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Association of varying degrees of meconium stained amniotic fluid with umbilical cord blood parameters and perinatal outcome

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Abstract
Background: Meconium stained amniotic fluid (MSAF) is a predictor of potential adverse fetal outcome. However, all fetuses with meconium passage do not have an adverse outcome. MSAF has been found to have significant association with an abnormal cord pH and lactate levels. Hence this study was undertaken to study the grades of MSAF and its effect on intrapartum management and relation with neonatal outcome.
Materials and Methods: A total of 126 subjects detected with MSAF after spontaneous or artificial rupture of membranes were enrolled in the study and were divided into two groups [Thin MSAF and Thick MSAF]. Association of various maternal high risk factors, fetal heart rate abnormalities, mode of delivery, cord blood parameters [pH and lactate] and neonatal outcomes were evaluated in relation to different grades of meconium staining.
Results: It was observed that thick MSAF was associated with abnormal cord blood parameters [High Lactate in 76.43% and low pH levels in 73.32%] in comparison to thin meconium [High Lactate in 30.28% and low pH in 26.66%]. Most common high risk factor for MSAF was post dated pregnancy. Subjects with thick MSAF had abnormal fetal heart rate pattern [70.45%], increased rates of LSCS [80.25%], low APGAR score [92.14%], increased need for resuscitation [86.10%], NICU admission [87.23%] and development of Meconium Aspiration Syndrome [12.77%] that was suggestive of poor perinatal and neonatal outcome.
Conclusion: Maximum subjects with thin MSAF had reassuring CTG and normal cord blood pH and lactate levels. Majority of them delivered vaginally with good neonatal outcomes. However presence of thick MSAF was associated with poor APGAR score, increased NICU admission and abnormal cord blood parameters.

Keywords: Meconium stained amniotic fluid, Cord blood parameters, Meconium Aspiration Syndrome, Cardiotocography

Introduction

Meconium-stained amniotic fluid (MSAF) has been considered as an obstetrical hazard and is a potentially grave sign of fetal compromise. It is generally associated with poor perinatal outcome including low APGAR score, increased rate of chorioamnionitis, enhanced incidence of NICU admissions, high rate of stillbirths and increased rates of instrumental deliveries as well as caesarean sections [1]. Incidence of MSAF increases with increasing gestational age especially in postdated pregnancy and ranges from 7 to 22 %, while meconium aspiration syndrome [MAS] occurs in 5 % of all the cases and MAS contributes to neonatal death up to 0.05% cases (1 in 2000 pregnancies) [2, 3].

The risk factors for MASF are both maternal as well as fetal. The major maternal factors are hypertensive disorders of pregnancy, diabetes mellitus, maternal chronic respiratory and cardiovascular diseases, post term pregnancy, intra hepatic disorder, anemia, maternal drug abuse and prolonged labor. The fetal factors include oligohydramnios and fetal growth restriction [4, 5].

Since all fetuses with MSAF do not have an adverse outcome, it is important to distinguish those who develop fetal distress promptly and intervene accordingly to prevent MAS and sequeal [6]. APGAR score is a subjective method for neonatal assessment on birth and is being practiced since ages. It indirectly reflects the acute and chronic insult that the fetus has gone through in the intrauterine life. Umbilical cord blood gas analysis is an objective indicator of fetal hypoxic damage and is now recommended in all the high risk deliveries by both British and American college of Obstetricians and Gynecologists [ACOG] [6, 7].

Therefore, in present study various maternal factors associated with MSAF, fetal heart rate abnormalities, mode of delivery, cord blood parameters [pH and lactate] and neonatal outcome have been evaluated in relation to different grades of meconium staining. This may help in providing proper care to the new born at birth and will help in further planning with subsequent management.

Material and Methods

- It was a Hospital based Prospective observational study conducted on 126 subjects in the Department of Obstetrics and Gynaecology of Sharda Hospital, Greater Noida in collaboration with Department of Paediatrics for a period of 9 months. The aim of the study was to know the association of varying degrees of meconium stained amniotic fluid with umbilical cord parameters and perinatal outcome. The primary objective was to study the cord blood pH and lactate levels in newborns delivered with varying degrees of MSAF. Secondary objectives included association of high risk factors, fetal heart rate pattern, mode of delivery and neonatal outcome by observing APGAR score, need for resuscitation, NICU admission and development of MAS in varying grades of MSAF.
- The inclusion criteria were term Gestation [>37 WEEKS TO 42 WEEKS], singleton pregnancy, cephalic presentation, primigravida / multigravida, spontaneous / Induced Labour The exclusion criteria were pregnancy with congenital malformations, intrauterine death and ante partum Hemorrhage.
- All women admitted in the labour room fulfilling the inclusion criteria and detected with MSAF during spontaneous or artificial rupture of membranes were enrolled in the study after obtaining the written informed consent. A detailed history regarding the age, gravid status, past obstetric history, and history of high risk factors during pregnancy were noted. This was followed by detailed clinical examination. Then on the basis of visual examination liquor was graded into thick / thin MSAF.
- Thin MSL: Translucent, light yellow to green in color.
- Thick MSL: Opaque, dark green in color with particulate material
- Continuous FHR monitoring was done with CTG and the tracing obtained was classified according to RCOG guidelines as normal, suspicious or pathological.
- Mode of delivery (Vaginal/ Instrumental/ LSCS) was noted.
- Paediatrician was always present at the time of delivery to access and resuscitate the baby if needed.

After delivery of baby cord blood sample was taken as per the procedure. A 10 to 15cm segment of umbilical cord was doubly clamped with kochers clamps as soon as possible after birth. Around 1 ml of arterial blood gas sample was taken from the umbilical artery in a heparinized syringe. The sample was processed immediately for ABG analysis in ABL 9 radiometer blood gas analyzer and cord blood pH and lactate levels were noted.

Statistical Analysis

Data generated was analyzed by SPSS statistical package version 21 and Microsoft excel. Chi square test was used to observe the association between the categorical data and T test was used for continuous data. If the p value is less that n 0.05 the test was considered statistically significant

Results

Out of total 126 subjects, 79 subjects (62.69%) had thin MSAF and 47 subjects (37.30%) had thick MSAF.

Most of the subjects diagnosed with MSAF were unbooked and belonged to age group of 20 to 25 years. Multigravidas were more common in study population.There was increasing trend of thick MSAF with increasing period of gestation.Most of the subjects ie 43 [91.48%] were induced, only 4 subjects [8.51%] came in spontaneous labour as shown in table 1.

Table 1: Demographic and obstetric parameters of study population

Variable		Thin MSL N=79		Thick MSL N=47		Chi-square	p-value
ANC Booking	Un -Booked	74	93.67%	45	95.74%	0.241	0.004
	Booked	05	6.33%%	02	4.26%		
Total		79	100%	47	100%		
Age (Years)	20-25	42	53.16%	25	54.28%	4.266	0.234
	26-30	22	27.84%	17	36.17%		
	31-35	10	12.65%	05	10.64%		
	>35	05	6.33%	00	0%		
Total		79	100%	47	100%		
Gravida	Primigravida	25	31.65%	18	38.30%	0.580	0.446
	Multigravida	54	68.35%	29	61.70%		
Period of gestation (weeks)	37- 38+6	43	54.44%	6	12.76%	0.469	0.002
	39- 40+6	35	44.30%	37	78.72%		
	>41	01	1.26%	04	8.52%		

Onset of labour		Meconium-stained amniotic fluid		Chi-square value	p-value
		Thin N=79	Thick N=47		
Onset of labour	Spontaneous	47(59.49%)	04 (8.51%)	0.936	0.006
	Induced	32 (40.50%)	43 (91.48%)		

Fig. 1 Show that majority of subjects had post dated pregnancy as an important risk factor associated with thick MSAF.

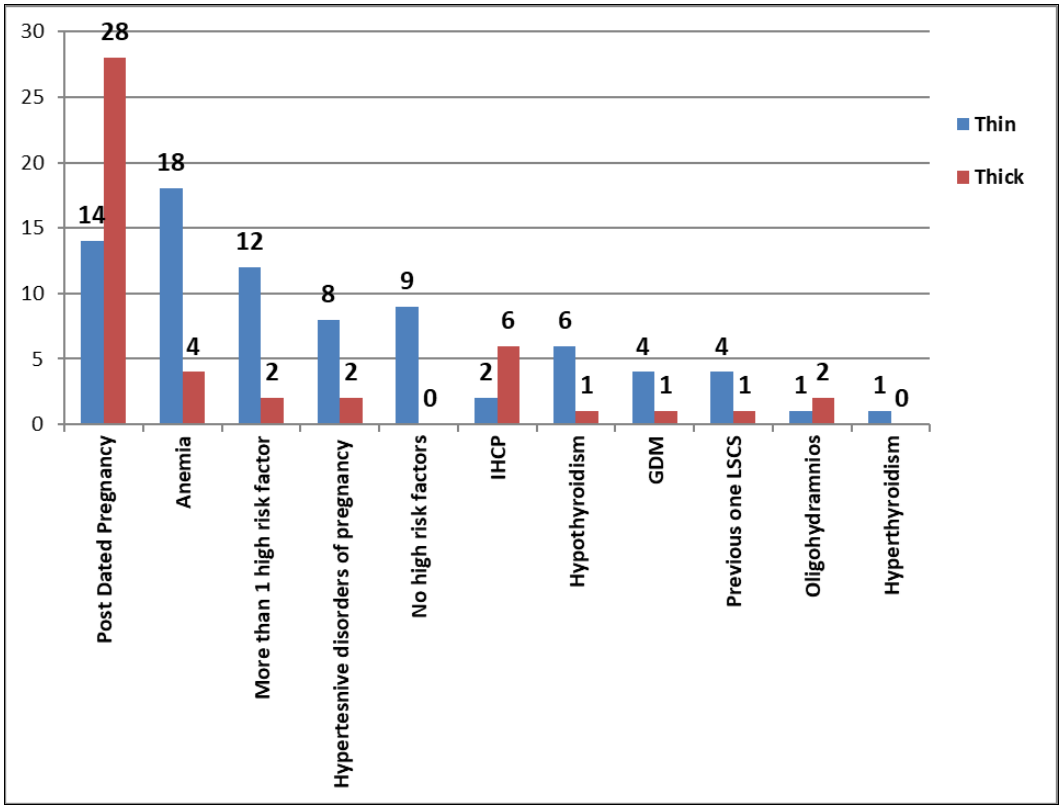

Fig 1: Distribution of Maternal High Risk-Factors

The CTG was reactive in most women with thin meconium (87.34%). There was a significantly higher incidence of suspicious (57.45%) and pathological CTG's (23.40%) in women with thick meconium compared to women with thin meconium (3.8%). The relation between CTG tracing and grading of MSAF was statistically significant ie P value 0.0032 as shown in Fig 2.

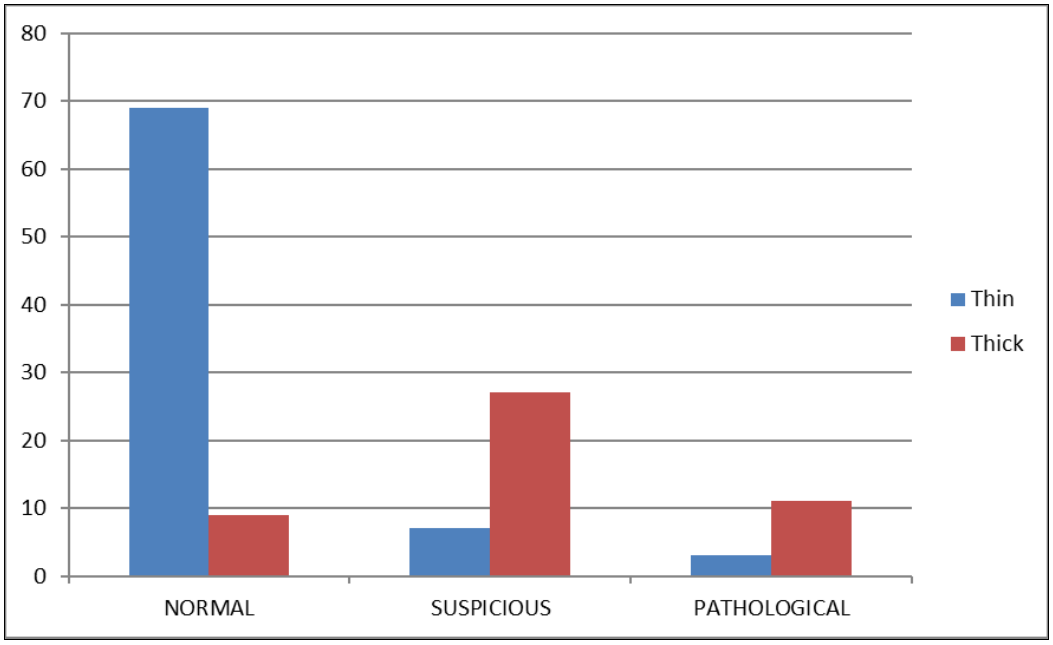

Fig 2: Distribution of CTG with grading of MSAF

Majority of patients with thin meconium had normal delivery (81.01%). Rate of caesarean section was higher in thick meconium (80.85%) and this was statistically significant (p<0.0001). Rates of instrumental delivery was (6.33%)in thick meconium as shown in Fig.3.

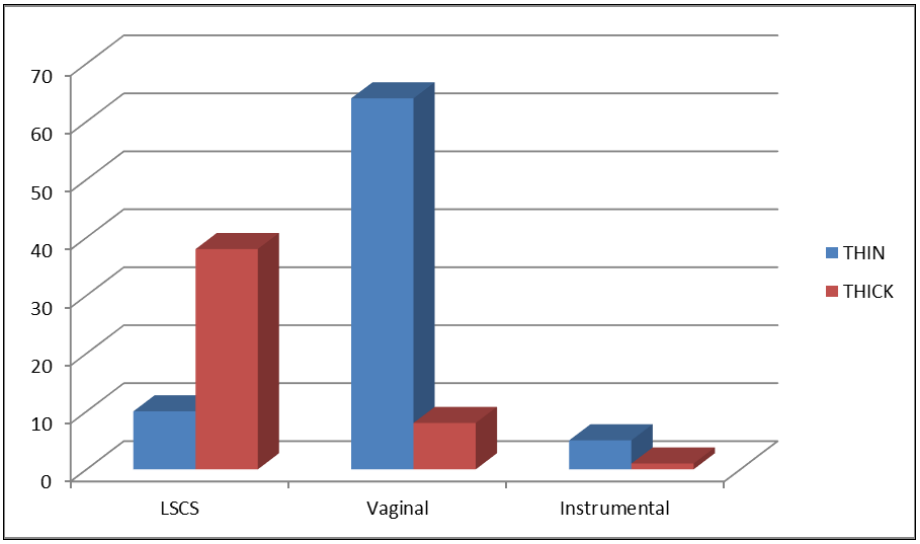

Fig 3: Distribution of mode of delivery

Fig 4 shows APGAR score < 7 at 1 minute in 29 subjects [61.70%] of thick MSAF and 14 subjects[17.72%] of thin MSAF. Association between APGAR score and grading of MSAF was statistically significant.

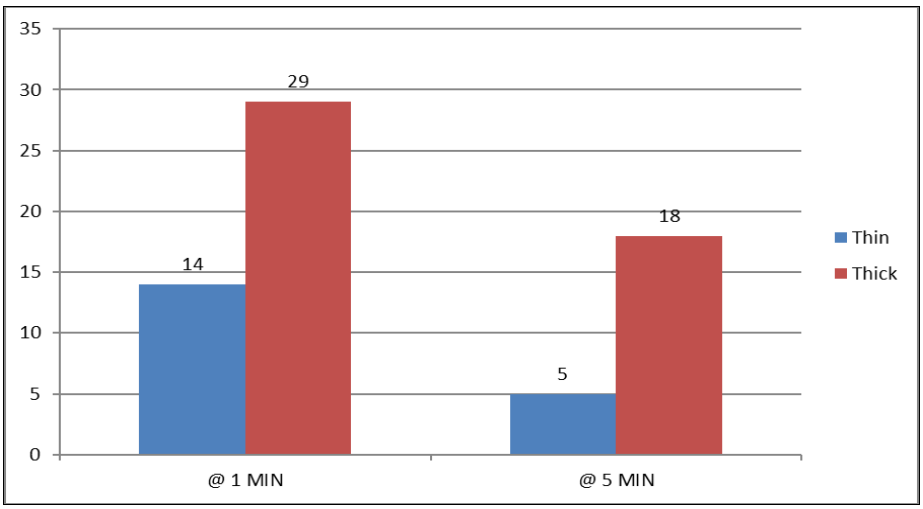

Fig 4: Distribution of APGAR scores of neonate

Majority of cases 55 [69.62%] born with thin MSAF required no resuscitation at birth. On the other hand 33 babies [70.21%] with thick MSAF needed bag and mask support and 8 babies [17.02%] required intubation and this was statistically significant as shown in Fig 5.

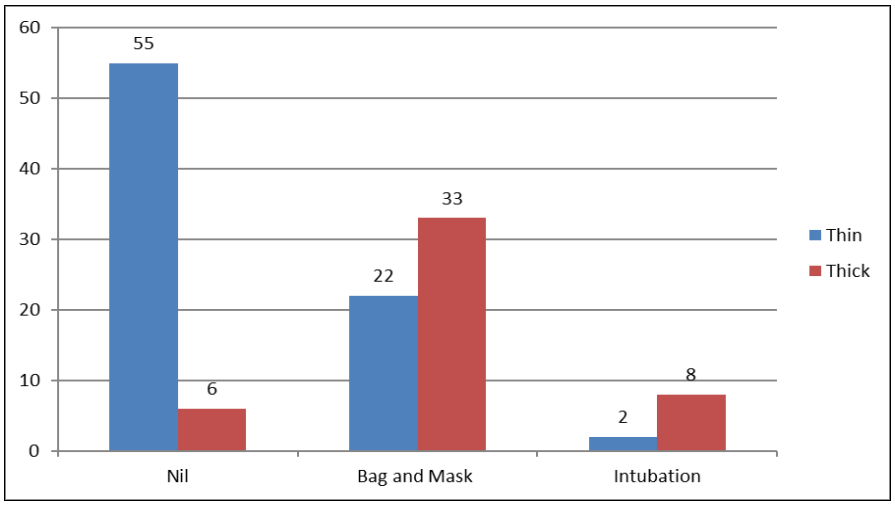

Fig 5: Distribution of need for resuscitation

More babies with thick MSAF 41 [87.23%] needed NICU admission in comparison to babies with thin MSAF 24 [30.38%] as shown in figure 6 and this was statistically significant.[P value < 0.00001].

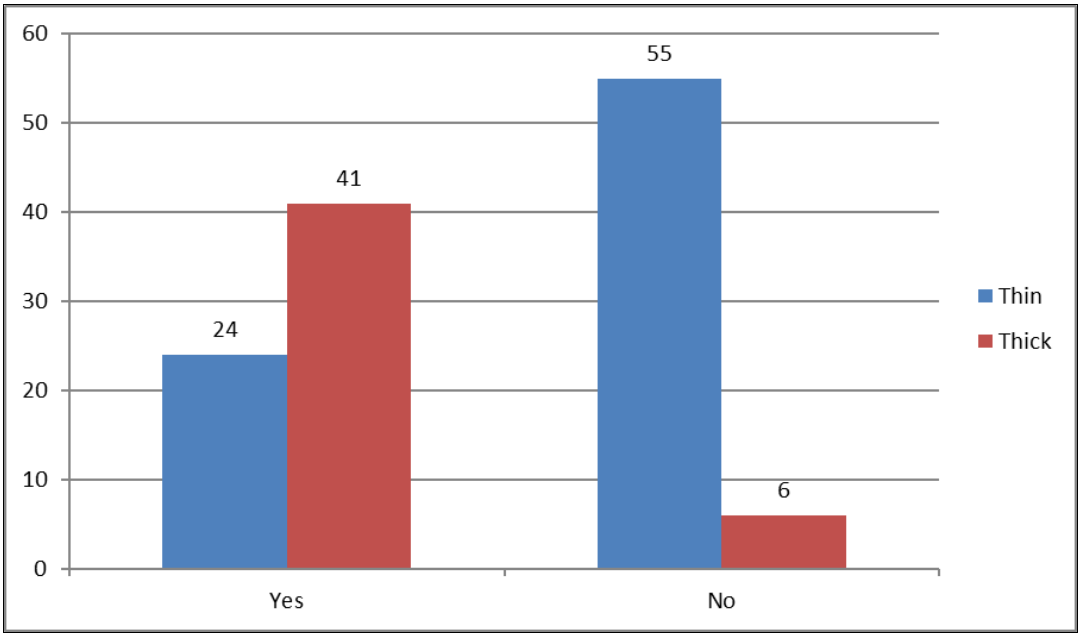

Fig 6: Distribution of Need for NICU admission of neonate

In our study, incidence of MAS was 5.5% [7/ 126]. Out of 7 babies who developed MAS, 6 babies had thick MSAF and only 1 baby had thin MSAF and this was statistically significant.

Study population with thin MSAF was most commonly associated with a normal cord pH and lactate. Abnormal cord pH (<7.2) indicating acidosis was seen in 11 subjects (73.3%) with thick MSAF and it was statistically significant as shown in figure 7.

The mean lactate value was 2.37+_0.71 in thick MSAF whereas it was 1.90+_0.53 in thin MSAF and was statistically significant as shown in Table 3 and Figure 8.

Table 3: Association of MSAF with Cord Blood Lactate

Variable		Thin MSL N=79	Thick MSL N=47
Cord blood Lactate (milli mole/l)	1.5-2	59 [81.50%]	9 (19.14%)
	2.1-2.5	13 (16.41%)	20 (42.50%)
	2.6-3.5	3 (3.79%)	6 (12.76%)
	3.6-4.5	1 (1.23%)	7 (17.02%)
	≥4.5	00	5 (10.63%)

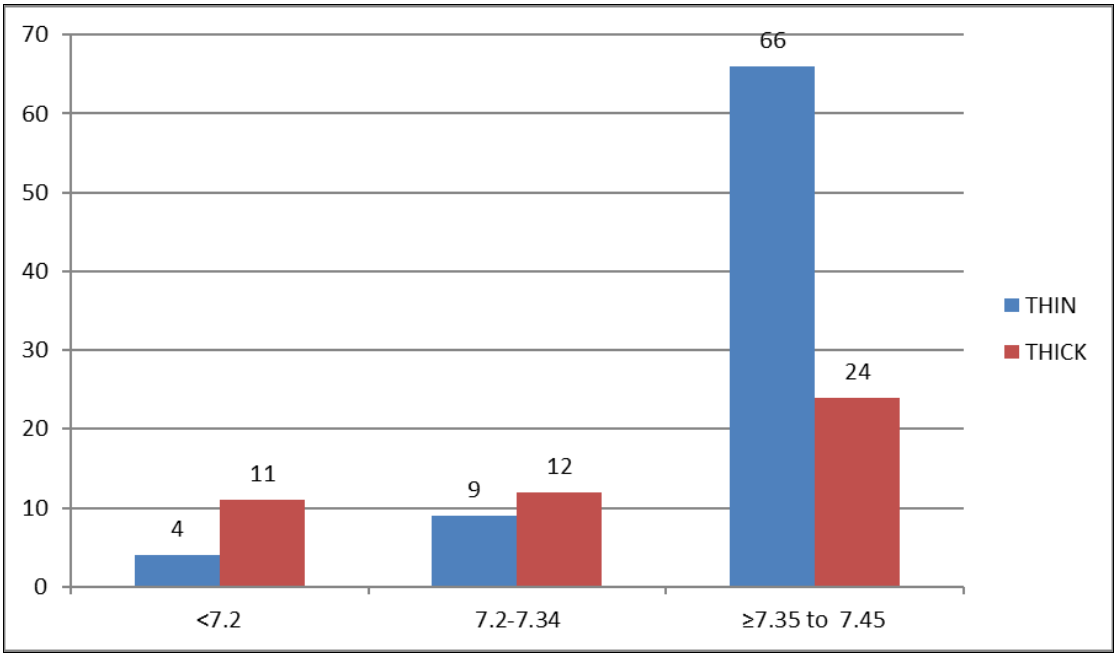

Fig 7: Distribution of Cord pH level of neonate

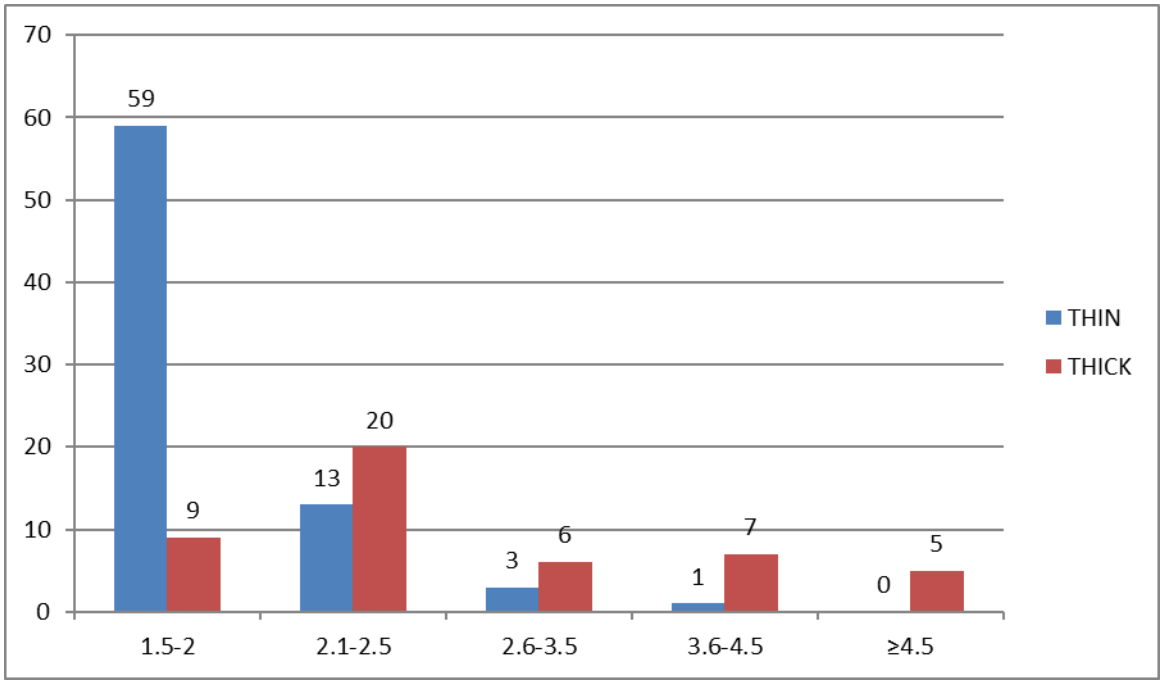

Fig 8: Distribution of lactate levels of neonate.

Discussion

In present study, out of total 126 subjects, 79 subjects (62.69%) had thin MSAF and 47 subjects (37.30%) had thick MSAF. Majority were in the age group of 20 to 25 years. In terms of age, present study correlates with the study conducted by Rafia *et al* as the maximum number of participants were younger than 25 years. [8] However, there was no statistical significance. This was in contrast to study conducted by Lee *et al* and Addisu *et al* in which most of the participants were older than 25 years. [9, 10] There was no significant association between various demographic parameters and grading of MSAF.

In our study incidence of both thin and thick MSAF was seen more in multigravida subjects ie 83 out of 126 [65.87%]. This can be attributed to more number of multigravida subjects enrolled during the study period. Similar findings have been reported in the study conducted by Mundhra *et al* and Agarwal[11]. This was in contrast to the study conducted by Unnisa *et al* and Becker *et al*, who reported a higher incidence of MSAF among primigravidas.[12, 13]

In present study incidence of thick MSAF increased with gestation. The average period of gestation [POG] was 38.42 weeks in thin MSAF and 40.64 weeks in group with thick MSAF. Similar result was seen in the study conducted by Sunoo *et al*. [14]. This can be explained by the fact that hormone motilin is secreted in increasing quantities by fetus as gestation advances.

In our study 42 subjects [33.33%] had postdated pregnancy as the most common risk factor associated with MSAF, whereas studies conducted by Rafia *et al* and Singh *et al* had reported post dated pregnancy as high risk factor in [22 %] and [12%] respectively.[8, 15] Maternal anemia was seen in 22 subjects [17.49%] and constituted the next associated high risk factor with MSAF. Majority of anemic subjects had thin MSAF. In literature it has been reported that women who had normal hematocrit levels were 83% less likely to develop MSAF than women who had anemia. In our study hypertensive disorders of pregnancy was seen in 10 subjects [7.93%]. Similarly, studies conducted by Addisu *et al* and Gupta *et al* stated that pre eclampsia constituted one of the most important risk factor in association with MSAF [10, 16]. In pre-eclampsia there is vasoconstriction leading to placental insufficiency which in turn causes fetal hypoxia leading to meconium passage. Intrahepatic cholestasis of pregnancy (IHCP) was found in 8 subjects [6.34%] [6 with thick meconium and 2 with thin meconium]. The probable cause of meconium passage in subjects with IHCP is bile acid induced increased gut motility of fetus.[16]

It was observed that 43 subjects ie [91.48%] with thick MSAF were cases of induced labour and only 4 subjects [8.51%] with thick MSAF were cases with spontaneous onset of labour Hence the relation between induction of labour and thick MSAF was statistically significant**.** This finding is in agreement with the study conducted by Afreen *et al* and Rahman *et al* that suggested maximum patients who were induced had thick MSAF. This might be related to tetanic uterine contractions following oxytocin administration or after using prostaglandins for IOL, which may result in intra uterine fetal hypoxia secondary to inadequate placental perfusion [17, 18]. When fetus suffers from distress, increased parasympathetic stimulation by vagus leads to passage of meconium.

In current study it was found that the dilatation of cervix at enrolment influenced the further course of labour and its management. Those with a higher dilatation [>5cms] at the time of detection of MSAF had a lower caesarean section rate in contrast to those with lesser dilatation [<5cms] at the time of diagnosis. This was in line with the study conducted by shweta *et al*. [19].

In present study majority of subjects with thick MSAF ie 32 [68.09%] delivered in less than one hour of detection of meconium and 15 subjects with thick MSAF [31.91%] delivered within one to three hours. This helped in reducing perinatal morbidity and mortality due to thick meconium and resulted in good perinatal outcome. Similar observation was cited in the study conducted by Shweta *et al* in which 50 % subjects with thick MSAF delivered within one hour of detection [19].

In our study 69 subjects [87.34%] with thin MSAF had normal CTG tracing and had better outcomes in terms of mode of delivery and perinatal outcome similar to study quoted by Anam *et al*. [20]. In current study thick MSAF was most commonly associated with suspicious or pathological CTG[87.45%]. This is in accordance with the study by Afreen *et al* [17]. Kumar *et al*

reported much lower CTG abnormality in [33.34%] subjects with thick MSAF [21]. On the contrary, Desai *et al* did not find any association of pathological CTG with thick MSAF [22]. We observed significant statistical association between grades of MSAF and types of CTG tracings. Abnormalities in the CTG at the time of detection of meconium influenced the trial of labour and mode of delivery. Higher rates of suspicious or pathological CTG's precipitated action which is evidenced by a higher Caesarean section rate in the thick meconium group.

The mode of delivery was influenced by dilatation of cervix at the time of detection and CTG abnormalities. It has been observed that obstetricians are more aggressive while managing labour complicated with MSAF leading to higher caesarean section rates. Literature reveals a large variation in caesarean section rates in MSAF across various studies. In our study most of the subjects [80.85%] with thick MSAF underwent caesarean section and only [17 %] had vaginal delivery [P value <0.001]. Similar results were seen in the study conducted by Nadia mohammad *et al*. [23]. In our study, most of the subjects with thin MSAF had normal CTG tracings and delivered vaginally [81.01%]. Only 6 cases had instrumental delivery. In present study there was significant statistical association between the grading of MSAF and mode of delivery.

In present study, most of the babies had a birth weight between 2.6 to 3 kg. There was no statistical significance between birth weight and grading of meconium staining.

In our study association between poor APGAR score and grading of MSAF was statistically significant. However, Becker *et al* found no statistical significance between grading of MSAF and APGAR scores [24].

More babies with thick MSAF [87.23%] needed NICU admission in comparison to babies with thin MSAF [30.38%]. So, association between NICU admission and grading of MSAF was statistically significant.

MAS is a well known complication of MSAF with incidence varying from 1 to 6 %. In our study incidence of MAS was 5.5%. It was seen in 6 cases of thick MSAF and 1 case of thin MSAF. This was in accordance with the study conducted by Nadia *et al*. [23]. and Patil *et al*. [25]. MAS was seen more in babies born to unbooked mothers signifying the importance of antenatal care. Its presence increases need for intubation, long term morbidity and mortality. The reason for higher incidence of MAS in thick MSAF is explained by the fact that in contrast to thin meconium, thick meconium may potentially block the airways.

In group categorized as pH <7.2, which is indicator of fetal acidosis only 4 subjects [26.66%] were thin MSAF and majority were thick MSAF 11subjects [73.33%]. It was found that the relation between abnormal pH [<7.2] and thick MSAF was statistically significant. These findings are almost similar to the studies performed by Fernandez *et al* and Misra *et al* who observed association of thick MSL with a cord blood pH < 7.2 in 20.1% and 22.1%, respectively [26, 27]. Afreen *et al* reported much higher association of thick MSAF [91.90%] with abnormal cord pH values [17].

In current study, thick MSAF was associated with higher cord lactate levels of > 2 milli mol/l in 80.85% of subjects. All the five babies with thick MSAF and having cord lactate levels more that 4.5 developed MAS and required intubation.

This was in line with the study conducted by Aafreen *et al*. that stated thick MSAF was associated with increased lactate levels in 75.7% patients [17]. Similar results were seen in a study conducted by Mark Muyingo *et al*. [28]. In our study, majority of subjects with thin MSAF [81.50%] were associated with normal cord lactate levels of 1.5 to 2 milli mol/l. The mean lactate level was 1.90 ± 0.53 milli mol/l in thin MSAF, whereas mean lactate value was 2.37 ± 0.71 in thick MSAF.It was observed that the relation between higher lacate levels and thick MSAF was statistically significant.

So in current study thick MSAF was associated with poor APGAR score, higher rates of NICU admission, abnormal cord blood parameters [pH lactate levels] and poor neonatal outcome. There was no early neonatal mortality observed in present study. Neonatal mortality ranging from 0.5% to 1.7% have been reported by previous studies.

Conclusion

MSAF alone is not an indicator of fetal distress especially in cases of thin MSAF.

Visual grading of liquor into thin and thick MSAF may help in timely obstetric intervention leading to better neonatal outcome. Maximum patients with thin MSAF and reassuring CTG in our study delivered vaginally with good neonatal outcome and had normal cord blood pH and lactate levels.

From our study it can be speculated that grading of MSAF is a biomarker of fetal hypoxia and it increases proportionately to the severity of hypoxia as suggested by poor APGAR score, increased NICU admissions, more requirement for assisted ventilation, abnormal cord blood parameters [pH, lactate] and adverse neonatal outcome in presence of thick MSAF. Cord blood pH and lactate levels can serve as a diagnostic tool for triaging neonates at risk of complications related to meconium exposure and can further aid health care providers in delivering the best possible care to this vulnerable population of neonates.

Declarations

Funding

None

Conflict of Interest

None declared

Ethical Approval

Approved by the institutional Ethics committee, SMS&R, Sharda University, Uttar Pradesh

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