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Foeto-Maternal Outcomes in Term Pregnancies with Meconium-Stained Amniotic Fluid: A Prospective Observational Study

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is a common intrapartum finding in term pregnancies and is strongly associated with meconium aspiration syndrome (MAS), operative delivery and adverse perinatal outcomes. This prospective observational study was undertaken to evaluate the maternal risk factors and foeto-maternal outcomes in term pregnancies complicated by MSAF at a tertiary care centre.

Material and Methods: The study was conducted in the Department of Obstetrics and Gynaecology, Mahatma Gandhi Medical College & Hospital, Jaipur, from July 2023 to December 2024. A total of 150 term, singleton, cephalic pregnancies with documented meconium-stained liquor following spontaneous or artificial rupture of membranes were included. Pregnancies with preterm labour, malpresentation, multiple gestation, congenital anomalies, antepartum haemorrhage, intrauterine fetal death or refusal of consent were excluded. Maternal demographic and obstetric variables, liquor characteristics, mode of delivery, neonatal birth weight, APGAR scores and early neonatal complications were recorded. Data were analysed using descriptive statistics and chi-square test, with $p < 0.05$ considered statistically significant.

Results: Most women belonged to rural, socio-economically middle or lower strata and were multigravida, with nearly half having anaemia. Intermediate-grade meconium was the predominant liquor finding, and more than two-fifths of women required caesarean delivery. A substantial proportion of neonates were low or very low birth weight and exhibited low APGAR scores, although only selected variables showed statistical significance. Post-dated gestation, absence of PIH and thick meconium were significantly associated with neonatal complications, and low 5-minute APGAR scores correlated strongly with adverse neonatal outcomes.

Conclusion: MSAF in term pregnancies emerges as a marker of composite maternal and fetal stress, with liquor thickness, post-datism and low 5-minute APGAR scores serving as key predictors of neonatal morbidity. Vigilant intrapartum monitoring, timely decision-making regarding mode of delivery and preparedness for prompt neonatal resuscitation are essential to mitigate MSAF-related adverse outcomes.

Keywords: *Meconium stained amniotic fluid; Meconium aspiration syndrome; Foeto maternal outcome; Term pregnancy; Obstetric risk factors.*

INTRODUCTION:

Meconium-stained amniotic fluid (MSAF), commonly referred to as green-stained liquor, remains an important obstetric challenge because of its strong association with adverse maternal and perinatal outcomes. Although major advances in intrapartum monitoring and neonatal care have reduced overall maternal and infant mortality, MSAF continues to be a

significant contributor to perinatal morbidity, meconium aspiration syndrome (MAS), operative delivery, and intensive care admission. Understanding the epidemiology, pathophysiology, and clinical implications of MSAF is therefore essential for guiding timely interventions and optimizing foeto-maternal outcomes.

The term "meconium" is derived from the Greek word "mekoni," meaning "poppy juice" or "opium-like," reflecting early beliefs that intrauterine exposure to meconium caused neonatal sleepiness or depression, a concept attributed to Aristotle.(Ross, 2005) Meconium is the thick, sticky material constituting the newborn's first bowel movement and is composed predominantly of water, desquamated intestinal epithelial cells, lanugo, vernix caseosa, bile pigments, and various gastrointestinal secretions.(Grand et al., 1976) Meconium typically appears greenish-yellow because of bile pigments, particularly bilirubin, which begin to accumulate in the fetal hepatobiliary system from around the second trimester, and in physiological conditions the fetal intestine remains sterile, so meconium is initially free of microorganisms. (Blumenthal et al., 1976)

MSAF is reported in approximately 13–16% of all deliveries and may represent either a marker of fetal maturity or a response to intrauterine stress. Several obstetric risk factors have been linked to MSAF, including post-dated pregnancy, prolonged labour, pre-eclampsia, maternal age, labour induction, obstructed labour, and intrauterine growth restriction (IUGR) (Fig. 1). Passage of meconium in utero is widely regarded as a fetal reaction to hypoxia and acidosis, whereby reduced oxygenation increases gastrointestinal peristalsis and relaxes the anal sphincter; transient umbilical cord or head compression can also provoke a vagal response that promotes meconium passage. (Balchin et al., 2011)

The presence of MSAF during labour has been correlated with higher rates of operative and caesarean delivery, prolonged labour, and postpartum complications such as puerperal infection and postpartum hemorrhage (PPH).(Galal et al., 2012) From the fetal standpoint, MSAF is a well-recognized marker of possible intrapartum compromise and is associated with abnormal fetal heart rate patterns, need for resuscitation at birth, perinatal asphyxia, neonatal sepsis, and early neonatal death. India has achieved substantial reductions in maternal and child mortality. Nevertheless, conditions such as MSAF and MAS continue to contribute to preventable perinatal deaths, as MSAF complicates an estimated 13–16% of deliveries and MAS arises in 2–10% of these, with approximately one in eight affected neonates not surviving.(Parween et al., 2022) In this context, detailed evaluation of foeto-maternal outcomes in pregnancies complicated by MSAF is crucial to refine risk stratification, inform intrapartum decision-making, and develop protocols tailored to resource-limited settings. Accordingly, the present investigation aims to assess the spectrum of maternal and neonatal outcomes associated with MSAF and to identify factors that may guide early prediction and improved clinical management in such cases.

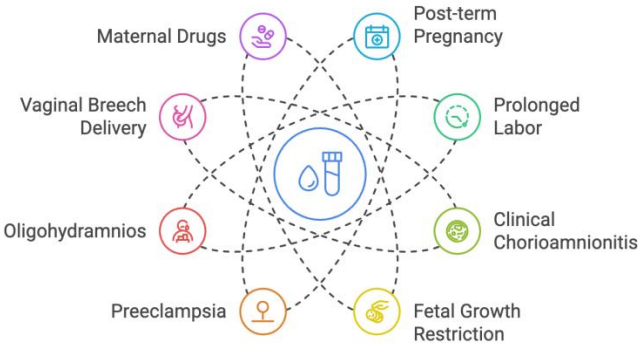

Fig. 1 Risk factors associated with meconium stained amniotic fluid (MSAF)

MATERIAL AND METHODS

Type of study- Prospective observational study.

Period of Study- July 2023 to December 2024

Place of Study: Department of Obstetrics and Gynaecology, Mahatma Gandhi Medical College & Hospital, Jaipur

Ethical committee and consent: Written and informed consent was obtained from all participants before enrolment into the study.

Inclusion criteria

1. Term pregnancies (>37 weeks Gestation)
2. Cephalic presentation
3. Live Singleton pregnancies
4. Meconium-stained Liquor with Artificial Rupture of Membranes or Spontaneous Rupture of Membranes

Exclusion criteria
1. Preterm labor (< 37 weeks of gestation)
2. Congenital anomalies
3. Multiple gestations
4. Intrauterine fetal death
5. Antepartum haemorrhage
6. Breech presentation
7. Patient who refused consent

SAMPLE SIZE:
A total of 150 patients reporting in the labor room of obstetrics and gynaecology department of Mahatma Gandhi hospital, Jaipur were included in the present study.

Statistical Analysis:
All the collected data was recorded in Microsoft Excel and analyzed. Categorical variables have been described as frequencies and percentages. p value <0.05 was considered statistically significant.

RESULTS:
The majority of women in the study were from rural areas (64.66%), with just over one-third residing in urban regions (35.33%) (Table 1). Socio-economically, half of the participants belonged to the middle class (50%), followed by the lower (31.33%) and upper (18.66%) classes. Most women were multigravida (88%), and only 12% were primigravida. Regarding nutritional status, 43.33% had a healthy BMI, while 34% were obese and 22% were overweight; underweight women constituted only 0.66%. Anaemia was present in 47.33% of patients, whereas 52.66% had normal haemoglobin levels.

With respect to liquor characteristics, Grade 2 meconium-stained liquor was the most common, observed in 63.33% of cases, while Grade 3 thick meconium was seen in 20.66% and Grade 1 in 16% (Table 2). Mode of delivery analysis showed that 57.33% of women delivered vaginally and 42.67% underwent LSCS, with a statistically significant difference favouring vaginal delivery ($p < 0.01$).

Neonatal anthropometry revealed that 46.66% of babies had low birth weight (<2,500 g) and 53.33% were classified as very low birth weight (<1,500 g) (Table 3). APGAR distribution showed that at 1 minute, 82 neonates had scores <7 and 68 had scores ≥7, and at 5 minutes, 74 had scores <7 and 76 had scores ≥7; these differences were not statistically significant ($p = 0.25$ and $p = 0.87$, respectively) (Table 4).

In the analysis of risk factors, neonatal complications were more frequent among nulliparous and primiparous women, although these associations did not reach statistical significance ($p = 0.09$ and $p = 0.055$, respectively), while no meaningful association was seen in multiparous women ($p = 0.62$) (Table 5). Postdated pregnancy showed a strong and significant association with neonatal complications ($p < 0.01$), whereas absence of postdatism did not ($p = 0.86$). Similarly, pregnancies without PIH were significantly associated with neonatal complications ($p < 0.01$), while the PIH group did not show a significant relationship ($p = 0.46$). Thick meconium-stained liquor was significantly associated with neonatal complications ($p < 0.01$), in contrast to thin and moderate meconium, which showed no significant association ($p = 0.41$ and $p = 0.47$, respectively).

When neonatal outcome was stratified by 5-minute APGAR score, 82.71% of infants with scores <7 developed complications compared with 28.98% of those with scores ≥7 (Table 6). This difference was statistically highly significant ($\chi^2 = 34.68$, $p < 0.01$ for APGAR <7; $\chi^2 = 12.18$, $p < 0.01$ for APGAR ≥7), and the overall comparison between groups also demonstrated significance ($\chi^2 = 3.84$, $p = 0.05$).

Table 1: Distribution of patients based on place of residence

		Number of patients	Percent
Place of residence	Rural	97	64.66
	Urban	53	35.33
Socio economic status	**Upper**	28	18.66
	Middle	75	50.00

	Lower	47	31.33
Gravida	**Primi**	18	12
	Multi	132	88
BMI categories	**Underweight**	1	0.66
	Healthy weight	65	43.33
	Overweight	33	22
	Obese	51	34
Hb levels	**Anaemia**	71	47.33
	Normal	79	52.66

Table 2: Grading in color of Liquor

Colour of Liquor	Number of patients	% of patients
Grade 1	24	16
Grade 2	95	63.33
Grade 3	31	20.66

Table 3: Birth weight of neonates

Categories	Criteria	Number of patients	Percent
Low birth weight	Less than 2,500 grams	70	46.66
Very low birth weight	Less than 1,500 grams	80	53.33

Table 4: Mode of delivery

Mode of Delivery	Number of patients	% of patients	p value
Vaginal delivery	86	57.33	<0.01**
LSCS	64	42.67	

Table 5: APGAR score of neonates

APGAR Score	<7	>7	*p* value
APGAR at 1 minute	82	68	0.25
APGAR at 5 minutes	74	76	0.87

Table 6: Comparison of parity, postdated, pregnancy induced hypertension (PIH), colour of liqour and neonatal complications

		Total number of patients	Neonatal complications	Chi square value	p value (Neonatal complica-tions)
Parity	**Nulliparous**	52	32	2.76	0.09
	Primiparous	61	38	3.68	0.055
	Multiparous	37	17	0.24	0.62
Postdated	**Yes**	46	36	14.69	<0.01**
	No	104	51	0.03	0.86
PIH	**Yes**	26	21	0.53	0.46
	No	124	66	17.7	<0.01**
Colour of liquor	**Thin**	24	14	0.66	0.41
	Moderate	95	44	0.510	0.47
	Thick	31	29	23.51	<0.01**

Table 7: Comparison based on APGAR score (5 minute) and neonatal complications

APGAR score (5min)	Total number of patients	Neonatal complications	Percentage	Chi square value	p value
<7	81	67	82.71	34.68	<0.01**
>7	69	20	28.98	12.18	<0.01**
Total	150	87	58	3.84	0.05

DISCUSSION:

The present study provides a comprehensive overview of the clinical profile and outcomes of term pregnancies complicated by meconium stained liquor (MSL), demonstrating that a constellation of maternal, fetal and intrapartum factors interact rather than any single variable acting in isolation. The investigation, which included detailed assessment of place of residence, socio economic status, BMI, maternal age, obstetric history, comorbidities and fetal condition, reinforces the concept that MSL is primarily a marker of global pregnancy stress and intrapartum compromise rather than a purely mechanical phenomenon of contaminated liquor.

From a maternal standpoint, most women belonged to socio economically vulnerable backgrounds and were multigravida, mirroring the case mix commonly seen in Indian tertiary centres and partly explaining the higher burden of intrapartum complications. These observations suggest that repeated pregnancies in settings of limited resources and variable antenatal surveillance may cumulatively increase exposure to risk factors that favour meconium passage, which is in partial agreement with Divia (2018), who also reported a substantial contribution of multigravida women but did not find a clear statistical separation between parity groups. (Divya .N V & G N Vasantha Lakshmi, 2020) According to the present investigation, weight or BMI and Hb levels of the mother did not have any direct correlation with the development of meconium-stained liquor. These findings are in agreement with the findings of Agrawal *et al*. (2021) (Rathoria et al., 2018) where 15 % were observed with anaemia and showed significant correlation with the studied parameters.

The grade of MSAL exhibited a significant correlation for maternal and neonatal complications. The lower segment Caesarean Section (LSCS) observed in 65 cases. All the modes of delivery showed a significant association between the categories. Earlier studies have found cases of meconium-stained liquor leading to higher caesarean section rate. Vijayasree *et al*. (2014) (Vijayasree et al., 2014) reported a significantly higher incidence of normal vaginal deliveries in the group with clear amniotic fluid compared to the group with meconium-stained amniotic fluid (MSAF).

The APGAR scores at 1 minute, 82 neonates had an APGAR score of less than 7, while 68 patients had a score greater than 7, and showed non-significant correlation between the two groups. Desai *et al*. (2017) (Desai et al., 2017)) found no statistically significant difference between the two groups regarding Apgar scores below 7 at both the 1-minute and 5-minute marks. In contrast, Niranjan et al. (2019) (Niranjan & Lucksom, 2019) reported a significant disparity, with 35% of neonates (70 cases) in the meconium group scoring below 6, compared to only 10% (20 cases) in the control group.

The weight of neonates soon after they were born was found to be 46.67% under low birth weight (<2.5 kg), 53.33% were very low birth weight (<1.5 kg) and no neonates fell under extremely low birth weight. Similarly, Agrawal *et al*. (2021) found that 25% cases reported <2 kg weight of neonatal whereas 40% cases were with 2-2.5 kg weight range of the neonates. The relationship between gestational age (post-dated pregnancies) were studied with post-dated pregnancies where 36 cases (41.37%) experienced maternal complications, conversely, in the non-post-dated group, 53 (60.91%) experienced maternal complications. Similar results were reported by Agarwal et al., 2023 (Agrawal & Modi, 2023).

The association between PIH and maternal complications showed statistically significant correlation. Rokade *et al*. (2016) (Rokade et al., 2016) reported around 28% cases in their study associating PIH with MSAF. The colour of liquor (thin, moderate and tick meconium-stained liquor) and neonatal complications showed significant correlation between the neonatal complications increase with the thickness of MSL whereas thin and moderate MSL showed non-significant correlation. Kashikar *et al*. (2021) (Kashikar et al., 2021) also reported out of 321 cases of meconium-stained liquor 57% women with thin meconium and 43% with thick meconium. The findings are also in agreement with the findings of Chhabra *et al*. (2007) where amongst all the MSAF cases, the incidence of thin meconium-stained amniotic fluid was higher than thick MSAF.

The study also assessed Apgar scores at 5 minutes, identifying 74 cases with scores below 7, all of which were associated with neonatal complications. A significant statistical correlation was observed between low Apgar scores and the presence of neonatal complications. Similar findings were reported by Qadir *et al*. (2016) (Qadir1 et al., n.d.) who found that low Apgar scores were more prevalent among neonates with meconium-stained amniotic fluid (MSAF) compared to the control group.

Overall, this study situates MSL within a multifactorial framework in which sociodemographic vulnerability, post-dated gestation, hypertensive disorders, IHCP, liquor thickness and intrapartum management decisions converge to shape both maternal and neonatal outcomes. By aligning with and extending existing literature (7–22), the findings emphasise the need for vigilant antenatal surveillance of high-risk pregnancies, early identification of post-dated and hypertensive cases, nuanced interpretation of liquor characteristics during labour and timely recourse to operative delivery when indicated. Such an integrated, context-sensitive approach is essential to mitigate the burden of morbidity and mortality associated with meconium-stained liquor in resource-limited settings.

CONCLUSIONS

This study comprehensively evaluates the risk factors associated with meconium-stained liquor (MSL) and its implications on both maternal and neonatal health outcomes. The findings emphasize the importance of identifying high-risk pregnancies and implementing timely interventions to mitigate adverse effects.

The study reveals that maternal factors such as socioeconomic status, parity, gestational age, and pregnancy-induced hypertension (PIH) have a significant association with the occurrence of MSL. The results show that multigravida women are more likely to experience MSL, suggesting that repeated pregnancies may increase the risk. Similarly, post-dated pregnancies were found to be a critical risk factor, with a higher prevalence of maternal complications, reinforcing the need for close monitoring of pregnancies that extend beyond the expected delivery date. Although maternal age, BMI, and anemia did not show a strong correlation with MSL, the presence of PIH was significantly associated with an increased risk of complications, aligning with previous research that links hypertensive disorders to adverse pregnancy outcomes.

The study also underscores the influence of MSL on neonatal outcomes. It was observed that as the meconium-stained liquor thickens, the risk of neonatal complications also escalated. Thick meconium-stained liquor was associated with a higher incidence of low APGAR scores, respiratory distress, and increased NICU admissions. The results indicate that neonates with lower APGAR scores at both one and five minutes faced greater risks of complications, including the need for prolonged hospitalization and respiratory support. This finding underscores the importance of immediate neonatal resuscitation and close postnatal monitoring in cases of thick meconium-stained liquor.

Mode of delivery was significantly impacted by the presence of MSL. A greater proportion of cases with moderate and thick meconium-stained liquor required lower segment cesarean section (LSCS), suggesting that MSL may contribute to fetal distress, necessitating surgical intervention. The findings align with previous studies that reported higher cesarean section rates in cases of MSL, indicating that obstetricians preferred for operative delivery when MSL is detected to prevent further fetal compromise. Additionally, vacuum-assisted and forceps-assisted vaginal deliveries were observed in several cases, highlighting the role of instrumental deliveries in managing high-risk pregnancies.

Another crucial finding of this study is the association between MSL and maternal complications. While conditions like intrapartum chorioamnionitis, puerperal fever, and endometritis were observed, their correlation with MSL was statistically insignificant. However, the presence of premature rupture of membranes (PROM) and diabetes mellitus (DM) in a subset of cases suggests that these conditions could contribute to the occurrence of MSL, warranting further investigation. The duration of hospital stay for both mothers and neonates was also examined, with results indicating that severe cases of MSL often required prolonged hospitalization.

Overall, this study reinforces the significance of MSL as a marker of potential obstetric and neonatal complications. The findings advocate for continuous fetal monitoring during labor, early detection of distress, and a multidisciplinary approach to managing pregnancies complicated by MSL. Given the strong association between thick MSL and adverse neonatal outcomes, healthcare providers should adopt a proactive approach, including enhanced prenatal surveillance, timely decision-making regarding mode of delivery, and improved neonatal care strategies. To gain a more comprehensive understanding of the long-term impacts of meconium-stained amniotic fluid on maternal and neonatal outcomes, further research involving larger sample sizes and prolonged follow-up is warranted.

CONCLUSION:

In conclusion, this study highlights meconium-stained liquor in term pregnancies as an important clinical marker of combined maternal and fetal stress rather than an isolated finding. Across 150 cases, adverse feto-maternal outcomes were more closely linked to dynamic factors such as post-dated gestation, hypertensive disorders, liquor thickness, intrapartum events and low Apgar scores than to static background variables like age, BMI or parity. The clear gradient of risk with increasing meconium thickness and the higher need for operative delivery and neonatal supportive care underscore the importance of early identification and vigilant intrapartum monitoring in such cases. Strengthening antenatal risk stratification, optimizing timing and mode of delivery in post-dated and high-risk pregnancies, and ensuring readiness for prompt neonatal resuscitation and intensive care are pivotal strategies to reduce the morbidity and mortality associated with meconium-stained liquor.

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