# Challenging neonatal clinical scenarios to aid examination preparation

Practical neonatology involves weighing up the relative merits of various different treatments before deciding on the best course to follow, and then repeating the process. It is for exactly this reason that the book described in this article is given that title – 'Practical Neonatology'.

**Cath Harrison**
BMedSci, BM, BS, DTM&H, FRCPCH
Consultant Neonatologist, Leeds Teaching Hospitals Trust and Lead Neonatologist for Embrace Transport Service
catherine.harrison@sch.nhs.uk

**Alan T Gibson**
MBBS, BSc, PhD, FRCP, FRCPCH
Consultant Neonatologist and Director of Neonatal Service, Sheffield Teaching Hospitals Trust

**Keywords**

preterm infant; respiratory distress syndrome; ventilation; management; chronic lung disease

**Key points**

**Harrison C., Gibson A.** Challenging neonatal clinical scenarios to aid examination preparation. *Infant* 2012; 8(2): 46-49.

1. There are often many different options for the management of neonatal conditions.
2. The evidence base is frequently lacking or poor.
3. Careful assessment of different treatment options is always essential.
4. Different individuals may respond in different ways.

Neonatology is a fascinating and challenging specialty where a broad knowledge base is essential. 'Practical Neonatology for MRCPCH and beyond' aims to cover much of that general neonatal knowledge in a small handbook which is easy and accessible to use. Initially, the authors started writing the book to provide neonatal questions to aid trainees taking their MRCPCH examination, but soon realised that this book could be used at any stage in training – and beyond. There are, for example, chapters on X-ray and scan interpretation, ventilation and blood gases, making it a useful educational tool for any practising neonatologist to use during teaching sessions. There are different question formats, but all aim to help develop initial action and management plans when faced with different clinical scenarios. The questions and the answers will challenge and provoke discussion, as there are many approaches that may be taken when dealing with clinical cases. The authors learnt much by writing the book and hope that other people may when reading it.

An example of a question in the chapter 'Problems with Prematurity' is shown below.

## Neonatal question

A 27-week gestation baby is brought round to the neonatal unit. He was born in good condition, requiring minimal resuscitation and is put on to nasal CPAP in 25% oxygen. Over the next four hours, his condition deteriorates. His oxygen requirement increases, there are obvious recessions and he is having recurrent apnoeas. A capillary gas at this point shows a mixed acidosis.

**a)** Which of the following actions would you consider?

Choose the three most appropriate answers.

i) Continue and reassess in an hour
ii) Increase continuous positive airway pressure (CPAP) pressure
iii) Intubate and give surfactant, and extubate back onto CPAP
iv) Intubate, give surfactant, and ventilate
v) Give antibiotics
vi) Load with caffeine
vii) Chest X-ray (CXR)
viii) Change to trigger assist CPAP.

A CXR is obtained (**FIGURE 1**).

**b)** Describe the CXR (see next page)

The baby is given surfactant, antibiotics and ventilated but pressures and oxygen requirement continue to increase. Arterial blood gases are just acceptable at a pressure of 26/4cm$H_2O$ in 80% oxygen. The baby suddenly becomes profoundly bradycardic and oxygen saturations fall to below 50%.

**c)** Which four options would you immediately investigate?

Transillumination shows a very bright hemithorax, and there is some improvement following insertion of a chest drain. Two hours later, there is further deterioration and a pneumothorax is detected on the opposite side. A chest drain results in re-inflation but the clinical condition does not improve significantly.

Twelve hours after the first pneumothorax the baby is in 100% oxygen, with pressure 32/4cm$H_2O$ and an arterial blood gas shows the following:

| | |
|---|---|
| pH | 7.18 |
| $pO_2$ | 2.4kPa |
| $pCO_2$ | 9.8kPa |
| BE | –4mEq/L |
| $HCO_3$ | 28mmol/L |

CXR shows relatively solid lungs with an air bronchogram. The pneumothoraces are well drained.

**d)** Which of the following actions would you consider?

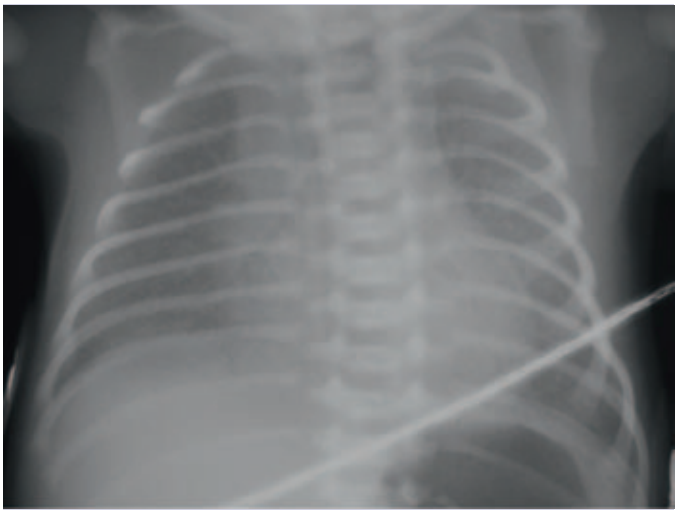


FIGURE 1

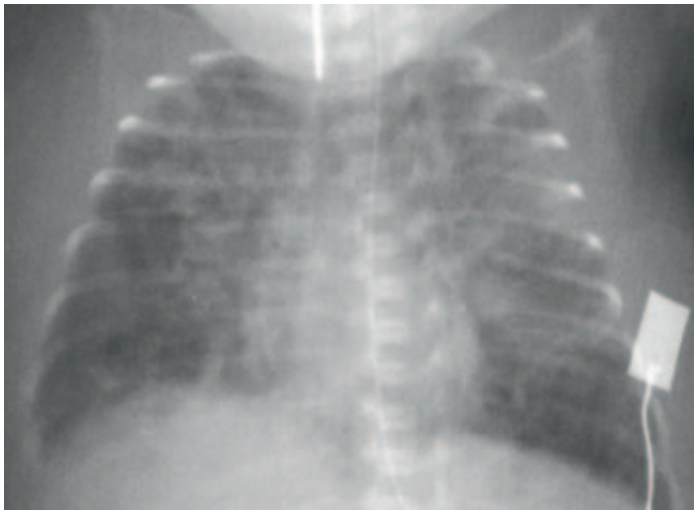


FIGURE 2

i) Increase positive inspiratory pressure (PIP)
ii) Increase positive end-expiratory pressure (PEEP)
iii) Repeat surfactant
iv) High frequency oscillatory ventilation (HFOV)
v) Nitric oxide
vi) Discuss palliative care with parents
vii) Diuretics
viii) Tolazoline

The baby stabilises on HFOV over the next few days and returns to conventional ventilation when mean airway pressure (MAP) falls to 12cm$H_2O$. He remains on conventional ventilation for the next 21 days, at the end of which pressure is 20/4cm$H_2O$ and he is in 60% oxygen.

A CXR is obtained (**FIGURE 2**).

**e)** Describe the CXR

**f)** Which of the following treatments would you consider? Choose two answers:

i) Antibiotics
ii) Diuretics
iii) Aminophylline
iv) Dexamethasone
v) Indomethacin
vi) Inhaled corticosteroids
vii) Inhaled bronchodilators
viii) Disodium cromoglycate

As part of the assessment of this infant, an echocardiogram has been performed which shows a large and clinically significant duct. The infant is now four weeks old (CGA 31 weeks).

**g)** Which of the following interventions would you consider?

i) Fluid restriction
ii) Digoxin
iii) Indomethacin
iv) Ibuprofen
v) Surgical ligation
vi) Diuretics
vii) Expectant treatment
viii) Prostacyclin
ix) ACE inhibitors

After a duct ligation and a course of dexamethasone, the baby is weaned off all ventilation and progresses onto low flow oxygen. He is ready to go home, gaining weight but still requiring 0.5L low flow oxygen.

**h)** What advice would you give the parents and what extra medication might you consider?

## Answers

**a)**

i) This would not be advisable. An infant becoming progressively more symptomatic is extremely unlikely to show spontaneous improvement at this gestation.
ii) If there is widespread atelectasis, increased CPAP pressure may help by recruiting more lung, but would not be a sensible first line option. It should not be considered unless the CXR confirms the atelectasis, and unless surfactant replacement has been given.
iii) Practice differs with respect to this option. There are some who believe this is appropriate and others who feel disturbance caused to the baby is likely to jeopardise stability and it is far more rational to continue gentle ventilation for some hours after administration.
iv) As mentioned above practice varies but this is probably the safest option. It is important that surfactant is given properly and that the most minimal ventilation possible is provided, and the infant is weaned as quickly as possible.
v) As a rule most units have a policy of antibiotic administration to preterm babies with respiratory distress, as sepsis cannot be ruled out immediately after birth and it is known that infection does contribute to a proportion of preterm deliveries.
vi) This might be appropriate in due course but a lack of respiratory drive is unlikely to be the main component of this infant's respiratory difficulties.
vii) A CXR is essential in this situation, as although respiratory distress syndrome (RDS) is the most likely diagnosis, other possibilities cannot be excluded, such as a pneumothorax.
viii) Newer advanced CPAP modes eg trigger assist and pressure trigger assist, are becoming increasingly popular. However, the exact circumstances in which use is most beneficial, is unclear. In this particular situation, surfactant would seem to be the most important component of immediate management.

**b)** The chest X-ray shows changes which are consistent with moderate RDS. There is an homogenous ground glass appearance with an air bronchogram. The air bronchogram is more prominent behind the right heart which can be a normal observation. The X-ray is slightly rotated making comments about heart size inaccurate.

**c)** In the case of any sudden deterioration in an infant, think DOPE.

**D**isplacement – although much can be done to optimise the stability of

endotracheal tubes, this still remains a common reason for deterioration.

**O**bstruction – many babies produce copious secretions of variable viscosity and tube obstruction is not uncommon.

**P**neumothorax – although the incidence of pneumothorax has fallen significantly since the advent of surfactant replacement therapy, it is still an important and potentially lethal reason for sudden deterioration.

**E**quipment – equipment failure may be a cause with tube disconnection being the commonest mechanical problem.

**d)**

i) Although increasing PIP may improve oxygenation, it is unlikely to be highly effective while continuing to ventilate conventionally, as the elevated pressure is not sustained for long enough to recruit atelectatic alveoli.

ii) Increasing PEEP may help recruit alveoli but very high pressure may be needed in a very sick infant. Research has shown this may be effective but the pressures required are usually outside the comfort zone for many practising neonatologists. Increasing PEEP will improve MAP but at the cost of decreased tidal volume, and the acidosis may worsen.

iii) This may be worth a trial particularly if insufficient treatment has been given previously. Although randomised controlled trials do not show any evidence of benefit for more than two doses, it must be remembered that this refers to a large group with heterogeneous conditions, and does not preclude the possibility of a response in selected individuals. Surfactant is inactivated by the inflammatory exudate that develops in RDS, and it may therefore be necessary to use higher than normal doses.

iv) Those who use HFOV would argue this would be the most appropriate intervention at this moment (in fact they may suggest it should have been commenced earlier). There still remains some debate about the most appropriate use of HFOV but there is good evidence to support its use for rescue ventilation, when the higher sustained MAP will assist in the recruitment of alveoli, although it may require several hours in which to do so.

v) Although it is tempting to try nitric oxide when oxygen requirements are high, the currently available evidence does not support use in preterm infants. Nitric oxide is indicated when there is evidence of pulmonary hypertension. In this case the primary problem is alveolar collapse.

vi) Discussions should be held with the parents throughout the baby's admission and they should be aware that the baby is very sick. It is rare for practitioners to consider palliative care when the problems are primarily respiratory and further treatment options exist. It might be appropriate to discuss this as a future option, but would not seem an appropriate action at present.

vii) There is no role for diuretics in the acute management of severe RDS.

viii) Tolazoline is a vasodilator thought to act through $H_2$ histamine receptors. Over the years, it has gained a reputation as a drug that may be effective in persistent pulmonary hypertension. On rare occasions, administration may be associated with a dramatic improvement in oxygenation. This has led people to associate the use of tolazoline with poor oxygenation for other reasons. As with nitric oxide, administration is unlikely to be effective unless pulmonary hypertension is the principle problem, and associated hypotension that it causes may be problematic.

**e)** The chest X-ray shows:

– Endotracheal tube *in situ*
– Hyperinflated lung fields – upward sloping ribs, compressed heart and bulging pleura
– Widespread patchy opacification
– Flattened diaphragm on the left
– Early cystic change particularly at bases.

**f)**

i) Antibiotics. Unless there is evidence of intercurrent infection there is no particular indication for antibiotic therapy. Antibiotics are not infrequently given as the changes on CXR often involve patchy opacification which is difficult to distinguish from areas of infection.

ii) Administration of diuretics may be associated with a rapid increase in compliance and a reduction in airway resistance. However, there is no published evidence of long-term benefit. Frusemide is often administered initially followed by maintenance therapy with a thiazide diuretic and spironolactone. Side effects are not uncommon, particularly electrolyte disturbance and nephrocalcinosis, and a strong case can be made for limiting the use of this therapy, particularly in long courses.

iii) Aminophylline. Small reports have suggested that intravenous and oral methylxanthines may be associated with some benefit. Evidence is limited and there is no proof of long-term benefit.

iv) Dexamethasone. There is considerable debate about the use of dexamethasone in preterm infants. A decade ago, there was wide usage, and steroids were often given to extubated babies simply because they required oxygen. Evidence suggests that corticosteroid administration may be associated with earlier extubation, reduced duration of supplementary oxygen, and in some groups, with a small increase in survival. However, long-term studies have suggested there may be a significant association between dexamethasone therapy and later neurodevelopmental problems, particularly cerebral palsy.

At the time of publishing, there is no clear consensus as to the most appropriate use of this therapy, and indeed whether it should be used at all. In practice, dexamethasone is still used, usually in infants who have been ventilated for a considerable period and have made little progress. There is some interest in regimes that use a much lower total dose of steroid, than were administered in the past and limited evidence that total dose is relevant with respect to complications.

v) Indomethacin has no role in this situation. It is however, essential that cardiac function is assessed in any infant who appears to be making no progress on the ventilator. Significant patent ductus arteriosus should be treated to optimise weaning from the ventilator.

vi) Inhaled corticosteroids – such as betamethasone and fluticasone – have been used in a number of trials, and meta-analysis has been performed. Although some short-term benefit may be seen (smaller in magnitude and slower onset when compared to systemic steroids), there is no evidence of sustained benefit.

vii) Inhaled bronchodilators such as salbu-

tamol and ipratropium may be associated with improvements in airways resistance, compliance and blood gases. There is no evidence of long-term benefit. Infants with chronic lung disease will often show evidence of both reversible and irreversible airway constriction in the months and years after discharge, and bronchodilator therapy is frequently used in this situation.

viii) Disodium cromoglycate may have an anti-inflammatory action and in a small number of studies, use has been associated with some improvement in ventilated infants. This treatment has never attained widespread use in this population.

**g)**

i) Fluid restriction is unlikely to help at this point in time due to the age of the baby. The evidence that fluid restriction is beneficial in the management of a ductus arteriosus is very limited and probably stems from the fact there has been a reported association between the development of the ductus arteriosus and higher fluid intake in the immediate postnatal period. The suggestion therefore that later restriction of fluid may be helpful in closing the ductus is not necessarily a logical one. There are some who would counsel against fluid restriction because of the associated nutritional deficit that this causes. Most people would consider fluid restriction if there was evidence of heart failure but in the absence of this complication, opinion is divided.

ii) Digoxin has been advocated for use in heart failure in babies but is not widely used. It has no role in this situation.

iii) Indomethacin has an established role in the closure of the ductus arteriosus and is discussed in more detail in Chapter 4. Efficacy is reduced in infants who are particularly immature and if administered at a postnatal age of more than two weeks. Despite this known fact, many people will still attempt a course of indomethacin in older infants.

iv) Ibuprofen may be effective in closing a duct but there is no information about the age when it is maximally effective. It is likely to be similar to that for indomethacin.

v) Surgical ligation will be the only treatment if there is a significant ductus, treatment is felt to be necessary and indomethacin has been ineffective or is contraindicated. Data suggest the rate of surgical closure is highly dependent on the availability and proximity of surgical expertise. Although this procedure is normally well tolerated, and effective, mortality rates as high as 10% have been reported and other significant complications may develop. Manipulation of the mediastinum may be associated with the development of chylothorax requiring prolonged drainage and nutrition with medium chain triglycerides (Monogen milk). Ventilation requirements can increase significantly in the postoperative period and acute and severe exacerbation of chronic lung disease can ensue.

vi) Diuretics may be indicated if heart failure is present, but have no specific role in ductal closure. There is some evidence that frusemide may, by an effect upon renal prostaglandin production, keep the duct open.

vii) Expectant treatment. If an infant appears stable and making progress, this may be a very appropriate course of action. No treatment of the ductus is without possible complication, and should not be started without due consideration. The presence of a ductus, does not, by itself, mean treatment is needed. However, in this case, the ductus is likely to be contributing to the infant's condition.

viii) Prostacyclin (epoprostenol) is a vasodilator that may be effective in persistent pulmonary hypertension. It has no effect upon the ductus.

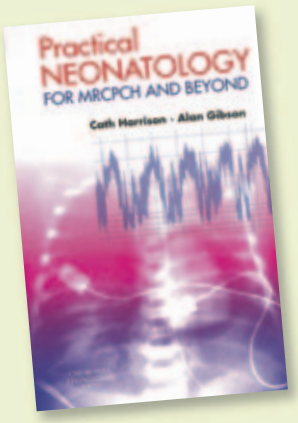
ix) ACE inhibitors are occasionally indicated in heart failure, hypertension, and anecdotally in a small number of babies with established chronic lung disease who have episodes of profound desaturations thought to be due to vascular instability. There is no published evidence of benefit in this situation, nor is there any evidence of effect upon the ductus.

**h)** Advice is to avoid contact with upper respiratory tract infections wherever possible, and consider palivizumab prophylaxis.

A substantial proportion of infants with chronic lung diseases are re-admitted to hospital within the first two years after birth (median of two admissions per baby). The majority of admissions are with upper respiratory tract infections and a number of infants may be extremely unwell requiring intensive care and ventilation. There is a significant mortality in this group. Parents should therefore be advised to avoid unnecessary exposure to people with respiratory tract infections, for instance, in shopping centres, on public transport, at GP surgeries.

Infants with chronic lung disease who contract respiratory syncytial virus (RSV) positive bronchiolitis may develop severe infection and there has been interest in the use of palivizumab prophylaxis. A course of treatment with this monoclonal antibody must run throughout the bronchiolitis season, is very expensive and consists of five monthly injections. Evidence shows that this can reduce the incidence of RSV but does not appear to influence the incidence of RSV-related death or requirement for ventilation. It may reduce the proportion of infants with longer-term respiratory morbidity, and decreases the healthcare expenditure for an individual. However, the cost of the prophylaxis programme for potentially susceptible infants would far exceed the healthcare savings for the relatively small number of individuals who would benefit. A number of cost benefit analyses from different countries have failed to prove economic benefit.

Currently many support prophylaxis for infants who go home in oxygen within three months of the beginning of the RSV season. There is more debate for the use in infants who do not. Current recommendations also suggest that prophylaxis should be used in infants with severe cyanotic heart disease and infants with immunodeficiencies. In both cases it is recommended that this is at the discretion of a specialist.




Currently available on Amazon for £22.39

ISBN: 978-0-443-07070-9
Price: £27.99
Publisher: Churchill Livingstone, Elsevier.