ORIGINAL RESEARCH

Clinical profile, risk factors and short-term outcome of neonates born with meconium stained amniotic fluid- experience of a tertiary care center

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is the result of passage of meconium in utero by the fetus antenatally or during labor process. However, MSAF is considered an alarming sign of fetal compromise and its occurrence is associated with a poor perinatal outcome. There is growing evidence that indicates its association with increased incidences of meconium aspiration syndrome (MAS), operative delivery, respiratory distress, neonatal sepsis, need for resuscitation, neonatal intensive care admission, and low Apgar score. MAS remains a serious problem in developing and newly industrialized countries, and MAS accounts for about 10% of all cases of respiratory failure with 25-39% mortality rate. **Methods:** This hospital-based cohort study was conducted in NICU of Paediatrics department of our hospital over two years from July 2019 to June 2021 including live newborns of gestational age >35 weeks born with MSAF and with no congenital anomalies. Clinical profile, risk factors and immediate neonatal outcome of such neonates was studied. **Result:** Out of 984 live births, 159 neonates were found to be born with MSAF, taking the incidence to 16.1%. Out of these, 24 (15.1%) suffered from MAS. 11 (45.8%) had features of mild MAS, 5 (20.8%) had moderate MAS while 8 (33.33%) had severe MAS. Mean birth weight of neonates born with MSAF was 3.24 kg ± 0.39 Kg, range: 1.87-4.46 kg. Low APGAR score, non-reassuring CTG, requirement of resuscitation, requirement of endotracheal suction, requirement of oxygen support, incidence of MAS and mortality were significantly associated with thick as compared to thin meconium-stained liquor. Overall, 19 (11.84%) neonates with MSAF and 5 (20.8%) neonates with MAS couldn't survive. **Conclusion:** The presence of MSAF at delivery is an indicator of probable foetal compromise. MSAF is usually associated with several maternal and neonatal risk factors. Meconium aspiration syndrome is the most severe complication of MSAF that contributes significantly to neonatal morbidity and mortality.

Key words: Amniotic fluid, meconium stained, meconium aspiration syndrome, MSAF.

INTRODUCTION

The term meconium was coined by Aristotle in 350 BC that refers to faecal material that accumulates in foetal colon throughout gestation. This word is derived from the Greek word mekoni, meaning poppy juice or opium.[1]. Meconium is sterile, thick, black-green, odourless material first observed in the fetal intestine during 3rd month of gestation. Meconium results from the accumulation of debris, including desquamated cells from the intestine and skin, gastrointestinal mucin, lanugo hair, fatty material from vernix caseosa, amniotic fluid and intestinal secretions. When aspirated into lung, either in the fetus or newly born infant, meconium may stimulate the release of cytokines and other vasoactive substances that lead to cardiovascular and

inflammatory response. In the fetus, passage of meconium occurs physiologically early in gestation, when it contributes to alkaline phosphatase in amniotic fluid. Foetal defecation diminishes after 16 weeks and ceases by 20 weeks, concurrent with innervations of anal sphincter.[2] At that time, the rectum appears to be filled with meconium. From approximately 20 to 34 weeks, fetal passage of meconium becomes infrequent.[3] Most newborn infants who pass meconium are mature (term). Many are post-mature and the babies may exhibit peeling of skin, long fingernails and decreased vernix. The vernix, umbilical cord and nails may be meconium stained, depending upon how long the infant has been exposed in utero. In general, nails become stained after 6 hours and vernix after 12 to 14 hours of exposure.

Passage of meconium normally occurs within the first 24 to 48h after birth. However, passage of fetal meconium resulting in MSAF, occurs in 8–20% of all deliveries [4,5] increasing to 23–52% after 42 weeks of gestation.[6,7] Meconium aspiration may occur before birth, or during the birth process. About 2–9% of infants born through MSAF develop MAS. [8,9,10] About one third of infants with MAS require intubation and mechanical ventilation[11]. Death occurs in 4.9% to 37% (median 12%) of infants with MAS.[5] The risk of meconium-stained amniotic fluid is strongly correlated with gestational age. Meconium-stained fluid is rarely seen prior to 37 weeks gestation but may occur in more than 30% of pregnancies that continue past 42 weeks gestation. Meconium aspiration syndrome (MAS) is defined as respiratory distress in an infant born through meconium-stained amniotic fluid (MSAF) with characteristic radiological changes and whose symptoms cannot be otherwise explained.[4] Cleary and Wiswell[5] (1998) had proposed a severity criteria to define MAS: (a) mild MAS is a disease that requires less than 40% oxygen for less than 48 hours, (b) moderate MAS is a disease that requires more than 40% oxygen for more than 48 hours with no air leak, and (c) severe MAS is a disease that requires assisted ventilation for more than 48 hours and is often associated with PPHN. Traditionally the passage of meconium has been thought to be a sign foetal distress from hypoxia. The hypothesis is that in utero hypoxia results in diving reflex causing preferential shunt of blood to vital organs and ischemia to gut. The ischemia or mesenteric vasoconstriction results in transient period of hyperperistalsis and relaxation of anal sphincter due to vagal stimulation causing passage of meconium.[12] Vagal stimulation of a mature gastrointestinal tract either due to compression of foetal head of umbilical cord may cause passage of meconium. Aspiration of meconium into the lungs may occur from both in utero gasping and post-partum imbibition during the initial breaths of the neonate. Hypoxia could be the cause or effect or both of meconium aspiration, favouring the view that intrauterine asphyxia is the cause which later on perpetuates and contributes to further hypoxia.[13,14] Factors that promote the passage of meconium in utero include placental insufficiency, maternal hypertension, preeclampsia, oligohydramnios, and maternal drug abuse, especially of tobacco and cocaine. Factors associated with the development of MAS among infants with MSAF include thicker consistency of meconium, non-reassuring foetal heart tracing, foetal acidosis, caesarean delivery, meconium below the cords, infants who needed intubation at birth, and a low Apgar score.[11,15] MAS remains a serious problem in developing and newly industrialized countries, and MAS accounts for about 10% of all cases of respiratory failure with 39% mortality rate.[16]

Aim and Objectives

- To study the incidence of MSAF and MAS in neonates born at our hospital.
- To study clinical profile, risk factors and outcome of such children

MATERIALS AND METHODS

Study Duration: two years fromJuly 2019 to June 2021

Study Setting: Neonatal intensive care unit of department of Paediatrics at Nalanda Medical College and Hospital. Patna, Bihar, India.

Study Design: hospital-based cohort study.

Inclusion and exclusion criteria: All neonates born during the aforementioned period were assessed for presence of meconium in amniotic fluid and those with a history of MSAF were enrolled in the study after obtaining informed consent from the guardians. Children with major congenital malformations were excluded from the study as they were referred to higher centre and so a follow up was not possible.

Data Collection: All neonates born with meconium-stained amniotic fluid were subjected to detailed antenatal and natal history, thorough clinical examination and investigations as per our NICU protocol. Information so obtained was compiled in a structured proforma. Maternal data regarding age, parity antenatal care, presence of risk factors e.g., eclampsia, pregnancy induced hypertension etc. were noted. Babies with respiratory distress were admitted in NICU and managed as per unit protocol. In neonates born out of MSAF deliveries, consistency of meconium, presence of meconium above or below the vocal card and Apgar score at 1 and 5 minutes were also documented. Following definitions were used:

Meconium Aspiration: The baby was labelled to have meconium aspiration when, in meconium-stained delivery, meconium was visualized below the vocal cord or some meconium could be sucked out during tracheal suctioning.

Meconium Aspiration Syndrome (MAS): The neonate was labelled to have MAS in the presence of all of the following: 1. Meconium staining of amniotic fluid and/or nails/umbilical cord/skin. 2. Development

of respiratory distress soon after birth. 3. Radiological evidence of aspiration pneumonitis with areas of atelectasis and hyperinflation.

Severity criteria of MAS: Severity criteria proposed by Cleary G M & Wiswell TE[5] to define MAS was used: 1. Mild MAS is disease that requires less than 40% oxygen for less than 48 hrs. 2. Moderate MAS is disease that requires more than 40% oxygen for more than 48 hrs with no air leak, and 3. Severe MAS is a disease that requires assisted ventilation for more than 48 hrs and is often associated with persistent pulmonary hypertension.

Statistical Analysis: Information so collected was tabulated and entered in Microsoft excel sheet and further analysed by SPSS ver.20® software for Windows. Variables were expressed as mean, standard deviation, percentages, proportions or percentiles as appropriate. We used Pearson's chi-square test for categorical parameters and independent samples' t test for continuous parameters. P-value <0.05 was taken as significant.

RESULT

Over the 2-year study period we assessed 984 live newborns delivered in Nalanda Medical College and Hospital, Patna. A total of 159 neonates were found to be born with MSAF, taking the incidence to 16.1%. Out of these 159 babies, 24 (15.1%) suffered from MAS. Overall incidence of MAS among all delivered babies was 2.44%. Of these 11 (45.8%) had features of mild MAS, 5 (20.8%) had moderate MAS while 8 (33.33%) had severe MAS. Mean birth weight of neonates born with MSAF was 3.24 kg ± 0.39 Kg, range: 1.87-4.46 kg. LBW was seen in 19 (11.9%) of these neonates. 98 (61.6%) were born by assisted or unassisted vaginal delivery while 61 (38.4%) were born by cesarean section. Male: female ratio was 1.2: 1 for MSAF (87 males vs 72 females) and 1.4:1 for MAS (14 males vs 10 females). However, the sex predilection was not statistically significant. Table 1 depicts demographic factors of the mothers

Table 1: Maternal demographic factors

Demographic characteristics	**N=159**
Gestational age (Mean ± SD)	39.73 ± 1.74
Maternal Age (Mean ± SD)	26.31±3.56
Maternal age more than 30 years (number, percentage)	62; 39.1%
Booking status: Booked (number; percentage)	75; 47.2%
Booking status: Unbooked (number; percentage)	84; 52.8%
Primipara (number; percentage)	97; 61.0%
Pregnancy induced hypertension (number; percentage)	17; 10.7%
Gestational Diabetes or Diabetes mellitus (number; percentage)	23; 14.5%
Anemia in pregnancy (number; percentage)	94; 59.1%
PROM (number; percentage)	14; 8.8%
IUGR (number; percentage)	15; 9.4%
Cesarean delivery	61; 38.4%
Thin MSAF (number; percentage)	121; 76.1%
Thick MSAF (number; percentage)	38; 23.9%

Only 4 cases of MAS occurred in post-term babies. However, incidence of MAS was significantly higher (p=0.12 in newborns delivered beyond 37 weeks of gestation (Term + post-term). It was observed that newborn weighing less than 2.5 kg contributed to only 10.7(n=17) cases of MSAF and 12.5% (n=3) cases of MAS. Most cases of both MSAF (n=122; 76.7%) and MAS (n=18; 75%%) were observed among babies weighing between 2.5 kg and 3.5 kg. AGA babies contributed for 59.7% (n=95) cases of MSAF and 70.8% (n=17) cases of MAS. Incidence of MAS was significantly higher (p=0.028) in AGA+LGA group as compared to SGA neonates. Incidence of MAS was significantly higher in children having 1 min APGAR of less than 7 (p<0.001). Incidence of both MASF and MAS was higher in Primipara (61% MASF; 79.2% MAS). Table 2 depicts the important antenatal risk factors for MSAF and MAS.

Table 2: Antenatal risk factors

RISK FACTORS FOR MSAF (n=159)		
Parameter	**Number**	**Percentage**
Maternal anaemia	57	35.84%
PIH	25	15.72%
PROM	19	11.94%
Oligohydramnios	25	15.7%
Chorioamnionitis	11	6.91%
Eclampsia	15	9.43%

RISK FACTORS FOR MAS (n=24)		
Parameter	**Number**	**Percentage**
Maternal anaemia	7	29.17%
PIH	3	12.5%
PROM	2	8.33%
Oligohydramnios	8	33.33%
CHorioamnionotis	2	8.33%
Eclampsia	3	12.5%

We also studied the relationship between consistency of MSAF (thin vs thick) and neonatal outcome as shown below in table 3. Low APGAR score, non-reassuring CTG, requirement of resuscitation, requirement of endotracheal suction, requirement of oxygen support, incidence of MAS and mortality were significantly associated with thick meconium-stained liquor. Not surprisingly, neonates born with thin MSAF were more likely to be asymptomatic at birth.

Table 3: Immediate Neonatal outcome in relation to grade of consistency of meconium

Outcome parameter	**Thin MSAF (n=123)**	**Thick MSAF (n=36)**	***p*-value**
NICU admission not required	97 (78.86%)	20 (55.55%)	**0.002**
APGAR score <7 at 1 min of age	12 (9.76%)	13 (36.11%)	**<0.001**
LBW	10 (8.13%)	7 (19.44%)	0.07
IUGR	09 (7.31%)	6 (16.66%)	0.09
Non-Reassuring CTG	32 (26.01%)	19 (52.77%)	**0.002**
Required resuscitation at birth	14 (11.38%)	16 (44.44%)	**<0.001**
Required endotracheal suctioning	04 (3.25%)	8 (22.22%)	**<0.001**
Required oxygen support	18 (14.63%)	19 (52.77%)	**<0.001**
MAS	10 (8.13%)	14 (38.88%)	**<0.001**
Cesarean section	40 (32.52%)	21 (58.33%)	0.07
Death	11 (8.94%)	8 (21.2%)	**0.04**

Meconium staining of amniotic fluid is considered as an indirect indicator of fetal hypoxia. Prolonged fetal hypoxia leads to perinatal depression which becomes evident as low Apgar score. Table 4 depicts 1st and 5th minute Apgar scores in neonates born with MSAF and without MSAF. It denotes that neonates born with MSAF have significantly lower APGAR scores as compared to neonates born with a clear fluid and a possibly higher risk of requirement of resuscitation at birth in MSAF group. Morbidity and mortality in neonates born with MSAF was also studied as shown in table 5 below. All cases of MAS had tachypnea with or without chest retractions. Of these, 11(45.8%) improved with oxygen therapy alone, 5 (20.8%) required NCPAP support while 8 (33.33%) needed mechanical ventilator support. Unfortunately, 19 neonates with MSAF died, giving mortality of 11.84%. Mortality of MAS cases in our study was 20.8% with 33.3% needing mechanical ventilator support during their NICU stay.

Table 4: APGAR scores at 1 min and 5 minutes of age

Parameter studied	**MSAF group (n=152)**	**Non-MSAF group (n=825)**	**P value**
APGAR score at 1 minute of age (mean± SD)	5.91 ± 0.87	8.52 ± 0.45	<0.001
APGAR score at 5 minutes of age (mean± SD)	7.13 ± 0.94	8.82± 0.39	<0.001

Table 5: Morbidity and mortality in neonates born with MSAF

Parameter studied	**Value**
Oxygen requirement (number; percentage)	49 (30.81%)
Mechanical ventilator requirement (number; percentage)	16 (10.06%)
Duration of ventilator requirement (mean ± SD)	5.49 ± 2.36
Duration of hospital stay (mean ± SD)	7.91 ± 3.51
Perinatal asphyxia (number; percentage)	25 (15.72%)
Hypoxic ischemic encephalopathy (number; percentage)	14 (8.80%)
Early onset neonatal sepsis (number; percentage)	19 (11.94%)
Mortality (number; percentage)	19 (11.94%)

DISCUSSION

In the present study we intended to study the problems associated with birth of a neonate with MSAF at our tertiary care level teaching hospital. Even with improved perinatal care, thousands of neonates every year have to suffer from the consequences of having born with a MSAF.

In this study, meconium-stained amniotic fluid (MSAF) cases were 16.1% out of total deliveries in our institute during study period. 24(15.1%) of MSAF cases went on to develop Meconium Aspiration Syndrome (MAS), overall incidence of MAS being 2.44% of all live births. These findings were similar to that observed by various authors, who described incidence of MSAF varying between 9 to 22%.[17] MAS have been reported to occur in 8.4- 25% cases of MASF.[18,19] Incidence of MAS among MASF babies was found to be 10.5% in a study done by Narang et al.[20] with the reported incidence of MAS out of total deliveries being 0.6%. Wiswell TE reported that MAS develops in 1.7% to 35.8% of infants born through MSAF.[5] Difference in incidence of MASF progressing to MAS in different studies can be attributed to associated co-morbid factors and interventions performed. In the present study majority of MAS babies had gestational age <42 weeks of age (83.33%). This correlates with findings of Errkola et al2[1] who found 95% cases of MAS in babies with gestation age of more than 36 weeks. In another study, the incidence of MSAF 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] These observations can be explained by the fact that the gastrointestinal tract of the preterm baby is relatively immature than term and post term babies. We found maximum incidence (75%) of MAS among children weighing 2.5-3.5 kg. Various studies have previously similarly found higher incidence among children weighing 2.5-3.8 kg.[19,22] Fischer et al (2011) found mean birth weight in MSAF to be 3388 + 549 gms.[23] In neonates suffering from MAS, APGAR Score was >7 in 6.9%, between 3-6 in 49.7% and < 3 in 43.4%, which is comparable with Gregory et al[24] who found APGAR > 7 (4.5%), 4-7 (49%) and < 3 (36.5%). It shows an important relation between APGAR Score and MAS babies. In 1988 Falciglia et al[25] reported that 60% cases of MAS had Apgar score < 6 at 1 min and after resuscitation the number reduced to 3% at 5 min. Pushpa Bhatia et al (2007) observed that Apgar score in 1 min was < 3 in 51.7% of MAS and at 5 min < 5 in 32.5% of MAS.[26]. In our study 2 neonates with Apgar score > 6 at 1 minute developed MAS; leading to conclusion that MAS can develop even in babies with normal Apgar score. Asphyxia could be the cause or effect or both of meconium aspiration and current understanding of in-utero meconium aspiration favours the view that intrauterine asphyxia is the cause which later on perpetuates and contributes to further hypoxia. The present study revealed that incidence of MSAF was higher in primiparous mothers as compared to multipara. Various previous studies[27,28] have reported similar observations. The increase in incidence of meconium staining with advancing gestational age in present study was in agreement with findings of most other workers.[29,30] In this study, antenatal risk factors for MAS were Oligohydramnios, maternal anaemia, PIH, eclampsia, PROM and Chorioamnionitis which is comparable to the findings of previous researchers.[23,25,26,27,28] In the present study, 11 (45.8%) had features of mild MAS, 5 (20.8%) had moderate MAS while 8 (33.33%) had severe MAS The finding were consistent with those of Gupta et al who reported 50% cases of mild, 16.6% cases of moderate & 33.3% cases of severe MAS out of total 18 cases.[31] Unfortunately, 19 neonates with MSAF died, giving mortality of 11.84%. Mortality of MAS cases in our study was 20.8% with 33.33% needing mechanical ventilation during their NICU stay. Previous studies had stated need for mechanical ventilation ranging from 29.7 – 44% cases of MAS.[29,30,31,32]

CONCLUSION

The presence of MSAF at delivery is an indicator of probable foetal compromise. MSAF is usually associated with several maternal and neonatal risk factors like hypoxia, placental insufficiency, preeclampsia, maternal hypertension, post-term pregnancy, Oligohydramnios. Meconium Aspiration Syndrome is one of the common clinical conditions observed during neonatal period and is one of the important causes of respiratory distress in newborns, contributing significantly to the neonatal morbidity and mortality.

Limitation

First limitation is that the present study was a single centre study. Second limitation is the relatively small sample size. Third limitation is that we didn't study the contribution of individual factors which were associated with MSAF and could have confounded our results. Fourth limitation is that a long term follow up was not done.

Conflict of interest: None to declare

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