

Efficacy of CPAP in Treatment of Hyaline Membrane Disease in NICU

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ABSTRACT

Hyaline membrane disease also called as respiratory is a common cause of admission in the NICU. It is a common health problem in preterm babies due to deficiency of surfactant. Surfactant reduces surface tension in the alveoli, prevents atelectasis and maintains stability continuous positive airway pressure (CPAP) that provides continuous distending pressure to the alveoli overcomes collapse and improves ventilation.

Objective: To study the efficacy of CPAP in the management of respiratory distress syndrome in NICU

Study Design: prospective hospital based longitudinal study.

Subject: All newborn, admitted to the NICU with signs of respiratory distress with onset within first 6hrs of life and chest x-ray suggestive of RDS were included.

Intervention: Bubble CPAP.

Results: Thirty-two babies out of forty-two were successfully weaned off CPAP with overall CPAP success rate of 80.2 %. There were significant differences in mean oxygen saturations pre-CPAP (78 ± 4.07) and post-CPAP (96.00 ± 1.11) commencement ($p = 0.001$). The mean birth weight of survivors were higher (1235.2) compared to those who died (923.04

gms), with a p-value of <0.05 . Babies that died had lower mean gestational age 28.3 weeks) than those that did not (32.3 weeks) though this was not statistically significant ($p > 0.05$).

Conclusion Noninvasive modalities of treatment like CPAP is cornerstone in treatment of mild to moderate cases of RDS. Its affordability, feasibility and good safety profile makes it treatment of choice in low income set up...

Keywords: Bubble CPAP, RDS, NICU, newborn.

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INTRODUCTION

Respiratory distress syndrome (RDS) is a leading cause of mortality, especially in preterm with very low birth weight (VLBW) and extremely low birth weight babies¹ Bubble CPAP is a non-invasive ventilation strategy for newborns with infant respiratory distress syndrome). It works by providing continuous positive airway pressure (CPAP) to the airway which distends the lungs, overcomes collapse and improves ventilation. In this method, blended and humidified oxygen is delivered via short nasal prongs or a nasal mask and pressure in the circuit is maintained by immersing the distal end of respiratory circuit and making the patient exhale against a column of water, generating bubbles (bubble CPAP). The depth to which the tubing is immersed underwater provides the PEEP generated in the airways of the infant. As the gas flows through the system, it "bubbles" out² and prevents buildup of excess pressure in the respiratory circuit.

Neonatal RDS, also called as hyaline membrane disease, is a disorder mainly of preterm infants.

Intermittent positive pressure ventilation (IPPV) with surfactant is the standard treatment for RDS. Continuous positive airway pressure (CPAP) was used for the first time in 1971 Gregory et al used in the treatment of respiratory distress syndrome. Because of its simplicity and low cost. It has the potential to be

implemented on a large scale² It is also associated with a decreased incidence of bronchopulmonary dysplasia (BPD).³

MATERIAL & METHODS

Type of Study

The study was a prospective hospital study of babies admitted to NICU of Hi-Tech Medical College and hospital between August 2016 and June 2017. Bubble CPAP had been used.

Study Object

The study conducted in (NICU) level-III at HITECH BBSR. All newborn, admitted to the NICU with signs of respiratory distress with onset within first 6hrs of life and chest x-ray suggestive of RDS were included.

Inclusion Criteria

All neonates with signs and symptom of respiratory distress, at <6 hr of life and chest x-ray suggestive of RDS.

Birth in HMCH or outside birth who are admitted with 6hrs of life.

Exclusion Criteria

1. Baby admitted in NICU without features of respiratory distress
2. Neonates weighing less than 900gms were excluded from trial CPAP.

3. Neonates likely to have causes of respiratory distress other than RDS like Meconium Aspiration Syndrome, TTN, CHD, congenital or syndromic babies.

Table I: Maternal characteristics of study subjects

| PARAMETERS | n (%) |
|-------------------------------|----------|
| Maternal age (years) | |
| 20-25 | 15(33.3) |
| 26-30 | 5 (13.3) |
| 31-35 | 16(38.1) |
| 36-40 | 9(16.7) |
| Antenatal steroids | |
| Received | 28(66.7) |
| Not Received | 14(33.3) |
| Mode of delivery | |
| Caesarean section | 34(80.1) |
| Vaginal Delivery | 8(19.0) |
| No of babies delivered | |
| Singleton | 30(71.4) |
| Twins | 12(28.5) |

Table II: Baseline characteristics of study subjects

| PARAMETERS | n (%) |
|---------------------------------|----------|
| Gestational ages (weeks) | |
| <= 28 | 20(47.6) |
| 28-32 | 15(35.7) |
| 33-34 | 7(16.7) |
| Gender | |
| Male | 16(38.1) |
| Female | 26(61.9) |
| Birth weight | |
| <1000g | 14(33.3) |
| 1000 – 1499 | 15(35.7) |
| 1500- 2500 | 13(31) |
| 5 minutes APGARS | |
| 0-4 | 3(7.1) |
| 5-7 | 12(28.6) |
| 8-10 | 27(64.3) |

RESULTS

A total of 202 neonates were admitted into the inborn NICU of HMCH during the study period, out of which 88 were preterm babies. Of the preterm babies, 42 subjects who were diagnosed with RDS and met all the inclusion criteria were recruited into the study. All the subjects had primary diagnosis of RDS with CXR findings in keeping with RDS. The maternal characteristics and the base line characteristics of the study subjects are shown in Tables I and II respectively.

The mean birth weight of subjects was 1235g±204. As per protocol, all babies' ≥33 weeks were commenced on bCPAP from NICU. Only 3 babies received surfactant administration (INSURE protocol) with median age at administration of 2.5 hours. Oxygen

saturation was monitored in all babies and the mean oxygen saturation pre- and post-CPAP were recorded. There were significant differences in mean oxygen saturations pre-CPAP (78.±4.07) and post-CPAP (96.00±1.11) commencement (p=0.02). The mean duration of bubble CPAP was 4±3.3 days.

Thirty-two babies were successfully weaned off CPAP with overall CPAP success rate of 80.2%. There were 16 (38.1%) mortalities during the study period. Ten (61.5%) of the deaths were RDS specific mortality with case fatality rate of 23.8%.

The mean birth weight of survivors were higher (1235.4g) compared to those who died (923.4g), with a p-value of <0.05. Babies that died had lower mean gestational age (28.3weeks) than those that did not (32.3 weeks) though this was not statistically significant (p >0.05). Babies whose mothers did not receive antenatal steroids also recorded more significant mortality (8 deaths out of 11 babies) compared to 8 deaths out of 18 babies of mothers who received (p=0.001).

DISCUSSION

Bubble CPAP has increasingly become the modality of choice for respiratory distress syndrome in low economic settings.^{3,5} Its attraction has been the low cost as it can be made from locally available materials^{5,7}, its potential to reduce need for invasive ventilation³ and its efficiency in preventing alveolar atelectasis with minimum risks for lung injury⁸⁻¹⁰ Globally, there has been a trend toward use of CPAP in the management of RDS in the newborn with well documented benefits.^{3-6,9,10} Different devices can be used to deliver CPAP; these include the conventional ventilators, variable-flow infant CPAP and the bubble CPAP.^{11,12} Also most of the mothers received antenatal steroid (66.7%) which has been associated with improvement in lung maturity¹³ with decrease in severity of RDS in preterm babies.¹⁴ It is probable that the use of prenatal steroids in majority of the subjects (66%) could have contributed to the success of the CPAP in our subjects. Audu et al⁵ in Abuja demonstrated immediate clinical improvement in oxygen saturation using customized bubble CPAP. Malik et al¹⁵ noted a rapid rise in SPO2 to >85% when CPAP was commenced and this was sustained by survivors. The findings in the current study showed similar trend with a mean increase in SPO2 post commencement of CPAP from 82.4% to 94%. Only 2 of our participants had surfactant administration as the others could not procure it due to its exorbitant price in Nigeria. Of the 2 babies that received surfactant, only one survived. Mortality in babies with RDS after administration of surfactant has also been documented in the studies by Rodriguez¹⁶ and Rojas-Reye et al.¹⁷ The baby that died in our study met the criteria for failed CPAP (despite surfactant administration) and would probably have benefitted from mechanical ventilation if it were available. Though surfactant therapy improves cardiorespiratory stability and oxygenation in babies with RDS, the need for respiratory support following its administration is well documented.^{3,10-14,16-18} Where there is unavailability or failure of CPAP, mechanical ventilation becomes the choice of respiratory support as it offers quick normalization and maintenance of blood gases and acid-base balance. But it has the drawback that it can cause more barotrauma, air-leak syndromes and chronic lung injuries as well as being very expensive and unaffordable in most resource poor settings.^{3,8-10,19} The case fatality rate of 23.8% in the present study though high, was lower than the findings by other studies that reported RDS as

accounting for more than half of their mortalities. The study also recorded mortality from other complications which are common in preterm babies such as intraventricular haemorrhage, necrotising enterocolitis, perinatal asphyxia and neonatal sepsis. Considering that nearly half (47.6%) of the cohort of neonates studied were products of ≤ 28 week gestation, severe RDS and its complications were expected. Babies that died during the study period had lower mean gestational age of 27.8 weeks and mean birth weight of 963.4g. The positive results obtained in this study demonstrates that simple interventions can go a long way in reducing neonatal mortality rate; this can be cascaded down to other doctors and health care providers that care for these neonates through training and retraining of these personnel. This would reduce morbidity and mortality from RDS. It is however also important to continue research into how to improve the effectiveness and ensure safety of this improvised bubble CPAP to ensure that these babies benefit optimally from it and prevent or reduce complications.

CONCLUSION

Bubble CPAP is a simple and cost effective intervention that can be used in resource limited settings to treat mild to moderate RDS in preterm babies and reduce morbidity and mortality and economic burden of preterm babies in the society.

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