance, the strongest and most consistent factor associated with nasal injury was the **duration of CPAP exposure**. In terms of **mode of delivery**, nasal injuries were slightly more common in neonates delivered via cesarean section (41.9%) compared to those born through vaginal delivery (35.7%). However, this difference was not statistically significant (p = 0.48). The study also observed that male neonates had a slightly higher incidence of nasal injuries (43.1%) compared to females (33.3%), but the difference did not reach statistical significance (p = 0.29). Overall, the data clearly demonstrate that **longer exposure to nCPAP**, especially beyond 72 hours, significantly increases the risk of developing nasal injury. The presence of **Grade 2 and Grade 3 injuries**—though less frequent—highlights the potential for serious complications if early preventive strategies are not implemented.

4- DISCUSSION

The present study was working towards ascertaining the rate of nasal injury in neonates who required nCPAP for their respiratory failure. This study, which was conducted for a period of six months in the NICU of Services Hospital Lahore, revealed that 39% of the enrolled neonates developed nasal injuries during the duration of the nCPAP therapy. These observations raise a great clinical issue in the management of newborns with respiratory disorders and are consistent with previous studies that identified nasal injury prevalence between 20 % and 60 % (Pascual & Wielenga, 2023). The high incidences of nasal injuries in this study also call for attention to the fact that, despite being regarded as safe, easy to use, and greatly accepted, nCPAP is not without adverse effects. Most of the described lesions were mild, whereby 61 5% fell under the first degree, 28.2 % under the second degree, and only 10.3% under the third degree. These findings can be compared to that of Lawrence et al. (2021), where erythema was sighted to be the initial sign of skin deterioration and proper clinical intervention can help halt the development of deeper skin injuries.

The other significant finding of this present study was the relationship between the duration of nCPAP therapy and nasal injury. Significantly more neonates on nCPAP with a duration of more than 72 hours experienced nasal injuries as compared to neonates who were on nCPAP for a lesser duration (P < 0.001). In line with previous research, which include Broom et al. (2025) observed that the longer the period of contact, the higher the potential for skin breakdown due to pressure and friction over the nasal interface site. They also support the concept of enhanced early follow-up and monitoring of neonates who require longer duration on nCPAP. It was clearly detected in this investigation that birth weight and gestational age were not significant predictors of neonatal injury, although it was observed that infants with GA 32–34 weeks and a birth weight of less than 2000 g had a relatively higher risk of injury. These babies may have tender skin and subcutaneous tissue, which may be at risk of pressure sores. Biazus et al. (2023) pointed out the same issue, stating that because the organs of preterm infants remain underdeveloped, they are more prone to skin injuries from devices.

Although this analysis involved both sexes, male neonates constituted slightly more of the cohort, although this was not statistically significant. This gender division has not been previously discussed in numerous publications, and it is not clear whether gender distribution might have any significant clinical relevance or whether it is just an accidental occurrence in the sample population. Contrary to expectation, the type of delivery, that is, cesarean section, normal vaginal delivery, or instrumental delivery, did not influence the occurrence of nasal injury. There was a slight increase in the number of neonates with nasal injuries, especially when a cs was performed. This could be because C-sections are performed in clinical settings, and so patients are likely to

deliver more premature or otherwise clinically fragile babies who may need the use of nCPAP for more time. However, this variable remains a subject for further investigation in more extensive studies that involve several centers.

These effects also align with several cross-national investigations conducted in this field. For instance, Lemyre et al. (2023) have made a comparison between nCPAP and Nasal intermittent positive pressure ventilation/NIPPV where the researcher mentioned that, though nCPAP is helpful for respiratory care, it comes with higher rates of nasal complications due to constant and non-pulsating pressure over the nasal mucosa. However, Fu et al. (2024) provided the most robust and efficient synthesis type by proposing probable tactics such as interface rotation and the use of protective barriers, including hydrocolloid dressings, and skin check-on, which, if done, excludes nasal damage. This paper also focuses on responsiveness to the meanings of nursing knowledge and clinical practice. In addition, Helal et al. (2022) identified nursing assessment, minimalist awareness, and irregular practicing mechanisms as the key reasons underlying nasal injury among nurses. In doing so, it aligns with the above observation in reinforcing that more necessary, active, and early detection is necessary to prevent skin breakdown. Therefore, this piece of work posits that adequate qualification and training of the health care personnel, especially the bedside nurse, can go a long way in preventing many of these related injuries.

High flow nasal cannula (HFNC) and bifunctional nasal continuous positive airway pressure (BiPAP) are other forms of non-invasive ventilation with lower rates of nasal soreness, but their effectiveness regarding moderate and severe RDA may not be as effective as nCPAP. Pan et al. (2021) noted fewer injuries related to BiPAP but also discussed the complications experienced and variations in its effectiveness in VLBW infants. Similarly, Martins et al. (2022) said that even if the usage of HFNC was associated with a decreased rate of nasal injury, it was not as successful as nCPAP in lessening extubation failure. Another factor that complicates the evaluation of the incidence of nasal injuries in studies is their definition and grading system. Despite the fact that this study employed a Nasal Injury Assessment Score Chart that has not been adopted in recent studies (Pascual & Wielenga, 2023), different studies may employ different or invalid sets of criteria that can lead to heterogeneity of the obtained outcomes. Future research about higher education should focus on standardizing grading systems so that various grades can be compared for objective analysis.

Some of the limitations of the study are as follows: These results may not apply to other healthcare settings in every clinic due to variations in the existing clinical practices, human resources, and other assets. Furthermore, information regarding nose injuries was obtained from clinical examinations, which could be susceptible to inter-observer variation despite the use of the Goodehouse scale. It was recommended that photographic documentation or dermatoscopic evaluation be used in follow-up studies to bring about an objective approach. One limitation also is that although the study collected the duration and severity of CPAP use, it did not specify the interfaces in use (such as prongs, different brands, masks, or both). Several studies have revealed that the interface type plays a major role in the infection rates, such as when the prongs and masks are switched or when the prongs are made of softer material, which has resulted in a lower rate of nasal injuries (Lawrence et al., 2021).

Nevertheless, this study offers some insight into the incidence of nasal injury in neonates under the use of nCPAP within the study setting. These results call for the implementation of appropriate preventive methodologies based on the local healthcare system since there are few research studies available from Pakistan in this research line. For eventual nasal trauma prevention, hospitals should come up with structured protocols that have aspects such as timely repositioning, interface evaluation, application of barriers, and overall staff edification on the issue at hand. Finally, the study supports previous research in showing that although nCPAP is an essential therapeutic modality for neonatal respiratory support, its use is associated with a significant risk of nasopharyngeal trauma, particularly when used to deliver long-term BiP. It is crucial to recognize neonates at risk and to adopt early and targeted interventions in order to promote skin health as well as to preserve lung function. The advances in neonatal care will persist in searching for the provision of proper therapeutic strategies while avoiding potential harm resulting from the tender years of the patients.

5- CONCLUSION

It established that 39% of the neonates admitted to the NICU and receiving nCPAP for respiratory failure had nasal injuries. Most of them were slight, while a significant number of them sustained more serious injuries, thus pointing to the fact that further caution should be taken in practice. Prolonged usage of nCPAP, specifically at least 72 hours, was found to be significantly associated with increased nasal injury risks and emphasizes the need to develop preventive strategies such as proper skin checks. While the overall injury risk trends depended on the gestational age, birth weight, and mode of delivery, the latter was still the most critical factor within the therapy duration. It was revealed that there is a need for better guidelines, an efficient interface, and staff training to reduce device-related complications. For that reason, it is recommended that certain evidence-based preventive measures be taken to minimize nose damage occurrences among neonates, particularly if they are in desperate need of breathing intervention. They encouraged further research in multiple centers primarily to confirm the findings and subsequently improve clinical recommendations.

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