

CASE SIX

SHORT CASE NUMBER: 3_9_6

CATEGORY: CHILDREN & YOUNG PEOPLE

DISCIPLINE: PAEDIATRICS

SETTING: HOSPITAL

TOPIC: NEONATAL PROBLEMS – BREATHING PROBLEMS IN THE NEWBORN PERIOD

Case

Luke Tobius, was born at 38+2 weeks gestation. His mother, May Tobius, G4P3, presented to the labour ward at full dilation with the baby's head on view and the presence of thick meconium. Within 3 minutes of arrival on labour ward Luke was born by normal vaginal delivery. His Apgar scores were 5 and 7 at 1 and 5 minutes respectively. He was transferred to the NICU where there was rapid onset of respiratory distress requiring 40% headbox oxygen. Chest x-ray revealed hyperinflation and coarse opacification.

Questions

1. Outline your management of Luke in terms of history, examination, investigation and management.
2. What is the likely diagnosis and why?
3. Respiratory distress is a generic term. Briefly explain what is meant by this term.
4. Summarise the key features of transient tachypnoea of the newborn (TTN).
5. In a table summarise the acute, subacute and chronic complications of respiratory distress syndrome.
6. Summarise the key aspects of treatment of a neonate with respiratory distress syndrome.
7. In a table briefly summarise the key features of congenital diaphragmatic hernia, oesophageal atresia and tracheo-oesophageal fistula.

Suggested reading:

- Jardine, L. & Davies, M. (2012) Breathing problems in the newborn. In: M. South. & D. Isaacs (Eds.) *Practical Paediatrics* (7thed). (pp. 352 – 362) Edinburgh: Churchill Livingstone/Elsevier.

1. Outline your management of Lyn in terms of history, examination, investigation and management.

History

The perinatal history should include the details of antenatal care, gestational age, the presence of poly or oligohydramnios, anomalies detected on ultrasound, risk factors for sepsis, history of foetal movements, the time meconium first noticed, duration of membrane rupture.

Examination

A comprehensive examination of the baby, including the presence of meconium staining of the cord, skin and nails and particularly the respiratory, cardiac and neurological systems.

Investigations

In addition to a chest x-ray, investigations would include:

- bacteriology - deep cultures: blood, urine, cerebrospinal fluid, gastric aspirate
- virological studies - nasopharyngeal aspirate, blood
- haematocrit and full blood count - ancillary evidence for sepsis
- chest transillumination with cold light source - diagnosis of pneumothorax
- passage of nasogastric catheters – rule out a diagnosis of choanal atresia, oesophageal atresia

Management

Management will include making a diagnosis, temperature control, monitoring and management of oxygen, fluid, electrolytes, acid base status, and treating the specific cause of respiratory distress and/or complications thereof.

The most likely diagnosis is meconium aspiration syndrome. Treatment for meconium aspiration syndrome is as for respiratory distress, with emphasis on humidification of inspired gases, postural drainage and airway suction, and antibiotics. Other management strategies may include surfactant, paralysis with non-depolarizing muscle relaxant, inhaled nitric oxide, high-frequency oscillator ventilation and extracorporeal membrane oxygenation.

2. What is the likely diagnosis and why?

Meconium aspiration syndrome. The presence of thick meconium in labour, early onset respiratory distress in a term or near term baby, with a chest x-ray revealing hyperinflation and coarse opacification makes the diagnosis of meconium aspiration syndrome the most likely.

3. Respiratory distress is a generic term. Briefly explain what is meant by this term.

Respiratory distress is the generic term used to describe the following clinical signs persisting for more than 4 hours:

- tachypnoea - respiratory rate in excess of 60 per minute
- chest retraction or recession - intercostal, subcostal, sternal or substernal
- cyanosis in room air - central
- flaring of ala nasae - use of accessory respiratory muscles
- expiratory grunt - particularly in preterm infants.

4. Summarise the key features of transient tachypnoea of the newborn (TTN).

Retained foetal lung fluid occurs when either there is an excess of lung fluid or clearance mechanisms are inefficient.

- Benign disorder in 1-2% of newborn infants
- Onset of tachypnoea, cyanosis and grunt in first 1-3 hours
- Usually responds to 30-40% oxygen and settles in 24-48 hours but may persist for 3-5 days
- Term or near term infant, caesarean section, breech delivery, male sex, birth asphyxia, heavy maternal analgesia
- Chest X-ray reveals coarse streaking, fluid in fissures giving 'wet lung'
- When managing an infant with suspected transient tachypnoea of the newborn observe for signs of clinical deterioration that suggest other diagnoses and fatigue.

5. In a table summarise the acute, subacute and chronic complications of respiratory distress syndrome.

Complications of respiratory distress syndrome		
Acute	Subacute	Chronic
Cardiopulmonary		
Perinatal asphyxia	Encephalopathy	Neurosensory disability
Pulmonary air leak	Consolidation/collapse	Bronchopulmonary dysplasia
Patent ductus arteriosus	Lung oedema	Sudden infant death syndrome
Pulmonary hypertension	Opportunistic infection	Subglottic stenosis
Pulmonary haemorrhage		Chronic obstructive pulmonary disease
Cerebral		
Cerebroventricular haemorrhage	Ventricular dilatation	Hydrocephalus
Periventricular leukomalacia	Cysts	Porencephaly
		Cerebral atrophy
Gastrointestinal tract		
Necrotizing enterocolitis	Bowel obstruction	Malabsorption

6. Summarise the key aspects of treatment of a neonate with respiratory distress syndrome.

Observation and monitoring

- Observation for colour, chest recession, expiratory grunt, flaring of ala nasae
- Continuous monitoring - heart rate, respiratory rate, skin temperature, blood pressure
- Fluid balance chart
- Thermoregulation in servocontrolled incubator (open or closed)
- Maintain mean BP >30 mmHg using volume expanders and inotropic support.

Oxygen

- Monitor percentage delivered continuously with analyser or use of O₂ blender.
- Monitor oxygenation continuously with pulse oximetry and transcutaneous PO₂ + PCO₂ monitor
- Warm to 36-37°C and humidify to 90-100%
- Delivery into head box (if >30%) or servocontrolled incubator
- Indwelling arterial catheter enables sampling for blood gas analysis and continuous BP monitoring.

Fluids

- Avoid oral feeding; gavage feed if mild respiratory distress
- Intravenous fluids and electrolytes (added after 24 hours) for moderate/severe distress
- Total parental nutrition after 72 hours if not feeding.

Venous/arterial access

- Reliable venous access is provided by insertion of umbilical venous catheter or peripheral intravenous central line
- Insertion of an umbilical or peripheral arterial line will facilitate blood sampling for analysis of blood gases and electrolytes and continuous blood pressure monitoring.

Acid-base balance

- Monitor blood gases
- Metabolic acidosis - volume replacement, inotropic support, NaHCO_3
- Respiratory acidosis - $\text{pH} < 7.20$ and $\text{PCO}_2 > 60$ mmHg infant needs assisted ventilation.

Assisted ventilation

Assisted ventilation usually consists of continuous positive airway pressure (CPAP) via nasal prongs or face mask or mechanical ventilation (CPPV) via an endotracheal tube. Rarely ventilation is given non invasively via nasal prongs or a face mask. The need for assisted ventilation at birth is determined by condition at birth, birth weight and gestational age and whether mother received antenatal steroids.

An approach to assisted ventilation after birth is:

- 24-26 weeks gestation - intubation, CPPV and prophylactic exogenous surfactant
- 27-31 weeks gestation - CPAP for airway stabilization and careful monitoring and assessment if establishes adequate spontaneous (especially if antenatal steroids) respirations.

All infants - intubation, CPPV and surfactant if:

- $\text{FiO}_2 > 0.6$ to maintain $\text{PaO}_2 > 60$ mmHg
- moderate to severe apnoea
- marked chest retractions on CPAP with increasing oxygen requirements
- rising $\text{PaCO}_2 > 60$ mmHg with $\text{pH} < 7.20$.

Techniques of mechanical ventilation vary between neonatal units and include intermittent mandatory ventilation, patient triggered ventilation, volume ventilation and high-frequency oscillation. Large infants often struggle or 'fight' the ventilator and benefit from analgesia and sedation or paralysis with a non-depolarizing muscle relaxant.

Surfactant replacement

Exogenous surfactant (natural, synthetic, partially synthetic) administered via endotracheal tube, both in prophylactic (infants < 30 weeks) and rescue modes, has resulted in a 40% reduction in mortality from RDS. Pulmonary air leaks have been dramatically reduced but not so bronchopulmonary dysplasia or patent ductus arteriosus. Exogenous surfactant may benefit selected infants with meconium aspiration, congenital pneumonia and congenital diaphragmatic hernia.

Management and prevention of infection

- Bacteriological investigation, which includes cultures of blood, tracheal and gastric aspirate, is essential before commencing antibiotics
- A penicillin (penicillin G or amoxicillin) and an aminoglycoside (gentamicin or tobramycin) are used when infection is suspected
- Prevention of infection involves meticulous hand washing for all procedures, the use of gloves for tracheal toilets and routine bacteriological surveillance and swabbing of all infants in intensive care nurseries
- Active chest physiotherapy may be required for pneumonia, collapsed segments of lungs and aspiration syndromes
- All infants with respiratory distress require correct positioning with frequent changes to facilitate ventilation and lung drainage

7. In a table briefly summarise the key features of congenital diaphragmatic hernia, oesophageal atresia and tracheo-oesophageal fistula.

	Congenital Diaphragmatic Hernia	Oesophageal Atresia and Tracheo-oesophageal Fistula
Key features	Incidence is 1/2500-5000 births. In the most common type of congenital diaphragmatic hernia (Bochdalek hernia) there is a defect of the left posterolateral part of the diaphragm that allows the contents of the abdomen to herniate into the left thoracic cavity. This limits the space available for the lungs to develop in utero. Right-sided diaphragmatic hernias account for only 15% of such lesions.	Incidence is 1 in 3000 births. This is a congenital abnormality where the midportion of the oesophagus is missing. In most there is an abnormal communication between the lower oesophageal segment and the trachea, called a distal tracheo-oesophageal fistula. About 50% of these infants have other congenital abnormalities, most of which form part of the VATER association (vertebral, cardiac, renal, anorectal and radial abnormalities). Major chromosomal abnormalities are seen in 5%, of which trisomy 18 and trisomy 21 are the most frequent. Many are premature and a history of maternal polyhydramnios is common.
Signs/symptoms	The resulting pulmonary hypoplasia creates severe respiratory distress within minutes of birth and in some infants is not compatible with long-term survival.	Any newborn infant who appears to salivate excessively at birth (drooling) should be suspected of having oesophageal atresia. Other symptoms include choking and coughing associated with feeds.
Diagnosis	Diagnosis of the condition may be made antenatally on routine ultrasonography. The diagnosis is confirmed after birth by a plain chest X-ray, which shows loops of bowel in the left chest. The heart is displaced to the contralateral side and there is little room available for the lungs.	The diagnosis is confirmed by passing a large, firm catheter, for example a 10 French gauge orogastric tube, through the mouth and finding that it cannot be passed more than about 10 cm from the gums. A plain X-ray of the torso will show gas in the bowel, confirming the presence of a distal tracheo-oesophageal fistula.
Treatment	Early treatment involves aggressive cardiorespiratory support and decompression of the bowel. When the child is stable, operative repair of the diaphragm is undertaken.	The child must not be fed; otherwise, aspiration of feeds into the lungs is likely to occur. Initial management involves regular suctioning of the upper oesophageal pouch to prevent aspiration until the tracheo-oesophageal fistula has been divided. The oesophageal ends are anastomosed at the time of thoracotomy to close the fistula.