



ORIGINAL RESEARCH PAPER

Medical Sciences

BUBBLE CPAP IN NEONATAL RESPIRATORY DISTRESS SYNDROME - AN EXPERIENCE IN A SPECIAL NEWBORN CARE UNIT

KEY WORDS: preterm, respiratory distress syndrome ,bubble CPAP,

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ABSTRACT

Objectives: To determine the efficacy of BCPAP in terms of immediate outcome in preterm neonates with mild to moderately severe HMD.
Material and Methods: This is a prospective study done in special care newborn unit attached to Gandhi Hospital. Fifty preterm babies with respiratory distress syndrome with Silverman score less than 7 were kept on BCPAP and were monitored for improvement and complications.
Results: BCPAP was successful in 43 and failed in 7 babies. Babies with gestational age of 32-34 weeks and 28-31 weeks had a CPAP success rate of 95.45% and 78.5% respectively. Babies born to mothers who received antenatal steroids had better outcome as compared to babies born to mothers who had not received antenatal steroids. Age of start of CPAP, duration of CPAP and maximum FiO₂ needed are significantly less in success group. Mean duration of hospital stay and mean duration of O₂ administration are less in success group. Incidence of complications like sepsis, pneumothorax, nasal septal damage were more in failure group. Mortality rate in CPAP success group is 2.32% whereas in CPAP failure group it is 28.57% which was statistically significant.
Conclusions: BCPAP improves the outcome of babies with mild to moderately severe respiratory distress syndrome. Routine usage of BCPAP in SNCUs would improve the survival of neonates with respiratory distress syndrome.

INTRODUCTION

Respiratory distress due to hyaline membrane disease (HMD) is one of the leading causes of death in preterm neonates contributing significantly to the neonatal mortality rate¹. Exogenous surfactant administration and mechanical ventilation accepted generally as the "standard of care"² for HMD is not widely available in our country. With the accumulating evidence that the barotrauma, volutrauma and biotrauma secondary to mechanical ventilation may lead to chronic lung disease^{3,4}, the current thinking is that the 'standard approach' may not be the ideal first choice for every case of HMD. Non invasive methods of respiratory support like conventional CPAP, Bubble CPAP (BCPAP), humidified high flow nasal cannulae, non invasive mechanical ventilation have all been tried and are shown to have a beneficial role in the management of less severe forms of HMD⁵. Even in advanced countries, the trend is now to stabilise neonates with HMD using CPAP with or without surfactant administration keeping intubation and mechanical ventilation as the last resort⁵. BCPAP with or without surfactant administration appears to be a suitable solution to cases with mild to moderate HMD. BCPAP can be carried out with little training in centres delivering secondary level neonatal care⁶. The present study is an attempt to determine the efficacy of BCPAP in terms of immediate outcome in preterm neonates with HMD.

METHODS

This is a prospective study done in the Special newborn care unit (SNCU) of Department of Pediatrics, Gandhi Hospital, Secunderabad between January 2016 to June 2016. Fifty preterm newborns with gestational ages between 28 and 34 weeks having mild to moderate Hyaline Membrane disease (Silverman Anderson Score(SAS) < 7) admitted in SNCU were included in the study. Gestational age of the neonates was calculated based on LMP, antenatal ultra sound and New Ballard Score. Informed Consent was taken from the parents after explaining the procedure and prognosis of the babies. Preterm neonates with less than 28wks of gestational age, severe HMD with SAS ≥ 7, prolonged and recurrent apnoea and those presenting with respiratory distress secondary to birth asphyxia, congenital anomalies of airway like choanal atresia, cleft palate, tracheo oesophageal fistula and congenital diaphragmatic hernia were excluded from the study. Approval was obtained from the Institutional Ethics committee of Gandhi medical college.

All preterm neonates presenting with respiratory distress in the first six hours of life were provisionally diagnosed as HMD. Routine investigations like CBP,CRP, Chest X ray are done for all the babies. Arterial blood gas analysis was done for babies whose SAS remained above 3 with >60% FiO₂ and PEEP >6. Eligible babies were started on BCPAP using the Fisher and Paykel CPAP system. The instrument comprises of a gas source- a blender connected to a source of oxygen and compressed air; a pressure generator- pressure in the bubble CPAP system is created by placing the distal expiratory tubing in water; a circuit with a patient interface - bi nasal prongs are used as the nasal interface between the circuit and the infant's airway.

The initial Positive end expiratory pressure (PEEP) was 5 cm of water and was later adjusted to obtain minimal retractions. The minimum and maximum PEEP was 4 & 7 respectively. Fio₂ was started at 50% and was adjusted subsequently to maintain oxygen saturation (SpO₂) between 88% and 92%. Once the target SpO₂ is achieved and the work of breathing improved, FiO₂ was gradually brought down to less than 30%. Flow of the gas was adjusted so as to produce continuous bubbling in the bubble chamber. Response to the intervention is studied by following SAS, oximetry for improvements in SpO₂ ,and serial arterial blood gas (ABG) analyses .BCPAP was considered successful if the respiratory distress decreased and baby could be successfully weaned off from CPAP. The criteria for weaning were absence of respiratory distress (no retractions and respiratory rate between 30 and 60/min) ; Spo₂ between 89% to 92% on an FiO₂ of 30% and a PEEP of 4cmH₂O. Babies were considered to have failed CPAP and were started on mechanical ventilation when they remained hypoxic with Spo₂ <88% or PaO₂ >50mm of Hg despite FiO₂ >60% and pressure >7 cm of H₂O and PaCo₂ >60mm of Hg and continuing to have retractions, grunting and recurrent apnoea. The babies who were weaned off successfully were considered as CPAP success group and the babies who required subsequent mechanical ventilation were considered as failure group.

All neonatal and CPAP variables like gestational age, birth weight, antenatal steroids, SAS, age of start of CPAP, initial FiO₂, initial PEEP ,maximum FiO₂, maximum PEEP, duration of CPAP, duration of oxygen administration, duration of hospital stay

and complications like sepsis, pneumothorax, nasal septal damage were compared between success and failure groups.

Data is analyzed using Chi-square test for comparison of proportions and Student 't' test to compare means between two groups. P value <0.05 is considered as significant.

RESULTS

Of the fifty babies 28 were males and 22 were females. Twenty eight babies were between 28-31 weeks gestational age (GA) and 22 babies were in 32 - 34 weeks GA. Twenty six babies weighed less than 1000gr and 24 babies weighed more than 1000 gr. Thirty babies had SAS of >3. Antenatal steroids were given to mothers of 41 of these fifty babies. The remaining mothers of 9 babies either received none or one dose of steroids.

CPAP was successful in 43 and failed in 7 babies. CPAP was successful in 24 out of 28 female and 19 out of 22 male babies. CPAP was successful in 22 of 28 babies with GA between 28-31 weeks and in 21 of 22 babies with GA between 32 - 34 weeks. CPAP was successful in 37 of the 41 babies whose mothers received two doses of antenatal steroids where as it was successful in 6 of the 9 babies whose mothers received a single or no antenatal steroids. Babies between 31-34wks of gestational age had a CPAP success of 95.45% as compared to gestational age of 28-30wks had success rate of 78.5% and p value 0.31. Babies with birth weight > 1000 gm had success rate of 95.8% as compared to babies having birth weight <1000gm with CPAP success rate of 76.92% ,which is statistically significant. Babies born to the mothers who received antenatal steroids had better outcome (CPAP success rate of 90%) as compared to babies born to the mothers who had not received antenatal steroids (CPAP success rate of 67%).

Table-1 COMPARISON OF CPAP VARIABLES BETWEEN CPAP SUCCESS AND FAILURE GROUPS

CPAP VARIABLES	CPAP SUCCESS (n=43)	CPAP FAILURES (n=7)	P VALUE
Age of start of CPAP in Hrs (Mean±SD)	4(±2.38)	6(±1.63)	0.001
INITIAL PEEP in cm of H ₂ O (Mean±SD)	5.3(±0.5)	6.1 (+0.69)	
INITIAL FiO ₂ in % (Mean±SD)	64 (+5.9)	62 (±7.55)	
MAX PEEP in cm of H ₂ O (Mean±SD)	5.6(±0.76)	6.8(±0.37)	
MAX FiO ₂ in % (Mean±SD)	64(±7.3)	82.8(±13.8)	0.0004
Mean duration of CPAP in Hrs (Mean±SD)	46.4(±23.5)	83.7(±41.18)	0.02

Age of start of CPAP is significantly less (P value 0.001) in success group emphasising that if CPAP is started early, better would be the outcome. Statistically significant decrease in duration of CPAP and maximum O2 requirement is seen in CPAP success group (P value 0.02 and 0.0004 respectively).(Table-1)

TABLE-2 COMPARISON OF OUTCOME BETWEEN CPAP SUCCESS AND FAILURE GROUPS

OUTCOME	CPAP SUCCESS n=43	CPAP FAILURES n=7	p VALUE
Mean duration of O ₂ administration in hours (Mean±SD)	114.3(±40.13)	194.8(±55.24)	0.001
Mean duration of hospital stay in days (Mean±SD)	12.3(±5.36)	22.4±(8.12)	0.0001

Mean duration of hospital stay and mean duration of O2 administration are decreased in success group as compared with failure group which are statistically significant.(Table-2)

TABLE-3 COMPARISON OF COMPLICATIONS AND MORTALITY BETWEEN CPAP SUCCESS AND FAILURE GROUP

COMPLICATIONS	CPAP SUCCESS n=43	CPAP FAILURES n=7	P VALUE
Pneumothorax	0	2(29%)	0.01
Sepsis	5(11.62%)	4(57.14%)	0.002
Septal damage	2(4.65%)	3(42.88%)	0.03
Mortality	1(2.32%)	2(28.57%)	0.03

In CPAP failure group 57.14% developed sepsis, where as in success group only 11.62% had sepsis which is statistically significant. In CPAP failure group 29% developed pneumothorax and 42.88% developed septal damage whereas no baby in success group suffered from any of these complications which are statistically significant.(Table-3). Mortality rate in CPAP success group is 2.32% whereas in CPAP failure group it is 28.57% which is statistically significant.(p value 0.03).

DISCUSSION

This is a prospective study done to determine the efficacy of bubble CPAP in HMD with mild to moderate respiratory distress. A total of 50 babies were included in our study. Out of 50 babies who were started on bubble CPAP, 43(85.14%) babies were weaned off successfully and the remaining 7(14.86%) babies required subsequent mechanical ventilation.

All the variables (Neonatal and CPAP) are compared between CPAP success and CPAP failure groups. The age of start of CPAP, duration of CPAP, duration of O₂ requirement and duration of hospital stay are studied in both the groups. The incidence of mortality and other complications like sepsis, pneumothorax and chronic lung disease are also analysed between CPAP success group and failure group.

In prospective studies done by Koti et al⁷ and Urs et al⁸ CPAP success rates were 75% and 80% respectively. The higher success rate in our study is possibly because we have excluded babies with severe HMD. In the present study 89.2% of male babies and 81.8% of female babies responded successfully to bubble CPAP comparable to other studies. In present study the success rate of babies with gestational age between 28-31 weeks and 32-34 weeks is 78.5% and 95.5% respectively. In our study 28 babies are between 28-31 weeks of GA where as in Urs et al⁸ study maximum babies were in 31-34 weeks group. In both the studies CPAP success rate appears to be more in the 31-34 weeks group. In present study 26% had birth weight less than 1000 gms in contrast to study conducted by Urs et al where 8% babies had birth weight less than 1000 gm. In the present study one baby had birth weight greater than 2000 gm where as in Urs et al study no baby had birth weight more than 2000 gm.. In the present study the BCPAP success rate of babies with birth weight between 1000-1500 gm and 1501-2000 gm is similar with 91.6% which is comparable with those of Urs et al. In the study by Koti et al⁷ 74.2% of babies with birth weight between 1000-1500 gm were weaned off successfully. Whereas in our study, the success rate in this group was 91.6%. In present study 89.47% of babies who received antenatal steroids and 66.66% babies who didn't receive antenatal steroids were weaned off successfully from CPAP which is comparable with Urs et al. In present study and Koti et al study the mean age of start of CPAP, the mean duration of O₂ administration and hospital stay are decreased in CPAP success group when compared to CPAP failure group. The difference in the mean age of initiation of CPAP was not statistically significant in Koti et al⁷ study where as it was significant in our study. Urs et al⁸ also indicated correlation of positive outcome with early initiation of CPAP. The findings suggest that early CPAP shortens the duration of oxygen support facilitating early discharge. Complications and mortality are found to be more in CPAP failure group in both the studies. In CPAP failure group 57.14% developed sepsis, where as in success group 12.50% has sepsis

which is statistically significant (P value - 0.006). In CPAP failure group 28.50% of babies developed pneumothorax. Development of complications like sepsis and pneumothorax suggest higher chances of failure of BCPAP⁹. Our study suggests a statistically significant (P value 0.009) decrease in mortality rate is seen in CPAP success as compared to CPAP failure group.

Bubble CPAP in neonates is efficient in decreasing the respiratory distress, is associated with fewer complications as well as lower mortality rate. Though the results of BCPAP from our study are encouraging, experience of other researchers suggests that BCPAP alone may not be sufficient in salvaging severe cases of HMD and significant number of babies with moderately severe RDS may require mechanical ventilation.

Nevertheless, use of BCPAP for neonatal respiratory distress in all the SNCUs in the country would improve the survival of preterm babies with RDS and thereby help in reducing the overall neonatal mortality^{10,11}.

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