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Troubled Waters: The Hidden Risks of Meconium-Stained Liquor

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ABSTRACT

Background: Meconium is a dark green substance made up of shed cells, mucus, and bile that usually accumulates in the fetal intestines and is expelled after birth. When meconium is present in the amniotic fluid, it is often regarded as an indicator of fetal distress, which can be associated with negative perinatal outcomes. This study aimed to investigate the different grades of meconium-stained amniotic fluid and their effects on immediate maternal and neonatal outcomes.

Methods: This prospective observational study was conducted from May 2023 to June 2024 at Karuna Hospital, Sendhwa, Madhya Pradesh. The study included 54 women with singleton pregnancies of gestational age ≥35 weeks presenting with meconium-stained amniotic fluid during labour. Continuous fetal monitoring using cardiotocography was performed. Maternal outcomes (delivery mode) and neonatal outcomes (APGAR scores, NICU admissions, neonatal complications) were documented and analyzed.

Results: Out of 54 cases, 37 (68.1%) were delivered by caesarean section, while the remaining 17 (31.9%) were delivered vaginally. Differences in delivery methods were observed based on meconium thickness ($\chi^2 = 20.66$, $p < 0.001$). Caesarean delivery rates were higher in cases of moderate meconium (59.5%) and thick meconium (29.7%) compared to cases of thin meconium (10.8%). Furthermore, APGAR scores significantly improved from the first to the fifth minute ($p < 0.05$). NICU admissions were notably higher for thick meconium cases (58.3%) and moderate meconium cases (41.7%), which was statistically significant ($p < 0.05$). Complications reported included birth asphyxia (16.66%), meconium aspiration syndrome with pneumonia (3.7%), and neonatal sepsis (1.85%).

Conclusion: The findings of this study indicate that MSAF is associated with an increased rate of caesarean deliveries, higher NICU admission rates, and significant neonatal complications. Early identification and prompt intrapartum management can enhance both maternal and neonatal outcomes.

Keywords: *Meconium-stained Amniotic fluid (MSAF), Meconium aspiration syndrome, Caesarean rates, Neonatal outcome*

1. INTRODUCTION

Meconium is a thick, sticky, dark greenish-black substance found in the intestines of fetuses and newborns. It is odorless and considered sterile. The composition of meconium includes water, amniotic fluid, lanugo, vernix caseosa, dead skin and intestinal cells, digestive secretions such as bile and pancreatic enzymes, mucus, and blood glycoproteins. The formation of meconium begins around the tenth week of gestation; however, it usually does not get expelled due to ineffective peristalsis, which is caused by low levels of motilin and the continuous contraction of the anal sphincter [1].

The incidence of meconium-stained amniotic fluid (MSAF) ranges from 10% to 27%, depending on gestational age and obstetric complications. Among cases of MSAF, the prevalence of meconium aspiration syndrome (MAS) varies between 5% and 20%, with the mode of delivery significantly influencing this outcome. [2-10]. Extensive research has identified several risk factors associated with the development of MAS. These include operative delivery, the presence of thick meconium, low APGAR scores, various obstetric complications, abnormal fetal heart rate patterns, post-term pregnancies, and oligohydramnios. Each of these factors has been consistently linked to an increased risk of MAS [11-12]. The occurrence of meconium-stained amniotic fluid (MSAF) is more common in cases of prolonged gestation. Several factors related to fetal development contribute to this phenomenon. These include the temporary activation of the parasympathetic nervous system due to cord or head compression, increased levels of motilin associated with gestational age, and an enhanced cholinergic nerve supply[1].

Typically, the fetus does not expel meconium into the amniotic fluid because intestinal contractions are lacking, which is a result of low motilin levels and continuous contraction of the anal sphincter [13]. The exact reasons some infants expel meconium while still in utero are not fully understood. Research by Poggi and Ghidini suggests that hypoxic stress in the fetus may cause relaxation of the anal sphincter and stimulate gastrointestinal contractions, promoting the passage of meconium [14]. Additionally, fetal hypoxia may lead to gasping efforts, increasing the risk of meconium inhalation. When meconium is inhaled, it can negatively impact the lungs through three primary mechanisms: airway obstruction, inflammation, and disruption of surfactant production[15].

Aspirating amniotic fluid stained with meconium can result in various degrees of respiratory distress in newborns, ranging from a mild and transient increase in respiratory rate to respiratory failure [16]. This condition is associated with poor perinatal outcomes, which can include low APGAR scores, a higher incidence of chorioamnionitis, increased rates of neonatal intensive care admissions, and a higher perinatal mortality rate[17]. Hence, the present study has been undertaken to study the grades of meconium-stained liquor and its effect on maternal and neonatal outcomes.

2. METHODS

The present study was prospective observational research conducted from May 2023 to June 2024 at the Labour unit of Karuna Hospital in Sendhwa, Madhya Pradesh. Formal permission was obtained from the hospital authority before starting the study.

Inclusion criteria: The inclusion criteria were live singleton pregnancy and cephalic presentation.

Exclusion criteria*:* Pregnant women in labour with an unknown last menstrual date, eclampsia, antepartum haemorrhage, intrauterine foetal death, congenital malformations, pre-existing maternal heart or lung disease, pregnancies with IUGR (intrauterine growth restriction) babies, and presentations other than cephalic.

All women admitted to Karuna Hospital who met the inclusion criteria were enrolled in the study after providing written informed consent. A detailed history was taken, including age, gravidity, parity, past obstetrical history, menstrual history, current pregnancy history, and any medical or surgical disorders. Following this, a general and systemic examination was conducted, along with an obstetrical examination. The height of the fundus, amount of amniotic fluid, fetal presentation, and fetal heart rate were all recorded. Additionally, a pelvic assessment was performed. When the membranes ruptured spontaneously or through artificial rupture of membranes (ARM), the colour of the amniotic fluid was noted. Women who developed meconium staining of the amniotic fluid during labour were also included in the study. Meconium was classified as either thin or thick according to the criteria established by Patil et al[18]. Continuous intrapartum fetal heart monitoring was performed using cardiotocography (CTG) tracing. The mode of delivery was documented concerning maternal outcomes, and after delivery, the condition of the newborn was assessed using the APGAR score and the baby's weight. The need for resuscitation, admissions to the neonatal intensive care unit (NICU), and any neonatal complications were also recorded.

3. DATA ANALYSIS

The collected data was coded and entered into an MS Excel sheet and further transferred into SPSS software (25.0) for statistical analysis.

Results: The study observed a total of 54 women who experienced meconium-stained amniotic fluid (MSAF) during labor. The perinatal outcomes were analyzed based on the grading of MSAF as thin, moderate, or thick.

Table No 1: Demographic characteristics based on Meconium-stained amniotic fluid

(N =54)

Parameters	Frequency	Percentage

1. Age in years	20 and below	16	29.6
	21-25	21	38.9
	26-30	11	20.4
	31-35	5	9.3
	Above 35	1	1.8
2. Gestational Age	Less than 37 weeks	4	7.4
	37 – 40 weeks	47	87.1
	More than 40 weeks	3	5.5
3.Newborn Birth weight	Less than 1500 gm	1	1.8
	1500 – 2500 gm	13	24.1
	2501 – 3500 gm	38	70.4
	More than 3500 gm	2	3.7
4. Gender of baby	Male	20	37.1
	Female	34	62.9

The age of the mother was found to be an independent factor as per Table 1 in determining the type of MSAF observed. The results showed that the majority 21(38.9%) of the cases were from the age group of 21-25 years; 47(87.1) cases gestational age fall between 37-40 weeks; 38(70.4%) birth weight were between 2501 to 3500 grams; 34(62.9%) babies were females.

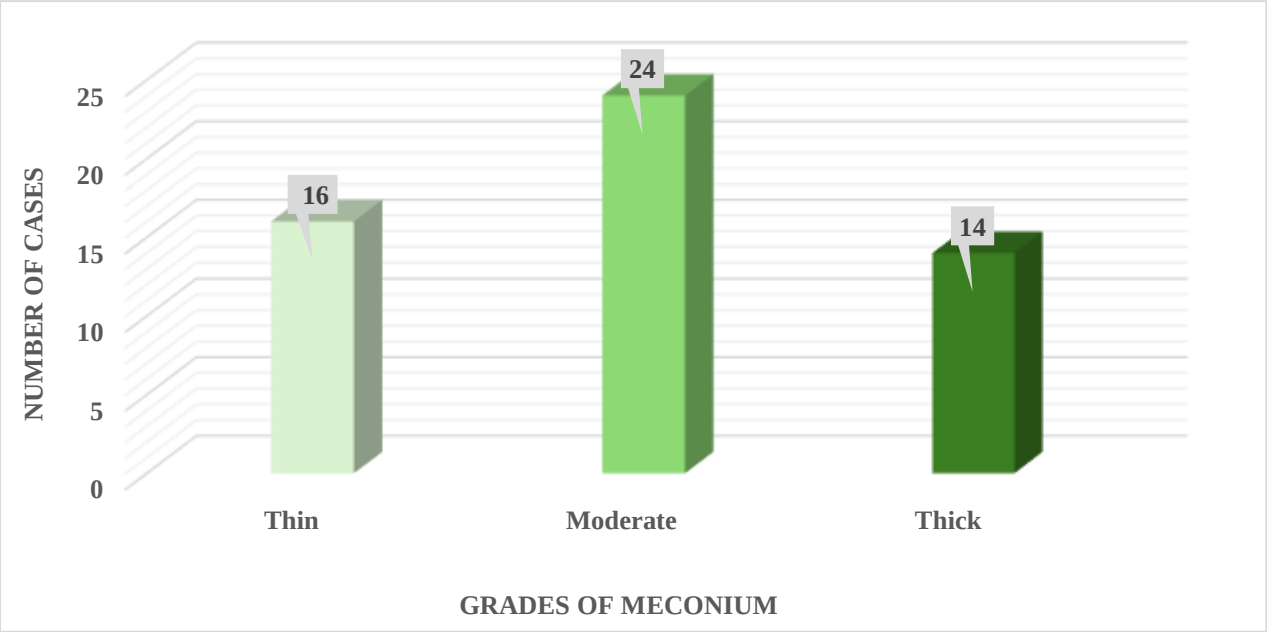

Figure 1: Number of MSAF cases based on grades of meconium

Table 2: Grades of meconium & Mode of delivery

(N =54)

Grades of Meconium	**Number of cases**	**Percentage**	**Mode of delivery**		**Chi square**	**P value**
			LSCS	**NVD**		

			No	%	No	%	value	
Thin	16	29.6	4	10.8%	12	70.6	20.66	0.00002
Moderate	24	44.5	22	59.5%	2	11.8		
Thick	14	25.9	11	29.7%	3	17.6		

According to the information presented in Table 2, a significant proportion of cases, 24(44.5%), exhibited moderately stained meconium, while 16(29.6%) displayed thin meconium, and 14(25.9%) showed thick meconium. In terms of delivery methods, among the cases with thin meconium, 4(10.8%) were delivered via lower segment cesarean section (LSCS), and 12(70.6%) were delivered vaginally. For the cases with moderately stained amniotic fluid, 22(59.5%) underwent LSCS, while 2(11.8%) were delivered vaginally. Among the 14 cases identified with thick meconium, 11(29.7%) were delivered through LSCS and the rest 3(17.6%) delivered vaginally. The calculated chi-square statistic is 20.66, with a p-value of 0.00002, indicating a statistically significant association between the type of meconium staining and the delivery method.

Table 3: Comparison of grades of meconium & Fetal heart rate (N=54)

Parameters		**Grades of Meconium**			**Chi-square**	**P value**
		Thin	Moderate	Thick		
FHR/Minute	< 90	0	2	7	23.74	<0.05
	90 – 120	2	4	4		
	120 – 160	12	18	3		
	>160	2	0	0		

Table 3, shows there was a significant variation between the Fetal heart rate and grades of meconium-stained cases. FHR dropped to below 90 among the thick MSAF; cases of thin and moderate MSAF maintained the normal FHR. The same has been depicted with statistical significance($p<0.05$).

Table 4: Comparison of grades of meconium & APGAR Score (N =54)

Grade of Meconium	**APGAR score at 1 minute**			**APGAR score at 5 minutes**			**Chi-square**	**P value**
	Normal (7-10)	Moderate (4-6)	Severe (0-3)	Normal (7-10)	Moderate (4-6)	Severe (0-3)		
Thin	13	3	0	16	0	0	13.72	<0.05
Moderate	13	11	0	20	4	0		
Thick	0	10	4	7	6	1		
Total	26	24	4	43	10	1		

In table 4 above, although there was a decline in the APGAR score at 1 minute, there was a significant improvement observed at 5 minutes. Most newborns returned to a normal APGAR score of 7-10 by 5 minutes. This variation resulted in statistically significant findings ($p < 0.05$).

Table 5: Association between type of meconium-stained liquor and NICU admission

(N=54)

Grades of meconium	**No of cases**	**NICU admission**	Chi-square	P value
Thin	16	0		
Moderate	24	5(41.7%)		

Thick	14	7(58.3%)	10.848	<0.05
Total	54	12		

Table 5 clearly shows that cases with thick meconium grade had a higher occurrence of NICU admissions at 7 (58.3%), followed by 5 (41.7%) cases with moderate meconium grade, which was statistically significant (p <0.05).

Table 6: Association between MSAF and its Neonatal outcomes

(N =54)

Parameters	**Frequency**	**Percent**
Birth complications Healthy babies without complications	42	77.7
Birth Asphyxia	9	16.66
MAS with pneumonia	2	3.70
Neonatal sepsis	1	1.85
Condition after birth		
Discharged in good condition	49	90.74
Referred for further treatment	5	9.25

Table 6 shows that out of 54 cases with Meconium-Stained Amniotic Fluid (MSAF), the majority, 42 (77.7%), were healthy and without complications. Only 9 (16.66%) developed asphyxia, 3 (3.7%) suffered Meconium Aspiration Syndrome (MAS) with pneumonia, and 1 (1.85%) had neonatal sepsis. With timely management, approximately 7 newborns recovered quickly from birth complications, and about 49 were discharged in good condition from the hospital. However, 5 cases were referred to a tertiary care hospital for further management.

4. DISCUSSION

The purpose of this study was to assess the fetal outcomes related to deliveries with meconium-stained amniotic fluid and to determine the risks of adverse outcomes associated with this condition. A significant portion of the patients, 38.8%, fell within the age group of 21 to 30 years. Neke Akhtar et al.. reported that the average maternal age was 26.2 ± 5.2 years [19].

In this study, it was found that 87.1% of the patients with meconium-stained amniotic fluid were at term. The above findings are consistent with Gupta et al., who observed a significant increase (86.7%) in the presence of meconium in amniotic fluid after 37 weeks[20], and also by Oyelese et al[21]. The majority of participants had a birth weight ranging from 2.5 to 3 kg. Sedaghatian et al[22].. reported similar outcomes, while Neke et al., found that over 75% of infants had birth weight exceeding 2.5 kg[19] . In our research, 37.1% of the infants were male, and 62.9% were female. This aligns with the findings of David et al., where 48% of the infants were male, and 52% were female [23].

In our study, 29.6% of the patients had thin meconium, 44.4% had moderate meconium, and 25.9% had thick meconium. These observations were similarly reported by Erum Majid Sheikh et al[24]. and Piper et al[25]. The number of cesarean sections (LSCS) was higher in the moderate and thick meconium groups, and this difference was statistically significant. Our study correlates with the research conducted by Shaikh et al[26]., in which the cesarean rate was 82%.

Any form of intrauterine stress can lead to expulsion of meconium from relaxed the anal sphincters, which may cause fetal hypoxia and, lower APGAR scores [27,28]. Furthermore, a fetus exposed to meconium-stained amniotic fluid (MSAF) can also have a low APGAR score, particularly if the meconium is thick enough to obstruct the oropharynx, contributing to a hypoxic state. Consequently, this study identified a significant relationship between low APGAR scores and the occurrence of meconium aspiration syndrome (MAS)[29,30].

The current study findings present that 41.7% of neonates born with moderate meconium were admitted to the NICU, while 58.3% of those delivered with thick meconium required NICU care. These results are consistent with findings from studies conducted by Qadir and Odongo et al[31,32]. Similar to our study, other research also showed a higher rate of NICU admissions for babies with thick meconium-stained amniotic fluid (MSAF). Furthermore, the incidence of birth asphyxia noted in our study was 16.66%, which is consistent with the results of several other studies as well[33,34].

5. CONCLUSION

Meconium-stained amniotic fluid can increase the risks for newborns, including birth asphyxia, meconium aspiration syndrome, hospitalization, and even mortality. Therefore, it is crucial to identify pregnant women at risk of passing meconium during labor to provide intensive fetal monitoring and prompt intervention. Having neonatal expertise and the necessary equipment—such as oxygen masks, laryngoscopes, suction catheters, endotracheal tubes, and AMBU bags—available during delivery is essential to reduce the morbidity and mortality rates associated with meconium-stained amniotic fluid. Additionally, an advanced neonatal resuscitation unit is necessary to manage any potential complications that may arise.

REFERENCES

[1] Goel A, Nangia S, Saili A, Garg A, Sharma S, Randhawa VS. Role of prophylactic antibiotics in neonates born through meconium-stained amniotic fluid (MSAF)--a randomized controlled trial. Eur J Pediatr. 2015 Feb;174(2):237-43. doi: 10.1007/s00431-014-2385-4. Epub 2014 Aug 3. PMID: 25084971.

[2] S. B., S. S., Devaraj, S., & E., N. Meconium aspiration syndrome and neonatal outcome: a hospital based study. *International Journal of Contemporary Pediatrics*, 2019 *6*(3), 1330–1335. https://doi.org/10.18203/2349-3291.ijcp20192038

[3] Halle-Ekane GE, N. Fon P, Koki PN, Tazinya AA, Ekollo R, Mboudou E. Maternal and Perinatal Outcomes in Childbirths with Meconium Stained Amniotic Fluid in a Low-resource Setting: A Prospective Cohort Study. Arch. Curr. Res. Int. [Internet]. 2019 Mar. 30 [cited 2025 Mar. 7];17(1):1-11. Available from: https://journalacri.com/index.php/ACRI/article/view/298

[4] Singh G, Singh O, Thapar K. Neonatal outcome in meconium stained amniotic fluid: a hospital based study. Int J Contemp Pediatr [Internet]. 2017 2025 ;4(2):356-60. Available from: https://www.ijpediatrics.com/index.php/ijcp/article/view/434

[5] Sori D, Belete A, Wolde M. Meconium-stained amniotic fluid: factors affecting maternal and perinatal outcomes at Jimma University Specialized Teaching Hospital, South West Ethiopia. *Gynecol Obstet (Sunnyvale)*. 2016. 6(394):2161-0932.1000394. doi: 10.4172/2161-0932.1000394

[6] Sundaram, R., & Murugesan, A. Risk factors for meconium-stained amniotic fluid and its implications. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 2017, *5*(8), 2503–2506. https://doi.org/10.18203/2320-1770.ijrcog20162247

[7] Tolu LB, Birara M, Teshome T, Feyissa GT. Perinatal outcome of meconium stained amniotic fluid among labouring mothers at teaching referral hospital in urban Ethiopia. *PloS One*. (2020) 15(11):e0242025. Available from https://doi.org/10.1371/journal.pone.0242025

[8] Unnisa S, Sowmya B, Rao SB, Rajagopal K. Maternal and fetal out come in meconium stained amniotic fluid in a tertiary centre. *Int J Reprod Contracept Obstet Gynecol*. (2016) 5(3):813–7. doi: 10.18203/2320-1770.ijrcog20160590

[9] Oliveira CPL, Flôr-de-Lima F, Rocha GMD, Machado AP, Guimarães Pereira Areias MHF. Meconium aspiration syndrome: risk factors and predictors of severity. JMatern Fetal Neonatal Med. 2019: 32(9):1492–8. doi: 10.1080/14767058.2017.1410700

[10] Ward C, Caughey AB. The risk of meconium aspiration syndrome (MAS) increases with gestational age at term. J Matern Fetal Neonatal Med. (2022) 35 (1):155–60. doi: 10.1080/14767058.2020.1713744

[11] Wiswell TE, Tuggle JM, Turner BS. Meconium aspiration syndrome: have we made a difference? Pediatrics. (1990) 85(5):715–21. doi: 10.1542/peds.85. 5.715

[12] Sheiner E, Hadar A, Shoham-Vardi I, Hallak M, Katz M, Mazor M. The effect of meconium on perinatal outcome: a prospective analysis. J Matern Fetal Neonatal Med. (2002) 11(1):54–9. doi: 10.1080/jmf.11.1.54.59

[13] Gelfand SL, Fanaroff JM, Walsh MC. Meconium stained fluid: approach to the mother and the baby. Pediatr Clin North Am 2004;51:655–667; ix.

[14] Gelfand SL, Fanaroff JM, Walsh MC. Meconium stained fluid: approach to the mother and the baby. Pediatr Clin North Am 2004;51:655–667; ix.

[15] Rawat M, Nangia S, Chandrasekharan P, et al. Approach to infants born through meconium stained amniotic fluid: evolution based on evidence? Am J Perinatol 2018;35:815–822.

[16] Ramakishore AV, Subramanyam KL, Mahesh G. A study on meconium aspiration syndrome cases attending to government general hospital Anantapuramu, Andhra Pradesh. Int J Res Health Sci. 2015;3(1):169-73

[17] Ahanya SN, Lakshmanan J, Morgan BL, Ross MG (2005) Meconium passage in utero: mechanisms,

consequences, and management. Obstet Gynecol Surv 60(1): 45-56.

[18] Vani RK, Pati B, Veena KS, Kumar HVR. Comparison of neonatal outcome parameters between thick and thin meconium-stained liquor: a prospective study. Int J Reprod Contracept Obstet Gynecol 2018;7:4407-12.

[19] Neke Akhtar, Fazilatunnesa, Sharmeen Yasmean. Mode of delivery and fetal outcome in meconium stained amniotic fluid in DMCH, 2006. Available at: www.jemds.com/data_pdf/Dr%20Uday%20Rajput2.doc.

[20] Gupta V, Bhatia BD, Mishra OP. Meconium stained amniotic fluid: Antenatal intrapartum and neonatal attributes. Indian Paediatr. 1996;33:293-7.

[21] Oyelese Y, Culin A, Ananth CV, Kaminsky LM, Vintzileos AM, Smulian JC. Meconium-stained amniotic fluid across gestation and neonatal acidbase status. Am J Obstet Gynaecol. 2006;108:345-9.

[22] Sedaghatian MR, Otheman L, Rashid N, Ramachandran P, Bener BA. An 8 year study of meconium stained amniotic fluid in different ethnic groups. Kuwait Med J. 2004;36:266-9.

[23] Erum Majid Sheikh, Sedaf Mehmood, Majed ahmed sheikh. Neonatal outcome in meconium stained amniotic fluid: one year experience. J Pak Med Assoc. 2010 Sep;60(9):711-4. 6.

[24] Piper JM, Newton ER, Berkus MD, Peairs WA. Meconium a marker of peripartum infection. Obstet Gynaecol (USA). 1998;91(5 Pt.1):741-5

[25] Shaikh EM, Mehmood S, Shaikh MA: Neonatal outcome in meconium stained amniotic fluid-one year experience. J Pak Med Assoc. 2010, 60:711-4.

[26] David AN, Njokanma OF, Iroha E: Incidence of and factors associated with meconium staining of the amniotic fluid in a Nigerian University Teaching Hospital. J Obstet Gynaecol. 2006, 26:518-20. 10.1080/01443610600797426

[27] Lakshmanan J, Ahanya SN, Rehan V, Oyachi N, Ross MG. Elevated plasma corticotrophin release factor levels and in utero meconium passage. Pediatr Res. (2007) 61(2):176–9. doi: 10.1203/pdr.0b013e31802d8a81

[28] Lakshmanan J, Oyachi N, Ahanya SA, Liu G, Mazdak M, Ross MG. Corticotropin-releasing factor inhibition of sheep fetal colonic contractility: mechanisms to prevent meconium passage in utero. Am J Obstet Gynecol. (2007) 196(4):357.e1–e7. doi: 10.1016/j.ajog.2006.11.034

[29] Khazardoost S, Hantoushzadeh S, Khooshideh M, Borna S. Risk factors for meconium aspiration in meconium stained amniotic fluid. J Obstet Gynaecol. (2007) 27(6):577–9. doi: 10.1080/01443610701469636

[30] Dohbit JS, Mah EM, Essiben F, Nzene EM, Meka EU, Foumane P, et al. Maternal and fetal outcomes following labour at term in singleton pregnancies with meconium stained amniotic fluid: a prospective cohort study. Open J Obstet Gynecol. (2018) 8 (09):790. doi: 10.4236/ojog.2018.89082

[31] Qadir S, Jan S, Chachoo JA, Parveen S: Perinatal and neonatal outcome in meconium-stained amniotic fluid. Int J Reprod Contracept Obstet Gynecol. 2016, 5:1400-5. 10.18203/2320-1770.ijrcog20161293

[32] Jain PG, Sharma R, Bhargava M. Perinatal outcome of meconium stained liquor in pre-term, term and post-term pregnancy. Indian J Obstet Gynecol Res. 2017;4(2):146-50.

[33] Mundhra R, Agarwal M. Fetal outcome in meconium stained deliveries. J Clin Diagn Res. 2013;7(12):2874-76.

[34] Khatun MHA, Arzu J, Haque E. Fetal outcome in deliveries with meconium stained liquor. Bangladish J Child Health. 2009;33(2):41-5.