

Nasal Trauma in Neonates Receiving CPAP And its Prevention in tertiary care hospital

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ABSTRACT

Objectives: To evaluate the frequency and severity of nasal trauma secondary to nasal continuous positive airway pressure (NCPAP) in neonates and different methods to reduce the nasal septum injury via CPAP

Methods: This is a prospective study carried out in the Neonatal Care Unit (NCU) of Lal Ded maternity hospital associated with Department of Pediatrics Government Medical College, Srinagar, Kashmir. The study included newborns that underwent NCPAP with prongs on admission and those receiving NCPAP after weaning from ventilator, from 1st January 2016 - 1st January 2017. Noses of the neonates were monitored from the first day of NCPAP treatment until its weaning. Nasal trauma was reported into Three Grades: (I) Erythema/pressure indentation (II) superficial Erosion and (III) Septal necrosis.

Results: 258 newborns were included in study, 136 males and 122 females. All enrolled newborn received CPAP. Babies were randomly allocated to different groups which included no barrier group and different barrier groups. Randomization of newborns who received no barrier (group 0) and different barriers (Group 1, 2, & 3) was done by systematic allocation, in which first newborn was randomly allocated to no barrier group (0) on particular day of admission, and subsequently alternating with other three groups i.e. Group 1, Group 2, Group 3. The mean gestational age, birth weight and CPAP days in each group is 31wk GA (28-35 wks) 1.2 Kg (0.7Kg-1.8Kg) & 5 days (3-10days) respectively. Incidence of Septal necrosis was 26.7% in the babies that had 'No barrier' applied at septal Hudson prongs interface (Group0), which was significantly more ($p < 0.001$) when compared with other three groups, and within barrier groups its incidence was, 2.8% with Cotton applied at septal and Hudson prongs interface with glycerine (Group1), 7.1% with Danaplast applied at interface (Group2) and 0.0% with Cotton soaked in normal saline (Group3) respectively. In Group 0 nasal septal injury Grade I is 35%, Grade II 35%, and Grade III 30.0%. In Group 1, Grade I septal injury is 84%, Grade II 12.7% & Grade III 2.8%. In Group 2, Grade I is 65.7%, Grade II 30.0%, Grade III 4.3% and Group3 Grade I 80.7%, Grade II 19.3% and Grade III 0.0%.

Conclusions: Nasal trauma is a frequent complication of NCPAP, especially in preterm babies and babies requiring nasal prongs for longer duration. Such nasal trauma can be prevented by applying a barrier as in Group 1, 2&3 in our study which shows statistically significant decrease in severe nasal septal injury. JMS 2017; 20 (2):96-100

Keywords: Continuous positive airway pressure (CPAP), septal injury, Barriers.

INTRODUCTION

Continuous Positive Airway Pressure (CPAP) is used to treat respiratory distress syndrome (RDS) in the newborns. It establishes and maintains open airways. The circuit is designed such that a continuous flow of humidified oxygen in combination with other compressed gases is delivered to the infants often with nasal prongs or masks¹. The CPAP goal is accomplished by supplying about 4-8 cm H₂O positive airway pressure into infant's airway^{1,2}. To apply this pressure system, three components are essential: 1)

continuous flow of a heated and humidified gas mixture (compressed air and oxygen) 2) a system connecting the device to the patients airway such as a facial mask, nasal prong, nasopharyngeal or endotracheal tubes 3) a mechanism of positive pressure generation in the system^{3,4}. A nasal prong is the most common device used because it is a less invasive way of supplying CPAP^{3,4}, typically called nasal CPAP or NCPAP. It is available in different sizes and usually made of light flexible material⁴. Despite its advantage, this device can harm the nostrils and cause discomfort and disfigurement in the long term⁵. The local pressure of NCPAP devices may lead to pressure lesions in the nose of the newborn due to its cutaneous vulnerability and anatomical factors such as end-vascularization of the columella and nostrils⁶. Application of different types of

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barrier at interface of columella and prongs were used in our study to prevent pressure induced injury. Hydrocolloid and silicone gel was used in different studies as barrier which showed reduction in CPAP induced nasal trauma^{7,8}. Nasal trauma represents a source of discomfort for patient, possible site of infection and a risk of long term functional or cosmetic sequelae^{7,8}. Research classifies nasal injuries caused by the use of prongs in three Grades: mild (Grade I), moderate (Grade II) and severe (Grade III). The mild Grade (I) is described as redness or nasal hyperaemia; the moderate (II) presents bleeding injuries and the severe Grade (III) refer to injuries with necrosis¹¹. Local irritation and trauma to the nasal septum may occur due to misalignment or improper fixation of nasal prongs^[12]. Breakdown and erosion on the septum at the base of the philtrum can occur when using nasal prongs, and columella necrosis can occur after only short periods of receiving NCPAP. Snubbing and circumferential distortion (widening) of the nares can be caused by nasal prongs, especially if NCPAP is being used for more than just a few days. Inadequate humidification can lead to nasal mucosal damage^{13,14}.

In Kashmir, no such study on the use of CPAP in neonates and subsequent nasal trauma has been published. This prospective study is aimed to fill this research gap by determining the frequency and severity of nasal trauma secondary to NCPAP in neonatal care unit of tertiary care maternity teaching hospital and different barrier methods used to reduce the incidence of NCPAP induced nasal trauma.

METHODS

This prospective study was carried out in the Neonatal Care Unit (NCU) of L D Hospital, an associated maternity hospital of Govt. Medical College Srinagar. The neonates were observed by the responsible doctor to assess nasal injuries without touching them every day before the change of shifts. Observations were recorded on observation sheets. The study included newborns that underwent NCPAP with prongs on admission and those receiving NCPAP after weaning from ventilator, from 1st January 2016 - 1st January, 2017. The sample size was 258 newborns. They were prospectively observed to detect nasal trauma from the first day of NCPAP treatment until its weaning. Standard policy in our NCU is to promote the routine use of NCPAP within minutes after birth for all newborns with respiratory distress regardless of etiology. Pressure of 4 - 6 cm H₂O is

maintained and oxygen is adjusted to keep PaO₂>50mm Hg. Endotracheal intubation and mechanical ventilation are considered when NCPAP is not sufficient to achieve a satisfactory PaO₂ while breathing 80/100% O₂ and/or lower the PaCO₂<65 mm Hg, or to relieve marked retractions or frequent apneas. Weaning NCPAP is considered when the tachypnea and retractions become minimal or have disappeared and when there is no longer need for supplemental oxygen. NCPAP is reintroduced when the infant has tachypnea>70/min, deep retractions or frequent episodes of apnea and bradycardia. Throughout the study period, the same NCPAP system was used (Fisher and Paykel Bubble-CPAP system BC 161, New Zealand, UK). This system involves a source of gas flow (6-8 L /min), air oxygen blender, humidifier (MR85, Fisher& Paykel Health Care, New Zealand) and respiratory circuit. Nasal tubing (Flexi trunk) and nasal prongs. A transparent template is available from Fisher-Paykel to suggest appropriate nasal prong-size according to the circumference of the nasal cavity and the width of the septum. This was used to determine the size of prongs needed for each infant. Generally using these guidelines: neonates <1000 g required 35/20, neonates 1000 - 2000 g required 40/30, and neonates 1500 - 2499 g required 50/40. The prongs were positioned at least 2 mm from the septum to avoid pressure necrosis and in other three groups different barriers were used at interface to avoid pressure on nasal septum. Prongs were secured using a head cap and Velcro felt^[15]. No baby in the study was given surfactant. For the purpose of study, four groups were made (Tables 1 & 2). In Group 0, Hudson prongs were applied directly at nasal septum interface, Group I Cotton with Glycerine was applied at interface of nasal septum with prongs, Group II pinched Danaplast was applied and Group III cotton soaked in normal saline was applied at septal prongs interface. Newborn babies were randomly allotted in each group. Infant were positioned supine, prone or on their sides. Nursing care included gentle massages of pressure points of nasal devices every 4-6 hr without any ointment. When a nasal trauma was noted, an ointment (sodium fusidate 20 mg) was applied with massages. To assess lesions caused by the NCPAP prongs, the stage of lesions, the nurse and researcher took the prongs out of newborns' nostrils briefly, checked their nostrils and immediately replace the prongs. Because inspection was external and not instrumented, it was possible to miss isolated internal trauma of the nostrils. We classified trauma based on the standardized classification of decubitus lesions

from the US National Pressure Ulcer Advisory Panel (NPUAP)^{16,17}. Grade I: Erythema not blanching, on an otherwise intact skin. Grade II: Erosion, with partial thickness skin loss. Grade III: Necrosis, with full thickness skin loss. When a patient presented with a nasal trauma of different stages, the most severe stage was taken into account.

Statistical Analysis: Data was analysed by using the statistical package for social sciences (SPSS) version 21. Descriptive statistics were presented as mean, standard deviation (SD), frequencies (NO.) and percentages (%). Chi square testing was used to assess the significance of the association between categorical variables (frequencies). Student's t- test was used to compare two means while ANOVA test (analysis of variances) was used to compare three means. Level of significance (p. value) <0.05 was considered significant.

RESULTS

258 newborns were included in study, 136 males and 122 females. All enrolled newborn received CPAP. Babies were randomly allocated to different groups in which no barrier and different barriers were applied. Randomization of group of infants who received no barrier (group 0) and who received different barriers (Group 1, 2, & 3) was done by systematic allocation, in which first newborn was randomly designated to no barrier group 0, on particular day of admission, and subsequently alternating with other three groups i.e. group 1, group 2 and group 3. The mean gestational age, birth weight and CPAP days in each group is 31wk GA (28-35 wks), 1.2 kg (0.7kg-1.8kg) & 5 days (3-10days) respectively. Incidence of Septal necrosis was 26.7% in the babies that had 'No barrier applied at septal Hudson prongs interface (Group 0), which was significantly more (p<0.001) when compared with other three groups, within which its incidence was 2.8% in Cotton applied at septal and Hudson prongs interface with glycerine (Group 1), 7.1% in Danaplast applied at interface (Group 2) and 0.0% in Cotton soaked in normal saline (Group 3) respectively. In Group 0 nasal septal injury Grade I is 35%, Grade II 35%, and Grade III 30.0%, in Group 1, Grade I septal injury is 84%, Grade II 12.7% & Grade III 2.8%, In Group 2 Grade I is 65.7%, Grade II 30.0%, Grade III 4.3% and Group 3 Grade I 80.7%, Grade II 19.3% and Grade III 0.0%

DISCUSSION

Nasal CPAP is the preferred means of ventilatory support

for most neonates with respiratory distress. Complications like nasal injuries can thus be expected and should be looked at and quantified. To date, there are limited reports in the literature regarding nasal injury complications^[15]. Comparison between various published studies is difficult because of highly variable descriptions and definitions of nasal trauma, which differ with each other in classifying severity of nasal injury from limited local redness to full necrosis. We proposed a simple and reproducible classifying system that included three stages adapted from the general classification of the US NPUAP^{15,16}. Incidence of Septal necrosis was 26.7% in the babies that had 'No barrier applied at septal Hudson prongs interface (Group 0), which was significantly more (p<0.001) when compared with other three groups, while as its incidence was 2.8% in Cotton applied at septal and Hudson prongs interface with glycerine (Group 1), 7.1% in Danaplast applied at interface (Group 2) and 0.0% in Cotton soaked in normal saline (Group 3) respectively. In Group 0 nasal septal injury Grade I is 35%, Grade II 35%, and Grade III 30.0%, in Group 1, Grade I septal injury is 84%, Grade II 12.7% & Grade III 2.8%, In Group 2 Grade I is 65.7%, Grade II 30.0%, Grade III 4.3% and Group 3 Grade I 80.7%, Grade II 19.3% and Grade III 0.0%. These results differ from Nascimento et al^[18] who found Grade I in 79.6%, Grade II in 19.7% and Grade III in 0.7% in their study group neonates.

Our study shows that more severe lesions would be expected without the use of barrier as postulated by Xie L et al⁷. As expected, neonates with younger gestational age had the more severe lesion, as also seen by Fischer et al¹⁹, and Alsop et al²⁰, who found that the frequency and severity of nasal trauma increased with lower gestational age (> 90% in neonate <32 week of gestational age. As also expected there was a significant inverse correlation between the birth weight and lesion stage, in agreement with Fischer et al^[19] and Robertson et al²¹, who estimated relative risk was significantly higher in patient weighing < 1500 (25%), (20%) respectively. The lesion stage was significantly and directly (positive correlation) correlated with the time duration on CPAP with severe lesion (Grade III) associated with the longer duration. This was also found by several other researchers including Fischer et al¹⁹, Yong et al²², Nascimento et al¹⁸ and Squires and Hyndman²³.

In our study we used cotton soaked in normal saline as one of the barrier methods (Group 3), whose frequent and prolonged use prevented (severe) Grade III injury due to

probably osmotic effect of normal saline that reduces edema and prevents subsequent erosion and necrosis of the nasal septum.

CONCLUSIONS

Nasal trauma is a frequent complication of NCPAP, especially in preterm neonates with RDS. Risk factors for advanced stages of nasal lesions includes lower gestational age, low birth weight and longer duration on CPAP. Since barrier at septal prong interface significantly reduces severe form of nasal injury and among available barrier methods used in our study normal saline soaked cotton swab is cost effective and easily available, we recommend this mode of barrier application.

Declaration of interest: The authors report no declarations of interest

Author's contributions: Participated in the study design, data collection, sequence alignment and drafting and finalization of the manuscript. All authors read and approved the final manuscript.

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Table 1. Group-wise sex distribution of the study subjects in whom the intervention was done (n=127)

Method	n	Male(n=66)		Female(n=61)	
• No barrier applied at septal Hudson prongs interface	33	16	48.5%	17	51.5%
• Cotton applied at septal and Hudson prongs interface with glycerine	33	19	57.6%	14	42.4%
• Danaplast applied at interface	33	19	57.6%	14	42.4%
• Cotton soaked with normal saline	28	12	42.9%	16	57.1%

Table 2. Comparison of Gestational age, Birth weight, and CPAP days between the four intervention groups

Gestational age (weeks)	N	Mean±SD	Range	P value
				0.921
• No barrier applied at septal Hudson prongs interface	33	31.5±2.5	28-35	
• Cotton applied at septal and Hudson prongs interface with glycerine	33	31.3±2.7	28-35	
• Danaplast applied at interface	33	31.2±2.3	28-35	
• Cotton soaked in normal saline	28	31.6±2.7	28-35	
Total	127	31.4±2.5	28-35	
Birth weight (Kg)				0.806
• No barrier applied at septal Hudson prongs interface	33	1.2±0.4	0.7-1.8	
• Cotton applied at septal and Hudson prongs interface with glycerine	33	1.2±0.4	0.8-1.8	
• Danaplast applied at interface	33	1.2±0.3	0.7-1.8	
• Cotton soaked in normal saline	28	1.2±0.3	0.8-1.7	
Total	127	1.2±0.3	0.7-1.8	
CPAP Days		-		0.801
• No barrier applied at septal Hudson prongs interface	33	5.4±2.2	3 – 10	
• Cotton applied at septal and Hudson prongs interface with glycerine	33	5.2±1.7	3-10	
• Danaplast applied at interface	33	5.6±1.8	3-10	
• Cotton soaked in normal saline	28	5.2±2.1	3-10	
Total	127	5.4±1.9	3-10	