STUDY OF BUBBLE CPAP AS A PRIMARY RESPIRATORY SUPPORT IN NEONATES WITH RESPIRATORY DISTRESS

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Abstract

Background: Respiratory distress is one of the commonest disorders of new-born and associated with most important causes of neonatal morbidity and mortality especially in premature babies. CPAP is a non-invasive method for applying a constant distending pressure level during inhalation and exhalation to support spontaneously breathing new-born with lung disease. Early CPAP reduced intubations, days on mechanical ventilation and with no increased complications.

Objectives: The study was done to describe the effectiveness of Bubble CPAP as a primary respiratory support in preterm and term neonates with Respiratory Distress as well as factors associated with CPAP failure in neonates.

Materials and Methods: A Prospective Analytical Study was carried out on 82 neonates with Respiratory Distress admitted in NICU within first six hours of life and were managed as per NICU protocol. All enrolled neonates were observed for at-least 72 hours for outcome and development of complications. All the Variables were analysed with the help of chi-square test.

Results: Out Of 82 neonates included in this study, (78%) neonates successfully weaned off from CPAP and 18 (22%) neonates who were on CPAP required mechanical ventilation. Male: Female ratio was 1.9:1, mean gestational age was 33.1 + 3.1 weeks and mean birth weight was 1.81 + 0.56 Kg observed in this study.

Conclusion: Bubble Continuous Positive Airway Pressure is safe, effective, and easy to use in preterm and term neonates with Respiratory Distress. Various factors influence the outcome of a neonate on CPAP and knowledge of these factors and their role in the successful outcome helps us in early detection of risk factors and prompt action for a better outcome.

Keywords: CPAP- Continuous Positive Airway pressure, NICU- Neonatal Intensive Care Unit.

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1. Introduction

Non-invasive respiratory support in the neonatal intensive care unit has been used for more than 35 years 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.[1]

Respiratory distress is one of the commonest disorders of new-borns. It is one of the most important causes of neonatal morbidity and mortality esp. in premature babies. The spectrum of respiratory distress in new-borns include Hyaline membrane disease, Congenital pneumonia, Meconium aspiration syndrome, Transient tachypnoea of new-born as well as other causes like congestive cardiac failure and congenital anomalies of lung.

Respiratory distress in new-born is a major challenge for clinician and management strategies often require respiratory support in the delivery room and later in the intensive care units. It is estimated that 5 - 10% of all new-borns need some form of respiratory support immediately following birth.

In India there is a shortage of resources and providing modern ventilator care to all the needy new-born patients puts tremendous stress on the already scarce financial resources. There is therefore a need to look for alternatives, which may reduce this burden without compromising the outcome. Apart from the issue of financial burden there is also the issue regarding complications of ventilation like barotrauma, air-leaks, infections, Broncho- pulmonary dysplasia etc. In keeping with concept of non-invasive ventilation, monitoring and therapy, CPAP is the new paradigm in the management of neonatal respiratory diseases.

Bubble CPAP has been available since 1970s and was introduced first as a method of supporting respiration of preterm infants in 1971[2]. Bubble CPAP has several potential advantages over invasive mechanical ventilation, such as low cost, lower risk of complications, and has been proposed as an inexpensive method of delivering

CPAP in developing countries[2,3]

The present study was an attempt to evaluate the role of bubble CPAP in treatment of neonate with respiratory distress syndrome and its complications and factors associated with failure of bubble CPAP.

2. Materials and Methods

Study Design and Setting: This is a prospective analytical descriptive study carried out for a period of 18 months in NICU, Dhiraj hospital, Vadodara district, India from February 2021 and July 2022. The Study was initiated after obtaining approval from the institutional ethics committee.

Inclusion Criteria: 1)All New-borns developing respiratory distress within 6 hours of birth, 2) All New-borns with respiratory distress admitted in NICU with Silverman Anderson score >3 in preterm and Downe's score >3 in full term, 3)Extramural New-born with respiratory distress (within 6hrs) Admitted within 24 hours of life.

Exclusion criteria: 1) New born having major congenital anomaly as a cause of Respiratory distress , 2)New born with Congenital Heart Disease as a cause of Respiratory distress ,3)New born receiving post extubation respiratory support.

3. Method

Neonates who met the inclusion criteria were included in the study after obtaining informed parental consent. Total 82 neonates with respiratory distress were enrolled for the study.

All CPAP ventilated neonates were managed as per NICU protocol under continuous monitoring. As per protocols details of antenatal, natal and postnatal history, birth weight, gestational age, type of delivery, Apgar score and other details were recorded in pre-formed proforma. Gestational age assessment was done according to LMP and EDD or early Ultrasonography dating. Post-delivery gestational age assessment was done according to New Ballard score.

Time of onset of respiratory distress was recorded and respiratory distress was graded according to Silverman Anderson Scoring for preterm neonates and Downe score for full-term neonates[4].

National Neonatal Perinatal Database of India (NNPD)[4] defines respiratory distress as presence of any two of the following features: 1) Respiratory rate > 60/min 2) Subcostal / intercostal recessions 3) Expiratory grunt / groaning In addition to the above features, presence of nasal flaring, suprasternal retractions, decreased air entry on auscultation of the chest also indicates the presence of respiratory distress.

Diagnosis of underlying aetiology of respiratory distress was made by using standard clinical, laboratory and radiological findings. Antibiotics, Intravenous Fluids, Feeds were started as per the clinical condition of neonates.

Continuous clinical monitoring of heart rate, respiratory rate, retractions, chest expansion, air entry, capillary refilling time, peripheral pulses, status of hydration and oxygen saturation was done every four hourly of CPAP ventilated neonates. Continuous monitoring of oxygen saturation was done using pulse oximeter.

All neonates were monitored for development of complications like nasal septum necrosis, air leaks, Gastric distension, patent ductus arteriosus, sepsis and Intra ventricular haemorrhage and associated co-morbidities sepsis, apnoea and pneumonia were treated as per NICU protocol.
Repeat chest radiographs were taken as and when necessary on the basis of clinical condition.
Weaning from CPAP was done once the neonate was stable clinically and depending on the etiology once the CPAP pressure was 5cm H20 and oxygen requirement (Fi02) was ≤ 25%. After stopping CPAP, the babies were given oxygen with 02 through hood, High flow nasal cannula or nasal prongs as needed[3].
(Markers of failure of CPAP) were as followed if neonates had Presence of retraction/grunt despite giving optimum CPAP, Fio2 >0.7 to maintain acceptable oxygen saturation at pressure of 7-8 cm of H2O, Persistent serious apnoeic episodes, PaC02 > 60 mm hg or Pa02 <50 mm hg. These neonates were shifted to mechanical ventilation and managed as per standard protocol.[4]
The end point of the study was a haemo-dynamically stable neonate's successfully weaned off from CPAP or shifted to mechanical ventilation.

Statistical Methods: The Data was primarily gathered in the structured proforma and details were entered in an excel sheet. For continuous variables, Mean and Standard deviation were estimated. Statistical analysis of the data was performed using statistical test. Chi square test was used for analysis. Significance was defined as p value <0.05. The comparisons between various independent variables were analysed using logistic regression.

4. Results

During the study period of 18 months from February 2021 to July 2022, 82 neonates were enrolled for the study admitted in neonatal intensive care unit. Out of 82 neonates, 69 were intramural and 13 were extramural who presented within 6 hours of life.
In present Study, Majority of 71 (86.5%) neonates were pre term (28 weeks – 37 weeks) and 11 (13.5%) were full term (> 37 weeks). Average gestational age was 33.1 + 3.1 weeks.
4 (4.8%) neonates were extreme low birth weight (< 1.00 kg), 27 (33%) neonates were very low birth weight (1.0-1.5 kg) and 42 (51.2%) neonates were low birth weight (1.5-2.5 kg).Average birth weight was 1.81 + 0.56 Kg**.** Male to Female ratio was 1.9:1.
Total 31 (37.8%) mother of neonates had received antenatal steroid out of which 22 mothers received complete dose of antenatal steroid and 9 mothers received partial dose of antenatal steroid. Rest 51 (62.2%) have not received course of Antenatal steroids.
59 (72%) neonates were having Hyaline Membrane Disease, 19 (23%) were having Transient Tachypnoea of New-born, 4 (4.8%) were having Meconium Aspiration Syndrome as a cause of respiratory distress. We studied that primary indication for requirement of CPAP was HMD.
Present Study showed that out of 82 neonates, 22(26.8%), 30 (36.6%), 22(26.8%), 8 (9.8%) had Downe's score 3,4,5,6 respectively at the initiation of CPAP.
Average duration of requirement of CPAP was 24 + 0.7 hour.
In present study, 4 (4.8%) neonates developed Pneumothorax, 3(3.6%) developed ROP and only 1 (1.3%) had nasal septal necrosis. Majority of neonates had Hyper-bilirubinemia followed by sepsis followed by shock as a morbidity associated with respiratory distress in enrolled neonates.
Out of total 82 neonates who required CPAP, 64 (78%) neonates successfully weaned off from CPAP and 18 (22%) neonates who were on CPAP required mechanical ventilation.
Present study Showed that 71 (86.5%) neonates discharged, 6(7%) neonates took DAMA, 5(6.1%) neonates died. Average duration of hospital stay was 16.1 + 0.5 days.

Fio2 requirement at the initiation of CPAP: 57 (89%) neonates in whom CPAP was successful Fio2 requirement at the initiation was ≤ 30. P value was <0.0001 which was statically significant showed there was statically significant association between Fio2 requirement and outcome of CPAP.

Downe' score/ Silverman Anderson score: In the Success group 34.4%, 43.8% had Downe's score 3, 4 respectively at the initiation of CPAP. In Failure group, 50%, 38.9% had Downe's score 5,6 respectively at the initiation of CPAP. P value was <0.0115 which was statically significant showed there was statically significant association between Downe's score and outcome of CPAP.

Associated Co-morbidities: One of the striking morbidities in our study population was having associated Sepsis. In Failure group, 72.2% had sepsis and 61.1% had shock as associated co-morbidities. P value was < 0.05 which was statistically significant showed that sepsis had major impact on outcome of CPAP in present study.

5. Discussion

In this prospective analytical descriptive study, we evaluated the effect of bubble CPAP in neonates with respiratory distress in both full term and

preterm neonates. We also evaluated associated factors responsible for CPAP Failure.

In present study Bubble CPAP was successful in 78% of neonates and 22% of neonates started on bubble CPAP required mechanical ventilation. Study done by Sunitha et al[5], Bubble CPAP was successful in 64% of neonates and 36% of neonates started on bubble CPAP required mechanical ventilation. Anil et al[6], Bubble CPAP was successful in 84% of neonates and 16% of neonates started on bubble CPAP required mechanical ventilation. Success rate was high in study done by Anil et al[6] in comparison to present study this might be due to their less sample size.

Gestational Age and CPAP outcome: In the present study, there was a no statistically significant association between gestational age and CPAP outcome.

Another study done by Urs et al[7], showed statistically significant P value was <0.001. Although this study was not comparable with present study because they had included only preterm neonates in their study while present study had included both preterm and full term neonates.

Birth weight and CPAP outcome: There was no significant association between birth weight of neonates and outcome of CPAP in present study. Other study done Urs et al[7] showed 75% success rate in <1000 gram, 81.8% in 1000-1500 gram, 77% in >1500 gram, statistically significant difference (p value <0.001) suggested that there was statically significant association between birth weight of neonates and outcome of CPAP.

Present study was not comparable to study done by Urs et al[7].This difference may be attributed to birth weight and gestational age of the neonates included in their study.

Initial Fio2 requirement and CPAP outcome: Neonates who required < 30 Fio2 on initiation of CPAP had more successful outcome (89%), p Value was < 0.0001 and statistically significant. Another study which was done by Winda I P et al[8,9] which was comparable with present study.

Associated Morbidities: In the present study showed that Sepsis, Pulmonary Haemorrhage and Shock as associated morbidities had significant statistical association with Outcome of CPAP.

Study done by Sunitha et al[5] was comparable with present study.

6. Conclusion

Bubble Continuous Positive Airway Pressure is safe, effective, and easy to use in preterm and term neonates with Respiratory Distress. Various factors influence the outcome of a neonates on CPAP. Knowledge of these factors and their role in the successful outcome helps us in early detection of risk factors and prompt action for a better outcome. Downe's Score and Fio2 requirement are found to be clinically relevant and easily accessible bedside tools for assessment of Respiratory distress.

As CPAP success rate were significant, Bubble CPAP should be considered as a primary mode of respiratory support in neonates with respiratory distress.

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Flow chart of Study

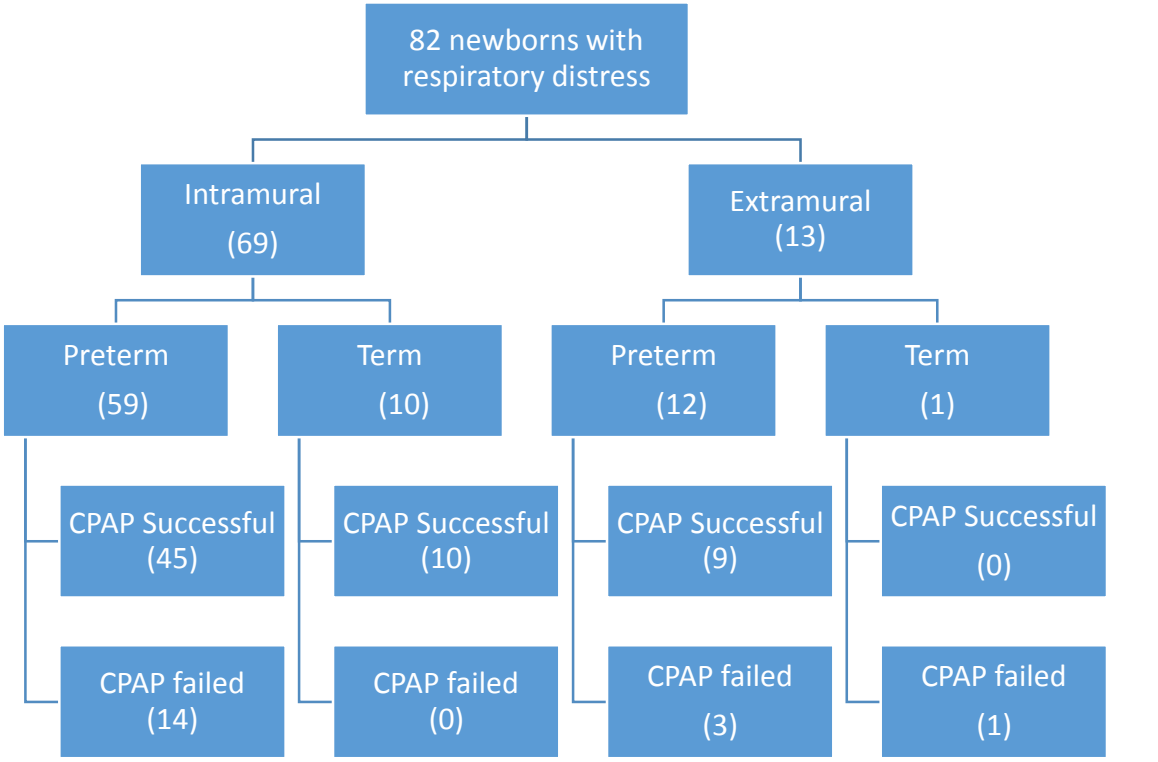

Table no1: Demographic distribution in study population

	Number of neonates (n=82)
Gestational Age (weeks)	
< 28 weeks	**0**
>28-33-week 6 day	**48 (58.5%)**
>34-36 weeks 6 days	**23 (28%)**
>37 weeks	**11 (13.5%)**
Birth Weight (Kg)	
<1.00	**4 (4.8%)**
>1-1.5	**27 (33%)**
>1.5 – 2.5	**42 (51.2%)**
>2.5	**9 (11%)**
Sex	
Male	**54 (65.8%)**
Female	**28 (34.2%)**

Mode of delivery	
Vaginal delivery	**44 (53.6%)**
LSCS	**38 (46.4%)**

Table 2: Distribution according to CPAP Settings

CPAP Settings	**Number of neonates (n=82)**
FiO2 Requirement at the initiation of CPAP	
< 30%	**64 (78%)**
>30 %	**18 (22%)**
Duration of CPAP (HOUR)	
< 6	**12 (14.6%)**
7-12	**25 (30.5%)**
13-24	**24 (29.3%)**
>24	**21 (25.6%)**

Table 3: Distribution according to CPAP complications and associated morbidities in study population

CPAP complications	**(n=82)**
Pneumothorax	4 (4.8%)
ROP	3 (3.6%)
Nasal septal necrosis	1 (1.3%)
Gastric Distension	0
Morbidities	**(n=82)**
Sepsis	27 (33%)
Hyperbilirubinemia	29 (35.3%)
Shock	14 (17%)
Pulmonary Haemorrhage	2 (2.4%)
Hypoglycaemia	2 (2.4%)

Table 4: Primary Outcome Measures

OUTCOME OF CPAP	**No of Neonates (n=82)**
CPAP Successful	64 (78%)
CPAP Failure	18 (22%)
Discharged	71 (86.5%)
Death	5 (6.1%)

DAMA	6 (7.3%)

Table 5: Secondary Outcome Measures

	CPAP Successful(n=64)	CPAP Failure (n=18)	P Value
Gestational Age (week)			
28-33 week 6 days	38 (59%)	10 (55.5%)	p Value = 0.3565
>34-36 week 6 days	16 (25%)	7 (38.9%)	
>37 weeks	10 (16%)	1 (5.6%)	
Birth weight (kg)			
<1.00 KG	2 (3.1%)	2 (11.1%)	p Value = 0.4361
>1-1.5 KG	22 (34.4%)	5 (27.8%)	
>1.5 – 2.5 KG	32 (50%)	10 (55.6%)	
>2.5 KG	8 (12.5%)	1 (5.5%)	
Place of Delivery			
INTRAMURAL (69)	55 (80%)	14 (20%)	p Value = 0.6368
EXTRAMURAL (13)	9 (69%)	4 (31%)	
Gender			
Male	41 (64%)	13 (72%)	p Value = 0.7161
Female	23 (36%)	5 (28%)	
Etiological Distribution			
HMD	42 (65.6%)	17 (94.5%)	
TTN	18 (28.1%)	1 (5.5%)	
MAS	4 (6.3%)	0	
Fio2 requirements at the initiation of CPAP			
< 30%	57 (89%)	7 (11%)	**p Value = <0.0001**
>30 %	7 (11%)	11 (89%)	
Downe's Score/ Silverman Anderson score			
3	22 (34.4%)	0	**p Value = 0.0115**
4	28 (43.8%)	2 (11.1%)	
5	13 (20.3%)	9 (50%)	
6	1 (1.5%)	7 (38.9%)	
Co-Morbidities			
Neonates with Sepsis	14 (21.8%)	13 (72.2%)	**p Value =0.0001**
Neonates with Shock	3 (4.68%)	11 (61.1%)	**p Value =<0.0001**