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Use of low-cost bubble continuous positive airway pressure in neonates with respiratory distress at a tertiary care hospital Quetta

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Abstract---Introduction: Respiratory distress is a prevalent and serious consequence of neonatal sepsis, premature birth and neonatal pneumonia which is responsible for more than half of all neonatal fatalities worldwide. Objective: To assess the use of low-cost bubble continuous positive airway pressure in neonates with respiratory distress at a tertiary care hospital Quetta. Methodology: The current study was cross sectional study carried out at the pediatrics department, Sandeman Provencial Hospital Quetta from 16th May 2017 to 16th Nov 2017. All in patients who fulfilled the inclusion criteria in the Department of pediatrics, Sandeman Provinvical Hospital Quetta were included in the study. After taking informed

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written consent, bubble continuous positive airway pressure was used in all the included patients to assess the outcome variable i.e survival. All the collected information was entered in the prescribed Performa. Results: In the current study, totally, 138 patients with respiratory distress were included. 84 patients (60.9%) were males & 54 (39.1%) were females, with the mean age of 6.98+2.78 years. The mean gestational age of mother was 38.5±1.26 weeks, the mean duration of achieving 21% O_2 was 81.60 (±0.81) hours, mean stay in hospital was 22.07 (±1.7) days. In our study 95 neonates (68.8%) survived. Conclusion: In conclusion, bubble CPAP is an efficient method for enhancing the oxygenation of infants with respiratory distress resulting from a variety of reasons. The use of BCPAP may reduce stay in hospital and the need for mechanical ventilation. In settings with limited resources, it could be most beneficial.

Keywords---respiratory distress, low cost bubble, preterm infants.

Introduction

Respiratory distress is a serious and prevalent consequence of neonatal sepsis, preterm birth and neonatal pneumonia which is responsible for >50% of all neonatal fatalities worldwide [1]. Respiratory distress syndrome (RDS) affects >50% of infants born at or before gestational age of 31 weeks [2]. Respiratory distress is linked to more than 80% of neonatal pneumonia infections and the majority of neonatal sepsis cases [3]. Preterm infants with respiratory distress syndrome who eventually acquire bronchopulmonary dysplasia had elevated serum Endothelin 1 levels on day 3 of life [4]. A major improvement in the care and management of RDS in very low birth weight neonates has been made as a result of non-invasive ventilation [5].

Neonatal respiratory assistance is often delivered in the industrialised world via the use of either "mechanical ventilation or Continuous Positive Airway Pressure (CPAP)" [1, 3]. However, for most settings with low resources, like Pakistan, ventilators and CPAP devices are costly and practically challenging [6, 7]. Respiratory disease is still one of the leading causes of neonatal mortality in the underdeveloped countries. CPAP is a safe and efficient treatment for neonates with respiratory distress, including those born prematurely or with low birth weight [6, 8]. Several investigations have demonstrated that CPAP may be successfully adopted in settings with low-resource by adapting commercially accessible equipment originally developed for high-resource settings [9, 10]. However, many low-resource settings find it impossible to use CPAP equipment due to their high cost and complexity.

For low-resource settings, inexpensive bCPAP system has just been designed. It can be put together for around $350, which is fifteen times less expensive than the typical stand-alone CPAP [8, 11]. BCPAP-treated neonates had a survival rate of 71.0% in comparison to 44.0% for controls. There are several studies showing the effectiveness of different locally modified bCPAP in countries with limited resources [12]. Researchers have shown that improvised bCPAP is an effective and

less costly way to provide respiratory support for infants with RDS in low resources neonatal hospitals in underdeveloped nations [13]. An overall CPAP success rate of 76.2% was achieved with the effective weaning off of 32 infants. During the research period, there were 10 RDS-specific deaths, with a rate of case mortality of 23.8% [14].

The current research is intended to assess the effectiveness of this revolutionary low cost bCPAP system since there are few studies on it. Because of the country's limited financial resources, most public hospitals in Pakistan lack the necessary number of ventilators, and most patients cannot afford the high costs of private medical care. This innovative method will be used in the future in such patients if it proves effective. Currently ventilators are used for neonates with RDS in our unit, which can lead to ventilator associated pneumonia, prolong hospital stay and is expensive. So morbidity and mortality could be cut down by using bCPAP as with this there is no risk of ventilator associated pneumonia and it will be also be cast effective.

Material and Methods

The current study was Cross sectional study carried out at the pediatrics department, Sandeman Provencial Hospital Quetta. The duration of the study was 6 months from 16th May 2017 to 16th Nov 2017. The sample size of our study was 138 patients by taking 64.6% of survival rate of neonates with RDS receiving bCPAP [15], Confidence level=95%, Margin of error= 8%.

Inclusion criteria

- Neonates with Respiratory distress diagnosed within 12 hours
- Either gender
- Full term, one born anytime from 37 weeks to 42 weeks of pregnancy
- Preterm, is one who is born before 37 weeks of pregnancy
- Neonates weighing 2.5kg to 5kg

Exclusion criteria

- Neonates with Cyanotic heart disease
- Cleft palate
- Diaphragmatic hernia
- Severe birth asphyxia
- Low birth weight

All patients who fulfilled the inclusion criteria in the Department of pediatrics, Sandeman Provincial Hospital Quetta were included in the study. After taking informed written consent, bubble continuous positive airway pressure was used in all the included patients to assess the outcome variable i.e survival. All the patients were followed for duration of four weeks. All the data including mean hospital stay and weight gain, survival, average duration of achieve 21%O_2, abdominal distention, Apnea, Hyperemia of nose were recorded in a prescribed Performa. Data analysis was done by using IBM SPSS (version 21). Mean (±SD)

was computed for age, stay in hospital; time of achieving 21%O_2 (hours) and weight gain per day. Frequency and percentages was calculated for gender, outcome i-e survival of the neonate (yes/no).

Results

In the current study, totally138 patients with respiratory distress were selected. Male patients in the current study were 84 (60.9%) & female patients were 54 patients (39.1%). The mean age (±SD) of newborn was 6.98+2.78 hours. The mean gestational age of mother was 38.5±1.26 weeks. The mean weight of neonates at birth was 3.10±0.45 kg. In our study 18 patients (13%) had sign and symptoms of apnea, 21 (15.2%) had hyperemia of nose, 46 (33.3%) had abdominal distension. The mean duration of achieving 21% O_2 was 81.60±0.81 hours. The mean weight gain in neonates per day was 17.60±0.95g. The mean hospital stay was 22.07±1.7 days. In our study 95 neonates (68.8%) survived.

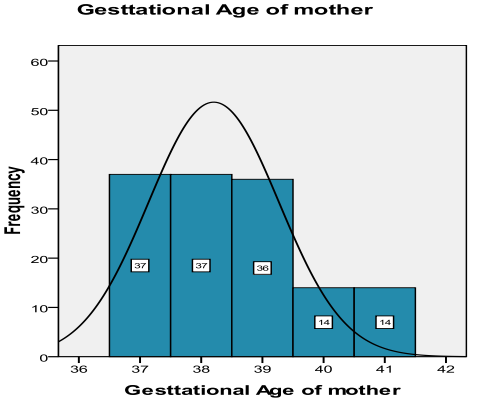

Figure 1. Gestational age of mothers

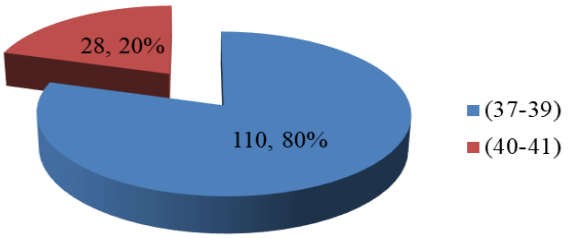

Figure 2. Percentages of patients according to gestational age of mother

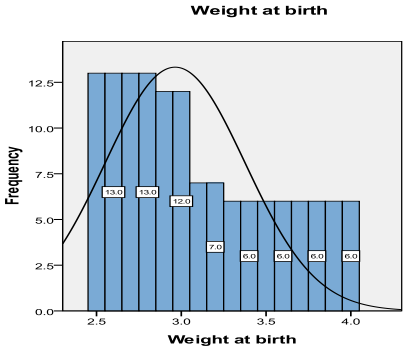

Figure 3. Frequency distribution of weight at birth

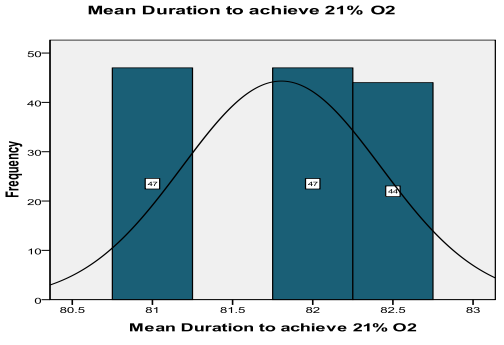

Figure 4. Frequency distribution of mean duration to achieve 21% o_2

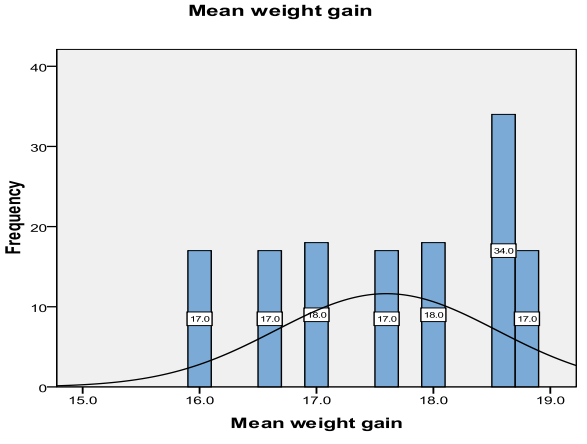

Figure 5. Frequency distribution of mean weight gain

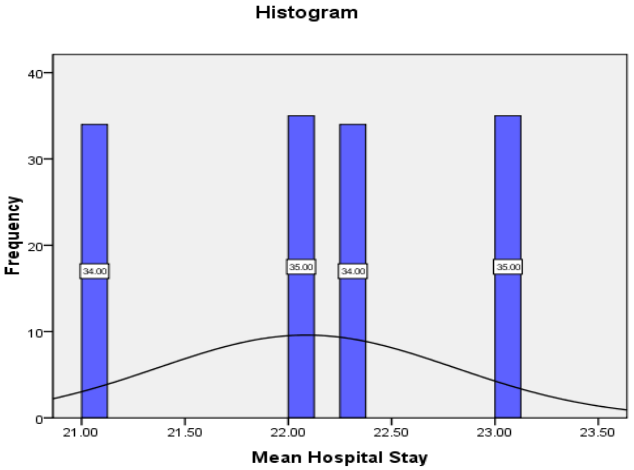

Figure 6. Frequency distribution of mean hospital stay

Table 1
Demographic, clinical outcomes parameter of the enrolled patients

Parameter	Sub-category	Frequency	Percentage
Gender	Male	54	39.1%
	Female	84	60.9%
Apnea	Yes	120	87%
	No	18	13%
Hyeremia of nose	Yes	117	84.8%
	No	21	15.2%
Abdominal distension	Yes	92	66.7%
	No	46	33.3%
Survival	Yes	43	31.2%
	No	95	68.8%

Discussion

Numerous investigations emphasized the use of Bubble CPAP in the therapy of RDS. High-frequency ventilation (HFV) waveforms are simulated by mechanical oscillatory vibrations that are delivered by B-CPAP [16, 17]. As a result, B-CPAP may simultaneously exhibit the qualities of CPAP and HFV [18]. According to reports, HFV preserves hemodynamics more effectively than traditionally managed mechanical ventilation [19, 20]. The current research is intended to evaluate the effectiveness of this revolutionary low cost bCPAP system since there are few studies on it.

In the current study, totally138 patients with respiratory distress were selected. Male patients in the current study were 84 (60.9%) & female patients were 54 patients (39.1%). The mean age (±SD) of newborn was 6.98+2.78 hours. The mean gestational age of mother was 38.5±1.26 weeks. The mean weight of neonates at

birth was 3.10±0.45 kg. In our study 18 patients (13%) had sign and symptoms of apnea, 21 (15.2%) had hyperemia of nose, 46 (33.3%) had abdominal distension. The mean duration of achieving 21% O_2 was 81.60±0.81 hours. The mean weight gain in neonates per day was 17.60±0.95g. The mean hospital stay was 22.07±1.7 days. In our study 95 neonates (68.8%) survived. Researchers in India and Australia have used randomized controlled trials to compare bubble CPAP to mechanical ventilation for premature neonates. Compared to mechanical ventilators, bubble CPAP was more effective for treating neonates [18]. When compared to a mechanical ventilator, bCPAP is better in a research by Lee et al. for premature infants [16].

The rate of failure of bCPAP was 24% in infants weighing less than 1250 g and 50% in infants weighing less than 750 g, according to a research by Ammari et al. [21]. Another study done by Koti et al. on 56 neonates reported 25% rate of failure of bubble CPAP [22]. In the research by Saha et al., 27% of infants who began using Bubble CPAP needed ventilation, compared to 51% in the control group. Over a period of more than 28 days, no infant needed oxygen. Only one infant experienced a pneumothorax, however that infant was managed on Bubble CPAP and did not need ventilation or chest tube drainage [23]. Using B-CPAP reduced the average cost of hospitalization in our research. Lanieta et al. have effectively proved the efficacy of BCPAP in a developing nation, and they have also documented the economic effectiveness of B-CPAP [24]. Pieper and colleagues have shown both the significance of continuous positive airway pressure (CPAP) in the absence of newborn critical care and the improvement in outcome that occurs in neonates who are managed with CPAP prior to being transferred to a tertiary hospital [25].

Conclusion

In conclusion, bubble CPAP is an efficient method for enhancing the oxygenation of infants with respiratory distress resulting from a variety of reasons. The use of BCPAP may reduce stay in hospital and the need for mechanical ventilation. In settings with limited resources, it could be most beneficial.

References

1. Lawn JE, Kerber K, Enweronu-Laryea C, Cousens S, editors. 3.6 million neonatal deaths—what is progressing and what is not? Semin Perinatol; 2010: Elsevier.
2. Clair CS, Norwitz ER, Woensdregt K, Cackovic M, Shaw JA, Malkus H, et al. The probability of neonatal respiratory distress syndrome as a function of gestational age and lecithin/sphingomyelin ratio. Am J Perinatol. 2008;25(08):473-80.
3. Duke T. Neonatal pneumonia in developing countries. Archives of Disease in Childhood-Fetal and Neonatal Edition. 2005;90(3):F211-FF9.
4. Gnanaratnem J, Finer NN. Neonatal acute respiratory failure. Curr Opin Pediatr. 2000;12(3):227-32.
5. Simoes EA, Cherian T, Chow J, Shahid-Salles SA, Laxminarayan R, John TJ. Acute respiratory infections in children. Disease Control Priorities in Developing Countries 2nd edition. 2006.

6. Kamath BD, MacGuire ER, McClure EM, Goldenberg RL, Jobe AH. Neonatal mortality from respiratory distress syndrome: lessons for low-resource countries. Pediatrics. 2011;127(6):1139-46.
7. Howson CP, Kinney MV, McDougall L, Lawn JE, Group BTSPBA. Born too soon: preterm birth matters. Reproductive health. 2013;10:1-9.
8. Nowadzky T, Pantoja A, Britton JR. Bubble continuous positive airway pressure, a potentially better practice, reduces the use of mechanical ventilation among very low birth weight infants with respiratory distress syndrome. Pediatrics. 2009;123(6):1534-40.
9. Watson A. Premarket Notification Decision for Fisher & Paykel Healthcare Bubble CPAP System. US Food and Drug Administration: 510 (k) Number K100011. 2010.
10. Bonner KM, Mainous RO. The nursing care of the infant receiving bubble CPAP therapy. Adv Neonatal Care. 2008;8(2):78-95.
11. De Klerk A, De Klerk R. Nasal continuous positive airway pressure and outcomes of preterm infants. J Paediatr Child Health. 2001;37(2):161-7.
12. Morley CJ, Davis PG, Doyle LW, Brion LP, Hascoet J-M, Carlin JB. Nasal CPAP or intubation at birth for very preterm infants. N Engl J Med. 2008;358(7):700-8.
13. Schmölzer GM, Kumar M, Pichler G, Aziz K, O'Reilly M, Cheung P-Y. Non-invasive versus invasive respiratory support in preterm infants at birth: systematic review and meta-analysis. BMJ. 2013;347.
14. Courtney SE, Pyon KH, Saslow JG, Arnold GK, Pandit PB, Habib RH. Lung recruitment and breathing pattern during variable versus continuous flow nasal continuous positive airway pressure in premature infants: an evaluation of three devices. Pediatrics. 2001;107(2):304-8.
15. DiBlasi RM. Nasal continuous positive airway pressure (CPAP) for the respiratory care of the newborn infant. Respir Care. 2009;54(9):1209-35.
16. Lee K-S, Dunn MS, Fenwick M, Shennan AT. A comparison of underwater bubble continuous positive airway pressure with ventilator-derived continuous positive airway pressure in premature neonates ready for extubation. Neonatology. 1998;73(2):69-75.
17. Nekvasil R, Krátký J, Penkova Z, Stejskal J. High frequency" bubble" oscillation ventilation in the neonatal period. Cesk Pediatr. 1992;47(8):465-70.
18. Kaur C, Sema A, Beri RS, Puliyel JM. A simple circuit to deliver bubbling CPAP. Indian Pediatr. 2008;45(4):312.
19. Lucking SE, Fields AI, Mahfood S, Kassir MM, Midgley FM. High-frequency ventilation versus conventional ventilation in dogs with right ventricular dysfunction. Crit Care Med. 1986;14(9):798-801.
20. Chiaranda M, Rubini A, Fiore G, Giron G, Carlon GC. Hemodynamic effects of continuous positive-pressure ventilation and high-frequency jet ventilation with positive end-expiratory pressure in normal dogs. Crit Care Med. 1984;12(9):750-4.
21. Ammari A, Suri M, Milisavljevic V, Sahni R, Bateman D, Sanocka U, et al. Variables associated with the early failure of nasal CPAP in very low birth weight infants. Newborn Infant Nurs Rev. 2006;6(2):68-75.
22. Koti J, Murki S, Gaddam P, Reddy A, Dasaradha Rami Reddy M. Bubble CPAP for respiratory distress syndrome in preterm infants. Indian Pediatr. 2010;47:139-43.

23. Shah L, Chowdhury MA, Hoque M, Rahman A. Effect of Bubble CPAP in PTLBW Neonates with Respiratory Distress. Acad J Pediatr Neonatol. 2017;3(2):555609.
24. Koyamaibole L, Kado J, Qovu JD, Colquhoun S, Duke T. An evaluation of bubble-CPAP in a neonatal unit in a developing country: effective respiratory support that can be applied by nurses. J Trop Pediatr. 2006;52(4):249-53.
25. Pieper C, Smith J, Maree D, Pohl F. Is nCPAP of value in extreme preterms with no access to neonatal intensive care? J Trop Pediatr. 2003;49(3):148-52.