ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 15, Issue, 05, pp.24796-24798, May, 2023
DOI: https://doi.org/10.24941/ijcr.45479.05.2023

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

A STUDY ON COMPARISON OF NASAL CPAP VS NIPPV IN PRETERM WITH RESPIRATORY DISTRESS SYNDROME AS POST EXTUBATION SUPPORT

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ARTICLE INFO

Article History:
Received 05th February, 2023
Received in revised form
14th March, 2023
Accepted 29th April, 2023
Published online 30th May, 2023

Key words:

NIPPV: Nasal Intermittent Positive pressure ventilation, NCPAP: Nasal Continuous Positive Pressure Ventilation.

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ABSTRACT

Objective: Nasal continuous positive airway pressure (NCPAP) is a useful method of respiratory support after extubation. However, some infants fail despite CPAP use and require reintubation. Recent evidence shows that synchronized nasal intermittent positive pressure ventilation (NIPPV) may decrease extubation failure in preterm infants. Our aim was to evaluate whether NIPPV decreases extubation failure compared with CPAP in preterm with respiratory distress syndrome (RDS) post extubation. ***Methods:*** Infants who were less than 37 weeks gestation ageor less than 1.8kg and who were mechanically ventilated for RDS in the first 7 days were extubated to either NIPPV or NCPAP afterextubation. The criteria for extubation were peak inspiratory pressure of ≤16 cm H_2O, positive end expiratory pressure of ≤5 cm H_2O, intermittent mandatory ventilation rate of 15 to 25, and fraction of inspired oxygen ≤0.30.Primary outcome was extubation failure and need for reintubation. Secondary outcomes included mean duration of non-invasive ventilation and mechanical ventilation after extubation, duration of hospital stay and mortality. ***Results:*** Seventeen (31.4%) of 54 infants required reintubation with the use of NIPPV versus 20(36.3%) of 55infants,with the use of CPAP (*P*=0.54). Themean duration of mechanical ventilation in NIPPV group was 1.63 days which was less than mean duration of mechanical ventilation of 1.96 days in CPAP group but the difference was not statistically significant (p=0.147). Similarly mean duration of non-invasive ventilation in NIPPV group was 3.01 days which was less than mean duration of non-invasive ventilation of 3.01 days in CPAP group but the difference was not statistically significant (p=0.081) . Six (11.1%) out of 54 patients in NIPPV died compared to 8 (14.54%) patients in CPAP group (p=0.58). There was no significant difference in duration of hospital stay (14.19 days in NIPPV group vs 14.96 days in CPAP group ; p=0.58). ***Conclusions:*** NIPPV did not decrease the rates of extubation failure after mechanical ventilation in preterm babies with RDS compared with NCPAP.

Citation: ***Dr. Pooja Yadav, Dr. Vivek Arora and Dr. Shivani Sharma.*** **2023.** "A study on comparison of nasal CPAP vs NIPPV in preterm with respiratory distress syndrome as post extubation support*". International Journal of Current Research*, 15, (05), .24796-24798.

INTRODUCTION

Respiratory distress syndrome (RDS) is seen mainly in preterm infants (1). The pathophysiology is primarily related to surfactant deficiency (2). Invasive mechanical ventilation use leads to adverse outcomes such as bronchopulmonary dysplasia (BPD) and neurodevelopment impairment (3,4). There a general consensus was developed to use methods to reduce it use which has lead to wide spread use of Non-invasive respiratory support in neonatal intensive care unit all over the world (4). Continuous positive airway pressure (CPAP) is useful in the management of preterm infants with respiratory distress syndrome (RDS) and apnea (5,6) and has been successfully used after extubation in RDS infants (7, 8). Nasal CPAP delivers constant distending pressure.

Use of CPAP has traditionally been with positive end-expiratory pressure (PEEP) levels between 5 and 8 cm H2O (8a, 8b). However, extubation failure is common following NCPAP use and can range from 25-50% (8,9). On contrary pressures and settings utilized with NIPPV use are highly variable [9a, 9b], but typically result in mean airway pressures that are higher than traditional CPAP levels. NIPPV is often used as a rescue form of non-invasive support when traditional CPAP is unable to support oxygenation and/or ventilation requirements. Studies have shown that Nasal Intermittent Positive Pressure Ventilation (NIPPV) may decrease these extubation failure and need for reintubation in these preterm infants recovering from RDS (10,11,12). Many studies have also shown that NIPPV may reduce the need for apnea and atelectasis (12). But according to a meta-analysis, the overall effect on decreasing extubation failure and need for reintubation is not significantly better compared to CPAP

(13). But since most of the studies have involved a small number of patients with different equipments and strategies it is difficult to reach firm conclusions thus limiting the strength of evidence (13). The main drawback of neonatal NIPPV is the lack of synchronization, which is difficult to achieve and is often unavailable. Nonetheless NIPPV is being used world wide in preterm infants without clear evidence of its benefit and possible adverse effects (14). The objective of this study was to compare whether NIPPV decreases extubation failure and need for reintubation compared to CPAP in ventilated preterm infants with RDS.

MATERIALS AND METHODS

Participants: Preterm infants who were diagnosed as RDS as per European Criteria in NICU in our institute , received surfactant therapy(SAS>3 and fio2 requirement >30 % on CPAP) and required mechanical ventilation with first 7 days were recruited for our study. The data were collected over a period of 16 months from July 2021 to December 2022.The exclusion criteria included those had congenital heart disease, Intraventricular hemorrhage , congenital malformations or parents did not give consent .At the end of the study 109 neonates were analyzed.

Ethics Approval: The study was approved by the Institutional Ethical Committee, and informed consent was obtained from all the parents of the participants.

Study procedure: All the parents of patients fulfilling the inclusion criteria were informed about the methodology of this study. Informed and written consent was taken in English, Hindi/local language as per patient convenience. In Preterm babies with RDS according to gestational age and birth weight criteria according to study ,silverman Anderson scoring was done on admission, if score>3 ,baby was initially put on CPAP .If on CPAP , fio2 requirement is more than 30 percent , surfactant was given either through LISA or INSURE. In INSURE Babies are extubated within 1 hr to either NIPPV or NCPAP group divided non randomily subject to availability of the device. In LISA group if baby undergone CPAP failure (fio2 requirement>60%and PEEP>6) within first 7 days and required mechanical ventilation , extubated to either NIPPV or NCPAP group. NCPAP was set at 5–6 cm H2O in the CPAP group using a gas flow of 5L/min. In theNIPPV group, the following parameters were set: a PIP of 12–15 cm H2O (for infants <1,000 g) and 14–18 cm H2O (for infants of 1,000–1,500 g), PEEP of 5–6 cm H2O, air flow of 5-6 L/min, peak pressure duration time of 0.35–0.4s and ventilator rate of 20-30 breaths/min. These parameters were adjusted according to careful clinical evaluation in order to obtain good chest excursion and to maintain oxygen saturation between 88 and 94%. Clinical data including the use of pre- and postnatal steroids, surfactant, blood gases, oxygen saturation and respiratory support were collected. Total duration of mechanical ventilation and oxygen supplementation were documented from birth until discharge or death. All infants were followed until they were discharge or death.

STATISTICAL ANALYSIS

A p-value <0.05 was considered significant. Data analysis was performed using SPSS statistical software version 23.0 (IBM SPSS Statistics). The primary outcome was defined as the need for reintubation afterextubation, according to the presence of at least 1 of 3 failure criteria: (1) hypercapnia in 2 consecutive blood gases with PaCO2 >65 mm Hg and pH <7.25; (2) the requirement for FiO2 >0.60 in order to obtain oxygen saturation ≥88%; (3) repeated episodes of significant apnea (2 or more episodes apnea per hour associated with bradycardia (<100 × min) or desaturation <80% in a 4-h period); (4) presence of 2 or more severe apnea and bradycardia episodes that required bag and mask ventilation for recovery. Secondary outcome variable included : The mean duration of non invasive ventilation after extubation, the mean duration of mechanical ventilation if required reintubation and the mean duration of hospital stay and mortality.

RESULTS

A total of 109 preterm infants born with birth weight less than 1.8kg and less than 37weeks of gestational age admitted within 24hours in our NICU during the study period, received surfactant therapy (by either LISA or INSRURE technique), kept on mechanical ventilation and extubated after fulfilling the criteria were included in the study.Outof these, 54 were extubated to NCPAP group and 55 were extubated to NIPPV group. All the infants were followed till discharge or death. Baseline characteristics were comparable in both the groups and are depicted in Table 1.

Table 1. Comparison of baseline characteristics of the two groups

Characteristics	NIPPV (*n* = 54)	NCPAP (*n* = 55)	*p*-value
Gender			
Male, (*n)*	34	31	0.483
Female, (*n*)	20	24	0.241
Birth weight, kg, mean	1.389	1.305	0.246
Birth weight group			
ELBW (<1000 g)(n)	2	6	0.07
VLBW (1000–1400 g) (n)	28	27	0.385
LBW (1401–1800 g) (n)	24	22	0.319
Gestational age (weeks), mean	32.33	31.47	0.103
Gestational age group			
≤30wks	16	22	0.127
31–34weeks, (*n*)	28	28	0.46
35–37 weeks, (*n*)	10	5	0.07
Mode of delivery			
Vaginal, (*n*)	37	40	0.315
Antenatal steroids			
Received	16	22	0.127

Table 2. Respiratory Outcome parameters of infants with RDS after extubation

Parameters	NIPPV (*n*=54)	NCPAP (*n*=55)	*p*-value
Extubation failure	17	20	0.54
Mean Duration of Non-Invasive Ventilation (days)	1.63	1.96	**0.147**
Mean Duration of MV(days)	3.01	3.39	0.08
Mean duration of Hospital stay (days)	14.19	14.96	0.48
Death (n)	6	8	0.58

Primary and secondary outcomes are shown in Table 2. With respect to primary outcome we found that 17 babies of out 54 in NIPPV group (31.4%) had extubation failure and need for reintubation which was less than 20 out of 55 babies in CPAP group (36.6%) but the difference was not significant (p=0.54). With respect to secondary outcomes the mean duration of mechanical ventilation in NIPPV group was 1.63 days was less than 1.96 in CPAP group but it was insignificant (p=0.147). Similarly there was no significant difference in mean duration of noninvasive ventilation between either groups (3.01 days in NIPPV vs 3.39 days in NCAP group ; p= 0.08) or duration of hospital stay (14.19 days in NIPPV vs 14.96 days in NCAP group ; p= 0.48). Although the mortality in NIPPV group (6patients:11.1%) was less than that of CPAP group (8 patient:14.45%) but again the difference was statistically insignificant (p=0.58).

DISCUSSION

In our study out of 54 patients in NIPPV, 46 patients were discharged successfully and 6 patients died during hospital stay and 2 patients took discharge against medical advice and out of 55 patients in CPAP group , 43 patients were discharged successfully, 8 patients died during hospital stay and 4 patients took patients took discharge against medical advice. Thus, although the findings in our study shows lesser extubationfailure, lesser duration on MV, lesser duration on NIV requirement and hospital stay with similar mortality of NIPPV compared to CPAP.

However ,the results were not statistically significant. The findings of our study is similar to study conducted by Estay et al(15) who found in their study that the extubation failure was 32.4% for NCPAP vs 32.1% for NS-NIPPV(p=0.08). This is different froma study conducted by Barrington et al(16)who found that NIPPV is better than nCPAP in terms of decreasing mortality following extubation in preterm neonates.

CONCLUSION

The reason for above findings in our study could be that ,most of the trials have used synchronized NIPPV delivery but due to non availability of equipment to deliver synchronized NIPPV in our NICU this study involved the use of NON- Synchronised Ventilation. Therefore, we need further study with bigger population and better synchronized S-NIPPV to draw a conclusion.

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