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Original Research Article

Maternal and perinatal outcomes in term pregnancies with meconium-stained amniotic fluid: a cross-sectional study from a tertiary care hospital in Nepal

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ABSTRACT

Background: Meconium, the gastrointestinal excreta of the fetus, was first described by Aristotle. Meconium-stained amniotic fluid (MSAF) has traditionally been considered a sign of fetal distress in presentations other than breech and is associated with adverse fetal outcomes. However, some consider fetal passage of meconium to be a physiological phenomenon that may still pose environmental hazards to the fetus before birth. This study was conducted to evaluate the maternal risk factors associated with MSAF and its effect on fetal outcome in terms of morbidity and mortality.
Methods: This hospital-based cross-sectional study was conducted in the Department of Obstetrics and Gynecology, National Medical College, Birgunj, over a period of 12 months from July 2020 to July 2021. A total of 184 pregnant women fulfilling the inclusion criteria were enrolled. The cases were divided into two groups: thin meconium-stained and thick MSAF. Data analysis included various maternal and fetal parameters. Maternal risk factors and fetal outcomes were evaluated.
Results: Among the 184 cases, 31.72% had thin MSAF, while 68.28% had thick meconium. The associated maternal risk factors included pregnancy-induced hypertension, anemia, oligohydramnios, intrauterine growth restriction, and prolonged labor. Cesarean section was performed in 63.03% of cases, primarily due to non-reactive cardiotocography. Of the 184 neonates, 30.43% required admission to the neonatal intensive care unit due to low Apgar scores. Perinatal death occurred in eight cases: three due to meconium aspiration syndrome (MAS), two due to sepsis, two due to birth asphyxia, and one due to pneumonitis.
Conclusions: The presence of thick MSAF is associated with increased perinatal morbidity and mortality, as well as significant maternal risk factors.

Keywords: Amniotic fluid, Meconium, Perinatal outcome

INTRODUCTION

The term meconium originates from the Greek word "Meconium Arion," which refers to opium-like substances believed to induce fetal sleep.[1] Meconium is composed of denuded intestinal epithelial cells, lanugo hair, amniotic fluid, mucus, enzymes, bile, and water. The incidence of meconium passage increases after 37 weeks of gestation. Three main theories have been proposed to explain fetal meconium passage: hypoxia-induced passage, neural-controlled gastrointestinal maturation, and relaxation of the anal sphincter.[2]

MSAF is classified as thin or thick. MSAF occurs in approximately 10-22% of all deliveries and complicates about 1.5% of cases, with a reported mortality rate of

nearly 40% due to MAS. Infants born through MSAF are at a 100-fold increased risk of developing respiratory distress, along with a five-fold increase in perinatal mortality.[3] Maternal risk factors such as hypertension, premature rupture of membranes, anemia, previous cesarean section, and prolonged labor are associated with an increased incidence of meconium passage. MSAF is also correlated with higher rates of cesarean delivery, neonatal intensive care unit admission, fetal distress, low birth weight, and neonatal death.[4]

MAS, one of the leading causes of perinatal mortality, presents with respiratory compromise, cyanosis, and pulmonary hypertension. Preventive strategies include amnioinfusion, suctioning, and endotracheal intubation when indicated. Ultrasonography plays an important role in monitoring amniotic fluid volume during pregnancy.[5]

This study on term pregnancies complicated by MSAF aims to understand its distribution, associated maternal risk factors, and correlation with fetal distress. Early identification of fetuses at risk is crucial to prevent MAS and other adverse perinatal outcomes. The study seeks to elucidate the frequency of MSAF and its association with high-risk maternal factors, fetal distress, and perinatal outcomes.

The objectives of this study are to investigate the outcomes of meconium-stained liquor in term pregnancies at a tertiary-level teaching hospital; to evaluate maternal risk factors responsible for MSAF; to identify the mode of delivery in labor complicated by MSAF; to explore neonatal outcomes associated with MSAF; and to compare perinatal outcomes between thick and thin MSAF.

METHODS

This hospital-based cross-sectional study was carried out over a period of twelve months, from July 2020 to July 2021after ethical clearance. A convenient sampling technique was employed. The calculated sample size was 171.9, based on a reported prevalence of 13.97% [6] of MSAF in term pregnancies; however, a total of 184 patients were ultimately enrolled in the study. Written informed consent was obtained from each participant, and confidentiality of all information and records was assured.

The inclusion criteria comprised term labor (>37 completed weeks and <42 completed weeks), cephalic presentation, and live singleton pregnancy. The exclusion criteria included congenital anomalies of the fetus and maternal comorbid conditions such as diabetes, thyroid disorders, and antepartum hemorrhage. The study variables included types of meconium, maternal age (in years), booking status, parity, gestational age, symptoms and signs, mode of delivery, neonatal outcome, Apgar scores, and birth weight.

Patients fulfilling the inclusion criteria were enrolled in the study. Upon admission, a detailed history was obtained regarding the period of amenorrhea, onset of labor pain, history of leaking, show, and any complications during pregnancy. A thorough general physical examination was performed, and vital signs were recorded. Per abdominal examination was conducted to assess uterine height in weeks, fetal lie, position of the back, presentation and position, and fetal heart rate. A detailed pelvic examination was performed to assess cervical consistency, effacement, and dilatation. The status of the membranes was noted. If membranes were ruptured, the type of liquor-thin or thick meconium-was recorded. Amniotic fluid that was thin, greenish-yellow in color was classified as thin meconium-stained liquor. Amniotic fluid that was dark green, tarry black, or muddy in color and of thick consistency was classified as thick meconium-stained liquor. Based on clinical grading, the study population was divided into two groups:

Group I (Thin)

Thin MSAF at the time of rupture of membranes or later during the course of labor.

Group II (Thick)

Thick MSAF at the time of rupture of membranes or later during the course of labor.

Maternal risk factors including pregnancy-induced hypertension, anemia, oligohydramnios, intrauterine growth restriction, and prolonged labor were recorded. Investigations included complete hemogram, urine examination for albumin, sugar, and microscopy, blood grouping and Rh typing, HIV, HBsAg, renal function tests, liver function tests when required, ultrasonography when indicated, and cardiotocography. Each high-risk neonate was assessed by a neonatologist. Apgar scores were recorded at one and five minutes after birth.

All neonates were observed for 24 hours after delivery. Babies who remained normal and did not develop complications during this period were kept with the mother. Neonates who developed signs of complications within 24 hours were admitted to the neonatal intensive care unit. Patients were followed until delivery and during the postnatal period. Data regarding mode of delivery, birth weight, Apgar scores, and neonatal outcomes were recorded in a predesigned proforma. Neonates were followed up until the seventh day of life, and their clinical condition was assessed. Any abnormalities, neonatal deaths, and causes of death occurring during hospital stay within the first week of life were recorded.

Statistical analysis

All collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 22. Microsoft Word and Excel were used for data calculation and tabulation. Primary data were entered into a master chart. Interim analysis was performed after completion of

ten cases, and necessary adjustments were made after discussion with the guide and co-guide. Regular meetings with the guides were conducted to resolve any issues. Descriptive statistical analysis, including frequency, mean, and distribution, was performed.

RESULTS

Among the 184 delivered cases, the majority, 68.28% (n=122), had thick MSAF, while 31.72% (n=62) had thin MSAF. Distribution of MSAF according to maternal age showed that 26.63% (n=49) were ≤20 years, 46.20% (n=85) were 21-25 years, 17.93% (n=33) were 26-30 years, and 9.24% (n=17) were ≥30 years. Out of 184 deliveries with MSAF, 71.74% (n=132) were unbooked cases, while 28.26% (n=52) were booked cases. Meconium-stained liquor was more common among multigravida women, with 60.87% (n=112) being multigravida and 39.13% (n=72) primigravida.

Regarding gestational age distribution, 26.09% (n=48) were between 37-38 weeks, 21.74% (n=40) were between 39-40 weeks, and 52.17% (n=96) were between 41-42 weeks. Among the 184 cases with MSAF, 31.51% (n=58) were associated with maternal complications. Pregnancy-induced hypertension was the most common complication, seen in 10.32% (n=19), followed by oligohydramnios in 8.69% (n=16), anemia in 6.52% (n=12), intrauterine growth restriction in 3.80% (n = 7), and prolonged labor in 2.17% (n=4), as shown in Table 1.

A significant association was observed between the consistency of meconium and the mode of delivery. The rate of cesarean section was highest in the thick meconium group due to an increased incidence of non-reactive cardiotocography. Cesarean section was performed in 40.76% (n=75) of cases with thick meconium compared to 22.28% (n=41) in the thin meconium group, as shown in Table 2. Among the total 184 cases, spontaneous labor occurred in 30.98% (n=57) of cases in the thin meconium group and 60.87% (n=112) in the thick meconium group. Among induced labor cases, 5.43% (n=10) had thick meconium-stained liquor and 2.72% (n=5) had thin meconium-stained liquor, indicating a higher association of meconium staining with spontaneous onset of labor, as shown in Table 3.

Non-reactive cardiotocography was observed in 64.13% (n=118) of cases, of which 46.20% (n=85) were in the thick meconium group and 17.93% (n=33) were in the thin meconium group. Non-reactive cardiotocography was more common in the thick meconium group, as shown in Table 4.

Among the neonates delivered through MSAF, 53.80% (n=99) were male and 46.20% (n=85) were female. Regarding birth weight, 19.35% (n=12) of neonates weighing ≤2.5 kg were from the thin meconium group, while 15.58% (n=19) were from the thick meconium group. Neonates weighing between 2.5-3.5 kg constituted 70.97% (n=44) in the thin meconium group and 69.67% (n=85) in the thick meconium group. Neonates weighing ≥3.5 kg included 9.68% from the thin meconium group and 14.75% from the thick meconium group.

The distribution of Apgar scores between 7-10 was 91.94% (n=57) in the thin meconium group and 68.85% (n=84) in the thick meconium group. Apgar scores between 4-6 were observed in 8.06% (n=5) of the thin meconium group and 22.95% (n=28) of the thick meconium group, while Apgar scores between 0-3 were seen in 8.20% (n=10) of cases in the thick meconium group. Low Apgar scores were more common in the thick meconium group.

A total of 38 neonates developed morbidity, including birth asphyxia in 24 cases, MAS (Figure 1 and 2) in 5 cases, sepsis in 5 cases, and pneumonia in 4 cases. Neonatal morbidity was higher in the thick meconium group, as shown in Table 5. Out of 122 neonates with thick MSAF, 40.16% (n=49) required NICU admission, compared to 11.29% (n=7) in the thin meconium group. Among 56 NICU-admitted cases, admission for seven days or more was more frequent in the thick meconium group (28.57%, n=14) compared to the thin meconium group (14.29%, n=1).

Perinatal mortality was predominantly observed in the thick meconium group, accounting for seven cases, while one perinatal death occurred in the thin meconium group. MAS was the leading cause of perinatal mortality in three cases, followed by sepsis and birth asphyxia in two cases each, and pneumonitis in one case, as shown in Table 6.

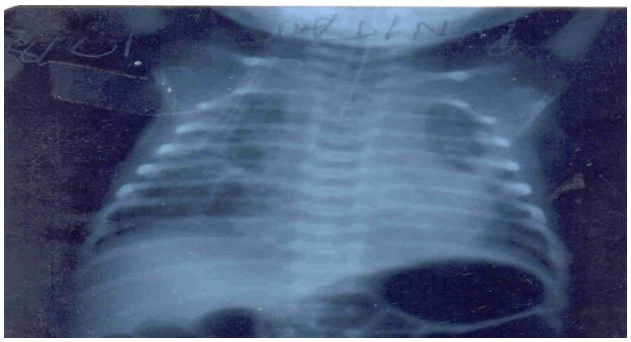

Figure 1: chest X- ray showing MAS.

Figure 2: Meconium-stained placenta.

Table 1: Distribution of maternal factors according to MSAF.

Maternal factors	N	Percentage
PIH	19	10.33%
Anemia	12	6.52%
IUGR	7	3.8%
Prolonged labor	4	2.17%
Oligohydramnios	16	8.69%
Total	58	31.51%

Table 2: Proportion of meconium consistency and mode of delivery.

Meconium consistency	Total	Normal deliveries		Vacuum extraction/forceps		Cesarean section deliveries	
		N	%	N	%	N	%
Thin	62	20	10.87	1	0.54	41	22.28
Thick	122	42	22.83	5	2.72	75	40.76
Total	184	62	33.70	6	3.26	116	63.04

Table 3: Proportion of mode of onset of labor according to meconium staining.

Mode of onset of labor	Thin meconium		Thick meconium		Total	
	N	%	N	%	N	%
Spontaneous	57	30.98	112	60.87	169	91.85
Induced	5	2.72	10	5.43	15	8.15
Total	62	33.70	122	66.30	184	100

Table 4: NST pattern in thick and thin meconium groups.

NST	Thin meconium		Thick meconium		Total	
	N	%	N	%	N	%
Reactive	29	15.76	37	20.10	66	35.87
Non-reactive	33	17.93	85	46.20	118	64.13
Total	62	33.70	122	66.30	184	100

Table 5: Distribution of cases of neonatal morbidity according to meconium-stained liquor.

Causes	Thin group		Thick group		Total	
	N	%	N	%	N	%
MAS	-	-	5	2.71	5	2.71
Sepsis	-	-	5	2.71	5	2.71
Pneumonia	-	-	4	2.17	4	2.17
Asphyxia	1	0.54	23	12.5	24	13.04
Total	1	0.54	37	20.09	38	20.63

Table 6: Causes of neonatal mortality, (n=184).

Causes	No. of babies	Percentage
MAS	3	1.63%
Sepsis	2	1.09%
Birth asphyxia	2	1.09%
Pneumonitis	1	0.54%

DISCUSSION

The passage of meconium may represent a normal physiological maturational process; however, it may also reflect fetal hypoxia or increased vagal activity secondary to cord compression. Although meconium is sterile, its passage into the amniotic fluid is clinically significant due to the risk of developing MAS and its sequelae.[7] Meconium is a nonspecific finding and may be associated with maternal or fetal conditions other than fetal hypoxia. MSAF has been implicated as an important factor influencing fetal well-being during both intrapartum and

postpartum periods.[8] The present study was undertaken to evaluate the significance of MSAF, its fetal outcome, and associated maternal risk factors among cases admitted from June 2020 to June 2021.

During the study period, 184 cases of MSAF fulfilling the inclusion criteria were analyzed. Among these, 62 cases had thin meconium and 122 cases had thick MSAF, noted at the time of spontaneous or artificial rupture of membranes. In the present study, 31.72% of cases had thin MSAF and 68.28% had thick MSAF, as most cases were referred from peripheral centers during labor. These findings were comparable with studies conducted by Shrestha and Vora whereas studies by Thobbi et al reported a higher proportion of thin MSAF cases.[7,9-11]

Maternal age

The present study correlated with the study conducted by Begum et al where the maximum number of patients with MSAF belonged to the 21-30-year age group (68.7%). In the present study, 64.13% of MSAF cases belonged to the same age group.[12]

Parity

MSAF was more common among multigravida women (60.86%) in this study, which was similar to findings reported by Ali et al where 73% of MSAF cases occurred in multigravida women.[13]

Gestational age

A larger proportion of cases (52.17%) belonged to the gestational age group of 41-42 weeks, correlating with findings by Chhetri et al where 63.8% of cases were between 41 and 42 weeks of gestation.[14]

Risk factors

Pregnancy-induced hypertension was the most common maternal risk factor associated with MSAF (10.32%), followed by oligohydramnios (8.69%), anemia (6.52%), intrauterine growth restriction (3.8%), and prolonged labor (2.17%). Similar findings were reported by Khillan et al where PIH was observed in 21.8% of cases, followed by oligohydramnios, anemia, IUGR, and prolonged labor.[15]

Non-stress test

The present study correlated with findings by Thobbi et al where non-reactive NST was observed in 45.30% of cases and was more common in the thick meconium group.[7] In the present study, non-reactive NST was observed in 64.13% of cases, with higher incidence in the thick meconium group (46.20%) compared to the thin group (17.93%). The overall higher incidence of non-reactive NST was attributed to delayed referral, as the study center serves as a referral unit for multiple health posts, PHCs, and hospitals. Early detection of fetal distress using NST contributed to reduced neonatal morbidity and mortality.

Mode of delivery

The rate of cesarean section and instrumental delivery was higher in the thick MSAF group. Overall, 63.04% of cases were delivered by cesarean section, with 40.76% in the thick meconium group and 2.72% undergoing instrumental delivery. Similar results were reported by Shrestha et al where 52.6% of thick MSAF cases required cesarean delivery.[9]

Neonatal outcomes

The majority of neonates had a birth weight between 2.5-3.5 kg, consistent with findings by Nayak et al.[16] Apgar scores at one minute were better in the thin MSAF group compared to the thick group, with improvement noted at five minutes. Low Apgar scores at five minutes, indicative of poor neonatal outcome, were more common in thick MSAF cases. Birth asphyxia occurred in 12.5% of thick MSAF cases compared to 0.54% in the thin group.

Perinatal morbidity was observed in 20.63% of cases, which was comparable to the study by Thobbi et al (18.7%).[7] NICU admission was required for 56 neonates, with higher admission rates in the thick MSAF group (40.16%) compared to the thin group (11.29%). These findings were comparable with studies by Shrestha et al and Begum et al.[9,12]

Perinatal mortality in the present study was 4.35%, with MAS being the leading cause of death, followed by birth asphyxia, sepsis, and pneumonitis. The fetal morbidity and mortality rates were comparable with those reported by Bala et al where morbidity was 33% and mortality was 4%.[2]

Limitations

This cross-sectional, hospital-based study conducted over a 12-month period had several limitations. Long-term neonatal outcomes were not assessed, and home deliveries, discontinuation of antenatal care, and deliveries occurring elsewhere within six weeks postpartum were not included. The relatively small sample size of 184 patients and exclusion of certain cases further limited analysis.

CONCLUSION

The frequency of MSAF varied significantly with maternal risk factors. Pregnancy-induced hypertension, oligohydramnios, anemia, intrauterine growth restriction, and prolonged labor showed significant association with MSAF. Thin MSAF alone was not an indicator of fetal distress; however, its association with abnormal fetal heart rate patterns should be considered an alarming sign for adverse neonatal outcomes. Thick MSAF was significantly associated with abnormal fetal heart rate

patterns, higher rates of cesarean section, low Apgar scores at one and five minutes, increased NICU admissions, and higher perinatal morbidity and mortality.

Neonates with MAS and birth asphyxia were more commonly observed in cases with thick MSAF and require NICU care for close monitoring and aggressive management. The admission-to-delivery interval and stage of labor play a crucial role in determining the mode of delivery and prevention of perinatal mortality. Continuous intrapartum fetal heart rate monitoring, grading of meconium, availability of NST, and monitoring of labor progress are essential in managing MSAF cases. Effective coordination between obstetricians and pediatricians is vital. As not all fetuses with meconium passage develop adverse outcomes, early identification of those at risk and timely intervention are essential to prevent complications related to MAS.

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