Original Article

To compare the efficacy and complication of nasal prongs vs nasal mask CPAP in neonates

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ABSTRACT

Background: *CPAP refers to the application of positive pressure to the airway of a spontaneously breathing infant throughout the respiratory cycle.*

Objectives: *To study the clinical pattern of CPAP in neonate*

Method: *Total 75 patient were enrolled in the study, 38 in the nasal mask and 37 were in the nasal prongs group. The result of the study was analysed by using Fisher exact test and unpaired t test for continuous variable.*

Results: *The base line characteristics such as birth weight, male and female, match in both the groups. The babies who were < 32wks and < 1500gm birth weight had more frequent trauma in both the groups. The severity of trauma was more as the duration of CPAP was increasing in both the groups. There was no difference of co morbidities like PDA, ROP, IVH in both the groups.*

Conclusion: *The of duration of CPAP was less in nasal prongs than nasal mask which is statistically significant, but there were no statistically significance of nasal trauma in comparison of both the groups*

Keywords: *CPAP, continuous pressure, nasal trauma, respiratory distress, ventilatory support*

Introduction

Non-invasive respiratory support in the neonatal intensive care unit (NICU) has been used for more than 35 years as a means to reduce complications of invasive mechanical ventilation. Specific types of non-invasive support have been implicated in preventing respiratory failure in spontaneously breathing infants, especially those with Respiratory Distress Syndrome (RDS).Technological progress, along with a better understanding of the applications of equipment, advances in the care of then neonate, and documented favourable patient outcomes have translated into trends that continue to promote non-invasive respiratory support for care of the neonate.

Respiratory support in the neonatal intensive care unit (NICU) is a mainstay to reduce complications of invasive mechanical ventilation. Nasal Continuous Positive Airway Pressure (CPAP) in infants is used for situations such as respiratory distress syndrome, apnea of prematurity, bronchomalacia with terminal airway collapse, and in other conditions that require positive pressure. Types of CPAP used in neonates include continuous low CPAP, variable flow CPAP, bubble or underwater seal CPAP, bi-level CPAP, synchronized non-invasive positive pressure ventilation, high flow nasal cannula, and nasal high frequency ventilation (NHFV) To apply CPAP, three components are essential required continuous flow of a heated and humidified gas mixture (compressed air and oxygen); a system connecting the device to the patient's airway such as facial masks, nasal prongs, nasopharyngeal or endotracheal tubes and a mechanism of positive pressure generation in the system.

The local pressure of CPAP devices to the nasal area tends to develop decubitus lesions in the newborn due to its cutaneous vulnerability and anatomical factors such as end-vascularisation of the columella and nostrils. [1,2] Nasal trauma represent a source of discomfort for patients, possible site of infection and a risk of long term functional or cosmetic sequelae. [3-5] Nasal traumas have been described in case reports. Yong et al have studied the effect of mask versus cannula in the development of nasal trauma and found no statistically significant difference between these two devices.

Yong et al included preterm baby with weight less than <1550gm, in present study all

babies were included and this was the first study from India for comparison of CPAP with two devices.

Materials and methods

This study was conducted in tertiary neonatal intensive care unit of Rainbow Children and perinatal centre, Banjara hills, Hyderabad between Jan 2011 to Oct 2011. This was a prospective randomized controlled study over a period of 1 year this study was approved by the ethical committee of the institute. Babies who received ventilator CPAP in our unit were included in the study however, babies who required CPAP for more than >24 hr duration were analysed. Total 75 patients were enrolled in the study, 38 in the nasal mask and 37 were in the nasal prongs group.

Inclusion criteria: All babies who received CPAP were included. Criteria used to start CPAP were:

- Preterm with sign of respiratory distress with grunting
- Preterm babies weaned off from the ventilator
- Apnea of prematurity
- Laryngotracheomalacia
- Term baby with respiratory distress requiring Fio2 >40% on hood box
- Term baby with HMD (hyaline membrane disease) and low volume lung

Exclusion criteria: Neonate who received CPAP in other unit and then transferred to our hospital.

Preterm baby who had respiratory distress in the form of grunting and tachponea started on CPAP with PEEP of 5-8cm of H_20 and Fio2 up to 80% and those babies who deteriorated on these setting were taken into CPAP failure category. [1]

All preterm babies <32wks and <1500gm directly extubated to CPAP according to randomization. Extubation criteria used from ventilator with minimal setting PIP: <14 cm of H_2O (adequate chest rise) PEEP:<4 cm H_2O, Rate:15 /min, Ti-0.30 sec ,Fio2< 35%. [6] Mechanical ventilation was considered when nCPAP was not sufficient to achieve a satisfactory PaO2 while breathing 80% O2, or not to relieve marked retractions or frequent apnoeas. Nasal CPAP was reintroduced when the infant had tachypnoea>70/min, deep retractions or frequent episodes of apnoea like four episode per hour or 2 episode requiring bag and mask ventilation and bradycardia. PEEP used for apnoea was 3-5cm of H_2o. Infants were weaned off from CPAP when they were comfortable, had no signs of distress, and maintained SpO2 of 88-93% while on FiO2 of <0.3.

The neonate's nose was inspected daily until the infants were weaned off nCPAP. The classes were taken for stages of trauma and nasal trauma was recorded by the two independent fellow of the unit in every shift. The condition of the nose was documented systematically for the presence of any of the type of trauma. Photograph of nasal trauma in three different angles were taken during the study period. The intraobserver and interobserver bias was minimised after showing photograph without labelling the photograph as prongs and mask group to two senior neonatologists and one Pathologist. Independent view and average of score was taken into study. Trauma was classified based on the standardised classification of the decubitus lesions from the US National Pressure Ulcer Advisory Panel (NPUAP).

Stage I: Erythema not blanching, on an oth0erwise intact skin. (Fig.1)

Stage II: Superficial ulcer or erosion, with partial thickness skin loss. (Fig.2)

Stage III: Necrosis, with full thickness skin loss. (Fig.3)

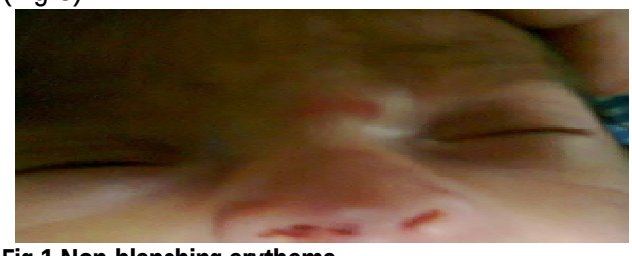

Fig.1 Non-blanching erythema

Fig.2 Superficial erosion

Fig.3 Necrosis of full thickness of skin

The result of the study was analysed by using Fisher exact test and unpaired t test for continuous variable. Logistic regression analysis was carried out to determine the significant risk factors associated with nasal trauma.

Results

In our study we took all babies including term or preterm while Yong et al took only very low birth weight babies in his study. Total 75 patients were enrolled in the study, 38 in the Nasal mask and 37 were in the nasal prongs group. There was no significant difference in the base line characteristics such as, birth weight, male and female mode of delivery and mean duration of ventilation in both the groups. (Table 1) Most common indication of CPAP was HMD in both the group 15 and 14 patient in nasal mask and prongs group respectively. Other indication of CPAP were VSD, PPHN, VAP (Maskgroup), Prongs (VAP2, TAPVC and Laryngotracheomalacia one each group). This was not statistically significant. (p value=1.00) There were severe trauma including Stage II and stage III present in 42% and 18.4% in <32wks and more than 32wks of gestation. There were 5.4% and 21.6% case in stage I nasal prongs with gestation of less than and more than 32wks respectively. Severe trauma including Stage II and stage III with 42% and 18.4% were seen in <32wks and more than 32wks of gestation.

Table 1: Demographic Data

	Nasal mask N-=38 (%)	Nasal Prongs N=37(%)	P value
Male	23(60.5)	20(52)	0.51
Female	15(39.47)	17(45.9)	
Surfactant	16(42)	18(48.6)	>0.05
Mode of delivery LSCS/NVD	35/3 (92/7.8)	30/7 (81/18.9)	0.19
Antenatal steroid	25(65)	15(40.5)	>0.05
CPAP at admission	29	30	1.0
Mean duration CPAP(hr)	173.2 ± 231.7	85.81±78.29	0.03
Mean duration of ventilation (hrs)	43.5 ± 59.7	65.7±135.8	0.36
Mean gestational age (weeks)	32.6 ± 4.57	34.4 ± 4.28	>0.05
Mean weight (gm)	1647.18 ± 760.49	1939.45 ± 779.48	
HMD	15(39.4)	14 (37.8)	1.00
AOP(Apnoea of prematurity)	7 (18.4)	6 (16.2)	
Post Extubation	9 (23.6)	7 (18.9)	
TTNB(Transient tachypnoea of newborn)	2 (5.2)	4 (10.8)	
MA (Meconium Aspiration)	2 (5.2)	1 (2.7)	
Other	3 (7.8)	4 (10.8)	

Table 2: Severity of trauma according to Gestation in both groups

Nasal Mask Gestation	Stage 1 (%)	Stage II (%)	Stage III (%)	P value	RR(95%CI)
<32wks	2(5.2)	12(31.5)	4(10.5)	0.04	
>32wks	6(15.7)	7(18.4)	-		
Total	8(20.9)	19(49.9)	4(10.5)	81.3%	0.24(0.05to1.0)
Nasal Prongs Gestation					
<32wks	2(5.4)	10(27)	4(10.8)	0.01	
>32wks	8(21.6)	4(10.8)	1(2.7)		
Total	10(27)	14(37.8)	5(13.5)	78.3%	0.20 (0.05 to 0.79)

Table 3: Severity of trauma according to weight in both groups

Nasal Prongs Weight	Stage I(%)	Stage II (%)	Stage III (%)	No Trauma	P value	RR(95%CI)
<1500	10(27)	7(18.9)	4(10.8)			
>1500	-	7(18.9)	1(2.7)	8(21.6)		
N(37)	10 (27)	14(37.8)	5(13.5)	8(21.6)	0.02	0.6 (0.2 to 0.70)
Nasal mask Weight						
<1500	1 (2.6)	13 (34.2)	3 (7.8)	4 (10.5)		
>1500	7 (18.4)	6 (15.7)	1 (2.6)	3 (7.8)		
N(38)	8 (21)	19 (49.9)	4 (10.4)	7(18.3)	0.01	0.11(0.01to0.84)

There was 27% stage 1 trauma seen in less than 1500gm of birth weight. Severe trauma including Stage II and stage III with 29.7% and 21.6 % were present in less than 1500gm and more than 1500gm birth weight babies. This was statistically significant (p value 0.02). There were 2.6% and 18.4% of stage 1 trauma seen in less than and more than 1500gm of birth weight. Severe trauma including Stage II and stage III with 42% and 18.3% were present in less than 1500gm and more than 1500gm birth weight babies. This was statistically significant (p value 0.01)

There were 2.6% and 18.4% of stage 1 trauma seen in less than and more than 1500gm of birth weight. Severe trauma including Stage II and stage III with 42% and 18.3% were present in less than 1500gm and more than 1500gm birth weight babies. This was statistically significant (p value 0.01). There were no significant difference in co morbidities condition like ROP (Retinopathy of prematurity), PDA (Patent ductus arteriosus),

BPD (Bronchopulmonary dysplasia), IVH (Intraventricular haemorrhage), NEC (Necrotizing enterocolitis) and Pneumothorax. But in CPAP failure rate was more in mask group as compared to prongs group (p value=0.03). Multivariate linear analysis showed that trauma was inversely proportion to gestation and birth weight but severity of trauma was directly proportion to the duration of CPAP. This was statistically significant.

Discussion

Nasal trauma secondary to nCPAP is an adverse event with potential short or long-term consequences. Little data are available in the literature on this topic, with reported incidences ranging from 20% to 60% [7,8,9,10,11] Comparisons between published studies are difficult because of different definition of trauma. Nasal masks, which were used in the 1970s, were abandoned in the 1980s as there was difficulty in maintaining a good seal and they tended to obstruct the nasal airways. [12,13] In recent years, the manufacturer of the IFD has produced soft silicon nasal masks, which can be used alternate of the nasal prong. These nasal masks are softer and fit the nasal airway better than the older generations of nasal masks of the 1970s.

The types of injury were similar in the two groups, the sites of injury differed. In the nasal mask group, injuries occurred primarily at the base of the nasal septum at the junction between the nasal septum and the philtrum. This suggests that this is the area at which the mask exerts the greatest pressure, as prolonged pressure leads to impairment of tissue perfusion with resultant skin trauma. Injuries in the nasal prong group were confined primarily to the medial aspect of the nostrils on the nasal septum, indicating this to be the site of maximum pressure exerted by the prong. The lateral part of the nostrils may expand outwards when the prong are applied; the medial parts, being less mobile, are exposed to greater persistent pressure from the prong with resultant trauma. The mean birth weight in nasal mask and nasal prongs were 1654.18 ± 760.49 and 2154.45 ± 779.48 respectively while in Yong et al [8] mean birth weight were 1085(232) and 1105(228) mean weight in gm, less weight patient were in Yong et all study, in nasal mask and nasal prongs respectively. The mean gestational age in nasal mask and nasal prongs were 32.8 ± 4.57 and 34.8 ± 4.28 respectively while in Yong et al mean gestational age in nasal mask and nasal prongs were 28.7(2.3) and 29.7(2.6) respectively not in concordance because he has taken only very low birth weight. Rego MA, Martinez FE et al [14] used Nasal CPAP in babies weighing 480g to 2,450g and corrected gestational age of 24 to 39 weeks and he concluded that CPAP was indicated in cases of apnea (12.5%), hyaline membrane disease (32.3%), pneumonia (4.2%), transient tachypnea (22%), and weaning from the ventilator (29%). The last indication was more frequent in children with lower weight ($p<0.01$). In our study we enrolled 75 patient and found indication of CPAP for apnea (17.3%), hyaline membrane disease (38.6%), transient tachyponea (8%), and weaning from the ventilator (21.3%).

The duration of CPAP was less in nasal prongs than nasal mask which was statistically significant. There was no significant difference of nasal trauma in both the groups. The babies who were less than 32wks and less than 1500gm birth weight had more frequent trauma in both the group. The severity of trauma was more as the duration of CPAP was increasing in both the groups. We concluded that nasal mask and nasal prongs cause equivalent trauma.

References

1. Goldsmith JP, Karotkin EH. Continuous distending pressure in Assisted Ventilation of the Neonate. JB Saunders: Philadelphia;1996.p.151-65.
2. Cartlidge P. The epidermal barrier. Semin Neonatol 2000;5:273–80.
3. Kopelman AE, Holbert D. Use of oxygen cannulas in extremely low birthweight infants is associated with mucosal trauma and bleeding, and possibly with coagulase-negative staphylococcal sepsis. J Perinatol 2003;23:94–7.
4. DeRowe A, Landsberg R, Fishman G. Neonatal iatrogenic nasal obstruction. Int J Pediatr Otorhinolaryngol 2004;68:613–7.
5. Smith LP, Roy S. Treatment strategy for iatrogenic nasal vestibular stenosis in young

children. Int J Pediatr Otorhinolaryngol 2006;70:1369–73.
6. Khalaf MN, Brodsky N, Hurley J, Bhandari V. A prospective randomized, controlled trial comparing synchronized nasal intermittent positive pressure ventilation versus nasal continuous positive airway pressure as modes of extubation. Pediatrics 2001;108:13–7.
7. Shanmugananda K, Rawal J. Nasal trauma due to nasal continuous positive airway pressure in newborns. Arch Dis Child Fetal Neonatal Ed 2007;92:F18.
8. Yong SC, Chen SJ, Boo NY. Incidence of nasal trauma associated with nasal prong versus nasal mask during continuous positive airway pressure treatment in very low birth weight infants: a randomised control study. Arch Dis Child Fetal Neonatal Ed 2005;90:F480–3.
9. Conner J, De Klerk R. Care of the Infant on nCPAP. The Vermont Oxford Network Delivery Room Management Clinical Trial, 2008. Available at: http://www.vtoxford.org
10. McCoskey L. Nursing Care Guidelines for prevention of nasal breakdown in neonates receiving nasal CPAP. Adv Neonatal Care 2008;8:116–24.
11. Squires AJ, Hyndman M. Prevention of nasal injuries secondary to NCPAP application in the ELBW infant. Neonatal Netw 2009;28:13–27.
12. Chernick V. Continuous distending pressure in hyaline membrane disease: of devices, disadvantages, and a daring study. Pediatrics 1973;52:114–5.
13. Kattwinkel J, Fleming D, Cha C., A device for administration of continuous positive airway pressure by the nasal route. Pediatrics 1973;52:131.
14. Rego MA, Martinez FE. Clinical and laboratorial repercussions of the nasal CPAP in preterm newborns 2000 Sep-Oct;76(5):339-48.

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