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Original Research Article

To understand the factors causing meconium aspiration syndrome (MAS) in relation to gestational age and birth weight and their immediate outcome

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Abstract

Aim: The aim of the study was to understand the factors causing meconium aspiration syndrome (MAS) in relation to gestational age and birth weight and their immediate outcome.

Methods: This study was carried out in Neonatal Intensive Care Unit of Surabhi institute of medical sciences Siddipet, Telangana. The study included the clinical profile of consecutive 50 cases of meconium aspiration syndrome admitted to the above center during the period of July 2021 to January 2023.

Results: The mean birth weight of babies with MAS was 2.68 kg (1.7- 4 kgs). In these study, maximum number of cases of MAS were seen in babies with birth weight between 2- 2.4kgs (n=19, 38%), followed by babies with birth weight between 2.5-2.9 kg (n=16, 32%). Babies with birth weight between 3-3.4 formed 22% (n=11) of cases. MAS were also seen in preterm babies. 4 (8%) cases were of 34-36 weeks of gestation and 4 cases (8%) belonged to 36-38 weeks of gestation. None of the cases were below 34 weeks of gestation. In this study of babies with MAS, the most common complication was birth asphyxia in (38%, n=19) of cases, followed by ARF in (n=10, 20%) cases. Septicemia was seen in 18% (n=9) cases, pneumothorax in 8% (n=4), pulmonary hemorrhage in 4% (n=2) and pneumonia in 4%. (n=2) of cases.

Conclusion: MAS is an entity which is commonly seen in term and post term babies with birth weight >2.5 kg. There is a significant correlation between the birth weight and outcome in MAS. When thick meconium stained liquor is noted prior to birth, anticipation is necessary and non vigorous babies need aggressive management and possibly early ventilation. Asphyxiated babies should be followed up astutely. Continuous monitoring and early intervention, followed by due resuscitation as per guidelines can reduce the morbidity, complications and the mortality in MAS.

Keywords: Birth weight, gestational age, immediate outcome, meconium aspiration syndrome

Introduction

Meconium aspiration syndrome (MAS) remains one of the most common causes of neonatal respiratory distress [1]. The overall frequency of Meconium-stained amniotic fluid (MSAF) varies between 5% to 25%. MAS occurs in 10% of newborns born through MSAF. Also, newborns with MSAF are 100 times more likely to develop respiratory distress compared to counterparts born with clear amniotic fluid. And approximately 30% to 50% of infants with MAS have severe MAS, defined as the need for mechanical ventilation. Meconium staining of amniotic fluid has been considered to be a predictor of poor fetal outcome because of the deleterious effect on neonatal lungs [2].

MSAF occurs with increasing frequency along with increase in gestational age of the fetus,

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the incidence being as high as 30% in post term pregnancy [3]. Most babies with MSAF are 37 weeks or older [4]. An increased incidence of MSAF is also due to hypoxia and infection, independent of fetal maturation. Meconium passage is a developmentally programmed postnatal event because 98% of healthy newborns pass meconium in the first 24 to 48 hours after birth [5]. Treatment of MAS is a challenge to neonatologists. Appropriate use of positive end expiratory pressure, surfactant therapy, recent advances like high frequency ventilation and inhaled nitric oxide have led to reduced incidence of adverse outcome and improved survival rate of newborns with MAS. Various studies have described the various attributes and morbidity pattern of MAS [6].

Meconium stained amniotic fluid occurs in 9% to 22% of live births with increasing frequency along with increase in gestational age of fetus. In utero, meconium passage rarely occur before 32 weeks of gestation and most babies with meconium stained amniotic fluid are 37 weeks or older. The incidence of MSAF increases with gestational age reaching as high as 30% in post term pregnancy. An increase incidence of MSAF is noted in presence of feto-maternal stress factor such as hypoxia and infection, independent of fetal maturation.

Meconium passage is a developmentally programmed post natal event because 98% of healthy newborn pass meconium in first 24 hours after birth [7]. Greater than 98% of cases MSAF are noted in fetuses at or following 37 weeks of gestation [8]. MSAF commonly occur in post term pregnancies and is relatively rare in preterm deliveries [9]. MAS remains challenging condition confronting neonatologists. Avoidance of post term pregnancies and improving intrapartum monitoring are beneficial. Recent advances in understanding and management of acute lung injury such as appropriate use of positive end expiratory airway pressure, surfactant therapy, high frequency ventilation, and use of inhaled nitric oxide has led to reduced incidence of adverse outcome and improved survival rate of infants with MAS. The aim of the study was to understand the factors causing meconium aspiration syndrome (MAS) in relation to gestational age and birth weight and their immediate outcome.

Materials and Methods

This study was carried out in Neonatal Intensive Care Unit of Surabhi institute of medical sciences Siddipet, Telangana. The study included the clinical profile of consecutive 50 cases of meconium aspiration syndrome admitted to the above center during the period of July 2021 to January 2023.

Inclusion criteria

1. Presence of meconium-stained amniotic fluid.
2. Tachypnea, retractions, grunting or other abnormal signs on physical examination consistent with pulmonary disease (i.e., onset of respiratory distress within 24 hours of life).
3. Need for supplemental oxygen or ventilator support
4. A compatible chest radiograph (Abnormal chest roentgenograms consistent with aspiration pneumonitis).

Exclusion criteria

1. The newborns with TTNB, HMD, congenital pneumonia, sepsis.
2. Newborns with meconium stained amniotic fluid but without any respiratory distress or chest X-ray findings not consistent with aspiration pneumonitis were excluded from the study.

Study population consisted of 50 newborns, with meconium staining and who developed meconium aspiration syndrome (MAS) and respiratory distress. It is a heterogeneous population. The cases were taken from babies admitted in NICU Surabhi Institute of Medical Sciences and the babies who required ECMO and inhaled nitric oxide were referred to higher center and followed up for their immediate outcome.

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Selection of Cases and Methods

All preterm, term and post term infants, appropriate for gestational age and birth weight, delivered normally or by caesarean section or forceps, fulfilling all the above criteria's for MAS who were admitted to NICU, during the above-mentioned period were included in the study. A detailed antenatal history was elicited to find out the etiology of passage of meconium into the amniotic fluid. Natal history was taken to find out the type of delivery and indications for any interventions or drugs used for delivery were obtained. Postnatal history was obtained regarding Apgar score, birth asphyxia, cyanosis, or any other complications and details of resuscitation measures done at birth. During delivery, the type of delivery and any complications in the mother were recorded and resuscitative measures done were suctioning of the oropharynx by obstetrician after delivery of head and suctioning of oropharynx and nasopharynx was done by paediatrician until no meconium could be recovered from mouth and nose. When required, endotracheal intubation was done and bag and tube ventilation was given. If baby was vigorous at birth, only oral and nasal suctioning was done. Stomach wash was given to prevent further vomiting and aspiration of meconium-stained fluid from stomach. In all meconium stained infants, APGAR score at 1 minute and 5 minute was assessed and gestational age assessment was done with modified Ballard's score.

All the babies were subjected to complete blood count, peripheral smear, serial chest X rays, arterial blood gas analysis, blood glucose, serum calcium, serum electrolytes. Sepsis workup like ESR, CRP, blood culture and sensitivity were done when indicated by the sepsis score.

Primary outcome: Mortality

Secondary outcomes

- Need for mechanical ventilation
- Incidence of asphyxia
- Pneumothorax and other complications.
- Duration of hospital stay.

Statistical analysis

Data was analysed using SPSS version 16. Using this software, frequencies, percentages, means, standard deviations, chi square test, paired t test, unpaired t test correlation were applied. A 'p' value less than 0.05 is considered significant.

Results

The study was conducted over a period of July 2021 to January 2023. During the study period of 18 months, out of 4690 deliveries, 472 (10.06%) babies had meconium stained liquor out of them 50 babies developed MAS (10.59%). The total number of babies admitted to NICU during the study period was 900 and out of them total number of cases with respiratory distress were 335. Out of 335 cases of respiratory distress admitted to NICU during the study period 50 (14.9%) babies had MAS.

Table 1: Attributes in meconium aspiration syndrome

Sex	No. of Cases	Percentage
Male	26	52
Female	24	48
Birth Weight (in kgs)		
1.5 – 1.9	02	4
2 – 2.4	19	38
2.5 – 2.9	16	32
3 – 3.4	11	22

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3.5 – 3.9	01	02
> 4	01	02
Maternal Data		
Fetal Distress	26	52
PIH	11	22
PROM	05	10
Oligohydramnios	05	10
Others	03	6
Mode of Delivery		
Caesarean Delivery	20	40
Normal Delivery	18	36
Vacuum Extraction	03	6
Forceps Delivery	09	18
Gestational Age (Weeks)		
< 34	0	0
34 – 36	05	10
36 – 38	03	06
38 – 40	24	48
40 – 42	14	28
> 42	04	08
APGAR Score at 1 minute		
0 – 3	16	32
4 – 6	29	58
> 6	05	10
Treatment		
Conservative Treatment	34	68
Ventilator Support	16	32

The sex distribution was almost equal in both male and female with 52% cases in males and 48% cases in females. The mean birth weight of babies with MAS was 2.68 kg (1.7- 4 kgs). In these study, maximum number of cases of MAS were seen in babies with birth weight between 2- 2.4kgs (n=19, 38%), followed by babies with birth weight between 2.5-2.9 kg (n=16, 32%). Babies with birth weight between 3-3.4 formed 22% (n=11) of cases. Babies with birth weight between 1.5-1.9kg, 3-5-3.9kg and > 4 kg had 1 case each of MAS. In this study fetal distress was found to be the most common (n=26, 52%) factor associated with MAS followed by PIH (n=11, 22%), PROM (n=5, 10%) and oligohydraminios (n=5, 10%), three cases (6%) were not associated with any factor. In the present study; majority of the cases of MAS occurred in term babies with mean gestational age of 38-40 weeks. 24 (48%) babies belonged to 38-40 weeks of gestation and 14(.28%) babies were of 40-42 weeks of gestation. 4 (8%) cases occurred in babies > 42 weeks of gestation. MAS were also seen in preterm babies. 4 (8%) cases were of 34-36 weeks of gestation and 4 cases (8%) belonged to 36-38 weeks of gestation. None of the cases were below 34 weeks of gestation. Out of all cases, 16 (32%) cases had severe asphyxia i.e., AS < 3 at 1 minute and 29 (58%) cases had mild to moderate asphyxia i.e., AS between 4-6 at 1 minute and apgar score > 6 is seen in 3 (10%) cases. In this study, conservative line of management was given with oxygen, restricted fluids, antibiotics, Vitamin K, calcium for 36 (68%) cases and only 16 cases (32%) needed ventilator support where indication was birth asphyxia, acute respiratory failure or other complications like pneumothorax. Out of 16 ventilated babies, 14 babies died and 2 babies survived and were discharged.

Table 2: Mortality attributes in MAS

Complications	No. of Cases	Percentage
ARF	10	20
BA	19	38
Septicemia	09	18

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Pneumothorax	04	08
Pulmonary Hemorrhage	02	04
Pneumonia	02	04
Others	23	46
Neonatal outcome		
Death	14	28
Discharge	36	72

In this study of babies with MAS, the most common complication was birth asphyxia in (38%, n=19) of cases, followed by ARF in (n=10, 20%) cases. Septicemia was seen in 18% (n=9) cases, pneumothorax in 8% (n=4), pulmonary hemorrhage in 4% (n=2) and pneumonia in 4%. (n=2) of cases. Some babies had more than one of the above-mentioned complications. 23 babies (46%) had complication other than those mentioned above. In this study, severe birth asphyxia was found to be the main cause of death in majority of cases followed by acute respiratory failure. Mortality occurred in 14cases (28%).

Discussion

Meconium aspiration syndrome remains one of the most 5 common causes of neonatal respiratory distress [10]. The overall frequency of MSAF varies between 5% to 25%. MAS occur in 10% of infants born through MSAF. Infants born through MSAF are 100 times more likely to develop respiratory distress compared to the counter parts born through clear amniotic fluid [11].

Of the maternal conditions associated, obstructed labour and resultant fetal distress is common in newborns who develop respiratory distress after MSAF.10 PIH was found in 23.58% cases in a study by Miller *et al*, and in 15.75% cases in a study by Pravin and Usha Krishna and in 11.20% by Fujikura *et al*. In the present study it was 21.27% [3, 12, 13]. Incidence of PROM was found in 6.6% cases by Miller *et al*, and in the present study it was 11.7% [12]. Incidence of MAS in our study was 14.9% which is comparable to 10.55% in the study by Narang *et al*. [14] In a study by Bhusan PK, *et al*, MAS occurred in 25% of all cases of MSAF [15]. In a study by Bharati Rao *et al*, the incidence of MSAF was observed to be 8.54% of which MAS was found in 16.1% of cases [16].

National neonatal perinatal database of India says that variables showing significant association with presence of MSAF were small for gestation fetal growth status, PIH, eclampsia, PROM>24 hours, oligohydramnnios, fetal bradycardia and fetal tachycardia. In a study done at BHU Varanasi, it was found that fetal distress during labour and Intra uterine growth restriction (IUGR) were significant risk factors associated with MAS. In another study by Hofmeyer GJ *et al*., [17], it was found that the presence of thick meconium staining of the amniotic fluid is an indicator of oligohydramnios, as meconium passed into a normal volume of amniotic fluid will usually appear thin. In the present study, only 10% cases were associated with oligohydramnios. The cause of fetal distress and neonatal respiratory distress in association with MSAF is not always clear. A prospective study was undertaken by Coughtrey H *et al*, [18], who concluded that fetal distress is common in infants who develop respiratory distress after MSAF. PIH was found in 23.58% cases in a study by Miller *et al*, [12], and in 15.75% cases in a study by Goud P *et al*., [12] and in 11.20% by Fujikura [13].

In the present study; babies with MAS, born by LSCS formed the highest percentage (n=20, 40%) followed by babies born by normal vaginal delivery (n=18, 36%) and (n=9, 18%) by forceps delivery. These figures are almost in correlation with figures of other authors. Narang *et al*, [14], found 54.2% babies were born by LSCS and 30.7% were delivered by normal vaginal delivery and 11.8% by forceps delivery. In the present study mean gestational age was found to be 38-40 weeks. Rossi EM *et al*, [19], found that 95% of cases were > 36 weeks gestation in their study. Davis RO *et al*, [20] stated that prevalence of MAS increases to 10% or more after 38 weeks.

In the present study mean birth weight was 2.68 kg ranging from 1.7 to 4.1kg. According to study by Goud P *et al*, [12] majority of babies in their study weighed 2.5 kg – 3 kg and 4.2% of

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babies weighed >3.5 kgs. In National Neonatal Perinatal Database of India 2002-2003, the mean birth weight of babies born through MSAF was 2646+552 gm. In the present study, APGAR score recorded at 1 minute < 3 is found in (n=16) 32% of cases with severe birth asphyxia; 58% (n=29) of cases had APGAR score between 4-6 with mild to moderate birth asphyxia; >6 is seen in 10% (n=5) cases. Miller *et al*. [12], found that APGAR at 1 minute was < 7 in 25.40% of cases.

In the present study birth asphyxia (n=19, 38%) was found to be most common complication followed acute respiratory failure (n=10, 20%) followed by septicaemia (n=9, 18%), followed by air leak syndrome (n=4, 8%). In a study by Wiswell TE *et al*, [21], it was found that 11.53% babies develop pneumothorax. In National Neonatal Perinatal Database of India 2002-2003, perinatal asphyxia was single most common cause of death (40.5%) in babies born through MSAF with overall mortality of 11.6%. In present study 34 (68%) cases were treated conservatively whereas 16 (32%) cases needed ventilator support. In a study by Wiswell TE *et al*, [21] they found that of the neonates with MAS, 29.7% required mechanical ventilation.

In present study, birth asphyxia was the main cause of death in 42.8% cases. Followed by ARF with pneumothorax in 21.4% of cases and then by ARF with septicemia with pulmonary hemorrhage and ARF with birth asphyxia with septicemia. Narang *et al*, [14], (1993) found that 53.8% cases of MAS had birth asphyxia and 15.8% had air leak and 3.8% had PPHN.

Conclusion

MAS carries a high mortality and morbidity. Highest mortality was associated with thick meconium when it was present below the vocal cords leading to non-vigorous baby and poor APGAR score at 1 minute. Nearly half the cases with MAS had moderate birth asphyxia. This indicates that passage of meconium can occur in utero, often considered a feature of stressed fetus and undoubtedly aspiration can occur before delivery. In such babies, resuscitation at birth may not be much beneficial and invariably leads to severe MAS. Severe the asphyxia, higher are the chances of thick meconium stained amniotic fluid and greater probability of MAS. Continuous intrapartum monitoring and early obstetric intervention, anticipation by the attending paediatrician in thick MSAF cases, followed by due neonatal resuscitation as per guidelines can reduce the morbidity, complications and the mortality.

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