RESPIRATORY PROBLEMS IN NEWBORNS ASSOCIATED WITH MECONIUM-STAINED AMNIOTIC FLUID

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ABSTRACT

BACKGROUND

Perinatal morbidity and mortality resulting from aspiration of Meconium-Stained Amniotic Fluid (MSAF) is due to the respiratory problems ranging from mild respiratory distress to meconium aspiration syndrome and meconium pneumonitis.

The aim of the study is to define the respiratory problems and to identify the determinants of respiratory distress in babies born through light, moderate and thick MSAF.

MATERIALS AND METHODS

This was a prospective observational study conducted in a university tertiary maternity care institute in Kerala. 150 term pregnancies with meconium-stained amniotic fluid were selected of which 50 cases were each of light, moderate and thick meconium staining.

RESULTS

Meconium-stained amniotic fluid was seen frequently in the age group between 20-25 years age than above age of 25 years ($p<0.0001$). Post-dated pregnancies and pregnancies complicated by pregnancy-induced hypertension and anaemia also showed a trend in increase occurrence of meconium-stained liquor. Severe birth asphyxia as indicated by Apgar score of <3 was seen in 72.7% of thick meconium staining compared to 18.2% and 9.1% with moderate and light staining of meconium ($P=0.004$). Respiratory distress in newborn was severe (meconium aspiration syndrome) in babies with thick meconium staining (80%) compared to 15% with moderate meconium and 5% with light meconium staining ($P<0.0001$). The hazard ratio for death was 8 times higher with meconium aspiration syndrome compared to newborns with aspiration of moderate or light meconium-stained amniotic fluid aspiration. The odds ratio was also very high with aspiration of thick meconium-stained amniotic fluid than the other groups (OR 11.43; 95%, CI 1.33 to 98.35; Z statistic 2.22; $P=0.03$).

CONCLUSION

Meconium staining of the liquor is an important warning signal of foetal distress and the likelihood is increased if associated with alterations in the foetal heart rate. Increased morbidity and mortality was found with aspiration of thick meconium. Meconium aspiration syndrome is a major cause of often preventable perinatal morbidity and mortality.

KEYWORDS

Respiratory Distress, Meconium-Stained Amniotic Fluid (MSAF), Meconium Aspiration Syndrome (MAS).

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BACKGROUND

The passage of meconium as a sign of foetal distress was originally described by Schwartz in 1858 and is now accepted that meconium in the third trimester is associated with increased incidence of foetal asphyxia. The stimulus for the passage of meconium before birth is foetal asphyxia.[1]

Meconium is the residue of gastrointestinal secretions mainly constituted by bile salts, bile pigments, foetal hair, squamous cells, mucopolysaccharides, cholesterol and swallowed amniotic fluid.[2] During foetal hypoxia, there is vasoconstriction in foetal gastrointestinal tract, hyperperistalsis and anal sphincter relaxation with passage of meconium into the amniotic sac. Incidence of meconium staining of the amniotic fluid increases with gestational age and correlates with functional bowel maturation.[2]The type of meconium and the time of passage are important factors in predicting foetal outcomes. Meconium staining of the amniotic fluid has been graded as light, medium and heavy. Thick or heavy meconium-stained liquor was associated with significantly low, 1 minute and 5 minutes Apgar score and low scalp pH values. Thus, the quality of meconium was considered as a significant predictor of intrapartum risk for asphyxia. Aspiration of the amniotic fluid showing moderate or thick meconium need vigorous suction of the oropharynx under direct laryngoscopic guidance to prevent meconium aspiration syndrome. The varied clinical picture of meconium aspiration depends on physical characteristics of meconium and foetal state of oxygenation. Although, respiratory movements occur in utero, no active respiratory efforts are

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seen except during stress when foetus has gasping respirations. The sizes of the meconium particles which are aspirated are responsible for subsequent changes. The complete obstruction of the bronchioles will lead to atelectasis, whereas incomplete obstruction may lead to ball valve mechanism leading to pneumothorax and pneumomediastinum. The pH of the meconium ranges from 5.5-7 and may cause irritation leading to inflammatory changes.[2] Moreover, meconium is known to enhance the bacterial growth. There is also increased pulmonary vascular resistance secondary to hypoxia and acidosis. Meconium also causes diffuse disseminated chemical pneumonitis.

Increased maternal age and maternal complications like pregnancy-induced hypertension and anaemia predispose to meconium staining. Post-dated pregnancies also increase the chance of meconium staining of the liquor.

The presence of Meconium-Stained Amniotic Fluid (MSAF) does not imply that the foetus is in extreme distress, but that it is close to its tolerance limits and needs close monitoring. If bradycardia supervenes, prognosis become less favourable. Meconium aspiration syndrome is a diffusely disseminated chemical pneumonitis involving all lobes of the lungs with alternating areas of atelectasis and hyperventilation.[2] Radiological abnormalities include infiltration, consolidation, atelectasis, hyperinflation, air leak and pleural effusion, etc. Intensive foetal monitoring with continuous foetal heart rate monitoring, uterine activity recording and foetal scalp pH recording are implemented. Any sign of foetal distress is an indication for immediate foetal scalp pH estimation and if the pH is less than 7.20 foetus is delivered by emergency caesarean section.[3,4]

Maternal monitoring includes correction of maternal dehydration, ketosis and avoidance of supine hypotension syndrome.

AIMS AND OBJECTIVES

To define the respiratory problems in babies born with different grades of aspiration of meconium-stained liquor and to identify the determinants of respiratory distress in babies born through light, moderate and thick MSAF.

MATERIALS AND METHODS

This was a prospective observational study of analysis of clinical profile of the newborn with meconium staining of the amniotic fluid. 150 newborns born through meconium stained amniotic fluid were included for study in a tertiary care referral institute for maternal and child health. The inclusion criteria were term pregnancies with meconium-stained amniotic fluid at ARM and /or term pregnancies with meconium-stained amniotic fluid following spontaneous rupture of membrane. Exclusion criteria included pregnancies of less than 37 weeks duration, newborns with body weight <2000 grams, newborns with other causes for respiratory distress detailed analysis of the antenatal history from the antenatal charts and complete clinical examination of the mothers were carried out with special attention to any systemic illness, which could contribute to hypoxia of the infant and predispose to meconium staining. Meconium staining was classified as light, moderate and thick staining. Light meconium staining was identified when amniotic fluid had a green tinge, whereas green opalescent fluid was considered as moderate meconium. When amniotic fluid was thick and opaque with meconium, it was considered thick or heavy meconium staining of the amniotic fluid. Respiratory distress in the newborn is recognised as one or more signs of increased work of breathing such as tachypnoea, nasal flaring, chest retractions or grunting. Normally, the newborn's respiratory rate is 30 to 60 breaths per minute. Tachypnoea is defined as a respiratory rate greater than 60 breaths per minute. Mild respiratory distress is when the baby is tachypnoeic, but active and pink, but has nasal flaring and improves with by throat suction, oxygen administration and warmth. In moderate respiratory distress, baby is tachypnoeic with laboured breathing, mild cyanosis, nasal flaring, intercostal space retraction, feeble cry and grunting, relieved with throat suction, oxygen administration and assisted ventilation for some period with chest radiograph showing patchy pneumonitis. In severe respiratory distress- baby cyanosed, feeble respiratory effort requires endotracheal intubation and ventilator support. Chest radiograph shows atelectasis and consolidation.

Term pregnancies with meconium-stained amniotic fluid were monitored intensely and decision regarding route of delivery was made after taking into consideration of the stage of labour, parity, favourability of the cervix, type of meconium staining and status of the foetal heart rate. Mothers were advised to rest in the left lateral recumbent position and oxygen was administered with nasal prongs with close monitoring of the foetal heart rate. Multigravida with good obstetric history, well established in labour and with good foetal heart rate was allowed to deliver vaginally, whereas any irregularity in foetal heart rate mandated caesarean section. Second stage was cut short by vacuum extraction. In patients with bad obstetric history and early in labour with unfavourable cervix and moderate and thick meconium-stained liquor were delivered by caesarean section. Newborns, soon after births were subjected throat suction with disposable catheters under laryngoscopic guidance and in asphyxiated cases, this was followed by endotracheal intubation and ventilation. Material obtained from throat suction was sent for culture and sensitivity. All newborns were attended by paediatrician. Babies who aspirated more than 5 mL of meconium-stained amniotic fluid and those with respiratory distress were admitted to newborn intensive care unit. Babies with moderate-to-severe asphyxia were intubated and assisted ventilation given in intensive care unit. Supportive care included intravenous fluids, oxygen inhalation and appropriate antibiotics. Babies who needed resuscitation and with minimal respiratory distress were reviewed with chest skiagram after 24 hours.

Statistical Analysis

Quantitative data were presented as a mean and Standard Deviation (SD) and compared by one-way analysis of variance. Qualitative data were presented as percentages

and compared using Pearson Chi-square or in the case of very rare conditions, Fisher's exact test. A p value below 0.05 for a 2-tailed Wald test was considered as statistically significant. Odds Ratio (OR) and Hazard Ratio (HR), their 95% Confidence Intervals (CI) were calculated. Statistical analyses were performed using SPSS version 16.

RESULTS

The incidence of meconium-stained amniotic fluid in all term pregnancies in the institute during the study period was 7.18%. Mean age of the mother was 22.4 ± 5.3 years. Majority of patients were between 20-25 years of age 84 (56%). 14 patients were above 30 years of age and thick meconium-stained liquor was slightly more frequent in this age group (7 out of 14 (50%)) compared to less than 25 years of age, but was not significant (28 out of 84 (33.3%) p=0.09) (see Figure 1). There was no difference in the frequencies, various grades of meconium staining in multiparous pregnancies and primiparous pregnancies (p=0.34) (Figure 2). Meconium-stained liquor was more frequent in post-dated pregnancy (54% vs. 46%), but was not significant statistically (P=0.42). Meconium-stained liquor was seen more frequently in babies born with birth weight more than 2500 grams (62.7% compared to babies with birth weight <2500 grams (37.3%) P=0.011.

Mode of delivery was vaginal in 81 (54%) and 14 of this were assisted by ventouse. 69 (46%) underwent caesarean section (p=0.42) (Figure 3). Babies born through moderate and thick MSAF had higher occurrence of delivery through caesarean section (RR 1.8; CI 1.13-2.85; z=2.502, p=0.01).

Apgar score at 1 minute and 5 minutes after birth were significantly different in different grades of meconium-stained liquor (Table 1). Low Apgar score between 4-6 was significantly higher in babies with thick meconium-stained liquor compared to babies who had moderate and light staining of meconium in liquor (60% vs. 36% vs. 18%; P=0.0002). Severe birth asphyxia as indicated by Apgar score of <3 was seen in 16% of thick meconium staining compared to 4% and 2% with moderate and light staining of meconium (P=0.004). Majorities of the babies who aspirated thick meconium-stained liquor had an Apgar score below 6 (80%) compared to only 10% where Apgar score was >7 (Pearson 33.47; phi + 0.047, p<0.0001) and needed intensive post-delivery care. Low Apgar score occurred more frequently, if there was thick MSAF (HR 2.5; 95%, CI 1.59-3.90; P=0.0001).

Overall, mortality rate was 6% (9 out 150 cases). In 2 cases, it was due to severe respiratory distress due to cord around the neck twice and were delivered as fresh still births. Excluding these two cases, the overall mortality was 4.7% comparable to previous reports. A high morbidity and mortality rate was observed among infants with aspiration of thick meconium-stained amniotic fluid. 16 (55.2%) of 29 cases of thick meconium-stained amniotic fluid aspiration had severe respiratory distress due to Meconium Aspiration Syndrome (MAS) compared to 4 (12.9%) of 31 cases of moderate and light meconium staining of the amniotic fluid (p<0.0008; Fisher's exact test two-tailed P) (Table 2). Among the babies born with severe respiratory distress due to MAS, 16 (80%) had thick staining of meconium in amniotic fluid, whereas moderate staining was seen in 3(15%) and light MSAF in 1(5%) (p=0.008).

The relative risk of death was 8 times higher with respiratory distress associated with thick meconium aspiration compared to respiratory distress associated with moderate or light meconium-stained liquor aspiration (RR 8.55; 95%, CI 1.14 to 64.23; Z statistic=2.09, p=0.04; NNT (harm) 4.1; 95%, CI 13.58 (harm) to 2.42 (harm)). Odds ratio was also 11.4 times higher in babies who aspirated thick meconium-stained liquor than those who aspirated light or moderate meconium-stained amniotic fluid (OR 11.4; 95%, CI 1.33 to 98.35; Z statistic 2.22; P=0.03).

Apgar Score	Meconium			Total N (%) 150 (100)	Significance
	Light N (%) 50 (100)	Moderate N (%) 50 (100)	Thick N (%) 50 (100)		
7 and above	40 (80)	30 (60)	10 (20)	80 (53.3)	χ^2 = 40.45 P=0.0001
4-6	9 (18)	18 (36)	30 (60)	57 (38)	
<3	1 (2)	2 (4)	8 (16) 2 FSB*(4)	13 (8.7)	

Table 1. Apgar Score and Meconium Staining of the Amniotic Fluid

*FSB - Fresh Stillbirth due cord around the neck.

Meconium Staining of Amniotic Fluid (MSAF)	Respiratory Distress			Total	Death	P value
	Mild	Moderate	Severe (MAS)+			
Light meconium	7 (70)	2 (20)	1 (10)	10 (16.7)	-	Fisher's exact test, 2-tailed p=0.008
Moderate meconium	11 (52.4)	7 (33.3)	3 (14.3)	21 (35)	1 (4.7)	
Thick meconium	10 (34.5)	3 (10.3)	16 (55.2)	29 (48.3)	8 (27.5)*	

Table 2. Respiratory Distress and Death in Meconium Aspiration

*Of these 2 fresh stillbirths with cord twice around the neck + MAS - Meconium Aspiration Syndrome.

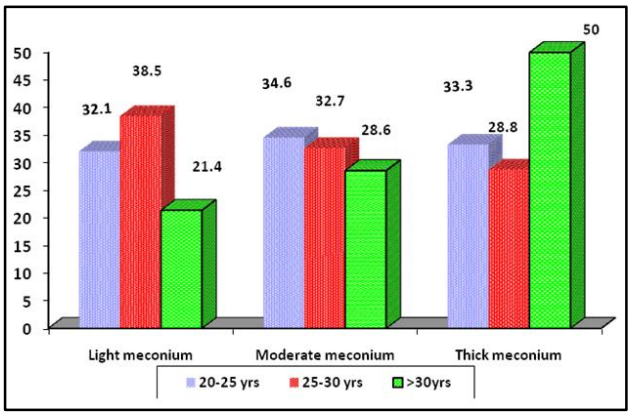

Figure 1. Age Distribution of Grades of Meconium Staining

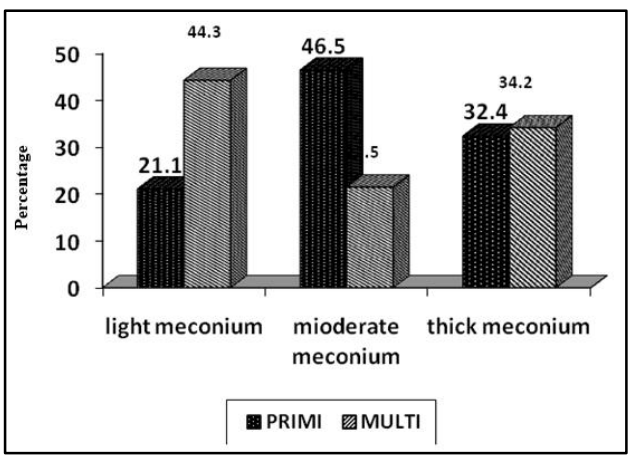

Figure 2. Parity and Meconium Staining

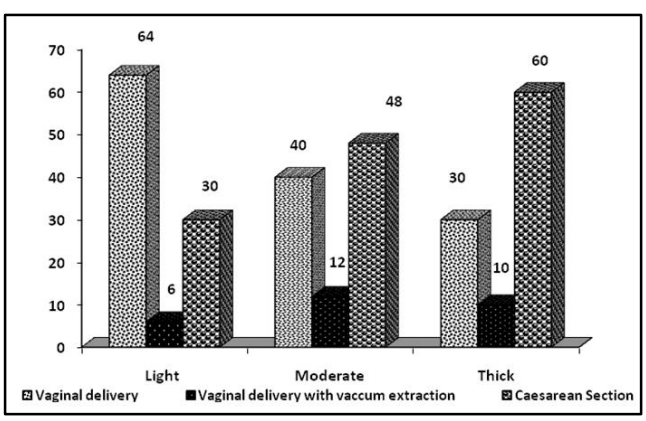

Figure 3. Mode of Delivery

DISCUSSION

Meconium-Stained Amniotic Fluid (MSAF) is seen in about 7.93% of all pregnancies in a population-based retrospective epidemiological study in France by Fischer et al.[1,2] This study in the tertiary care centre showed an incidence of 7.18% comparable to the previously reported series. The mean age group was 22.4 ± 5.3 years and majority in this study belonged to less than 30 years of age 136 (90.7%) and 14 (9.3%) were above the age of 30 years. Slightly higher prevalence of thick meconium-stained liquor was noted in older age group (>30 years), but was insignificant (50% vs. 33%, p=NS.). MSAF and meconium aspiration syndrome in newborn is seen more frequently in past dated pregnancies.[1,3,4,5]In this study, also past date pregnancies were more in MSAF and MAS compared to term pregnancies (54% vs. 46%; p=0.42), but was statistically insignificant probably due to small sample size.

Mode of delivery also showed differences between various grades of meconium-stained amniotic fluid. Normal or vacuum-assisted vaginal delivery was more common in 70% and 52%, respectively, in light and moderate MSAF, whereas vaginal or assisted vaginal delivery in only 40% in thick MSAF (P=0.03) see figure 3. Frequently, in those with thick MSAF, mode of delivery was caesarean section indicating the foetal distress and higher likelihood of foetal heart variation and increased chance of severe respiratory distress and MAS. Odds ratio was 2.74; 95%, CI 1.33 to 5.64; z=2.34, P=0.006). This is similar to previously reported data that severe respiratory distress and MAS are associated with delivery by caesarean section indicating more severe foetal distress in utero.[6,7]

Thick meconium is usually regarded as a common finding in severe meconium aspiration syndrome and most studies were focused on neonates born through moderate or thick MSAF.[8,9] This study also confirms the occurrence of moderate and severe respiratory distress (MAS) due to aspiration of thick MSAF (59.4%) compared to its occurrence in aspiration due to moderate MSAF (31.2%) and light MSAF (9.4%) (p=0.008).

Low Apgar score correlated with the severity of grade of MSAF in this study and severe birth asphyxia as indicated by Apgar score of <3 was seen in 20% of newborns with thick MSAF compared to 4% and 2% with moderate and light staining of meconium (P=0.004) (Table 1). 72.7% of babies with Apgar score less than 3 at 1 minute had thick MSAF with aspiration and only 18.2% and 9.1% of the babies with Apgar less than 3 had moderate and light MSAF, respectively (P=0.004). Apgar score of <6 was seen in 80% of the thick MSAF, whereas it was 40% and 20% in moderate MSAF and light MSAF group suggestive of severe foetal distress and asphyxia as well high propensity for MAS when Apgar is <6 at 1 minute. This is similar to previous observations made by several authors and low Apgar score correlated with the occurrence of severe MAS.[2,7,10-15]

Overall, mortality was 6%. This is compared to the results of recent large epidemiological survey by Fisher et al where the mortality rate was 6.7% in aspiration of thin MSAF and 8.5% in aspiration of thick MSAF.[2] The relative risk of death was 8 times higher with aspiration of thick MSAF compared to aspiration of thin or moderate MSAF in this study. The odds ratio was also 11 times higher in babies with aspiration of thick MSAF than those who aspirated thin or moderate MSAF. This is similar to the earlier observations where severe respiratory distress occurs due to increased occurrence of MAS with aspiration of thick or moderate MSAF.[16,17]

CONCLUSION

The incidence of Meconium-Stained Amniotic Fluid (MSAF) was 7.18% in this study. The important determinants of severe respiratory distress and Meconium Aspiration

Syndrome (MAS) were moderate or thick MSAF, low Apgar score below <6. Very low Apgar score <3 was associated with thick MSAF (HR 2.5; 95%, CI 1.59 to 3.90; P=0.0001). The relative risk of death was 8 times higher with aspiration of thick MSAF than with aspiration of slight or moderate MSAF. The odds ratio for death was also very high (11 times) with thick MSAF.

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