Original Research Article

Cord blood parameters and fetal outcome in neonates with fetal distress due to meconium staining liquor- an observational study

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ABSTRACT

Background: Meconium staining liquor (MSL) results from passage of meconium during labour and is used to diagnose fetal distress. Thick and granular meconium has been found to have a significant association with an abnormal cord pH and lactate and worst neonatal outcome. The aim of this study was to analyse and compare the mode of delivery, cord blood parameters and fetal outcomes in cases diagnosed with different degrees of meconium staining liquor.
Methods: An observational study was carried out on 76 labouring patients presenting in the active stage of labour with term, singleton pregnancy with cephalic presentation diagnosed with either thin or thick MSL. The cases were followed up and compared in thin or thick MSL group for the mode of delivery (normal vaginal delivery, instrumental delivery or caesarean section), fetal cord blood parameter after birth (cord blood pH and lactate) and the neonatal outcome.
Results: 39 cases were diagnosed with thin MSL. Of these, 74.4% delivered by a normal vaginal delivery. Maximum cases had normal cord blood parameters with a favourable neonatal outcome. 37 cases had thick MSL. Lower segment caesarean section (LSCS) rate was highest in this group (i.e. 48.6%). The neonatal outcomes were as follows- 24.3% had an APGAR score <7, 43.2% required assisted ventilation, 43.2% required NICU admission and 13.5% had an early neonatal death.
Conclusions: Thin MSL should be closely monitored and can be followed up for normal vaginal delivery.

Keywords: Cord blood parameters, Fetal distress, Meconium staining liquor, Mode of delivery

INTRODUCTION

Intrapartum fetal monitoring is used for timely diagnosis of inadequately oxygenated fetuses. This facilitates appropriate action, which should be taken before occurrence of any injury to the fetus, and also to avoid unnecessary obstetric interventions. The severity of hypoxia and resulting acidosis in the fetus depends upon multiple factors like the intensity, duration and repetitive nature of hypoxia, along with the capacity of the fetus to cope with the situation. Diagnosis of fetal distress is important in labour to reduce neonatal morbidity and mortality. Changes in fetal heart rate (FHR) patterns and colour of liquor helps in diagnosis of fetal distress in labour.

Meconium staining liquor (MSL) results from passage of meconium during labour or delivery, and is a marker commonly used to diagnose fetal distress. Meconium is formed from fetal cellular debris and secretions, and is passed due to increased rate of peristalsis, anal sphincter relaxation, and vagal and sympathetic stimulation due to fetal hypoxia and is more common in late-term and post-term babies after 37 weeks of gestation.[1] Thick and granular meconium has been found to have a significant association with low cord pH and acidemia.[2]

MSL is thus associated with increased incidence of operative vaginal delivery, lower segment caesarean section (LSCS), birth asphyxia, neonatal sepsis, and neonatal intensive care unit (NICU) admissions as

compared to clear amniotic fluid.[3] APGAR score all around the world is used to assess the newborn immediately after delivery. It indirectly reflects the acute and chronic insult that the fetus has gone through in the intra uterine life. APGAR score less than seven at five minutes of life is considered a poor score.[4]

Cord blood parameters like pH and lactate analysis in the first few minutes of life is the most accurate way of quantifying objectively the occurrence of hypoxia/acidosis in the intrapartum period just prior to birth.[5] Lactate is a more specific parameter to differentiate between a hypoxic and normal newborn. High levels of lactate are related with anaerobic glycolysis occurring due to hypoxia producing excess lactic acid, the excess H+ ions react with HCO_3^- ions in fetal blood causing metabolic acidosis. Lactate correlates well with a poor APGAR score. Cord blood pH<7.2 is defined as acidaemia, and pH<7.0 is defined as severe acidemia.[6]

Meconium staining liquor can lead to various complications in the newborn such as pulmonary haemorrhage, respiratory distress, PPHN, IVH, need for ventilatory support. High lactate levels have been found to be directly proportional to the severity of these complications.[7] Therefore present study was planned to find out the maternal and neonatal outcome in study population diagnosed as MSL.

METHODS

This was an observational study carried out on 76 labouring patients between October 2019 to March 2021 presenting to the labour room of Safdarjung Hospital in the active stage of labour with term, singleton pregnancy with cephalic presentation diagnosed with meconium staining liquor (MSL) with or without fetal heart rate abnormalities after taking consent from the ethical committee of our hospital. The sample size was calculated by the study of Gandhi et al on 110 patients operated for fetal distress diagnosed by intermittent auscultation and/or meconium stained liquor linked cord blood pH and observed that the proportion of neonatal acidaemia at birth in study population was 53.6%.[6] Taking this value as reference, the minimum required sample size with 10% margin of error and 5% level of significance is 76 patients.

Women with gross congenital anomaly of fetus, prematurity and intrauterine fetal demise were excluded from the study.

The consistency of liquor was noted as either thin or thick. The study participants recruited were followed up for the mode of delivery (normal vaginal delivery, instrumental delivery or caesarean section), fetal cord blood parameters immediately after birth (cord blood pH and lactate) and the neonatal outcome (in terms of APGAR score, need for assisted ventilation, NICU stay or early neonatal death). Immediately after birth, in all participants included in the study group, we took 0.5 ml of umbilical artery blood sample from the double clamped umbilical cord in a pre heparinized syringe and followed it up for arterial blood gas (ABG) analysis.

The outcome measures were cord blood pH and lactate values in neonates, APGAR score less than 7 at 5 minutes, NICU admission rates within first 24 hours and mode of delivery. The mode of delivery, cord blood parameters and neonatal outcomes of thin and thick MSL were compared.

Statistical analysis

Data were coded and recorded in MS Excel spreadsheet program. SPSS v23 (IBM Corp.) was used for data analysis. Descriptive statistics were elaborated in the form of means/standard deviations and medians/IQRs for continuous variables, and frequencies and percentages for categorical variables. Data were presented in a graphical manner wherever appropriate for data visualization using histograms/box-and-whisker plots/column charts for continuous data and bar charts/pie charts for categorical data. Group comparisons for continuously distributed data were made using independent sample 't' test when comparing two groups. If data were found to be non-normally distributed, appropriate non-parametric tests in the form of Wilcoxon test were used. Chi-squared test was used for group comparisons for categorical data. Linear correlation between two continuous variables was explored using Pearson's correlation (if the data were normally distributed) and Spearman's correlation (for non-normally distributed data). Diagnostic tests were used to calculate sensitivity, specificity, NPV and PPV. Statistical significance was kept at p <0.05.

RESULTS

This was an observational study carried out in the labour room of our hospital on 76 labouring patients diagnosed with MSL after taking consent.

The age distribution of study population with thin and thick MSL were almost the same, with maximum study population between the age group pf 18-32 years (p value 0.073). Primigravidas were slightly more common in study population with both thin and thick MSL (p value 0.83). The average period of gestation (POG) was 38.69 weeks with thin MSL and 39.34 weeks in study population with thick MSL (p value 0.043). Thin MSL was more commonly associated with a spontaneous onset of labour, while thick MSL was more commonly associated with an induced onset of labour (p value 0.204) (Table 1). Risk factors in the form of previous LSCS, hypertensive disorder of pregnancy, GDM, anaemia, oligohydramnios and hypothyroidism were commonly associated with both thin and thick MSL. Amongst these risk factors, hypertensive disorder of pregnancy was most commonly associated with thick MSL (p value 0.435) while previous caesarean section was most commonly associated with thin MSL, (p value0.365) (Table 2).

Table 1: Demographic and obstetric parameters of study population.

	Thin MSL	Thick MSL	χ^2	P value
Age (years)	**Fisher's exact test**			
18-25	19 (48.7%)	21 (56.8%)		
26-32	19 (48.7%)	16 (43.2%)	7.728	0.073
>32	1 (2.6%)	0 (0.0%)		
Total	39 (100.0%)	37 (100.0%)		
Parity	**Chi-squared test**			
Primigravida	20 (51.3%)	21 (56.8%)		
Multigravida	19 (48.7%)	16 (43.2%)	0.372	0.830
Total	39 (100.0%)	37 (100.0%)		
Onset of labour	**Chi-squared test**			
Spontaneous	22 (56.4%)	18 (48.6%)		
Induced	17 (43.6%)	19 (51.4%)	3.180	0.204
Total	39 (100.0%)	37 (100.0%)		
Mean POG	38.69 weeks	39.34 weeks	2.18	0.043

Table 2: Risk factors for MSL in study population.

Parameters	Thin MSL (n=39)	Thick MSL (n=37)	P value
Previous LSCS	8 (20.5%)	8 (21.6%)	0.365[3]
Hypertensive disorder of pregnancy	6 (15.4%)	10 (27.0%)	0.435[3]
GDM	2 (5.1%)	0 (0.0%)	0.340[2]
Anaemia	2 (5.1%)	7 (18.9%)	0.034[3]
Oligohydramnios	7 (17.9%)	6 (16.2%)	0.848[3]
Hypothyroidism	3 (7.7%)	2 (5.4%)	1.000[2]

Table 3: Association of MSL with mode of delivery and fetal parameters.

Parameters	Thin MSL (n=39)	Thick MSL (n=37)	P value
FHR*			<0.001[2]
WNL	30 (76.9%)	10 (27.0%)	
Recurrent late decelerations	9 (23.1%)	19 (51.4%)	
Bradycardia	0 (0.0%)	7 (18.9%)	
Tachycardia	0 (0.0%)	1 (2.7%)	
Mode of delivery*			<0.001[2]
NVD	29 (74.4%)	12 (32.4%)	
Operative VD	4 (10.3%)	7 (18.9%)	
LSCS	6 (15.4%)	18 (48.6%)	
Cord blood pH category*			<0.001[2]
<7	0 (0.0%)	5 (13.5%)	
7-7.1	7 (17.9%)	19 (51.4%)	
7.11-7.19	2 (5.1%)	10 (27.0%)	
≥7.2	30 (76.9%)	3 (8.1%)	
Cord blood lactate*			<0.001[3]
≤4.2 mmol/L	32 (82.1%)	9 (24.3%)	
>4.2 mmol/L	7 (17.9%)	28 (75.7%)	
APGAR <7	2 (5.1%)	9 (24.3%)	0.053[3]
Assisted Ventilation*	1 (2.6%)	16 (43.2%)	<0.001[3]
Intubation*	1 (2.6%)	8 (21.6%)	0.028[2]
NICU admission*	2 (5.1%)	16 (43.2%)	<0.001[3]
Early neonatal mortality*	0 (0.0%)	5 (13.5%)	0.043[2]
Cord blood pH abnormal*	9 (23.1%)	34 (91.9%)	<0.001[3]
Cord blood lactate abnormal*	7 (17.9%)	28 (75.7%)	<0.001[3]
Both pH and lactate abnormal *	4 (10.3%)	28 (75.7%)	<0.001[3]

***Significant at p<0.05, 1: Kruskal Wallis Test, 2: Fisher's Exact Test, 3: Chi-Squared Test, 4: One-Way ANOVA

On further analysis of MSL with the fetal heart rate, it was found that thin MSL was most commonly associated with a normal FHR (i.e. in 76.90% study population) followed by persistent late decelerations seen in 23.1% study population. Thick MSL was most commonly associated with persistent late decelerations seen in 51.4% study population, followed by a normal heart rate pattern seen in 27%, bradycardia in 18.9% and tachycardia in 2.7% study population (p value <0.001) (Table 3, Figure 1).
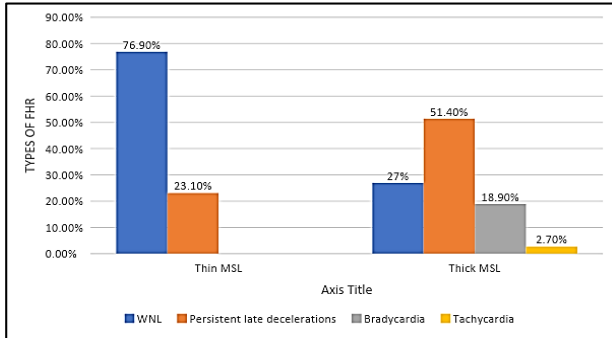

Figure 1: Association between different FHR and MSL.

Normal vaginal delivery was most commonly seen in study population with thin MSL, followed by LSCS and instrumental vaginal delivery. On the other hand, LSCS was most commonly associated in study population with thick MSL, followed by normal vaginal delivery and instrumental vaginal delivery, (p value <0.001) (Table 3, Figure 2).
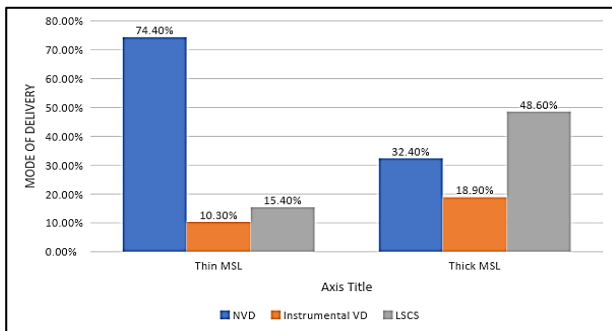

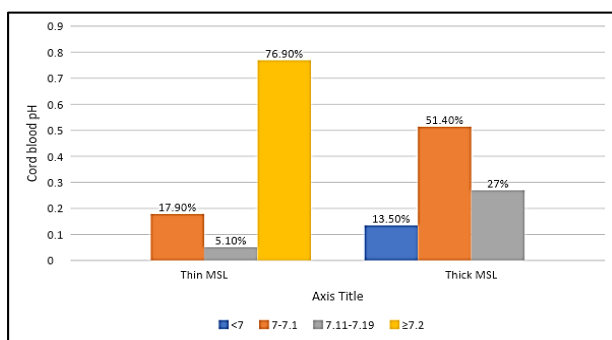**Figure 2: Various modes of delivery in cases.**

Figure 3: Distribution of cord blood pH in cases.

Study population with thin MSL were most commonly associated with a normal cord blood pH and lactate. Abnormal cord blood pH and lactate was most commonly seen in study population with thick MSL (p value <0.001) (Table 3, Figures 3 and 4).
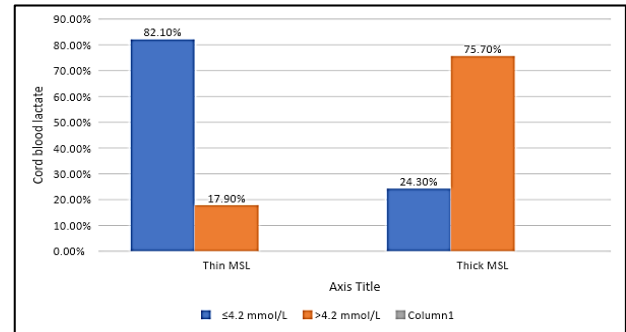

Figure 4: Distribution of cord blood lactate in cases.

Worst neonatal outcomes were seen in study population with thick MSL. 24.3% neonates had an APGAR score <7, 43.2% neonates required assisted ventilation, 21.6% required intubation, 43.2% were also admitted in the NICU, while 13.5% neonates had an early NND (p value <0.001) (Table 3, Figure 5). On further analysing the cause of the NND, it was observed that 3 neonates had meconium aspiration syndrome and 2 had HIE grade 2. Study population with thin MSL had an overall better neonatal outcome (p value <0.001) (Table 3, Figure 5).
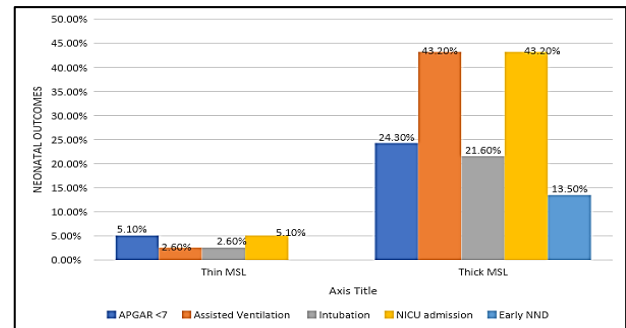

Figure 5: Distribution of neonatal outcomes in cases.

DISCUSSION

Meconium-stained liquor results from passage of meconium during labour or delivery, and is a marker commonly used to diagnose fetal distress.[1] Thick and granular meconium is found to have a significant association with low cord pH, acidaemia and poorer perinatal outcome.[2,8]

The incidence of thin MSL (39%) and thick MSL (37%) were almost same in our study, but thick MSL was associated with higher rates of NICU admission, poor APGAR score and poorer neonatal outcome. These findings correlate with those made by Gluck et al and Espinheira et al.[3,8]

Thick MSL was most commonly associated with persistent late decelerations. This is in accordance with the study by Kumar et al where 33.34% study population had FHR abnormality and MSL.[9] But, in contrast to the study by Samiyappa et al where 67.6% study population had both MSL and FHR abnormality.[10]

Most of the women with thick MSL had caesarean delivery, 48.6% versus 15.4%, p<0.001. This is comparable to the studies by Samiyappa et al, Fernadez et al and Misra et al where the caesarean section rate was higher with thick MSL.[10-12] Our study also found that the study population operated by LSCS for thick MSL were most commonly associated with persistent late decelerations. This is comparable to the study by Kumar et al where caesarean section was most commonly done for FHR abnormality with MSL (38.4%).[9]

In our study, 18.9% study population with thick MSL had instrumental delivery compared with 10.3% in women with thin MSL. The rate of instrumental delivery was comparable to that found by Espinheira et al (18.1%).[11] This is in contrast to the findings of Samiyappa et al, who observed forceps assisted VD to be slightly higher in thin MSL group (21.3%) as compared to the thick MSL group (20.9%).[10] In study by Kumar et al most of women with thick MSL had normal vaginal delivery.[9]

Thick MSL was most commonly associated with an abnormal cord blood pH and lactate, seen in 91.9% and 75.7% study population respectively, p<0.001. Abnormal cord blood pH and lactate were higher in our study as compared to the observations by Gandhi et al where only 44.8% study population with thick MSL had a cord blood pH<7.2.[6] These findings are also in contrast to the study 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.[11,12]

In our study, thick MSL and cord blood pH<7 was associated with abnormal cord blood lactate, maximum neonates requiring assisted ventilation, intubation, NICU admission, APGAR score less than seven and early NND, while thin MSL was associated with the best cord blood parameters and best neonatal outcomes. Also, maximum study population with thin MSL had a normal vaginal delivery. This is in accordance with the study by Syed et al who reported a strong correlation between low umbilical cord blood pH and a low APGAR score at five minutes.[13] The number of neonates with a low APGAR score in our study was comparable to the study by Gandhi et al and Misra et al where 10% and 12.9% of newborns respectively had an APGAR score of less than seven.[6,12] On the other hand, Tolu et al and Espinheira et al observed that the APGAR score in MAS was less than seven at five minutes in 36.8% and 23.6% newborns respectively.[3,8] Incidence of acidaemia seen in the above mentioned neonates is comparable to the study by Gandhi et al and Kacho et al.[6,14]

A similar study can be conducted with a larger sample size. As intensive monitoring is required to enable early pick up of cases, Operation Theatre and doctor ratio should be more balanced. Sample was taken from our hospital only, this limited our results.

CONCLUSION

Thin MSL has better cord blood parameters than thick MSL. Thick MSL was associated with higher rates of NICU admission, poor APGAR score and poor neonatal outcome (in terms of requirement for assisted ventilation and intubation, and early NND). Worst neonatal outcome was seen with both FHR abnormality and thick MSL, while thin MSL had the best neonatal outcomes.

A significant association was found between study population diagnosed as fetal distress on the basis of MSL with low cord blood pH, abnormal lactate, poor APGAR score, requirement for assisted ventilation, NICU admission and early NND.

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