SECTION: 2 RESPIRATORY PROBLEMS AND MANAGEMENT

MECONIUM ASPIRATION SYNDROME (MAS)

Respiratory distress in the presence of meconium liquor with patchy opacification and hyperexpanded lung fields on CXR.

EPIDEMIOLOGY

- Meconium stained liquor occurs in ~3-24% of all deliveries.
- Before 37 weeks gestation, the risk is < 2%,
- After 42 weeks the risk is ~40%.
- Thick meconium in the liquor increases the risk of fetal acidosis and is related to adverse outcome. Thick meconium, fetal tachycardia or absent response to contractions may identify an infant at high risk.
- MAS often occurs in the post-mature infant or in the presence of other placental insufficiency syndromes.

PATHOPHYSIOLOGY

There is often a history of fetal distress and meconium in the liquor. 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, which then causes obstruction at delivery.

The meconium causes a ball-valve effect in the airways, resulting in areas of collapse and areas of overexpansion due to gas trapping. Air leak is common. Chemical inflammation from the meconium leads to a pneumonitis.

Meconium also inhibits endogenous surfactant. Secondary persistent pulmonary hypertension is present as a result of the atelectasis, hypoventilation, acidosis and intra-pulmonary shunting.

CLINICAL PRESENTATION

The infant with MAS may be cyanosed, tachypneic, with a hyperinflated chest. 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.
- Hyperoxia test may help to eliminate the possibility of cyanotic heart disease. This involves administering 100 % oxygen to the infant for 15 minutes and observing the pre and post ductal oxygen saturation. The saturations should not increase in cyanotic heart disease. However, the oxygen saturation may not increase in a critically sick neonate with MAS also. In this case an arterial blood gas should be performed. In cyanotic heart disease, the $PaCO_2$ will be normal to low, where as in meconium aspiration syndrome, it is invariably high.
- Any infant with MAS who is requiring FiO_2 > 0.6 should have an echocardiogram to exclude cyanotic heart disease.
- Chest X-ray typically shows patchy opacifications with areas of atelectasis and other areas of hyperinflation.

MANAGEMENT

Early stabilisation is the most important management strategy. The pre-ductal saturation indicates oxygen saturation of blood supplied to the brain; and hence, ventilator changes should be made based on pre-ductal saturations where possible. Management should be

similar to that of treating for pulmonary hypertension: *See Persistent Pulmonary Hypertension of the Newborn*

1. Treat with antibiotics until sepsis excluded.
2. Temperature / glucose regulation.
3. Inhaled nitric oxide (iNO) is a selective pulmonary vasodilator and hence will decrease pulmonary arterial pressure if it gets into the airways. It should be considered in infants requiring FiO_2 >60% after optimizing ventilation. Consider echocardiography at this stage.
4. **Other vasodilator drugs:** Phosphodiesterase inhibitors like sildenafil and milrinone may be of benefit as a vasodilator to decrease pulmonary vascular resistance. Milrinone should be used cautiously as it may cause systemic hypotension, especially when used in conjunction with iNO.
5. High Frequency Jet Ventilation (HFJV): The combination of atelectasis and air trapping that occurs in MAS may be managed better with HFJV than high frequency oscillation ventilation (HFOV). Use lower HFJV rate to avoid air trapping; and higher PEEP to splint airways and allow meconium to evacuate. Refer to HFJV clinical guidelines for details.
6. In presence of pulmonary hypertension, the pulmonary arterial blood pressure may be supra-systemic, therefore higher systemic blood pressures are needed to overcome the pulmonary pressure and allow blood flow into the lung. Optimising blood pressure will help to improve pulmonary blood flow. Although, inotropic support with dopamine or adrenaline may help to push systemic blood pressure above pulmonary blood pressure; these should be used with caution because of their non-selective nature of vasopressor action, resulting into worsening of pulmonary hypertension and increasing cardiac afterload.
7. Sedation with morphine or midazolam may help decrease pulmonary arterial pressure. Judicious use of muscle relaxant may be required in situations where patient continues to "fight" against ventilator. If muscle relaxation is required; vecuronium is preferred to pancuronium because it has minimal effect on the heart.
8. In presence of pulmonary hypertension with right to left shunt, maintaining patency of ductus arteriosus with prostaglandin E1 infusion may improve right ventricular function by decreasing afterload.
9. High Frequency Oscillation Ventilation (HFOV) / iNO: HFOV can assist in opening up the lung to improve administration of iNO, and improve oxygenation and CO_2 removal. Because neonates may already have hyper-inflated lungs with MAS, volume optimisation must be achieved with care due to potential for air leak. Start the infant on a MAP equal to that on the conventional ventilator and gradually increase it. See HFOV / iNO for detailed management.
10. Surfactant: Meconium inactivates endogenous surfactant. Surfactant improves gas exchange and decreases the oxygenation index. The need for ECMO has significantly reduced since iNO and surfactant have been administrated to infants with severe MAS. Exogenous surfactant may be given every 6 hours and the dose may be repeated as many times as needed. Surfactant should be considered for any infant with MAS who is ventilated and in > 50% oxygen. Some infants may acutely deteriorate after bolus surfactant administration. Therefore; surfactant administration for MAS should always be discussed with consultant. Surfactant may need to be given in more than two aliquots because of the large volume.
11. Minimal handling: Typically the infants with MAS are very sensitive to handling. Frequency of routine cares and handling should be discussed with consultant and senior nursing staff. Ensure pressure relieving devices are utilised.
12. Weaning an infant off therapy needs to be a slow process and attempted only after discussion with a consultant.
13. ECMO: With the use of inhaled nitric oxide, surfactant and high frequency ventilation need for ECMO has decreased. Consider ECMO for the infants with MAS and severe respiratory failure unresponsive to the conventional management. Always discuss with

other neonatal consultants before discussing with PICU consultant regarding eligibility and feasibility. Involve parents in the decision making. Typically the infants more than 34 weeks gestation and more than 2000 g weight with reversible cardiac/pulmonary failure and no major neurological insult are potential candidates for ECMO.

14. The prognosis of infants with meconium aspiration syndrome is dependent on the degree of severity of the pulmonary hypertension and other end-organ involvement. With the dramatic recent reduction in incidence of air leak, the mortality has dropped to 0.15 %.

National Standards – 1- Care provided by the clinical workforce is guided by current best practice
Legislation -
Related Policies - Persistent Pulmonary Hypertension of the Newborn
Nitric oxide
Vecuronium
High Frequency Oscillation Ventilation

Other related documents –

RESPONSIBILITY	
Policy Sponsor	**Neonatology Clinical Care Unit**
Initial Endorsement	June 2006
Last Reviewed	June 2015
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