Original Article

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Neonatal Outcomes in Meconium Stained Amniotic Fluid Delivery: A Rural Perspective

Paediatrics Section

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ABSTRACT

Introduction: Presence of meconium in amniotic fluid is a potentially serious sign of foetal compromise and has demonstrated that the incidence of MSAF rises with gestational age. The incidences of admission to Neonatal Intensive Care Unit (NICU) with various neonatal disorders were higher in pregnancies complicated by MSAF.

Aim: To study clinical profile and outcomes in neonates born through MSAF at tertiary care hospital in rural area of Andhra Pradesh.

Materials and Methods: This cross-sectional, descriptive study included a total of 4462 infants who were admitted in the NICU of Nimra Institute of Medical Sciences and Hospital, Andhra Pradesh from December 2017 to January 2020. All pre-term, term and post-term infants, delivered normally or by caesarean section or instrumental delivery, with MSAF, were included in the study. A detailed ante-natal, natal and postnatal history was taken for the neonates to detect the aetiology of MSAF, type and duration of delivery and any complications Post delivery. All the clinical assessment and lab investigations, X-ray assessments were done for the subjects as and when required. The observations were noted along with the treatment given.

Results: Out of 4462 infants admitted in study period, 436 (9.78%) had MSAF and 96 (22.01%) developed Meconium Aspiration Syndrome (MAS). MSAF infants born by Normal Vaginal Delivery (NVD) formed 220 (50.46%), Lower Segment Caesarean Section (LSCS) 176 (40.37%) and 40 (9.17%) instrumental delivery. MAS infants born by LSCS formed 38 (21.59%), NVD 52 (23.63%) and instrumental delivery 6 (15%). The mean gestational age was 38-40 weeks. MAS developed in 18 (50%) infants with gestational age >42 weeks, 12 (12%) between 40-42 weeks and 50 (23.36%) between 38-40 weeks (significant relationship, p-value 0.012). The mean birth weight was 2.599±441 kg. MAS developed more in infants of birth weight 2-2.499 kg and least were of birth weight between 1.5-1.999 kg. Male to female ratio was 1.27:1. Thick MSAF was seen in 160 (36.69%) and thin MSAF in 276 (63.31%) infants (p-value 0.001). In MAS infants, 82 had thick and 14 thin MSAF. Among MSAF alone infants (n=340), 142 (41.75%) were associated with birth asphyxia. Among MAS infants, incidence of birth asphyxia was 66 (68.75%). Thirty eight MAS infants developed complications. Pneumothorax was the most common complication. Overall, mortality was 160 (36.69%). MAS contributed to 22.5% of these deaths. A 60 (62.5%) MAS infants were discharged and 36 (37.5%) died.

Conclusion: MAS was most consistently associated with thick MSAF. Preventive measures like timely evaluation of high risk factors, preparedness for untoward intrapartum events and close monitoring of MSAF infants can be taken to minimise the mortality and morbidity rates, because it is a global problem especially in under-developed countries.

Keywords: Birth asphyxia, Gestational age, Meconium aspiration syndrome

INTRODUCTION

The incidence of meconium stained amniotic fluid (MSAF) rises with gestational age reaching as high as 30% in post term pregnancies. In-utero, meconium passage rarely occurs before 32 weeks of gestation and most infants with MSAF are associated with an increased perinatal mortality and morbidities. The overall frequency of MSAF varies from 5% to 25%.

MAS which is the most common cause of neonatal respiratory distress and even perinatal death is frequently seen in post-term pregancy or growth restricted foetuses, is caused by aspiration of meconium during intra-uterine life [1]. The MAS is defined as respiratory distress in an infant born through MSAF whose symptoms cannot be otherwise explained [2]. MAS was classified as mild, moderate and severe [3]. MAS is defined by the criteria of Presence of meconium below the vocal cords, clinical respiratory distress in the first 24 hours of life and abnormal chest X-ray consistent with aspiration pneumonitis [4].

MAS occur in 10% of infants born through MSAF [5]. The incidence of admission to NICU with respiratory distress syndrome, birth asphyxia, chorioamnionitis, foetal distress or foetal acidosis was higher in pregnancies complicated by MSAF. The rates of severe mental retardation and cerebral palsy are significantly greater among infants born with MSAF [6,7]. Maternal factors which may result, in-utero passage of meconium include placental insufficiency, maternal hypertension, maternal infections, pre-eclampsia, oligohydromnios, intra-uterine growth restriction, maternal drug abuse (tobacco or cocaine) and increased maternal age [2].

The exact aetiology of MSAF remains unclear. In-utero, meconium passage rarely occurs before 32 weeks of gestation and most infants with MSAF are 37 weeks or older [8]. Prolonged labour has also been considered as a risk factor for the passage of meconium, as proved by study by Saunder K who showed the same in result and observation [9]. Prolonged rupture of membranes also showed to be a risk factor. The predictive value of meconium by its thick, dark and tenacious consistency, was better when it occured in high risk patients. Lightly stained meconium was found to have a poor correlation with foetal hypoxia while the moderate and thick meconium growth was found to have signicant greater risk of an abnormal Foetal Heart Rate tracing, a one and five minute APGAR scores less than seven, a cord PH less than 7.2, sepsis, need for oxygen requirement and level three NICU admission for infants [10].

Avoiding post-term pregnancies and to improve intrapartum monitoring, are few beneficial steps in reducing the incidences of foetal complications. Apart from these, appropriate use of positive

end expiratory pressure, surfactant therapy, high frequency ventilation and inhaled nitric-oxide are the recent advances that have led to reduced incidence of adverse outcome and improved survival of infants with MAS [11]. The perinatal morbidity and mortality related to MSAF can be decreased if major risk factors are recognised early and by closely monitoring of the labour and careful decisions that are made about the timing and mode of delivery [12].

The prevention strategies in the study area couldn't be designed due to the fact of paucity of evidence on the magnitude and other factors of MSAF. Therefore, this study was aimed to determine the portion of various morbidities and mortality in infant born through MSAF.

MATERIALS AND METHODS

The present study is a cross-sectional descriptive study performed in NICU of Nimra Institute of Medical Sciences and Hospital, Jupudi, Vijayawada, Krishna, Andhra Pradesh, from December 2017 to January 2020 were included in the study after obtaining approval from the Institutional Ethics Committee.

Inclusion criteria: All neonates born with MSAF as well as those admitted in NICU with respiratory distress with history of MSAF during the study period were included in the study after obtaining informed consent from their parents.

Exclusion criteria: Neonates with respiratory distress secondary to any Cardiovascular System (CVS) aetiology, congenital malformations and life threatening congenital anomalies or those born to Veneral Disease Research Lab (VDRL), Hepatitis B surface Antigen (HBsAg) and Human Immunodeficiency Virus (HIV) positive mothers, neonates of multiple gestations or that extremely premature and extremely low birth weight were excluded from this study.

If the history of MSAF was not available, cord or nail staining of meconium was taken into consideration and hence, a total of 4462 infants admitted in the NICU during the study period. A detailed antenatal, natal and significant post-natal history was elicited from mothers to find out the aetiology of passage of meconium into the amniotic fluid, the type of delivery and indications for any interventions or drugs used for delivery etc., for all the enrolled subject of the study. During delivery, the type of delivery and any complication in the mother were recorded. Any resuscitative measures whenever required were performed as per 2015 American Heart Association Guidelines for Neonatal resuscitation [13]. Resuscitation details were noted. In all MSAF infants; the gestational age assessment was done with New Ballard's score [14] and the detailed clinical assessment was done. In all cases, investigations like complete blood counts (Haemoglobin, Total and differential leucocyte count, platelets, PCV and peripheral smear) were done. Septic work-up with Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP) test and blood culture was done when indicated. Radiological assessment was undertaken with X-rays. Transient metabolic disturbances with blood glucose, serum calcium, electrolytes and arterial blood gases were estimated and interpreted whenever required. The 2D-Echocardiography was performed in suspected cases of persistent pulmonary hypertension of newborn.

MSAF infants were monitored for respiratory distress during hospital stay by using Downe's scoring system [15] in term infants and Silverman Anderson scoring in pre-term [16]. The Oxygen saturation in the blood was monitored by pulse oximeter. The assessment of Hypoxic Ischemic Encephalopathy (HIE) was done by Sarnat and Sarnat clinical staging [17].

STATISTICAL ANALYSIS

Data entry was done in Microsoft Excel and analysis was done using descriptive statistics, Statistical Software (Epi Info 7) was used for calculation of frequencies, percentage and mean and calculation of standard deviation was done. Chi-square test was conducted to calculate p-value. $p<0.05$ is considered as statistically significant.

RESULTS

Out of 4462 infants, admitted during the period of the study, 436 (9.78%) infants had MSAF. Out of which, 96 cases were diagnosed to have MAS with an incidence of 22.07%. Infants admitted with MSAF, born by NVD formed the highest percentage (n=220, 50.46%) followed by LSCS (n=176, 40.37%) followed by instrumental delivery (n=40, 9.17%) [Table/Fig-1].

Mode of delivery	MSAF (%)	MAS (%)
LSCS	176 (40.37)	38 (21.59)
NVD	220 (50.46)	52 (23.63)
Instrumental	40 (9.17)	6 (15)
Total	436 (100)	96 (22.02)

[Table/Fig-1]: Relation of Mode of Delivery with MSAF and MAS.
Chi-square test (p-value >0.05).

In this study, MAS developed in 38 (21.59%) out of 176 infants born by LSCS. 52 (23.63%) developed MAS out of 220 infants born by NVD. Out of 40 infants born by instrumental delivery, 6 (15%) developed MAS. In this study, p-value was 0.4719 ($p>0.05$) which was statistically not significant [Table/Fig-1].

In the present study, mean gestational age was found to be 38-40 weeks. In this study, MAS developed in 18 (50%) infants with gestational age >42 weeks. 12 (12%) infants developed MAS with gestational age between 40-42 weeks out of total 100 infants. Out of 214 infants with gestational age between 38-40 weeks, 50 (23.36%) developed MAS [Table/Fig-2].

Gestational age (weeks)	MSAF cases (%)	MAS (%)
34-36	26 (5.96)	2 (7.69)
36-38	60 (13.76)	14 (23.33)
38-40	214 (49.08)	50 (23.36)
40-42	100 (22.94)	12 (12)
>42	36 (8.26)	18 (50)
Total	436 (100)	96 (22.02)

[Table/Fig-2]: Relation of Gestational Age with MSAF and MAS.
Chi-square test (p-value >0.05)

The mean birth weight was 2.599±441 kg. MAS developed more in infants with birth weight 2-2.499 kg, 42 (25.60%) infants developed MAS. Least cases of MAS were in infants with birth weight 1.5-1.999 kg [Table/Fig-3].

Birth weight (kgs)	MSAF cases (%)	MAS (%)
1.5-1.999	12 (2.75)	2 (16.66)
2-2.499	164 (37.62)	42 (25.60)
2.5-2.999	174 (39.9)	36 (20.68)
3-3.4	60 (13.76)	10 (20)
>3.5	26 (5.97)	6 (23.07)
Total	436 (100)	96 (22.02)

[Table/Fig-3]: Relation of Birth Weight with MSAF and MAS .
Chi-square test (p-value >0.05)

Thick MSAF was found in 160 infants (36.69%) and thin MSAF was found in 276 infants (63.31%) [Table/Fig-4]. Out of 96 infants which developed MAS, the incidence of MAS in infants born out of thick MSAF was 82 (51.25%) and those born out of thin MSAF was 14 (5.07%) [Table/Fig-4]. This was statistically highly significant with p-value of 0.0001 ($p<0.05$).

All infants were assessed for respiratory distress. At the time of admission, 362 infants had APGAR of score 0 and 62 infants had score between 4-6. Only 12 infants had score >6 at admission. Out

Consistency of Meconium	MSAF cases (%)	MAS (%)
Thin	276 (63.31)	14 (5.07)
Thick	160 (36.69)	82 (51.25)
TOTAL	436 (100)	96 (100)

[Table/Fig-4]: Relation of Consistency of Meconium with MSAF and MAS.
Chi-square test (p-value >0.05)

of the 362 infants who did not have distress at the time of admission, 22 infants developed distress later. The proportion of infants born out of MSAF alone (n=340), 142 (41.75%) were associated with birth asphyxia, 54 (15.8%) had sepsis, 50 (14.7%) had documented hypoglycaemia, 62 (18.23%) had hypocalcaemia, 44 (12.94%) had Peripheral Circulatory Failure (PCF) [Table/Fig-5].

Comorbidity	MSAF alone (%)	MAS
Birth asphyxia	142 (41.76)	66 (68.75)
Sepsis	54 (15.88)	36 (37.5)
Hypoglycemia	50 (14.70)	24 (25)
Hypocalcemia	62 (18.23)	20 (20.83)
PCF	44 (12.94)	30 (31.25)

[Table/Fig-5]: Distribution of Comorbidities in MSAF Alone and MAS.
Chi-square test (p-value >0.05)

In the present study, 96 infants developed MAS and among them the incidence of birth asphyxia was 66 (68.75%), sepsis 36 (37.5%), hypoglycaemia 24 (25%), hypocalcaemia 20 (20.83%), PCF 30 (31.25%) [Table/Fig-5]. In the present study, out of 96 infants who developed MAS, 38 infants developed complications. Pneumothorax was seen to be the most common complication 16 (16.6%), followed by acute renal failure 12 (12.5%) and pulmonary haemorrhage 10 (10.41%) [Table/Fig-6].

Complication	Cases	Percentage
Pneumothorax	16	16.6
Pulmonary hemorrhage	10	10.41
Acute renal failure	12	12.5

[Table/Fig-6]: Distribution of Complications among MAS.
Chi-square test (p-value >0.05)

In this study, out of 96 infants who developed MAS, 46 (47.92%) were treated conservatively and 50 (52.08%) were ventilated. In this study, overall mortality was 160 (36.69%). MAS contributed to 22.5% of these deaths. Out of 96 infants who developed MAS, 60 (62.5%) were discharged and 36 (37.5%) infants died. Birth asphyxia was the most common comorbidity contributing to death.

DISCUSSION

The present study correlates the clinical factors-mode of delivery, gestational age, birth weight, consistency of meconium, histories of comorbidities with the incidence of MSAF and MAS and associated complications in various subjects. In a study by Rao B et al., 16.1% of infants out of those with MSAF, were found to be suffering from MAS [18]. In a study done at Banaras Hindu University, Varanasi, incidence of MSAF was 14.3% [19], as compared to the incidence of 22.07% in the present study. The incidence in this study correlates with other studies. Narang A et al., found that 10.55% was the incidence of MAS in their study [20]. Overall incidence of MAS was 21.51 per thousand live births. Narang A et al., found 54.2% infants were born by LSCS and 30.7% were delivered by NVD and 11.8% by instrumental delivery [20]. In this study, it is observed that the incidence of infants born out of MSAF was higher in NVD in view of increased number of referrals from the peripheral hospitals. In this study, MAS developed in 38 (21.59%) out of 176 infants born by LSCS. 52 (23.63%) developed MAS out of 220 infants born by NVD. Out of 40 infants born by instrumental delivery, 6 (15%) developed MAS. In this study, p-value was 0.4719 (p>0.05) which was statistically not significant. A cross- sectional study at one hospital in Jordan, it was found that LSCS was significantly higher in infants who developed MAS than in who did not (57.9% vs. 24.3%) [21]. Erkkola R et al., found that 95% of the infants were >36 weeks of gestation in their study [22]. In the present study, mean gestational age was found to be 38-40 weeks. In a study by Eiden RD et al., they observed the frequency of MSAF to increase with increase in gestational age of the foetus [23]. The past study by Suresh GK et al., related the mean gestational age of the infants with the consistency of MSAF, just as in the present study [24]. The rate of MSAF increases with advanced gestational age as per observation in the previous study by Blacin I et al., [25]. In this study, MAS developed in half of infants with gestational age >42 weeks. 12% infants developed MAS with gestational age between 40-42 weeks out of total 100 infants while out of 214 infants with gestational age between 38-40 weeks, 50 (23.36%) developed MAS. These values were statistically significant. In National Neonatal Perinatal Database of India 2002-2003, the mean birth weight of babies born through MSAF was 2.646±0.552 kg comparable to the mean birth weight of 2.599±441 kgs in the present study. The results seen in this study correlates with other studies [18,24,26]. MAS developed more in infants with birth weight 2-2.499 kgs. Least cases of MAS were in infants with birth weight 1.5-1.999 kgs, hence birth weight found no statistically significant correlation with the incidence of MAS, in the present study. The male to female ratio in present study was 1.27:1. In a study by Firdau U et al., the male to female ratio was close to 1:1 [27].

In a study conducted by Tayade S, results stated, incidence of thick MSAF was 36.66% and thin MSAF was 63.34% [28]. Incidence in this study correlates with other studies. In a study conducted by Supriya K et al., results stated, MAS was significantly higher in the thick MSAF group compared to the thin MSAF i.e., 90% with thick and 10% with thin [29]. Thus consistency of meconium is an important factor in the development of MAS. Bhat RY et al., found thick MSAF as the only significant factor contributing to MAS [30]. In the present study, out of 96 infants which developed MAS, 82 infants were contributed by thick MSAF and 14 infants were contributed by thin MSAF. This correlates with the above studies this was statistically highly significant with p-value of 0.0001. In a study conducted by Firdaus U et al, the incidence of birth asphyxia was 8.5%, sepsis 14%, hypoglycaemia 11%, hypocalcaemia 18%, PCF 7% [27].

Narang A et al., found that 53.8% infants of MAS had birth asphyxia [20]. In the same study conducted by Firdaus U et al., the incidence of co morbidities in infants with MAS were, birth asphyxia in 61%, sepsis in 35%, hypoglycaemia in 48%, hypocalcaemia in 16%, PCF in 68% [27]. The present study correlates with the these studies. In a study by Wiswell TE et al., it was found that 11.53% infants developed pneumothorax [31]. Narang A et al., found that 15.8% had air leaks [20]. In a study conducted by Firdaus U et al., 16% had pulmonary haemorrhage [27]. This study correlates with the mentioned previous studies.

29.7% of the total infants with MAS, required mechanical ventilation, as was evident in the previous study by Wiswell TE et al., [31]. In a study by Rossi EM et al., out of 48 infants of MAS, who were delivered through thick meconium, 44% infants required mechanical ventilation [32]. Wiswell TE et al., found acute respiratory failure and air leaks, as the main causes of death of majority of infants [31].

Limitation(s)

Out born infants could not be considered in the study as proper antenatal work-up was not available and follow-up of infants after discharge could not be done.

CONCLUSION(S)

Thick MSAF help to anticipate the need for neonatal resuscitation irrespective of gestational age. The incidence of MSAF in preterm infant is uncommon (7.69%). Some infant may not develop respiratory distress at birth but developed later hence the close respiratory distress monitoring is needed for the all infants born through MSAF. MAS were most consistently associated with thick meconium. Higher incidence of birth asphyxia was associated with MSAF, hence it should be always be suspected in evaluating and managing the MSAF infant. The mortality related to the MAS is higher hence infant born through MSAF having complications should be shifted to NICU with advanced facilities for respiratory support. Timely evaluation of antenatal and intrapartum high risk factors associated with MSAF provides early prediction of untoward events in order to avoid birth asphyxia, MAS and its complications.

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