Original Article

Labour room Continuous Positive Airway Pressure (LR CPAP) in preterm neonates <34 weeks: An Indian experience

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ABSTRACT

Early continuous positive airway pressure (CPAP) has proven to be beneficial in reducing ventilator dependence and subsequent chronic lung disease in neonates suffering from Respiratory distress syndrome (RDS). However, the efficacy of initiating labour room (LR) CPAP has not been determined prospectively in resource limited settings like India. Hence the objective of the present study was to study the efficacy of LR CPAP in preterm neonates with RDS in resource limited Indian settings. This was a prospective observational study including preterm neonates (26-34 weeks with RDS) carried out over a period of 6 months (January to June 2016) when the CPAP was initiated in LR. The outcome was compared with a similar population during the corresponding period of the previous year when CPAP was initiated in NICU. The historical controls were retrieved from case records and matched for gestational age and birth weight with the study population. There was 36% absolute risk reduction in the need for surfactant and 56% for mechanical ventilation in the LR CPAP group respectively. LR CPAP reduces the need for mechanical ventilation and surfactant in preterm neonates with RDS in resource limited settings.

Keywords

Labour room, CPAP, Preterm neonates.

INTRODUCTION

In preterm neonates, immature development of the airways and limited surfactant secretion result in a strong tendency to alveolar collapse with reduced functional residual capacity. Many neonates born at <34 weeks gestation require respiratory support for the same. The best approach to the initial respiratory management of these neonates is uncertain [1].

In an attempt to prevent the injuries caused by mechanical ventilation, there has been a search for less aggressive (non-invasive) ways of providing respiratory support for these neonates. The recent evidence supports early continuous positive airway pressure (CPAP) for management of respiratory distress in these preterm neonates [2,3].

CPAP generates a continuous distending pressure in the alveoli throughout the respiratory cycle. It splints the airways, improves lung compliance, conserves

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surfactant and reduces work of breathing. It prevents the loss of pulmonary volume and minimizes the use of mechanical ventilation and surfactant [2,3]. Extended use of CPAP is associated with stimulation of the lung units to grow. In theory, the earlier the CPAP is applied, the lower the tendency for loss of functional residual capacity and the easier the respiratory stabilization of these preterm neonates. Early CPAP may be beneficial in reducing ventilator dependence and subsequent chronic lung disease in the extremely low birth weight (ELBW) neonates [2,3].

In a study done by Narendran et al comprising of 312 preterm neonates, it was shown that early bubble CPAP reduced delivery room intubations, days on mechanical ventilation and postnatal steroid usage. It was associated with increased postnatal weight gain and no complications [4].

One more study done by Gittermann et al proved that early nasal CPAP is an effective treatment of respiratory distress in very low birth weight neonates, significantly reducing the need for intubation and mechanical ventilation [5].

To the best of our knowledge, the efficacy of initiating LRCPAP and their subsequent clinical course has not been determined prospectively in a population of preterm neonates in India.

Labour room (LR) CPAP was introduced in our unit in 2015. Thus, the objective of the present study was to assess the efficacy of LR CPAP applied early to preterm neonates. The hypothesis raised is that the LR CPAP reduces the need for surfactant and mechanical ventilation during the first 7 days of life, leading to a lower incidence of respiratory morbidity and mortality during the hospital stay.

MATERIAL AND METHODS

After obtaining approval from the Institutional Ethics Committee, an informed consent in local language from parents was procured prior to enrollment of their neonates. This was a prospective observational study carried out in a Level IIIB NICU of a tertiary care hospital for a period of 6 months (January to June 2016). The study included all spontaneously breathing preterm neonates (<34 completed weeks of gestational age) with mild to moderate respiratory distress (Silvermann Andersson Score SAS > 3) (Annexure 1). Preterm neonates < 26 completed weeks of gestation, and neonates with critical congenital heart disease, lethal congenital anomalies, evidence of shock, apnea requiring positive pressure ventilation and those neonates with severe respiratory distress (SAS > 6) were excluded from the study.

Annexure 1- Silverman Anderson Score.

Score	Upper chest retraction	Lower chest retraction	Xiphoid retraction	Nasal flaring	Grunting
0	None	None	None	None	None
1	Lag on inspiration	Just visible	Just visible	Just visible	Only with stethoscope
2	See-saw	Marked	Marked	Marked	Audible to naked ear

The primary outcomes evaluated were the need for surfactant therapy and the need for mechanical ventilation. The secondary outcomes evaluated were death and/or bronchopulmonary dysplasia.

A total of 30 preterm neonates fulfilling the inclusion criteria, who were initiated on LR CPAP during the study period were prospectively enrolled. These neonates were compared to historical controls, matched for birth weight and gestational age (born between January to June 2015), and initiated on CPAP after admission in NICU.

Gestational age was calculated by last menstrual period (LMP) date and antenatal USG scan. In case of discrepancy, the New Ballard Score was considered definitive for gestational age assessment. Respiratory distress was estimated by Silverman Anderson score SAS (Annexure 1). After placing the neonate under warmer, oxygen saturation (SpO2) was monitored by attaching pulse oximeter (Masimo model radical 7). Perfusion and hemodynamic stability of the neonate were assessed. Preterm neonates born between 26 to 34 weeks of gestational age having respiratory distress and satisfying the inclusion criteria were enrolled

after informed consent from the parents. CPAP was administered using nasopharyngeal tube as interface on Bear Cub 750 PSV. Initial setting for CPAP was 5 cm H2O and oxygen requirement of 10% greater than baseline. CPAP and oxygen requirement was titrated according to the respiratory distress and the targeted saturation (SpO2 90-95%). CPAP was increased by 1 cm H2O (maximum of 7 cm H2O) if the SAS score remained >3 despite being on CPAP for 1 hour. Subsequently, the neonate was transferred in a pre-warmed incubator using a T-piece resuscitator (delivering the same CPAP) to Neonatal Intensive Care Unit (NICU). If the oxygen requirement exceeded 30% then surfactant was administered. Persistence of respiratory distress after CPAP level of 7 cm H2O and FiO2 requirement of >50%, was considered indication for mechanical ventilation for the study.

Data were collected daily for 72 hours and weekly till 36 weeks of gestation (LR CPAP group). Bronchopulmonary disease (BPD) was defined as oxygen requirement at 36 weeks corrected gestational age.

Similar birth weight and gestational age matched controls from the previous year in the similar time period were retrospectively studied.

Statistical analysis

The SPSS software version 16 was used to do the statistical analysis. Fisher's exact test was used to calculate the two sided p value with the level of significance being 0.05.

RESULTS

The study group and control group had similar demographic profile (Table 1).

Table 1- Baseline characteristics of cases and control.

	LR CPAP Group (n=30)	Control Group (n=30)	P value
Birth weight (grams)	1161.60 ± 396.52	1239.00 ± 246.61	0.89
Gestational age (weeks)	29.72 ± 2.09	30.60 ± 2.01	1.00
SGA	2 (6.7%)	2 (6.7%)	1.00
Male gender	15 (50%)	17 (56.7%)	0.79
LSCS: n (%)	12 (40%)	6 (20%)	0.15
Antenatal steroids	22 (73.3%)	20 (66.7%)	0.44

LSCS - lower segment Caesarean section, SGA - small for gestational age, LR CPAP - labour room continuous positive airway pressure.

The analyses revealed that 30% neonates in LR CPAP group required surfactant as compared to 66.67% neonates in the control group, with a significant p value (p = 0.009) (table 2). Nine neonates (30%) in LR CPAP group required mechanical ventilation versus 26 neonates (86.67%) in the control group. The p value was statistically significant (p = 0.0001, Table 2).

Table 2- Comparison of primary and secondary outcomes.

Variable	LR CPAP Group n (%)	Control Group n (%)	P value
Need for mechanical ventilation	9 (30.00%)	26 (86.67%)	0.0001
Need for surfactant	9 (30%)	20 (66.67%)	0.009
Death and\or BPD	6 (20%)	8 (26.66%)	0.76

LR CPAP - labour room continuous positive airway pressure, BPD – bronchopulmonary dysplasia.

However, there was no statistical difference between the 2 groups in terms of combined outcome of death and\or BPD, with a p value of 0.76 (Table 2).

There were no complications including pneumothorax in both the groups.

DISCUSSION

In this study, we demonstrated that LR CPAP reduced the need for mechanical ventilation from 86% to 30%. In a similar study done by Gittermann et al, they showed that the need for mechanical ventilation was reduced from 53% to 30% [5]. There was a relative risk reduction of 53% in the use of surfactant between the 2 groups favouring the LR CPAP group. In the landmark trial done by Morley et al in 2008, the need for intubation and surfactant was halved in the CPAP group [2]. In the study done by Finer et al testing the feasibility of labour room CPAP in extremely low birth weight neonates, the need for intubation was reduced by 20% [6].

Narendran et al found 29% reduction in the need for mechanical ventilation and 11% reduction in the need for a surfactant. They also found 10% reduction in the combined outcome of death and\or BPD in the LRCPAP group. However, the mean gestational age was 26 weeks and birth weight was 750 grams in that study [4].

Several publications report a decrease in BPD in association with early CPAP treatment and it has been speculated that this association was causal [7]. A Cochrane review done in 2015 has shown that early CPAP reduces the overall mortality (number needed to benefit was 7) [8]. We did not see such a decrease. To demonstrate a clinically significant reduction in the prevalence of BPD or mortality, from 30% to 20% (with a Type I error of 0.05 and a Type II error of 0.2), 313 patients would be required per study group. Our study was not powered to detect such a difference.

This study has major implications for initial management of preterm neonates with RDS in resource limited settings like India. These preterm neonates can be stabilized on LR CPAP before transfer to a higher centre. Early recruitment of alveoli by administration of CPAP stabilizes functional residual capacity and conserves surfactant, thereby reducing the morbidity and mortality associated with RDS in preterm neonates < 34 weeks gestational age.

In summary, we found that LR CPAP was an effective way to reduce the need for surfactant and mechanical ventilation.

Limitations of the study

It was an observational study with historical controls. However, the before-after trial design used in this study allows us to draw some conclusions pertaining to the major outcome measurements.

CONCLUSION AND RECOMMENDATION

Labour room (LR) CPAP reduces the need for intubation, mechanical ventilation and surfactant in preterm neonates with RDS. Use of LR CPAP is an efficacious means of reducing the need for surfactant and mechanical ventilation in resource limited settings, thereby improving neonatal care.

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