Meconium stained amniotic fluid and meconium aspiration syndrome

Incidence

Meconium can be found in the gastrointestinal tracts of fetuses as early as 14-16 weeks gestational age. Although 75% of meconium is water, the remaining 25% consists of gastric secretions, bile salts, mucus, vernix, lanugo, blood, pancreatic enzymes, free fatty acids and squamous cells. Meconium staining of the amniotic fluid (MSAF) is found in approximately 15% of pregnancies. MSAF rarely occurs before 38 weeks' gestation. The incidence of this condition increases with longer gestations and approximately 30% of newborns have MSAF at 42 weeks.

Several lines of evidence challenge the concept that aspiration of meconium is responsible for severe MAS and suggest that other events cause the syndrome, with meconium in the lungs as an co- incidental finding. The passage of meconium in utero may be a response to stresses such as chronic hypoxia, acidaemia or infection, processes that may interfere with clearing of meconium.

Consequences

The most severe condition associated with meconium passage in utero, the meconium aspiration syndrome (MAS), occurs in 2 to 5% of patients with MSAF. At RPA Hospital from 1992-1997, 102 infants had a diagnosis of MAS. Forty-seven (46%) were ventilated with 3 (6% of ventilated infants) dying.

Diagnosis

Usually, MAS is diagnosed on the clinical history of an infant born through meconium stained liquor, an infant with respiratory distress and coarse opacification seen on CXR. The diagnosis is supported by acidosis and meconium suctioned from below the cords. CXR findings are not prognostic on severity of MAS.

Treatment

Pre-delivery prevention of MAS:

Routine induction before 41 weeks reduces perinatal mortality, but only shows a trend towards reduction of MAS. Amnioinfusion for meconium stained liquor in labour can reduce the number of babyÂ’s developing MAS (RR 0.44, 95%CI 0.25-0.78), but is associated with some serious maternal side effects. The benefit of this therapy needs to be further investigated before implementing.

Post delivery prevention of MAS:

Post delivery prevention of MAS used to be focussed on adequate suctioning. It was believed that diligent suctioning of the fetal oropharynx and trachea at delivery could decrease the rate of MAS. However, recent randomized studies showed no reduction of severe MAS with early oropharyngeal suctioning and/or
endotracheal suctioning of the trachea.

- Paediatric staff should be present at deliveries where there is thick meconium staining of the liquor or where there is evidence of fetal distress.
- A multicentre randomised controlled trial found there was no advantage in oral and pharyngeal suction as the head delivers. ⁸
- If the baby is apparently vigorous at birth (heart rate >100, spontaneous respiration, reasonable tone), intubation and tracheal suction is not indicated, unless the baby subsequently has poor respiratory effort or early respiratory distress. ⁷⁻⁹
- Intubation should be performed after adequate suctioning to clear the airway if the baby is depressed at birth or if the baby is not maintaining adequate ventilation (like in any resuscitation of the newborn). Tracheal suction should be performed if the baby has moderate or thick meconium obstructing the airways. ⁷
  - Suction trachea quickly following intubation prior to initiation of IPPR (if this is necessary)
  - Use low flow wall suction set at 100-120mmHg (measured when tubing is occluded)
  - Pass a size 3 - 3.5mm endotracheal tube to the carina (gentle resistance is met at ~ 5cm below cords)
  - Attach the meconium aspirator, occlude the side port and withdraw the endotracheal tube. Once is usually sufficient unless tube is obstructed with meconium.
- An extended period of time spent intubating and aspirating meconium should be avoided, since these babies may have an urgent need for oxygen.

As a guideline, three clinical different scenarios of MAS can happen. At one end of the clinical spectrum there is the apparently vigorous baby (heart rate >100, spontaneous respiration, reasonable tone). Intubation and tracheal suction is not indicated in this group. At the other end is the completely flat baby, in which quick suction of the trachea prior to initiation of IPPR followed by intubation is a good option. One must remember that those babies may have an urgent need for oxygen, so an extended period of time spent intubating and aspirating meconium should be avoided. The babies born through meconium who present in between the aforementioned scenarios should be managed with a focus on normal resuscitation guidelines with attention to the airway (suction if necessary), breathing (proper bag and mask ventilation or intubation) and circulation.

**Treatment of established MAS:**

With an established MAS, treatment is focussed on the proposed pathophysiology. At the pulmonary level, MAS is believed to be caused by a combination of mechanical blockage of small airways and production of chemical pneumonitis by meconium particles, inactivation of surfactant and pulmonary vasoconstriction. Respiratory disease in these infants is a combination of aspiration, asphyxia and pulmonary hypertension so prompt provision of adequate oxygenation is essential.

Ventilatory strategies are set to prevent air-trapping by allowing enough expiratory time and/or apply high frequency ventilation ¹⁰. Animal studies suggest optimum oxygenation can be achieved by supplying enough PEEP for alveolar recruitment ¹¹. Babies at risk of pulmonary hypertension need to remain at all times in optimal inspired oxygen to keep PaO₂ 100-120 mmHg or SaO₂ > 98%. CO₂ should be targeted at the normal range (35-40 mmHg) to provide an optimal pH. Sedation and paralysis should be started if the baby is not synchronized with the ventilator.

Correcting acidosis can improve cardiac function ¹² and optimal hemoglobin is needed for adequate tissue oxygenation. Maintaining normal to high systemic blood pressure in MAS with pulmonary hypertension can improve oxygenation. ¹³-(see PPHN guideline)

Surfactant treatment reduces the number of infants requiring ECMO but showed no differences in mortality ¹⁴. In the largest of studies of this systematic review the treatment group received up to 4 doses of 150mg/kg Survanta every 6 hours. A click test could assess the need for surfactant in MAS.

Nitric Oxide treatment improves outcome in near term babies with severe hypoxic respiratory failure including MAS and can be started after echocardiographic confirmation of pulmonary hypertension. ¹⁵.
There is insufficient evidence that steroids reduce mortality or morbidity in MAS, but one cohort study showed benefit from the combination of surfactant lavage and steroids.\(^\text{17}\). Dexamethasone may facilitate extubation of infants who are unable to be weaned from the ventilator, and it may be considered for use after informed parental consent.\(^\text{18}\).

### Key Points

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### References

5. Crowley P. Interventions for preventing or improving the outcome of delivery at or beyond term. Cochrane Database Syst Rev. 2000;(2):CD000170


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