ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 05 | May - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

USE OF EARLY NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE IN TREATMENT OF PRETERM NEONATES WITH HYALINE MEMBRANE DISEASE (NEONATAL RESPIRATORY DISTRESS SYNDROME)

Neonatology

Dr Ranjeet Kumar Assistant Professor, Department of Pediatrics, Medini Rai Medical College & Hospital, Palamu (Jharkhand).

Dr Aarti Sharma Senior Resident, Department of Pediatrics, AIIMS, Raipur (Chhattisgarh).

Dr Falak Naaz Junior Resident, Department of Pediatrics, SCB Medical College & Hospital, Cuttack (Orissa).

Dr Zeeshan Ahmed* Senior Resident, Department of Pediatrics, AIIMS, Raipur (Chhattisgarh). *Corresponding Author

ABSTRACT

Objective: To evaluate the outcome of early nasal CPAP in premature neonates with neonatal respiratory distress syndrome.
Methods: 100 babies of 28-34 weeks gestational age admitted in Neonatal ICU of Nalanda Medical College & Hospital, Patna (Bihar, India), with clinical diagnosis of HMD, requiring respiratory support were treated with early nasal CPAP and studied prospectively from 1st November 2014 to 31st October 2016.
Results: We found a success rate of 80% in babies with HMD, who were managed with early nasal CPAP alone. Remaining 20% needed intubation and higher mode of ventilation. Mild and moderate grade HMD were effectively managed with early nasal CPAP ($P<0.05$). It was also found to be effective in babies of mothers who have received antenatal steroids ($P<0.05$).
Conclusion: Prematurity is the commonest predisposing cause for HMD. Early nasal CPAP is safe, inexpensive and effective means of respiratory support in HMD. It is useful in mild and moderate grade disease. It may not be a replacement for assisted ventilation in severe disease. It is also found to be more effective in babies of mothers who have received antenatal steroids.

KEYWORDS

Hyaline membrane disease; Nasal CPAP

INTRODUCTION

Neonatal respiratory distress syndrome (RDS) is a condition of pulmonary insufficiency which commences at or shortly after birth and increases in severity over the first 2 days of life. Clinically, RDS presents with early respiratory distress comprising cyanosis, grunting, retractions and tachypnea. Respiratory failure may develop, indicated by blood gas analysis, and the diagnosis can be confirmed on chest X-ray with a classical 'ground glass' appearance and air bronchograms. If left untreated death may occur from progressive hypoxia and respiratory failure. In survivors resolution begins between 2 and 4 days. RDS is due to a deficiency of alveolar surfactant along with structural immaturity of the lung and it is mainly, but not exclusively, a disease of preterm babies. The Vermont Oxford Neonatal Network definition requires that babies have a PaO 2 <50 mm Hg (<6.6kPa) in room air, central cyanosis in room air or need for supplemental oxygen to maintain PaO 2 >50 mm Hg (>6.6 kPa), as well as the classical chest X-ray appearances. With modern early management this classical definition of RDS may not be achieved and making the diagnosis on the basis of having administered surfactant may be an overestimate. Bubble CPAP is a newer CPAP delivering system. It is CPAP delivered by CPAP system with underwater seal. It has been shown that CPAP delivered by underwater seal causes vibration of the chest due to gas flow under water, which is transmitted to infant's airway. These vibrations simulate waveforms produced by high frequency ventilation[4]. Bubble CPAP has also been shown to reduce need for intubation and mechanical ventilation[5], postnatal steroids and trend towards decreased incidence of chronic lung disease[6]. With an underwater blow off system, sufficient flow creates continuous bubbling from the end of the underwater tube, placed at a specified depth underwater, to ensure that circuit pressure is maintained. A comparison of underwater bubble endotracheal (ET) CPAP with conventional ventilator derived (ET) CPAP in preterm neonates suggests that such oscillation contributes to gas exchange[7]. It is relatively a simple and inexpensive way of generating CPAP. It also has the advantage that if there is inadequate pressure owning to a large leak the bubbling can be seen to stop.

Present study is a hospital based study and aims at managing increased number of babies with neonatal respiratory distress syndrome with a non-invasive approach in the form of early nasal CPAP.

AIMS AND OBJECTIVES

To evaluate the outcome of early nasal CPAP in premature neonates with neonatal respiratory distress syndrome admitted in Nalanda Medical College & Hospital.

METHODS

The study was conducted at Neonatal ICU, Nalanda Medical College & Hospital, Patna (Bihar, India). 100 cases of clinically diagnosed HMD with gestational age 28-34 weeks admitted to Neonatal ICU were subjects of this study. These babies requiring respiratory support were treated with early nasal CPAP (within 6 hours of onset of respiratory distress) and studied prospectively from November 2014 to October 2016. The period of collection of data was two years.

Design of the study: Hospital based observational study.

Duration of the study: Two years i.e., from 1st November 2014 to 31st October 2016.

Definitions:

Hyaline membrane disease: The baby should meet all of the following three clinical criteria[8]:
1. Preterm neonate
2. RDS having onset within 6 hours of birth.
3. Amniotic fluid L/S ratio of <1.5 or negative gastric aspirate shake test or Skiagram of chest showing either poor expansion with air bronchogram or reticulogranular pattern or ground glass opacity

CPAP is successful when: The saturation is >85%; PaO_2 of 60-80 mm Hg, $PaCO_2$ of 25 to 45 mm Hg and pH of 7.3 to 7.4 with FiO_2 <0.6. Baby has no respiratory distress.

CPAP failure is defined as:
- PO_2 < 50 mm Hg or PCO_2 > 60 mm Hg with FiO_2 >0.6.
- SAS score >6.
- Recurrent apnea.

Inclusion criteria for cases: - All preterm neonates admitted in our hospital with gestational age between 28-34 weeks with diagnosed HMD after taking consent from parents/ guardians.

Exclusion criteria for cases:
1. All term neonates
2. Neonates with congenital malformations.
3. Babies born to mothers receiving general anesthesia, phenobarbitone, pethidine and other drugs likely to depress the baby.
4. Babies with meconium aspiration syndrome.

5. Babies with birth asphyxia.

Method of collection of data:
100 babies with gestational age between 28-34 weeks admitted with clinical diagnosis of HMD requiring respiratory support were treated with early nasal CPAP (within 6 hours of onset of respiratory distress) and studied prospectively from November 2014 to October 2016. All babies with HMD were evaluated using Silverman Anderson (SA) scoring, blood gas analysis and pulse oximetry. Babies with SA score of >4 or requiring FiO2 > 0.4 to maintain PaO2 above 50-60 mm Hg were treated with early nasal CPAP and effectiveness was judged using SA scoring and blood gas analysis. If symptoms progress and FiO2 requirement is >0.6 to maintain SpO2 above 85%, babies were ventilated.

Method of Statistical Analysis
After the completion of the study, data was analyzed using appropriate statistical methods to find out the effectiveness of early nasal CPAP in the treatment of preterm infants with HMD. Babies treated with nasal CPAP treatment were classified into two groups namely success and failure group and comparison between the groups were carried out as follows:

1. Proportions were compared using chi-square (χ^2) test of significance. Proportion of cases belonging to specific group of parameter or having a particular problem was expressed in absolute number and percentage.

2. The results were averaged (mean±standard deviation) for each parameter (duration of treatment, age at admission, age at treatment and ABG parameter) between the groups. Student's't' test used to find a significant difference between two means.

In all above test, "p" value of less than 0.05 was accepted as indicating statistical significance.

RESULTS
100 babies admitted with clinical diagnosis of HMD requiring respiratory support were treated with early nasal CPAP and studied prospectively from November 2014 to October 2016. Out of total 100 babies who were managed with nasal CPAP, it proved effective in 80 babies (80%), remaining 20 babies (20%) had to be intubated and required ventilation.

Table-1: Distribution Of Babies Based On Gestation Age And Results

Gestational age in weeks	Total	Success		Failure	
		Number	Percent	Number	Percent
28-30	24	10	41.67	14	58.33
31-32	60	56	93.30	4	6.67
33-34	16	14	87.50	2	12.50
Total	100	80	80.00	20	20.00
χ^2 = 14.50	df=2	p>0.001			

Table–1 depicts there is statistically significant difference between success and failure groups with respect to gestational age (p<0.001). Higher the gestational age more is the success rate.

Table-2: Distribution And Outcome Of Babies Based On Birth Weight

Birth weight (gms)	Total	Success		Failure	
		Number	Percent	Number	Percent
<999	8	6	75.00	2	25.00
1000-1500	72	58	80.50	14	19.50
1501-2000	20	16	80.00	4	20.00
Total	100	80	80.00	20	20.00
χ^2=0.071	df=2	p>0.05			

Table-2 shows that success and failure rates are not significantly different with respect to birth weight.

Table-3: Antenatal Steroids And Outcome With CPAP

Steroids received	Total	Success		Failure	
		Number	Percent	Number	Percent
Yes	56	52	92.86	4	7.14
No	44	28	63.63	16	36.37
Total	100	80	80.00	20	20.00
χ^2 =6.5	df =1	p<0.05			

Table-3 show antenatal steroids in mother had definite role in better outcome of HMD.

Table-4: SA Score In Study Group Before And After Treatment

SA Score	Before treatment (n=100)		After 6 hours (n=100)		After 12 hours (n=80)	
	Number	Percent	Number	Percent	Number	Percent
1	--	--	--	--	26	32.5
2	--	--	14	14.0	52	65.0
3	--	--	50	50.0	2	2.5
4	32	32.0	16	16.0	--	--
5	62	62.0	--	--	--	--
6	6	6.0	18	18.0	--	--
7	--	--	2	2.0	--	--

Table-4 shows distribution of babies based on SA score. 61.2% were in score 5, 6% in score 6 and 32% in score 4 before institution of CPAP. Nasal CPAP was started when SA score was 4 or more. This shows the effectiveness of early nasal CPAP in managing HMD.

DISCUSSION
100 preterm babies with gestational age 28 – 34 weeks with HMD were treated with early nasal CPAP. Out of 100, 80 babies (80%) were effectively managed with early nasal CPAP alone. Remaining 20 (20%) had to be intubated and required more invasive mechanical ventilation. The EuroNeoNet figures for 2010 show an incidence of 92% at 24–25 weeks' gestation, 88% at 26–27 weeks, 76% at 28–29 weeks and 57% at 30–31 weeks[1]. Recent large clinical trials show that when managed with early CPAP babies of 26–29 weeks can be managed without intubation or surfactant about 50% of the time[2].

Out of 20 babies who required ventilation 90% of the babies were less than 32 weeks gestation age; remaining 10% were between 33-34 weeks. Analysis of these results shows that outcome is better with increase in gestational age (statistical significance p<0.05). Jacobsen et al have shown better outcome in babies with gestational age of <33 weeks. They found significant reduction in mechanical ventilation from 76% to 35% (p=0.00001). Urs et al[10](2009) have found better outcome in gestational age of 32-34 weeks (p<0.001).

We looked into effect of birth weight of the babies and overall outcome. Out of 100 babies, 8 belonged to weight of <999 g, 72 in 1000-1500g and remaining 20 were >1501 g. We found an overall success rate of 75% in babies <999 g, 80.5% in 1000-1500 g and 80% in babies >1500 g. Out of 20 babies who failed 80% were <1500 g and remaining 20% above 1500g. Studies have shown better outcomes in VLBW and ELBW. Aly H et al[11](2004) studied outcome of nasal CPAP in ELBW. They found no significant trends in mortality rate among the baseline group and the 3 groups after the institution of the nasal CPAP practice. Nasal CPAP management increased in the surviving infants over time, whereas the need for surfactant treatment decreased.

We found statistically significant improvement (p<0.005) in SA score after application of nasal CPAP. SA scoring also helped us to predict which babies would go for ventilation. Recent study[12] showed, infants who received CPAP in circumstances where NICU access was denied had a significantly improved short-term survival (at 24 hours), with trends towards improved long-term survival. Urs et al[10](2009) have shown significant improvement in Downes score after application of bubble CPAP.

Blood gas analysis was the other parameter, which helped us to decide success and failure on early nasal CPAP. In our study we found that babies on CPAP had significant improvement in oxygenation (p<0.05), other parameters varied. With this we could reduce FiO2 significantly and wean down the babies.

Out of 20 babies who failed on nasal CPAP, 80% of them had severe grade HMD and 20% showed moderate HMD. With this we conclude that early nasal CPAP is effective in mild and moderate HMD. It may not be a replacement for assisted respiratory support (ventilation) in severe cases of HMD. One study by Urs et al[10](2009), conclude that CPAP is effective in mild and moderate grade HMD.

Antenatal steroid administration helps us to predict the severity of HMD and need for invasive respiratory support. We found results similar to those of Sandri F et al[3] (2004) who showed trend towards greater failure in babies who had not received antenatal steroids

(p=0.02). Urs et al[10](2009) have also shown that CPAP is more effective in babies of mothers who have received antenatal steroids.

WHAT THIS STUDY ADDS?

1. CPAP is a safe and effective mode of therapy in preterm neonates with respiratory distress especially in low resource settings with a very-low risk of side effects like pneumothorax.
2. It can be instituted easily by paramedical staffs after 1 to 2 months of training and it has the potential to bring down the requirement and the cost of surfactant therapy. This reduction has huge financial implications for low resource countries like India.

CONCLUSION

Prematurity is the commonest predisposing factor for HMD. Its incidence increases as gestational age decreases. Early nasal CPAP is useful in mild and moderate grade HMD. It may not be a replacement for assisted respiratory support (ventilation) in severe HMD. Nasal CPAP is found to be effective in babies of mothers who had received antenatal steroids. Nasal CPAP is safe, inexpensive and effective means of respiratory support in HMD. In developing countries like ours, there is high burden of prematurity and sub-optimal use of antenatal steroid administration resulting in frequent HMD. Use of early nasal CPAP which is simple, non-invasive, has low capital outlay and does not require expertise, is an option for most places that cannot provide invasive ventilation.

Considering its high degree of effectiveness, if used early in the course of illness as we found in our study, it can serve as a useful modality to minimise ventilation needs in babies suffering from Hyaline Membrane Disease.

REFERENCES

1. EuroNeoStat Annual Report for Very LowGestational Age Infants 2010. The ENS Project.Hospital de Cruces, Unidad Neonatal5-D, Plaza de Cruces s/n, 48903 Barakaldo, Spain. Info.euroneonet @ euskalnet.net.
2. Dunn MS, Kaempf J, de Klerk A, de Klerk R,Reilly M, Howard D, Ferrelli K, O Orell J, SollRF, Vermont Oxford Network DRM Study Group: Randomized trial comparing 3 approaches to the initial respiratory management of preterm neonates. Pediatrics 2011;128:e1069–e1076
3. Whitsett JA, Pryhuber GS, Rice WR, Warner BB, Wert SE. Acute respiratory disorders. In: Avery GB, Fletcher MA, MacDonald MG (eds), Neonatology: Pathophysiology and Management of the Newborn, 4 ed. Philadelphia: J.B. Lippincott Company; 1994: 429-452.
4. Lawson EE, Birdwell RL, Huang PS. Augmentation of pulmonary surfactant secretion by lung expansion at birth. Pediatr Res 1979; 13: 611-614.
5. Locker R, Greenspan JS, Shaffer TS et al. Effect of nasal CPAP on thoraco-abdominal motion in neonates with respiratory insufficiency. Pediatr Res. 1994; 11: 259-264.
6. Lee US, Dunn MS, Fenwick M et al. A comparison of underwater bubble continuous positive airway pressure (CPAP) with ventilator derived CPAP in preterm neonates ready for extubation. Biol Neonate 1998; 73: 69-75.
7. Narendran V, Donovan EF, Hoath SB et al. Early bubble CPAP and outcomes in ELBW preterm infants. J Perinatol 2003; 23: 195-199.
8. Effect of Treatment of Premature Infants with Respiratory Distress Using Low-cost Bubble CPAP in a Rural African Hospital. J Trop Pediatrics (2016) :62:(5):385-389. DOI: https://doi.org/10.1093/tropej/fmw023. Published: 25 April 2016
9. Sandri F, Ancora G, Lanzoni A et al. Prophylactic nasal continuous positive airways pressure in newborns of 28-31 weeks gestations : multicenter randomized controlled clinical trial. Arch Dis Child Fetal Neonatal Ed. 2004 Sep; 89(5): F394-8.
10. Prashanth S Urs, Firdose Khan, Maiya PP. Bubble CPAP – A primary respiratory support for respiratory distress syndrome in newborns. Indian Pediatrics 2009; 46: 409-411.
11. Aly H, Milner JD, Patel K et al. Does the experience with the use of nasal continuous positive airway pressure improve over time in extremely low birth weight infants? Pediatrics 2004; 9(114): 697-702.
12. Pieper CH, Smith J, Maree D et al. Is nCPAP of value in extreme preterms with no access to neonatal intensive care. J Trop Pediatr 2003; 49: 148-152.
13. Joris N, Sudre P, Moessinger A. Early application of CPAP in newborns with gestational age below 34 weeks lowers intubation rate and shortens oxygen therapy without altering mortality and morbidity. Schweiz Med Wochenschr. 2000; 130(49): 1887-93.
14. Carlos JS, Diagnostic imaging. In: Martin RJ, Fanaroff AA, Michele CW, editors. Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant. 8th ed. Philadelphia: Mosby Elsevier Publishers; 2006.p.713-714.
15. Schmid ER, Dangel PH, Duc GV. The use of nasal CPAP in newborns with RDS. Eur J Intensive Care Med. 1976; 2(3): 125-30.
16. Boo NY, Zuraidah AL, Lim NL et al. Predictors of failure of nasal continuous positive airway pressure in treatment of preterm infants with respiratory distress syndrome. J Tropical Pediatr. 2000 Jun; 46(3): 172-5.
17. Kahn DJ, Courtney SE, Steele AM, Habib RH. Unpredictability of delivered bubble nasal continuous positive airway pressure: role of bias flow magnitude and nares-prong air leaks. Pediatr Res 2007;62(3):343-347.
18. Kahn DJ, Habib RH, Courtney SE. Effects of flow amplitudes on intraprong pressures during bubble versus ventilator-generated nasal continuous positive airway pressure in premature infants. Pediatrics 2008; 122(5):1009-1013.
19. Chang HK. Mechanisms of gas transport during ventilation by high frequency oscillation. J ApplPhysiol 1984;56(3):553-563.
20. Pillow JJ. High-frequency oscillatory ventilation: mechanisms of gas exchange and lung mechanics. Crit Care Med 2005;33(3 Suppl):S135-S141.
21. Gupta S, Sinha SK, Tin W, Donn SM. A randomized controlled trial of post-extubation bubble continuous positive airway pressure versus Infant Flow Driver continuous positive airway pressure in preterm infants with respiratory distress syndrome. J Pediatr 2009;154(5):645-650.