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USE OF NONINVASIVE POSITIVE PRESSURE VENTILATION AS A PRIMARY MODE OF RESPIRATORY SUPPORT IN NEONATES WITH PRETERM RESPIRATORY DISTRESS SYNDROME

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ABSTRACT

Background: Respiratory distress syndrome (RDS), formerly known as Hyaline Membrane Disease is a disease, typical of preterm neonates caused by insufficient pulmonary surfactant in the lung alveoli. It is characterized by increased work of breathing in the form of tachypnea, chest retraction, and often associated with reduced air entry and cyanosis. The use of NIPPV is well established in many neonatal conditions. NIPPV reportedly improves blood gases, respiratory effort, respiratory rates, tidal volume and ventilatory response to high level of CO2. **Materials And Methodology:** A hospital based cross sectional study was conducted over a period of 1 year from July 2022 to December 2022 in NICU of Jorhat Medical College and Hospital. The Sample size is calculated by taking 95% confidence interval and 5% desired precision and the sample size is 60. All Preterm neonates fulfilling the selection criteria(<34 week gestation) were put under NIPPV with minimal settings, and settings were calibrated based on the severity of respiratory distress which was graded using Downe's scoring system. Additional use of Surfactant and Antenatal steroid and its association with the success of NIPPV was studied. **Results:** Of the 60 patients included in the study, 42 (70%) showed success with NIPPV, with highest success rates between gestational age 30- 34 weeks (82%) and birth weight between 1.5-2kg. (73%). A strong positive correlation with success of NIPPV is seen with use of antenatal steroids, lower Downes score and lesser Fio2 requirement at the start of NIPPV. **Conclusion:** The study highlighted that NIPPV can be used as an effective mode of respiratory support in neonates with preterm Respiratory Distress Syndrome.

INTRODUCTION

Respiratory Distress Syndrome is an important cause of mortality and morbidity in preterm infants. RDS severity ranges widely from the need for low supplemental oxygen only to severe lethal respiratory failure, even with surfactant therapy and mechanical ventilation. Pathophysiology of RDS is explained by a surfactant-deficient lung that is prone to collapse, which results in ventilation perfusion mismatch, severe hypoxemia and lung injury. Invasive ventilation is potentially life saving, but associated with increased pulmonary morbidity- respiratory infection, ventilator induced lung injury, and increased risk of chronic lung disease.

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The use of NIPPV is well established in many neonatal conditions. NIPPV reportedly improves blood gases, respiratory effort, respiratory rates, tidal volume and ventilatory response to high level of CO2. NIPPV is used to aid ventilator weaning and reduces the rate of reintubation. There has been a persistent search for lesser invasive alternatives to support infants with respiratory failure. This is especially relevant in the small preterm infant who is more susceptible to acute complication and chronic sequelae. Nasal continuous positive pressure and most recently nasal intermittent positive pressure ventilation are found to be useful strategies that can be used to support infants with respiratory failure in lieu of invasive mechanical ventilation[1] Recent NNF guidelines 2020 strongly recommends use of NIPPV delivered by a ventilator using synchronized or non synchronized methods as a primary mode of treatment in preterm with risk of RDS[2] and recent IAP guidelines also suggests use of NIPPV with minimal settings as the initial respiratory support of choice in neonates with preterm RDS.[3]

AIMS AND OBJECTIVES-

To assess the outcome of NIPPV in management of Preterm neonates (< 34week) with Respiratory Distress Syndrome

MATERIALS AND METHODOLOGY

The present study was done prospectively during a time period of 6 months(01/07/2022-31/12/2022) in a tertiary care hospital. All the preterm neonates admitted in both the outborn and inborn unit of NICU of Jorhat Medical College and Hospital who fulfill selection criteria were included in the study.

INCLUSION CRITERIA

1. All Preterm Infants<34 weeks gestation with sign of Respiratory Distress.

EXCLUSION CRITERIA

1. Neonates with gestational age >34 weeks.
2. Neonates with congenital malformation like congenital diaphragmatic hernia, airway anomaly, congenital heart disease.

STUDY METHOD

After obtaining written informed consent from parents, relevant information was recorded in predesigned proforma and Downe score used for grading the RDS. Neonates < 34 weeks of gestation with any sign of respiratory distress were included in the study. Downe's score is calculated at the time of application of NIPPV and at 6 and 12 hrs of post NIPPV application and accordingly the settings of the ventilator was calibrated**.** Eligible babies were started on Non Invasive Ventilation with initial settings of; PEEP-5cmH2O, PIP- 15cmH2O, Rate - 30bpm, Ti- 0.35s, Fio2 - 30%

SUCCESS OF NIPPV

NIPPV was considered to be successful if the respiratory distress improved and the baby could be successfully weaned off from NIPPV

THE CRITERIA FOR WEANING:

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 <5 cm of H2O.

NIPPV FAILURE(IAP Guiddelines):

Infants were diagnosed to have failed NIPPV and were started on mechanical ventilation when they:

(a) Remained hypoxic, i.e. SpO2<90% despite FiO2>60%.

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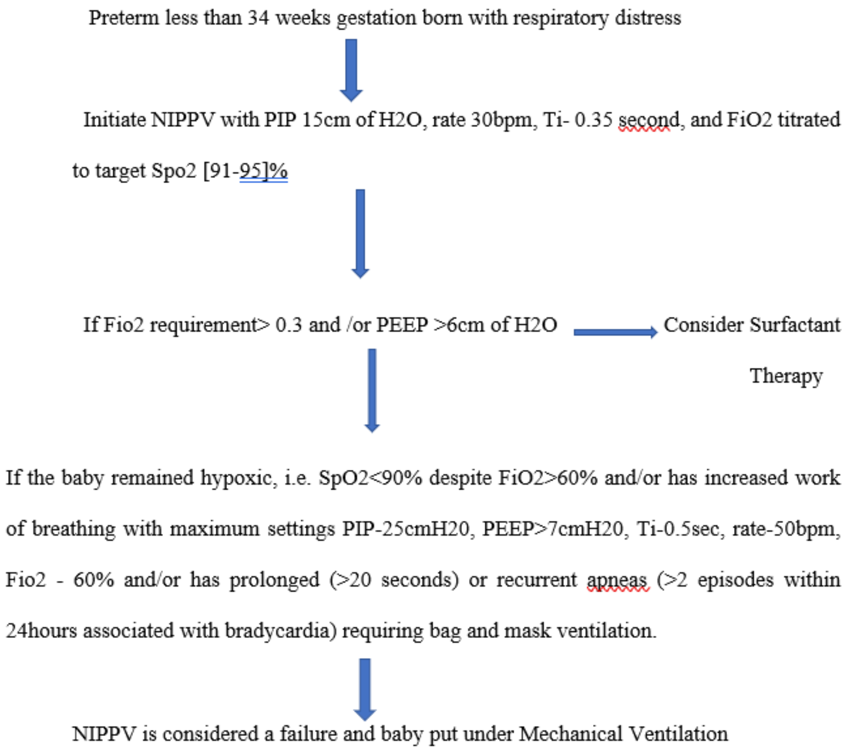
(b) Had increased work of breathing with maximum settings PIP-25cmH20, PEEP>7cmH20, Ti-0.5sec, rate-50bpm, Fio2 - 60%.
(c) Had prolonged (>20 seconds) or recurrent apneas (>2 episodes within 24hours associated with bradycardia) requiring bag and mask ventilation.

SURFACTANT THERAPY
Surfactant therapy is indicated when:
a) Fio2> 30% and/or b) PEEP > 6 cm H20 is required.
Porcine surfactant(Curosurf) was used at a dose of 200mg/kg and administered by INSURE technique.

FLOW CHART FOR MANAGEMENT OF PRETERM RDS IN OUR STUDY



RESULTS

Table 1: DISTRIBUTION ACCORDING TO GENDER (n=60)

Gender	No of Babies	Percentage(%)
Male	26	43.3
Female	34	56.6
Total	60	100

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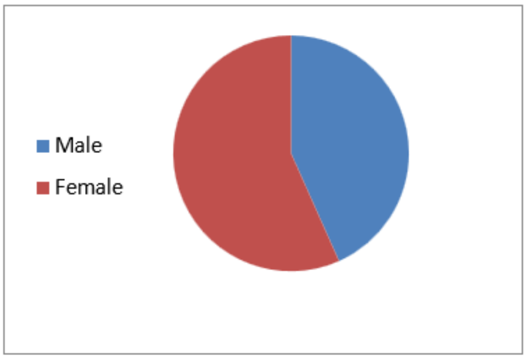

Figure 1: **Distribution According to Gender (n=60)**

TABLE 2: DISTRIBUTION ACCORDING TO GESTATIONAL AGE (n=60)

Gestational age	No of Babies	Percentage(%)
<28weeks	4	6.6
28-30 weeks	10	16.6
30-32 weeks	18	30
32-34 weeks	28	46.6

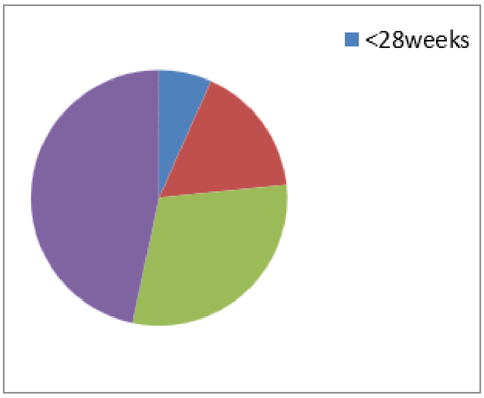

Figure 2: **DISTRIBUTION ACCORDING TO GESTATIONAL AGE(n=60)**

TABLE 3: DISTRIBUTION ACCORDING TO BIRTH WEIGHT(n=60)

Birth weight	No of Babies	Percentage(%)
<1 kg	5	8.3
1-1.5kg	15	25
1.5-2.0kg	23	38.3
>2kg	17	28.3

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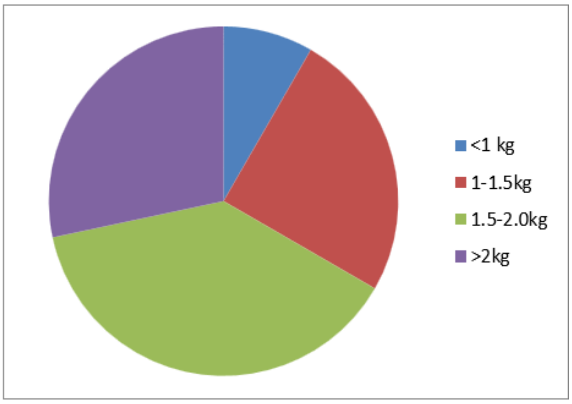

Figure 3: DISTRIBUTION ACCORDING TO BIRTH WEIGHT(n=60)

TABLE 4: DISTRIBUTION ACCORDING TO USE OF ANTENATAL STEROIDS(n=60)

ANS	No of Babies	Percentage(%)
NO	10	16.6
1 DOSE	28	46.6
2 DOSE	6	10
3 DOSE	0	0
4 DOSE	16	26.6

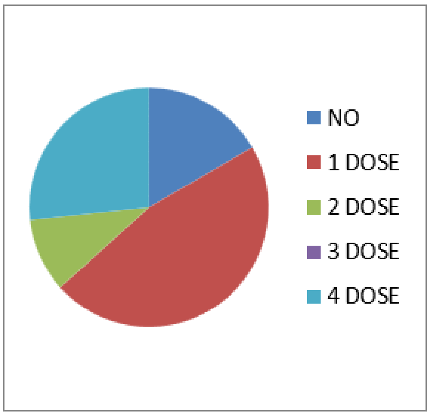

Figure 4: DISTRIBUTION ACCORDING TO USE OF ANTENATAL STEROIDS(n=60)

TABLE 5: DISTRIBUTION ACCORDING TO SURFACTANT USE(n=60)

SURFACTANT USE	No of Babies	Percentage(%)
YES	12	20
NO	48	80

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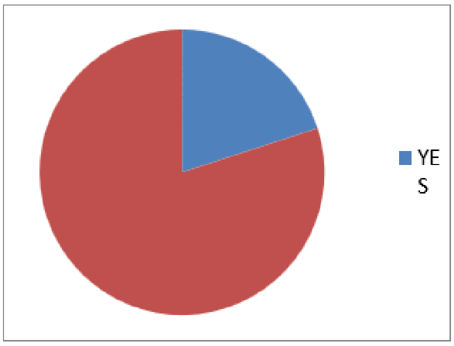

Figure 5: DISTRIBUTION ACCORDING TO SURFACTANT USE(n=60)

TABLE 6: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV

OUTCOME	
SUCCESS	42
FAILURE	18

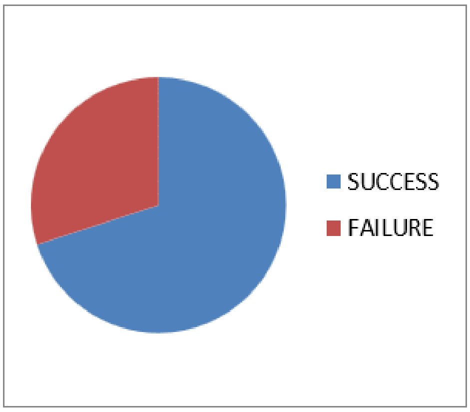

Figure 6: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV

TABLE 7: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV BASED ON BIRTH WEIGHT(n=60)

Birth Weight	**Success**	**Failure**
<1KG	25%	75%
1-1.5KG	63%	37%
1.5-2KG	78%	22%
>2KG	100%	0%
P value	< 0.00001	

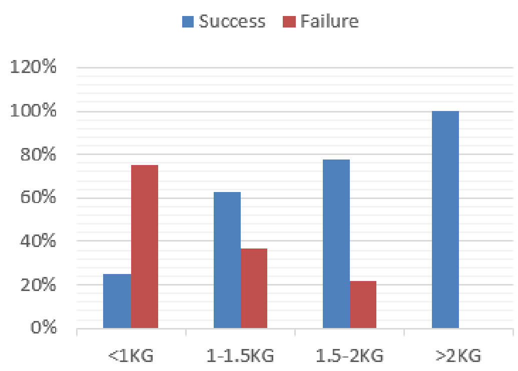

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FIGURE 7: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV BASED ON BIRTH WEIGHT(n=60)

TABLE 8: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV BASED ON GESTATIONAL AGE

Gestational Age	Success	Failure	
<28 weeks	20%	80%	
28-30 weeks	68%	32%	
30-32 weeks	78%	22%	
32-34 weeks	86%	14%	
P value	< 0.0001		

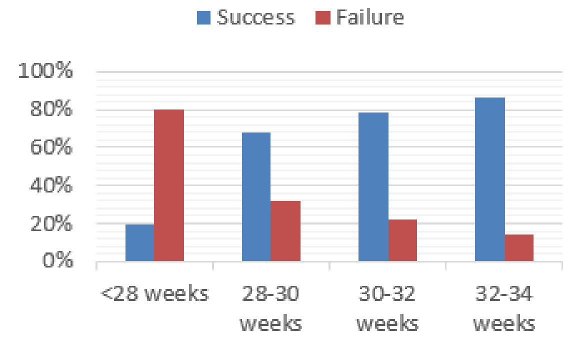

Figure 8: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV BASED ON GESTATIONAL AGE

TABLE 9: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH ANS USE

ANS	Success	Failure	
Not Used	50%	50%	
Used	68%	32%	
P value	<.00968		

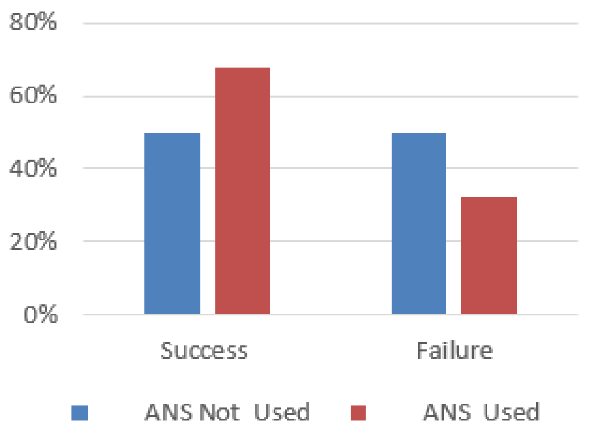

Figure 9: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH ANS USE

TABLE 10: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH SURFACTANT USE

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Use Of Surfactant	**YES**	**NO**	**P VALUE**
Success	60%	68%	
Failure	40%	32%	
P value	.238593.		

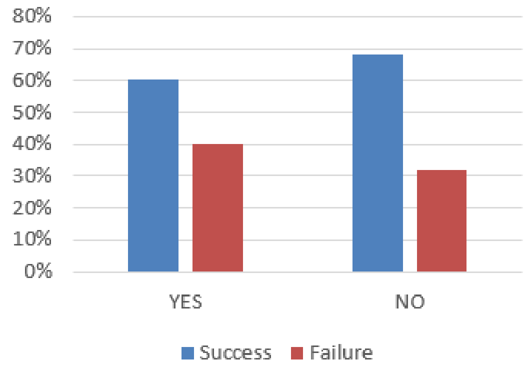

Figure 10: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH SURFACTANT USE

TABLE 11: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH RESPECT TO DOWNE SCORE AT START OF NIPPV

Downe score	**Success**	**Failure**
At the start of NIPPV		
2	100	0
3	100	0
4	78	22
5	59	41
6	34	66
P value	< 0.00001.	

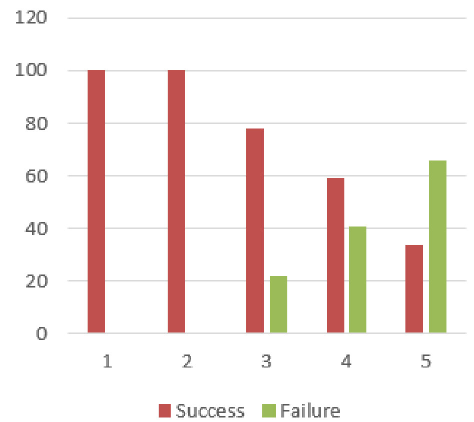

Figure 11-DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH RESPECT TO DOWNE SCORE AT START OF NIPPV

TABLE 12: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH RESPECT TO INITIAL FiO2 REQUIREMENT AT START

FiO2	**<30%**	**30-50%**	**>50%**	**P Value**
Success	88%	61%	23%	

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Failure	12%	39%	77%	

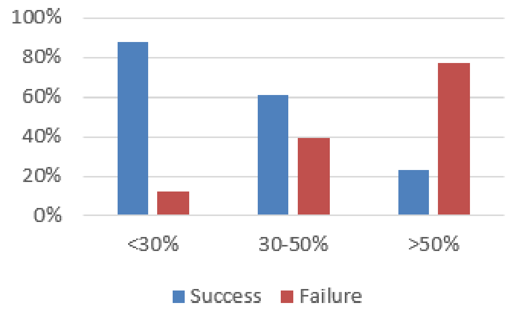

Figure 12: DISTRIBUTION ACCORDING TO OUTCOME OF NIPPV WITH RESPECT TO INITIAL FiO2 REQUIREMENT AT START

DISCUSSION

The study shows a significant success rate in neonates with preterm respiratory distress treated with NIPPV (70%) .The failure rate of 30% in our study is similar to study conducted by *Kirpalani H et al.* during 2007- 2011.[4] Success rate was highest amongst neonates with gestational age 30- 34 weeks (82%) and with birth weight between 1.5- 2kg (73%) thus showing positive association between birth weight and gestational age. In our study the failure rate in neonates with gestational age < 28 weeks is 80% as compared to neonates with gestational age between 30 - 34 weeks where failure rates is 18% which is similar to study conducted by *Fernandez-Gonzalez SM et al.* where failure rate in neonates with gestational age < 28 weeks is 63% and 8.5% in neonates with gestational age > 28 weeks[5]. In our study failure rate is 77% in neonates requiring FiO2 > 50% at the start of NIPPV where as 12% in neonates requiring Fio2 < 30%, thus showing a positive association between FiO2 requirement and success of NIIPPV, which is similar to a study performed by *Roberts et al.* which showed a higher rate of intubation within 72 hrs of neonates requiring higher Fio2 at the beginning of NIIPV.[6] In our study, neonates receiving antenatal steroids(ANS) have a success rate of 68% whereas success rate in neonates not receiving ANS is 50% thus showing a positive association between ANS and NIPPV success. Above finding is similar to study performed by *Badiee z et al.* where success in ANS group is 78.9%.[7]. In this study it is seen that patients with lower Downe's score at presentation had better outcome compared to the patients with higher Downe's score. The failure rate in neonates with Downe's score greater than 5 was 66%. In our study success rate among the neonates receiving surfactant is 60% whereas success rate among the neonates not receiving surfactant is 68%, Thus the use of surfactant and success of NIPPV had no significant association. Aforementioned finding is similar to a study performed by *Sara M. Fernandez-Gonzalez et al.* where the success rate in neonates receiving surfactant is 59% whereas success rate in neonates not receiving surfactant is 71%.[5]

CONCLUSION

This observational prospective study was done to assess the use of NIPPV as a primary mode of ventilation in preterm neonates presenting with respiratory distress syndrome. The outcome was better in preterm neonates receiving antenatal steroid (ANS), with lower Downe's Score and those requiring lower FiO2 at start of NIPPV. The gestational age as well as birth weight has a positive relationship with the success of NIPPV. Based on the result of the present study, it can be concluded that NIPPV is an effective mode of respiratory support in preterm neonates with respiratory distress syndrome.

LIMITATIONS OF STUDY

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- This study is an observational study. Comparative study of NIPPV with other non invasive mode of ventilation is required to compare the effectiveness of NIPPV.
- This study was performed with limited sample size, time and resources.

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