PREDICTORS OF CONTINUOUS POSITIVE AIRWAY PRESSURE FAILURE IN PRETERM INFANTS WITH EARLY ONSET RESPIRATORY DISTRESS

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Abstract

- Preterm neonates are at high risk of developing respiratory distress (RD) in the immediate post-natal period. Traditionally, these infants are managed by intubation and mechanical ventilation. The risks of mechanical ventilation to premature lungs are well known. Even a brief exposure to large volume breaths can initiate an inflammatory cascade leading to bronchopulmonary dysplasia (BPD).

- Avoiding intubation in the delivery room and stabilization with nasal continuous positive airway pressure (NCPAP) improves outcomes. Recently, use of CPAP is becoming the first-line treatment in preterm infants at birth, reducing the need for mechanical ventilation and surfactant replacement.

- However, NCPAP failure rates remain unacceptably high, with many newborns requiring secondary mechanical ventilation as well as delayed surfactant administration, with increased risk of mortality and major morbidity. Several reports have suggested that NCPAP failure is associated with a higher risk of adverse outcomes, including pneumothorax, BPD and intraventricular hemorrhage (IVH), than the group for whom NCPAP successfully avoids intubation.

- Identifying infants at risk for NCPAP failure could help target early interventions to avoid intubation and MV. Several factors associated with NCPAP failure have been proposed in the literature, mainly lower gestational age, birth weight, oxygenation parameters in the first hours of life and the presence of severe respiratory distress syndrome (RDS) on the initial chest radiograph. However, there is still a need to evaluate the modifiable risk factors that result in NCPAP failure.

Aim of the work

- This study aimed to detect early predictors of NCPAP failure in preterm infants ≤34 weeks with early onset mild to moderate respiratory distress.

Methods

- This was a prospective observational study conducted on (120) preterm infants delivered at Alexandria University Maternity Hospital (AUMH) whose gestational age was ≤ 34 weeks with mild to moderate respiratory distress admitted to the neonatal intensive care unit (NICU) on NCPAP. Early CPAP failure was defined as the need for mechanical ventilation in the first 72 h after birth.

- Baseline characteristic predictors and outcome variables were compared between infants who had successful and failed nasal CPAP. To find the predictors of NCPAP failure, multivariable logistic regression analysis with backward stepwise elimination variable selection method was used.

- Reliability of Fraction of inspired oxygen (FiO_2) and saturation oxygen pressure index (SOPI) to predict NCPAP failure was assessed by using receiver operating characteristic (ROC) curve.

Results

- From 120 infants included, 54 (45%) failed NCPAP. Bivariate analysis showed gestational age, saturation oxygen pressure index (SOPI), Silverman Anderson respiratory severity score (RSS), highest NCPAP settings (positive end-expiratory pressure (PEEP), FiO_2) in first 72 hours, product of PEEP and FiO_2 and initial chest X-ray were all risk factors of NCPAP failure. However, only gestational age (P= 0.003; OR 0.641; 95% CI 0.479-0.858), antenatal steroid intake (P= 0.023; OR 0.27; 95% CI 0.087-0.836) and FiO_2 (P= 0.0001; OR 8.918; 95% CI 3.044-26.123) were significant predictors for NCPAP failure by multivariate analysis.
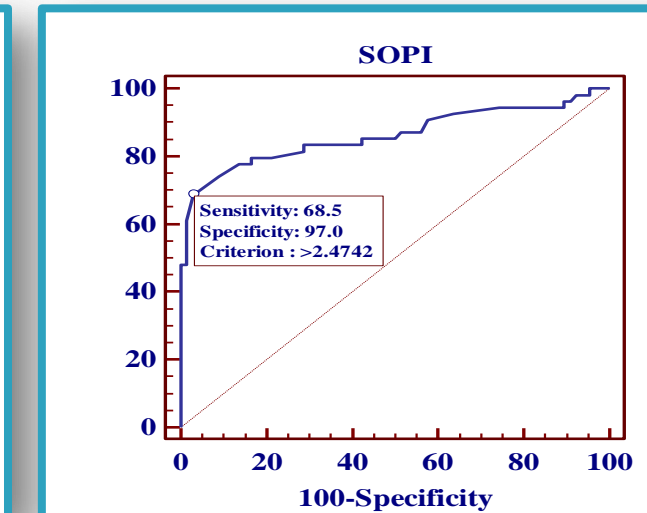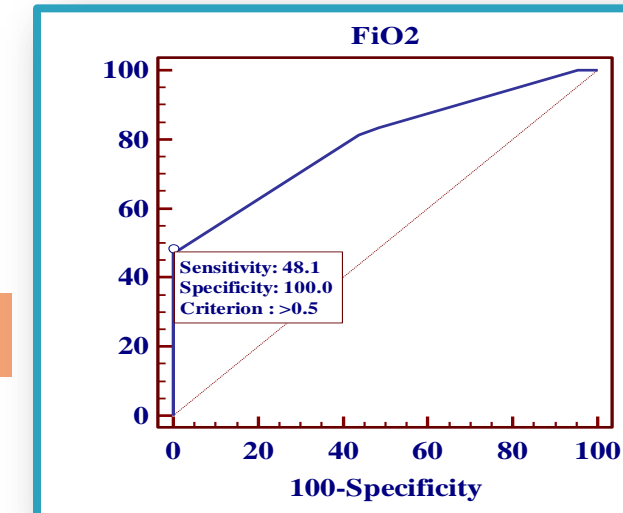
Model	Unstandardized Coefficients		Odd Ratio	Sig.	95% Confidence Interval for Odd Ratio	
	B	Std. Error			Lower Bound	Upper Bound
Constant	14.899	4.740	-	0.002*	-	-
Gestational age	-0.445	0.149	0.641	0.003*	0.479	0.858
Antenatal steroids intake [a]	-1.309	0.577	0.270	0.023*	0.087	0.836
Chest X ray [b]				0.645	0.922	2.647
➤Severe RDS	0.035	1.043	1.036	0.973	0.134	8.001
➤Pneumonia	0.720	0.769	2.054	0.349	0.455	9.271
Product of PEEP &FiO_2 [c]	0.462	1.037	1.58	0.656	0.208	12.11
FiO_2	2.188	0.548	8.918	0.0001*	3.044	26.123

Dependent Variable: CPAP failure   *: statistically significant ≤0.05
a; Not taking steroid   b; Mild and moderate RDS   c; ≥1.28

- By testing the reliability of FiO_2 and SOPI to predict CPAP failure, a cut-off point of FiO_2 >0.5 had a sensitivity of 48.15%, specificity of 100%, its positive predictive value was 96.3% and its negative predictive value was 69.9%, area under the curve (AUC) was 0.796 (P= 0.0001). While a cut-off point of SOPI >2.47 had a sensitivity of 68.52%, specificity of 96.97%, its positive predictive value was 94.9% and its negative predictive value was 79.0%, AUC was 0.86 (P= 0.0001).

FiO2 — Sensitivity: 48.1 Specificity: 100.0 Criterion : >0.5

SOPI — Sensitivity: 68.5 Specificity: 97.0 Criterion : >2.4742

Conclusions

- CPAP failure occurs frequently in preterm infants, and is associated with high risk of mortality and major morbidities.

- The early initiation of CPAP in combination with a tolerance of a higher FiO_2 threshold (FiO_2 > 0.5) for CPAP failure may have increased the number of infants succeeding with CPAP. The low incidence of BPD at 36 weeks PMA in infants successfully maintained on CPAP suggests a possible benefit of that approach.

- Gestational age, antenatal steroid intake and FiO_2 are predictive of CPAP failure in preterm newborns.

- An FiO_2 of >0.5 in first 72 hours of life is predictive of CPAP failure in preterm infants ≤ 34 weeks.

- Saturation oxygen pressure index (SOPI) offers a near-continuous non-invasive assessment tool for newborns on NCPAP. A SOPI of > 2.47 is predictive of CPAP failure in preterm infants ≤ 34 weeks.