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MECONIUM STAINED AMNIOTIC FLUID AND MECONIUM ASPIRATION SYNDROME: A PROSPECTIVE STUDY.

Pediatrics

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ABSTRACT

Objectives: This study was to evaluate the incidence of meconium aspiration syndrome in babies born to mothers with meconium stained amniotic fluid and were to determine the risk factors leading to MSAF, the significance of blood levels of lactate in determining severity of MAS, determine immediate perinatal outcomes of babies with MSAF and MAS and to evaluated the mortality rate of babies that develop MAS.

Methodology: A total of 75 babies born of mothers with MSAF were enrolled in this study. Detail assessment was taken to all babies. Gestational age was calculated as per Modified Ballard score. Blood sample was taken for blood lactate levels estimation and x ray were done. Other routine investigations were performed throughout NICU stay.

Results: Data was analyzed by using IBM SPSS Statistics 24 model. Pearson chi-square test and Fisher exact tests were used to assess the association between attributes. Binary logistic regression analysis was used to assess the risk factors for MAS. P value was taken ≤ 0.05 for significant differences.

Conclusions: Incidence of MAS was 10.7% of MSAF babies. MSAF and MAS were more common in Babies of para 1 and para 2 mothers. Anaemia followed by pregnancy induced hypertension was common risk factors for MSAF and MAS. MAS was more common in male babies. Term babies and who were birth weight > 3000 grams were affected with MSAF and MAS. Majority of babies with MSAF had no asphyxia. Tachypnea and expiratory grunting were commonly seen in babies with MAS. Babies with MAS, the commonest radiological findings were observed on the right side alone (50%), followed by bilateral changes (37.5%). Majorities of babies with MAS had blood lactate levels 7.5-15mmol/l. Blood lactate levels in MSAF babies can predict the severity of MAS. Mortality rate of babies with MAS was 12.5%.

KEYWORDS

MSAF, MAS, Term baby, birth weight

INTRODUCTION

Reported incidence of MSAF is 10% in all pregnancies.[1] Although, the incidence has decreased a little in the last decade due to improved fetal monitoring and timely termination of pregnancy, the situation is more or less the same in remote areas with limited access to healthcare facilities.

About 5% of babies born with MSAF develop MAS and 50% of these babies require mechanical ventilation.[2] The proportion of neonates admitted to NICU is several folds higher among babies born through MSAF than in those born with clear amniotic fluid.[3,4] Furthermore, meconium stained infants are100-fold more likely to develop respiratory distress as compared to those born with clear amniotic fluid.[5,6] According to Neonatal Perinatal Database, MAS accounts for 1.4% of Neonatal ICU admissions and 22.5% of cases with respiratory distress.[1]

Majority of full term fetuses do not pass meconium until after delivery. This is because at the most distal end of gastrointestinal tract, meconium cap is present, which is particularly viscous. Also, peristaltic movements are absent and the anal sphincter tone is increased.[7]

Conditions producing fetal hypoxia and perinatal asphyxia are an important cause of fetal distress. Some commonly seen conditions that cause fetal hypoxia are Rh incompatibility, diabetic mother, acute or chronic hypertension, eclampsia, anaemia in pregnancy, chronic cardiac or pulmonary disease in mother, maternal drug abuse; placental causes such as abnormal placentation, placental abruption, umbilical cord prolapse, cord entanglement or compression, abnormalities of umbilical vessels, fetal hydrops, fetal anaemia and shock etc.[8] Among these, anaemia and PIH are the commonest risk factors.[9]

Perinatal factors such as breech presentation, obstructed labour, prolonged labour, PROM, hand prolapse also cause in-utero stress, thus leading to passage of meconium unless early intervention is taken. Breech presentation is a significant cause of MSAF in preterm babies.[1]

Other than Fetal hypoxia and perinatal asphyxia, sometimes presence of infections such as chorioamnionitis, urinary tract infections in mother also triggers passage of meconium into the amniotic fluid.

Besides maternal infections, fetal infection with listeriosis is also associated with MSAF due to fetal diarrhoea.[1,5]

In the presence of acute or chronic hypoxia, and/or infection, fetal diving reflex sets in. It shunts blood away from visceral circulation towards more vital organs i.e. the brain, heart and adrenal glands.This in turn produces intestinal ischemia, which produces a transient period of hyper-peristalsis and relaxation of the anal sphincter tone, thus facilitating passage of meconium into the amniotic fluid.[7]

On the basis of the amount of meconium passed into amniotic fluid and its appearance, MSAF can be categorised into three types: (i) when amniotic fluid is thinly stained with meconium, it is referred to as watery MSAF, (ii) when amniotic fluid is opaque but without any particles, it is called as moderately stained MSAF, (iii) when amniotic fluid contains thick meconium with particulate matter, it is called pea-soup type MSAF.[2] Thickly stained amniotic fluid with particulate matter (pea soup type) and yellow staining of skin, umbilical cord and nails are associated with greater risk of development of MAS.[5]

Aspiration of meconium stained amniotic fluid may occur in-utero, during parturition or after birth. In intrauterine life, in the the setting of acute or chronic hypoxia, gasping by the fetus leads to aspiration of this meconium stained amniotic fluid.[2,10]

Similarly, when a baby is born with MSAF, any meconium present in the nose or oral cavity can be aspirated into the lungs as soon as the baby starts to breath. This meconium, when aspirated, can obstruct the airways, causes impaired gaseous exchange and marked respiratory distress.[11] But not all MSAF babies develop MAS.

Meconium Aspiration Syndrome (MAS) is defined as development of respiratory distress, along with radiological evidence, in a neonate with MSAF, which cannot be otherwise explained and is associated with presence of meconium below the laryngeal cords, with no evidence of sepsis.[12,13]

It is one of the most common causes of respiratory distress in term and post-term newborns.[5]

MAS constitutes a wide spectrum of respiratory disease, ranging from mild respiratory distress to severe disease and death, despite mechanical ventilation. Severe MAS appears to be caused by pathologic intrauterine processes, primarily chronic hypoxia, acidosis and infection. [2] Also, incidence of severe MAS increases with increasing gestational age ranging from 0.1% at 37-38 weeks to 0.5% at 42 weeks of gestation.[7]

The pathophysiology of MAS is an extremely complex process due to interplay of a number of mechanisms like airway obstruction, chemical pneumonitis and surfactant inactivation. [1,5] Aspiration of meconium into the trachea causes acute mechanical obstruction of proximal and distal airways. Partial airway obstruction creates a ball-valve effect leading to air trapping and airleaks, resulting in increase of antero-posterior diameter of the chest, increased expiratory resistance and increase in functional residual capacity of lungs. Complete obstruction of distal airways leads to regional atelectasis and ventilation-perfusion (V/Q) mismatch. Both V/Q inequalities and airleaks lead to hypoxemia, hypercarbia and acidosis, thus producing clinical features of MAS.[1,7]

Besides direct mechanical obstruction, meconium also disrupts surfactant function ,which further aids in atelectasis, decreasing lung compliance and hypoxia. Surfactant inactivation occurs due to direct cytotoxic effect of meconium on type II pneumocytes as well as decrease in the level of surfactant proteins A and B.[2,5,14]

Additionally, meconium itself may be toxic to the pulmonary epithelial cells resulting in chemical pneumonitis. Aspirated meconium stimulates the production of pro-inflammatory mediators including cytokines and vasoactive substances such as phospholipase A_2, IL-8, platelet activating factor and TNF- α. The resultant chemical pneumonitis produces mechanical obstruction as well as direct hypoxia and acidosis due to parenchymal damage, mimicking an injury pattern similar to ARDS.[2,7]

About one-third infants with MAS develop PPHN. Conversely, two-thirds of infants with PPHN are associated with MAS.[2,15]

PPHN contributes to significant mortality due to MAS. When perinatal asphyxia is associated with MSAF and multi-organ dysfunction ensues due to hypoxia, then the outcome becomes worse and there is a higher chance of development of PPHN and severe MAS in these babies.[1]

Babies with MAS have typically two patterns of lung involvement. When the underlying pathology is predominant mechanical obstruction of airways, in such babies MAS typically presents as respiratory distress manifesting with tachypnea, prolonged expiratory phase, marked suprasternal and/or intercostal and/or subcostal retractions, grunting, cyanosis and hypoxemia soon after birth, in an infant heavily stained on the nails, skin and umbilical cord with meconium or born through thick meconium.[1] Infants with severe MAS often have a 'barrel shaped' chest due to increased anteroposterior diameter of the thorax secondary to obstructive emphysema. Occasionally, bilateral wet sounds and wheezing may be present. The course is progressive during initial 48-72 hours, after which condition starts to improve unless it is complicated by PPHN, which manifests as intractable hypoxemia and acidosis.[11]

Partial obstruction of small airways can lead to pneumomediastinum, pneumothorax or both, seen in approximately 25% of cases with severe MAS. Pleural effusions are also detected in about 30% of infants with MAS. [7] Pulmonary air leaks are 10 times more likely to develop in MSAF babies than those without meconium staining and often occur at the time of resuscitation.

When surfactant inactivation is the predominant pathogenic process, such cases babies have a RDS-like picture with signs of respiratory distress, but a normal shaped chest.[1]

Cases with less severity, particularly those with non-particulate meconium aspiration may present with a gradual onset pneumonitis and mildly increased work of breathing or peaceful tachypnea, which reaches a peak at 1 to 3 days of life and then resolves slowly over the first week.[7]

Tachypnea of MAS usually appears within first 6 hours and hence, babies born with MSAF are recommended to be kept under close observation for atleast 6 hours to look for appearance of respiratory distress. This tachypnea may persist for 2-3 weeks even after clinical improvement.[1,11]

Chest radiographs of babies MAS are heterogenous, with coarse patchy infiltrates, widespread consolidation and areas of hyper aeration, as evidenced by hypertransluscence of lungs, horizontal alignment of ribs and depressed domes of diaphragm(at or below 7th intercostal space). [2,7,11] These X-Ray changes are bilateral, non-uniform and asymmetric. Additional presence of pneumothorax, pleural effusion may also be seen. In babies with RDS like picture, typical 'white out' lung can be seen on chest x ray.[1]

Chest radiographs are abnormal in more than one-half of infants with meconium detected below vocal cords, although less than 50% cases with abnormal x ray findings have severe clinical disease. Radiographic resolution typically occurs slowly over 7-10 days. Also, the severity of chest radiographs does not correlate well with the severity of clinical picture.[7] A normal radiograph of chest in an infant with severe hypoxemia and no cardiac malformation suggests the diagnosis of pulmonary hypertension.[11]

MAS is classified into three types on the basis of severity of respiratory disease as follows:-
(i) Mild MAS is a disease that requires < 40% oxygen for < 48 hours; (ii) Moderate MAS is a disease requiring > 40% oxygen for > 48 hours, without air leak; (iii) Severe MAS is a disease requiring assisted ventilation for > 48 hours, often associated with PPHN.[2]

Diagnosis of MAS is essentially clinical- onset of respiratory distress at birth or within hours, in the setting of MSAF. Investigations like chest X-Ray, arterial blood gas analysis, blood lactate levels complete blood counts, C-Reactive protein aid in management of multi-organ involvement, in optimising respiratory care as well as in excluding other differential diagnoses.

Assessment of acid-base status is crucial as V/Q mismatch and perinatal stress are prevalent in MAS.[2] Arterial blood gas measurement helps to determine the cause of acidosis, which can be metabolic acidosis due to perinatal hypoxia itself or respiratory acidosis due to parenchymal disease and PPHN.

A complete blood count should be done to look for infection as a contributor to perinatal asphyxia. Serum electrolytes i.e. sodium, potassium and claim concentrations should be done after 24 hours of life as SIADH and acute renal failure are frequent complications of perinatal stress.[2]

Although respiratory distress in a neonate born with MSAF is a manifestation of MAS, but MSAF may also be an incidental finding in other conditions associated with respiratory distress in a newborn.

Some such conditions which should be excluded before diagnosing MAS are congenital pneumonia, TTN (Transient Tachypnea of newborn), asphyxial lung injury, congenital malformations like CDH etc.

Neonates with MAS usually have HIE as a comorbidity. In-utero passage of meconium is associated with an increased risk of perinatal morbidity and neonatal mortality, severe acidemia, need for caesarian section, need for intensive care and oxygenation , and poor neurological outcomes.

Despite advances in the understanding of pathophysiology of MAS and availability of newer therapeutic methods, babies having MAS-PPHN have a higher risk of mortality. Of course, the ultimate outcome in survivors depends upon the extent of CNS injury from asphyxia and other associated complications.[5]

As soon as fetal heart rate decelerations and/or poor beat to beat variability is detected, prompt termination of pregnancy should be done.[11]

In pregnancies which continue post date, termination should be done by induction or LSCS as early as 41 weeks of gestation, to prevent passage of meconium and development of MAS. The mode of delivery

does not appear to significantly impact the risk of aspiration of meconium.[2]

Amnioinfusion, which is infusion of isotonic saline into the amniotic sac was earlier thought to decrease cord compression, dilute the meconium and decrease its toxicity after aspiration. However, recent studies conclude that it does not decrease the risk of development of MAS, need for LSCS and, neonatal morbidity and mortality. [5,7] Hence, it is no longer recommended because of a higher risk: benefit ratio. **Objectives** of our study was to know the incidence of Meconium aspiration syndrome in babies born to mothers with meconium stained amniotic fluid, determine the risk factors leading to MSAF, evaluate the significance of blood levels of lactate in determining severity of MAS, determine immediate perinatal outcomes of babies with MSAF and MAS and mortality rate of babies that develop MAS.

MATERIALS AND METHODS

This study was conducted in the Department of Paediatrics - neonatology unit, in association with the Departments of Obstetrics and Radio-diagnosis, during a period from December 2015 to June 2017. The attendants of entire subject sign an inform consent approved by institutional ethical committee of Katihar Medical College, Katihar, Bihar, India was sought.

Study Design: Prospective cohort study.
Sample Size: A total of 88 neonates born to mothers with MSAF were included in the study, out of which 13 dropped out due to LAMA's, thus leaving the sample size to a total of 75 neonates.

Inclusion Criteria: All inborn neonates born to mothers with meconium stained amniotic fluid.
and/or Outborn neonates brought to Katihar Medical College within one hour of birth, with history of MSAF and/or Meconium staining of nails,umbilicus and skin.

Case Exclusion Criteria:
1. Neonates with Respiratory distress syndrome (RDS).
2. Neonates with Transient tachypnoea of newborn (TTN).
3. Neonates with Congenital Pneumonia or sepsis.
4. Neonates with any gross congenital malformation.
5. Neonates with MSAF presenting after one hour of postnatal life.

All cases were assessed for presence of antenatal risk factors, mode of delivery, period of gestation, parity of mother, type of presentation, complications during labour,thickness of meconium and resuscitation details resuscitation at birth. Birth weight along with baby details were also noted. Gestational age was calculated as per Modified Ballard score and babies classified into preterm (<37 weeks), term(37- $41^{6}/_{7}$ weeks) and post term(at or > 42 weeks).

Following admission into the NICU, a complete examination of the babies was done and daily vitals monitoring along with evidence of seizures, need for mechanical ventilation and evidence of MAS/ air leak syndromes/ PPHN/ HIE were kept into account.

Immediately after admission, a blood sample was taken for blood lactate levels estimation. Also, other routine investigations done throughout NICU stay and a chest x ray were done.

The selected cases were monitored and evaluated until discharge from the NICU or till they succumbed to the disease. All data was collected on pre printed case proformas (Annexure I) throughout the course of disease.

Respiratory distress was defined by presence of any two or more of the following: (i) Respiratory rate > 60 per minute; (ii) Chest retractions; (iii) Grunting.

Chest X-ray findings suggestive of MAS include bilateral coarse infiltrates, widespread consolidation and areas of hyper-aeration.

STATISTICAL ANALYSIS

Data was analyzed by using IBM SPSS Statistics 24 model. Pearson chi-square test and Fisher exact tests were used to assess the association between attributes. Binary logistic regression analysis was used to assess the risk factors for MAS.

OBSERVATIONS

In this study, out of 75 babies born of mothers with MSAF, Among them 8(10.7%) babies were developed MSAF.

Table.1. Correlation between MSAF, MAS and Parity of Mother

PARITY	NON-MAS MSAF	MAS	TOTAL
First child	30	3	33
Second	19	2	21
Third	6	1	7
Fourth	8	2	10
Fifth	2	0	2
Sixth	2	0	2
TOTAL	67	8	75

When Correlation between MSAF, MAS and Parity of Mother was done, we were got p Value 0.911, which is greater than 0.05.This was suggested that there was no significant association between parity of mother and MSAF or MAS in this study.

Table.2. Sex of the baby, MSAF and MAS

SEX	NON-MAS MSAF	MAS	TOTAL
Female	27	2	29
Male	40	6	46
Total	67	8	75

When sex of babies were compared, then we found p value 0.473, which is greater than 0.05. There was no association between sex of the baby and MSAF or MAS.

Odds ratio (2.025, with 95% confidence interval 0.38 to 10.79) between sex of the baby and MSAF and MAS indicates that in comparison to females, male neonates have two times more chances of having MSAF.

Table.3. Antenatal complications, MSAF and MAS

Antenatal Complication	Non-mas Msaf	Mas	Total
Anemia	29	5	34
Pre-eclampsia	1	0	1
PIH	18	2	20
UTI	15	1	16
Others (Jaundice, APH)	3	0	3
Eclampsia	1	0	1
TOTAL	67	8	75

When comparison of antenatal complication were performed between MSAF and MAS. We were found Pearson Chi-square test= 1.516, p Value= 0.911 (p value > 0.05).

This means that association between antenatal complications and MSAF or MAS was not significant.

In our study, 25 babies were delivered vaginally, among them 3 babies were developed MAS. And 50 babies were delivered by caesarean section, among them 5 babies were developed MAS. When association was performed between mode of deliveries, we were got Pearson Chi-square test= 0.177, p value= 0.915 (p value > 0.05). There was no association between mode of delivery and MSA or MAS.

Table.4. Association of Asphyxia with MSAF and MAS

PERINATAL ASPHYXIA	NON-MAS MSAF	MAS	TOTAL
No asphyxia	47	3	50
Mild	14	1	15
Moderate	2	1	3
Severe	4	3	7
TOTAL	67	8	75

When comparison was done between asphyxia with MSAF and MAS. We were found that Pearson Chi-square test= 10.624, p value=0.014 (p value < 0.05). This was shown a significant association between MSAF or MAS and Perinatal asphyxia.

Table.5. Period of gestation, MSAF and MAS

PERIOD OF GESTATION	NON-MAS MSAF	MAS	TOTAL
<37 Weeks	10	1	11
37-416/7 weeks	56	5	61
> 42 weeks	1	2	3
TOTAL	67	8	75

When compared the period of gestation, we were found Pearson Chi square test = 10.292, p Value= 0.006, which is less than 0.05 i.e. term babies had higher chances of having MAS and MSAF.

Table.6. Birth weight of baby, MSAF and MAS

BIRTH WEIGHT	NON-MAS MSAF	MAS	TOTAL
<1500 grams	0	0	0
1500-1999 grams	6	1	7
2000-2499 grams	14	3	17
2500-2999 grams	23	1	24
>3000 grams	24	3	27
TOTAL	67	8	75

In this study, we were seen that majority of cases who developed MSAF had birth weight greater than 3000 grams.

Table.7. Respiratory rate, MSAF and MAS

RESPIRATORY RATE	NON-MAS MSAF	MAS	TOTAL
Upto 60 per min	63	2	65
> 60 per min	4	6	10
TOTAL	67	8	75

When respiratory rate of babies with MSAF and MAS were compared, we found that the p value= 0.0001, which is less than 0.05. This shows significant association of respiratory rate with MSAF or MAS.

Odds ratio (47.250, with 95% confidence interval 7.12 to 313.61) between respiratory rate and MSAF and MAS indicates that newborns delivered with MSAF having respiratory rate equal to or more than 60 per minute have about 47 times more chance of having MAS compared to those with respiratory rate less than 60.

Tachypnea due to MAS was differentiated from that of HIE by doing ABG analysis of every baby (Babies with MAS have significant acidosis, while those with HIE have respiratory alkalosis).

In this study, expiratory grunting was present in 7 (87.5%) out of 8 babies who were developed MAS.

Table.8. Radiological changes in MAS

RADIOLOGICAL CHANGES	NUMBER	%
Bilateral	3	37.5
Right lobe	4	50
Left lobe	1	12.5
TOTAL	8	100

Out of 8 babies with MAS, 50% of the babies (4) had radiological changes in the right hemithorax, followed by bilateral changes seen in 3 babies (37.5%) and only 1 (12.5%) baby showing changes in left sided lung.

In present study, Out of total 8 babies of MAS, Ventilatory support was required in 3 babies (37.5%).

Table.9. Blood Lactate levels, MSAF and MAS

LACTATE LEVEL	NON- MAS MSAF	MAS	TOTAL
<7.5 mmol/l	47	0	47
7.5-15 mmol/l	19	5	24
>15 mmol/l	1	3	4
TOTAL	67	8	75

When level of blood lactate were compared, we were found Pearson Chi square test value= -0.648 and -0.643 between blood lactate levels and APGAR scores at 1 and 5 minutes, respectively. p Value= 0.000, which is less than 0.05. We were Suggested that there was significant reciprocal correlation between blood lactate levels and APGAR scores.

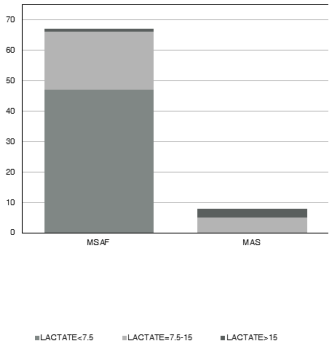


Figure.1. Blood Lactate levels, MSAF and MAS.

Table.10. Mortality in MAS

MORTALITY	NUMBER	%
Death	1	12.5
Survival	7	87.5
TOTAL	8	100

Out of 8 babies who were developed MAS, 1 baby was died. Thus, the mortality rate in present study was 12.5%.

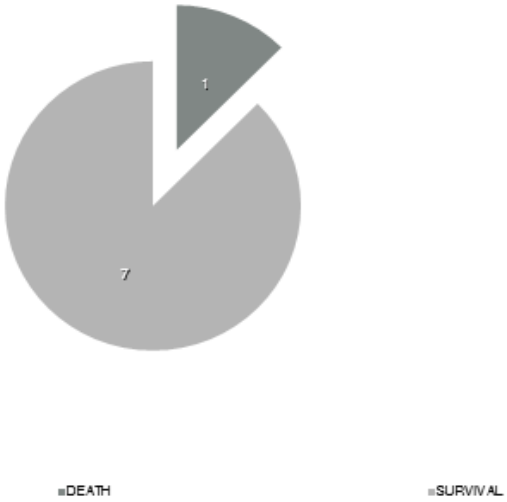


Figure.2. Mortality in MAS

DISCUSSION

The study was designed to know the incidence of MAS in MSAF, risk factors associated with MSAF and development of MAS, immediate perinatal outcomes associated with MSAF and MAS, significance of blood lactate levels with development of MAS and mortality rate of babies who develop MAS. During the study, which was carried out over a period of 18 months, 75 babies were born to mothers having MSAF, which were included in this study. Out of these, 8 babies (10.7%) developed MAS.

Thus, in the present study the incidence of MAS in MSAF babies was 10.7%. Similar was the incidence reported by Narang et al, who found an incidence of MSAF in 7.48% of all deliveries and among these 10.5% developed MAS, which is similar to that reported in the present study.[16] Rossi et al found MAS in 8.6% of infants delivered through MSAF. [17] He further compared the incidence of MAS in thick and thin MSAF and reported an incidence of 19% in thick meconium as compared to 4.6% and 2.9% in moderate and thin MSAF respectively. Davis et al observed MSAF in 15.3% of total live births out of which MAS was found in 2.1% cases.[18] Pendse et al concluded in his study that meconium in amniotic fluid occurs 10-50 times more frequently than MAS.[19] They observed an incidence of MAS in 1.3% of cases, though meconium was present in 91% cases. Gupta et al found the incidence of MAS in 6.4% of thick MSAF while none of the babies developed MAS with thin MSAF. [20] Sedaghetian et al found an incidence of MSAF in 19% cases and the prevalence of MAS was5% in thick and none in thin MSAF cases. Bhide et al found an incidence of MAS in 22.9% of total MSAF deliveries.[21] Blackwell et al found an incidence of MSAF in 21% of the total deliveries and MAS developed in 10.6% of the total and 2.9% of MSAF babies. [22] Fischer et al (2012) reported an incidence of MAS to be 0.18%, whereas, Keziah et al (2017) reported an incidence of 6.7%.[23,26]

Majority of babies were born to mothers who were primigravida i.e. 44.7%, while with parity 2 and parity 3, the incidence of MSAF was 28% and 9.3% respectively. The percentage of cases with parity >3 were 17.3%, but the association between parity of mother and occurrence of MSAF and MAS is not statistically significant. Miller et al also assessed the association between parity and MSAF and found no statistical significance (p value> 0.05). [25] Out of 8 cases of MAS, 50%, 25% and 12.5% were associated with parity 1,2 and 3 respectively, while 12.5% was the incidence with parity > 3. The difference in the incidence of MAS in babies born to para 1, para 2 and para3 mothers was not significant (p>0.05).Fischer et al (2012) reported that 59.5% cases of severe MAS were seen in nulliparous mothers, but the study too failed to label nulliparity as a risk factor for occurrence of MSAF and MAS.[23]

In the present study, 59.7% babies were males and 41.3% were females. 75% of the babies who developed MAS were males and 25% were females. Statistically, no significant association was seen (p value= 0.473) as shown in table 3. Similarly, Wiswell, Yong and Ho also observed that male neonates were more prone to MAS than females.

Anemia and PIH were the predominant risk factors causing MSAF, seen in 43.2% and 26.8% cases respectively. Other risk factors were pre-eclampsia, UTI, eclampsia and others like APH, jaundice etc. seen in 4.4%, 19.4% and 1.5% of cases respectively. PIH, UTI and eclampsia constituted together 32.9% of the incidence of MSAF in this study.

Sasikala et al also observed anaemia and PIH as the predominant risk factors of MSAF , observed to be 26% and 18% respectively. [9] Anaemia was the predominant risk factor (17.24%) causing MSAF as per the observation of Bhide et al. [21] Gupta et al evaluated the relationship between MSAF and antenatal and intra-partum factors and reported that MSAF was more common in pregnancies associated with PIH and severe anemia.[20]

According to his study, APH, PIH and pre-eclamptic toxaemia were the predominant risk factors accounting for 2.5%, 3.9% and 3.4% cases respectively. However, according to Nayak and Dalal, toxaemia was the predominant causative factor for MSAF seen in 10.28% cases. [24] Similarly, toxaemia as the causative factor was observed by Miller et al too.[25] The difference in incidence of risk factors causing MSAF in different studies may be due to variations in disease pattern.

Out of 8 cases of MAS, Anaemia was the commonest risk factor seen in 62.5% cases, PIH in 25% cases , UTI in 25% and eclampsia in 12.5%. Further statistical analysis showed no significant correlation between these risk factors and MAS. Keziah et al (2017) reported that increased maternal age, term and post term pregnancy, oligohydramnios and premature rupture of membranes, are the risk factors for developing MAS.[26]

In 67.1% cases of MSAF, mode of delivery was LSCS, while in 32.8% the mode of delivery was vaginal. The difference in the modes of delivery in babies affected with MSAF was not statistically significant in our study (p value= 0.915). According to Bhatia et al, 53.63% of babies with MSAF were delivered vaginally, 43.02% by LSCS and in 3.35% cases, the delivery was instrumental (vacuum or forceps). [27] Nayak and Dalal also observed a higher incidence of vaginal deliveries i.e. 82.1% in babies born with MSAF. [24] Fischer et al reported that 37.2% of babies who developed MAS were born through caesarian section, thus again showing a higher rate of vaginal deliveries associated with MAS. [23]

Rossi et al reported a higher incidence of caeserian delivery in thick meconium group (27%), as compared to thin and moderate meconium groups. [17] However, this could not be compared with our study as no distinction was made between thick, moderate and thin meconium.

83.5% babies in the present study were term, 14.6% were preterm and 1.4% were post-term. On statistical analysis, the number of term babies was significant as compared to preterm and post-term babies i.e. p value=0.004.

In a study conducted by Narang et al, 95.4% of babies were >37 weeks and 4.6% were between 33-36 weeks.[16] In the study conducted by Yoder et al , average gestational age of babies with MSAF was 41.4 weeks and it was 40.2 weeks in a study conducted by Suresh and Sarkar. However, Gupta et al observed that 55% of babies born with MSAF were post-term. [20]

In the present study, 62.5% of babies who developed MAS were term, 25% were post-term and 12.5 % were preterm. The average gestational age reported by Falciglia in MAS was 38.9 +/- 1.9 weeks in one study (1975) and 4.07 +/- 1.7 weeks in the second study (1983). [28] The average gestational age was 40.6 weeks as given by Rossi et al. In a study conducted by Davis et al, 59% of babies who developed MAS were term. In the present study, only 1.4 % of MSAF babies were post-term. [29]

In the present study, birth weight of majority of babies born to MSAF was > 2000 grams(90.6%), with > 3000 grams constituting 35.8 %of the total babies. In a study conducted by Narang et al, 95.4% babies born to MSAF mothers had a birth weight of >2000 grams.[16] Nayak and Dalal in their study observed that 61.4% of the babies had birth weight between 2.5 to 3.5 kg. Mean birth weight recorded in babies with MSAF by Suresh and Sarkar was 2677 grams. However, Miller recorded a mean birth weight of 3400+/- 515 grams in babies born with MSAF. According to Gupta et al, 17.3% babies born with MSAF were in the weight group of 1501-2000 grams. [20]

Out of 8 cases of MAS, 7 (87.5%) of the babies had birth weight >2000 grams, and none of the babies were below 1500 grams. Average birth weight recorded in babies who developed MAS by Davis et al and Rossi et al were 3021.6 grams and 3485 grams respectively.

In the present study, 70.1% of the babies born with MSAF had no asphyxia and 29.9 % had asphyxia at birth, with 20% presenting with mild asphyxia, 4 % with moderate asphyxia and 5.9% with severe perinatal asphyxia. Statistical analysis showed a significant association of MSAF and asphyxia.

Similarly, in a study conducted by Narang et al 11.03% of the total MSAF babies had an APGAR score of 0-3, 13.4% had APGAR scores between 4-6 and 75.25 had an APGAR score >7.

Nayak and Dalal had also found that of the total MSAF babies 70.5% had no asphyxia at birth, 1.5% had mild asphyxia , 8% had moderate asphyxia and 6.5% had severe asphyxia. [24] Similarly, in a study conducted by Rossi et al 25.9% of the total MSAF babies had an APGAR score<5 at one minute and only 3.1% had APGAR scores <5 at 5 minutes. [17] 74.1% babies in their study had no asphyxia. Sasikala et al reported that of the 150 cases of MSAF, 39.3% had no asphyxia, 28.6% had mild asphyxia, 18% had moderate asphyxia and 10 % had severe asphyxia at birth. [9] The differences in the above studies could be explained due to the fact that all 150 babies selected for the study had thick MSAF.

In the present study, out of 8 MAS babies, 37.5% had no birth asphyxia, 12.5% had mild asphyxia, 12.5% had moderate asphyxia and 37.5% had severe asphyxia. Statistically, the difference in babies having asphyxia and those having no asphyxia was significant.

In a study conducted by Narang et al, 53.% babies with MAS had APGAR scores of 0-3, 23.07% had APGAR scores of 4-6 and 23.7% had scores of 7-10. However, Rossi et al reported that 23% babies of MAS had APGAR scores <5 at one minute. [17]

The difference from the present study could be explained by the fact that only the babies with APGAR scores <5 had been included in that study and babies with APGAR scores 5 and more were not included.

Out of 75 babies of MSAF, respiratory distress was present in 27% of the cases. In 10.7% cases, respiratory distress as well radiological opacities were present and these were labeled to be having MAS. Out of 8 babies of MAS, respiratory rate was more than 60 in 6 babies (75%) while 2 had a respiratory rate equal to or below 60. 7 out of 8 babies had expiratory grunt (87.5%) while 1(12.5%) baby had no grunt.

Tachypnea and grunting combined were present in 6 (75%) cases, tachypnea and chest indrawings in 6 (75%) cases and chest indrawings with grunting in 7 (87.5%) cases. Chest indrawings and grunting were the most common form of respiratory distress in babies with MAS. The triad of chest indrawings, grunting and tachypnea were present in 6(75%) cases. No comparable data is available regarding distribution of cases according to clinical presentation of respiratory distress.

In the present study, all 8 cases of MAS had radiological changes in the form of opacities. Maximum changes were seen on the right side alone (50%) followed by bilateral changes (37.5%).

Out of 8 babies of MAS, mechanical ventilation was required in 3 babies which amounted to 37.5%. Bhatia et al reported the requirement of mechanical ventilation in 33.3% of MAS cases. [27]

In the present study, out of 8 babies who developed MAS, 3(37.5%) had a blood lactate level >15 mmol/l and 5(63.5%) had levels between 7.5 and 15 mmol/l. Shah et al (2004) in their study concluded that neonates with blood lactate levels > 7.5 mmol/l at 1 hour of age were at

a higher risk of developing neurological and systemic complications. [30] Also, Karabayir et al in 2015 concluded that blood lactate levels in MAS babies were $8.5^{+}3.4$ mmol/l and blood lactate levels correlated significantly with duration of hospitalization.

1 out of 8 babies with MAS died, thus giving a mortality rate of 12.% in the present study. Chaturvedi et al found that out of 16 cases of MAS, 2 died(12.5%). Bhatia et al found the mortality due to MAS being 23/248 i.e. 9.3% cases. [27] In another study in 2008, Bhat et al reported a mortality rate of 13.3%. [31]

SUMMARY AND CONCLUSION

This study was summarized as follows :-

1. In the present study, incidence of MAS in babies born through MSAF was 10.7%.
2. Babies born to primi gravida mothers with MSAF were the maximum (44.7%). Majority of babies with MAS were born to para 1 and para2 mothers (37.5% and 25%) respectively.
3. Anemia in mother was the commonest risk factor (43.2%), followed by PIH (26.8%) in mothers having MSAF. Among the babies with MAS, anaemia and PIH were again the commonest risk factors accounting for 62.5% and 25% of the cases respectively.
4. LSCS was the commonest mode of delivery in majority (67.1%) cases with MSAF, followed by normal vaginal delivery (32.8%). In babies with MAS also, LSCS was the commonest mode of delivery (62.5%).
5. MSAF was more common in male babies (59.7%). Similar was the distribution in babies with MAS (75%).
6. Majority of babies born with MSAF were born term (83.5%) and 1.4% were post-term and the rest were preterm babies(14.9%) . In babies with MAS, 62.5% were born term, 25% post-term and the rest were preterm.
7. Majority of babies with MSAF were born >3000 grams (35.8%) and none of the babies were below 1500 grams. In babies with MAS, 37.5% were > 3000 grams.
8. Majority of babies with MSAF had no asphyxia at birth(70.1%). Only 5.9% had severe asphyxia. In babies with MAS, 37.5% had no birth asphyxia while 37.50% had severe asphyxia at birth.
9. In babies with MAS, tachypnea and expiratory grunting were present in 75% and 87.5% cases respectively.
10. Tachypnea was the most common form of respiratory distress in babies with MSAF present in 5.9 % cases.
11. In babies with MAS, the commonest radiological findings were observed on the right side alone (50%), followed by bilateral changes (37.5%) cases.
12. 3 babies out 8 babies who developed MAS, required ventilatory support, incidence being 37.5%.
13. Majority of babies who developed MAS had blood lactate levels between 7.5-15 mmol/l, present in 63.5% cases. Since, the correlation between blood lactate levels and APGAR score was proved to be significant, hence it can be concluded that obtaining blood lactate levels in MSAF babies can predict the severity of MAS, although this significance needs to be further evaluated over a larger sample size.
14. Out of 8 babies with MAS, 1 baby died, thus giving the mortality rate of 12.5% in the present study.

Hence, we concluded that incidence of MAS was 10.7% of MSAF babies. MSAF and MAS were more common in Babies of para 1 and para 2 mothers. Anaemia followed by pregnancy induced hypertension was common risk factors for MSAF and MAS. MAS was more common in male babies. Term babies and who were birth weight > 3000 grams were affected with MSAF and MAS. Majority of babies with MSAF had no asphyxia. Tachypnea and expiratory grunting were commonly seen in babies with MAS. Babies with MAS, the commonest radiological findings were observed on the right side alone (50%), followed by bilateral changes (37.5%). Majorities of babies with MAS had blood lactate levels 7.5-15mmol/l. Blood lactate levels in MSAF babies can predict the severity of MAS. Mortality rate of babies with MAS was 12.5%.

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