Original Research Article

Nasal intermittent positive pressure ventilation versus nasal continuous positive airway pressure for preterm infants with respiratory distress syndrome

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Abstract

Objective: Primary- To determine among the preterm infants with RDS, whether the use of early Nasal intermittent positive pressure ventilation (NIPPV) versus early Continuous positive pressure ventilation (CPAP) reduces the need for invasive ventilation within first 72 hours. Secondary -To compare the duration of primary non invasive ventilation on respective modes, total duration of oxygentherapy, complication rates of feed intolerance, necrotizing enterocolitis, Intraventricular hemorrhages, nasal trauma, time taken to achieve full feeds and duration of hospital stay. **Methods:** This is a comparative randomized controlled study, held at inborn NICU, Cheluvamba Hospital, attached to MMC and RI, Mysuru between May and June 2018. Neonates (30-36 weeks gestational age) having RDS within 6 hours of birth were allocated to either CPAP or NIPPV mode. **Results:** A total of 50 neonates were enrolled in the study (27 to early CPAP and 23 to early NIPPV mode). Failure rate and need for mechanical ventilation within 72 hours was though less in early NIPPV mode, but not statistically significant. (14.4% of NIPPV versus 29.6% of CPAP respectively, p=0.313). The duration of NIPPV/CPAP and incidence of nasal trauma on respective mode was significantly less for NIPPV than CPAP. (Duration- 19.90 hrs versus 32.10 hrs respectively, p=0.000. nasal trauma- 0.0% versus 22.2% respectively, p=0.016). The duration of hospital stay was significantly longer for neonates on CPAP mode. **Conclusion:** Among preterm infants with RDS with moderate respiratory distress, early use of NIPPV does not decrease the need of mechanical ventilation but reduces the duration of early respiratory support, incidence of nasal trauma and duration of hospital stay as compared to CPAP.

Key Word: Respiratory distress syndrome, CPAP, NIPPV, preterm neonate.

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INTRODUCTION

RDS is the most common respiratory morbidity in preterm infants[1]. There has been increasing interest in the use of non invasive ventilation for preterm infants, aiming to reduce invasive mechanical ventilation and associated complications such as subglottic stenosis, pneumonia, broncho pulmonary dysplasia[2]. NIPPV and NCPAP are the ways of supporting babies' breathing in a less invasive way. The tubes are shorter and go only to the back of nose and therefore cause less damage to the lungs. NIPPV has widely used in NICU as a mode of non invasive ventilation. It works by recruiting alveoli, decreasing work of breathing, improving stability of chest wall and less asynchrony of thoraco abdominal movement has been shown with application of NIPPV in newborn infants[3]. The other non invasive ventilation mode, NCPAP provides steady pressure to the back of nose that is transmitted to the lungs, helping baby breathe

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comfortably. Many studies[4] show NIPPV is more effective than CPAP in preventing post extubation failure. Literature comparing early use of NIPPV with CPAP as primary modes of respiratory support is sparse[5]. Hence as it is necessary to evaluate the effectiveness of NIPPV compared to NCPAP as primary mode of treatment in preterm babies with RDS, we hypothesized that early NIPPV in preterm babies with RDS may reduce chances of intubation in comparison to early NCPAP.

PATIENTS AND METHODS

This is a comparative randomized control study which was conducted in inborn NICU, Cheluvamba Hospital, attached to MMC and RI, Mysuru between May and June 2018. All preterm babies between 30-36 weeks gestational age with RDS who met inclusion criteria were included in the study.

Inclusion criteria:

1. Neonates between 30- 36 weeks of gestation.
2. With moderate respiratory distress defined by Silverman Anderson score(4-6).
3. Within 6 hours of life. Respiratory distress defined as tachypnea(respiratory rate> 60/min), chest retractions, grunting.(any of the 2 features)

Exclusion criteria:

1. Infants with 5 min Apgar score<5
2. Infants with major congenital malformations
3. Cleft lip or palate
4. Symptomatic PDA
5. Sepsis
6. Intraventricularhemorrhage
7. Antenatally diagnosed congenital heart disease.
8. Consent not provided or refused
9. Cardiovascular instability or intubation at admission to the NICU

METHODOLOGY

RDS is diagnosed based on the (i) clinical findings (ii) chest Xray read by 2 paediatricians blinded by the cases. Surfactant administration prophylactically was not considered. A total of 50 preterm babies were considered in the study based on the eligibility criteria. Institutional ethical committee clearance for the study was obtained. Written informed consent was obtained from parents. Neonates were enrolled to either NCPAP or NIPPV based on simple random sampling, if NIPPV was unavailable, baby was allocated to CPAP. Based on this 23 subjects enrolled to NIPPV and 27 were enrolled to NCPAP. So two cases were allocated to CPAP due to unavailability of NIPPV. Non synchronised NIPPV mode delivered via Bellavista 1000 ventilator (imtmedicalag. Gewerbestrassse8. 9470 Buchs. Switzerland), using short nasal prongs. NIPPV was initiated at a PIP of 15-16cm of water, PEEP of 5cm of water, inspiratory time(Ti) 0.3-0.35sec,rate of 30-40/min and flow: 6-7L/min. NCPAP was delivered by bubble CPAP(FANEM medical devices India) with HUDSON'S prongs as interface. CPAP was initiated at PEEP of 5cm H2O, flow rate of 6L/min. FiO2 in both modes was adjusted to keep oxygen saturation by pulse oximetry between 91-94% (SUPPORT and BOOST II trial recommendations).

Criteria for weaning

- Reduction in respiratory distress (SAS score<3) with hemodynamically stable status.
- SpO2>90%
- PEEP of 4 cm of H2O
  Stepwise reduction of FiO2 by 5% was done and when SAS score was<3, subjects were weaned to nasal prongs at 1.5-2L/min O2.

The orogastric tube was inserted and kept open to decompress the stomach. Vital parameters like heart rate, respiratory rate, and SpO2 were continuously monitored.ABG could not be regularly monirored due to limited resource. Abdominal girth was measured twice a day. Neurosonogram was performed within 3 days of birth, at the end of 1 week and during discharge.

OUTCOME MEASURES

Subjects were monitored for primary outcome i.e, failure of CPAP/NIPPV within 72 hours of life. Failure of CPAP is defined as (i) hypoxia with SpO_2< 88% despite FiO_2 >60% (ii)PEEP> 6cm of H_2O, (iii) SAS score > 6 despite maximum settings (iv) recurrent apnea (> 3 episodes within 24 hours) or any episode of apnea requiring bag and mask ventilation. Failure of NIPPV is also defined by the above criteria in addition, PIP >26.

Subjects were monitored for following secondary outcomes:

- Duration on respective primary respiratory support
- Total duration of oxygentherapy
- Feed intolerance(prefeed aspirate >50%, abdominal girth>2cm and abnormal abdominal Xray, any of the 2)
- Time to reach full feeds
- Necrotising enterocolitis
- Intra ventricular haemorrhages.
- Septicemia
- Nasal trauma
- Duration of hospital stay.

Statistical Analysis: The data was analysed by frequency, percentage, mean, standard deviation, chi square t test independent samples.

RESULTS

A total of 50 neonates were evaluated, of which 23 were allocated to early NIPPV and 27 were allocated to early NCPAP. Differences in baseline characteristics were not statistically significant (table 1).

Table 1

	NIPPV(n=23)	CPAP(n=27)
Gestational age(weeks)	33.6	32.3
Birth weight(grams)	1630	1490
Sex (male %)	11(47.8%)	17(63%)
Sex(female %)	12(52.2%)	10(37%)
Silverman Anderson score	4.7	5.1

Though the failure rate and need for mechanical ventilation within 72 hours was less in early NIPPV group compared to early NCPAP group(table 2) but was not statistically significant(p=0.313). Our study did not prove early NIPPV is better than early CPAP in preterm neonates with RDS. The duration of NIPPV/CPAP and incidence of nasal trauma on respective mode was significantly less for NIPPV than CPAP (table 2, Duration- 19.90 hrs versus 32.10 hrs respectively, p=0.000. nasal trauma- 0.0% versus 22.2% respectively, p=0.016)

Table 2: Primary and secondary outcomes in two study groups

	NIPPV (n=23)	CPAP(n=27)	P value
Failure in first 72 hr	4(17.4%)	8(29.6%)	0.313
Duration of primary support(hrs)	20	32	0.000
Duration of O2 therapy (hrs)	57	74	0.089
Feed intolerance	11(47.8%)	11(40.7%)	0.406
Time to reach full feeds(days)	5	7	0.08
NEC	5(21.7%)	2(7.4%)	0.145
IVH> grade 2)	1(4.3%)	1(3.7%)	0.908
Sepsis	6(26.1%)	11(40.7%)	0.276
Nasal trauma	0(0%)	6(22.2%)	0.016
Duration of hospital stay(days)	12	16	0.021

DISCUSSION

In this study early NIPPV and CPAP are comparable in decreasing need for intubation and mechanical ventilation in preterm neonates of 30-36 weeks gestation with RDS. Though babies on NIPPV mode has less failure rates but was not statistically significant, hence in our study NIPPV was not superior to CPAP in decreasing chances of mechanical ventilation. Study by Sai Kishore *et al*[2].showed less failure rates with NIPPV as compared to CPAP in preterm neonates of 28-34 weeks gestation. The duration on primary non invasiveventilation (mean duration: NIPPV-20hrs, CPAP-32 hrs, p=0.000) and duration of hospital stay(mean duration NIPPV- 12 days, CPAP- 16 days, p=0.021) was significantly less in NIPPV group than CPAP group in our study. Study by Sunil Kishore *et al*[2].showed no significant difference in both group in aspects of duration of primary respiratory support and duration of hospital stay. Our results showed effect of early NIPPV was modified by gestational age. In our study neonates less than 30 weeks were not involved. The mean gestational age in our study is high (NIPPV-33.6 Weeks, CPAP-32.3 weeks), where as the other two studies[3,5] have comparable gestational age. Primary outcome was evaluated by 72 hours as need for intubation beyond 48-72 hours is unrelated to RDS. In our study we have used non synchronised NIPPV. Previous studies have used both synchronized[5,6,7] and non synchronized[2,8] NIPPV. The initial and maximum settings that we used in both CPAP and NIPPV were comparable to the previous studies[2,5]. In this study the incidence of nasal trauma was low in NIPPV group than babies on CPAP. All 6 documented cases belonging to CPAP group had grade I[9] nasal injury. In study by Sunil Kishore *et al*. local upper airway injury was comparable in both the groups. We did not document any BPD cases in our study. Kugelman *et al*. reported less incidence of BPD with NIPPV (2%) compared to CPAP (17%) (p=0.03) whereas study by Sunil Kishore *et al*. showed no significant difference in 2 groups.

Limitations of our study

- Gestational age less than 30 weeks was not included
- Small sample size
- Shorter duration of study
- Randomization bias exists in 2 cases due to non availability of NIPPV and were put to CPAP
- As the interventions could not be masked to the treating team, chances of performance and measurement bias exists. Efforts were taken to minimize this by defining ‘failure criteria’.

CONCLUSION

We conclude that among preterm neonates with moderate respiratory distress within 6 hours of life, in those who do not require surfactant, early NIPPV and early NCPAP are comparable in reducing the need for intubation and mechanical ventilation. Early NIPPV is associated with lesser duration of primary respiratory support, less incidence of nasal trauma and short duration of hospital stay. So we recommend early NIPPV in neonates of 30-36 weeks gestation and who do not require surfactant.

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