

Outcome of Bubble (CPAP) Continuous Positive Airway Pressure in Neonates with Respiratory Distress and its failure factors.

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ABSTRACT

Introduction: Bubble CPAP is an important, simple, non-invasive, and cost effective treatment modality for respiratory distress in neonates. The aim of our study was to know the outcome of Bubble CPAP in preterm and term neonates requiring respiratory support and to study its failure factors.

Material and methods: A retrospective observational study with Bubble CPAP was done on 100 babies both term and preterm with respiratory distress requiring for respiratory support admitted in NICU of Government General Hospital, Guntur. Monitoring was done clinically, with pulse oximeter, radiologically and with blood gases. Neonates with respiratory distress secondary to sepsis, necrotizing enterocolitis, congenital anomalies like Tetralogy of Fallot, cleft lip with cleft palate, congenital diaphragmatic hernia, choanal atresia, who had severe respiratory distress with cardio vascular instability were excluded in our study.

Results: The mean gestational age was 32-34 weeks, birth weight was 1.4 kgs. 52% were very low birth weight <1.5 kgs. CPAP failure rate was higher in preterm and very low birth weight. The most common disease for starting Bubble CPAP was Respiratory Distress Syndrome 56 cases followed by Meconium Aspiration Syndrome 16 cases, congenital pneumonia, Transient Tachypnea of New Born and Birth Asphyxia. The common complications on CPAP were shock, apnea and nasal damage. Overall failure rate was 36% (36 cases). All babies who failed on CPAP were put on mechanical ventilation. Failure among Respiratory Distress Syndrome was about 42%, in Meconium Aspiration Syndrome 31%, congenital pneumonia 35.7%. Higher cases of sepsis and pulmonary hemorrhage were seen in failure group. Overall survival rate of the study was 64% (64 cases).

Conclusion: Bubble Continuous Positive Airway Pressure is safe, effective and easy to use in preterm and term neonates with mild to moderate Respiratory Distress. The major failure factors in our study were sepsis, recurrent apnea. The success rate was 64%.

Keywords: Bubble Continuous Positive Airway Pressure, Preterm, Term Neonate, Very Low Birth Weight, Respiratory Distress Syndrome.

INTRODUCTION

Continuous Positive Airway pressure (CPAP) is an important treatment modality for Respiratory Distress Syndrome in neonates. It can be applied via a face mask, nasopharyngeal tube or nasal prongs, using a conventional ventilator, bubble circuit or a CPAP driver.¹ Bubble CPAP (B-CPAP) is one of the low cost nasal CPAP delivering systems with under water seal. CPAP delivered by underwater seal causes vibrations of the chest due to gas flow under water and these vibrations

simulate wave forms produced by high frequency ventilation. B-CPAP also a less expensive method of respiratory support most suitable to neonatal units with limited resources in developing countries.² Gregory et al first pioneered the use of B-CPAP in neonatology with their landmark paper in the 70s in Columbia.³ B-CPAP differs from conventional CPAP in that in B-CPAP the expiratory limb is placed under water and oscillatory vibrations transmitted into the chest resulting in wave forms similar to those produced by high frequency ventilation CPAP, often thought to be the missing link between supplemental oxygen and mechanical ventilation and is gaining immense popularity in neonatal intensive care units. Being technically simple, in expensive and effective, it has become the primary modality of respiratory support in preterm, very low birth weight neonates. This study was planned to look at the effectiveness of B-CPAP in reducing mortality and need for invasive ventilation and its safety as a form of respiratory support in preterm babies.^{5,6,9} The aim of our study was to know the outcome of B-CPAP in preterm and term neonates requiring respiratory support and to study its failure factors.

MATERIAL AND METHODS

A retrospective, observational study with B-CPAP was carried out in the NICU of government general hospital Guntur, a tertiary care hospital. Data was collected from November 2018 to April 2019 of both preterm and term babies with respiratory distress who were connected to B-CPAP. The study was also to know the failure factors so we can overcome of those and utilize this modality more widely.

Inclusion criteria were preterm and term (38 weeks of gestational age) babies with neonatal gestational age 28 weeks to 38 weeks with respiratory distress syndrome, neonates with mild to moderate respiratory distress based on Downes score and Silverman Anderson score and neonates

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with Transient Tachypnea of Newborn, Meconium aspiration syndrome, congenital pneumonia birth asphyxia.

Exclusive criteria were neonates with respiratory distress secondary to sepsis, necrotizing enterocolitis, congenital anomalies like Tetralogy of Fallot, Cleft lip and palate, congenital diaphragmatic hernia, choanal atresia and neonates requiring intubation at birth and severe cardiovascular instability.

Informed consent was taken from parents. The details of birth history, risk factors in pregnancy, type of delivery and need for resuscitation was recorded. Study population was put on B-CPAP. All babies were nursed under radiant warmers on servo controlled skin mode. B-CPAP was started with 5cmH₂O and FiO₂ adjusted to maintain pulse oximeter saturations between 88% to 94% in < 1.5 kg and 92% to 94% in >1.5kg babies.

Monitoring was done clinically, with pulse oximetry, X-rays and ABGs for requirement of change in settings, complications, failure and outcome, time of starting CPAP, total duration of therapy and time taken to wean were noted. Weaning off B-CPAP was done when the respiratory distress decreased to Downes score <3 and ABGs were normal. Trails off B-CPAP were done before finally discontinuing B-CPAP.

Failure of B-CPAP was defined as:

1. Requirement of pressure >8cmH₂O
2. FiO₂ requirement >0.6
3. PaO₂ <50mmHg on maximum acceptable settings
4. PaCO₂>60mmHg and PH <7.25 on maximum acceptable settings
5. Air leak on B-CPAP
6. Recurrent apnea on B-CPAP despite caffeine citrate

Data was analyzed as mean, SD, by making tables.

RESULTS

There were total 100 babies who were put on B-CPAP out of which 64 were weaned successfully while others were intubated and were considered in failure group.

The mean gestational age of the study was 32-34 weeks and birth weight was 1.401 kgs.52% of the population was very low birth weight babies; CPAP failure rate was higher in these babies.

The most common disease for starting B-CPAP was Respiratory Distress Syndrome (56%) followed by Meconium Aspiration Syndrome (16%), Congenital pneumonia (14%), Transient Tachypnea of New Born (8%) and Birth Asphyxia (6%). There was no difference in the result with the age of

| Cause | B-CPAP | Failure rate |
|----------------|--------|--------------|
| RDS | 56 | 42%(24) |
| MAS | 16 | 31%(5) |
| Cong pneumonia | 14 | 35.7%(5) |
| TTNB | 8 | Nil |
| BA | 6 | 33.3%(2) |
| Total cases | 100 | |

Table-1: Cause of respiratory distress (N=100).

| Variable Factors | Success on B-CPAP(N=64) | Failure on B-CPAP(N=36) | P-value |
|-----------------------------------|-------------------------|-------------------------|---------|
| Birth weight in Kgs | 1.6 | 1.2 | 0.89 |
| Age at CPAP | 1 hr | 1.08 hr | 0.55 |
| Gestational age PT(N=70)/FT(N=30) | PT(N=38)/FT(N=26) | PT(N=32)/FT(N=4) | |
| Sex: Male(N=42) | 26 | 16 | |
| Duration (no. of days) | 5.02 | 1.53 | 0.045 |
| Silverman score at 15min. | 4.3 | 6.2 | 0.541 |
| Recurrent apnea | 1 | 8 | 0.025 |

Table-2: Comparison of factors affecting-CPAP outcome

| Outcome | Success (N=64) | Failure (N=36) | P-value |
|----------------------|----------------|----------------|---------|
| Nasal damage | 3 | 0 | |
| Sepsis | 3 | 24 | 0.004 |
| Shock | 1 | 27 | 0.002 |
| DIC | 0 | 15 | 0.002 |
| Pulmonary Hemorrhage | 0 | 14 | 0.002 |

Table-3: Complications on B-CPAP

| Outcome | B-CPAP |
|---------------------------------------|--------|
| Recovered | 64 |
| Failure | 36 |
| Recovered from Mechanical Ventilation | 7 |
| Deaths | 29 |

Table-4: Outcome of B-CPAP(N=100)

onset of B-CPAP in our study. The Silverman score was more in failure group indicating failure associated with severity of the disease. The duration of stay on B-CPAP was more in success group table 2.

The common complications on B-CPAP were shock, apnea and nasal damage. Overall failure of B-CPAP occurred in 36% cases. All babies who failed B-CPAP were put on mechanical ventilation. Failure in respiratory distress syndrome group were 24/56 (42%), meconium aspiration syndrome 5/16 (31%), congenital pneumonia 5/14 (35.7%), birth asphyxia 2/6 (33.3%) and transient tachypnea of newborn- nil cases. Higher cases of sepsis, pulmonary haemorrhage were seen in failure group table 3. Overall success rate of study population was 64%.

DISCUSSION

64 babies out of 100 who were treated with B-CPAP were considered successful treatment which was lower than that founded by Shamil et al 66%.⁷ 38% failed B-CPAP and required mechanical ventilation in Gupta et al study which was higher than that founded in our study 36%.⁸ Koti et al conducted a retrospective analytical study on 56 neonates with 25% B-CPAP failure which was lower than that founded in our study.⁹

Respiratory Distress Syndrome remains the most common indication for use of B-CPAP in neonates the World over. This was also the case in our study. Overall failure rate of B-CPAP was 36% and failure rate among RDS was 42% which was similar to most of the other studies.

Verder et al published the first randomized controlled trial of surfactant installation during CPAP showing that in infants with moderate to severe respiratory distress the need the need for subsequent mechanical ventilation could be reduced by half after single dose of surfactant.¹⁰ In our study we could give surfactant only in 10 cases out of 56 cases with Respiratory Distress Syndrome because of available limited resources in our set up. Of these, 4 cases failed CPAP(40%). Indian studies on CPAP have shown a failure rate of 25-50%. Our study showed that during B-CPAP there was a good normalization of ABGs. This was consistent with other studies like Roberts et al study.¹¹

In our study it showed that in immediate outcome recurrent apnea, shock, sepsis higher in failure group. In Koti et al study apnea as immediate outcome was more as compared to our study.⁹ The overall success rate was 64% which was lower compared to other studies as we had more preterm and very low birth weight babies and due to high prevalence of sepsis in our set up.

CONCLUSION

Bubble Continuous Positive Airway Pressure is safe, effective and easy to use in preterm and term neonates with mild to moderate Respiratory Distress. The major failure factors in our study were sepsis, recurrent apnea. The success rate was 64%.

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