

Meconium Aspiration Syndrome

Key Points

- Thin or old meconium rarely causes a problem; but thick / particulate meconium can.
- Aspiration of meconium can cause a range of problems including **airway obstruction, pneumothorax, pulmonary inflammation** and **surfactant inactivation** and **persistent pulmonary hypertension**
- Meconium Aspiration Syndrome can range from mild respiratory distress to significant hypoxia.
- There is an association with HIE and some babies may also need therapeutic cooling.

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Abbreviations

CPAP	Continuous Positive Airway Pressure
HFOV	High Frequency Oscillation Ventilation
LFNC	Low Flow Nasal Cannula
MAS	Meconium aspiration syndrome
MSAF	Meconium-stained amniotic fluid
NLS	Neonatal Life Support
OI	Oxygenation Index
PIP	Peak Inspiratory Pressure
PPHN	Persistent Pulmonary Hypertension of the Newborn
UAC	Umbilical Artery Catheter

Contents

Definition.....	3
Clinical features and Diagnosis	3
Differential Diagnosis	3
Clinical Management.....	4
Resuscitation and Post Delivery Prevention of MAS	4
Subsequent Observations	4
Admission to SCBU	4
Surfactant	4
Cardiovascular	5
Investigations	5
Monitoring.....	5
CFM and Therapeutic Hypothermia.....	5
Sepsis.....	5
References	6
Full version control record	7

Definition

Meconium aspiration syndrome (MAS) is defined as respiratory distress in newborn infants born through meconium-stained amniotic fluid (MSAF) whose symptoms cannot be otherwise explained ^[1].

MAS can present with varying degrees of severity from mild respiratory distress to life-threatening respiratory failure.

Passage of meconium may occur during fetal distress and is commoner in post-term labours. Thin or old meconium rarely causes problems but thick / particulate meconium is more likely to cause problems. Aspiration of meconium can lead to **airway obstruction** (and risk of **pneumothorax**), **pulmonary inflammation** and **surfactant inactivation** ^[2], as well as **persistent pulmonary hypertension**. There may also be associated hypoxic ischaemic encephalopathy.

- **Airway obstruction:** large particles of meconium block airways causing hypoxia and can lead to alveolar collapse (and VQ mismatch). Obstruction with meconium can also have a ball-valve effect leading to overdistention and risk of hyperinflation / over-distention and **pneumothorax** (and other air leaks syndromes) ^[2].
- **Pulmonary inflammation:** following meconium aspiration there is an increase in alveolar neutrophils and inflammatory mediators (eg cytokines etc) resulting in inflammation and alveolar epithelial cell damage. There is often a **systemic inflammatory response** with reduced WCC and increased CRP ^[2].
- **Surfactant inactivation:** meconium directly damages the cells that produce surfactant as well as changing the properties of surfactant to make it inactive ^[2].
- **Persistent pulmonary hypertension:** pulmonary vascular resistance remains high due to hypoxia from inadequate inflation of the lungs and VQ mismatch.

Clinical features and Diagnosis

MAS is diagnosed on the clinical history of an infant born through meconium-stained liquor, with respiratory distress (tachypnoea, cyanosis, grunting and increased work of breathing) soon after birth. Coarse patchy opacification is seen on CXR.

The diagnosis is supported by acidosis and meconium suctioned from below the cords (sometimes a respiratory alkalosis due to tachypnoea may be seen). CXR findings are not prognostic for severity of MAS.

Differential Diagnosis

Transient Tachypnoea of the Newborn
Sepsis
Cyanotic congenital heart disease
Respiratory Distress Syndrome (RDS)
Pneumothorax
Developmental lung conditions

Clinical Management

Resuscitation and Post Delivery Prevention of MAS

- A multicentre randomised controlled trial found there was no advantage in oral and pharyngeal suction as the head delivers^[3].
- If the baby requires resuscitation, follow the NLS algorithm. If a baby has inhaled significant quantities of thick meconium, then very likely that baby is stressed and has been gasping^[5]. Initial resuscitation efforts should be directed at inflating the lungs and follow the standard NLS algorithm^[5].

Subsequent Observations

If a baby is born in reasonable condition but with thick meconium present, the baby can stay with mother with observations carried out at 1 hour and 2 hours and then 2-hourly for 12 hours.

(For thin or old meconium, then only a single set of observations is required.)

Admission to SCBU

- If baby develops respiratory distress or cyanosis, then admit promptly to SCBU.
- For full term babies, give generous oxygen aiming to keep SaO₂ at 95-100%^[4] (good oxygenation may prevent/lessen PPHN).

Respiratory support

This depends on the severity of the MAS and can range from Low Flow Nasal Cannula (LFNC) Oxygen to High Flow Therapy (HFT) or CPAP to mechanical ventilation.

- **LFNC:** in mild MAS this is often sufficient.
- **HFT / CPAP:** Although there is an increased risk of air leaks in MAS, HFT and CPAP can be used and have been shown to reduce the number of babies with MAS needing intubation and ventilation^[6].
- **Ventilation:** around a third of babies with MAS need ventilation.
 - Ventilation is indicated if hypoxia/high FiO₂ (FiO₂ > 0.6)^[4], hypercapnia (PaCO₂ > 8kPa) or acidosis (pH < 7.25)^[2]
 - Ventilation may be indicated for poor perfusion or blood pressure
 - Use Volume ventilation with tidal volume 4-5mls/kg, may need to use higher tidal volumes, e.g., 6mls/kg
 - Increased PIP^[4] (>30 cmH₂O) may be required to achieve adequate tidal volumes.
 - Consider using a longer IT (0.4s or higher) with slower rates^[4] (to avoid incomplete expiration and air trapping)
 - Aim for normocarbida (PaCO₂ 4-5.5 kPa) and O₂ sats > 95%^[4].
 - Consider HFOV (High Frequency Oscillation Ventilation) especially if PIP is >30cm H₂O. Please discuss with and get guidance from Tertiary Neonatal Unit beforehand (please see tertiary unit HFOV guideline for further information).
 - Sedate baby well and add vecuronium if not settled easily on morphine.
 - Optimise filling with fluid bolus prior to sedation and paralysis.

Surfactant

Consider treatment with surfactant either by bolus or lavage. However, there is a lack of clear evidence to demonstrate a benefit of surfactant and which method (bolus or lavage) is superior^[7], therefore please discuss with consultant before administration.

(Limited) evidence suggests that surfactant treatment in MAS does not have an increased rate of complications^[7].

Cardiovascular

- Ensure adequate filling (may need fluid bolus 0.9%NaCl) and aim for BP at upper end of normal range (to try to avoid PPHN).

Investigations

- Partial septic screen – FBC, CRP, Blood Cultures
- PCV
- Serial Blood gases – if concerns regarding PPHN please do atrial gas and calculate OI.
- Blood Glucose, (U+E, LFT, Bone profile, Coagulation screen – if considering PPHN or HIE)
- CXR
- Cranial USS (important if considering transfer or ECMO)
- Echocardiogram (if available) – to establish cardiac anatomy and evidence of PPHN.

Monitoring

- **for PPHN:** if baby remains hypoxic despite high FiO₂ with a pre/post ductal saturation discrepancy (>5%, often 10-15%) then:
 - inform consultant early.
 - please refer to tertiary PPHN guideline for further management including investigations and treatment strategies
 - discuss with tertiary neonatal unit and neonatal transfer team early.
- For severely unwell babies requiring arterial access, consider right radial arterial line rather than UAC (umbilical artery catheter) so that arterial gases will be pre-ductal and an accurate OI (Oxygenation Index) can be calculated (see tertiary neonatal PPHN guideline for further information on calculation of IO).

Other considerations:

CFM and Therapeutic Hypothermia

Remember there is an association between MAS and HIE. Use therapeutic hypothermia guideline to determine which babies reach criteria for active cooling.

Sepsis

Cover for sepsis with antibiotics: First line: Benzyl penicillin and Gentamicin

References

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Version History

Version	Date	Guideline Lead(s)	Status	Comment
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3	Oct 2018	Dr K Gardner, Consultant Paediatrician	Final	
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Related Documents

Document Type	Document Name
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