RESEARCH PAPER

# Outcome of Bubble CPAP Ventilation in NICU, Puducherry

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## ABSTRACT

**Background:** Neonatal and perinatal mortality rates serve as crucial indicators of a nation's health status, reflecting the overall effectiveness of its healthcare system. A major contributor to neonatal mortality in India is respiratory distress, which accounts for approximately 32-52% of neonatal deaths. Respiratory distress is one of the most common issues faced by newborns worldwide, affecting 3-7% of all live births. Assisted ventilation plays a pivotal role in the management of respiratory distress in neonates. Invasive ventilation, though potentially lifesaving, is one of the most expensive therapies in neonatal intensive care units (NICUs). On the other hand, non-invasive ventilation, particularly Bubble CPAP (Continuous Positive Airway Pressure), offers several advantages. It is relatively simple, cost-effective, and can be monitored with a pulse oximeter. With proper training, Bubble CPAP has been shown to be highly effective in managing neonatal respiratory distress, with fewer long-term complications compared to invasive methods. Hence, this study aims to study the outcome of noninvasive ventilation using Bubble CPAP in neonates with respiratory distress admitted in Newborn Unit in tertiary care hospital.

**Materials and Method:** A prospective observational study with successive sampling was conducted, and 100 newborns who met the inclusion criteria were included. For newborns with a Downes score of 4–6, a Silverman score of >4, or chronic hypoxemia, bubble CPAP (Fisher & Paykel) was started after stabilization. Secure prong installation, humidification, suctioning, gastric decompression, and monitoring for problems such prong displacement, nasal obstruction, mucosal ulceration, and pneumothorax were the main focuses of nursing care. SPSS was used to do the statistical analysis.

**Results:** Silverman's score indicated that 73% of neonates evaluated prior to bubble CPAP therapy had moderate respiratory distress, and 27% had severe respiratory distress. By contrast, Downes scoring revealed that 68% had moderate distress (5–6), 28% had severe (>7), and 4% had mild (<4). 95% of people survived overall, whereas 5% died. Interestingly, there were no fatalities in the mild or moderate groups, whereas the severe cases had a 17.9% fatality rate. Although it had no impact on overall hospital stay, early CPAP beginning was associated with better survival and shorter therapy duration. Prolonged hospital stays were associated with greater Silverman's scores and severity of distress, highlighting the importance of disease burden in healthcare. Although there were survivors in every Downes category, the groups with lower scores had the highest survival rates, indicating the positive outcomes with less severe initial distress. These results demonstrate that baseline severity is still the best indicator of hospital stay duration and overall outcome, while also highlighting the efficacy of bubble CPAP in lowering infant mortality and the significance of prompt commencement.

**Conclusion:** The present study findings highlight the importance of initiating CPAP early in neonates with respiratory distress to improve survival and reduce complications. Longer hospital admissions and worse morbidity were associated with severe cases, which were identified by higher Silverman's and Downes scores. This underscores the significance of early identification, fast intervention, and careful monitoring to maximize results.

**Keywords:** Neonates, Respiratory distress, Bubble CPAP (Continuous Positive Airway Pressure), Silverman's score, Downes score.

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## INTRODUCTION

Neonatal and perinatal mortality rates serve as crucial indicators of a nation's health status, reflecting the overall effectiveness of its healthcare system. In developed countries, the neonatal mortality rate (NMR) typically ranges from 3 to 5 per 1000 live births, while the perinatal mortality rate stands between 8 and 9 per 1000 live births. In contrast, despite significant advancements in healthcare, India continues to experience high neonatal and perinatal mortality rates. Currently, India's NMR is 19.1 per 1000 live births, which remains a significant public health concern [1].

Respiratory distress is a significant factor to newborn mortality in India, accounting for around 32-52% of neonatal deaths. Three to seven percent of all live births are affected by respiratory distress, making it one of the most prevalent problems that babies encounter globally. In these situations, prompt and efficient interventions—such as proper ventilatory support, oxygen supplementation, maintaining an ideal body temperature, and adequate resuscitation—can greatly lower mortality and increase survival rates [2].

Assisted ventilation plays a pivotal role in the management of respiratory distress in neonates. It is a short-term, acute intervention that temporarily supports the process of respiration, either partially or completely, until the newborn can resume independent breathing. There are two primary types of assisted ventilation: invasive and non-invasive [3].

Invasive ventilation, though potentially lifesaving, is one of the most expensive therapies in neonatal intensive care units (NICUs). It carries risks of associated morbidity, such as a higher incidence of bronchopulmonary dysplasia and retinopathy of prematurity in preterm infants, as well as an increased likelihood of infections. Additionally, it requires highly skilled medical personnel, frequent blood sampling (e.g., ABG monitoring), and substantial labor costs for nurses and respiratory practitioners, making it a costly and resource-intensive option [4].

Non-invasive ventilation, particularly Bubble CPAP (Continuous Positive Airway Pressure), provides several benefits. A pulse oximeter can be used to monitor it, and it is rather easy and affordable. Compared to invasive techniques, Bubble CPAP has been demonstrated to be very successful in treating infant respiratory distress with fewer long-term problems when used with the right training. Bubble CPAP offers a practical way to manage a lot of newborns in low-resource environments, such secondary-level hospitals in developing nations like India. It is one of the most economical interventions in newborn care since it offers a practical and accessible way to lower morbidity and death [5].

## AIM AND OBJECTIVES

To study the outcome of noninvasive ventilation using Bubble CPAP in neonates with respiratory distress admitted in Newborn Unit in tertiary care hospital.

## MATERIALS AND METHODS

This prospective observational study was carried out over 18 months (May 2023–October 2024) in the NICU of a tertiary care center in Puducherry after ethics approval (No:48/SVMCH/IEC-Cert/May23). Using consecutive sampling, 100 neonates fulfilling inclusion criteria (respiratory distress, $SPO_2$ <85% despite oxygen, inborn and outborn, term and preterm) were enrolled, with a 95% confidence interval, 9% margin of error, and an expected improvement proportion of 61%. Exclusion criteria included severe distress (score >7/10), unstable cardiovascular status, refractory seizures, and major congenital anomalies. Eligible neonates received stabilization, and bubble CPAP (Fisher & Paykel) was initiated for Downe score 4–6, Silverman score >4, or persistent hypoxemia. Nursing care emphasized secure prong placement, humidification, suctioning, gastric decompression, and monitoring for complications such as prong displacement, nasal blockage, mucosal ulceration, and pneumothorax. Informed parental consent was obtained, and data were systematically collected.

## STATISTICAL ANALYSIS

Data were presented as mean, standard deviation, frequency and percentage. Continuable variables were compared using the independent sample t-test and the One-way ANOVA test, while Mann-Whitney U test and Kruskal Wallis test was used to compare non-normally distributed continuous data between independent groups. Correlation between continuous and continuous variables were done using Spearman's rho correlation test. Data analysis was performed using IBM-SPSS version 25.0 (IBM-SPSS Science Inc., Chicago, IL).

## RESULTS AND DISCUSSION

The results were given in tables (1-11) and figure (1).

The distribution of respiratory distress severity among neonates based on Silverman's score prior to the initiation of bubble CPAP therapy. According to data 73% of neonate exhibited moderate respiratory distress while 27% had severe respiratory distress at the time of assessment. The distribution of Downes score among neonates with respiratory distress prior to initiation of CPAP. The majority of neonates 68% had Downes score of 5-6, indicates moderate respiratory distress, about 28% had score of >7, reflecting severe distress, while 4% had score of below 4, consistent with mild distress.

Overall, 95% of patients in the study population who received CPAP (Continuous Positive Airway Pressure) therapy survived, and 5% of patients died even with CPAP support. The excellent survival rate indicates that the examined group's respiratory distress was largely managed by CPAP. The clinical usefulness of CPAP as a non-invasive breathing technique with positive results is supported by this research.

CPAP was started for the majority of newborns during the first five hours of their lives, and many of them needed support for 50–150 hours during the course of the therapy. Early commencement appears to be associated with more beneficial results in terms of shorter duration, emphasizing the significance of prompt respiratory intervention in newborns in distress, even though the dotted trend line implies a minor rise in CPAP duration with delayed initiation. The majority of newborns remained in the hospital for four to fourteen days, while there was a wide range of hospital stays reported. Later initiation of CPAP may be weakly associated with longer hospital stays. However, with a P value of 0.626, this correlation is statistically insignificant, indicating that timing of CPAP initiation alone does not significantly impact the total duration of hospital stay. The average age of CPAP initiation among survivors was 4.50 hours, whereas for those who expired, it was significantly higher at 10.18 hours. This indicates that earlier initiation of CPAP is associated with improved survival outcomes, suggesting a potential benefit of early respiratory support in reducing neonatal mortality.

Total hospital stay duration among neonates based on the severity of respiratory distress as measured by the Silverman's Score. Neonates with moderate respiratory distress had an average hospital stay of 7.61 days and those with severe respiratory distress had a longer average hospital stay of 9.29 days. Higher Silverman's scores, reflecting more severe respiratory distress, are associated with prolonged hospital stays, emphasizing the impact of disease severity on healthcare utilization.

Mild respiratory distress was defined as less than 4, moderate respiratory distress as 5-6, and severe respiratory distress as more than 7, according to the DOWNES score categories. The main findings were that the groups with DOWNES scores <4 and 5–6 showed no deaths (0%). Of individuals having a DOWNES score greater than seven, 82.1% lived and 17.9% died. Every survivor was represented in every DOWNES score category; however, lower score groups showed higher survival rates, suggesting better outcomes with less acute initial distress.

The mean maternal age in our study was 26.80 years (SD 3.39), reflecting a relatively young population. This aligns with Sodawat et al. (2018) [6] and Sahoo & Dey (2023) [7], who reported maternal ages below 30 as common, often linked to increased neonatal morbidity. Sodawat et al. (2018) also noted that advanced maternal age (>35 years) may contribute to complications such as preterm birth and respiratory distress due to placental insufficiency [6].

Most neonates (58%) in our study were born at term (>37 weeks), while 5% were born at 28–32 weeks, 17% at 32–34 weeks, and 20% at 34–36 weeks. Consistent with Sodawat et al. (2018) [6], preterm infants, especially <34 weeks, showed the highest risk of respiratory distress. Ali et al. (2019) [8] similarly emphasized the vulnerability of neonates <32 weeks to RDS and TTN due to immature lungs. However, our findings align with Upadhyaya et al. (2024) [9] and Meena et al. (2019) [10], where TTN and MAS were more prevalent in term infants.

Infants with VLBW (<1500g) and ELBW (<1000g) made up 26% and 6% of the cases, respectively. This is similar to the findings of Sahoo & Dey (2023) [7] and Nagendra et al. (1999) [11], who discovered a robust link between respiratory distress and low birth weight. Neonatals who are VLBW or ELBW are especially vulnerable to RDS and BPD, and they frequently need mechanical ventilation. Our results support those of Meena et al. (2019) [10] and Zaman et al. (2013) [12], who found that low birth weight is a significant risk factor for mortality and serious respiratory problems.

In the present study, 68% of neonates were delivered via cesarean section (C-section) and 32% vaginally. Prior studies, including Sodawat et al. (2018) [6] and Werner et al. (2012) [13], consistently report higher risks of respiratory distress, particularly TTN, in C-section deliveries, especially elective ones without labor. Vaginal delivery aids fluid clearance from the lungs, reducing complications. Preterm infants delivered via C-section in our cohort showed more severe distress, aligning with Vosbeek et al. (2021) [14], who noted increased respiratory complications and ventilation needs in preterm and ELBW neonates.

According to Zhu et al. (2014) [15] and Werner et al. (2012) [13], associated hypertension to preterm birth and IUGR, maternal hypertension (41%) was a substantial contribution to respiratory distress. In line with the findings of Gaurav et al. (2023) [16] and Zhu et al. (2014) [15], who observed greater rates of sepsis and pneumonia, premature rupture of membranes (PROM, 20%) raised the risk of infection and respiratory distress. According to Sahoo & Dey (2023) [7], preterm labor (42%) was another significant predictor, and newborns with preterm labor and undeveloped lungs were more likely to have RDS and TTN.

Respiratory distress in our cohort was primarily due to:

- **Sepsis (33%)**: the leading cause, impairing gas exchange and increasing morbidity.
- **TTN (23%)**: common in term infants, resolving within 48–72 hours but requiring monitoring.
- **MAS (12%)**: caused by meconium aspiration, leading to airway obstruction and inflammation.
- **Birth Asphyxia (14%)**: oxygen deprivation during labor, resulting in respiratory failure.
- **HMD/RDS (4%)**: linked to surfactant deficiency in preterm neonates.
- **Aspiration Pneumonia (3%)**, **CHD (9%)**, and **Congenital Pneumonia (2%)** also contributed.

The most prevalent causes were sepsis (33%), TTN (23%), birth asphyxia (14%), and MAS (12%). Sepsis and TTN dominated, highlighting infection and fluid clearance issues as major contributors. TTN was observed in both term and preterm infants, consistent with Sodawat et al. (2018) [6] and Upadhyaya et al. (2024) [9]. MAS, more frequent in term/post-term neonates, matched findings by Zaman et al. (2013) [12] and Gaurav et al. (2023) [16].

Comparison with Existing Literature on Respiratory Distress Causes;

**Sepsis (33%)**: Our findings align with Sodawat et al. (2018) [6], where sepsis was a leading cause of neonatal respiratory distress, particularly in preterm and VLBW infants with immature immunity. Low birth weight neonates (26%) in our study were more prone to sepsis, consistent with Ali et al. (2019) [8].

**Transient Tachypnea of the Newborn (TTN, 23%)**: Slightly higher than the 4–14% range reported by Zhu et al. (2014) [15] and Sodawat et al. (2018) [6], but within expected limits. TTN was observed in both term and preterm infants, consistent with Zaman et al. (2013) [12]. CPAP was the main supportive treatment.

**Meconium Aspiration Syndrome (MAS, 12%)**: Comparable to Nagendra et al. (1999) [12] and Zhu et al. (2014) [15]. MAS is more common in term/post-term infants, often linked to vaginal delivery and meconium-stained fluid. Ventilatory support was frequently required.

**Hyaline Membrane Disease (HMD/RDS, 4%)**: Consistent with Sodawat et al. (2018) [6] and Zaman et al. (2013) [12], where RDS was prevalent in neonates <32 weeks and VLBW infants.

**Birth Asphyxia (14%)**: Matches Ali et al. (2019) [8] and Sodawat et al. (2018) [6], highlighting oxygen deprivation during labor as a major cause of RD.

**Congenital Pneumonia (2%) and Aspiration Pneumonia (3%)**: Findings align with Sodawat et al. (2018) [6] and Gaurav et al. (2023) [16], where pneumonia was a significant contributor, especially in preterm neonates.

Clinical Presentation and Management;

**Signs and Symptoms**: Common features included tachypnea, nasal flaring, grunting, retractions, and cyanosis, consistent with Meena et al. (2019) [10] and Zhu et al. (2014) [15]. Severe cases risked hypoxemia, acidosis, and shock.

**Management Approaches**:

- **CPAP**: Most frequently used effective in TTN, MAS, and HMD. Our study showed a 95% survival rate, comparable to Sodawat et al. (2018) [6] and Ali et al. (2019) [8]. Early initiation (within 4 hours) improved outcomes, consistent with Gaurav et al. (2023) [16].
- **Mechanical Ventilation**: Reserved for severe MAS and HMD when CPAP was insufficient, consistent with Sahoo & Dey (2023) [7]. Associated with higher morbidity and longer hospital stays.
- **Antenatal Steroids**: Administered to 90% of mothers, enhancing fetal lung maturity and reducing RDS incidence. Findings align with Zhu et al. (2014) [15], Meena et al. (2019) [10], and AAP guidelines (2018).

**Efficacy of CPAP and Survival Outcomes:** CPAP demonstrated a 95% survival rate, comparable to 86–96% reported by Sodawat et al. (2018) [6] and Ali et al. (2019) [9]. It was particularly effective for moderate distress (TTN, MAS, HMD), reducing invasive ventilation needs. Early CPAP initiation improved survival, consistent with Sodawat et al. (2018) [6] and Gaurav et al. (2023) [16]. Mechanical ventilation, though necessary in severe cases, was linked to prolonged hospitalization and higher morbidity.

**Survival Rates and Mortality:** Our study reported a survival rate of 95%, with 5% mortality. This aligns with studies using CPAP for moderate respiratory distress, where early intervention improves outcomes. Severe cases requiring mechanical ventilation, particularly MAS and HMD, were linked to higher mortality. Zhu et al. (2014) [10] reported similar mortality rates in preterm neonates requiring ventilation.

**Complications Related to Respiratory Distress:** Complications included gastric distension (5%), pneumothorax (4%), and skin abrasions (13%). These findings are consistent with Sodawat et al. (2018) [6]. Gastric distension, often due to swallowed air during CPAP, required nasogastric decompression. Pneumothorax, though less frequent, resulted from excessive CPAP pressure, necessitating careful monitoring. Skin abrasions, associated with CPAP masks, were mild and managed with skin care and mask adjustments.

**Impact of Early CPAP Initiation:** Early CPAP initiation (<4 hours) significantly improved survival and reduced complications. Neonates who began CPAP early had better outcomes, consistent with Ali et al. (2019) [8] and

Sodawat et al. (2018) [6]. Early CPAP prevented progression of distress, reduced mechanical ventilation needs, and minimized complications such as pneumothorax and recurrent apneas. Gaurav et al. (2023) [16] also emphasized early CPAP in TTN and MAS for improved outcomes.

**Correlation and Statistical Analysis**

**Timing of CPAP and Outcome:** Mean CPAP initiation age was 4.50 hours for survivors versus 10.18 hours for non-survivors, statistically significant ($p < 0.0001$). Early initiation strongly correlated with improved survival, corroborating Sodawat et al. (2018) [6] and Zhu et al. (2014) [15].

**Silverman's Score:** Moderate distress (score 4–6) had a mean CPAP duration of 95.45 hours, while severe distress (>7) had 91.74 hours. The difference was not significant ($p = 0.628$). However, severe distress required mechanical ventilation (mean 1.45 hours), unlike moderate cases (0.00 hours), with significance ($p = 0.019$).

**Downes Score:** CPAP duration varied across scores (<4: 104.08 hours; 5–6: 95.16 hours; >7: 91.34 hours), but differences were not significant ($p = 0.747$). Mechanical ventilation duration was higher in scores >7, though not statistically significant ($p = 0.074$). Hospital stay correlated significantly with both Silverman's ($p = 0.015$) and Downes scores ($p = 0.013$), consistent with Sodawat et al. (2018) [6] and Yeasmin et al. (2023) [17].

## CONCLUSION

In conclusion, our study highlights the critical role of early CPAP initiation in improving survival rates and reducing complications in neonates with respiratory distress. The findings demonstrate that timely respiratory support, especially within the first few hours of life, significantly enhances neonatal outcomes and minimizes the need for mechanical ventilation.

Severe cases of respiratory distress, as indicated by higher Silverman's and Downes scores, require more intensive care and are associated with longer hospital stays and increased morbidity. These results reinforce the importance of early diagnosis, prompt intervention, and ongoing monitoring to optimize the management of neonatal respiratory distress.

## LIMITATIONS

1. Single-center study: Being conducted in a single institution may limit the generalizability of findings to other NICU settings with different protocols.
2. Limited Sample size: The relatively small number (n=100) of enrolled neonates may reduce the statistical power and ability to detect less common complications

## REFERENCES


1. Richardus JH, Graafmans WC, Verloove-Vanhorick SP, Mackenbach JP. The perinatal mortality rate as an indicator of quality of care in international comparisons. Medical care. 1998 Jan 1;36(1):54-66.
2. Kamath BD, MacGuire ER, McClure EM, Goldenberg RL, Jobe AH. Neonatal mortality from respiratory distress syndrome: lessons for low-resource countries. Pediatrics. 2011 Jun 1;127(6):1139-46.
3. Goldsmith JP, Karotkin E, Suresh G, Keszler M. Assisted ventilation of the neonate E- book. Elsevier Health Sciences; 2016 Sep 2.
4. Sharma D, Murki S. Making neonatal intensive care: cost effective. The Journal of Maternal-Fetal& Neonatal Medicine. 2021 Jul 18;34(14):2375-83.
5. Janssens JP, Cantero C, Pasquina P, Georges M, Rabec C. Monitoring long term noninvasive ventilation: benefits, caveats and perspectives. Frontiers in Medicine. 2022 May 19;9:874523.
6. Sodawat R, Garg P, Singh C, Sharma P. Clinico-epidemiological study of respiratory distress in newborn and associated risk factors. Int J ContempPediatr. 2018 Jul;5(4):1576-82.
7. Sahoo M, Dey S, Sahoo S, Das A, Ray A, Nayak S, Subudhi E. MLP (multi-layer perceptron) and RBF (radial basis function) neural network approach for estimating and optimizing 6-gingerol content in Zingiber officinale Rosc. in different agro-climatic conditions. Industrial Crops and Products. 2023 Aug 1;198:116658.
8. Ali K, Kagalwalla S, Cockar I, Williams EE, Tamura K, Dassios T, Greenough A. Prediction of prolonged ventilator dependence in preterm infants. European Journal of Pediatrics. 2019 Jul 1;178:1063-8.
9. Upadhyaya AP, Yadav BK, Tripathee S, Aryal A. A Descriptive Study on the Causes of Respiratory Distress in Neonates at a Tertiary Care Center in Nepal.
10. Meena R, Kobal MR, Dhanwadkar SS, NB AK. A clinical study of respiratory distress in neonates.

11. Nagendra K, Wilson CG, Ravichander B, Singh SP. Incidence and etiology of respiratory distress in newborn. Medical Journal Armed Forces India. 1999 Oct 1;55(4):331-3.
12. Zaman S, Goheer L, Riaz H. Prevalence and etiology of respiratory distress in newborns. Pak Armed Forces Med J. 2013 Mar 1;63(1):22-5.
13. Werner EF, Savitz DA, Janevic TM, Ehsanipoor RM, Thung SF, Funai EF, Lipkind HS. Mode of delivery and neonatal outcomes in preterm, small-for-gestational-age newborns. Obstetrics &Gynecology. 2012 Sep 1;120(3):560-4.
14. Vosbeek EG, Beijers RJ, Maastricht UM, Gerver WJ, Nijhuis JG, Kramer BW. Association Between the Method of Delivery and Respiratory Outcomes in Extremely Preterm and Extremely Low Birth Weight Infants: a Retrospective Cohort Study in Newborns From 2000-2003. J Pediat Infants. 2021 Mar 15;4:56-64.
15. Zhu JJ, Bao YY, Zhang GL, Ma LX, Wu MY. No relationship between mode of delivery and neonatal mortality and neurodevelopment in very low birth weight infants aged two years. World Journal of Pediatrics. 2014 Aug;10:227-31.
16. Gaurav NS, Ahmad ST. The epidemiology of neonatal respiratory distress in a tertiary care neonatal Centre Kashmir India. International Journal of Contemporary Pediatrics. 2023 Jul;10(7):1040.
17. Yeasmin N, Khanam W, Parvin R, Adnan MA, Hossain MI, Mondal MT, Islam R. Risk factors, causes and hospital outcome of respiratory distress among neonates admitted in neonatal intensive care unit of a tertiary hospital. International Journal of Contemporary Pediatrics. 2023 May;10(5):627

## TABLES AND FIGURE

**Table 1: Descriptive Statistics**

| Descriptive Statistics | Mother's Age (years) |
|---|---|
| **Mean** | 26.80 |
| **Standard Deviation** | 3.39 |
| **Minimum** | 19.00 |
| **Median** | 27.00 |
| **Maximum** | 35.00 |

**Table 2: Distribution of Maternal and Neonatal Characteristics in the Study Population**

| | | | |
|---|---|---|---|
| **Prevalence of Intrauterine Growth Restriction (IUGR)** | | | |
| | | No of patients | Percentage |
| IUGR | No | 91 | 91.0% |
| | Yes | 9 | 9.0% |
| **Prevalence of Multiple Pregnancies** | | | |
| | | No of patients | Percentage |
| Multiple Pregnancies | No | 81 | 81.0% |
| | Yes | 19 | 19.0% |
| **Gestational Weeks Distribution** | | | |
| | | No of patients | Percentage |
| Gestation weeks | 28-32 | 5 | 5.0% |
| | 32-34 | 17 | 17.0% |
| | 34-36 | 20 | 20.0% |
| | >37 | 58 | 58.0% |
| **Prevalence of Very Low Birth Weight (VLBW)** | | | |
| | | No of patients | Percentage |
| VLBW (≤1500g) | Yes | 26 | 26.0% |
| | No | 74 | 74.0% |

| Prevalence of Extremely Low Birth Weight (ELBW) | | | |
|---|---|---|---|
| | | No of patients | Percentage |
| ELBW (≤1000g) | Yes | 6 | 6.0% |
| | No | 94 | 94.0% |
| **Prevalence of Maternal Hypertension** | | | |
| | | No of patients | Percentage |
| Maternal Hypertension | No | 59 | 59.0% |
| | Yes | 41 | 41.0% |

**Table 3: Perinatal Clinical Characteristics and Early Neonatal Outcomes**

| Prevalence of Premature Rupture of Membranes (PROM) | | | |
|---|---|---|---|
| | | No of patients | Percentage |
| Premature Rupture of Membranes | No | 80 | 80.0% |
| | Yes | 20 | 20.0% |
| **Prevalence of Preterm Labour** | | | |
| | | No of patients | Percentage |
| Preterm Labour | Yes | 42 | 42.0% |
| | No | 58 | 58.0% |
| **Mode of Delivery Distribution (Caesarean vs. Vaginal)** | | | |
| | | No of patients | Percentage |
| Mode of Delivery (C-Section) | Caesarean | 68 | 68.0% |
| | Vaginal | 32 | 32.0% |
| **Fetal Distress Prevalence** | | | |
| | | No of patients | Percentage |
| Fetal Distress | No | 63 | 63.0% |
| | Yes | 37 | 37.0% |
| **Prevalence of Antenatal Steroid Use** | | | |
| | | No of patients | Percentage |
| Antenatal Steroids | No | 10 | 10.0% |
| | Yes | 90 | 90.0% |
| **Apgar Scores at 1 Minute** | | | |
| | | No of patients | Percentage |
| Apgar 1 min (≤3) | No | 91 | 91.0% |
| | Yes | 9 | 9.0% |
| **Apgar Scores at 5 Minutes** | | | |
| | | No of patients | Percentage |
| Apgar 5 min (≤3) | No | 100 | 100.0% |
| **Use of Bag and Mask at Birth** | | | |
| | | No of patients | Percentage |
| Bag and Mask at Birth | No | 85 | 85.0% |
| | Yes | 15 | 15.0% |

**Table 4: Silverman's Score Before CPAP and Downes Score**

| Silverman's Score Before CPAP | | | |
|---|---|---|---|
| | | No of patients | Percentage |
| Silverman's Score Before CPAP | Moderate respiratory distress | 73 | 73.0% |
| | Severe respiratory distress | 27 | 27.0% |
| **DOWNES SCORE** | | | |
| | | No of patients | Percentage |
| DOWNES SCORE | <4 | 4 | 4.0% |
| | 5-6 | 68 | 68.0% |
| | >7 | 28 | 28.0% |

**Table: 5 Outcome of CPAP and complications**

| Outcome of CPAP | | | |
|---|---|---|---|
| | | No of patients | Percentage |
| Outcome of CPAP | Expired | 5 | 5.0% |
| | Survived | 95 | 95.0% |
| **Complications** | | | |
| | | No of patients | Percentage |
| Complications | Gastric Distension | 5 | 5.0% |
| | No Complication | 73 | 73.0% |
| | Pneumothorax | 4 | 4.0% |
| | Recurrent Apnoea | 1 | 1.0% |
| | Secondary Infection | 4 | 4.0% |
| | Skin Abrasion | 13 | 13.0% |

**Table 6: Association between Timing of CPAP Initiation and Clinical Course**

| Age When CPAP Started (hours) | | |
|---|---|---|
| | | Duration of CPAP (hours) |
| Age When CPAP Started (hours) | Correlation Coefficient | 0.125 |
| | P value | 0.215 |
| **Mechanical Ventilation Duration** | | |
| | | Mechanical Ventilation Duration (hours) |
| Age When CPAP Started (hours) | Correlation Coefficient | 0.051 |
| | P value | 0.616 |
| **Total Hospital Stay Duration** | | |
| | | Total Hospital Stay (days) |
| Age When CPAP Started (hours) | Correlation Coefficient | 0.049 |
| | P value | 0.626 |

**Table 7: Association between Age at CPAP Initiation and Development of Complications**

| Comparison of Age When CPAP Was Started and Outcome of CPAP (Survived vs. Expired) | | | | |
|---|---|---|---|---|
| | | Age When CPAP Started (hours) | | P value |
| | | Mean | Standard Deviation | |
| Outcome of CPAP | Survived | 4.50 | 4.55 | <0.0001 |
| | Expired | 10.18 | 8.86 | |
| **Complications Based on Age When CPAP Started** | | | | |
| | | Age When CPAP Started (hours) | | P value |
| | | Mean | Standard Deviation | |
| Complications | No Complication | 4.35 | 4.06 | <0.0001 |
| | Gastric Distension | 3.30 | 4.87 | |
| | Pneumothorax | 13.23 | 9.56 | |
| | Recurrent Apnoea | 12.00 | | |
| | Secondary Infection | 11.15 | 7.15 | |
| | Skin Abrasion | 2.68 | 3.19 | |

**Table 8: Association of Silverman's Score with CPAP Duration, Mechanical Ventilation Duration, and Length of Hospital Stay**

| Comparison of CPAP Duration and Duration by Silverman's Score | | | | | |
|---|---|---|---|---|---|
| | Silverman's Score Before CPAP | | | | P value |
| | Moderate respiratory distress | | Severe respiratory distress | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | |
| Duration of CPAP (hours) | 95.45 | 33.78 | 91.74 | 34.08 | 0.628 |
| **Comparison of CPAP Duration and Mechanical Ventilation Duration by Silverman's Score** | | | | | |
| | Silverman's Score Before CPAP | | | | P value |
| | Moderate respiratory distress | | Severe respiratory distress | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | |
| Mechanical Ventilation Duration (hours) | 0.00 | 0.00 | 1.45 | 5.36 | 0.019 |
| **Comparison of Total Hospital Stay and Duration by Silverman's Score** | | | | | |
| | Silverman's Score Before CPAP | | | | P value |
| | Moderate respiratory distress | | Severe respiratory distress | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | |
| Total Hospital Stay (days) | 7.61 | 2.89 | 9.29 | 3.39 | 0.015 |

**Table 9: CPAP Outcome and Complication Profile According to Silverman's Score**

| CPAP Outcome by Silverman's Score | | | | | | |
|---|---|---|---|---|---|---|
| | | Silverman's Score Before CPAP | | | | P value |
| | | Moderate respiratory distress | | Severe respiratory distress | | |
| | | Count | Column N % | Count | Column N % | |
| Outcome of CPAP | Expired | 0 | 0.0% | 5 | 18.5% | <0.0001 |
| | Survived | 73 | 100.0% | 22 | 81.5% | |
| **Complications by Silverman's Score** | | | | | | |
| | | Silverman's Score Before CPAP | | | | |

| | | Moderate respiratory distress | | Severe respiratory distress | | P value |
|---|---|---|---|---|---|---|
| | | Count | Column N % | Count | Column N % | |
| Complications | Gastric Distension | 4 | 5.5% | 1 | 3.7% | 0.764 |
| | Pneumothorax | 2 | 2.7% | 2 | 7.4% | |
| | Recurrent Apnoea | 1 | 1.4% | 0 | 0.0% | |
| | Secondary Infection | 3 | 4.1% | 1 | 3.7% | |
| | Skin Abrasion | 11 | 15.1% | 2 | 7.4% | |
| | No Complication | 52 | 71.2% | 21 | 77.8% | |

**Table 10: Association of Downes Score with Respiratory Support Duration, Clinical Outcomes, and Length of Hospital Stay**

| CPAP Duration and Mechanical Ventilation by DOWNES Score | | | | | | | |
|---|---|---|---|---|---|---|---|
| | DOWNES SCORE | | | | | | P value |
| | <4 | | 5-6 | | >7 | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | |
| Duration of CPAP (hours) | 104.08 | 34.85 | 95.16 | 34.22 | 91.34 | 33.26 | 0.747 |
| **Mechanical Ventilation Duration and Outcome by DOWNES Score** | | | | | | | |
| | DOWNES SCORE | | | | | | P value |
| | <4 | | 5-6 | | >7 | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | |
| Mechanical Ventilation Duration (hours) | 0.00 | 0.00 | 0.00 | 0.00 | 1.40 | 5.27 | 0.074 |
| **Total Hospital Stay and Outcome by DOWNES Score** | | | | | | | |
| | DOWNES SCORE | | | | | | P value |
| | <4 | | 5-6 | | >7 | | |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | |
| Total Hospital Stay (days) | 9.00 | 2.81 | 7.45 | 2.84 | 9.43 | 3.37 | 0.013 |

**Table 11: Clinical Outcome and Complication Profile Stratified by Downes Score**

| Outcome of CPAP and Outcome by DOWNES Score | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | DOWNES SCORE | | | | | | P value |
| | | <4 | | 5-6 | | >7 | | |
| | | Count | Column N % | Count | Column N % | Count | Column N % | |
| Outcome of CPAP | Expired | 0 | 0.0% | 0 | 0.0% | 5 | 17.9% | 0.001 |
| | Survived | 4 | 100.0% | 68 | 100.0% | 23 | 82.1% | |

**Complications by DOWNES Score**

| | | DOWNES SCORE | | | | | | P value |
|---|---|---|---|---|---|---|---|---|
| | | <4 | | 5-6 | | >7 | | |
| | | Count | Column N% | Count | Column N% | Count | Column N % | |
| Complications | Gastric Distension | 0 | 0.0% | 4 | 5.9% | 1 | 3.6% | 0.677 |
| | Pneumothorax | 0 | 0.0% | 2 | 2.9% | 2 | 7.1% | |
| | Recurrent Apnoea | 0 | 0.0% | 1 | 1.5% | 0 | 0.0% | |
| | Secondary Infection | 0 | 0.0% | 3 | 4.4% | 1 | 3.6% | |
| | Skin Abrasion | 2 | 50.0% | 9 | 13.2% | 2 | 7.1% | |
| | No Complication | 2 | 50.0% | 49 | 72.1% | 22 | 78.6% | |

**Figure: 1 Cause of Respiratory Distress**