

# A 3-Year Review Of Meconium Aspiration Syndrome

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## ABSTRACT

**Aim of study:** To review the incidence, morbidity and mortality of Meconium Aspiration Syndrome (MAS). To identify possible predictors of MAS in newborns with thick meconium-stained amniotic fluid (MSAF) at delivery.

**Methodology:** Case records of babies with MSAF delivered in Singapore General Hospital from 1.1.1991 to 31.12.1993 were studied retrospectively.

**Results:** In the study period, 1,893 babies (15% of live births) had MSAF and 174 babies (1.4% live births) developed MAS. The incidences of MAS in newborns with light, moderate and thick MSAF were 0.3%, 5.8% and 61% respectively. Complications associated with MAS were metabolic acidosis (52%), air leak syndrome (2%), persistent pulmonary hypertension (2%) and hypoxic ischaemic encephalopathy (0.5%). The mortality rate of babies with MAS was 2%. Newborns with thick MSAF were more likely to develop MAS if they were males, small-for-gestational-age, had fetal distress and meconium was sucked from the trachea at birth.

**Conclusion:** Vigilant perinatal monitoring of high risk babies with MSAF and proper resuscitation at birth would help reduce the incidence of MAS and its associated complications.

**Keywords:** meconium-stained amniotic fluid, meconium aspiration syndrome

## INTRODUCTION

This study was done to determine the incidence, morbidity and mortality of MAS and to identify any possible antenatal or perinatal predictors of MAS in neonates with thick MSAF. Meconium aspiration syndrome (MAS) is a significant cause of neonatal morbidity and mortality. In the United States, it has been reported that about 13% of the 4 million babies born each year have meconium-stained amniotic fluid (MSAF) and 5% developed MAS<sup>(1)</sup>.

The term *meconium* is derived from the Greek word *meconium-arion*, meaning "opium-like" as it was believed to induce fetal sleep<sup>(2)</sup>. Meconium is a viscous, odourless greenish-black liquid present in the fetal gastrointestinal tract from between the 10th and 16th week of gestation. It consists of gastro-intestinal secretions, bile, bile acids, mucus, pancreatic juice, cellular debris, amniotic fluid and swallowed vernix caseosa, lanugo and blood<sup>(2,3)</sup>. The passage of

meconium at birth is rare due to lack of strong peristalsis, good anal sphincter tone and a plug of viscous meconium in the rectum. In-utero passage of meconium seldom occurs before the 37th week of gestation<sup>(4)</sup>. Numerous studies have concluded that the passage of meconium in-utero is a sign of fetal hypoxia or acidosis<sup>(5,6)</sup>. However, the aspiration of meconium may occur as a result of in-utero gasping or initial breaths taken at birth<sup>(7)</sup>.

In 1960, immediate tracheal-suction of newborns with MSAF was first suggested<sup>(8)</sup>. However, it was only since the mid-1970s that intra-partum oropharyngeal suctioning with immediate postnatal intubation and direct tracheal suctioning were widely advocated as effective measures in preventing MAS<sup>(9,10)</sup>. Wiswell et al reported that the routine use of intubation and suctioning from the 1970s to the 1980s has significantly reduced the incidence of MAS and also its mortality<sup>(1)</sup>.

## METHODS

### Study population

The study population consisted of all neonates delivered in Singapore General Hospital in a 3-year period (January 1991 to December 1993) with thick MSAF and MAS. Data obtained from the statistical records of the Neonatal Department included the total annual livebirths and number of newborns with complications of MSAF and MAS. The antenatal and perinatal characteristics as well as complications primarily due to MAS were obtained from the neonatal case records.

### Definition of MAS

MAS was diagnosed using the following criteria:

1. A history of MSAF. The consistency of meconium-staining of the amniotic fluid was described as light, moderate or thick by the obstetrician in accordance to its appearance.
2. Radiological evidence of patchy consolidation with areas of atelectasis and hyperaeration.
3. The presence of respiratory distress such as tachypnoea, grunting and chest retractions. Respiratory distress is not considered an absolute criterion as newborns with mild MAS evident on chest X-ray may be asymptomatic.

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### Management of MSAF and MAS

All newborns with MSAF had intrapartum oropharyngeal suction performed by the obstetrician before delivery of the shoulders and the thorax. Immediately after delivery, babies with thick MSAF as well as those with light or moderate MSAF with respiratory distress or depression were subjected to direct tracheal suction and monitored in the level 2 or 3 nursery depending on the baby's condition. Oxygen therapy was given via a hood, nasal CPAP device or mechanical ventilation to maintain adequate oxygenation. Investigations done for newborns with thick MSAF and all symptomatic neonates included chest X-rays, full blood count, pyogenic blood culture and arterial blood gas analysis. Neonates confirmed to have radiological evidence of MAS were given antibiotics for seven days (iv ampicillin 50 mg/kg/day 12 hourly and im gentamicin 2.5 mg/kg/dose 12 hourly). If the subsequent chest X-ray on day 7 showed no residual disease and the baby is asymptomatic, antibiotics were discontinued.

Newborns with light MSAF who were asymptomatic were observed in the level 1 nursery for at least 24 hours before discharge.

### Statistical methods

Statistical analysis was performed using the chi-squared test for dichotomous variables and unpaired student's t-test for the comparison of continuous variables.

A p-value of less than 0.05 was considered statistically significant.

### RESULTS

From January 1991 to December 1993, there were 12,268 liveborn neonates, of which 1,893 (15%) had MSAF and 174 (1.4% livebirths) developed MAS. The annual incidence of newborns with MSAF remained at approximately 15% throughout the 3-year period. However, the incidence of MAS in babies with MSAF showed a gradual decline from 11% in 1991 to 6.2% in 1993 ( $p=0.03$ ).

The majority of babies with MAS did not have any antenatal complications. The most common antenatal complications were maternal pre-eclampsia (11.5%) and maternal pyrexia (11%) (Table I).

The perinatal characteristics of this cohort of babies with MAS is shown in Table II.

**Table I - Antenatal complications of neonates with MAS**

Antenatal complications	No. (n=174)	%
Maternal pre-eclampsia	20	11.5
Maternal pyrexia	19	11
Prolonged rupture of membranes	9	5
Gestational diabetes mellitus	7	4
Oligohydramnios	5	3
Maternal infection	2	1
Antepartum haemorrhage	1	0.5

**Table II - Perinatal characteristics of babies with MAS**

Perinatal characteristics	No. (n=174)	%
Race		
Chinese	74	42
Malay	82	47
Indian	15	9
Others	3	2
Males	107	62
Post-dates (>40 weeks)	96	55
Small for gestational age	14	8
Mode of delivery		
normal vaginal delivery	35	26
forceps delivery	17	13
vacuum extraction	11	8
emergency LSCS	71	53
Consistency of MSAF		
light	3	2
moderate	38	22
thick	133	76
I min APGAR < 4	17	10
5 min APGAR < 6	4	2
	Mean	SD
Birthweight (gm)	3,256	522
Gestation (weeks)	39.6	1.2

### Meconium aspiration syndrome: Morbidity and mortality

The symptomatology of MAS depends on its severity and ranged from the asymptomatic to respiratory failure with persistent pulmonary hypertension and death. In this study, only 42 (24%) of babies with radiological evidence of MAS developed respiratory distress requiring oxygen therapy for more than 24 hours, of which 9 were on mechanical ventilation. Ninety-one (52%) had metabolic acidosis (pH <7.2 and base deficit >5) needing correction with 4.2% sodium bicarbonate (Table III). Other complications of MAS were uncommon; pneumothorax 4 (2%), persistent pulmonary hypertension 3 (2%) and hypoxic ischaemic encephalopathy 1 (0.5%). The mortality rate of MAS in this study was 2%. All 3 deaths were due to persistent pulmonary hypertension.

### Newborns with thick MSAF

#### Presence of meconium in the trachea and incidence of MAS

During the same study period, there was a total of 219 neonates with thick MSAF, of which 106 (48%) were found to have meconium suctioned from the trachea at delivery and 76 (72%) were diagnosed to have MAS. Although 113 (52%) of babies with thick MSAF did not have any meconium suctioned from the trachea, 57 (50%) developed MAS. The presence of meconium in the trachea significantly increased the risk of MAS, but the absence of meconium obviously did not preclude its occurrence as aspiration may occur in-utero with dispersion of meconium to the smaller bronchioles.

**Table III - Morbidity and mortality in babies with MAS**

Complications	No. (n=174)	%
Metabolic acidosis	91	52
Pneumothorax	4	2
Persistent pulmonary hypertension	3	2
Hypoxic ischaemic encephalopathy	1	0.5
Death	3	2

Eighty-six (39%) babies with thick MSAF did not have clinical signs or radiological evidence of MAS. However, as 14 (16%) of these babies actually had meconium suctioned at birth, it is reasonable to conclude that effective resuscitation prevented aspiration. Therefore, routine oropharyngeal and tracheal suctioning of neonates with thick MSAF should continue to be practised to minimise the occurrence of MAS.

#### Predictors of MAS in babies with thick MSAF

The antenatal and perinatal characteristics of thick MSAF babies with and without MAS were compared to determine if there were predictive factors of MAS. Factors found to be significantly related to MAS in thick MSAF babies were male gender, smallness for gestational age, evidence of fetal distress and meconium in the trachea at birth (Table IV).

**Table IV - Thick MSAF neonates with and without MAS: comparison of perinatal characteristics**

Perinatal factor	MAS (n=133) No. (%)	No MAS (n=86) No. (%)	p value
Male	79 (59)	39 (45)	0.04 *
Post-dates	77 (58)	50 (58)	0.97
BW (g), mean (SD)	3,209 (490)	3,075 (482)	0.99
GA (wks), mean (SD)	39.7 (1.2)	39.5 (1.4)	0.14
SGA	11 (8)	15 (17)	0.04*
Fetal distress	31 (23)	8 (9)	0.01*
Em LSCS	61 (46)	29 (34)	0.07
1 min APGAR < 5	14 (11)	8 (9)	0.77
5 mins APGAR < 7	3 (2)	4 (5)	0.36
Meconium in trachea	47 (35)	14 (16)	0.01*
BW	birthweight		
GA	gestational age		
SGA	small for gestational age		
*	p < 0.05		

## DISCUSSION

The incidence, morbidity and mortality of MAS in Singapore General Hospital was found to be similar to previous reported series. Although the annual incidence of MSAF remained stable at 15%, the significant decline in the annual incidence of MAS from 11% to 6.2% over the 3-year study period was most likely attributed to improved perinatal management and resuscitation of the newborn with MSAF.

As 76% of 174 neonates with MAS were delivered through thick MSAF, timely and adequate resuscitation of this group of newborns is crucial in reducing the incidence of MAS. It is not beneficial that all asymptomatic babies delivered through light or moderate MSAF be subjected to a screening chest X-ray in view of the radiation exposure and cost. In contrast, as only 0.3% and 5.8% of babies with light and moderate MSAF respectively developed MAS, the current management of babies with light and moderate MSAF is adequate in the context of limited resources and manpower. The management of newborns with MSAF is in accordance to guidelines proposed at the "1992 National Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care in Dallas"<sup>(11)</sup>.

This study attempted to identify antenatal and perinatal characteristics of neonates with thick MSAF which may predict the development of MAS. The positive factors identified were male gender, smallness for gestational age, fetal distress and presence of meconium in the trachea at delivery. In the presence of MSAF upon rupture of membranes, the additional problems of intra-uterine growth retardation with evidence of fetal distress as evidenced by abnormal cardio-tocography trends should alert us to greater vigilance in ensuring closer perinatal monitoring and optimal timing of delivery followed by adequate suction of the airway and resuscitation of the newborn at birth.

There is much controversy regarding the pathophysiology of MAS, obstetric intervention and delivery-room management of MSAF babies. However, even the use of increasingly sophisticated equipment in perinatal monitoring and the best

resuscitation efforts will not completely prevent the occurrence of MAS because aspiration of MSAF can occur undetected in-utero.

Newer modes of neonatal management of MAS are emerging and the effectiveness of the use of surfactant and liquid ventilation with perfluorochemicals are being tested in clinical trials<sup>(7)</sup>. Adjunctive therapies with ECMO and inhaled nitric oxide are reported in babies with MAS complicated by persistent pulmonary hypertension. Although ECMO has been reported to increase the survival of babies who did not respond to conventional mechanical ventilation, the adverse sequelae and cost of the technique make it an unattractive alternative until further refinements are made. Therefore, management of MAS will remain a challenge in neonatal intensive care.

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