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ORIGINAL ARTICLE

Efficacy of Nasal Continuous Positive Airway Pressure by Bubble CPAP in Neonates with Respiratory Distress Syndrome

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ABSTRACT

Objective: Efficacy of Bubble CPAP in neonates with respiratory distress syndrome as the primary mode of respiratory support.

Study Design: Descriptive case series.

Place and Duration of Study: Neonatology Department of Children Hospital and Children's Hospital & University of Child Health Science Lahore duration of study was 6 months, from 06-04-2017 to 05-10-2017.

Material and Methods: Ninety five premature newborns (≤34 weeks gestation) admitted to the NICU were included having respiratory distress and chest X-ray suggestive of RDS. Bubble CPAP was used for ventilation of these neonates. Outcome variable was frequency of successful treatment assessed after 24 hours.

Results: The mean gestational age of patients in our study was 31.24 ± 1.99 weeks and the mean age of the patients was 70.24 ± 26.72 hours. There were 58 (61%) male and 37 (39%) female patients with a male to female ratio of 1.6:1. Mean birth weight was 2.32±0.37 Kg. Mean respiratory rate at admission was 71.21±5.87 breaths/min while the mean oxygen saturation was 78.19±5.34%. After 24 hours of bubble CPAP, there was significant improvement in the mean respiratory rate (56.57 ± 4.58 vs. 71.21 ± 5.87 breaths/min; p=<0.001), mean oxygen saturation (89.86±2.31 vs. 78.19 ± 5.34%; p=<0.001) and frequency of chest in-drawing (14.7% vs. 70.5%; p=<0.001). Successful treatment (efficacy) was found to be 80 (84.2%).

Conclusion: Bubble CPAP may be considered as a first line respiratory support in preterm and very preterm babies with RDS. Its routine use for such neonates in future practice before opting invasive ventilation reduces the need of mechanical ventilation..

Key Words: *Respiratory distress syndrome, Bubble CPAP, Continuous positive airway pressure*

INTRODUCTION

In developing countries, respiratory failure is a leading cause of neonatal mortality. One of the common cause of this respiratory failure is severe respiratory distress syndrome (RDS) which is more common in preterm babies. In premature babies, it is due to surfactant deficiency and in term infants is usually due to meconium aspiration syndrome[1] and neonatal pneumonia which

together account for over one-half of all neonatal deaths globally.[1] RDS may develop in more than 50% of babies born at ≤31 weeks of gestation.[2,3]

In low and middle-income countries continuous positive airway pressure (CPAP) is an effective and simple supportive modality used to support neonates with respiratory failure.[4] CPAP increases the functional residual capacity of the lung resulting in better gas exchange.[5] Although Bubble CPAP (B-CPAP) is an ideal mode of non-invasive ventilation in preterm neonates with RDS but with increasing use of mechanical ventilators a first option its use becomes limited even before it could gain acceptance.[2] Early use of B-CPAP is safe, less invasive and cost effective mode in treating preterm and term infants with RDS thus reduces the need for mechanical ventilation which is an invasive mode.[6] There is increase in the use of CPAP therapy for infants with respiratory distress in countries like Australia and New Zealand.[6,7]

The B-CPAP circuit that we utilized was first described by Kaur et al.[8] The B-CPAP system consists of a blended, humidified gas source (4–6 L/min). It is attached to nasal prongs by an inspiratory circuit. The expiratory circuit tubing is separately attached from the nasal interface. The CPAP level is determined by the distance of the distal end of the expiratory tubing is placed below the water-seal surface determining the Peak End Expiratory Pressure.[9,10]

World-wide nasal CPAP is used for a variety of neonatal respiratory conditions and is effectively used in extubation failure, especially in cases of RDS and apnea of prematurity, as an alternative to intubation and ventilation.[11,12]

Use of a low-cost B-CPAP system to treat neonatal respiratory distress is shown to significantly improve the overall survival. The beneficial effects were greater for neonates having very low birth weight and RDS[13,14] B-CPAP devices are cheaper and mostly adapted for low-resources settings. It provides a more stable level of pressure compared to high flow nasal cannula.[15]

The objective of this study was to observe whether a low-cost B-CPAP applied to patients with respiratory distress syndrome can improve the course of illness and overall prognosis.

MATERIALS AND METHODS

This study involved 95 premature newborns (≤34 weeks of gestation) of both genders presenting with RDS admitted to the neonatal intensive care unit with respiratory distress and chest X-ray suggestive of RDS. The data was collected after taking ethical approval from IRB and consent from the parents. All the Infants with a prenatal diagnosis of heart defects, anatomical defects, history of birth asphyxia or presented in shock were excluded. Respiratory distress which was defined as chest retraction, increased respiratory rate above 60 breaths per minute and blood gases having arterial pCO2 > 60 mm Hg, or O2 saturation < 88% at room air or cyanosis. Patients were selected by non-probability, consecutive sampling. B-CPAP was used for ventilation of these neonates. Outcome variable was frequency of successful treatment assessed after 24 hours. While using the B-CPAP for ventilation of these neonates, respiratory rates, oxygen saturation measurements and chest findings were recorded pre and post B-CPAP by a trained doctor on a pre-designed proforma. Outcome was assessed after 24 hours. If improvement in the oxygen saturation and decrease in respiratory rate and chest in-drawing occurred, it was considered as effective. Data was analyzed through SPSS version 19.0. Numerical variables; age, weight, gestational age, oxygen saturation and respiratory rate are presented by mean ± SD. Categorical variable i.e. gender and efficacy has been presented by frequency and percentage. Data has been stratified for gender and birth weight (<2.5 Kg, ≥2.5 Kg) to address effect modifiers. Post-stratification chi-square test has been applied taking p value ≤0.05 as statistically significant.

RESULTS

The age of the patients ranged from 4 hours to 96 hours with a mean age of 70.24 ± 26.72 hours. There were 58 (61%) male patients with a male to female ratio of 1.6:1. The gestational age ranged from 28 weeks to 34 weeks with a mean of 31.24 ± 1.99 weeks. Birth weight ranged from 1.5 Kg to 2.9 Kg with a mean of 2.32 ± 0.37 Kg. Mean respiratory rate, mean oxygen saturation and Chest in-drawing in neonates at admission is shown in table 1. After 24 hours of bubble CPAP,

there was significant improvement in the mean respiratory rate (56.57 ± 4.58 vs. 71.21 ± 5.87 breaths/min; p= <0.001), mean oxygen saturation (89.86 ± 2.31 vs. 78.19 ± 5.34%; p=<0.001) and frequency of chest in-drawing (14.7% vs. 70.5%; p=<0.001) as shown in fig 1).

TABLE 1: Baseline characteristics of study sample (n=95)

Characteristics	Study Sample (n=95)
Age (hours)	70.24±26.72
Gender	
Male	58 (61%)
Female	37 (39%)
Gestational Age (weeks)	31.24±1.99
<32 weeks	56 (59%)
≥32 weeks	39 (41%)
Birth Weight	2.32±0.37
<2.5 Kg	54(57%)
≥2.5 Kg	41(43%)
Respiratory Rate at admission (breaths/minute)	71.21±5.87
Oxygen Saturation at admission (%)	78.19±5.34
Chest In drawing at admission (%)	67 (70.5%)

The frequency of successful treatment (efficacy) was found to be 84.2% (80 babies) with RDS treated with bubble CPAP. There was no statistically significant difference in the frequency of efficacy across various gender (p=0.927) and birth weight (p=0.788) groups as shown in table 2.

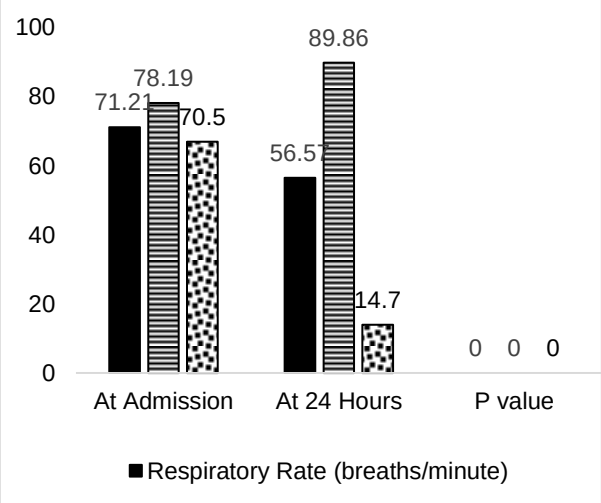

Fig 1: Improvement in mean respiratory rate, mean oxygen saturation and frequency of chest in-drawing after 24 hrs from baseline (n=95)

TABLE 2: Comparison of frequency of efficacy across gender& birth weight (n=95)

Category		Efficacy	Total	Total	p-value
		Yes (n=80)	No (n=15)		
Gender	Male (n=28)	49 (84.50)	9 (15.50)	58 (100.0)	0.927
	Female (n=37)	31 (83.80)	6 (16.20)	37 (100.0)	
	Total	**80 (84.20)**	**15 (15.80)**	**95 (100.0)**	
Birth Weight	<2.5 Kg (n=54)	45 (83.30)	9 (16.70)	54 (100.0)	0.927
	≥ 2.5 Kg (n=41)	35 (85.40)	6 (14.60)	41 (100.0)	
	Total	**80 (84.20)**	**15 (15.80)**	**95 (100.0)**	

DISCUSSION

B-CPAP is a popular mode of non-invasive ventilation for these babies. Early CPAP is safe and beneficial in treating RDS in terms of less invasiveness and cost effectiveness, thus reducing the need for mechanical ventilation.[6]

Underwater bubble CPAP (B-CPAP) and ventilator-derived CPAP (V-CPAP) are two of the most popular CPAP modes, and they use different pressure sources. Currently studies are lacking to suggest which CPAP system is superior to another for improving outcomes. Bubble CPAP is constant-flow, variable-pressure CPAP system. There is great interest in this form of CPAP support worldwide, mainly because it is simple to operate, inexpensive and safe. Because of this reason we planned this study to see the efficacy of nasal continuous positive airways pressure by Bubble CPAP in neonates with respiratory distress

In the present study, the mean gestational age of patients was 31.24 ± 1.99 weeks and the mean age of the patients was 70.24 ± 26.72 hours. Parkash et al.[17] reported similar mean age of 70.58 ± 110.02 hours and the mean gestational age was 36.32 ± 2.72 weeks presenting at National Institute of Child Health, Karachi. Age of

presentation is important because if diagnosed and managed timely outcome is better.

We observed that there were 58 (61.1%) male and 37 (38.9%) female patients with a male to female ratio of 1.6:1. Shiraziet al.[18] (1.2:1) and Khan et al.[19] (2.4:1) also reported similar male predominance in neonates with RDS in local population. Malik et al.[20] (1.6:1), Rakholia et al.[21] (1.7:1) and Barkiya et al.[22] (1.9:1) and reported similar male predominance in Indian neonates with RDS.

In the present study, mean birth weight was 2.32 ± 0.37 Kg. 54 (56.8%) neonates weighed <2.5 Kg at birth while the remaining neonates had birth weight ≥2.5 Kg. Parkash et al.[17] reported similar mean birth weight of 2.41 ± 2.4 Kg among such neonates in local population while Bijari et al.[23] reported it to be 1.9 ± 0.7 Kg in Iran. Shirazi et al. observed similar frequency of <2.5 Kg neonates (53.0%) at Children Hospital, Pakistan Institute of Medical Sciences, Islamabad. Rakholia et al.[21] (60.6%) and Malik et al.[20] (63.4%) also observed similar frequency of <2.5 Kg neonates with RDS in India.

The frequency of successful treatment (efficacy) was found to be 84.2% (80 babies) with RDS treated with B-CPAP. Our results are similar to the previously published report by Tagare et al.[24] who in a similar study in Australian preterm neonates with RDS observed the efficacy of B-CPAP to be 82.3%. A similar frequency of efficacy has also been observed by Kawaza et al.[13] who reported it to be 64.6% in America.

The present study is first of its kind in local population and adds to the limited existing evidence on the topic. Bubble CPAP is the recognized mode of ventilation for babies with distress in resource limited environment with excellent results. It is also simple, low-cost and easy to operate which further encourage its use in local setup.

CONCLUSION

Bubble CPAP may be considered as a primary mode of respiratory support in RDS even in preterm, very preterm and ELBW babies with RDS irrespective of patient's gender and birth weight. Its routine use for such neonates in future practice before opting invasive ventilation reduces the need of mechanical ventilation.

Conflict of interest: Nil

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