International Journal of Contemporary Pediatrics
Arora V et al. Int J Contemp Pediatr. 2017 May;4(3):939-942
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20171702

Original Research Article

Outcome of premature babies with RDS using bubble CPAP

Vivek Arora, Sandip G. Gediya*, Rupali Jain

Department of Pediatrics, Rabindranath Tagore Medical College, Udiapur, Rajasthan, India

Received: 15 February 2017
Accepted: 10 March 2017

***Correspondence:**
Dr. Sandip G. Gediya,
E-mail: drsandipgediya@gmail.com

ABSTRACT

Background: Respiratory distress syndrome (RDS) contributes significantly to mortality and morbidity. Continuous positive airway pressure (CPAP), when applied to premature infants with RDS, re-expands collapsed alveoli, splints the airway, reduces work of breathing and improves the respiration. Objectives: To ascertain the immediate outcome of preterm infants with RDS on Bubble CPAP and identify risk factors associated with its failure.
Methods: This was a prospective analytical study and inborn preterm infants (gestation 28 to 34 weeks) admitted to the NICU with RDS were included in the study. All the spontaneously breathing infants were stared on bubble CPAP and different variables were recorded. Those in whom CPAP failed were given surfactant and mechanical ventilation.
Results: 170 neonates were enrolled in the study. 52 (30.5%) babies failed CPAP. The predictors of failure were; partial or no response to Antenatal Steroids (ANS), white-out on the chest X-ray, Silverman Anderson scoring >6 or FiO2 > 0.4 after 15-20 minutes of CPAP, extreme prematurity. Other maternal and neonatal variables did not influence the need for ventilation. Rates of mortality and duration of oxygen requirement was significantly higher in babies who failed CPAP. No baby had chronic lung disease.
Conclusions: Infants with no or partial exposure to antenatal steroids, white-out chest X-ray and those with higher FiO2 requirement after initial stabilization on CPAP are at high risk of CPAP failure (needing mechanical ventilation). Bubble CPAP is safe for preterm infants with RDS; it decreases need of surfactant and mechanical ventilation.

Keywords: Antenatal steroids, Bubble continuous positive airway pressure, Continuous positive airway pressure failure, Prematurity, Respiratory distress syndrome

INTRODUCTION

Respiratory distress syndrome **(**RDS) contributes significantly to mortality and morbidity. Continuous positive airway pressure (CPAP), when applied to premature infants with RDS, re-expands collapsed alveoli, splints the airway, reduces work of breathing and improves the respiration.[1] Atelecto-trauma (repeated opening and collapse of the alveoli), bio-trauma (intubation of the airway) and volum-trauma (overstretching of the alveoli), the key determinants of ventilator induced lung injury are minimal or absent in gentler modes of ventilation such as nasal CPAP.[2,3] Bubble CPAP, when used appropriately, is more cost effective, less intensive, requires less training and has lower risk of complications. However, not all preterm infants with RDS respond to CPAP.[4] We conducted this prospective analytical study to evaluate the immediate outcome of preterm infants (gestation 28 to 34 weeks) with RDS on Bubble CPAP, and to study the risk factors associated with failure of Bubble CPAP.

METHODS

This study was conducted at level III NICU RNT Medical College Udaipur form April 2015 to April 2016. All preterm infants with gestation between 28 to 34 weeks, admitted to the neonatal intensive care unit with

respiratory distress syndrome (RDS) were included. Babies requiring intubation at birth and those with major malformation were excluded. If the parents opted for non-aggressive management in the antenatal counseling or refused consent, such babies were not included in the trial. Eligible babies were started on Bubble CPAP with bi-nasal prongs (Fisher and Paykel Healthcare, New Zealand). PEEP was started at 5 cm of water and adjusted to minimize chest retractions. FiO2 was adjusted to maintain SpO2 between 87% and 95%. Flow was titrated to the minimum to produce continuous bubbling in the bubble chamber. If baby had requirement of FIO2 >0.4 and/or pH <7.20 were given surfactant by INSURE technique (Intubate, Surfactant and Extubate after 3 to 5 minutes of intermittent positive pressure ventilation). Bubble CPAP was considered to be successful if the respiratory distress improved and the baby could be successfully weaned off from CPAP. The criteria for weaning was absence of respiratory distress (minimal or no retractions and respiratory rate between 30 and 60 per minute) and, SpO2 >90% on FiO2 <30% and PEEP <5cm of water. Infants were diagnosed to have failed CPAP and were started on mechanical ventilation when they: (a) remained hypoxic, i.e. SpO2 <87% despite FiO2 >70% and PEEP >7cm of water; (b) had severe retractions on PEEP >7cm of water; (c) had prolonged (>20 seconds) or recurrent apneas (>2 episodes within 24 hours associated with bradycardia) requiring bag and mask ventilation; and, (d) had severe metabolic acidosis or shock requiring inotropic support (dopamine and or dobutamine) >20µg/kg/min. Infants failing CPAP in the first 1 week of life were considered to be CPAP failures. Data collection of maternal variables included multiple births, pregnancy induced hypertension, preterm premature rupture of membrane, cesarean section and antenatal steroids. Gestational age was calculated based on mothers last menstrual period and or early pregnancy ultrasound scan or New Ballard score. Infant variables evaluated included birth weight, gestational age, presence of IUGR (weight <10th on Lubchenko percentile), Apgar score at 1 minute, delivery room management (oxygen, bag and mask, intubation), X-ray chest, arterial blood gas, FiO2 requirement and Silverman Anderson's score. Based on radiological findings, the severity of RDS was graded as mild (mild granularity of lungs), moderate (generalized granularity of lungs with air-bronchogram with preserved cardiac borders) and severe (white out lungs with loss of cardiac borders). The study assessed the following outcomes: CPAP failure, mortality, incidence of pneumothorax, ROP, CLD, duration of hospital stay and predictors of CPAP failure. Variables distributed normally are represented as mean + SD and the others as medians (range). Maternal, infant and clinical data was compared between infants who succeeded CPAP with CPAP failures. P value <0.05 was considered to be significant. The study was approved by the institute ethics committee and informed consent was obtained from either the father or a guardian.

RESULTS

We enrolled 170 neonates in the study. The mean gestation was 30.48±2 weeks and mean birth weight was 1290 ± 404 grams. 120 mothers received either 1 (n=78, 45.9%) or 2 doses (n=42, 24.7%) of antenatal steroids (Table 1).

Table 1: baseline characteristics of participants.

Characteristics	n (%)
Males	112(66)
Twins	12(0.1)
VLBW	84(49.4)
PIH	38(22.2)
APH	25(14.7)
PROM >18 hours	20(11.8)
2 doses of ANS	42(24.7)
1 dose of ANS	78(45.9)
LSCS	30(17.6)
Diabetes	3(0.01)
Resuscitation	16(0.09)

Table 2: Maternal and neonatal variables among neonates with CPAP sources and CPAP failure.

Variables	CPAP Success N=118 (%)	CPAP Failure N=52 (%)	P Value
Birth weight (g) (mean±SD)	1468±520	1320±302	0.39
GA (weeks) (mean±SD)	31.2±2	30±2	0.73
Male	78 (66.1)	34 (65.4)	0.22
Twins	8 (6.7)	4 (7.7)	0.50
Birth weight <1500 gm	62 (52.5)	22 (42.3)	0.32
Birth weight <1000 gm	28 (23.7)	22 (42.3)	0.48
PROM	14 (11.9)	6 (11.5)	0.48
Chest X-ray of RDS	72 (61)	52 (100)	0.002
Antenatal steroids given	90 (76.3)	30 (57.7)	0.003

The median age of starting CPAP was 1.6 hours of life. INSURE was done in 30.54% (52 babies) and the median age of surfactant administration was 3 hrs (range 1 hr to 15 hrs of life). The median duration of CPAP was 26 hours (range 6 -144 h). In infants surviving till discharge, median duration of hospital stay was 11 days (range 3-37 days). No baby had chronic lung disease. 3 (1.7%) developed retinopathy of prematurity requiring laser therapy. Fifty-two (30.5%) babies failed CPAP. Fourteen (8%) babies died during the hospital stay. The variables associated with failure of CPAP were: no or only partial exposure to antenatal steroids, whiteout on the chest X-ray, Silverman Anderson's score >6 or FiO2 ≥40% after 15 to 20 minutes of CPAP and extreme prematurity.

Other maternal and neonatal variables did not influence the need for ventilation (Table 2).

There was more incidence of pneumothorax seen with CPAP but mortality was higher in the babies who required ventilation (Table 3).

Table 3: Immediate outcome.

Outcome	CPAP success N=118 (%)	CPAP failure N=52 (%)	P value
Pneumothorax	14 (11.9)	4 (7.7)	0.002
Apnea	12 (10.1)	6 (11.5)	0.25
Duration of O2 (h) (mean±SD)	102 ± 90	192 ± 62	0.04
Hospital stay (d) (mean±SD)	12 ± 4.2	14 ± 2	0.56
Mortality	0 (0)	14 (26.9)	0.002

DISCUSSION

This is one of the few prospective studies on the role of Bubble CPAP for RDS in preterm neonates (gestation 28 to 34 weeks). In our study 30.54% of babies started on Bubble CPAP required ventilation. No baby required oxygen for more than 28 days. Total 18 babies had pneumothorax but out of these 14 babies were stabilized on Bubble CPAP whereas 4 babies required mechanical ventilation but none of them required chest tube drainage. No exposure to antenatal steroids, severe RDS as suggested by white out X-ray, higher FiO2 and persisting distress after stabilization on CPAP, are the early predictors of CPAP failure.

In a retrospective study by Ammari, et al, the failure rate of Bubble CPAP was 24% in babies' ≤1250g and 50% in babies ≤750g.[5] None of the babies with gestation >30 weeks failed CPAP. In their study, nearly 65% of the babies were ELBW and 85.5% of babies had gestation less than 30 weeks as against 29.4% and 41.2% respectively in our study. The main difference between our study and that by Ammari, et al. are, (a) ours is a unit which is doing Bubble CPAP for RDS for 6 months before the onset of the study, (b) we used Fisher and Paykel nasal prongs while it was Hudson prongs in their study, (c) definition of CPAP failure included FiO2 >70% and PEEP >7cm for the first 7 days of life as against FiO2 >60% for the first 72 hours of life.[5] No PEEP criteria were set in their study. These major differences might explain the differences in failure rates in the two studies. Since most events in the early neonatal period are reflections of the care and support in the first couple of days, we choose 7 days as the cut off for CPAP failures.

In other uncontrolled studies and in the studies comparing INSURE with ventilation, CPAP failure rate ranged from 14% to 40%.[4] The difference may be attributed to birth weight and gestation of infants enrolled, type of nasal interface, the CPAP device, age of starting CPAP, and use of antenatal steroids and surfactant. In the study by Ammari, et al.[5], the predictors of CPAP failure were (i) need for positive pressure ventilation at birth; (ii) alveolar to arterial oxygen difference (A-a DO2) >180mm of Hg on the first blood gas; and (iii) severe RDS on the initial chest X-ray. Similar to their study, parameters of severe lung disease such as white out chest X-ray, higher FiO2 requirement and higher Silverman Anderson's score were associated with CPAP failure in our study. In comparison with A-a DO2, we feel FiO2 requirement and Silverman Anderson's scoring are more clinically relevant and easily assessable variables.

In a case-control study by Boo, et al, of the 97 preterm babies (gestation <37 weeks) with RDS on ventilator CPAP or bubble CPAP, 38% failed CPAP and required ventilator.[6] Babies were given ventilator support for hypoxia (SpO2 <90%) on FiO2 ≥90%. Only 34% of the infants in their study received antenatal steroids and the authors did not report usage of surfactant in their study. Similar to our study and that by Ammari, et al. severe RDS on the chest X-ray was an important predictor of CPAP failure.[5] The higher failure rates in the study by Boo, et al may be attributed to inadequate usage of antenatal steroids and may be due to lesser use of surfactant.[6]

CONCLUSION

We conclude that Bubble CPAP for RDS in moderately preterm babies is safe and associated with lesser lung injury (no CLD or prolonged oxygen requirement). Nearly 30.54% of these infants fail CPAP and the predictors for failure are no exposure to antenatal steroids, severe RDS, persisting FiO2 ≥40% or persisting distress even after stabilization on CPAP.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. VanMarter LJ, Allred EN, Pagano M, Sanocka U, Parad R, Moore M, et al. Do clinical markers of barotraumas and oxygen toxicity explain interhospital variation in rates of chronic lung disease? The Neonatology Committee for the Developmental Network. Pediatrics. 2000;105:1194-201.
2. Attar MA, Donn SM. Mechanisms of ventilator induced lung injury in premature infants. Semin Neonatol. 2002;7:353-60.
3. Jobe AH, Kramer BW, Moss TJ, Newnham JP, Ikegami M. Decreased indicators of lung injury with continuous positive expiratory pressure in preterm lambs. Pediatr Res. 2002;52:387-92.

4. Stevens TP, Harrington EW, Blennow M, Soll RF. Early surfactant administration with brief ventilation vs. selective surfactant and continued mechanical ventilation for preterm infants with or at risk for respiratory distress syndrome. Cochrane Database Syst Rev. 2007;4:CD003063.
5. Ammari A, Suri M, Milisavljevic V, Sahni R, Bateman D, Sanocka U, et al. Variables associated with the early failure of nasal CPAP in very low birth weight infants. J Pediatr. 2005;147:341-7.
6. Boo NY, Zuraidah AL, Lim NL, Zulfiqar MA. Predictors of failure of nasal continuous positive airway pressure in treatment of preterm infants with respiratory distress syndrome. J Trop Pediatr. 2000;46:172-5.

Cite this article as: Arora V, Gediya SG, Jain R. Outcome of premature babies with RDS using bubble CPAP. Int J Contemp Pediatr 2017;4:939-42.