GUIDELINE

# Meconium Aspiration Syndrome

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| **Scope (Staff):** | Nursing and Medical Staff |
| **Scope (Area):** | NICU KEMH, NICU PCH, NETS WA |

**Child Safe Organisation Statement of Commitment**

CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.

**This document should be read in conjunction with this disclaimer**

## Aim

This guideline aims to describe clinical features and management of newborn infants with meconium aspiration syndrome (MAS).

## Risk

Non-adherence to the guideline may increase morbidity and mortality in infants with MAS.

## Definition

MAS is a clinical diagnosis that includes delivery through meconium-stained amniotic fluid (MSAF) with respiratory distress, characteristic appearance on chest x-ray and lack of alternative diagnosis for respiratory distress.

## Background

- Meconium-stained liquor occurs in 8–25% of births and, among these between 3% and 12% of infants born with MSAF develop MAS.
- Incidence of MAS increases between 38 and 42 weeks, from 0.24% to 1.42%
- Risk factors are caesarean delivery, advanced gestation, ethnicity, low Apgar score at birth, and fetal heart rate abnormalities.
- MAS often occur in the post-mature infant or in the presence of other placental insufficiency syndromes.

- The clinical course is variable with mild respiratory distress to the most severe cases of respiratory distress with hypoxic respiratory failure and persistent pulmonary hypertension of new-born.
- Infants with MAS are at higher risk of having pulmonary air leaks and hypoxic-ischaemic encephalopathy.

## Pathophysiology

- The pathophysiology of MAS is complex. Meconium is comprised of gastrointestinal, hepatic, and pancreatic secretion, cellular debris, swallowed amniotic fluid, lanugo, and vernix. It begins to appear in the fetal intestine by the twelfth week of gestation. However, because of good anal sphincter tone, lack of strong peristalsis, and low level of motilin, in utero passage is uncommon until term. In utero hypoxia and acidosis can cause vagal response leading to increased peristalsis and a relaxed anal sphincter resulting in meconium passage.
- Intra-uterine distress (at any time in gestation) may initiate gasping in utero. This may result in amniotic fluid and particulate matter to be inhaled into the large airways. When meconium particles are aspirated, it causes physical obstruction of airways, chemical pneumonitis leading to surfactant dysfunction and inflammation which further leads to parenchymal disease.
- The meconium causes a ball-valve effect in the airways, resulting in complete obstruction of airways causing areas of collapse or atelectasis or areas of overexpansion due to gas trapping and air leak.
- Meconium is a potent activator of inflammatory mediators, including cytokines, complement, prostaglandins and reactive oxygen species. Meconium activates two main recognition systems of innate immunity, the Toll-like receptors, and the complement system, which not only leads to lung dysfunction (pneumonitis) but also causes systemic inflammatory response.
- The atelectasis, hypoventilation, acidosis may lead to secondary persistent pulmonary hypertension (PPHN). The acidosis contributes to PPHN resulting in right to left shunting of blood causing severe hypoxemia. Hypoxemia contributes to ventricular dysfunction and complicates PPHN. Left ventricular dysfunction elevates left atrial pressure causing pulmonary venous hypertension and exacerbates hypoxemia.

## Clinical Presentation

The infant with MAS may have cyanosis, tachypnoea, grunting, nasal flaring, retractions, a hyper inflated chest (barrel shaped chest) and coarse breath sounds on auscultation. They may have marked swings in oxygen saturation due to intra and extra-pulmonary shunting. Poor perfusion may result from impaired cardiac function.

## Investigations

- Pre and post-ductal oxygen saturations to measure the degree of shunting.

- Echocardiogram is gold standard to diagnose PAH and to exclude cyanotic heart disease.
- Chest X-ray findings include diffuse, asymmetric, patchy, or streaky infiltrates with areas of hyperinflation, consolidation, or atelectasis, pneumo-mediastinum, pleural effusions, and pneumothorax.
- Ultrasound can be used in the diagnosis of MAS and pneumothorax by those trained in lung ultrasound.

## Management of MAS

**In the birthing room:** Routine intubation immediately after birth for tracheal suctioning for vigorous or non-vigorous infants exposed to MSAF is not recommended (ANZCOR 2023 Neonatal Resuscitation).

Emphasis should be placed on initiating ventilation rapidly in non-breathing or ineffectively breathing newborns. Rarely, a newborn may require intubation and tracheal suctioning to relieve airway obstruction.

Respiratory management of infants with MAS is challenging due to inhomogeneous lung disease with areas of atelectasis/consolidation and hyperinflation/pneumothorax. In addition, MAS increases risk of PPHN.

Management of MAS is similar to that of pulmonary hypertension (Refer to Persistent Pulmonary Hypertension of the Newborn) and involves:

1. Treating with antibiotics until sepsis is excluded
2. Pre and post-ductal saturation monitoring
3. Optimising temperature and glucose regulation
4. Minimising handling. Typically, infants with MAS are overly sensitive to handling, therefore discuss frequency of routine cares and handling with consultant and senior nursing staff. Pressure relieving devices should be used.
5. Adequate oxygenation therapy forms the mainstay of PPHN therapy. Some authors recommend maintaining higher oxygen saturation targets for SaO2 (94-98%) and pre-ductal PaO2 (60-100 mmHg).
6. Inhaled nitric oxide (iNO) is a selective pulmonary vasodilator and will decrease pulmonary arterial pressure if it gets into the airways and should be considered in infants requiring $FiO_2$ >0.6 after optimizing ventilation.
7. Surfactant. In systematic reviews surfactant administration was found to reduce the severity of respiratory illness, the duration of mechanical ventilation, hospital stay, and ECMO support. Consider Surfactant therapy for infants with MAS who are ventilated, and in >50% oxygen. Some infants may acutely deteriorate after surfactant administration in a single bolus so surfactant administration should always be discussed with the consultant and may need to be given in 2-3 aliquots because of the large volume.
8. Mechanical ventilation. Refer to Persistent Pulmonary Hypertension of the Newborn. High Frequency Jet Ventilation, High Frequency Oscillatory

Ventilation. Use premedication for non-emergency intubations. Ventilated infants may require sedation with opioids (morphine / fentanyl) and occasionally benzodiazepines (midazolam) to minimise pain and agitation that can result in ventilatory asynchrony and pulmonary vasoconstriction. Avoid routine use of muscle paralysis as it is associated with increased mortality.

## Extra Corporeal Membrane Oxygenation (ECMO) for the Neonate

With the use of inhaled nitric oxide, surfactant, and high frequency ventilation the need for ECMO has decreased. Consider ECMO for the infants with MAS and severe respiratory failure unresponsive to conventional management. Involve parents in the decision making. Typically, infants >34 weeks gestation and >2000grams with reversible cardiac/pulmonary failure and no major neurological insult are potential candidates for ECMO.

## Prognosis

The prognosis of infants with meconium aspiration syndrome is dependent on the degree of severity of the pulmonary hypertension and other end-organ involvement.

| Related CAHS internal policies, procedures and guidelines |
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| ECMO |
| High Frequency Jet Ventilation |
| High Frequency Oscillation Ventilation |
| Neonatal Medication Protocols (health.wa.gov.au) |
| Nitric Oxide Therapy |
| Persistent Pulmonary Hypertension of the Newborn |

**References and related external legislation, policies, and guidelines**


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