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Original Research Article

Clinical profile of meconium aspiration syndrome in relation to birth weight and gestational age

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ABSTRACT

Background: Meconium aspiration syndrome (MAS) is a commonly encountered entity in neonates delivered in rural health centres.
Methods: A prospective observational study was conducted in 50 consecutive cases of MAS who were admitted in Level III NICU of the Department of Pediatrics of a tertiary care teaching hospital located 50 kms from Jaipur city amidst rural surroundings from 1st January 2016 to 31st July 2017. Appropriate statistical analysis was carried out using Medcalc statistical software (version 16.4).
Results: Out of 3585 deliveries, prevalence of MSAF and MAS was 14% and 8.5% respectively. The M:F ratio of study subjects was 1.2:1.The maternal risk factors significantly associated with MAS were maternal anemia (p value-<0.001), maternal age >30 (p value-0.025) and unbooked pregnancies (p value-0.032). The mean birth weight was 2734±499gms. Majority of cases of MAS were seen in babies with birth weight between 2.5-3.5 kg (n=30, 60%).The mean gestational age was 38.6±2.4 weeks. 30 (60%) babies were delivered after completing 37-<40 weeks of gestation and 9 (18%) babies were of 40-<42 weeks of gestation. The common complications observed were exaggerated physiological hyperbilirubinemia (75%), birth asphyxia (50%) and septicaemia (27.08%). The commonest cause of mortality was birth asphyxia (57.14%) and pneumonia (42.8%).
Conclusions: MAS is a cause of concern for the attending obstetrician and pediatrician as it is associated with life threatening complications and mortality. Efforts need to be invested in promotion of institutional antenatal care and institutional deliveries so that maternal risk factors can be identified and managed effectively, especially in rural areas.

Keywords: Gestation, Meconium, Profile, Weight

INTRODUCTION

Meconium is a thick viscous, dark green substance which is composed of intestinal epithelial cells, mucus, lanugo, intestinal secretions such as bile.[1]

The passage of meconium may simply represent the normal physiological in-utero gastrointestinal maturation process or it may indicate an acute or chronic hypoxic event, thus making it a warning sign of fetal compromise.[2] Meconium aspiration syndrome (MAS) may be defined as a respiratory distress which develops shortly after birth with radiographic evidence of aspiration pneumonitis in the presence of meconium stained amniotic fluid(MSAF).[3,4]

Though the incidence of MAS has decreased in the last decade owing to improved obstetric practices, the

mortality rate still ranges significantly between 5-37%.[5] In addition to it, the rate of severe mental retardation and cerebral palsy is significantly higher among surviving infants born with MAS.[6]

Keeping in view the significant morbidity and mortality associated with MAS and also the fact that there is a paucity of studies conducted in neonatal units located in rural areas, this study was designed to outline the clinical profile of neonates diagnosed with MAS and also to evaluate the maternal risk factors associated with it.

METHODS

This prospective observational study was conducted in 50 consecutive cases of meconium aspiration syndrome who were admitted in Level III Neonatal Intensive Care Unit (NICU) of the Department of Paediatrics of a tertiary care teaching hospital located 50 kms from Jaipur city amidst rural surroundings from 1st January 2016 to 31st July 2017. Using the formula n=4pq/e2 with error 5% and power more than 90%, a minimum sample size of 39 patients was calculated.

All preterm, term and post-term neonates having birth weight appropriate or small for gestational age, delivered either normally or by caesarean section or by forceps/vaccum extraction with meconium stained liquor and subsequently manifesting as meconium aspiration syndrome with following features were included in this study :

- Presence of chest retractions or grunting,
- neonates requiring supplemental oxygen or assisted ventilation,
- Skiagram chest findings suggestive of meconium aspiration syndrome.
- Parents who provided consent for participation.

The following neonates were excluded from this study:

- Neonates with meconium stained liquor without subsequent respiratory distress and radiological signs of meconium aspiration syndrome in chest skiagram.
- Neonates diagnosed with other causes of respiratory distress- respiratory distress syndrome, transient tachypnea of newborn, congenital pneumonia or any other congenital pulmonary anomalies and metabolic disorders.
- Parents refusing to provide consent for participation.
- Babies with chromosomal anomalies or any congenital malformation related with other system.

Observing all aseptic measures, all babies with meconium stained amniotic fluid were received and placed under a radiant warmer in the labour room or operation theatre complex. Neonatal Resuscitation was performed as per AAP NRP Guidelines 2015.[7] In all the study subjects, APGAR scoring at 1 minute and 5 minutes was performed. All babies were shifted to NICU for further clinical observation. Upon inclusion in this study, a detailed antenatal history from the mother was elicited to identify the possible etiology of passage of meconium into the amniotic fluid.

Gestational age assessment was performed by Modified Ballard's scoring and birth weight assessment by electronic weighing scale (Equinox® BE-EQ 22 model D=10g). A detailed clinical examination was carried out and respiratory distress was monitored using Downe's Scoring System in all study subjects. A Downe's score >4 was an indication to commence CPAP and a score >6 for intubation and mechanical ventilation.

All study subjects were subjected to further management as per standard NICU protocol prepared for babies with meconium aspiration syndrome. They were subsequently monitored for clinical complications and final outcomes i.e. discharge from NICU or death.

The laboratory investigations done in all the study subjects were complete blood counts, CRP, blood culture, blood glucose, serum calcium, serum electrolytes and arterial blood gas (ABG).

Radiological assessment was performed by serial chest skiagrams as directed by the clinical condition and monitoring of the study subjects as per standard NICU protocol. All historical details and observations including resuscitative measures, clinical features and outcomes were recorded in a pretested proforma.

Appropriate statistical analysis was carried out using Medcalc statistical software (version 16.4). Mean and standard deviations were calculated using standard methodologies. A value of $p < 0.05$ was considered significant. Approval for this study was provided by ethics committee of this institution.

RESULTS

Of the 3584 deliveries, 534 (14%) babies had meconium stained liquor, of which 50 babies (8.5%) were diagnosed as cases of meconium aspiration syndrome. These cases were included in this study and labelled as study subjects. The sex ratio (male: female) of the study subjects was 1.2:1.

The maternal risk factors significantly associated with meconium aspiration syndrome in the study subjects were maternal anemia (p value-<0.001), maternal age >30 (p value-0.025), unbooked pregnancies (p value-0.032) and pregnancy induced hypertension (p value-0.041) (Table 1). The study subjects delivered by normal vaginal route formed the highest percentage (n=27, 54%) of cases followed by babies by caesarean section (n=15, 30%).

Table 1: Association of maternal and fetal risk factors with meconium aspiration syndrome in study subjects.

Variables	MSAF (N=534)		MAS (N=50)		'p' Value*	Adjusted odds ratio	95% CI
	No.	%	No.	%			
Maternal age >30	63	11.80	12	24.00	0.025	2.7849	1.1721 - 4.7555
Primigravida	306	57.30	25	50.00	0.397	0.8268	0.4635 - 1.4750
Unbooked pregnancies	161	30.15	23	46.00	0.032	2.5065	1.0983 - 3.5463
Pregnancy Induced Hypertension (PIH)	53	9.93	10	20.00	0.041	2.4294	1.0730 - 4.7973
Maternal Anemia	312	58.43	5	10.00	<0.001	3.5864	1.0309 - 5.2024
Antepartum hemorrhage	7	1.31	1	2.00	0.814	1.5364	0.1852 - 12.7451
Chorioamnionitis	6	1.12	1	2.00	0.893	1.7959	0.2119 - 15.2213
Premature rupture of membranes	69	12.92	5	10.00	0.710	0.7488	0.2873 - 1.9516
Cord problems	55	10.30	5	10.00	0.860	0.9677	0.3686 - 2.5404

Table 2: Distribution of study subjects with respect to gestational age.

Gestational Age (In weeks)	No. of study subjects (n=50)	%
30-<32	2	4.00
32-<34	1	2.00
34-<36	4	8.00
36-<38	4	8.00
38-<40	28	56.00
40-<42	9	18.00
>42	2	4.00
Total	50	100.00

The mean gestational age of study subjects was 38.6±2.4 weeks. 30 (60%) babies were delivered after completing 37-<40 weeks of gestation and 9 (18%) babies were of 40-<42 weeks of gestation (Table 2). There were 9(18%) babies who were delivered prematurely (30-<37weeks) in this study out of which 2 babies were declared still born. The mean birth weight of the study subjects was 2734±499gms. In this study, maximum number of cases of MAS were seen in babies with birth weight between 2.5-3.5 kgs (n=30, 60%), followed by babies with birth weight less than 2.5 kg (n=17, 34 %).2 babies declared still born had weight 1.6 kg and 1.7 kg each at birth (Table 3).

Table 3: Distribution of study subjects with respect to birth weight.

Birth weight (kg)	No. of study subjects (n=50)	%
<2.5	17	34.00
2.5-3.5	30	60.00
>3.5	3	6.00
Total	50	100.00

Out of 50 babies, 37(74%) babies were delivered with thick meconium stained liquor and remaining (n=13, 26%) babies with thin meconium stained liquor. In this study, all babies required and were provided resuscitation as per NRP Guidelines 2015 (Table 4).[7]

Table 4: Requirement of resuscitation in study subjects.

Steps of Resuscitation	No. of study subjects (n=50)	%
Initial steps	50	100
Oxygen inhalation	50	100
Bag mask ventilation (BMV)	29	58
Endotracheal intubation	20	40
Chest compressions	4	8
Medications	2	4
Total	50	100

In this study, majority of the babies (n=45,93.75%) had onset of respiratory distress at birth. Majority of the study subjects (n=35, 72.9%) had a Downe' score ≥6 followed by 13 cases (27.08%) bearing a score of 4-5.31 (62%) cases had severe asphyxia i.e., an APGAR score ranging from 0-3 at 5minute and 17 (34%) cases had mild to moderate asphyxia i.e., an APGAR score between 4-6 at 5 minutes.

Table 5: Complications of meconium aspiration syndrome (MAS) as observed in study subjects.

Complications of MAS	No. of study subjects (n=50)	%
Exaggerated physiological hyperbilirubinemia (EPL)	36	75.00
Birth Asphyxia (BA)	24	50.00
Septicemia	13	27.08
Seizure	10	20.83
Acute renal failure (ARF)	7	14.58
Pneumonia	5	10.42
Pneumothorax	4	8.33
Metabolic acidosis (MA)	3	6.25
Hypoglycemia	1	2.08

The complications of MAS as observed in study subjects is shown in Table 5. 32 babies had more than one of the above-mentioned complications. An increase in number of study subjects having complications-exaggerated physiological hyperbilirubinemia and birth asphyxia was observed within increase in birth weight (2.5-3.5kg) and gestational age (38-42 weeks).

Table 6: Cause of mortality as observed in study subjects.

Causes of mortality	No. of study subjects (n=50)	%
Birth asphyxia	4	57.14
Septicemia	2	28.5
Pneumonia	3	42.8
Pneumothorax	1	14.2

In this study, out of 50 babies, 41 study subjects (82%) were discharged. Mortality was observed in 7 babies (14%) having gestational age 38-42 weeks and birth weight more than 2.5kg. 2 babies (4%) were still born having gestational age 32-34 weeks and 34-36 weeks respectively. The underlying causes of mortality as observed in study subjects are shown in Table 6.

DISCUSSION

In this study, incidence of meconium aspiration syndrome was 8.5%. This observation is similar to that of Gauchan et al and Swain et al in which the incidence of meconium aspiration syndrome was 8.4% and 8.5% respectively.[8,9] Other studies have found incidence rate as low as 3.03% to as high as 18%.[1,2,10,11] This probably reflects the level of antenatal care in different places where these studies were conducted.

In this study, maternal risk factors significantly associated with meconium aspiration syndrome in the study subjects were maternal anemia, maternal age >30, unbooked pregnancy and pregnancy induced hypertension. Maternal anemia was similarly and significantly observed as a risk factor in other studies.[1,12-14] Maternal age >30 was observed as a risk factor in 14.4% cases.[15] Unbooked pregnancy as a significant risk factor was also reported by Bhide et al and Mundra et al.[2,16] Pregnancy induced hypertension has been reported by Hanoudi et al (30%), Ashtekar et al (19.3%), Mundra et al (16.9%) and Ramakishore AV et al (12%).[1,2,12,17]

Predictors of MAS as observed in this study provide a possible way of early identification of high risk cases and to reduce consequent morbidity and mortality. Most peripheral centers in our country are devoid of facilities for managing high risk deliveries or giving essential newborn care. If incorporated into basic training for health workers these predictors can facilitate early referral and proper management. Secondly, remediable or preventable causes provide opportunities for intervention and planning in presence of adequate institutionalized monitoring and follow-up.

In this study, 54% of the study subjects were delivered by normal vaginal route followed by caesarean section (30%). This may be explained by the fact that majority of mothers (81.4%) from adjoining rural areas were admitted in advanced stages of labour along with inherent risk factors and complications. Moreover, they were primarily handled by local *dai* (midwife) who referred them to our hospital in this condition for further management. Ramakishore AV et al observed that 48% babies were delivered normally followed by 36% babies by caesarean section.[12] Behera et al observed a higher incidence of meconium aspiration syndrome associated with normal vaginal delivery (71.4%), in comparison to caesarean section (28.6%).[18] In the study of Fischer et al, babies with meconium aspiration syndrome delivered by normally vaginal route were 44.9% followed by caesarean section (37.2%).[19]

Foetal outcome is directly correlated with consistency of meconium. The risk of perinatal death is increased five to seven times when a thick meconium is present at the onset of labour. In this study, majority of study subjects (n=37, 74%) were delivered with thick meconium out of which mortality was observed in 6 babies (16.2%). Gauchan et al (74%) and Sangeetha et al (88%) have also observed similarly in their studies.[8,20] This further consolidates the fact that thick meconium is strongly associated with meconium aspiration syndrome. Neonates with thin meconium are more likely to have passed meconium as a physiologic maturational process and they are more likely to be healthy at birth as mortality was observed in 1 case (76%) despite thin meconium in this study. However, these neonates still require intensive monitoring in NICU after birth.

In this study, majority of the babies (93.7%) had respiratory distress immediately after birth which was similar to other studies.[5,8,10]

The M: F ratio observed in this study was 1.2:1 which is in contrast to the observation of Espinheria et al where more females were observed to manifest meconium aspiration syndrome.[5] Though statistically insignificant, this may also be due to gender bias toward female sex which is quite prevalent in adjoining rural areas.

In this study, the highest number of babies (60%) were bearing a birth weight in range of 2.5kg-3.5kg, followed by babies in <2.5 kg category. This observation corresponds to that of Ramakishore AV et al.[12] However, there were less number of study subjects in other studies in less than 2.5 kg category as compared to this study.[1,20]

Incidence of meconium aspiration syndrome increases with gestational age and this was quite evident in this study. In this study, 74% had gestational age beyond term. 46% of the deliveries were unbooked and 2 babies

were delivered beyond 42 weeks because these mothers had previous successful home deliveries. So, they had waited for longer time and had come to hospital only when they had felt that was high time to deliver. This observation corresponds to study conducted by Ashtekar et al in which 84.5% of babies had a gestation age of 38-42 weeks.[1] Errkola et al found 95% cases more than 36 weeks.[21] In the study conducted by Eiden et al, the frequency of meconium stained amniotic fluid increased with increasing gestational age of fetus i.e. 7% before 38 weeks, 78% between 38-42 weeks and 35% or more in pregnancies lasting longer than 42 weeks.[22]

All babies required resuscitation at birth with 2 babies declared still born. Majority (n=34, 70.8%) of study subjects required mechanical ventilation and the rest were treated conservatively. This was quite significant as compared to other studies in which usage of mechanical ventilation ranged from 23.07% to 44%.[1,23,24] This may be explained by the fact that majority of mothers were admitted in advanced stages of labour with associated complications, thus predisposing to fetal hypoxia, distress and passage of thick meconium *in utero*. This also further explains the occurrence of significant complications of meconium aspiration syndrome in study subjects.

Meconium aspiration syndrome is a frequent cause of poor fetal outcome as it increases the number of admission in neonatal intensive care unit. In this study,the common complications observed in study subjects were exaggerated hyperbilirubinemia (75%), asphyxia (50%), septicemia (27.08%), seizures (20.8%), acute renal failure (14.5 %), pneumonia (10.4%) and pneumothorax (8.3%). This is similar to the observation by other studies.[1,25]

In this study, mortality was observed in 14% (n=7) of study subjects which corresponds to the observations of Gauchan et al (14%) and Ramakishore et al (12%).[8,12] All these 7 babies were being mechanically ventilated. However other studies have quoted mortality rate of 2.7-33%.[9,25-27]

The wide variation in mortality results due to the difference in the levels of care in various neonatal facilities across the world and the availability of adjunctive therapies like nitric oxide and extracorporeal membrane oxygenation (ECMO) exclusively at few centers only in India.

The commonest cause of mortality in this study was birth asphyxia (57.14%) followed by pneumonia (42.8%), septicemia (28.5%) and pneumothorax (14.2%). According to National Neonatal Perinatal Database of India 2002-2003, birth asphyxia was the single most common cause of death (40.5%) in babies born through meconium stained amniotic fluid.[28] These observations are similar to that of Ashtekar et al and Narang et al where birth asphyxia was the significant cause of mortality in 37.5% and 53.8% cases respectively.[1,29] Occurrence of complications and mortality was significantly associated with increase in birth weight and gestational age. This can be explained by the fact that with increase in gestational age and presence of maternal risk factors, there is increased predisposition to passage of meconium and consequent complications in the foetus.[30] Stillbirth in 2 preterm neonates was associated with thick meconium stained liquor. The remaining 8 preterms included in this study developed MAS despite presence of thin meconium, thus mandating the strict clinical monitoring of all such neonates in immediate postnatal period in the NICU.

The strengths of this study were that it was a prospective study conducted in a rural tertiary health center which outlined the maternal risk factors significantly associated with meconium aspiration syndrome.

Nowadays, identification of perinatal asphyxia remains a major endpoint of MAS prevention. Also, guidelines for monitoring of fetal risk factors for early detection and management need to be established. These overall results suggest that severe MAS is an antenatal disease thus justifying adapted antenatal care.

CONCLUSION

Meconium stained amniotic fluid is a cause of concern for the attending obstetrician and pediatrician as it is associated with life threatening complications and mortality. Efforts need to be invested in promotion of institutional antenatal care and promotion of institutional deliveries so that maternal risk factors can be identified and managed effectively especially in rural areas. Certain measures including imparting the knowledge of neonatal resuscitation according to latest AAP NRP 2015 Guidelines to medical personnel along with its effective implementation coupled with advanced infrastructural neonatal intensive care facilities can surely go a long way in reducing the morbidity and mortality as a result of meconium aspiration syndrome.

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