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Assess the outcome of CPAP on preterm babies with respiratory distress syndrome attending the pediatrics unit in a tertiary care center, Telangana state

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Abstract
Introduction: On an average 15 million preterm babies are born around the world out of which more than one million die soon after the birth, mainly due to respiratory disorders. Across 184 countries, preterm birth rate ranges from 5% to 18%. In India, out of 27 million babies born every year, 3.5 million babies are premature.
Methodology: Hospital based observational Prospective study, conducted from March 2019 to December 2019 (10 Months). Neonates with a diagnosis of respiratory distress syndrome admitted between March 2019 to December 2019 in Neonatal Intensive Care Unit in RVM Institute of medical sciences, private teaching hospital, Siddipet district, Telangana state.
Results: Of the total 140 preterm neonates, 30 neonates (21%) belong to gestational age 28-31 weeks, 28 neonates (33%) belong to gestational age 32-34 weeks, and 64 neonates (46%) belong to gestational age 35-37 weeks. Of the total 140 neonates in this study, more than half of the neonates (n = 100, 71%) were having birth weight < 2 grams less than half (n = 40, 29%) were having birth weight > 2 grams. Mean birth weight was 1792.69 grams. Majority, 114 (81%) of the subjects had Successful outcome with CPAP in this study.
Conclusion: CPAP as well as timely Surfactant administration and antenatal steroids can increase the survival rate among neonates with RDS.

Keywords: Respiratory distress syndrome (RDS), neonates, preterm, surfactant, continuous positive pressure ventilation (CPAP)

Introduction

The common cause of neonatal mortality in preterm babies is Respiratory distress syndrome. Overall incidence of RDS is about 10-15 per 1000 live born affecting 10-15% preterm babies [1]. The primary cause of RDS is inadequate pulmonary surfactant. If untreated, this will result in epithelial injury & pulmonary edema which further interferes with surfactant function, producing clinical picture of Respiratory Distress Syndrome [2]. On an average 15 million preterm babies are born around the world out of which more than one million die soon after the birth, mainly due to respiratory disorders. Across 184 countries, preterm birth rate ranges from 5% to 18% [3]. In India, out of 27 million babies born every year, 3.5 million babies are premature[4]. The primary risk factor for RDS is prematurity followed by perinatal asphyxia, prolonged labour, maternal diabetes, absence of antenatal steroid administration to mother. Continuous Positive Airway Pressure (CPAP), when applied to preterm infants with RDS is associated with benefits in terms of reduced respiratory failure and reduced mortality. CPAP refers to the application of positive pressure to the airway of a spontaneously breathing infant throughout the respiratory cycle. It is a non-invasive respiratory support option and a means to avoid harmful effects of positive pressure ventilation[5]. Bubble CPAP when used appropriately, is more cost effective, non-invasive, requires no special training to operate CPAP and has lower risk of complications. However not all preterm infants with RDS respond to CPAP [6, 7]. There are limited studies on safety and effectiveness of CPAP in Telangana state so the aim and objective of this study is to assess the effectiveness of CPAP on immediate outcome of preterm neonates with RDS (Gestational age 28 to < 37 weeks) and to study the risk factors associated with failure of CPAP in RVM hospital, Siddipet, Telangana state.

Methodology

Hospital based observational Prospective study, conducted from March 2019 to December 2019 (10 Months). Neonates with a diagnosis of respiratory distress syndrome admitted between March 2019 to December 2019 in Neonatal Intensive Care Unit in RVM Institute of medical sciences, private teaching hospital, siddipet district, Telangana state.

Inclusion criteria: All Neonates with gestational age between 28 weeks to < 37 weeks with RDS.

Exclusion Criteria: 1.Neonates with gestational age < 28 weeks and ≥ 37 weeks. 2. Neonates with respiratory distress secondary to birth asphyxia, congenital pneumonia, sepsis, congenital anomalies like cleft lip, cleft palate, tracheoesophageal fistula, congenital other anomalies involving respiratory tract. 3. Parents/Attendants who do not want to participate and didn't give consent. Prior ethical committee permission obtained from RVM institutional ethical committee. Appropriate statistical tests were applied using software SPSS version 22. Percentages, mean values, p value were calculated and results analysed.

Results

Of the total 140 preterm neonates, 30 neonates (21%) belong to gestational age 28-31 weeks, 28 neonates (33%) belong to gestational age 32-34 weeks, and 64 neonates (46%) belong to gestational age 35-37 weeks. Majority of study population belong to the gestational age 32-34 weeks (33%) and 35-37 weeks (46%). Mean Gestational age was 34.4 weeks.

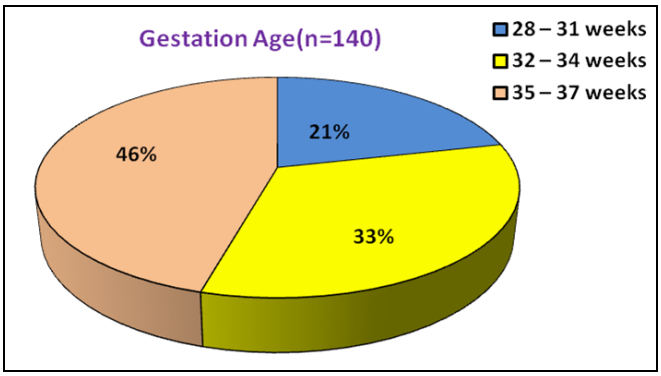

Fig 1: Age distribution of neonates

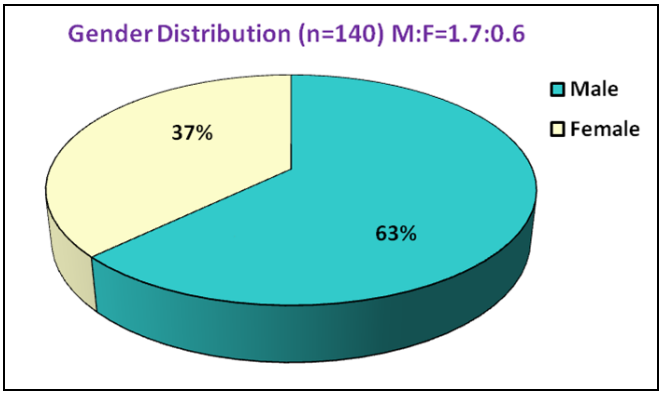

Fig 2: Gender distribution among the neonates

Male neonates are 63% and females are 37%, which shows male preponderance in this study with male: female ratio being 1.7: 0.6.

Table 1: Birth weights of the neonates

Birth Weight	Number	Percentage
≤ 1000 grams	10	7
1001-1500 grams	52	37
1501-2000 grams	38	27
> 2000 grams	40	29
Total	140	100

Of the total 140 neonates in this study, more than half of the neonates (n = 100, 71%) were having birth weight < 2 grams less than half (n = 40, 29%) were having birth weight > 2 grams. Mean birth weight was 1792.69 grams.

Table 2: Demographic and etiological variables of study neonates

Variable	Mean or total percentage(n=140)
Birth weight (gm) (mean)	1792.69
Gestational age in weeks (mean ± SD)	34.4
Age at CPAP (Hrs) (mean ± SD)	13.94
Duration of CPAP (Hrs) (mean ± SD)	52.56
Cesarean Delivery	80(57%)
Sepsis	24 (17%)
Surfactant	20 (14%)
Antenatal steroid	6 (4%)

57% were caesarean deliveries followed by 43% normal vaginal delivery was observed in this study. Sepsis was observed in 17%, followed by lack of surfactant in 14% and antenatal steroid was used in 4% of the mothers.

Table 2: Showing CPAP outcome with Gestational age among the study neonates

Gestational Age	CPAP outcome				($\chi 2$, P<0.05) *
	Success		Failure		
	No	%	No	%	
28 – 31 weeks	20	18	10	38	(8.2075,0.0165*)
32 – 34 weeks	36	32	10	38	
35 – 37 weeks	58	51	6	23	
Total	114	100	26	100	

*- P<0.05 there is a significant association between CPAP outcome and Gestational Age by using chi-square test

Success with CPAP observed maximum in neonates with gestational age 35-37 weeks (51%), followed by neonates with gestational age 32-34 weeks (32%) and 28-31 weeks (18%). Failure with CPAP is equally high in neonates with gestational age 28- 31 weeks (38%), followed by neonates with gestational age 32-34 weeks (38%).There is a temporal relationship of CPAP success rate with increasing gestational age. Statistical significance was also noted. (p=0.0165)

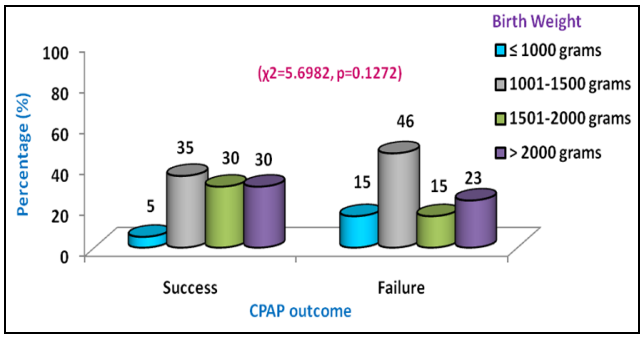

Fig 3: Showing CPAP outcome with Birth Weight

CPAP success is maximum in neonates with birth weight > 1001 -1500 grams (35%), followed by neonates with birth weight 1501 - 2000 grams (30%) and > 2000 grams (30%). CPAP was least successful in neonates with birth weight ≤ 1000 grams (5%). CPAP failure is highest in neonates with birth weight >1001-1500 grams (46%), followed by neonates with birth weight >2000 grams (23%).There is no statistical significance observed with CPAP and the birth weight of neonates.

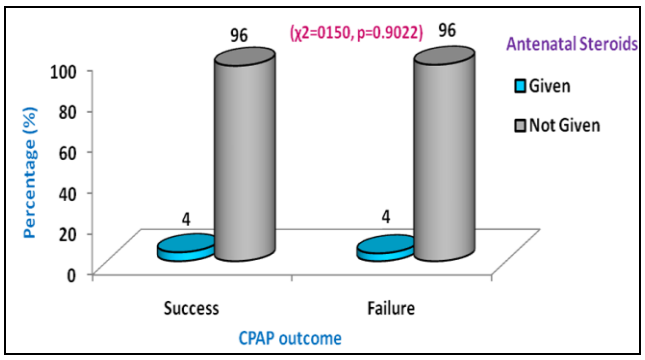

Fig 4: CPAP outcome with steroid therapy in antenatal period

Neonates in whom steroids were administered CPAP success is (4%) and failure is also (4%). Only 6 (4%) premature neonates received antenatal steroids.

Table 3: Showing CPAP outcome with mode of delivery

Mode of Delivery	CPAP outcome				(χ2 ,*P*<0.05) *
	Success		Failure		
	No	%	No	%	
NVD	44	39	16	62	(4.5501,0.0329*)
LSCS	70	61	10	38	
Total	114	100	26	100	

*- *P*<0.05 there is a significant association between CPAP outcome and Mode of Delivery by using chi-square test

Success with CPAP was highest with babies delivered by LSCS (61%), than with babies born by Normal Vaginal Delivery (39%) and the difference was found to be statistically significant. (p=0.0329)

Table 4: CPAP outcome and Silverman Anderson score

Silverman Anderson score	CPAP outcome				(χ2 ,*P*<0.05) *
	Success		Failure		
	No	%	No	%	
3-4	16	14	3	12	(3.7603,0.1525)
5-6	78	68	14	54	
7-9	20	18	9	35	
Total	114	100	26	100	

The CPAP success rate with Silverman Anderson score at admission 3-4 and 5-6 was 14% and 68% respectively. In case of Silverman Anderson score ≥ 7 the success rate was only 18%.

Table 5: Surfactant and CPAP outcome

Use of Surfactant	CPAP outcome				(χ2, *P*<0.05) *
	Success		Failure		
	No	%	No	%	
Yes	16	14	4	15	(0.0315,0.8591)
No	98	86	22	85	
Total	114	100	26	100	

Of the total surfactant administered cases CPAP success is among (14%) than CPAP failure (15%). Surfactant was given to 20 (14%) neonates only.

Table 6: CPAP initiation time (age in hours) and outcome status

Age (hrs.) at CPAP starting	CPAP outcome				(χ2 ,*P*<0.05) *
	Success		Failure		
	No	%	No	%	
<24 hours	90	79	14	54	(6.9832,0.0082*)
>24 hours	24	21	12	46	
Total	114	100	26	100	

*- *P*<0.05 there is a significant association between CPAP outcome and Age (in hrs) at CPAP starting by using chi-square test

Success with CPAP was maximum (79%) where CPAP was started within 24 hours after birth than when CPAP was started after 24 hours after birth (21%) and the difference was found to be statistically significant. (p=0.0082)

Table 7: Complication observed among the neonates

Complication	Number	Percentage
sepsis	29	21
Nasal trauma	22	16
IVH	1	1
Pneumothorax	3	2
Shock	5	4
PVL	3	2

Most common complication was sepsis (21%) followed by nasal trauma (16%). Followed by shock was seen in only four neonates.

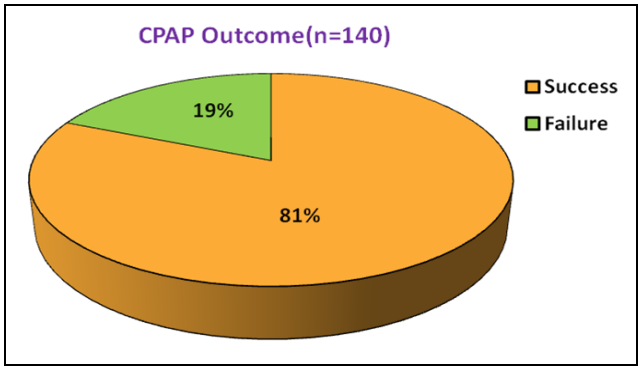

Fig 5: Overall outcome of CPAP on the neonates

Majority, 114 (81%) of the subjects had Successful outcome with CPAP in this study.

Discussion

This study includes 140 preterm neonates, admitted from March 2019 to December 2019. Of the total 140 neonates, 114 neonates (81%) were successfully weaned off from the CPAP, which is near similar with than that of Prashanth URS *et al.* [8] (80%) and J.Koti *et al.* [7] (75%). Statistically significant CPAP success was seen in neonates born to mothers who had received antenatal steroids in the study by Prashanth *et al.* and Koti *et al.* Success was higher in neonates who were given antenatal steroids, however no significance was found for antenatal steroids in the study by Ajay sethi *et al.* [9] (p value= 0.148) and Shamil *et al.* [10] (p value = 0.148) 44. In the present study the percentage of neonates who received antenatal steroids (4%) was very low compared to all the above studies. In this study the mean

age of starting CPAP was 13.94 hours of life, which was significantly higher than that in Prashanth *et al.* (5.5 hours). Cochrane systematic review concluded that the application of CPAP early in the course of the disease as compared to late CPAP was associated with a significant reduction in subsequent use of invasive ventilation. In the present study CPAP success rate was more in neonates in whom CPAP was started early (<24 hours p value = 0.0082) which was similar to Shamil A *et al*. (p value = 0.024). Surfactant was administered in 20 (14%) the outcome was near similar to the studies conducted by Ajay sethi *et al*. 17 (41.4%) and Sunil B *et al*. [11] 13 (16.9%). Various studies conducted on CPAP reported a failure rate of 25-50%. The causes of CPAP failure in the present study are low gestational age, silverman score ≥ 7 and delay in starting CPAP (>24 hrs), antenatal steroid not used in many cases and presence of sepsis and nasal trauma.

Conclusion

Antenatal steroid coverage in preterm deliveries, immediate CPAP care within <24hrs time and usage of surfactant in preterm babies are the major factors contributing in successful treatment of respiratory distress syndrome. Sepsis and nasal trauma were most common complications on CPAP. Such complications can to be reduced by proper aseptic techniques and proper handling techniques by staff of the equipment used for care.

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