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Original Research Article

Incidence and Complications of Meconium Aspiration Syndrome in Term Neonates – A Prospective Observational Study

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Abstract

Background: Meconium aspiration syndrome (MAS) is a major respiratory condition in term neonates, occurring when meconium-stained amniotic fluid (MSAF) is aspirated, causing airway obstruction, inflammation, and surfactant dysfunction. MSAF is seen in 10-20% of term deliveries worldwide, with MAS developing in 5-30% of those cases depending on setting and meconium thickness. In India, higher rates are often reported in tertiary centers due to referral patterns and delayed care. Risk factors include post-term gestation, fetal distress, and thick meconium. Complications range from respiratory failure and pneumothorax to persistent pulmonary hypertension of the newborn (PPHN), hypoxic-ischemic encephalopathy, and mortality. Despite improvements in perinatal care, MAS contributes significantly to neonatal intensive care admissions. This study examined the incidence and complications of MAS in term neonates at a tertiary hospital in Gujarat, India, to provide local insights and support improved protocols.

Material and Methods: This prospective observational study was carried out over a year at a tertiary care hospital in western Gujarat, screening 940 term deliveries. Neonates with MSAF were followed for MAS signs. Institutional Ethics Committee approval was obtained, following Helsinki guidelines, with parental informed consent. Inclusion: term (37-42 weeks) neonates with MSAF. Exclusion: preterm/post-term extremes, congenital anomalies, non-MSAF births, or incomplete data. Data included demographics, clinical features, complications, and outcomes via records and follow-up. SPSS version 25 was used; chi-square for associations, logistic regression for risks, $p<0.05$ significant.

Results: Of 940 term deliveries, 132 (14%) had MSAF, and 16 (12.1%) developed MAS, giving an incidence of 1.7 per 100 live births. Males were 62.5% (10/16). Complications included respiratory failure (68.8%), pneumothorax (18.8%), PPHN (12.5%), neurological injury (12.5%), and sepsis (6.3%). Mortality was 6.25% (1 case). Detailed tables cover demographics, incidence by gestation, complications, and outcomes.

Conclusion: MAS incidence in this cohort matches regional Indian trends, with notable preventable complications. Strengthening antenatal surveillance and timely delivery interventions could lower burden. Enhanced neonatal management in high-risk cases remains key.

Keywords: Meconium Aspiration Syndrome, Term Neonates, Incidence, Complications, Respiratory Failure, India.

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Introduction

Meconium aspiration syndrome (MAS) is a serious neonatal respiratory issue arising from inhalation of meconium-stained amniotic fluid (MSAF), leading to mechanical blockage, chemical inflammation, and gas exchange problems. It predominantly affects term and post-term infants, where fetal stress triggers meconium passage. In high-income countries, incidence has declined with better obstetric monitoring, but in low- and middle-income regions like India, it persists due to variable access to care. Pathophysiology includes surfactant inactivation, airway obstruction, and secondary infection risks. Symptoms appear soon after birth, with tachypnea, grunting, and cyanosis, often requiring intensive support. [1,2] Common risk factors are post-term pregnancy, oligohydramnios, maternal conditions like hypertension, and intrapartum fetal distress. Complications extend to air leaks like pneumothorax, persistent pulmonary hypertension (PPHN), hypoxic brain injury, and multi-organ effects from prolonged hypoxia. Studies show MSAF in 10-15% of deliveries, with MAS in 5-20% of MSAF cases, varying by meconium consistency and setting. Indian reports indicate

higher proportions in rural or referral centers. Long-term issues like chronic lung disease highlight the importance of early detection and management.[3,4] This study is justified by the need for updated, institution-specific data in Gujarat, where term deliveries are increasing and local MAS patterns remain under-documented. Evaluating incidence and complications will help identify modifiable factors, refine protocols, and guide senior pediatric faculty in advocating for better perinatal practices to reduce neonatal morbidity.

Material and Methods

The study was a prospective observational cohort conducted at a tertiary care hospital in western Gujarat, India, over a year. It involved monitoring term neonates born through MSAF for MAS development. General information included routine antenatal checks, labor monitoring, and immediate neonatal assessment. Ethical considerations were paramount; approval was granted by the Institutional Ethics Committee, adhering to Helsinki Declaration principles. Informed written consent was obtained from parents or guardians prior to enrollment, ensuring confidentiality and voluntary participation. No interventions beyond standard care were applied, minimizing risks.

Inclusion criteria encompassed neonates at 37-42 weeks gestation with confirmed MSAF during delivery, vigorous at birth or requiring resuscitation. Exclusion criteria involved preterm infants (<37 weeks), post-term (>42 weeks), those with major congenital malformations, intrauterine growth restriction unrelated to MAS, or deliveries without MSAF. Cases with maternal substance abuse or incomplete records were also excluded to maintain data integrity.

Data collection involved demographic details, clinical parameters, and complication profiles via standardized proformas. Statistical analysis used SPSS 25.0; descriptive statistics for frequencies, chi-square for categorical associations, and for risk factors. P-values <0.05 indicated significance, with confidence intervals at 95%.

Results

In 940 term deliveries screened, 132 neonates (14%) were delivered through MSAF, and 16 (12.1% of MSAF) met MAS criteria, for an overall incidence of 1.7 per 100 term live births. Males comprised 10 (62.5%), mean birth weight 3.05 kg (range 2.4-3.7 kg), and mean gestational age 39.1 weeks. Respiratory distress began within 6 hours in 81% of cases, often needing supplemental oxygen or support. No strong link existed with maternal age ($p=0.18$), but fetal distress signs correlated significantly ($p<0.01$).

Table 1: Demographic Characteristics of Neonates with MAS (n=16)

Parameter	Number (%) or Mean ± SD
Male	10 (62.5%)
Female	6 (37.5%)
Birth Weight (kg)	3.05 ± 0.35
Gestational Age (weeks)	39.1 ± 1.0
Maternal Age (years)	27.8 ± 3.9
Mode of Delivery: Vaginal	11 (68.8%)
Cesarean	5 (31.2%)

Table 2: Incidence of MAS by Gestational Age

Gestational Age	Total MSAF Cases	MAS Cases (%)
37-38 weeks	45	3 (6.7%)
39-40 weeks	57	7 (12.3%)
41-42 weeks	30	6 (20.0%)

Table 3: Frequency of Complications in MAS Cases (n=16)

Complication	Number (%)
Respiratory Failure	11 (68.8%)
Pneumothorax	3 (18.8%)
Persistent Pulmonary Hypertension (PPHN)	2 (12.5%)
Neurological Injury	2 (12.5%)
Sepsis	1 (6.3%)
Metabolic Acidosis	1 (6.3%)

Table 4: Outcomes of Neonates with MAS (n=16)

Outcome	Number (%)
Full Recovery	13 (81.3%)
Required Follow-up	2 (12.5%)
Mortality	1 (6.25%)

Discussion

Meconium aspiration syndrome remains a notable challenge in neonatal respiratory care, especially in term infants where fetal compromise leads to meconium passage and subsequent lung injury. The condition's severity varies with meconium thickness, timing of aspiration, and promptness of intervention. This overview aligns with ongoing literature stressing integrated obstetric-neonatal strategies to mitigate impact. [5,6]

Our study's MAS incidence of 12.1% among MSAF cases (17 per 1000 live births) is consistent with several Indian reports. For instance, a rural tertiary center in India documented 31.8% MAS in MSAF, higher due to post-term predominance, while a South Indian observational study reported 1.79% overall incidence among admissions. Internationally, epidemiology reviews note 2-12% MAS in MSAF, with lower figures in high-resource settings like the US (around 1.8 per 1000). Differences likely stem from referral bias and antenatal monitoring access in our context. [7,8,9]

Respiratory failure was prominent at 68.8%, similar to patterns in Indian studies where ventilation needs were common in MAS cohorts. A tertiary center analysis showed comparable rates requiring support, while international data from Taiwan highlight long-term pulmonary risks but lower acute failure in managed cases. These align with our observations, though our rate reflects typical tertiary referral delays. [10,11]

Pneumothorax affected 18.8%, close to reports from Indian profiles (around 5-10%) and Pakistani series (9.6%). Global reviews suggest 5-20% air leak incidence, reduced by modern ventilation. Our findings emphasize early radiographic evaluation in symptomatic infants to manage this complication effectively. [12]

PPHN occurred in 12.5%, echoing South Indian data (24.8% in severe cases) and guidelines noting it as frequent in MAS. International Taiwanese studies link PPHN to neurodevelopmental issues, while Chinese cohorts report higher in early-term.

This underscores echocardiography importance and targeted therapies like inhaled nitric oxide. Neurological injury was seen in 12.5%, comparable to Chinese 9-year data (up to 52% in subsets) and Indian reports associating hypoxia with encephalopathy. Global overviews tie it to overall distress severity. Long-term follow-up is essential for affected neonates in our setting. [13]

Mortality stood at 6.25%, aligning with Indian tertiary observations (4.34%) and reductions in recent studies through better care. Ethiopian and Pakistani reports show higher rates in limited-resource emergencies, while international trends indicate declines with protocols. Our low figure suggests effective management despite challenges. [14]

Limitations involve single-center focus, potentially affecting wider applicability, and clinical rather than universal advanced imaging reliance.

Conclusion

Our study on meconium aspiration syndrome (MAS) in 940 term neonates shows an incidence of 1.7 per 100 live births (12.1% in MSAF cases), aligning with Indian regional trends. Key complications include respiratory failure (68.8%) and pneumothorax (18.8%), highlighting ongoing burdens. Timely antenatal monitoring for late-term cases and fetal distress can mitigate risks. Enhanced delivery protocols, like selective intubation, may lessen severity. Prior studies underscore localized data's value for tailored interventions. Reducing MAS morbidity demands integrated obstetric-neonatal care. This offers insights for senior faculty in training and policy. Future multicenter trials could validate findings. Proactive strategies promise better neonatal outcomes.

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