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Outcome of Bubble CPAP Ventilation in the Management of Respiratory Distress Syndrome and Predictor Factors Associated With Cpap Failure in Preterm Neonates <34 Weeks Of Gestation

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ABSTRACT
Background: Neonatal Mortality Rate (NMR) is 24.9 per 1000 live births in India according to National Family Health Survey-5 and prematurity is the leading cause behind it. Bubble CPAP is an emerging less expensive and effective method of respiratory support especially in preterm and is most suitable to neonatal units with limited resource in developing countries.
Objective: To ascertain the outcome of bubble CPAP ventilation in preterm neonates with RDS and identify predictor factors associated with its failure.
Methodology: A hospital based observational study was conducted in the Inborn unit of NICU, Department of Paediatrics, Silchar Medical College & Hospital from June 2021 to May 2022.A total of 100 preterm neonates (<34 weeks) with RDS (SAS score 4-6) were included in the study. CPAP success and failure were the primary outcomes assessed in the study. Variables were compared between CPAP success and CPAP failure groups.
Results: The mean gestational age and birthweight was 31.5±1 weeks and 1620±50 gram. CPAP success & failure were 79% & 21% respectively. Neonates with no or partial exposure to antenatal steroids, birthweight <1.5 kg, white-out chest X-ray, higher SAS score before starting CPAP, higher FiO_2 & PEEP requirement after initial stabilization on CPAP, presence of PDA/sepsis are at high risk of CPAP failure (P value <0.05). Complication was minimal (18%) with CPAP use.
Conclusion: Early use of bubble CPAP in preterm neonates is associated with lesser need for mechanical ventilation as well as reduced hospital stay and has improved the survival rate.
Keywords: -CPAP, preterm, RDS

I. INTRODUCTION

In India, an estimated 26 million children are born every year.[1] Neonatal and perinatal mortality rates are the major indicators for the health status of the nation. Neonatal mortality (NMR) is 24.9 per 1000 live birth in India according to NFHS-5, of which the most common cause is prematurity.[2] In India, despite the remarkable progress in urban areas neonatal and perinatal mortality rates are very high

Respiratory distress occurs among 4 -7% of all neonates and is the reason for 30-40% of admission to the NICU.[3,4]It is more common among preterm (30%) in comparison to post-term (21%) and term neonates (4.2%).[4] Invasive ventilation has increased neonatal survival but at the expense of increased morbidity, in the form of bronchopulmonary dysplasia (BPD) &air leaks.[5]

Bubble CPAP is an emerging less expensive and effective non-invasive method of respiratory support to reduce morbidity and mortality. It is most suitable for neonatal units with limited resources in developing countries.[6]This study was conducted to establish the outcome of bubble CPAP ventilation in neonates admitted with respiratory distress and to know the predictor factors of CPAP success and failure.

II. MATERIALS AND METHODS

A hospital-based observational study was conducted in the Inborn unit of Neonatal Intensive Care Unit, Silchar Medical College & Hospital from June 2021 to May 2022.A total of 100 preterm neonates (<34 weeks) with RDS were initiated on bubble CPAP (Fisher & Paykel). Preterm neonates (<34 weeks) with RDS and with SAS (Silverman Anderson Score)[7] score of 4-6 was included in the study. Newborns with life threatening congenital anomalies was excluded from the study. CPAP success and failure were the primary outcomes assessed in the study &variables were compared between them.

CPAP SUCCESS: –
The success being defined as persistent SPO > 87-93%, with no respiratory distress and survival[2]

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CPAP FAILURE: –

FiO_2 requirement > 60% & PEEP>8cm H_2O

$PaCO_2$ >60mmHg, PaO_2 <50 mmHg and pH<7.25 on maximum acceptable settings

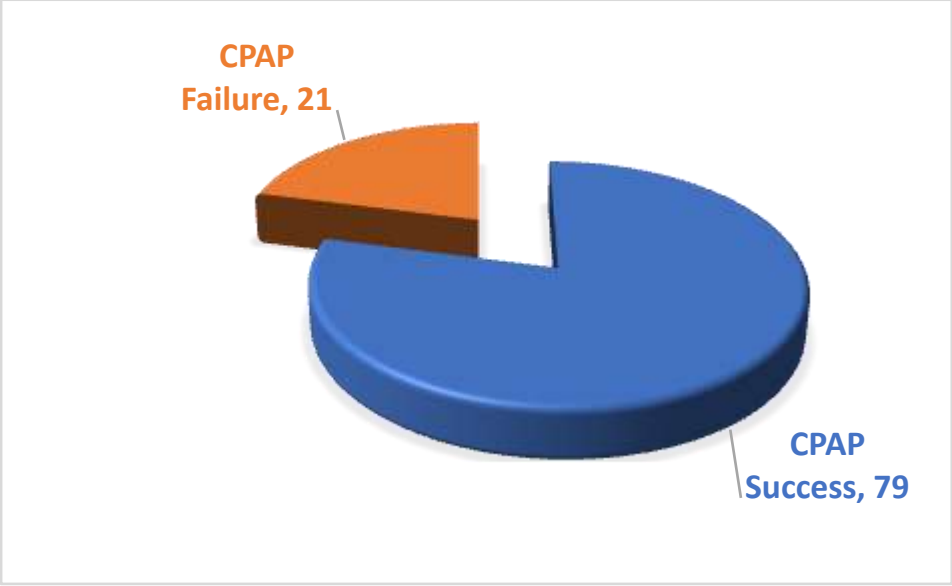
CPAP failures were shifted to mechanical ventilation.

Data was entered in MS excel & analysis was conducted in SPSS 20.0. Categorical variables were expressed in frequencies and proportions. Mean & standard deviation were calculated for Continuous variables. Mann-Whitney test was applied to test the association between outcomes and continuous variables. Chi-square test and Fishers exact test were applied to test the association between categorical variables. P Value of <0.05 was considered statistically significant.

III. RESULTS AND OBSERVATIONS

OUTCOME	FREQUENCY(n)	PERCENTAGE (%)
CPAP SUCCESS	79	79%
CPAP FAILURE	21	21%
TOTAL	100	100%

79% of the neonates survived using bubble CPAP ventilation. CPAP failure was seen in 21% of the study subjects



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ASSOCIATION BETWEEN VARIABLES AND OUTCOME

SERIAL NUMBER	VARIABLES	CPAP SUCCESS n=79	CPAP FAILURE n=21	P VALUE
1	**GESTATIONAL AGE (Weeks) (Mean± SD)**	32±5	29±3	**0.023**
2	**BIRTHWEIGHT**			
	<1.5 kg	23(65.7%)	12 (34.3%)	**0.012**
	>1.5 kg	56 (86.1%)	9(13.8%)	
3	**MODE OF DELIVERY**			0.311
	NVD	35 (83.3%)	7 (16.7%)	
	LSCS	39 (73.6%)	13 (25%)	
	AVD	4(80%)	1(20%)	
4	**GENDER**			0.906
	Male	35 (79.5%)	9 (20.5%)	
	Female	44 (78.6%)	12 (21.4%)	
	ANTENATAL STEROIDS			
	FULL	36 (90%)	4 (10%)	0.001
	PARTIAL	21 (65.6%)	11(34.4%)	
	NO	15 (53.6%)	13(46.6%)	

SERIAL NUMBER	VARIABLES	CPAP SUCCESS n=79	CPAP FAILURE n=21	P-VALUE
6	**AGE OF INITIATION ON CPAP (hours) (mean±SD)**	2±2.32	7±2.08	0.03

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7	**SAS SCORE (mean±SD)**	4.7±0.8	5.8±0.8	<0.001
8	**FiO_2**	48.2±5	57.9±3	0.03
9	**SURFACTANT REPLACEMENT THERAPY**	17(58.9 %)	12(41.4%)	0.356
10	**DURATION ON CPAP** (Hours) (Mean± SD)	31±7	47±3	0.682

The mean gestational age in the CPAP failure group was 29±3compared to 32±5 in the CPAP success group and lower gestational age was birthweight of <1.5 kg showed CPAP success when compared to 86.1% of neonates with >1.5 kg birthweight showed CPAP success. Neither the gender nor the mode of delivery had any significant association with the outcome

Mean age of starting CPAP in the success group was 2±3.2 hours and this was significantly associated with the outcome. A lower SAS score of 4.7±0.8 prior to initiation of CPAP was associated with CPAP success. Neither the duration on CPAP nor the surfactant administration while on CPAP affected the outcome.

significantly associated with CPAP failure. Only 65.7% of neonates with a

SERIAL NUMBER	VARIABLES	CPAP SUCCESS	CPAP FAILURE	P-VALUE
11	**PDA**	4(5.1%)	9(42.9%)	0.02
12	**WHITE OUT CHEST XRAY**	7(30.5%)	16(69.5%)	<0.001
13	**COMPLICATIONS**			
	CPAP belly	2 (50%)	2 (50%)	0.70
	Nasal septal damage	4 (66.7%)	2 (33.3%)	
	Superficial abrasion of skin around nose	6(75%)	2(25%)	

42.9% of newborns with PDA showed CPAP failure and only 5.1% of newborn with PDA showed CPAP success. White out appearance on chest x ray was present in 69.5% of neonates who showed CPAP failure and was statistically significant. Complication associated with CPAP use was minimal and the type of complication developed in the newborn was found to have no association with the outcome.

IV. DISCUSSION

Bubble CPAP in pre-term neonates is efficient in decreasing respiratory distress. In the study conducted by Byram S et al[8]and Arora V et al[9] CPAP success was 71% and 73.1% which is comparable with the present study. Study conducted by Manandhar SR et al[10], showed better survival rate (94%) with the use of CPAP and mortality was only 6% among neonates with respiratory distress which is much less compared to the present study. Studies by Parasuramappa H et al[11] andPillai MS et al[12]also showed outcome of bubble CPAP depends on gestational age of the neonate which is comparable with the present study

In the study conducted by Arora V et al [9], mother of 24.7% newborns received full course steroid which was less compared to the present study,45.9% received incomplete steroid and 29.4% did not received any steroid which was almost like the present study and the administration of antenatal steroid has significant association with the outcome of CPAP. In the study conducted by, Mathai SS et al[13], 92.3% and 50% of neonates survived when CPAP was initiated within 5 hours and after 5 hours of birth respectively, hence showing significant association with the outcome.

In the study by Koti J et al[14], there was significant association between presence of PDA, white out chest Xray and CPAP failure which was similar to the present study. Usage of CPAP was associated with minimum complications as reported by Tagare A et al[15] whereas study done by Thaddanee R et al[16] showed that usage of CPAP was associated with relatively more complications, compared to the present study.

Predictors of CPAP Failure

-no or partial exposure to antenatal steroids
-birthweight <1.5 kg & decreasing gestational age
-delayed initiation of CPAP
-higher SAS score before starting CPAP
-higher FiO_2 requirement after initial stabilization on CPAP
-presence of PDA and white-out chest X-ray

V. CONCLUSION

Bubble CPAP is safe, cost-effective & easy to use in all limited resource settings. Early use of bubble CPAP is associated with a lesser need for mechanical ventilation in preterm neonates with mild to moderate RDS. Complications are very minimal with CPAP and can be easily avoided with proper nursing care and monitoring.

LIMITATION

Sample size was smaller.

Proportion of babies below 28 weeks of gestation is low, which limits the generalizability of the results.

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