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Clinical Characteristics and Immediate Outcomes of Meconium Aspiration Syndrome in Neonates: A Prospective Study

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is linked to Meconium Aspiration Syndrome (MAS), a serious respiratory condition in neonates. It is essential to comprehend the risk factors and clinical features for efficient management and prevention. This study investigates the incidence, prenatal risk factors, and postnatal consequences of multiple exposure syndrome in newborns.

Methods: At the SVP PG Institute of Paediatrics, a prospective study covering 5460 newborn admissions was carried out over a year. Ninety-six newborns with MAS were among the 780 patients with a history of MSAF that were found. Comprehensive prenatal and neonatal histories, gestational age determination, adherence to diagnostic criteria, and evaluation of immediate results were all part of the data-gathering process. For the statistical analysis, SPSS 16.0 was used.

Results: The most frequent maternal risk factor linked to MAS was found to be prolonged labour (26%) and was followed by preeclampsia (22.9%) and anaemia (19.8%). 53.1% of deliveries were caesarean sections. With a mean gestational age of 38–40 weeks, term newborns (64.5%) accounted for the majority of MAS cases. Predominant birth weights were 2.5–2.9 kg (37.5%). Sepsis (57.2%), hypoxic-ischemic encephalopathy (36.4%), and shock (16.6%) were among the complications. Sepsis was linked to mortality in 28.5% of cases and pneumothorax in 23.8%.

Conclusion: MAS is still a significant problem in neonatal care that requires an all-encompassing strategy. It is imperative to take preventative actions, such as early identification of risk factors, careful observation, and timely intervention. Even if the results of therapy modalities have improved, standardisation and accessibility are still issues, particularly in underdeveloped nations. Reducing the infant mortality linked to MAS requires addressing these issues.

Key-words: Meconium Aspiration Syndrome, Neonates, Respiratory Distress, Meconium-Stained Amniotic Fluid, Gestational Age, Birth Weight, Antenatal Risk Factors, Neonatal Mortality

INTRODUCTION

Meconium aspiration syndrome (MAS) is a serious risk to the respiratory health and survival of newborns, and its presence in amniotic fluid has long been thought to be an unreliable indicator of the health of the fetus [1].

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Meconium-stained amniotic fluid (MSAF) can be seen in between 5% and 25% of pregnancies, and 10% of newborns born with MSAF will have MAS. The risk of respiratory distress in infants delivered with MSAF is 100 times higher than in infants delivered with clear amniotic fluid [2].

With increasing gestational age, the risk of MSAF rises and peaks in post-term pregnancies at 30%. Regardless of foetal age, elevated MSAF incidence is seen in the presence of feto-maternal stresses like hypoxia and infection [3]. Meconium transit is a common postnatal event; in the first 24 to 48 hours following birth, about

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98% of healthy babies pass meconium [4]. Foetuses that are 37 weeks or older are the source of more than 98% of MSAF cases [5]. MSAF is generally infrequent in preterm deliveries and is more frequently linked to post-term pregnancies [5,6].

MAS management is a major difficulty for neonatologists. It is advantageous to employ tactics like improving intrapartum surveillance and preventing post-term pregnancies. The use of positive end-expiratory pressure, surfactant therapy, high-frequency oscillatory ventilation, and inhaled nitric oxide, among other recent developments in the understanding and management of acute lung injury, have significantly improved the results of mechanical assisted breathing (MAS).

The objective of the present study was to evaluate the clinical features of meconium aspiration syndrome (MAS) in newborns, with particular attention to birth weight, gestational age, and the immediate consequences of these findings.

MATERIALS AND METHODS

This prospective study was conducted at SVP PG Institute of Pediatrics, affiliated with SCB Medical College and Hospital, Cuttack, over one year (November 2020 to October 2021). Out of 5460 newborn admissions during this period, 4892 newborns exhibited respiratory distress, with 780 having a history of meconium-stained amniotic fluid (MSAF). The study focused on 96 cases (out of 780) of meconium aspiration syndrome, approved by the Institute's ethical committee.

Diagnostic Criteria for Meconium Aspiration Syndrome:

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

Study Population- The study included 96 newborns with meconium staining and who developed meconium aspiration syndrome, forming a heterogeneous population. Cases were selected from the general newborn wards and neonatal intensive care unit, including the ICU step-down ward, at SVP PG Institute of Pediatrics, and were followed up for their immediate outcomes.

Selection of Cases and Methods- All preterm, term, and post-term infants, delivered by various means, meeting the criteria for MAS, were included through purposive sampling. Exclusion criteria encompassed newborns with other respiratory conditions, congenital issues, sepsis, and those without respiratory distress despite meconium-stained amniotic fluid.

Data Collection- A detailed antenatal and natal history was obtained to identify the etiology of meconium passage. Postnatal history included Apgar score, birth asphyxia, and complications, with details of resuscitative measures. Gestational age assessment utilized Ballard's score. Routine investigations and radiological assessments were conducted, with management tailored to the severity of respiratory distress.

Statistical Analysis- Data entered in MS-Excel 2019 underwent correction for typographical errors and analysis using SPSS 16.0. Chi-square tests compared qualitative data, with a significance level set at 95% ($p<0.05$).

RESULTS

In our study, prolonged labor was found to be the most common (n=25, 26%) factor associated with MAS followed by Pre-Eclampsia (n=22, 22.9%), Anemia (n=19, 19.8%) and oligohydramnios (n=12,112.5%).

Table 1: Maternal Risk factors associated with MAS

Maternal Risk	No. of cases	Percentage
Anemia	19	19.8
APH	7	7.3
Cord around neck	1	1.0
Oligohydramnios	12	12.5
Preeclampsia	22	22.9
Prolonged Labor	25	26.0
PROM	10	10.4

In our study, babies with MAS born by normal and assisted vaginal delivery formed 46.9% of cases and babies born by Caesarean delivery 53.1%.

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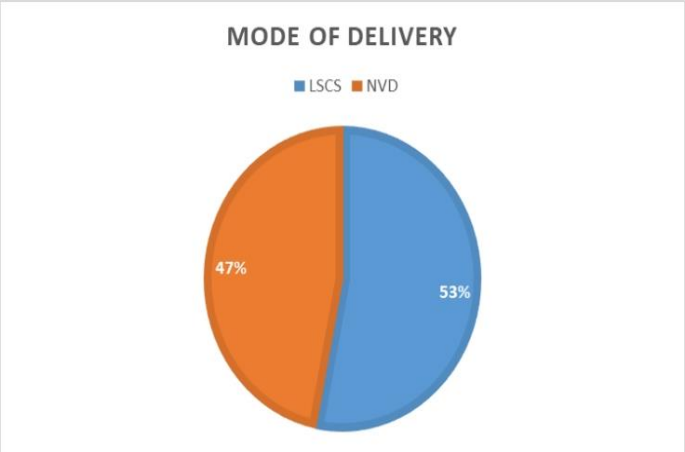

Fig. 1: Mode of Delivery and MAS

Table 2: Gestational age and MAS

Gestational Age	No Cases of MAS	Percentage
<34 weeks	3	3.1
34-36 weeks	5	5.2
36-38 weeks	15	15.6
38-40 weeks	62	64.5
40-42 weeks	11	11.4

In the present study, most of the cases of MAS occurred in term babies with a mean gestational age of 38-40 weeks. 62 (64.5%) babies belonged to 38-40 weeks of gestation and 11(11.4%) babies were of 40-42 weeks of gestation. 2 (6.89%). MAS was also seen in preterm babies. 5 (5.2%) cases were of 34-36 weeks of gestation and 15 (15.6%) belonged to 36-38 weeks of gestation. 3 cases (3.1%) were born before 34 weeks of gestation.

Table 3: Birth weight and MAS

Birth Weight	No of Cases of MAS	Percentage
1.5-1.9 kg	12	12.5
2-2.4 kg	26	27.0
2.5-2.9 kg	36	37.5
3-3.4 kg	16	16.6
3.5-3.9 kg	6	6.2

The mean birth weight of babies with MAS was 2.55 kg (1.0-3.5 kgs). In our study, maximum number of cases of MAS were seen in babies with birth weight between 2.5-2.9kg (n=36, 37.5%), followed by babies with birth weight between 2.0-2.4 kg (n=26, 27.0%). Babies with birth weight between 3-3.4 formed 16.6% (n=16) of cases. Babies between 1.5-1.9kg formed 12.5% (n=12), and those 3.5-3.9kg formed 6.2%(n=6). In our study, female babies were more affected (n=57,59.4%) than males (n=39,40.6%).

Table 4: Downe's score at admission to MAS

Downe's score	No of Cases of MAS	Percentage
4	26	27.08
5	26	27.08
6	31	32.2
7	8	8.3
8	5	5.2

In this study, with 96 babies of MAS at admission 26 cases (27%) had Downe's score of 4, and 26 cases (27%) had a score of 5; 31 cases (32.2%) cases had score of 6, 8 cases (8.3%) had score of 7, 5 cases (5.2%) had score of 8 at the time of admission.

Table 5: APGAR score at 1 minute in MAS cases

APGAR Score	No Cases of MAS	Percentage
0-3	2	2.08
4-6	79	82.29
>6	15	15.62

Out of all cases, 2 (2.08%) cases had severe asphyxia i.e., AS ≤ 3 at 1 minute and 79 (82.29%) cases had mild to moderate asphyxia i.e., AS between 4-6 at 1 minute and Apgar score > 6 is seen in 15 (15.62%) cases.

Table 6: Complications in MAS

Complication	No of cases of MAS	Percentage
HIE 2	35	36.4
HIE 3	8	8.3
Sepsis	55	57.2
Shock	16	16.6
DIC	3	3.1
Meningitis	3	3.1
AKI	9	9.3
Hypoglycemia	8	8.3
Jaundice	9	9.3

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PPHN	7	7.2
Pneumothorax	5	5.2
No complications	7	7.2

Sepsis was seen as the most frequent complication (n=55,57.2%) followed by HIE 2 (n=35,36.4%) and shock(n=16,16.6%). Less frequent complications were acute kidney injury (AKI), jaundice, hypoglycemia, pneumothorax, PPHN.

Table 7: Mortality in MAS

Most attributable cause	No of deaths
Pneumothorax	5
Sepsis	6
PPHN	4
HIE 3	3
HIE 2	1
DIC	2

Most of the mortality is due to sepsis (n=6,28.5%), followed by pneumothorax(n=5,23.8%), PPHN(n=4,19%), and HIE3(n=3,14.2%). HIE 2 and DIC were less frequent causes to be attributed. It is worth noting that though we have taken the most attributable cause, multiple factors are contributing to deaths in most cases.

Table 8: Neurological Outcomes in MAS

Neurological Status	No of Cases of MAS	Percentage
Abnormal Neurological examination at discharge/death	38	39.5
Normal neurological examination	58	60.4

In our study, 58(60.4%) newborns had a normal neurological examination at the time of discharge, as assessed by Amiel Tison system of neurological assessment. Rest of them (n=38,39.5%) had depressed reflexes owing to the effects of birth asphyxia.

Table 9: Correlation between APGAR at 1 minute and mortality

Outcome	Apgar<7	Apgar>7	p-value*
Death	21(25.9%)	0	0.026
Discharge	60(74.1%)	15	-

**Pearson's Chi Square test*

APGAR Score at the time of birth seems to correlate with the outcome of MAS patients. Those having score of <7 had significant mortality than those with score>7. Analysis was done using Pearson chi-square test, showing a p-value of 0.026, which is statistically significant.

Table 10: Correlation between Respiratory distress and mortality

Outcome	Downe's<5	Downe's>5	p-value*
Death	0	21	0.022
Discharge	26	49	-

**Pearson's Chi Square test*

Downe's Score at the time of admission were compared and analyzed using Pearson chi square test. Significant mortality was seen in the group having score ≥ 5, with p-value of 0.02, thus was statistically significant.

DISCUSSION

Out of the 5460 admissions that were registered during the study period, 4892 (89.5%) of the infants had trouble breathing. Among them, 96 experienced meconium aspiration syndrome (MAS), with a meconium aspiration fluid (MSAF) prevalence of 12.3%, and 780 (15.9%) were born with MSAF. This frequency closely matches the results of Swain et al.'s 1987 study, which showed 13.92% MSAF and 8.5% MAS. Between 1.7% and 35.8% of these individuals have MAS, according to studies that report a prevalence of MSAF ranging from 5.6% to 24.6% [7,8]. Within the reported range, the current study's MSAF and MAS prevalence is quite acceptable.

Meconium staining and subsequent MAS were found to occur more frequently in deliveries linked to prolonged labour (26%), hypertension (22.9%), and maternal anaemia (19.8%) in the current study. We compared

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these incidence rates with other writers' reports. According to research by Coughtrey [9] newborns that have respiratory distress during MSAF frequently experience foetal distress. The prevalence of pregnancy-induced hypertension (PIH) was reported to be 11.20% by Rahman *et al*. [10], 15.75% by Argyridis and Arulkumaran [11], and 23.58% by Gallo *et al*. [12], In this investigation, 22.9% of the participants had PIH. It was discovered that the incidence of premature rupture of membranes (PROM) was 10.4% as opposed to 6.60% in research conducted by Ayres-de-Campos D *et al.* [13]. According to Gupta *et al*. [14]. meconium passing in postdated pregnancies with oligohydramnios led to 12.5% in our study.

Significant correlations have been found between MSAF and small-for-gestation foetal growth status, PIH, eclampsia, extended rupture of membranes (>24 hours), oligohydramnios, foetal bradycardia, and foetal tachycardia, according to the National Neonatal Perinatal Database of India 2002–2003. Research conducted at BHU in Varanasi and by Hofmeyer GJ and Xu [15] suggested links between MAS and intrauterine growth restriction (IUGR), heavy meconium staining in amniotic fluid, and foetal distress during labour. Small-for-gestational-age and IUGR foetuses made up 47.9% of the population in our study.

In the current study, the greatest percentage of newborns with MAS were delivered by caesarean section (53.1%), with normal or aided vaginal delivery (46.9%) coming in second. These results are consistent with data presented by other writers. 54.2% of babies were born by caesarean section, according to Narang *et al.* [16] however, 80% of meconium aspiration cases were linked to caesarean sections by Bhusan *et al.* [17].

The current study's mean gestational age of 38–40 weeks was discovered to be in line with the findings of Erkkola *et al.* [19] who discovered that 95% of cases had gestations longer than 36 weeks. According to Green and Paul101, at 38 weeks, the prevalence of MAS rises to 10% or higher. Research conducted by Narang *et al*., Bhusan *et al.* and Alchalbi *et al*. showed that as gestational age increases, so does the prevalence of meconium-stained amniotic fluid. [16,18]

Most MAS newborns (86.3%) in this study showed significant respiratory distress upon entry, as determined by their Downes score (which ranged from 4 to 6). It has been observed that many infants with meconium aspiration are relatively well for a few hours after birth before developing progressive respiratory distress. George and Goodling106 et al. showed that in puppies, the meconium moves progressively to the periphery of the lung with each breath.

In the current study, mild to moderate birth asphyxia was indicated by scores between 4-6 in 82.3% of cases, while 2% of cases with severe birth asphyxia had APGAR scores reported at 1 minute ≤ 3. APGAR scores at one minute were found to be less than seven in 7.5% of instances by Erkkola [19] but Alchalbi *et al.* [18] reported scores less than seven in 25.40% of cases.

Sepsis accounted for the majority of complications in the current study (57.2%), with HIE-2(36.4%), shock (16.6%), AKI and jaundice (9.3%), hypoglycemia, HIE-3(8.3%), PPHN (7.2%), pneumothorax (5.2%), DIC, and meningitis (3.1%) following in order. In 7.2% of instances, there were no extrapulmonary problems. Pneumothorax occurred in 11.53% of infants with MAS, according to research by Green *et al*. [20]

CONCLUSIONS

Meconium Aspiration Syndrome (MAS) is a serious risk to infants, which highlights the necessity of preventative measures. The illness has prenatal as well as postnatal roots; in the event of foetal distress, anticipation becomes critical due to the prevalence of maternal risk factors. Severe cases, which involve intrauterine gasping brought on by hypoxia and acidosis, probably happen prior to the first breath. To lessen the severity of MAS, current preventative techniques in the birth room centre on intubating and suctioning depressed newborns; nonetheless, total prevention is still unattainable. Still, a major obstacle persists, particularly in developing nations: the absence of uniform therapy facilities and management practices.

Summary

In summary, negative outcomes can be considerably reduced by early detection and care based on knowledge of the maternal and neonatal risk factors connected to meconium aspiration syndrome. Although enlightening, the study has some drawbacks, including the use of follow-up data for outborn patients and the possibility of underreporting details related to resuscitations in delivery rooms. Improving MAS management and lowering infant mortality need addressing these issues and developing standardised protocols.

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Data collection- Bijayalaxmi Mallick
Data analysis and Interpretation- Asmit Shobhan Behera
Literature search- Satyaranjan Mallick
Writing article- Asmit Shobhan Behera
Critical review- Asmit Shobhan Behera
Article editing- Asmit Shobhan Behera
Final approval- MaAsmit Shobhan Behera

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