Advanced Medical Journal, Vol.10, No.4, P.112-118,2025 https://doi.org/10.56056/amj.2025.405

Maternal and Fetal Outcomes in Term Deliveries with Meconium-Stained Amniotic Fluid

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Abstract

Background and objectives: Meconium-stained amniotic fluid is a poor predictor of neonatal outcome. Its presence is a possible sign of fetal distress and is related to poor perinatal outcomes. So, this study aimed to assess the maternal and perinatal outcomes in deliveries complicated by meconium-stained liquor.

Methods: A prospective observational cross-sectional study was conducted at Sulaimani Maternity Teaching Hospital, Sulaimaniyah, Iraq from May 01, 2022, to May 01, 2023, on 100 pregnant women with meconium-stained amniotic fluid after membrane rupture. The women's clinical data were collected and observed during labor. Then, the maternal and perinatal outcomes in deliveries complicated by meconium-stained liquor were assessed and analyzed statistically.

Results: The age of the pregnant women with meconium-stained amniotic fluid was 29.32 ± 6.6 years, and most of them were multiparous (68%), needed artificial membrane rupture (69%), and delivered by caesarean section (57%). Fetal heart rates were abnormal in 48%, which was higher among cases of grade III meconium (68%), and 29% of neonates had respiratory distress syndrome (p=0.001). Most neonates (71%) required admission to the neonate intensive care unit, with grade III meconium accounting for 76% of admission. The incidence of perinatal fetal death was 1.0%.

Conclusions: Mode of delivery and fetal outcome were affected by the grades of meconium-stained amniotic fluid. Most patients with grade II meconium underwent caesarean delivery, while most patients with grade III meconium reported fetal heart abnormalities, fetal respiratory distress syndrome, and neonate intensive care unit admission.

Keywords: Fetal outcome, Labour, Maternal outcome, Meconium-stained amniotic fluid

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Introduction

Meconium is a tenacious and viscous substance that forms in the colon of the fetus and often passes after delivery.[1] Meconium passage is a physiologically predetermined process in babies within the first 24 - 48 hours of birth. But for a variety of reasons, the fetus may pass meconium in the amniotic fluid during pregnancy.[2] Thus, green amniotic fluid due to meconium is known as meconium-stained amniotic fluid (MSAF), rare before 37 weeks of pregnancy, and the chance increases as gestational age increases.[2-4] Meconium-stained amniotic fluid is an obstetric complication that is present in 5 to 20% of patients who are in labour.[5] Meconium first appears in fetal ileum from 10 weeks of gestation, and after 34 weeks, its passage increases and reaches approximately 30% at 40 weeks and 50% at 42 weeks.[4] The increased incidence of MSAF with progressive gestational age possibly reflects the maturation of peristalsis in the fetal intestine, intestinal parasympathetic innervations and myelination. Once the fetus undergoes hypoxia or asphyxia, increased parasympathetic stimulation by the vagus results in the passage of meconium. Intrauterine asphyxia also leads to a gasping response by which meconium enters the trachea. When it has been aspirated into the lungs, it causes mechanical obstruction to airways, chemical pneumonitis and atelectasis.[3] Meconium-stained amniotic fluid has an unknown specific etiology, however; obstetric factors like prolonged labour, post-term pregnancy, low birth weight, intrauterine growth restriction and hypertensive disorders, as well as medical and sociodemographic risk factors like anemia and cholestasis, are considered contributing factors.[6] Meconium-stained amniotic fluid raises the risk of cesarean delivery, fetal distress, admission to the Neonatal Intensive Care Unit (NICU), and fetal death.[7] Approximately 10 to 20% of live deliveries exhibit meconium in the amniotic fluid, yet few infants are adversely affected.[4] Therefore, this study aimed to assess the maternal and fetal outcomes in relation to the mode of delivery, rate of cesarean section (CS), Apgar score and NICU admission among women with MSAF.

Patients and methods

This prospective observational cross-sectional study was performed in Sulaimani Maternity Teaching Hospital, Sulaimaniyah, Iraq, over a period of one year, from May 01 2022 to May 01 2023, on 100 pregnant women who visited the hospital with spontaneous onset of labour and discovered to have MSAF following spontaneous or artificial rupture of membranes. Women with a term singleton pregnancy between 37 - 40 weeks of gestation, cephalic presentation, and without fetal anomalies were enrolled, while those with intrauterine growth restriction/fetal death, induction of labour, and twin pregnancy were excluded. The fetus's heart rate was monitored by external Cardiotocography (CTG) and any abnormality such as repeated decelerations, fetal bradycardia or sinusoidal pattern were recorded. Then, a well-validated questionnaire was used to collect women's age, gravidity, parity, gestational age that was calculated by late first/early second-trimester ultrasound, last menstrual period and mode of delivery. Simultaneously, fetal outcomes were also reported, including Apgar scores at one and five minutes, fetal weight, gender, NICU admissions, birth asphyxia, and fetal death. Then, the association between maternal and fetal outcomes in relation to MSAF grades were determined. According to the standard grading system for meconium, MSAF can be classified into three grades: grade I or thin meconium which is translucent mild yellow-green with no particulate matter, grade II meconium is opalescent light green with few particulate matters and grade III is opaque, deep green with extra particulate

https://doi.org/10.56056/amj.2025.405

matter. Grades II and III are considered as thick meconium.[4,8,9] The Scientific Committee approved the study protocol at the Kurdistan Higher Council for Medical Specialties (KHCMS), Sulaimaniyah, Iraq and participants' written and verbal consents were obtained before starting the study. The data was analyzed using Statistical Package for Social Science (SPSS, Chicago, IBM, USA, Version 25). The Chi-square and Wilcoxon-Mann-Whitney U tests were used to explore the association between variables and the grades of MSAF. A p-value <0.05 is considered statistically significant, p<0.001 is a highly significant difference.

Results

Among patients with MSAF, 27 had grade I meconium, 48 had grade II and 25 had grade III. The mean maternal age was 29.32 ± 6.6 years, and their age ranged from 18 to 41 years, while the mean gestational age was 37.8 ± 0.87 weeks. Most patients were multiparous (68%), had artificial rupture of membrane (69%), and delivered by CS (57%). No significant differences (p>0.05) were observed between all variables (maternal age, gestational age, parity, and mode of membrane rupture) and meconium grades, except for mode of delivery (p=0.001). This means that MSAF grades correlated to the mode of delivery, and most patients with grade II meconium underwent CS (n=34, 71%), and most patients with grade I gave vaginal delivery (VD) (n=20, 75%), as shown in Table (1).

Table (1): Maternal clinical characteristics among MSAF cases and their grades.

Variable		MSAF Grade			Total (n=100)	p-value
		Grade I (n=27)	Grade II (n=48)	Grade III (n=25)		
Mean maternal age (Years)	29.32±6.6	30.78±6.06	28.94±6.4	28.48±7.4	100	0.616
Mean gestational age (Weeks)	37.8±0.87	37.81±0.73	38.04±0.77	37.56±0.71	100	0.142
Number (%)						
Parity						
Primigravida		5.0 (19%)	20 (42%)	7.0 (28%)	32(32%)	0.105
Multiparous		22 (81%)	28 (58%)	18 (72%)	68(68%)	
Rupture of membrane						
Spontaneous		9.0 (34%)	15 (32%)	7.0 (28%)	31(31%)	0.916
Artificial		18 (66%)	33 (68%)	18 (72%)	69(69%)	
Mode of delivery						
VD		20 (75%)	14 (29%)	9.0 (36%)	43(43%)	0.001*
CS		7.0 (25%)	34 (71%)	16 (64%)	57(57%)	

CS: Caesarean section, MSAF: Meconium-stained amniotic fluid, VD: Vaginal delivery, SD: Standard deviation. *: Highly significant difference using the Chi-square test.

Additionally, a significant association (p=0.001) was seen between grades of MSAF and the CTG findings (fetal heart rate) in which most patients had normal CTG findings (52%), and 48% had abnormal CTG). Most women with grade II meconium had abnormal CTG (27 out of 48), followed by grade III (17 out of 25), as shown in Table (2).

https://doi.org/10.56056/amj.2025.405

Table (2): Cardiotocographic findings among MSAF cases and their grades.

Fetal heart rate		MSAF Grades			Total (n=100)	p-value
		Grade I (n=27)	Grade II (n=48)	Grade III (n=25)		
Number (%)						
CTG finding	Normal	23 (85%)	21 (44%)	8.0 (32%)	52(52%)	0.001*
	Abnormal	4.0 (15%)	27 (56%)	17 (68%)	48(48%)	

CTG: Cardiotocography, MSAF: Meconium-stained amniotic fluid. *: Highly significant difference using the Chi-square test

Moreover, the mean fetal weight at birth was 3.3 ± 0.27 kg (minimum 2.8 kg and maximum 3.9 kg). Most neonates were females (53%), required NICU admission (71%), and 32% had respiratory distress syndrome (RDS), especially those with grade III meconium (n=14, 56%). Additionally, the mean Apgar score at one minute reported highest in grade I meconium (7.35 ± 0.85), while at five minutes reported highest in grade II (8.75 ± 2.15). Fetal death (n=1.0) was found only with grade II that was delivered by VD, presented with RDS, and admitted to NICU for 12 hours. No significant association was found between all mentioned fetal factors and MSAF grades, except for RDS (p=0.001), as shown in Table (3).

Table (3): Neonatal outcome among MSAF cases and its grades.

Neonate factor		MSAF Grades			Total (n=100)	p-value
		Grade I (n=27)	Grade II (n=48)	Grade III (n=25)		
Mean fetal weight (Kilogram)	3.3±0.27	3.31±0.28	3.28±0.26	3.31±0.30	100	0.464
Mean Apgar score	At one minute	7.35±0.85	6.95±1.25	6.75±1.1	7.02±1.07	0.589
	At 5 minutes	8.25±1.7	8.75±2.15	8.01±1.6	8.34±1.81	0.528
Number (%)						
Gender	Male	17 (63%)	20 (41%)	10 (40%)	47 (47%)	0.086
	Female	10 (37%)	28 (59%)	15 (60%)	53 (53%)	
NICU admission	Required	17 (63%)	35 (72%)	19 (76%)	71 (71%)	0.539
	Not required	10 (37%)	13 (28%)	6.0 (24%)	29 (29%)	
Respiratory distress syndrome		5.0 (17%)	13 (27%)	14 (56%)	32 (32%)	0.001*
Fetal death		0.0(0.0%)	1.0(0.48%)	0.0(0.0%)	1.0(1.0%)	

MSAF: Meconium-stained amniotic fluid, NICU: Neonatal intensive care unit. *: Significant difference using the Chi-square test.

Discussion

Meconium passage might be a natural physiological event that reflects fetal development; thus, we aimed to observe the maternal/fetal outcomes in women with MSAF. In this study, 27% of patients with MSAF had grade I meconium, 48% had grade II and 25% had grade III. In this regard, Gluck et al. reported 4.4% of MSAF patients had grade I (light meconium), 11.2% had grade II (intermediate meconium), and 1.8% had grade III (high meconium). Whereas

https://doi.org/10.56056/amj.2025.405


Begum et al. showed 30% of MSAF patients had grade I, 40% had grade II and 30% had grade III liquor.[3,10] Both studies showed similar results to this study, in which they showed that grade II reported the highest incidence than grade I and grade III. The development of MSAF may be due to the physiological maturation and motility of the fetal gastrointestinal tract or the fetal response to hypoxic stress that can promote the release of arginine vasopressin from the fetal pituitary to stimulate the smooth muscles of the colon favoring the onset of hyperperistalsis and the relaxation of the anal sphincter. However, also vagal stimulation from umbilical cord compression can increase peristalsis and relaxation of anal sphincter, then intrauterine passage of meconium with or without fetal hypoxic stress.[10] Among pregnant women, 43% gave VD, while 57% delivered by CS, which was significantly increased in those with MSAF. These outcomes agreed with that of Parween et al., in which the rate of CS was 49% in women with MSAF; however, these findings are lower than that stated by Shaikh et al. who reported a high rate of CS (82%) in patients with MSAF.[8,11] We may attribute the high incidence of CS in this study to inadequate intrapartum fetal heart monitoring. As such, the presence of meconium in the amniotic fluid was an alarming sign of fetal distress and treated accordingly by emergency CS.Additionally, most patients with grade II meconium underwent CS (71%), while most patients with grade I gave VD (74%). In this regard, Dani et al. showed that grade III MSAF deliveries were associated with a higher frequency of CS (32%) rather than grade I (20%) and grade II (15%). [12] These disparities among studies might be related to the sample size and maternal factors.Also, we found a significant correlation between MSAF and abnormal fetal heart rate monitored by CTG (p=0.001), in which fetal heart rate abnormalities were more prevalent in patients with grade II and III meconium (56% and 68%, respectively). These outcomes are aligned with that of the Kashikar et al. studies, which found most women (71.5%) had thin meconium (grade I MSAF) and reactive CTG, while 36.3% had thick meconium (grade II and III MSAF) and greater frequency of abnormal CTGs (p=0.001). [13]Additionally, we found a highly significant relationship between meconium grades and RDS development in neonates (32%) (p=0.001). This result is correlated with the study outcomes of Unnisa et al. and Mohapatra et al.[14,15] In the current study, 47% of neonates were males, and 53% were females, which is similar to that found by David et al. (48% males vs 53% females), while it is not agreed with that of Parween et al. (52% males vs 48% females).[8,16] Furthermore, we had only one male neonate death that had grade II meconium and was delivered by VD, presented with RDS and was admitted to NICU for 12 hours. Similar results were reported by Nesa et al. However, a high incidence of perinatal death (n=5.0) was reported by Mundhra and Agarwal due to meconium aspiration (n=4.0), severe birth asphyxia with hypoxic-ischemic encephalopathy (n=1.0).[17,18] These disparities among studies might be related to sample size, maternal factors, and type with severity of fetal diseases. In this study, the mean Apgar score at one minute reported highest in grade I meconium (7.35 ± 0.85), while at five minutes reported highest in grade II (8.75 ± 2.15). On contrary, Begum et al. found that poor Apgar scores were significantly high in grade III compared to grade I and grade II meconium. [3] Also, we found the mean Apgar score at one minute to be 7.02 ± 1.07 and at five minutes to be 8.34 ± 1.81. Ghimire et al. found lower mean Apgar scores at one minute (6.82 ± 1.87) and at 5-minute (8.16 ± 1.33) in neonates with MSAF compared to this study. [20] These differences might be related to the maternal

https://doi.org/10.56056/amj.2025.405

medical condition, mode of delivery, umbilical cord condition and lactate concentration of the neonate.[21]

The present study also showed that 71 (71%) newborns needed to be admitted to the NICU, 17 of whom had grade I meconium, 35 had grade II, and 19 had grade III. Our findings are quite higher than those reported by Hiremath et al. who found that only 4.0% of newborns required NICU admission for grade I, 10.6% for grade II, and 13.3% for grade III. [19] However, our results were higher (71%) than those reported by Halle-Ekane et al. who found that 40% of the neonates delivered with MSAF needed NICU admission. [22] Consequently, the high rate of NICU admission in this study might be because of fetal distress and routine hospital management that sending fetal with MSAF to NICU for at least 12-hours, as well as the hospital is a tertiary referral care center that receives large numbers of pregnant women. The limitations of this study were small sample size, short duration and single-center study.

Conclusions

The mode of delivery was affected by the MSAF grades, as most patients with grade II meconium underwent caesarean delivery. Also, fetal outcome affected by the MSAF grades, in which most patients with grade III meconium reported fetal heart abnormalities, fetal respiratory distress syndrome, and neonate intensive care unit admission.

Conflict of interest

Not declared.

Acknowledgements

We would like to thank the authorities of Sulaimani Maternity Teaching Hospital for their help and support with this study.

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