



ASSESSMENT OF FETAL AND NEONATAL OUTCOME IN MECONIUM-STAINED AMNIOTIC FLUID AT TERTIARY CARE CENTRE

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is a common intrapartum finding associated with increased maternal intervention and neonatal morbidity. Although the presence of meconium does not always indicate fetal distress, thick meconium and abnormal fetal heart rate patterns are frequently linked with adverse neonatal outcomes, including meconium aspiration syndrome (MAS), birth asphyxia, and neonatal intensive care unit (NICU) admission. This study aimed to assess fetal and neonatal outcomes in pregnancies complicated by MSAF.

Methods: A prospective observational study was conducted over 18 months at a tertiary care center from July 2024 to January 2026. A total of 66 pregnant women with meconium-stained amniotic fluid were enrolled according to predefined inclusion and exclusion criteria. Maternal demographic details, obstetric characteristics, intrapartum findings, cardiotocography (CTG) patterns, mode of delivery, and neonatal outcomes were recorded. Neonates were assessed using Apgar scores at 1 and 5 minutes and monitored for complications such as meconium aspiration, MAS, respiratory distress, birth asphyxia, sepsis, NICU admission, and early neonatal death. Data were analysed using descriptive statistics.

Results: The mean maternal age was 29.29 ± 6.73 years, and the mean gestational age was 38.80 ± 1.81 weeks. Abnormal fetal heart rate patterns were observed in 28.8% of cases. Caesarean delivery was required in 50% of women. Meconium aspiration occurred in 25.8% of neonates, while 13.6% developed MAS. NICU admission was required in 37.9% of newborns. The mean Apgar score improved from 7.37 ± 1.36 at 1 minute to 8.30 ± 1.50 at 5 minutes. Early neonatal mortality was low (1.5%), and 86.4% of neonates were discharged healthy.

Conclusion: MSAF remains an important intrapartum risk factor associated with increased operative delivery and neonatal morbidity. Careful fetal monitoring, early identification of fetal distress, and timely neonatal resuscitation significantly improve perinatal outcomes. Thick meconium and abnormal CTG findings were strongly associated with adverse neonatal outcomes.

KEYWORDS: Meconium-stained Amniotic Fluid, Meconium Aspiration Syndrome, Cardiotocography, Neonatal Outcome, Fetal Distress, NICU.

Introduction

Meconium-stained amniotic fluid (MSAF) occurs in approximately 12–16% of all deliveries worldwide, with incidence rising to 25–30% in post-term pregnancies beyond 41 weeks.^[1,2] Meconium is a sterile, viscous, greenish-black substance composed of intestinal epithelial cells, lanugo, bile salts, mucus, and enzymes, normally retained in the fetal intestine until after birth. Its antepartum or intrapartum passage into the amniotic cavity has long been considered a marker of fetal distress, primarily attributed to hypoxic-induced vagal stimulation, increased peristalsis, and anal sphincter relaxation.^[3]

However, contemporary evidence suggests that meconium passage is not always pathological; it can also represent physiological gastrointestinal maturation, especially in term and post-term fetuses.^[4] This dual nature makes MSAF a clinical challenge: it may be benign or indicate fetal compromise requiring urgent intervention. The most feared complication is meconium aspiration syndrome (MAS), characterized by airway obstruction, surfactant inactivation, chemical pneumonitis, and persistent pulmonary hypertension of the newborn (PPHN), which remains a major cause of neonatal respiratory morbidity and mortality.^[5]

Historically, MSAF prompted routine intrapartum oropharyngeal suctioning and even prophylactic endotracheal suctioning, but large randomized trials have shown no benefit from these practices.^[6] Current guidelines (ACOG, 2017; NRP 2020) recommend that management be guided by fetal heart rate patterns and neonatal vigor at birth rather than the presence of meconium alone.^[7,8] Despite these advances, MSAF continues to be associated with increased rates of cesarean section, operative vaginal delivery, and NICU admissions, particularly in low- and middle-income countries where intrapartum monitoring may be suboptimal.^[9]

Given the paucity of recent prospective data from Indian tertiary care centers, this study was undertaken to assess fetal and neonatal outcomes in pregnancies complicated by MSAF, to identify risk factors for adverse outcomes, and to evaluate the utility of CTG in predicting neonatal compromise.

Materials and Methods

Study Design and Setting

A prospective observational study was conducted in the Department of Obstetrics and Gynaecology at the National Institute of Medical Sciences & Research, Jaipur, Rajasthan, India. The study was carried out over a period of 18 months from 1st July 2024 to 1st January 2026.

Ethical Approval

The Institutional Ethics Committee approval was obtained

(Ref. No.: NIMSUR/IEC/2024/1016, dated 11/05/2024). The study was conducted in accordance with the Declaration of Helsinki and Indian Council of Medical Research (ICMR) guidelines. Written informed consent was obtained from all participants in either English or the vernacular language (Hindi).

Study Population

All pregnant women admitted to the labour room with singleton pregnancies, gestational age ≥ 37 weeks, and MSAF (thin or thick) diagnosed either at admission or during labour, willing to participate in the study were enrolled. Multiple gestation, pre-term gestation (< 37 weeks), non-cephalic presentation (breech, transverse), major fetal congenital anomalies, known uterine anomalies or prior uterine scar other than previous LSCS, rupture of membranes > 24 hours before admission were excluded from the study.

Sample Size Calculation

Based on a reported proportion of neonatal symptoms after MSAF of 22% ($p=0.22$) from previous literature, with a 95% confidence interval ($Z_{\alpha/2}=1.96$) and margin of error $d=0.10$, the sample size was calculated as:

$$N = \frac{(1.96)^2 \times p \times (1 - p)}{d^2} = \frac{3.84 \times 0.22 \times 0.78}{0.01} \approx 66$$

A total of 66 consecutive eligible women were enrolled.

Data Collection

A detailed maternal history including age, parity, gestational age, antenatal complications, and obstetric history was recorded in a predesigned proforma. The colour and consistency of amniotic fluid were documented during labour and categorized as thin or thick meconium.

Continuous fetal monitoring was performed using cardiotocography. Mode of delivery and intrapartum findings were documented. Neonatal assessment was performed using Apgar scores at 1 and 5 minutes. Neonates were observed for complications such as respiratory distress, meconium aspiration, MAS, sepsis, birth asphyxia, and NICU admission for 24–72 hours.

Statistical Analysis

Data were entered and analyzed using Microsoft Excel. Quantitative variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages.

Results

Maternal Demographic Characteristics

The mean maternal age was 29.29 ± 6.73 years (range: 18–42 years). Majority of women (65.2%) resided in urban areas and belonged to lower socioeconomic status (51.52%). Booked cases constituted 63.6%, indicating

relatively good antenatal care access. Table 1 illustrates maternal demographic characteristics.

Table 1: Maternal Demographic Characteristics

Variable	Frequency	Percentage
Age (years), Mean $\pm$ SD	29.29 $\pm$ 6.73	–
Residence		
Urban	43	65.2%
Rural	23	34.8%
Socioeconomic Status		
Lower	34	51.52%
Middle	27	40.91%
Upper	5	7.58%
Booking Status		
Booked	42	63.6%
Un-booked	24	36.4%

Obstetric Profile

Mean gravida was 2.92 ± 1.47 and mean parity was 0.89 ± 1.14 . Mean gestational age at delivery was 38.80 ± 1.81 weeks (range: 37–42 weeks). Clear, thin meconium, and thick meconium each accounted for exactly 33.33% (22 cases each). Maternal complications (anemia, hypertensive disorders, gestational diabetes, hypothyroidism) were present in 34.8% of cases (Table 2).

Table 2: Obstetric Profile

Variable	Mean $\pm$ SD / Frequency	Percentage
Gravida	2.92 ± 1.47	–
Parity	0.89 ± 1.14	–
Gestational Age (weeks)	38.80 ± 1.81	–
Type of Liquor		
Clear	22	33.33%
Thick meconium	22	33.33%
Thin meconium	22	33.33%
Complications		

Variable	Mean $\pm$ SD / Frequency	Percentage
Present	23	34.8%
Absent	43	65.2%

Intrapartum Characteristics

Mean duration of labor was 7.90 ± 2.66 hours. Mode of delivery was equally split: 33 (50%) vaginal deliveries and 33 (50%) lower segment cesarean section (LSCS). Abnormal fetal heart rate patterns were seen in 28.8% of cases, and 25.8% had abnormal partograph progress (Table 3).

Table 3: Intrapartum Characteristics

Variable	Frequency	Percentage
Duration of Labour (hrs), Mean $\pm$ SD	7.90 ± 2.66	–
Mode of Delivery		
Vaginal	33	50%
LSCS	33	50%
Fetal Heart Rate Pattern		
Normal	47	71.2%
Abnormal	19	28.8%
Partograph Remarks		
Normal Progress	49	74.2%
Abnormal Progress	17	25.8%

Neonatal Characteristics

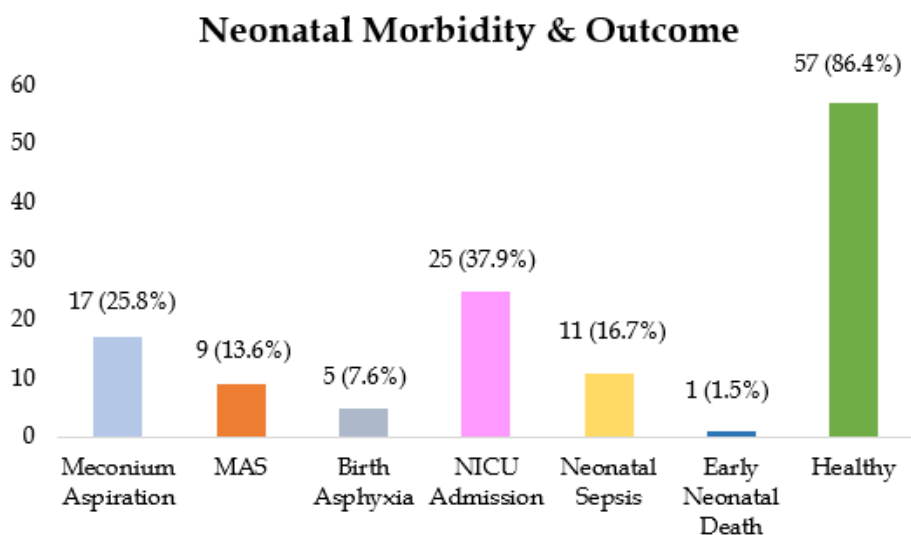
Male-to-female ratio was 1.06:1. Mean birth weight was 2.94 ± 0.42 kg. Live births accounted for 98.5% (65/66), with one stillbirth (1.5%). Mean Apgar score improved from 7.37 ± 1.36 at 1 minute to 8.30 ± 1.50 at 5 minutes (Table 4).

Neonatal Morbidity and Outcomes

Among 66 neonates, meconium aspiration was observed in 17 neonates (25.8%), of whom 9 (13.6%) progressed to MAS. Birth asphyxia occurred in 5 cases (7.6%). NICU admission was required in 37.9% (25 neonates), with mean NICU stay of 1.19 ± 2.06 days (range: 0–10 days). Neonatal sepsis was diagnosed in 11 cases (16.7%). One early neonatal death (1.5%) occurred due to severe MAS with PPHN. Overall, 57 neonates (86.4%) were discharged healthy. Figure 1 illustrates neonatal morbidity and outcomes.

Table 4: Neonatal Characteristics

Variable	Frequency / Mean $\pm$ SD	Percentage / Range
Baby Sex		
Male	34	51.5%
Female	32	48.5%
Birth Weight (kg)	2.94 $\pm$ 0.42	–
Birth Outcome		
Live Birth	65	98.5%
Still Birth	1	1.5%
Apgar Score (1 min)	7.37 $\pm$ 1.36	–
Apgar Score (5 min)	8.30 $\pm$ 1.50	–

**Figure 1. Neonatal Morbidity & Outcomes**

Laboratory and Ultrasound Findings

Mean maternal hemoglobin was 10.99 ± 1.37 g/dL, indicating mild anemia. Mean random blood sugar was 133.1 mg/dL (Table 5). Abnormal thyroid profile was seen in 21.2% (14/66). Ultrasound showed abnormal findings (oligohydramnios, fetal growth restriction, or placental changes) in 48.5% of cases (Figure 2).

Table 5: Laboratory Parameters

Variable	Mean $\pm$ SD / Frequency	Percentage / Range
Hb (g/dL)	10.99 $\pm$ 1.37	–
RBS (mg/dL)	133.1	–
Thyroid Profile		
Normal	52	78.8%
Abnormal	14	21.2%

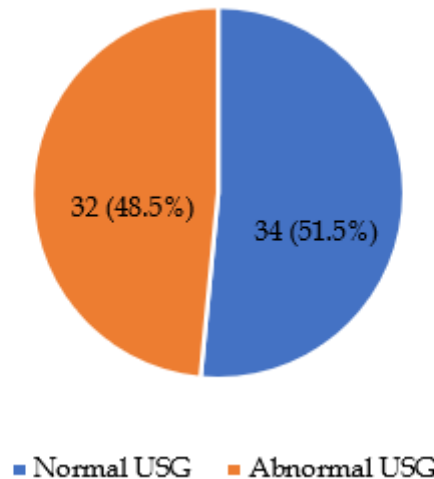


Figure 2. Maternal Ultrasonography Findings

Discussion

The present study assessed fetal and neonatal outcomes in pregnancies complicated by meconium-stained liquor (MSL) at a tertiary care centre. The findings demonstrated that abnormal fetal heart rate patterns, increased operative delivery rates, and significant neonatal morbidity—including meconium aspiration and NICU admissions—were associated with MSL.

In the current study, the mean maternal age was 29.29 ± 6.73 years, which is comparable to findings reported by Kc et al., who observed that MSL commonly occurs in women aged 25–30 years and is frequently associated with term pregnancies.^[10] Similarly, Desai et al. reported that most cases of meconium-stained amniotic fluid were observed in women aged between 26 and 30 years, consistent with the demographic distribution in the present study.^[11]

The mean gestational age in our study was 38.80 ± 1.81 weeks, indicating that MSL was predominantly a term phenomenon. This aligns with the findings of Unsworth et al., who reported a higher incidence of meconium passage beyond 37 weeks of gestation due to fetal maturity and increased vagal stimulation.^[12] Ravichandran et al. also confirmed that post-term and term pregnancies are strongly associated with increased meconium passage.^[13]

In the present study, abnormal fetal heart rate (FHR) patterns were noted in 28.8% of cases. Kaur et al. reported abnormal cardiotocography (CTG) findings in approximately 30% of cases with MSL, demonstrating a strong association between abnormal FHR tracings and fetal distress.^[14] Similarly, Sharma et al. found that abnormal CTG significantly increased the likelihood of cesarean delivery and adverse neonatal outcomes in cases of MSL.^[15]

Regarding mode of delivery, 50% of women underwent cesarean section (LSCS), which is consistent with the findings of Chaudhary et al., who reported cesarean rates ranging from 45% to 55% in pregnancies complicated by

thick meconium.^[16] Increased operative intervention in MSL cases is commonly attributed to non-reassuring fetal status. Saxena et al., emphasized that MSL is associated with higher operative delivery rates due to concern for fetal hypoxia.^[17]

Neonatal outcomes in the present study revealed that 25.8% of neonates had meconium aspiration and 13.6% developed meconium aspiration syndrome (MAS). Comparable findings were reported by Basu et al., who observed MAS in 10–15% of neonates born through meconium-stained liquor.^[18] Sood et al. also demonstrated that thick meconium is significantly associated with increased incidence of MAS and respiratory distress.^[19]

NICU admission was required in 37.9% of neonates in our study. This is in agreement with Verma et al., who reported NICU admission rates of approximately 35–40% in neonates delivered with MSL.^[20] Similarly, Reddy et al., highlighted that neonates born through thick meconium had significantly higher NICU admissions compared to those with clear liquor.^[21]

The mean Apgar scores at 1 minute (7.37 ± 1.36) and 5 minutes (8.30 ± 1.50) in the present study indicate overall favourable outcomes, though initial mild depression was observed in some neonates. Singh et al., reported similar Apgar trends, with improvement at 5 minutes following prompt neonatal resuscitation.^[22]

Birth asphyxia was observed in 7.6% of neonates in this study. Gupta et al. documented comparable rates of birth asphyxia in MSL cases, emphasizing that abnormal CTG and thick meconium are significant risk factors.^[23]

The incidence of neonatal sepsis (16.7%) in the present study aligns with findings from Mishra et al., who reported increased infection risk in neonates exposed to prolonged rupture of membranes and meconium-stained fluid.^[24]

Early neonatal mortality in this study was low (1.5%), which is consistent with improved neonatal care and early

intervention strategies. WHO (2021) global data indicate that timely intrapartum monitoring and neonatal resuscitation significantly reduce mortality in cases complicated by MSL.^[25]

Ultrasound abnormalities were observed in 48.5% of cases. Patel et al. (2022) reported that abnormal antenatal Doppler findings are associated with increased likelihood of fetal distress and meconium passage.^[26]

Maternal hemoglobin and thyroid abnormalities were noted in a subset of women. Kumar et al. demonstrated that maternal anemia is associated with increased fetal distress and higher rates of MSL.^[27] Likewise, Joshi et al. found that thyroid dysfunction may contribute indirectly to adverse perinatal outcomes.^[28]

Overall, the present study findings are consistent with recent literature showing that meconium-stained liquor is associated with increased operative delivery, abnormal fetal heart rate patterns, higher NICU admissions, and risk of meconium aspiration syndrome. However, with timely intrapartum monitoring and appropriate neonatal care, perinatal mortality can be minimized.

However, small sample size limits generalizability of the findings. Lack of control group (clear amniotic fluid cases) limits comparative analysis. Short neonatal follow-up period (24–72 hours) does not assess long-term outcomes. This study also did not assess the potential confounding factors (maternal comorbidities, interventions), which may influence outcomes.

Conclusion

Meconium-stained amniotic fluid remains a common intrapartum finding, and in this study, it was observed alongside higher rates of cesarean section, abnormal fetal heart rate patterns, meconium aspiration syndrome, and NICU admissions. However, with continuous CTG monitoring, careful partograph assessment, timely recognition of fetal compromise, and adherence to NRP 2020 neonatal resuscitation guidelines, the majority of neonates achieved favourable outcomes. Early neonatal mortality remained low in this tertiary care setting.

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Conflict of Interest

The authors do not have any conflicts of interest.

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