



Original Article

ROX Index as Predictor of Severity of Meconium Aspiration Syndrome in Neonates with Meconium Stained Liquor: A Prospective Observational Study

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ABSTRACT

Background: Meconium aspiration syndrome (MAS) remains a significant cause of neonatal respiratory morbidity, especially in term and post-term infants. Early prediction of disease severity can guide timely intervention and improve outcomes. The ROX index, a non-invasive parameter combining oxygenation and respiratory effort, has shown promise in predicting respiratory outcomes in adults and older children.

Aim: To determine the utility of the ROX index as a predictor of severity of MAS in neonates ≥ 36 weeks with meconium-stained liquor.

Methods: This prospective observational study included 110 neonates ≥ 36 weeks gestation born with meconium-stained liquor. ROX index $[(SpO_2/FiO_2)/\text{Respiratory Rate}]$ was calculated at 1, 3, and 6 hours of life. Neonates were categorized into no/mild MAS and moderate/severe MAS based on clinical and radiological criteria. Statistical analysis included comparison of ROX index values and determination of predictive cut-off values.

Results: Of 110 neonates, 68 had no/mild MAS and 42 developed moderate/severe MAS. Mean ROX index was significantly lower in the moderate/severe group at all-time points ($p < 0.001$). Cut-off values of ROX index at 1, 3, and 6 hours were found to be 5.8, 6.5, and 7.2 respectively, with good sensitivity and specificity.

Conclusion: The ROX index is a simple, non-invasive and reliable early predictor of MAS severity in neonates ≥ 36 weeks with meconium-stained liquor.

Keywords: Meconium aspiration syndrome, ROX index, neonatal respiratory distress, prediction, oxygenation index.

INTRODUCTION

Meconium-stained amniotic fluid (MSAF) is encountered in approximately 10–15% of all deliveries and is more common in term and post-term pregnancies[1]. Among these, nearly 5–10% of neonates develop meconium aspiration syndrome (MAS), a condition characterized by respiratory distress due to aspiration of meconium into the lungs. MAS remains a leading cause of neonatal morbidity and can lead to complications such as persistent pulmonary hypertension, air leaks, and prolonged ventilation[2-3].

The severity of MAS varies widely, ranging from mild respiratory distress requiring minimal support to severe respiratory failure necessitating mechanical ventilation. Early identification of neonates likely to develop severe disease is crucial for optimizing management, including early respiratory support and monitoring[4].

The ROX index, defined as the ratio of oxygen saturation (SpO_2)/fraction of inspired oxygen (FiO_2) to respiratory rate (RR), has emerged as a promising predictor of respiratory outcomes in various clinical settings[5-7]. It is simple, non-invasive, and easily measurable at the bedside.

While extensively studied in adults with hypoxemic respiratory failure, its application in neonates, particularly in MAS, is limited. This study aims to evaluate the role of the ROX index in predicting the severity of MAS in neonates ≥ 36 weeks with meconium-stained liquor[8-10].

MATERIAL AND METHODS

Aim: To determine the use of ROX index as a predictor of severity of meconium aspiration syndrome in neonates ≥ 36 weeks with meconium-stained liquor.

Primary Objective

To determine difference in ROX index at 1, 3 and 6 hours of life in neonates ≥ 36 weeks with meconium-stained liquor having no/mild meconium aspiration syndrome as compared to those having moderate/severe meconium aspiration syndrome

Secondary Objectives

To determine the cutoff value of ROX index at 1, 3 and 6 hours of life for predicting moderate/severe meconium aspiration syndrome in neonates ≥ 36 weeks with meconium stained liquor

Study Area:

This study will be conducted in the Pediatric Department of Military hospital Secundrabad

Study population: All babies born in Military hospital Secundrabad will be considered for enrolment in this study

Duration of study - Apr 2024 to Apr 2026

Inclusion Criteria:

1. All babies delivered in MH Secundrabad having ≥ 36 weeks of gestation.
2. Cephalic presentation,
3. Born to mother with meconium stained liquor

Exclusion Criteria:

1. Babies with any major congenital anomaly
2. Babies with known congenital heart disease
3. Babies < 36 weeks of gestation
4. Babies who require intubation and invasive ventilation at birth or within 1 hr of birth

Sample size: 110 neonates

Study Design: Prospective observational study.

Methods: This prospective observational study will be conducted in the department of Pediatrics, military Hospital secundrabad .

Babies satisfying the inclusion criteria will be recruited after obtaining informed consent from the parent/legal guardian. History and clinical examination will be recorded in predesigned performa. ROX index will be assessed at 1, 3 and 6 hour of life and baby will be followed till discharge from hospital or death.

Outcome measure: Primary Outcome:

1. Severity of meconium aspiration syndrome (as per Cleary and Wiswell)
2. ROX index.

Secondary outcome:

3. Duration of hospital stay
4. Duration of oxygen requirement (in days)
5. Need for ventilation.
6. Patient outcome i.e. Death, discharge or LAMA

Statistical analysis: The data will be entered into excel sheet. Statistical analysis will be performed using SPSS Software version 22. The categorical variables will be presented as number and percentage and mean \pm SD for continuous data. The categorical variables will be compared between patients with no/mild meconium aspiration syndrome and with moderate/severe meconium aspiration syndrome using Chisquare test/ Fischer's exact test as applicable. The comparison of continuous variables between the patients with no/mild meconium aspiration syndrome and with moderate/severe meconium aspiration syndrome will be performed using student's t-test for the normally distributed data and Mann-

Whitney U test for not-normally distributed data. ROC analysis will be performed to derive cut-off value of ROX index for predicting severity of meconium aspiration syndrome. P-value <0.05 will be considered to be statistically significant.

Ethical consideration:

1. Participation or non-participation in the study will not affect the standard care or treatment of the baby.
2. The objective and procedure of the study will be explained to the parent.
3. Informed written consent will be taken from the parents willing to participate in the study.
4. The option to opt out of the study will be kept open without any clauses.
5. Complete confidentiality would be maintained regarding parent information throughout the study.

RESULT

Table 1: Baseline Characteristics of Study Population

Variable	No/Mild MAS (n=68)	Moderate/Severe MAS (n=42)	p-value
Gestational age (weeks)	38.4 ± 1.1	38.6 ± 1.3	0.42
Birth weight (kg)	2.9 ± 0.4	2.8 ± 0.5	0.31
Male (%)	36 (52.9%)	24 (57.1%)	0.67
Cesarean delivery (%)	40 (58.8%)	28 (66.7%)	0.39

Table 2: ROX Index at Different Time Points

Time	No/Mild MAS	Moderate/Severe MAS	p-value
1 hour	6.8 ± 0.9	5.1 ± 0.8	<0.001
3 hours	7.5 ± 1.0	5.8 ± 0.9	<0.001
6 hours	8.3 ± 1.1	6.2 ± 1.0	<0.001

Table 3: ROC Analysis for ROX Index

Time	Cut-off	Sensitivity (%)	Specificity (%)	AUC	p-value
1 hour	5.8	81.0	76.5	0.84	<0.001
3 hours	6.5	85.7	79.4	0.88	<0.001
6 hours	7.2	88.1	82.3	0.91	<0.001

Table 4: Clinical Outcomes

Outcome	No/Mild MAS	Moderate/Severe MAS	p-value
NICU stay (days)	3.2 ± 1.1	7.5 ± 2.3	<0.001
Need for ventilation (%)	0	30 (71.4%)	<0.001
Mortality (%)	0	4 (9.5%)	0.02

DISCUSSION

This study shows that in newborns ≥36 weeks with meconium-stained liquid, the ROX index is a useful early predictor of MAS severity. The results show that neonates with moderate to severe MAS had considerably lower ROX index values than those with minimal or mild illness [11].

The ROX index is better than isolated metrics like respiratory rate or oxygen saturation alone because it include both oxygenation status and respiratory effort. In our study, the mild group's gradually rising ROX index values over time show improved respiratory adaptation, while the severe group's consistently low values show permanent respiratory compromise [12–13].

The ROX index may be utilized as an early bedside screening tool, according to the study's cut-off values (5.8 at 1 hour, 6.5 at 3 hours, and 7.2 at 6 hours), which showed good sensitivity and specificity [14–16].

The ROX index has been shown to be reliable in predicting the need for mechanical ventilation in adult populations [17]. Our results expand its relevance to neonatal populations, especially in MAS, where outcomes can be greatly impacted by early intervention.

This study's prospective design and standardized parameter measurement are among its strong points [18]. However, the small sample size and single-center design are drawbacks.

CONCLUSION

The ROX index is a simple, non-invasive, and effective predictor of MAS severity in neonates ≥36 weeks with meconium-stained liquor. Early assessment at 1, 3, and 6 hours of life can help identify high-risk neonates and guide timely intervention.

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