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Original Research Article

Outcome of preterm babies with respiratory distress syndrome on nasal CPAP

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ABSTRACT

Background: Continuous positive airway pressure (CPAP) has become a useful modality in management of respiratory distress in preterm babies. Nasal CPAP was found to be safe and effective means of treating mild and moderate RDS and apnoea of prematurity; Continuous Positive Airway Pressure (CPAP) is a cost-effective and minimal invasive respiratory support for the newborn. The aim of the study was to assess whether the introduction of continuous positive airway pressure (CPAP) results in improved respiratory outcomes in preterm neonates ≤36 weeks of gestation in KIMS hospital.
Methods: The study was an observational clinical study, undertaken in KIMS hospital, Bangalore, Karnataka, between November 2015 to October 2016. All babies born ≤36 weeks of gestational age with respiratory distress were included in this study. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups and Non-parametric setting for Qualitative data analysis
Results: Seventy-seven premature newborn babies with ≤36 weeks of gestation were included in the study and were put on nasal CPAP. The incidence of CPAP failure was 22.1% (95% CI 14.27-32.54%). The proportion of neonates who required surfactant was 16.9% (10.14-26.77%) and the proportion of children who met with mortality was 6.5% (10.14-26.77%) in this study.
Conclusions: Early institution of CPAP in the management of RDS in premature neonates can significantly reduce the need for mechanical ventilation (MV) and surfactant therapy.

Keywords: Continuous positive airway pressure, Non-invasive ventilation, Respiratory distress syndrome

INTRODUCTION

Respiratory Distress Syndrome (RDS) is the commonest cause of respiratory distress in preterm infants. Deficiency of pulmonary surfactant is one of the most important factors contributing to the development of respiratory RDS. In immature lungs, the elevated surface tension resulting from surfactant deficiency leads to alveolar collapse at the end of expiration, atelectasis, uneven inflation and regional alveolar over distension. If untreated, this will result in epithelial injury and pulmonary edema which further interfere with surfactant function, producing the clinical picture of RDS. The main risk for RDS is prematurity. Other factors that increases the risk of RDS are perinatal asphyxia, maternal diabetes, lack of labour, absence of antenatal steroid administration to the mother and male gender.[1]

In preterm infants with respiratory distress syndrome (RDS), the application of continuous positive airway pressure (CPAP) is associated with benefits in terms of reduced respiratory failure and reduced mortality.

Continuous positive airway pressure (CPAP) is a non-invasive respiratory support option and a means to avoid harmful effects of positive pressure ventilation. Continuous positive airway pressure (CPAP) is a continuously applied distending pressure (CDP) used for maintenance of an increased transpulmonary pressure during expiratory phase of respiration, in a spontaneously breathing patient. It is distinct from intermittent positive pressure ventilation (IPPV) or intermittent mandatory ventilation (IMV) in which breathing is taken over by the machine completely and the increase in pulmonary pressure occurs during both inspiratory as well as expiratory phases.

Positive pressure therapy was first used by Poulton, and Oxan in 1936 who used facemask to treat acute ventilatory insufficiency.[2] Harrison was the first to recognize the use of an increased alveolar pressure during expiration in infants with respiratory distress syndrome (RDS).[3] He observed that grunt appears in cases of RDS, which increases progressively with increasing severity of disease and abolition of this grunt by use of endotracheal tube led to decrease in partial arterial pressure of oxygen (PaO_2) and further worsening of the disease. Gregory, et al. first described two methods of delivery of CPAP in 1971 for treatment of RDS: through endotracheal tube and by pressure chamber around infant's head.[4] Subsequently facemask and nasopharyngeal tube have been used.[5] Currently, the most commonly used method is delivery of CPAP by nasal prongs. Infants with mild RDS can often be managed on CPAP alone, without surfactant treatment. Many strategies came for management of RDS in preterm neonates like Prophylactic surfactant (PS) followed by a period of MV PS, prophylactic surfactant with rapid extubation to bubble nasal CPAP (intubate-surfactant-extubate) or initial management with bubble CPAP and selective surfactant treatment (n CPAP). Out of all these, INSURE (Intubation surfactant extubation) procedure, has been in use for almost two decades.

The present study was undertaken to assess the outcome of nasal CPAP in premature infants treated in a tertiary care hospital.

Our aim is to assess whether the introduction of continuous positive airway pressure (CPAP) results in improved respiratory outcomes in preterm neonates ≤36 weeks of gestation in KIMS hospital, and also for various outcomes (mechanical ventilation, mortality and need for surfactant) in preterm babies with respiratory distress syndrome.

METHODS

Study design

An observational clinical study setting: KIMS hospital, located in Bangalore, Karnataka.

Study population

Preterm babies with gestational age ≤36 weeks delivered in KIMS hospital.

Study duration

Data was collected in period of November 2015-October 2016.

Inclusion criteria

Babies born ≤36 weeks of gestational age with respiratory distress. Respiratory distress was considered moderate if Downe's score was >4.

Exclusion criteria

Babies with congenital anomalies (trachea - oesophageal fistula/ congenital diaphragmatic hernia/ upper airway obstruction/ major cardiovascular/central nervous system/neuro-muscular abnormalities), needed intubation at birth (Downe's score >7), apnea and sepsis.

Sample size

A total of 77 eligible babies were included in the study.

Study procedure

Preterm babies born ≤36 weeks were started on nasal CPAP soon after birth with moderate respiratory distress. The diagnosis of RDS was based on following classic symptoms: need of supplemental oxygen, tachypnea, intercostal retractions, nasal flaring, grunting. Babies who failed were put on mechanical ventilation and given surfactant.

CPAP failure was defined as

- SpO_2 <88% on FiO_2 >60% for >30 minutes (with requirement of CPAP >8 cms of H_2O)
- Blood gases showing,
- PH <7.20
- PCO_2 ≥65 mm Hg
- PO_2 <50 mm Hg on FiO_2 >60%
- Pathologic apnea
- Increasing Retractions

Statistical procedures

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

The number of neonates who were delivered by LSCS were 53 (68.8 %) and 24 (31.2%) neonates by normal delivery. Male children constituted 50 (64.9 %) of the study subjects (Table 1, Table 2).

Table 1: Distribution of patients as per mode of delivery.

Mode of delivery	No. of neonates	%	P-value
Normal	24	31.2	0.18
LSCS	53	68.8	0.00
Total	77	100.0	

Table 2: Distribution of patients as per gender.

Gender	No. of neonates	%
Female	27	35.1
Male	50	64.9
Total	77	100.0

In our study, significant success was observed in preterms born between 33-36 weeks and in infants with birth weight between 1500-2500 g. (Table 3, Table 4).

Table 3: Distribution of patients as per gestational age (in weeks).

Gestational Age	No. of neonates	%
≤27 weeks	2	2.6
28-32 weeks	32	41.6
33-36 weeks	43	55.8
Total	77	100.0

Table 4: Distribution of patients as per weight (gms).

Weight (gms)	No. of neonates	%
≤900gms	4	5.2
1000-1499gms	30	39.0
1500-2499gms	43	55.8
Total	77	100.0

A total of 77 eligible neonates were included in the study Nasal CPAP proved to be effective in 60 (77.9%) out of total 77 babies; 17 (22.1%) babies required mechanical ventilation. (Table 5).

Table 5: Distribution of patients requiring mechanical ventilator.

Mechanical ventilator	No. of neonates	%
No	60	77.9
Yes	17	22.1
Total	77	100.0

The three most common predisposing factors associated with RDS seen in study population were Premature rupture of membranes (PROM) and pregnancy induced Hypertension (PIH), oligohydramnios, seen in 29 (37.7%), 11 (14.3%) and 10 (13%) of the subjects respectively. The other predisposing factors were Gestational Diabetes Mellitus (GDM), Abnormal Fetal Doppler (Table 6).

Table 6: The predisposing factors associated with RDS.

Primary outcome	Frequency	%	SE	95% CI
PROM	29	37.7	2.61	27.67-48.83
GDM	4	5.2	0.44	2.04-12.61
PIH	11	14.3	1.16	8.17-23.80
Oligohydra-mnios	10	13.0	1.06	7.21-22.28
Doppler Changes	5	6.5	0.55	2.81-14.32

The incidence of CPAP failure who require mechanical ventilation was 22.1% (95% CI 14.27-32.54%) in study population. The neonates who required surfactant was 16.9% (10.14-26.77%), and who met with mortality was 6.5% (10.14-26.77%) (Table 7).

Table 7: Descriptive analysis of primary outcome measures in study.

Primary outcome	Frequency	%	SE	95% CI
Mechanical ventilation	17	22.1	1.71	14.27-32.54
Surfactant given	13	16.9	1.35	10.14-26.77
Mortality	5	6.5	0.55	2.81-14.32

DISCUSSION

In 1971, Gregory et al, first described the method of delivery of CPAP in treating RDS (4). Similar studies have been done regarding the use of CPAP in preterm RDS. In our study, significant success (77.9%) was observed in preterm babies born between 33-36 weeks and birth weight between 1500-2500g.Sai Sunil Kishore et al., in their randomized controlled trial reported that neonates between 28-34 weeks' gestation with respiratory distress who were put on early-CPAP showed less failure rate and less need for intubation.6 This study also shows that 41.6% neonates between 28-32 weeks showed improved outcome. Cochrane et al showed that early use of CPAP decreases the need for intermittent positive pressure ventilation (IPPV) by about 50%. It is also associated with decreased BPD in several reports.[7] Finer NN et al reported that, neonates who received CPAP treatment, required less mechanical ventilation or postnatal corticosteroids for bronchopulmonary dysplasia as compared with the ones who received surfactant

treatment.[8] In present study, out of 77 neonates only 16.9% required surfactant and 22.1% required mechanical ventilation. Similar study by Zaharie G et al and Bohlin et al reported that using early CPAP may reduce need for surfactant and mechanical ventilation.[9] Boo, et al showed significant improvement in Downes score after application of CPAP on neonates with moderate RDS.[10] Our study also shows that out of 77 neonates, 77.9% came out of moderate RDS. Lanieta, et al and Pieper, et al have showed improved outcome in neonates treated with CPAP and has considered as a primary mode of respiratory support in resource poor settings.[11,12] Verder, et al. and Reininger, et al. showed that CPAP along with surfactant (by InSurE) as compared to CPAP alone in preterm neonates with moderate RDS decreases the need of mechanical ventilation.[13,14] Tapia et al reported that a controlled trial of spontaneously breathing VLBW babies weighing 800-1500 g were put on either CPAP/INSURE or Oxygen/Mechanical ventilation group, showed that need for Mechanical ventilation was lower in the CPAP/INSURE group, as was the use of surfactant.[15] This study also shows that 39% of babies weighing 1000-1499 g showed effective results. Similar study done by Bassiouny et al showed infants with RDS, treated with nCPAP, incidence of CPAP failure was 39% and significant improvement of RDS was seen.[16]

CONCLUSION

In our study, early institution of CPAP in the management of RDS in premature neonates significantly reduced the need for mechanical ventilation and surfactant therapy. CPAP in preterms with RDS is a lifesaving, relatively simple and non-invasive technique. It is most useful when used early in course of disease.

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