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RESEARCH ARTICLE

Analytical study for neonates with respiratory distress on Bubble Continuous Positive Airway Pressure admitted to NICU of Minia University Hospital

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Abstract

Introduction: Using nasal continuous positive airway pressure (CPAP) for neonatal respiratory support is highly increasing in low and middle-income countries. It reduces the needs for mechanical ventilation in neonates with respiratory distress (RD) in tertiary hospitals.

Objectives: This is a prospective non-randomized study aims to evaluate the role and efficiency of bubble CPAP in treatment of neonatal respiratory distress and correlation of bubble CPAP failure with different studied demographic, clinical and laboratory variable data.

Patients and methods: The study included all neonates with respiratory distress admitted to neonatal intensive care unit (NICU) - Minia University hospital from 1st of January to 31st of December 2017.The study analyzed the rate of failure and response of management of those patients on bubble CPAP and compared them with other different treatment modalities according to variable recorded demographic, clinical and laboratory data.

Results: Among the 280 cases, 149 patients (53.2%) were treated with oxygen, 52 patients (18.6%) needed to be treated with bubble CPAP, 79 patients (28.2%) needed to be intubated and mechanically ventilated (MV). Our study showed more incidences of bubble CPAP therapy of RD cases with higher gestational ages and birth weight, milder grades of RD, absence of sepsis in comparison with mechanical ventilation and vice versa for comparison with nasal oxygen therapy.

Conclusion:CPAP is an effective treatment of RD leading to significant improvement of outcome reducing hospital stay, need for invasive mechanical ventilation with its harmful adverse effects and thus the case fatality rate of RD cases and so the overall mortality rate of the NICU.

Key words: Respiratory distress, CPAP; Neonates; NICU, Preterm

Background:

Respiratory conditions are the most common reason for admission to a neonatal unit in both term and preterm infants. [1] Preventive and therapeutic measures for some of the most common causes are well studied and when implemented can reduce the burden of disease. Failure to readily recognize symptoms and treat the underlying cause of respiratory distress in the newborn can lead to short- and long-term complications, including chronic lung disease (CLD), respiratory failure, and even death [2]. Progress in neonatal intensive care is closely related to improvements in the management of respiratory failure in small infants. Current modalities of ventilator assistance range from CPAP to various modes of mechanical ventilation. The advent of less invasive methods of delivering CPAP to infants with RDS is associated with reduced need for intubation and mechanical ventilation and a lower incidence of CLD [3]. Continuous positive airway pressure re-expands collapsed alveoli, splints the airway, reduces work of breathing and improves the respiration [4]. Bubble CPAP, when used appropriately, is more cost effective, less intensive, requires less training and has lower risk of complications [5]. Patients and Methods: In January 2017, a strategy was established to promote the systematic use of bubble CPAP to avoid intubation and MV in neonates requiring ventilator assistance. All neonates admitted with respiratory distress were treated with oxygen by nasal cannula initially. Observation of clinical response was done. Improved cases did not need more intervention. Resistant and irresponsive cases were conducted on bubble CPAP. Clinical response of bubble CPAP cases was observed, cases either improved and successfully weaned or deteriorated and failed. Excluded cases were intubated and ventilated from the start. Demographic and clinical data of neonates included in the study were collected and analyzed. The data was correlated with CPAP success from one side and compared to other treatment modalities from the other side. Demographic data including weight, age, sex, maternal age, gestational age, cause and grade of respiratory distress, length of hospitalization, duration of ventilator assistance, and mortality were collected. In addition to laboratory data including hemoglobin, white blood cells count platelet count, C-reactive protein and arterial blood gases which were recorded and analyzed for neonates assisted during the study period. Fisher & Paykel Healthcare bubble CPAP was used in our study[6].The laboratory investigations were done under supervision of

medical staff team of clinical pathology unit in Minia University Hospital as follows: • CBC (Using SYMEX XP 300 machine). • CRP (Biomed – CRP " Egy - Chem" - catalog No.301040). • ABG (Using BG_800A machine). Inclusion criteria for neonates treated with bubble CPAP: 1) Respiratory distressed neonates irresponsive to usual oxygen treatment through nasal cannula were included. Oxygen requirement 30% or more to maintain SpO2 92–96% was an indicator for bubble CPAP interference. **Exclusion criteria:** 1- Severe cardiorespiratory instability in the form of shock and severe hypotension. 2- Unstable respiratory drive with frequent apneic episodes resulting in desaturation and/or bradycardia. 3- Inability to maintain PaCO2 less than 60 mmHg. 4- Surgical causes interfering with nasal bubble CPAP application.

Results: Study of clinical characters of bubble CPAP cases demonstrated significant relation of maternal age .

Discussion:

This study represents one of few prospective studies on the efficacy of nasal bubble CPAP in treating respiratory distress in both full term and preterm neonates of variable pulmonary and non-pulmonary causes despite definite age for interference.

In our study, RD cases showed male predominance for all studied groups (Table 1). This was in agreement with many studies reported predominiece of male gender and also reported 1.6 ratios for males to females of total cases **[7-10]**. It may be related to different hormonal profile which affects surfactant synthesis intrauterine.

Regarding to gestational age, we found that preterm cases were more than full term ones in all studied groups with no significant variation in the mean of GA per weeks. The results were in agreement with two studies observed preterm age group predominance among all treated groups**[10,11]**. The results are explained by the fact that preterm neonates were more susceptible to RDS because of relative surfactant deficiency.

The outcome of bubble CPAP therapy was expressed by mortality rate of 42.3% in comparison with 22.8% ($p<0.01$) for oxygen group (Cases died on oxygen only as there was no available CPAP or MV at time of arrest) and also in comparison to 92.4% ($p<0.001$) for MV group (Table 1)(Figure 1). The results may be reflection of the severity of illness for the selected cases for each group. This was in agreement with one study**[7]** noted higher mortality rate for mechanically ventilated group versus oxygen/CPAP group, also in agreement

with another study **[12]** who noticed high survival rate for bubble CPAP group.

[11] divided cases into group treated with bubble CPAP and another group treated with oxygen due to unavailability of the device on time of admission and this explains the higher survival rate of bubble CPAP group in contrary to our result.

We observed significant relation ($p<0.001$) of higher mean birth weight to CPAP success with highest failure rate for ELBW group (Table 2) (Figure 3). This was in agreement with others **[8,13]**. Also, we found significant positive correlation ($p<0.001$) between higher gestational ages (GA) and bubble CPAP success with 100% failure rate for GA≤29 weeks. The same positive correlation was noted by other reports**[8, 13-15].**

This significant relation may be attributed to correlation of lower birth weight and gestational age with more incidences of apneic episodes, cardiovascular instability and other complications of prematurity.

Regarding cause of RD, RDS represented the majority of failed cases. This was in agreement with ***Pillai et al., 2011*****[13]** who also correlated severity of RDS with CPAP failure. This reflects the need of more advanced intervention for severe cases of RDS considering surfactant use and/or mechanical ventilation.

In contrary to two studies **[14,15],** we found significant ($p<0.001$) longer duration of hospital stay of succeeded cases. The disagreement in results may be due to high mortality rate of failed cases in our study, most of cases died soon after CPAP failure.

As regard to laboratory data, our study correlated sepsis with CPAP failure by using higher CRP levels ($p<0.001$) and lower platelet counts ($p<0.03$) at failure of CPAP as indicators (Table 3). This was in agreement with the previous two studies**[13,14]** who correlated early neonatal sepsis with CPAP failure. The study revealed correlation of CPAP success with improving acidosis and hypoxia as interpreted by our ABG results. This was in concordance with other studies **[12,15]**.

As regard to the outcome of neonates treated with bubble CPAP, the rate of success was 57.7%, 30.8% of cases were ventilated, and 11.5% were deteriorated and died(Figure 2,3).The limited experience of physicians dealing with the Bubble CPAP was one of the causes which led to CPAP failure. Similar results were recorded by other reports **[8,12,14]** who reported that CPAP relatively succeeded to manage most of included RD cases.

Conclusion

CPAP is an effective treatment of respiratory distress leading to significant improvement of outcome of admitted neonates.Bubble CPAP use can reduce hospital stay, need for invasive mechanical ventilation with its harmful adverse effects and thus the case fatality rate of RD cases and so the overall mortality rate of the NICU. Bubble CPAP success is significantly correlated with higher birth weight, older gestational age, normal Hb level, proper sepsis control.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AE and RA conceived the study, carried out its designing, coordinated the implementation, helped to perform the statistical analysis and drafted the manuscript. RA and NM participated in the design of the study, analysis and interpretation of data and revised the statistics and final draft of the manuscript. RM participated in the conception and design of the study, collected the data and performed the statistical analyses. ME was responsible for interpretation of laboratory data of patients and revision of the manuscript. All authors read and approved the final manuscript.

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References

1. Pramanik AK, Rangaswamy N, Gates T. Neonatal respiratory distress. Pediatric Clinics. 2015;62(2):453-69.
2. Mahoney AD, Jain L. Respiratory disorders in moderately preterm, late preterm, and early term infants. ClinPerinatol. 2013; 40:665–78.
3. Polin RA, Sahni R. Newer experience with CPAP. SeminNeonatol 2002;7:379-89.
4. VanMarter LJ, Allred EN, Pagano M, Sanocka U, Parad R, Moore M, et al. Do clinical markers of barotraumas and oxygen toxicity explain interhospital variation in rates of chronic lung disease? The Neonatology Committee for the Developmental Network. Pediatrics. 2000;105:1194-201.
5. Stevens TP, Harrington EW, Blennow M, Soll RF. Early surfactant administration with brief ventilation vs. selective surfactant and continued mechanical ventilation for preterm infants with or at risk for respiratory distress syndrome. Cochrane Database Syst Rev. 2007;4:CD003063.
6. Fisher &Paykel Healthcare. Bubble CPAPsystem. [online] Available from: https://www.fphcare.com/bubble-cpap-system/ [Accessed 2nd June 2017].
7. Bajaj M, Natarajan G, Shankaran S, Wyckoff M, Laptook AR, Bell EF, et al. Delivery Room Resuscitation and Short-Term Outcomes in

Moderately Preterm Infants. The Journal of pediatrics. 2018;195:33-8. e2.
8. Arora V, Gediya SG, Jain R. Outcome of premature babies with RDS using bubble CPAP. International Journal of Contemporary Pediatrics. 2017;4(3):939.
9. Shin J, Park K, Lee EH, Choi BM. Humidified High Flow Nasal Cannula versus Nasal Continuous Positive Airway Pressure as an Initial Respiratory Support in Preterm Infants with Respiratory Distress: a Randomized, Controlled Non-Inferiority Trial. J Korean Med Sci. 2017; 32(4):650-5.
10. Rezzonico R, Caccamo LM, Manfredini V, Cartabia M, Sanchez N, Paredes Z, et al. Impact of the systematic introduction of low-cost bubble nasal CPAP in a NICU of a developing country: a prospective pre- and post-intervention study. BMC Pediatr. 2015;15:26.
11. Kawaza K, Machen HE, Brown J, Mwanza Z, Iniguez S, Gest A, et al. Efficacy of a low-cost bubble CPAP system in treatment of respiratory distress in a neonatal ward in Malawi. PloS one. 2014;9 (1):e86327.
12. Liton C S, Mak Azad C, Md Mahbubul H, Md. Abdulla A M, Maksudur R. Effect of Bubble CPAP in PTLBW Neonates with Respiratory Distress. Acad J PedNeonatol. 2017; 3(2): 555609.
13. Pillai MS, Sankar MJ, Mani K, Agarwal R, Paul VK, Deorari AK. Clinical prediction score for nasal CPAP failure in pre-term VLBW neonates with early onset respiratory distress. Journal of tropical pediatrics.
14. Koti J, Murki S, Gaddam P, Reddy A, Reddy MDR. Bubble CPAP for respiratory distress syndrome in preterm infants. Indian pediatrics. 2010;47(2):139-43.
15. 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. The Journal of pediatrics. 2005;147(3):341-7.
16. Amatya S, Macomber M, Bhutada A, Rastogi D, Rastogi S. Sudden versus gradual pressure wean from Nasal CPAP in preterm infants: a randomized controlled trial. Journal of perinatology: official journal of the California Perinatal Association. 2017; 37(6):662-7. Citation:

Table 1:"Demographic and clinical data of studied groups of RD cases"

Item		Oxygen		Bubble CPAP		MV		P value
		NO	%	NO	%	NO	%	
Sex	**Male** **Female**	94 55	63.1% 36.9%	36 16	69.2% 30.8%	48 31	60.8% 39.2%	0.6
Maturity	**Full term ≥ 37 weeks** **Preterm ≤36 weeks**	50 99	33.6% 66.4%	19 33	36.5% 63.5%	38 41	48.1% 51.9%	0.09
Cause	**Pulmonary** **Non-pulmonary**	134 15	89.9% 10.1%	39 13	75% 25%	45 34	57% 43%	0.001*
Outcome	**Improved** **Died**	115 34	77.2% 22.8%	31 21	57.69% 42.31%	6 73	7.6% 92.4%	0.001*
Total		149	53.2%	52	18.6%	79	28.2%	-
		280 ses (100%)						

NO (%):number and frequency for qualitative date, CPAP:continuous positive air way pressure, MV:mechanical ventilator.

Table 2:"Demographic and clinical data of studied bubble CPAP cases."

Item	Bubble CPAP success N=30	Bubble CPAP failed N=22	P-value
Age (months)	3.3±5.4	2.1±3.3	0.4
Sex Male Female	 24 (66.7%) 6 (37.5%)	 12 (33.3%) 10 (62.5%)	0.5
Birth weight (gm) NBW ≥2.5 LBW 1.5-2.4 VLBW 1.1-1.4 ELBW ≤1	2.3±0.8 12 (92.3%) 14 (77.8%) 2 (18.2%) 2 (20%)	1.3±0.5 1 (7.7%) 4 (22.2%) 9 (81.8%) 8 (80%)	0.001*
Gestational age (weeks) ≥37 30-36 ≤29	35.7±0.8 15 (83.3%) 15 (60%) 0 (0%)	31.3±3.4 3 (16.7%) 10 (40%) 9 (100%)	0.001*
Maternal age (years)	29.8±6.8	25.6±5.3	0.02*
Cause of RD Pulmonary Non pulmonary	 21 (51.2%) 9 (81.8%)	 20 (48.8%) 2 (18.2%)	0.06
Pathology RDS Pneumonia MAS NS CHD	 11 (36.7%) 5 (83.3%) 4 (100%) 8 (88.9%) 2 (66.7%)	 19 (63.3%) 1 (16.7%) 0 (0%) 1 (11.1%) 1 (33.3%)	0.01*
Length of hospitalization (days)	16.6±12.6	6.1±4.3	0.001*

Independent sample (t) test for analysis of quantitative variables represented by Mean ± SD. Chi – square (x^2) for analysis of qualitative data represented by Freq. (%)

*CPAP: continuous positive air way pressure, BW: birth weight, NBW: normal birth weight, LBW: low birth weight, VLBW: very low birth weight, ELBW: extremely low birth weight. RD: respiratory distress, RDS: respiratory distress syndrome, PN: pneumonia, MAS: meconium aspiration syndrome, NS: neonatal sepsis, CHD: congenital heart disease. *significant*

Table 3: "Analysis of laboratory results of bubble CPAP group of RD cases."

Item		Bubble CPAP success N=30	Bubble CPAP failed N=22	P-value
Hb (gm/dl)	At start At weaning or failure	14.6±2.4 12.7±1.6	15.2±2 12.4±2.8	0.3 0.5
TLC(ulx10^3)	At start At weaning or failure	13.2±6.1 10.7±3.4	14.1±10.9 13.6±10.8	0.7 0.2
Platelet(ulx10^3)	At start At weaning or failure	193±92 206±94	205±109 142±117	0.6 0.03*
CRP (mg/dl)	At start At weaning or failure	34±40 5±6	19±30 40±34	0.1 0.001*
pH	At start At weaning or failure	7.3±0.09 7.38±0.03	7.28±0.12 7.28±0.1	0.4 0.001*
SO2	At start At weaning or failure	90.5±13.5 97.3±2.6	85.4±11.7 84.1±10.3	0.1 0.001*
PO2	At start At weaning or failure	97.9±38.1 110.7±21.9	94.8±42.4 87.1±33.1	0.7 0.3
PCO2	At start At weaning or failure	35.9±11.1 35.4±4.1	35.8±15.6 35.3±16.1	0.9 0.9
HCO3	At start At weaning or failure	16.5±5.2 19.6±2.8	15.5±6.9 16.5±6.9	0.6 0.03*

*Independent sample (t) test for analysis of quantitative variables represented by Mean ± SD. Chi – square (x^2) for analysis of qualitative data represented by Freq. (%)*significant.* *SO2: oxygen saturation, Hb: hemoglobin, TLC: total leucocyte count., CRP: C-reactive protein*

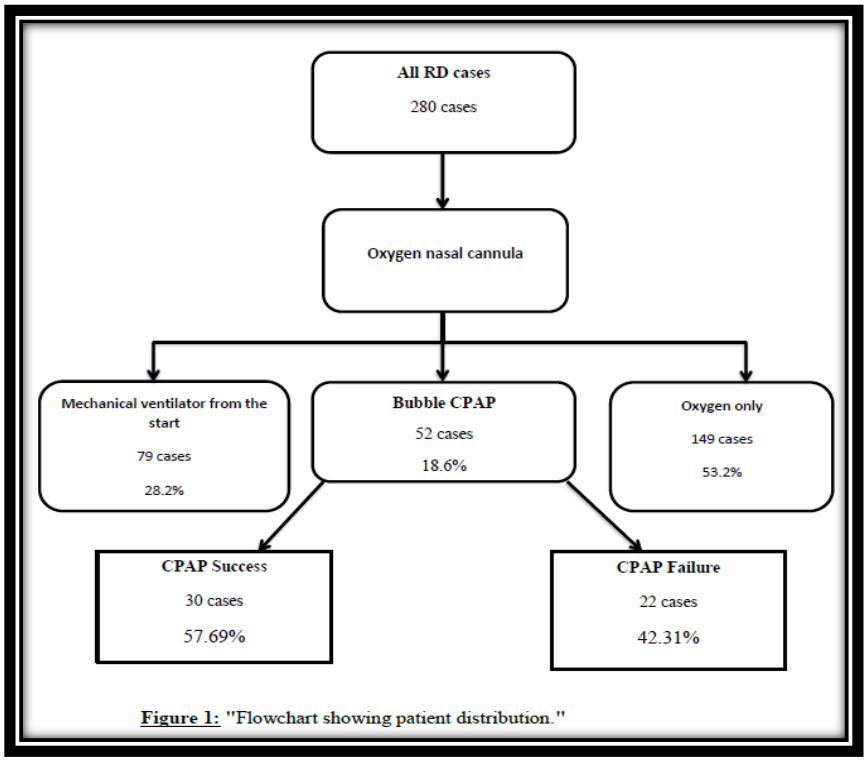

Figure 1: "Flowchart showing patient distribution."

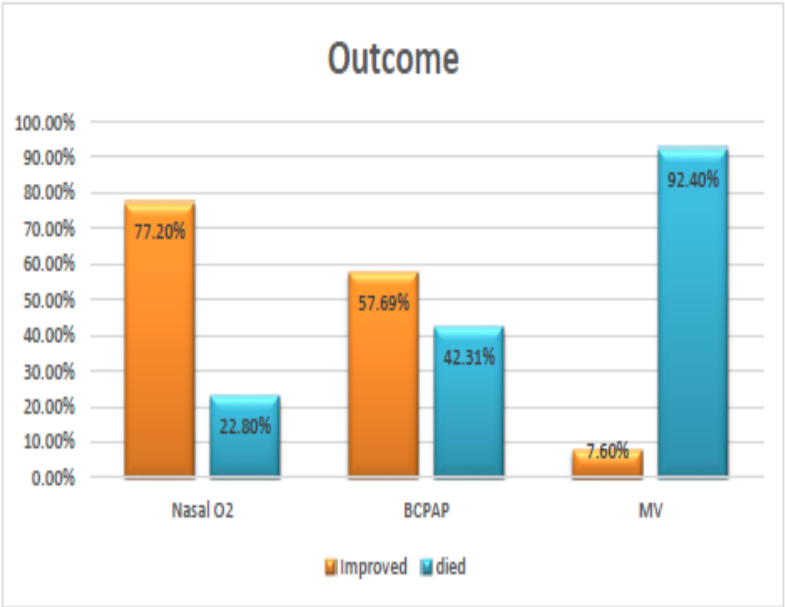

Figure 2: "Outcome of different groups of RD cases."

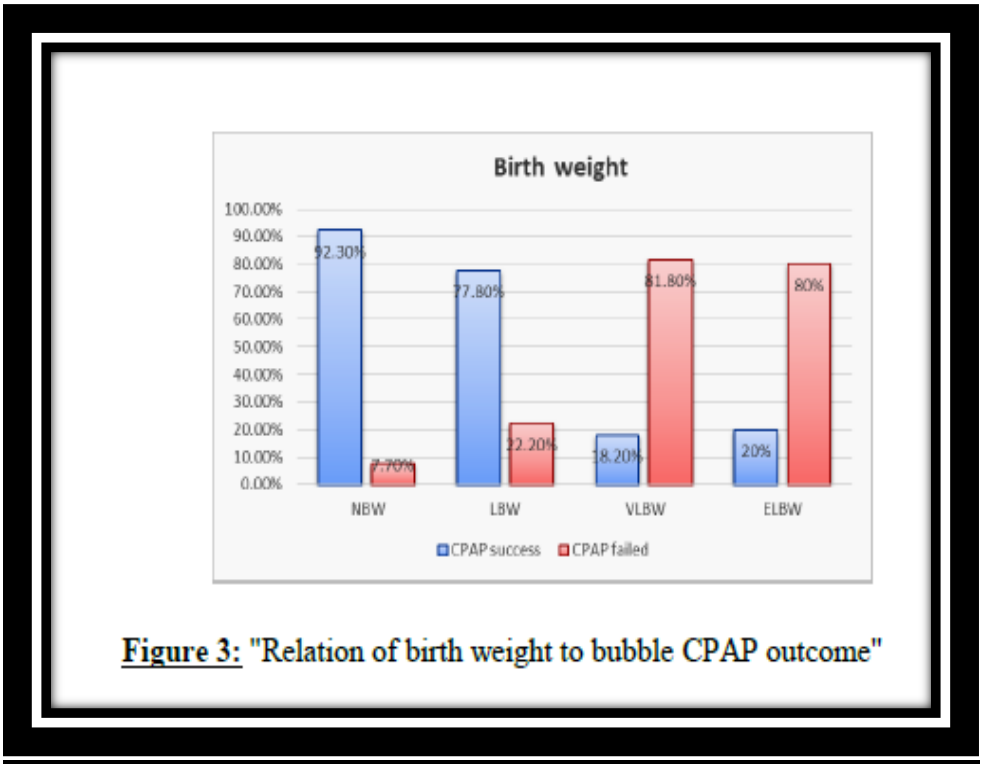

Figure 3: "Relation of birth weight to bubble CPAP outcome"

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