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Preterm Neonatal Need for Mechanical Ventilation in Prophylactic Continuous Positive Air Pressure (CPAP) Versus Therapeutic CPAP

[1]Nida Zeeshan, [1]Tooba Karim, [1]Farid Adnan, [2]M. Ashraf Chaudhry
[1]*Department of Pediatrics, CMH Medical College, Lahore.*
[2]*Department of Community Medicine, CMH Medical College, Lahore.*

ABSTRACT

Introduction: Preterm birth leads to number of life-threatening complications especially respiratory issues. Continuous Positive Airway Pressure (CPAP) is a conventional method used to keep the airways functional. However, limited literature is available on comparative benefit of prophylactic nasal CPAP vs. therapeutic CPAP specially in terms of preventing need for mechanical ventilation.
Aims & Objectives: To compare the frequency of need for mechanical ventilation in prophylactic CPAP versus therapeutic CPAP in preterm neonates.
Place and duration of study: The study was carried out at Neonatal Intensive Care Unit (NICU), Department of Pediatrics, Combined Military Hospital, Lahore between February 1 to August 1, 2019.
Material & Methods: This randomized controlled trial was conducted on 174 cases using non-probability consecutive sampling. The patients were divided into two groups randomly (group-A and Group -B) using lottery method. Group 'A' received therapeutic CPAP only and Group 'B' received prophylactic CPAP in the first half an hour after birth. Data was entered and analyzed using the software SPSS version 20. For inferential statistics, p-value ≤ 0.05 was considered significant.
Results: The mean age of patients in Therapeutic group was 16.71 ± 13.05 hours and in Prophylactic group the mean age was 12.62 ± 16 hours. In tTherapeutic group 61(70.1%) cases needed mechanical ventilation and in Prophylactic group 23(26.4%) cases needed mechanical ventilation, the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group as compared to Prophylactic CPAP group, p-value < 0.001. There was significant association of need for mechanical ventilation with gender, gestational age and birth weight.
Conclusion: This study concludes that the frequency of mechanical ventilation was statistically higher in Therapeutic CPAP group as compared to Prophylactic CPAP group in preterm infants between 28-32 weeks of gestation. Hence in future, every expected preterm baby is recommended to be given prophylactic CPAP to minimize the related complications. This can help to reduce the neonatal mortality rate.

Keywords: Preterm birth, CPAP, therapeutic CPAP, Prophylactic CPAP

INTRODUCTION

Preterm birth remains to be a critical public health issue with alarmingly high numbers of infant mortality as well as morbidity.[1] Almost 15 million infants are born preterm per-annum but majority of these numbers are seen in developing countries. Studies have reported the global prevalence of preterm birth in range between 5 to 8%.[2,4] However,in Pakistan the prevalence has been reported as high as 21.4% reported recently.[5] Preterm birth also leads to number of life threatening complications including but not limited to cerebral palsy, sepsis, developmental delays specially related to cranial nerve and posture, gastro-intestinal disorders and most significantly respiratory issues.[6]Immature lung development is considered the major culprit for respiratory disorders leading to Respiratory Distress Syndrome (RDS) and apnea.[7] These problem make it difficult for newborn to maintain required breathing without any clinical support.[8] Continuous Positive Airway Pressure (CPAP) is a conventional method used to keep the airways functional by sending air through the nose thus preventing need for surfactant and any assisted ventilation process.[9] Some studies have reported that early CPAP may reduce the risk of endotracheal intubation, broncho-pulmonary dysplasia (BPD) as well as intermittent positive pressure ventilation (IPPV).[10,11]
Studies have been recently conducted on potential benefit of prophylactic nasal CPAP compared to

therapeutic CPAP to compare the effectiveness of each type specially in terms of preventing need for mechanical ventilation.[12] A study reported that use of prophylactic respiratory support may be helpful in preventing any degradation of pulmonary function as well as need of surfactant or mechanical ventilation.[13] Another study reported the need for mechanical ventilation in first 72 hours of life was necessary in 18 cases (72%) of therapeutic CPAP and in 35 cases (53,84%) of Prophylactic CPAP.[14]

The global literature comparing the two techniques reports results with no consensus. Moreover, literature comparing the two types of CPAPs is very limited yet.[15, 16] In Pakistan, no study on this topic has been published yet. The study can help us to generate baseline data and if we find lower rate of mechanical ventilation using prophylactic CPAP then in future every expected preterm baby can be planned to give prophylactic CPAP to minimize the complication such as ventilator associated pneumonia, broncho-pulmonary dysplasia. Therefore, this study is designed to determine and compare outcome of prophylactic CPAP versus therapeutic CPAP in terms of need for mechanical ventilation.

MATERIAL AND METHODS

This randomized controlled trial was conducted in Neonatal Intensive Care Unit (NICU), Department of Pediatrics, Combined Military Hospital, Lahore for a period of six months (Feb 1, 2019 till Aug 1, 2019). Ethical approval was taken from the Ethical Review Committee,vide No.695/ERC/CMH/LMC, CMH Lahore Medical College. The parents/caregivers of the included subjects were briefed about the purpose, benefits and potential risks involved with the research. The willing participants were asked to sign an informed consent.

Data was collected from 174 preterm neonates between 28-32 weeks of gestation of either gender or any birth weight using non-probability consecutive sampling. The sample size was calculated taking expected percentage of mechanical ventilation in 72% of therapeutic CPAP and 53.84% of prophylactic CPAP at 5% level of significance and 80% power of test Whereas infants with neonatal sepsis (proven on culture) and major congenital anomalies (already diagnosed clinically) were excluded. The patients were randomly divided into two groups (group-A and Group -B) using lottery method. Group 'A' received therapeutic CPAP only and Group 'B' received prophylactic CPAP in the first half an hour after birth. The primary outcome was the need for mechanical ventilation (MV) within the first 72 hours of life (as per operational definition). All data was collected by researcher herself.

Data were entered and analyzed using the software SPSS version 20. Mean and standard deviation were calculated for quantitative variables like gestational age and birth weight whereas qualitative variables (like gender and need of mechanical ventilation) were described as frequencies and percentages. Data were stratified for gender, gestational age, and birth weight to address effect modifiers. Post stratification Chi-square test was applied and p-value ≤ 0.05 was considered significant.

RESULTS

Descriptive statistics of age, gestational age and birth weight is shown in Table-1. In Therapeutic group 61(70.1%) cases needed mechanical ventilation and in Prophylactic group 23(26.4%) cases needed mechanical ventilation, the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group as compared to Prophylactic CPAP group, p-value < 0.001 (Table-2). In male cases the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (70.9%) as compared to Prophylactic CPAP group (30.2%), p-value < 0.001 while in female cases the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (68.8%) as compared to Prophylactic CPAP group (20.6%), p-value < 0.001. In 28-30 weeks of gestation, the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (90%) as compared to Prophylactic CPAP group (35.7%), p-value < 0.05 while in 30.1-32 weeks of gestation the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (67.5%) as compared to Prophylactic CPAP group (24.7%), p-value < 0.001 (Table-3).

In patients with birth weight < 1.5 kg the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (78%) as compared to Prophylactic CPAP group (30.3%), p-value < 0.001 while in cases with birth weight 1.5-2.49 kg the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group (53.6%) as compared to Prophylactic CPAP group (14.3%), p-value =0.005 (Table-3).

	CPAP	Mean	S.D	Mini	Max
Age (hours)	**Therapeutic (n=87)**	16.71	13.05	1.00	72
	Prophylactic (n=87)	12.62	16.71	1.00	70
Gesta-tional Age (week)	**Therapeutic (n=87)**	31.61	0.81	29.00	32.00
	Prophylactic (n=87)	31.46	0.83	29.00	32.00
Birth weight (kg)	**Therapeutic (n=87)**	1.40	0.24	0.940	2.180
	Prophylactic (n=87)	1.33	0.26	0.930	2.235

Table-1: Descriptive statistics of age (hours), gestational age (weeks) and birth weight (kg) in both study groups.

Need for Mechanical Ventilation	Study Group		Total
	Therapeutic CPAP	Prophylactic CPAP	
No	26 (29.9%)	64 (73.6%)	90 (51.7%)
Yes	61 (70.1%)	23 (26.4%)	84 (483%)
Total	87 (100.0%)	87 (100.0%)	174 (100.0%)

Table-2: Comparison of Need for Mechanical Ventilation in both study groups.
Chi-square = 33.2
P-value< 0.001 (Highly Significant)

Name		Need for Mechanical Ventilation	Study Group		p-value
			Therapeutic CPAP	Prophylactic CPAP	
Gender	**Male**	**No**	16(29.1%)	37(69.8%)	<0.001**
		Yes	39(70.9%)	16(30.2%)	
	Female	**No**	10(31.2%)	27(79.4%)	<0.001**
		Yes	22(68.8%)	7(20.6%)	
Gesta-tional age	**28-30 (weeks)**	**No**	1(10%)	9(64.3%)	0.008*
		Yes	9(90%)	5(35.7%)	
	30.1-32 (weeks)	**No**	25(32.5%)	55(75.3%)	<0.001**
		Yes	52(67.5%)	18(24.7%)	
Birth weight	**<1.5 (kg)**	**No**	13(22%)	46(69.7%)	<0.001**
		Yes	46(78%)	20(30.3%)	
	1.5 – 2.499 (kg)	**No**	13(46.4%)	18(85.7%)	0.005*
		Yes	15(53.6%)	3(14.3%)	

Table-3: Comparison of Need for Mechanical Ventilation in both study groups with respect to gender, gestational age and birth weight.
**Highly significant
*Significant

DISCUSSION

Pre-term birth has significant contribution in worldwide prevalence of infant mortality and morbidity.[17] The complications associated with preterm birth are both short and long term and some long term complications may prove fatal as well. Respiratory disorders that usually emerge due to lack of enough surfactants and immaturity of lungs in preterm newborn may cause BPD, injury to mucosa or even the lung itself, infection and even death.[18]Timely intervention through CPAP may prevent the risk of further damage to the lungs and need for intubation. Conventionally therapeutic or curative CPAP was practiced for this purpose.[19] However, recent studies have questioned the comparative effectiveness of therapeutic versus paraphyletic CPAP.

In current study there were 55(63.22%) male and 32(36.78%) female cases while in Prophylactic group there were 53(60.92%) male and 34(39.08%) female cases. We found that 61(70.1%) cases with therapeutic CPAP needed mechanical ventilation compared to 23(26.4%) in Prophylactic group, the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group as compare to Prophylactic CPAP group, p-value < 0.00. One other study reported that in 18 cases (72%) of therapeutic CPAP and in 35 cases (53,84%) of Prophylactic CPAP, mechanical ventilation was required. [14]

Another study reported that thirty-three (31.4%) infants in the prophylactic surfactant group needed MV in the first 5 days of life compared with 34 (33.0%) in the CPAP group (risk ratio: 0.95 [95% confidence interval: 0.64–1.41]; P = .80).[20] One Multicentric randomised controlled clinical trial showed that Surfactant was needed by 22.6% in the prophylaxis group and 21.7% in the rescue group. Mechanical ventilation was required by 12.2% in both the prophylaxis and rescue group. The incidence of air leaks was 2.6% in both groups. More than 80% of both groups had received prenatal steroids.[21]

A number of studies have been conducted on therapeutic or prophylactic CPAP individually or in comparison with other techniques.[20] but very limited literature is available both internationally as well as locally to compare the two techniques. Hence this study serves as a cornerstone in comparing the two techniques and adding knowledge in local literature. More studies should be conducted on larger scale to achieve better insights in this regard as well.

CONCLUSION

This study concludes that the frequency of mechanical ventilation was statistically higher in therapeutic CPAP group as compared to Prophylactic CPAP group in preterm infants between 28-32 weeks of gestation. Hence in future, every expected preterm baby is recommended to be given prophylactic CPAP to minimize the related complications. This can help to reduce the neonatal mortality rate.

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The Authors:
Dr. Nida Zeeshan
FCPS Part IITrainee,
Department of Pediatrics,
CMH Medical College, Lahore.

Dr. Tooba Karim
FCPS Part II Trainee,
Department of Pediatrics,
CMH Medical College, Lahore.

Dr. Farid Adnan
FCPS Part II Trainee,
Department of Pediatrics,
CMH Medical College, Lahore.

Prof. Dr. M. Ashraf Chaudhry
HOD Community Medicine,
Department of Community Medicine,
CMH Medical College, Lahore.

Corresponding Author:
Prof. Dr. M. Ashraf Chaudhry
HOD Community Medicine,
Department of Community Medicine,
CMH Medical College, Lahore.
Email: drmachaudhry@gmail.com