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Research Article

Meconium Aspiration in a Tertiary Hospital in Southern Nigeria: Incidence, Treatment and Outcome

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Abstract

Background: Children with meconium aspiration syndrome (MAS) are at risk of long-term respiratory and neurodevelopmental morbidity and mortality. A reduction in the risk factors and appropriate management of MAS can lead to improved survival.

Objective: To determine the incidence, treatment and the outcome of meconium aspiration syndrome among neonates in Uyo.

Methods: Case notes of neonates who had meconium aspiration, between 2010 and 2019, were retrieved. Information extracted were the age at presentation, gender, weight on admission, maternal and paternal demography, diagnostic criteria, treatment and outcomes.

Results: A total of 45 (0.57%) out of 7845 admissions were diagnosed with MAS. The median age on admission was one hour, with a male preponderance (54.1%). Forty-four (97.8%) of our patients had a gestational age above 37 weeks. Thirty (66.6%) mothers and 32 (71.4%) of the fathers had at least secondary level of education. Forty-two (93.3%) children with MAS, were born through thick meconium (93.3%), 20 (44.4%) neonates had mild Oxygen requirement, 43 (95.6%) neonates developed respiratory distress at <24 hours of life, and 36(80%) of the neonates were born to booked mothers. Forty-two (93.3%) of children with MAS received oxygen and antibiotics respectively. Delivery via caesarean section had a positive correlation with fetal hypoxia in MAS. Forty-one (91.1%) of children with MAS were discharged. The case fatality rate of MAS in our series was 6.7%.

Conclusion: The incidence of MAS, in our study is low, however the case fatality rate is still high. There is need to provide more technologically advanced treatment options for MAS in our tertiary institutions in order to reduce to the barest minimum the long-term morbidities and mortality associated with severe MAS.

Keywords: Meconium Aspiration Syndrome; Treatment; Outcome; Nigeria

Introduction

Liquor is meconium stained in some deliveries. Meconium is a viscous dark green substance which is made up of denuded gut epithelial cells, lanugo hair, bile salt/acids and water. It is produced in fetal gut as early as the tenth week of gestation but excreted at about 34 weeks when there is fetal gut maturity. Meconium is usually passed a few hours after delivery but intrauterine hypoxia and acidosis can cause intrauterine passage of meconium [1], it is also associated with low APGAR Scores [1]. Intrauterine passage can occur in term and postdate infants without stress especially from vagal stimulus caused by head or cord compression [2]. However in preterm deliveries, intrauterine meconium passage has been shown to be associated with feto-maternal stress and infection [3].

The incidence of Meconium stained amniotic fluid (MSAF) varies from 5.5-20% and is dependent on gestational age and the study population [4]. Meconium aspiration Syndrome (MAS) is the major complication of MSAF and can occur either in utero or by the infant at the first breath after delivery. Meconium aspiration Syndrome complicates about 5% of infants born through MSAF and has a case fatality rate of 5-40% [2].

In a study in South-western Nigeria, MAS accounted for 6.1% of neonatal respiratory distress but together with perinatal asphyxia caused more than 30% of deaths in term neonates [5]. In another study in Ilesa Nigeria, MAS accounted for 4% of neonatal respiratory distress [6]. In a study in Iraq, MAS (14.3%) was the third commonest cause of respiratory distress in the newborn after transient tachypnoea of the newborn and hyaline membrane disease [7].

Risk factors of meconium aspiration include post-term deliveries, pre-ecclampsia, placental insufficiency, maternal diabetes, black ethnicity, maternal tobacco use and Oligohydramnios [2]. The mechanism of injury of MAS includes mechanical obstruction of airways, chemical peritonitis, vasoconstriction of pulmonary vessels, inactivation of surfactants and complement activation [8]. The respiratory manifestations of MAS include tachypnoea, dyspnoea, cyanosis, air trapping and reduced respiratory compliance giving the child a 'barrel shaped' chest. The Clearly and Wiswell severity grading system for MAS grades it into Mild, Moderate and severe [9]. The treatment of MAS is dependent on the severity and ranges from surfactant replacement to mechanical ventilation with high settings. Alternative treatment such as inhaled nitric oxide or extra-corporeal membrane oxygenation (ECMO) can also be undertaken [8].

In a cohort study conducted in Australia involving more than two million live births conducted between 1995 and 2002, 1061(0.43 per 1000 livebirths) children were intubated on account of MAS. Children born after 40 weeks gestation accounted for 34% of all cases. Forty two percent of the children with MAS were delivered via ceaserean section and there was a strict association between a low five minute apgar score and being intubated for MAS. More than 50% of the infants had more than one treatment modality including but not limited to inhaled nitric oxide (iNO), administration of exogenous surfactant, high frequency ventilation and ECMO. The median duration of intubation was three days with increasing duration of oxygen therapy and length of hospital stay. The case fatality rate (CFR) was 2.5%, which is in contrast to the 23.5% CFR reported in Nigerian Study [10,11]. The main strength of the Australian study was in the large number of infants studied and the ability to establish longitudinal trends. The major limitation however, was that mild and moderate cases of MAS were not studied and this was attributed to the difficulty in establishing the diagnosis of mild and moderate cases of MAS [10].

In, low/middle income economies (LMIC), the management of MAS is usually limited by the un-availability of mechanical ventilation and surfactants and where these are available the cost of treatment is usually very high. These limitation in treatment options contributes to high case fatality seen especially in severe cases of MAS [11].

There is a paucity of data on the incidence of MAS in southern Nigeria. In view of the high case fatality rate of MAS especially in cases of delayed or missed diagnosis and the propensity of children that had MAS to present with a hyper-reactive airway in later life [11,12], We decided to perform this study on MAS in our centre to determine the incidence, treatment and outcome of MAS. It is hoped that this study will add to the knowledge on the burden of MAS in our environment and also highlight some of the prevailing challenges in the diagnosis and management of MAS in a low/middle income country (LMIC).

Method

This study was conducted in the special care baby unit (SCBU) and sick baby Unit (SBU) of a tertiary hospital in Southern Nigeria over a 10 - year period (2010- 2019). The special care baby has five incubators, fifteen cots, five phototherapy unit, and one resuscitaire and caters for inborn admissions, while the SBU with 4 incubators, 24 cots, and one resuscitaire caters for out-born admissions. There are no facilities for mechanical ventilation. There are two consultant neonatologist with their resident doctors and house officers overseeing both units.

This was a retrospective cross-sectional study using secondary data. Case notes of all babies with a diagnosis of MAS from the ward register between 2010 and 2019 were retrieved. All babies delivered through meconium stained liquor or with a history of meconium stained liquor (outborn) were reviewed. The meconium was graded by the obstetrician as thick if it was dark green in color, if it was viscous like pea soup, and/or if it was particulate; the meconium was graded as thin when it was yellow or green, homogenous, and watery. The actual time of meconium passage was not available.

Meconium aspiration syndrome was defined as the onset of respiratory distress after birth with meconium-stained body and liquor with or without features of air leaks [13]. Chest radiograph may show widespread patchy or homogenous opacities, infiltrates and evidence of air trapping [13].

Apgar score was used in all in-borns; a score <7 in the first minute and fifth minute was regarded as asphyxia [14].

Hypoglycemia was defined as whole blood glucose <2.2 mmol/l (40 mg/dl) [15]. Metabolic acidosis was defined as serum bicarbonate of <20 mmol/L [16].

A diagnosis of MAS was made clinically and severity was graded using the Clearly and Wiswell severity grading system for MAS which grades it into Mild, Moderate and severe [8].

- Mild MAS: Disease requiring <40% oxygen for <48hours
- Moderate MAS: Disease requiring >40% oxygen for >48 hours with no air leak.
- Severe MAS: Disease requiring assisted ventilation for more than 48 hours often associated with persistent pulmonary hypertension (PPHN)

A study Proforma was developed for each patient. The details obtained using the study proforma included the age, gender, gestational age (GA) and weight on admission of the neonate, Maternal age, parity, booking status, occupation and mode of delivery and Paternal education and occupation. Other details included in the study proforma were the treatment requirements, including the duration of oxygen needed to cause resolution of symptoms, preventive measures undertaken, treatment modalities, adjunctive therapies and the outcome.

Ethical clearance was obtained from the University of Uyo Teaching Hospital, ethical review committee.

Data was entered and analysed using STATA version 12. Continuous data were summarised using measures of central tendency with appropriate measures of dispersion. Categorical data were summarised using percentage. Chi square was used to determine the relationship between two categorical variables at 5% level of significance. Results are presented in tables and chart.

Results

A total of 45 children out of 7845 admissions (SCBU and SBU) had a clinical diagnosis of MAS giving an incidence of 0.57% over the study period. The median age on admission was one hour (range 0.5-120 hours) and 24 (54.3%) of the patients were males. Forty-four (97.8%) of the babies were term or Post-date. The mean weight of the babies was 3.15 ± 0.64kg (Table 1).

Demographic characteristics	Frequency (n)	Percentage (%)
Gender		
Male	24	54.3
Female	21	46.7
Gestational Age		
34-37	1	2.2
37-40	23	51.1
Above 40	21	46.7

Table 1: Demographic characteristic of babies with meconium aspiration syndrome in UUTH.

Table 2 shows that majority (66.6%) of the mothers had at least a secondary level of education and 11 (24.4%) of the mothers were traders and unemployed respectively. In addition, 35 (77.7%) of the mothers were monoparous, while 71.4% of the fathers had at least a secondary level of education.

Demographic characteristics	Frequency (n)	Percentage (%)
Mother level of education		
No formal	9	20.0
Primary	6	13.4
Secondary	15	33.3
Tertiary	15	33.3
Mother occupation		
Trading	11	24.4
Artisan	6	13.4
Teachers	7	15.6
Students	5	11.1
Unemployed	11	24.4
Others	5	11.1
Parity		
1	20	44.4
2	15	33.3
3	4	8.9
Above 3	6	13.4
Tribe		
Annang	9	20.0
Ibibio	24	53.3
Efik	3	6.7
Igbo	3	6.7
Others	6	13.3
Father level of education		
Primary	13	28.8
Secondary	16	35.6
Tertiary	16	35.6

Table 2: Parental characteristics of babies with meconium Aspiration syndrome in UUTH.

Table 3 shows that forty-two (93.3%) children with MAS, were born through thick meconium, 20 (44.4%) neonates had mild Oxygen requirement, 43 (95.6%) neonates developed respiratory distress at <24 hours of life, and 36(80%) of the neonates were born to booked mothers. The only treatment apart from oxygen given to 42 (93.3%) of the babies with MAS was antibiotics administration.

Clinical features	Frequency (n)	Percentage (%)
Thick meconium		
No	3	6.7
Yes	42	93.3
Oxygen requirement		
No data	3	6.7
Mild	20	44.4
Moderate	13	28.9
Severe	9	20.0
Fetal hypoxia		
Yes	25	55.6
No	20	44.4
Low Apgar		
Yes	24	53.3
No	21	46.7
Abnormal fetal heart rate		
Yes	1	2.2
No	44	97.8
Respiratory distress within 24 hours		
Yes	43	95.6
No	2	4.4
Booking		
Yes	36	80.0
No	9	20.0
Intrapartum fetal monitoring		
Yes	10	22.2
No	35	77.8
Prolonged labour		
Yes	8	17.8
No	37	82.2
Ceaserean Section		
Yes	26	57.8
No	19	42.2

Treatment		
Steroids		
Yes	1	2.2
No	44	97.8
Antibiotics		
Yes	42	93.3
No	3	6.7
Sedation		
Yes	3	6.7
No	42	93.3
Magnesium sulphate		
Yes	2	4.4
No	43	95.6

Table 3: Clinical features and treatment of babies with MAS.

Table 4 shows that only caesarean section had a positive correlation (p=0.001) with fetal hypoxia in our study.

The mean ± SD maternal age of patients with mild, moderate and severe oxygen requirement was 28.2 ± 3.4; 27.4 ± 2.1; 27.8 ± 3.4 respectively. Maternal age, booking status, parity, maternal level of education and intrapartum monitoring of labour were not significantly associated with the severity of MAS (Table 5).

Figure 1 shows that 41 (91.1%) patients with a diagnosis of MAS were discharged, three (6.7%) died and one (2.2%) left against medical advice (LAMA).

Discussion

Our study has shown a prevalence rate of 0.57% for MAS. This rate is low compared to other studies that showed a prevalence rate of 0.97-5.7% [11,17-18]. These differences are probably due to the population sizes, study design and the fact that other centres are bigger referral centres with better facilities and resources for the management of MAS [11,17]. In addition, the retrospective nature of our study and the poor record keeping in our centre may also account for these differences.

Our study, showed that 44 (97.8%) of our study population with MAS were either term or post-date babies. This finding is in

Variables	Fetal hypoxia n (%)		Total (n = 45)	p-value
	Yes (n = 25)	No (n = 20)		
Thick meconium				
Yes	23 (92.0)	19 (95.0)	42 (93.3)	1.000
No	2 (8.0)	1 (5.0)	3 (6.7)	
Caesarean section				
Yes	20 (80.0)	6 (30.0)	26 (57.8)	0.001+
No	5 (20.0)	14 (70.0)	19 (42.2)	
Prolonged labour				
Yes	5 (20.0)	3 (15.0)	8 (17.8)	0.716
No	20 (80.0)	17 (85.0)	37 (82.2)	
Booked				
Yes	20 (80.0)	16 (80.0)	36 (80.0)	1.000
No	5 (20.0)	4 (20.0)	9 (20.0)	
Parity				
1	13 (54.1)	7 (41.2)	20 (48.8)	0.566
2	9 (37.5)	6 (35.3)	15 (36.6)	
3	1 (4.2)	3 (17.6)	4 (9.8)	
Above 3	1 (4.2)	1 (5.9)	2 (4.9)	
Correct acidosis				
Yes	5 (20.0)	3 (15.0)	8 (17.8)	0.716
No	20 (80.0)	17 (85.0)	37 (82.2)	
Correct hypoglycaemia				
Yes	2 (8.0)	3 (15.0)	5 (11.1)	0.642
No	23 (92.0)	17 (85.0)	40 (88.9)	

Table 4: Fetal hypoxia among babies with meconium aspiration syndrome in UUTH.

Variables	Oxygen requirement n (%)			Total (n = 42)	p-value
	Mild (n = 20)	Moderate (n = 13)	Severe (n = 9)		
Maternal age (years)					
Less than 30	13 (41.9)	11 (35.5)	7 (22.6)	31 (100.0)	0.489
Above 30	7 (63.6)	2 (18.2)	2 (18.2)	11 (100.0)	
Parity					
1	7 (41.2)	7 (41.2)	3 (17.6)	17 (100.0)	
2	8 (53.3)	4 (26.7)	3 (20.0)	15 (100.0)	
3	1 (25.0)	1 (23.0)	2 (50.0)	4 (100.0)	0.755
Above 3	4 (66.7)	1 (16.7)	1 (16.7)	6 (100.0)	
Booking status					
No	4 (50.0)	2 (25.0)	2 (25.0)	8 (100.0)	1.000
Yes	16 (47.1)	11 (32.4)	7 (77.8)	34 (100.0)	
Intrapartum monitoring					
No	15 (46.9)	8 (25.0)	9 (28.1)	32 (100.0)	
Yes	5 (50.0)	5 (50.0)	0 (0.0)	10 (100.0)	0.113
Level of education					
No formal education	3 (33.3)	4 (44.4)	2 (22.2)	9 (100.0)	
Primary	3 (60.0)	1 (20.0)	1 (20.0)	5 (100.0)	0.881
Secondary	8 (61.5)	3 (23.1)	2 (15.4)	13 (100.0)	
Tertiary	6 (40.0)	5 (33.3)	4 (26.7))	15 (100.0)	

Table 5: Determinants of the severity of Meconium Aspiration syndrome.

Figure 1: Pie chart showing Outcome of babies with Meconium aspiration syndrome.

keeping with studies that had an increasing incidence of MAS with gestational age above 37 weeks and is keeping with the onset of foetal gut motility and meconium excretion from 34 weeks and above [19-21]. In addition, a greater prevalence of MAS has been seen in babies of black Africa ancestry and this has been attributed to earlier maturation of the gastrointestinal tract in black ethnic groups [20].

Our study shows that 66% of mothers that had babies with MAS had at least secondary level of education, these may not be a true predisposition to MAS, but rather a confirmation to the globally known truth that mothers with formal education have a better health seeking behaviour than those without formal education [22]. Majority of our children with MAS were born through thick meconium, developed respiratory distress <24 hours after birth and were born to booked mothers. These findings corroborate others that have shown than birth through thick meconium and fetal distress are both predisposing factors to MAS and also prognostic factors on the severity of MAS [10,23-24]. The finding of majority of MAS being seen in booked mothers is probably a reflection that other ante-partum and intra-partum factors play a part in the onset of MAS. In addition, it is possible that many un-booked babies may have died in their respective places of delivery before they could be brought to the hospital. Majority of the babies in our series had Fetal hypoxia, low Apgar scores, and had no intrapartum monitoring in labour. Fetal hypoxia and low Apgar scores have been recognised as poor prognostic factors in various studies [10,23-24]. In addition, low Apgar scores could also lead to some confusion in diagnosis, where a diagnosis of Severe birth asphyxia is initially made resulting in a delay in providing the appropriate treatment for MAS, therefore leading to extensive morbidity and a higher rate of mortality.

Our study has also highlighted our challenge in the management of MAS, due to the limited resources and treatment options for MAS to Oxygen, steroids, antibiotics and Magnesium Sulphate. This is in contrast to the recommended and current treatment options like surfactants, inhaled nitric oxide, mechanical ventilation and ECMO which has led to better survival rates in children with severe MAS from developed countries [8,10-11]. The use of antibiotics in the treatment of MAS which was prevalent in our study is controversial [8]. However, due to the poor infection control and relatively occasional unhygienic practices in the labour/delivery area with a tendency of Neonatal sepsis in our patients, our use of antibiotics was justified. In addition, the report from northern Nigeria, confirmed sepsis (40.8%) as the commonest cause of admission in their NICU and the second commonest cause of mortality (21.7%) justifies our use of antibiotics in managing these neonates [18].

Our study revealed that only delivery via CS had a strong association with the fetal hypoxia seen in MAS. This could be explained by the lack of forewarning of meconium passage in ceasarean deliveries in which membrane were not ruptured [24]. In addition, this could be a reflection of the fact that those who were delivered via CS had already been stressed in-utero from conditions like obstructed labour, or other causes of fetal distress thereby leading to passage of meconium [10].

Most of our patients did not have intrapartum fetal monitoring. Intrapartum fetal monitoring has proved to be useful in predicting both favorable and unfavorable outcomes and thus effective in monitoring pregnancies complicated by meconium passage [6,24].

Majority of our patients were discharged, and this attests to the fact that early interventions like intra-trachael suctioning, use of oxygen and good nursing care would result in a favourable outcome for children with mild to moderate MAS even in the absence of technologically advanced equipment and expensive medication like surfactants.

Our case fatality rate (CFR) of 6.7% is high and all the mortality was among children with severe MAS (i.e three out of seven [42.86% CFR]) but less than that of other studies [11,17]. This high CFR in severe cases of MAS makes a case for the need for surfactants, inhaled nitric oxide C-PAP, mechanical ventilation and possibly ECMO in a tertiary facility like ours for the management of severe MAS as these treatment options have been proven to reduce the respiratory morbidity and mortality associated with severe MAS.

Conclusion

The prevalence of MAS is low in our study, however the case fatality rate especially for severe MAS is high. In view of our findings, emphasis should be placed on the prompt recognition and prevention of the predisposing factors to MAS to improve survival. In addition, our findings have highlighted the need adequate intrapartrum monitoring and the provision of more technologically advanced treatment options like exogenous surfactants, inhaled nitric oxide, nasal CPAP and mechanical ventilators in order to reduce the long-term respiratory morbidity and mortality associated with severe MAS.

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