IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 5 Ser.11 (May. 2020), PP 14-19
www.iosrjournals.org

Efficacy of Early Nasal Continuous Positive Airway Pressure in Preterm Neonates with Hyaline Membrane Disease (Neonatal Respiratory Distress Syndrome)

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Abstract: *Mechanical ventilation is the standard treatment for hyaline membrane disease (HMD) and has increased neonatal survival. However this increased survival has come at the expense of increased morbidity in the form of chronic lung disease, longer duration of hospital stay and at the cost of expensive technology. Alternate form of respiratory support is early nasal CPAP. Hence present study aims at managing increasing number of preterm babies with HMD with a non-invasive approach in the form of early nasal CPAP. 45 babies of 28-34 weeks gestational age admitted in Neonatal ICU of Rajendra institute of medical sciences, Ranchi with clinical diagnosis of HMD, requiring respiratory support were treated with early nasal CPAP and studied prospectively from March 2017 to August 2018. Chi-square and other appropriate tests were done. We found a success rate of 80% in babies with HMD, who were managed with early nasal CPAP alone. Remaining 20% needed intubation and higher mode of ventilation. Mild and moderate grade HMD were effectively managed with early nasal CPAP (P<0.05). It was also found to be effective in babies of mothers who have received antenatal steroids (P<0.05). : Prematurity is the commonest predisposing cause for HMD. Early nasal CPAP is safe, inexpensive and effective means of respiratory support in HMD. It is useful in mild and moderate grade disease. It may not be a replacement for assisted ventilation in severe disease.*

Date of Submission: 07-05-2020 Date of Acceptance: 21-05-2020

I. Introduction

Neonatal respiratory distress syndrome (neonatal RDS), previously called hyaline membrane disease, is a developmental disorder of mainly preterm infants. Structural immaturity of the lungs, surfactant deficiency and surfactant dysfunction are main problems of preterm newborns, leading to respiratory distress. Despite of new preventive strategies neonatal RDS is still the leading causes of mortality and morbidity in neonatal intensive care[1].

II. Material And Methods

This hospital based observational study was carried out in patients of Department of Paediatrics and Neonatology at Rajendra Institute Of Medical Sciences, Bariatu, Ranchi, Jharkhand from March 2017 to August 2018 .A total 45 babies of 28-34 weeks gestational age admitted in Neonatal ICU of Rajendra institute of medical sciences, Ranchi with clinical diagnosis of HMD, requiring respiratory support were for in this study.

Study Design: hospital based observational study

Study Location: This was a tertiary care teaching hospital based study done in Department of Paediatrics and Neonatology at Rajendra Institute Of Medical Sciences, Bariatu, Ranchi, Jharkhand

Study Duration:. March 2017 to August 2018

Sample size: 45 patients.

Inclusion criteria:

1. All preterm neonates born in our hospital with gestational age between 28-34 weeks with diagnosed HMD after taking consent from parents/ guardians.

Exclusion criteria:

1. All term neonates
2. Neonates with congenital malformations.
3. Babies born to mothers receiving general anesthesia, phenobarbitone, pethidine and other drugs likely to depress the baby.
4. Preterms born outside our hospital
5. Babies with meconium aspiration syndrome.
6. Babies with birth asphyxia.

Statistical analysis

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL). Student's *t*-test was used to ascertain the significance of differences between mean values of two continuous variables and confirmed by nonparametric Mann-Whitney test. In addition, paired *t*-test was used to determine the difference between baseline and 2 years after regarding biochemistry parameters, and this was confirmed by the Wilcoxon test which wasa nonparametric test that compares two paired groups. Chi-square and Fisher exact tests were performed to test for differences in proportions of categorical variables between two or more groups. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

Total number of deliveries and preterm births (<37 weeks) and incidence of Hyaline Membrane Disease (HMD) in Rajendra institute of medical sciences, Ranchi during the study period i.e., from. March 2017 to August 2018 were determined.

Table-1: Incidence of preterm babies and HMD among total no. of deliveries.

Total number of deliveries	9615
Total number of preterm neonates (<37 weeks)	803
Incidence of preterm neonates	8.35%
Total number of diagnosed HMD cases	230
Incidence of HMD in neonates with gestational age between 28-34 weeks	2.39%

45 babies admitted with clinical diagnosis of HMD requiring respiratory support were treated with early nasal CPAP and studied prospectively from March 2017 to August 2018 . Out of total 45 babies who were managed with nasal CPAP, it proved effective in 36 babies (80%), remaining 09 babies (20%) had to be intubated and required ventilation.

Figure 1- Outcome of nCPAP treatment among study group

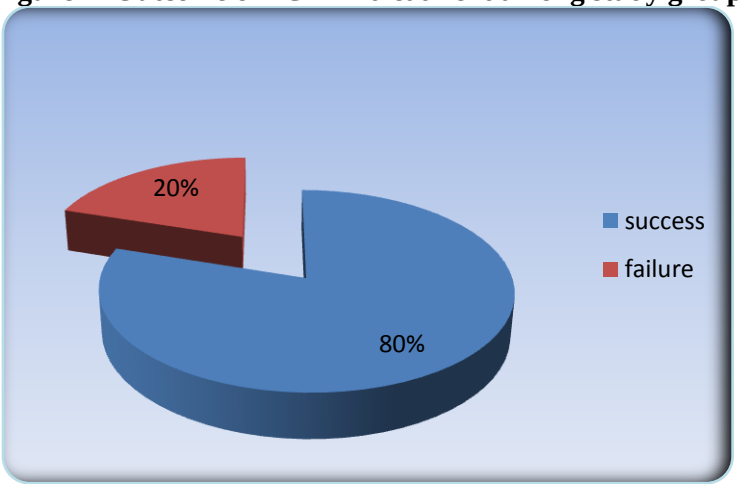
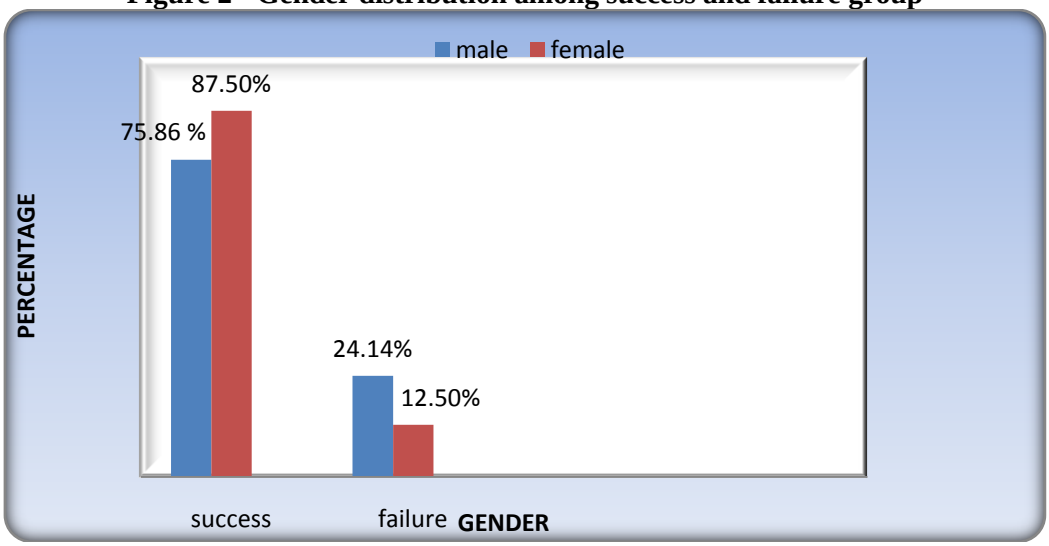
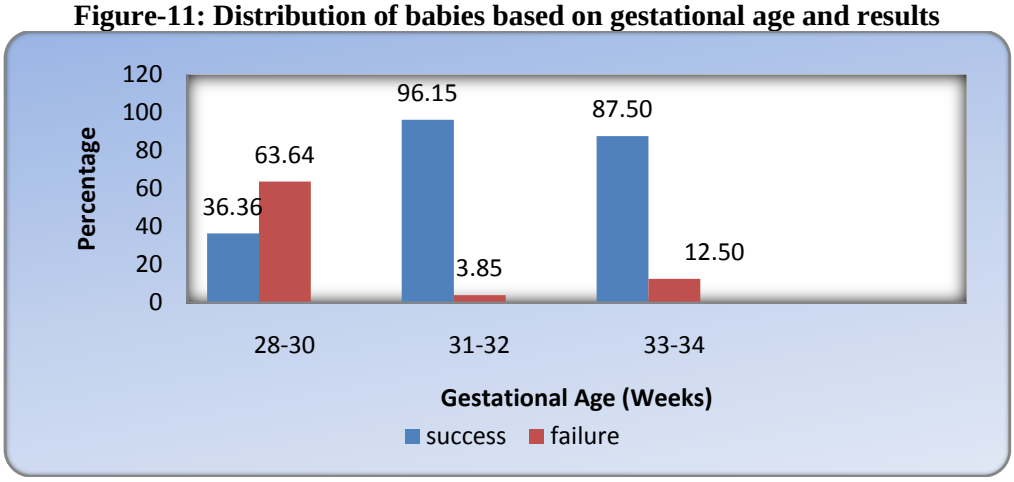


Figure 2 - Gender distribution among success and failure group



Out of 45 babies, 11 belonged to gestation age of 28-30 weeks, 26 babies were in 31-32 weeks gestation and remaining 8 in 33-34 weeks gestational age. In babies who were between 28-30 weeks there is 36.36% success and 63.64% failure rate. Outcome in babies of 31-32 weeks gestation is 96.15% and 3.85% success and failure rates respectively. Among 33-34 weeks, success rate is 87.50% and failure rate is 12.50%. There is statistically significant difference between success and failure groups with respect to gestational age ($p<0.001$). Higher the gestational age more is the success rate.

Figure-11: Distribution of babies based on gestational age and results



In figure4 Out of 45 babies, 4 belonged to <999 g, 32 in 1000-1500 g and remaining 9 were in >1501 g. In babies who were <999 g 50% were managed with early nasal CPAP alone and 50% failed. Outcomes in 1000-1500 g group were 81.25% and 18.75% success and failure rates respectively. In babies >1500 gm success and failure rates were 88.89% and 11.11% respectively ($p>0.05$). Success and failure rates are not significantly different with respect to birth weight**.**

Figure 4- Distribution of birth weight of the babies among success and failure group

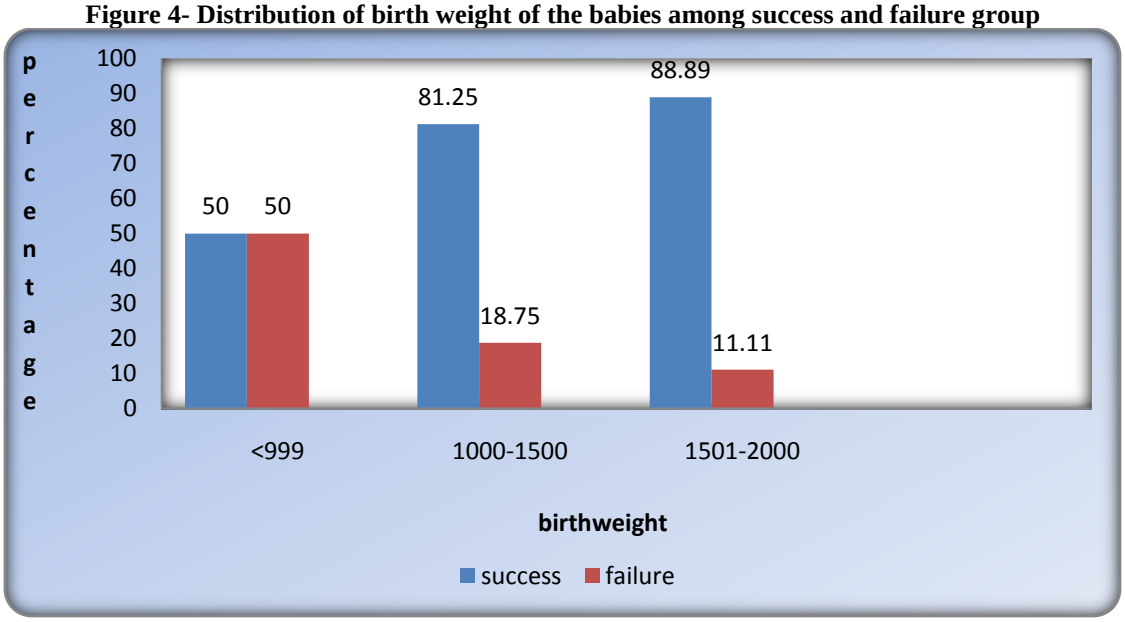


Figure 5- shows in which group of babies based on radiological appearance of early nasal CPAP proved more effective. It is found that in moderate grade HMD, success rate is 92.30% (statistically significant $p<0.005$) and only 7.70% failed. In severe grade HMD 50.00% failed and 50.00% was the success.

Figure 5- Results of early nasal CPAP based on radiological appearance

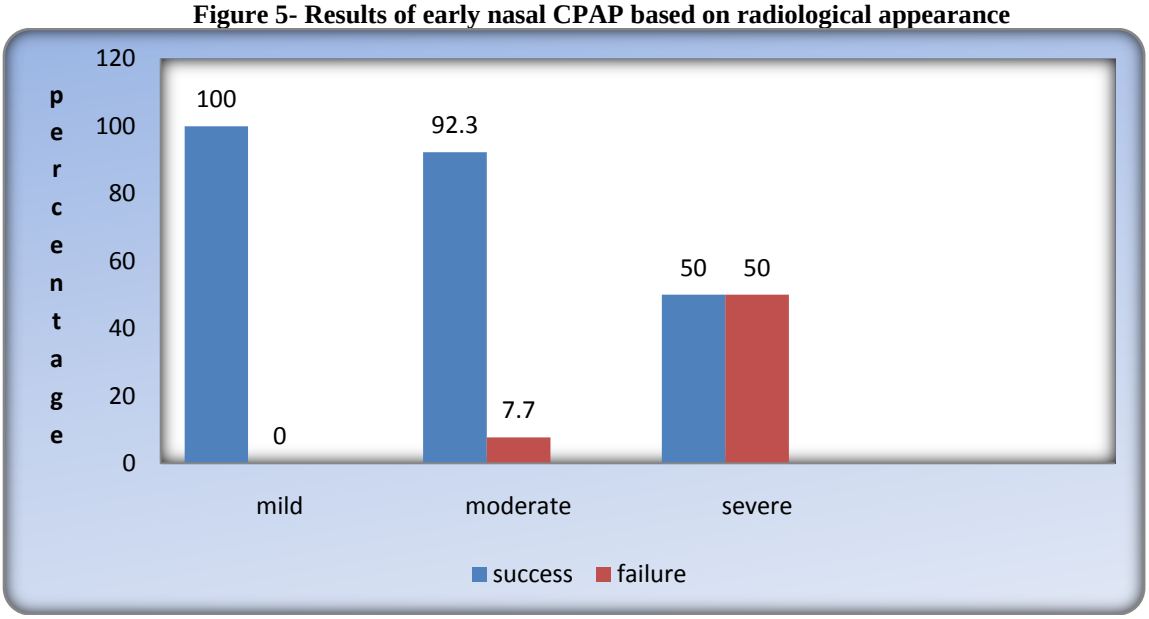
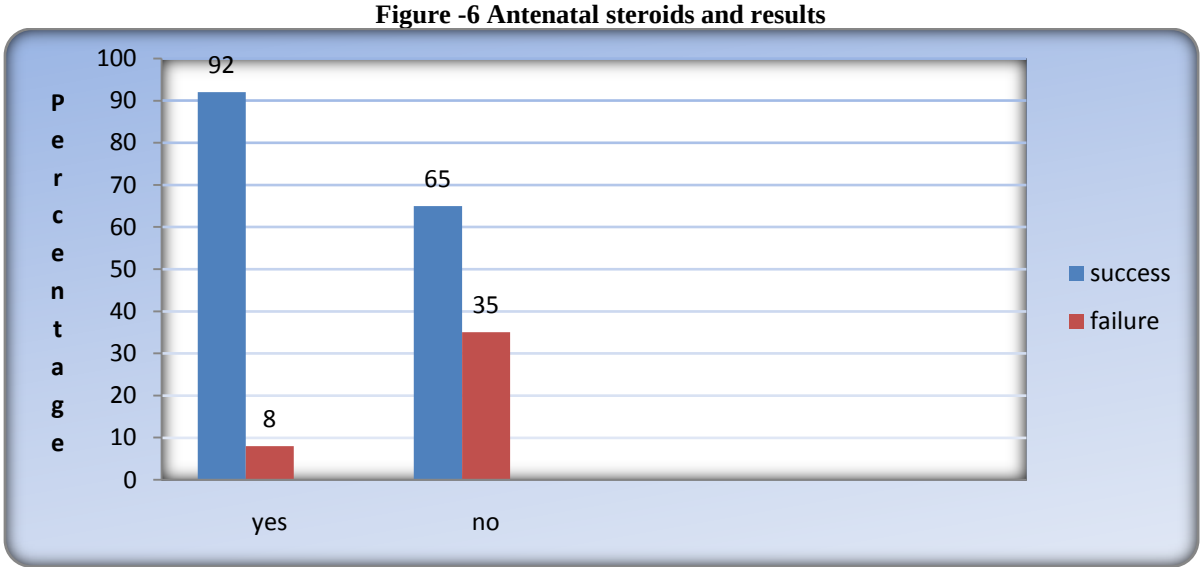


Figure 6 show outcomes in babies who received antenatal steroids. It is found that success rate was 92.00% in babies of mothers who had received antenatal steroids, whereas only 65.00% of the babies improved whose mothers did not receive antenatal steroids (statistically significant $p<0.05$). Hence, antenatal steroids in mother had definite role in better outcome of HMD.

Figure -6 Antenatal steroids and results



IV. Discussion

The incidence of prematurity in our study is 8.35% as compared to WHO data, 19 feb 2018, 12.96% in India[1]. The incidence of HMD in this study is 2.39%.as compared to 6.8-14.1% of preterm livebirths in our country[2]. According to NNPD 2002-03 report[3] involving 151,436 intramural deliveries, the incidence of HMD in our country was 1.3% of all live births.

45 preterm babies with gestational age 28 – 34 weeks with HMD were treated with early nasal CPAP. Out of 45 , 36 babies (80%) were effectively managed with early nasal CPAP alone. Remaining 08 (20%) had to be intubated and required more invasive mechanical ventilation.

Out of 45 babies, 11 belonged to gestational age 28-30 weeks, 26 babies were in 31-32 weeks gestation and remaining 8 in 33-34 weeks gestational age. In babies who were between 28-30 weeks, we found overall success of 36.36%, babies between 31-32 weeks gestation showed 96.15% success rates. Out of 09 babies who required ventilation 88.89% of the babies were less than 32 weeks gestation age; remaining 11.11% were between 33-34 weeks[.Only 2 babies survived on ventilation ,one of VLBW with gestational age of 31 weeks and another of LBW with gestational age of 33 weeks] . Analysis of these results shows that outcome is better with increase in gestational age (statistical significance $p<0.05$).

We looked into effect of birth weight of the babies and overall outcome. Out of 45 babies, 4 belonged to weight of <999 g, 32 in 1000-1500 g and remaining 9 were >1501 g. We found an overall success rate of 50% in babies <999 g, 81.25% in 1000-1500 g and 88.89% in babies >1500 g. Out of 9 babies who failed 88.89% were <1500 g and remaining 11.11% above 1500g.

Nasal CPAP management increased in the surviving infants over time, whereas the need for surfactant treatment decreased

In our study effectiveness of early nasal CPAP was judged based on SA scoring . Out of 14 babies who were in SA score 4, 35.71% improved to score 2 and 42.86% to score 3 after 6 hours. These babies improved further and were weaned off subsequently. Remaining 3 babies (21.43%) who were in SA score 4 worsened to SA score 6 after 6 hours and had to be ventilated. Out of 31 babies who were in score 5 or more before early nasal CPAP, 3.23% improved to score 2, 58.06% to score 3 and 22.58% to score 4 after 6 hours. Remaining 5 babies (16.13%) in this group worsened to score >6 and failed. 2 babies were in score 6 before treatment. All of them improved to score 4 after 6 hours. We found statistically significant improvement ($p<0.005$) in SA score after application of nasal CPAP. SA scoring also helped us to predict which babies would go for ventilation.

Early nasal CPAP is effective in mild and moderate HMD. It may not be a replacement for assisted respiratory support (ventilation) in severe cases of HMD.

Whether antenatal steroid use has any effect on overall outcome of babies treated with CPAP?

We found that 23 (92.00%) of 25 babies whose mothers had received antenatal steroids improved with nasal CPAP, whereas out of 20 babies whose mothers had not received antenatal steroids only 13 (65.00%) improved and 7 (35.00%) failed. Statistical analysis showed $p<0.05$ (significant). Antenatal steroid administration helps us to predict the severity of HMD and need for invasive respiratory support.

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V. Conclusion

- Prematurity is the commonest predisposing factor for HMD. Its incidence increases as gestational age decreases. nasal CPAP is useful in mild and moderate grade HMD. It may not be a replacement for assisted respiratory support (ventilation) in severe HMD.
- Nasal CPAP is found to be effective in babies of mothers who had received antenatal steroids.
- Nasal CPAP is safe, inexpensive and effective means of respiratory support in HMD.

In developing countries like ours, there is high burden of prematurity and sub-optimal use of antenatal steroid administration resulting in frequent HMD. Use of early nasal CPAP which is simple, non-invasive, has low capital outlay and does not require expertise, is the option for us where most places cannot provide invasive ventilation.

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Dr.(Prof.)Rajeeva Mishra, et. al. "Efficacy of Early Nasal Continuous Positive Airway Pressure in Preterm Neonates with Hyaline Membrane Disease (Neonatal Respiratory Distress Syndrome)." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(5), 2020, pp. 14-19.