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A Study of Clinical Profile and Outcome of Neonates Ventilated with Bubble Continuous Positive Airway Pressure

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ABSTRACT
The primary determinants of the country's health are the rates of neonatal and perinatal death. Neonatal and perinatal death rates are 3-5 and 8-9 per 1000 live births, respectively, in wealthy nations. In India, neonatal and perinatal mortality rates remain high despite notable advancements in metropolitan regions. To study the clinical profile and outcome of non-invasive ventilation using bubble continuous positive airway pressure in neonates with respiratory distress in a tertiary care centre. The Study design was Prospective study. Study period from November 2018 to October 2019 and total sample size: 100. In Survived group, 5 patients had Respiratory distress syndrome, 25 patients had Birth asphyxia, 15 patients had Meconium aspiration syndrome and 5 patients had congenital pneumonia. In Mechanical ventilation, 10 patients had Respiratory distress syndrome, 10 patients had Birth asphyxia, 20 patients had Meconium aspiration syndrome and 10 patients had congenital pneumonia. Association of Diagnosis with Outcome was statistically significant (p=0.0149). We concluded that CPAP is one of the best methods of treatment in neonates with respiratory distress. It is highly beneficial among preterm neonates especially less than 34 weeks who were the major victims for lung immaturity. Neonates diagnosed to have Respiratory Distress Syndrome recovered more with usage of non-invasive ventilation like Bubble CPAP.

INTRODUCTION

The primary determinants of the country's health are the rates of neonatal and perinatal death. Neonatal and perinatal death rates in wealthy nations are 3-5 and 8-9 per 1000 live births, respectively[1]. In India, neonatal and perinatal mortality rates remain high despite notable advancements in metropolitan regions. In India right now, there are 30.92 newborn deaths for every 1000 live births. Numerous studies show that respiratory distress in the newborn period accounts for about half (32-52%) of this[2]. One of the most prevalent newborn issues worldwide is respiratory distress, which affects 3-7% of all live births. Mortality and morbidity can be decreased in cases of respiratory distress by providing appropriate and prompt resuscitation, oxygen supplementation, maintaining an ideal temperature, prompt referral and optimal ventilatory support. One of the key strategies for treating neonatal respiratory distress is assisted ventilation. The goal of this brief, acute intervention is to partially or fully support the newborn's physical breathing mechanism until they can breathe on their own. In patients who are breathing on their own, continuous positive airway pressure (CPAP) is a form of positive airway pressure in which air flow is injected into the airways to maintain a constant pressure to keep the airways open. The pressure in the alveoli above atmospheric pressure at the conclusion of expiration is known as positive end-expiratory pressure, or PEEP. In addition to providing PEEP, CPAP keeps the set pressure constant during inspiration and expiration of the breathing cycle[3]. Centimeters of water pressure (cm H_2O) are used to measure it. In contrast to bilevel positive airway pressure (BiPAP), which varies depending on whether the patient is breathing or inhaling, CPAP does not. The terms expiratory positive airway pressure (EPAP) and inspiratory positive airway pressure (IPAP) refer to these pressures. With CPAP, patients must initiate all of their breaths and no additional pressure is given over the predetermined threshold. In addition to maintaining PEEP, CPAP can reduce atelectasis, increase alveolar surface area, enhance V/Q matching, and ultimately improve oxygenation. Although CPAP by itself is frequently insufficient to support ventilation, it can also indirectly help with it. Non-invasive ventilation requires additional pressure support during inspiration (IPAP on BiPAP).

MATERIALS AND METHODS

Study Design: Prospective study.

Study Period: November 2018 to October 2019.

Place of Study:
Sample Size: 100.

Inclusion Criteria:

- Neonates with respiratory distress [Downes score 4-6].
- Neonates with Oxygen Saturation [SPO2] <85% even with supplemental oxygen.

Exclusion Criteria:

- Babies with severe respiratory distress[DOWNES SCORE>7/10].
- Unstable cardiovascular status.
- Prolonged and refractory seizures.
- Major congenital anamolies including airway anamolies, pulmonary hypoplasia. Diaphragmatic hernia.

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0., SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests, which compare the means of independent or unpaired samples, were used to assess differences between groups. Paired t-tests, which account for the correlation between paired observations, offer greater power than unpaired tests. Chi-square tests (χ^2 tests) were employed to evaluate hypotheses where the sampling distribution of the test statistic follows a chi-squared distribution under the null hypothesis; Pearson's chi-squared test is often referred to simply as the chi-squared test. For comparisons of unpaired proportions, either the chi-square test or Fisher’s exact test was used, depending on the context. To perform t-tests, the relevant formulae for test statistics, which either exactly follow or closely approximate a t-distribution under the null hypothesis, were applied, with specific degrees of freedom indicated for each test. P-values were determined from Student's t-distribution tables. A p-value $\leq$ 0.05 was considered statistically significant, leading to the rejection of the null hypothesis in favour of the alternative hypothesis.

RESULTS AND DISCUSSIONS

Table1: Association Between Diagnosis: Outcome

Diagnosis	Survived	Mechanical ventilation	P-value
Respiratory distress syndrome	5(10.0%)	10(20.0%)	0.0149
Birth asphyxia	25(50.0%)	10(20.0%)	
Meconium aspiration syndrome	15(30.0%)	20(40.0%)	
Congenital pneumonia	5(10.0%)	10(20.0%)	
Total	50	50	

Table2: Distribution of Complication

Complication	Frequency	Percentage
No complication	70	70.00%
Complication(pneumothorax)	30	30.00%
Total	100	100

Table3: Distribution of Outcome

Outcome	Frequency	Percentage
Survived	40	40.0%
Mechanical ventilation	60	60.0%
Total	100	100.0

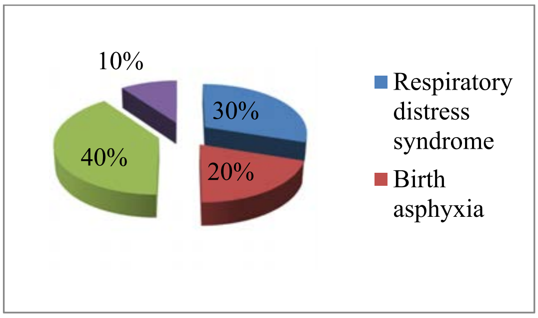

Fig. 1: Distribution of Diagnosis

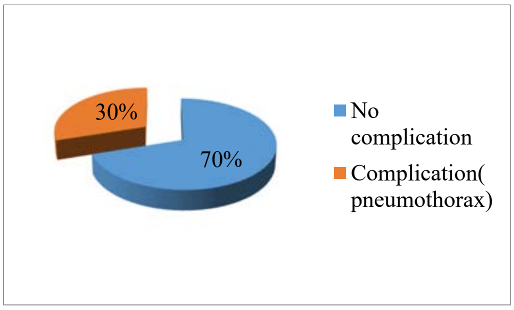

Fig. 2: Distribution of Complication

In Survived group, 5(10.0%) patients had Respiratory distress syndrome, 25(50.0%) patients had Birth asphyxia, 15(30.0%) patients had Meconium aspiration syndrome and 5(10.0%) patients had congenital pneumonia. In Mechanical ventilation, 10(20.0%) patients had Respiratory distress syndrome, 10(20.0%) patients had Birth asphyxia, 20(40.0%) patients had Meconium aspiration syndrome and 10(20.0%) patients had congenital pneumonia. Association of Diagnosis with Outcome was statistically significant (p=0.0149). In our study, 70 (70.0%) patients had No complication and 30 (30.0%) patients had Complication (pneumothorax).The value of z is 5.6569. The value of p is < .00001. The result is significant at p<.05. In our study, 40 (40.0%) patients had survived and 60 (60.0%) patients had Mechanical ventilation. The value of z is 2.8284. The value of p is .00466. The result is significant at p<.05.In our study, 30 (30.0%) patients had Respiratory distress syndrome, 20 (20.0%) patients had Birth asphyxia, 40 (40.0%) patients had Meconium aspiration syndrome and 10 (10.0%) patients had congenital pneumonia. The value of z is 3.5355. The value of p is .0004. The result is significant at p<.05. For infants experiencing respiratory distress from a variety of causes, CPAP is a useful and easy-to-use tool. In contrast, BUBBLE CPAP requires little training to use and is simple to construct. This study examined the effects of CPAP on 100 infants experiencing respiratory distress. Meconium aspiration syndrome, congenital pneumonia, birth asphyxia and respiratory distress syndrome were among the several causes of respiratory distress that were identified. The study included both term and preterm infants. CPAP was particularly beneficial for newborns between 32 and 34 weeks of gestation. The gender of the babies had no discernible effect on the results. Using CPAP produced superior results for babies weighing 1.5 kg or more at delivery. Infants under 1kg in weight either needed mechanical ventilation due to CPAP FAILURE or needed prophylactic intubation. Using bubble CPAP, four infants weighing <1kg survived this research. When compared to newborns delivered with LSCS, those delivered during labor naturals and assisted vaginal delivery fared better. An investigation into CPAP in premature infants: According to Neeraj Gupta, Shiv Sajan Saini and Srinivas Murki Praveen Kumar's update on the latest research and its implications for developing nations[4], CPAP was effective for babies who were >32 weeks along in their gestation and weighed >1000 grams at delivery. A newborn's respiratory distress can be evaluated using a variety of ratings. The Downes and Silverman Anderson scores are frequently employed., the latter is mostly applied to preterm newborns. In this study, severity was analyzed using the Downes score. While a score of greater than 7 was seen as a symptom of impending respiratory failure necessitating mechanical ventilation, a score of 3-6 was regarded as a signal for CPAP. With CPAP, the majority of the infants with scores between 4 and 5 experienced a noteworthy outcome. Shashidhar A, Suman Rao PN and Joe Jose's study on the Downes score for assessing respiratory distress in preterm newborns revealed that the score had better inter-rater variability and could be applied broadly to the assessment of respiratory distress[5]. When using CPAP, newborns who needed a PEEP of 4 or 5 fared well. A longer CPAP duration was necessary for those who needed a PEEP of 6. Neonates with 40% and 50% FiO2 requirements performed well. The majority of infants with a 60% FiO2 demand needed mechanical ventilation. Increased FiO2 requirements can be used to forecast the need for mechanical breathing, according to a prospective multicenter study on FiO2 as a predictor of CPAP failure conducted by Ewa Gulczynska[6]. The baby's maturity, birth weight and the course of antenatal steroids all had a significant impact on how long CPAP lasted. Both term and late preterm babies used CPAP for <twenty-four hours and fared well. Of the 130 infants that needed CPAP for longer than twenty-four hours, 76.2% lived well, while 23.8% experienced CPAP Failure. According to a study by Nicolas Bamat, Erik A. Jensen and Haresh Kirpalani on the duration of continuous positive airway pressure in preterm newborns, neonates with lower gestational

ages needed more time on CPAP[7]. Steroids were crucial in helping the newborns' lungs mature, which improved their respiratory distress. The results of CPAP were drastically different for neonates who had a full course of prenatal steroids. Additionally, the survival rate was higher for those who had an incomplete course of steroids. Therefore, it was discovered that even a single steroid dose had a significant positive impact on the neonatal outcome. The need for artificial ventilation was mostly caused by the patient not receiving any steroid doses at all. According to a study by Vivek Arora, Sandip G. Gediya, and Rupali Jain[8] on the outcome of premature babies with RDS using bubble CPAP, 30.5% of CPAP failure occurred among infants who had either not been exposed to antenatal steroids at all or had been exposed to them in part. In this study, 17.6% of newborns who did not receive prenatal steroids experienced CPAP failure, while 81.5% of kids who received the full course of steroids demonstrated positive results. There were not many side effects from long-term CPAP use, such as pressure injuries and nasal damage. With the right nursing care and supervision, they can be prevented. Pneumothorax was one of the significant consequences. Higher pressure levels and extended CPAP use resulted in air leaks. Appropriate diagnosis and monitoring can also help avoid this. Pneumothorax occurred in 3% of the newborns in this trial, compared to 2% in a prospective study by S.S. Mathai, Surg Cmde, VSM, a. Rajeev, Surg and K.M. Adhikari, Surg Capt, on the safety and efficacy of bubble CPAP in preterm neonates with respiratory distress[9].

CONCLUSION

We concluded that one of the most effective ways to treat newborns experiencing respiratory distress is with CPAP. Preterm neonates, particularly those under 34 weeks, who were the main victims of lung immaturity, benefit greatly from it. Using non-invasive ventilation, such as Bubble CPAP, improved the recovery of newborns with Respiratory Distress Syndrome. Staff nurses in the NICU can apply this since it doesn't require skilled professionals for setup. The Downes score can be used to track improvement after CPAP treatment and to quickly determine the degree of respiratory distress. The prognosis of preterm newborns with immature lung function and, consequently, the outcome with CPAP, was significantly influenced by antenatal steroids. With the right nursing care and supervision, CPAP complications were extremely rare and completely preventable.

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