Effect of Bubble CPAP on severe pneumonia and severe respiratory distress in children and neonates: Detailed prospective observational study

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Pneumonia /ALRTI

- Commonest causes of morbidity and mortality in developing countries
- ~1.3 million children die annually.
- 11–20 million children hospitalized. (UNICEF, WHO , 2006).
- ~ 13% of children with pneumonia needing hospitalization have hypoxemia
- PNG: pneumonia accounts for 25-35% of all hospitalization and deaths

Bubble CPAP

- CPAP = continuous positive airway pressure

- Effects on lung function
  - maintenance of functional residual capacity
  - improves lung volume recruitment
  - prevents atelectasis
  - maintains energy reserves.

- CPAP with optimal humidification very helpful.

- Research on implementation and effectiveness of bCPAP
- Our study: most effective CPAP set-up, and the steps to implementation.

Aim / objectives

- To record detailed observations on the use of bubble CPAP
- To evaluate the clinical and other characteristics of children responding to CPAP
- To document the technical, clinical and training requirements in clinical pediatric care
- To educate clinicians with skills and knowledge

Methods

- **Study population**: 64 children
- **Study design**: detailed prospective observational study
- **Study site**: Pediatric HDU and the SCN in PMGH
- **Study duration**: March 2014 to August 2016
- **Selection criteria**: Children with severe pneumonia; children and neonates with severe respiratory distress. SpO_2 <90% despite oxygen
- Exclusion criteria: congenital heart disease, severe anaemia in heart failure, or severe birth asphyxia

- Pulse oximeter and respiratory distress score monitoring
- Quality assurance checks for oxygen concentrators and circuits
- Circuits and concentrators assessment.

- Training
- **Data extraction and analysis**: data form, MS Excel, STATA .
- **Ethical clearance**: SMHS, PMGH and MRAC

Results: Baseline characteristic

Characteristic	Total n=64
Male, n (%)	41 (64.1%)
Age in months: median (IQR)	3 (2-7)
Neonates (< 1month), n (%)	15 (23.4%)
Infants 1-12 month, n (%)	39 (68.4%)
>12 months, n (%)	7 (12.3%)
Weight (median, IQR)	4.7 (3.3-6.1)

Clinical observations characteristics

	Pre CPAP	1hr	24hr	48hr
Number of survivors n, (%)	64	64	48	39
Type of respiratory support requiring	CPAP			
SpO_2 , median (IQR)	78 (53.3-86.8)	92 (8-97.8)	96.5 (91.5-99)	98 (89.8-99)
Respiratory Distress Score, median (IQR)	11 (10-12)	9 (8-11)	8 (7-9)	7 (6.75-9)

Predictors of outcome

Characteristic	Total	Survived	Died	Univariable Odds Ratio (95% CI)	p-value
Neonatal age	18	8	10	1.05 (0.35-3.2)	0.93
Sepsis	8	0	8		**
Anemia	13	7	6	0.65 (0.19-2.2)	0.49
HIV	12	1	11	12.8 (1.5-106.8)	0.018 *
Tuberculosis	5	2	3	1.3 (0.2-8.3)	0.80
Severe malnutrition	5	1	4	3.6 (0.4-34.3)	0.26
Any comorbidity	35	14	21	1.6 (0.59-4.3)	0.35
Pre-CPAP SpO_2	64	77.4 (72.8-83.0)%	65.3 (57.9-72.7)%		0.013 *
Pre-CPAP RDS	64	10.7 (10.2-11.2)	10.8 (10.3-11.4)		0.72
One hour SpO_2	64	92.0 (88.5-95.3)%	83.3 (78.4-88.3)%		0.02 *
One hour RDS	64	8.8 (8.1-9.4)	9.9 (9.2-10.5)		0.006 *

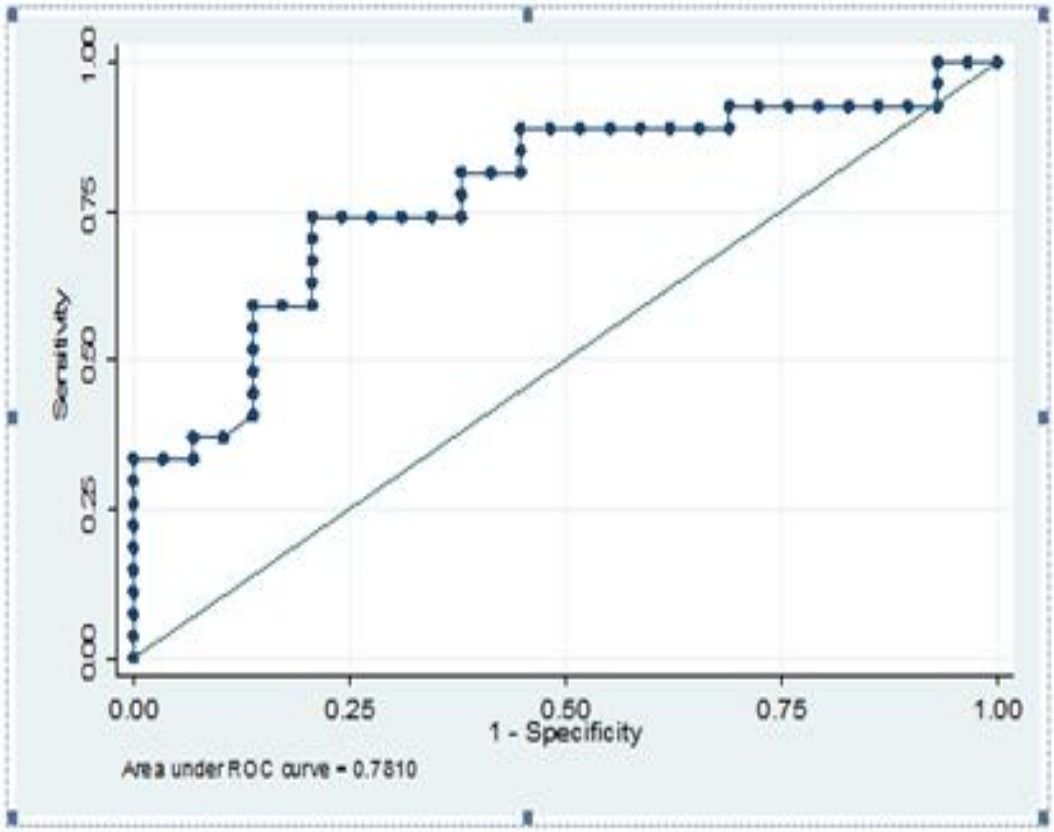


Figure 1. Area under the ROC curve for HIV, sepsis, the pre-CPAP SpO2, and the SpO2 and respiratory distress score one hour after commencing CPAP.

- Mortality: 54.7% (n=35). Multivariate :HIV (p =0.038), SpO_2 at 1 hour (p=0.08)

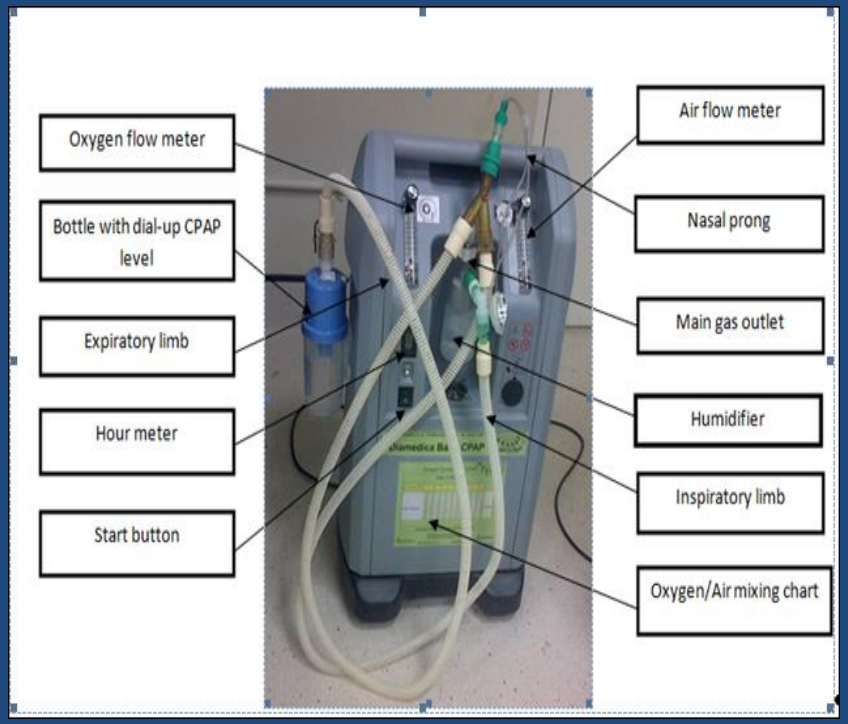
Discussion

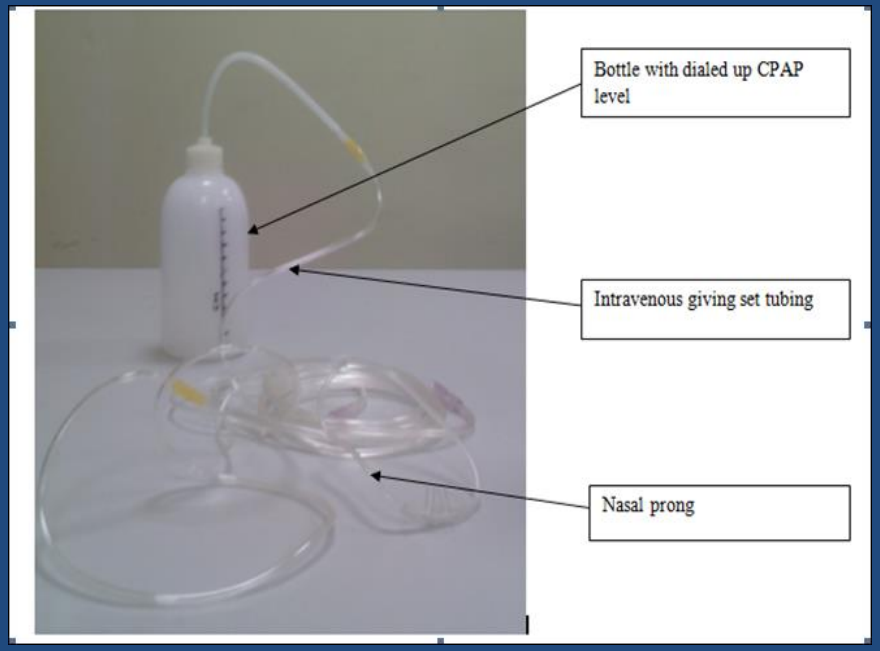
- HIV, sepsis, the pre-CPAP SpO_2, SpO_2 and respiratory distress score predicted outcome
- High mortality rate
  - Seriously ill patients and comorbidities
  - Late presentations, delaying administration of CPAP
  - Early familiarity of CPAP use.

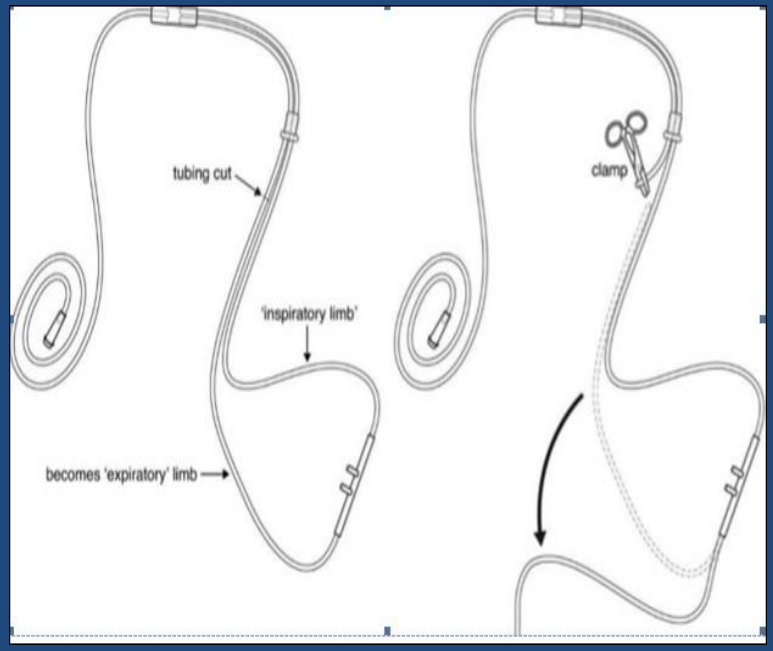
- Decreasing mortality rate
  - Early intervention of CPAP
  - Comorbidities and seriously ill patients managed properly
  - Clinicians familiar and confident in using CPAP

- Our study showed significant improvement in oxygenation and respiratory distress

Determining best equipments




Bottle with dialed up CPAP level
Intravenous giving set tubing
Nasal prong


tubing cut
'inspiratory limb'
becomes 'expiratory' limb
clamp

Way forward

- Introduce into selected provincial hospitals pediatric HDU
- Criteria and standardize respiratory distress score in using CPAP
- Protocol in care and using CPAP machine
- Hospital support in maintenance and ongoing procuring of equipment

Conclusion

- Bubble CPAP improves oxygenation and respiratory distress
- Risk factors for outcome:
  - HIV
  - Sepsis
  - Pre-CPAP SpO_2
  - At one hour low SpO_2 and RDS

- Majority of doctors not confident initially
- Need more nurses to be familiar with CPAP.
- Need for technical and clinical training .

Recommendation

- b CPAP with oxygen driven by oxygen concentrator, low resistance, robust circuits
- Early intervention of CPAP
- More training, familiarity and implementing CPAP.
- Protocol for training program and assessing skills and knowledge
- Financial and technical support .

References

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