REVIEW

How has research in the past 5 years changed my clinical practice

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Arch Dis Child Fetal Neonatal Ed 2007;**92**:404–407. doi: 10.1136/adc.2006.107540

This article discusses how research in the past 5 years into management strategies influencing respiratory outcomes has changed (or not changed) the author's clinical practice. Changes include using inhaled nitric oxide but no longer systemic pulmonary vasodilators in term born infants with pulmonary hypertension. Use of postnatal steroids is now restricted to systemic administration in infants with severe respiratory failure and who are ventilator dependent beyond 2 weeks of age. Infants with bronchopulmonary dysplasia, unless they have pulmonary hypertension, are maintained at oxygen saturation levels of 90–92% rather than $\geq 95\%$. Supine sleeping is instituted in prematurely born infants without contraindications several weeks prior to neonatal discharge to reinforce to parents the importance of supine sleeping their baby at home. Further research is required to identify the optimal respiratory support strategy, particularly for very immature infants.

studies, including anecdotal series and comparisons with historical controls, with impressive reductions in the need for intubation and ventilation and the rate of bronchopulmonary dysplasia (BPD).^{1,2} Meta-analysis of the few randomised trials that have been reported has not shown significant differences in important clinical outcomes, such as BPD, but the samples have been small.³ The results of large trials, however, will soon become available.

Patient triggered ventilation

There have been no recent large randomised studies comparing A/C and SIMV with conventional ventilation or each other, hence the rationale for my use of these modes as above is based on earlier evidence.^{4–8} Meta-analysis of randomised trials has shown that patient triggered ventilation (A/C or SIMV) is associated with a marked reduction in the duration of ventilation if started in the recovery rather than the acute stage of the illness.⁴ In a small randomised trial, A/C was associated with a shorter duration of weaning than SIMV,⁷ possibly reflecting that A/C is associated with lower oxygen consumption, indicating reduced work of breathing.⁸ Newer triggered modes, pressure support ventilation and proportional assist ventilation, have shown advantages in physiological studies in the past 5 years; I await positive results of definitive randomised studies before introducing them in my routine clinical practice.

Volume cycled/targeted ventilation

Some practitioners are using volume cycled (VCV) or volume targeted ventilation (VTV). Meta-analysis of the results of four randomised trials comparing VCV or VTV with pressure limited ventilation found that, compared with pressure limited ventilation, VCV or VTV was associated with considerable reductions in the duration of ventilation and rates of pneumothorax and severe intracranial haemorrhage, but there were no reductions in the incidence of BPD or death.⁹ However, all the four trials included small numbers of infants (only 178 in total) and the study designs were also different. During VCV a constant volume is delivered regardless of the infant's respiratory activity. In VTV the peak inflating

My clinical practice is evidence based and protocols on the neonatal unit are reviewed as research results become available. In this article, I have concentrated on how research reported in the past 5 years has changed my clinical practice and, equally important, why in certain areas it has not! I have restricted my comments to management strategies influencing respiratory outcomes, as this has been an active area of research.

RESPIRATORY SUPPORT

In the past 5 years, my approach to the management of a premature infant with initial respiratory distress has largely not altered. Premature infants with respiratory distress are supported by high frequency positive pressure ventilation, "weaned" on triggered ventilation (assist control (A/C) rather than synchronous intermittent mandatory ventilation (SIMV)) and small babies extubated to continuous positive airway pressure (CPAP). In infants with severe respiratory failure, I use high volume strategy high frequency oscillatory ventilation (HFOV) and in infants born at term I use inhaled nitric oxide.

Continuous positive airway pressure

Many practitioners prefer CPAP rather than intubation and ventilation, as they perceive this to be a gentler form of respiratory support. Indeed, such an approach has been associated in non-randomised

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Accepted 14 March 2007

pressure is servo controlled so that a preset volume is delivered during various trigger modes: A/C, SIMV and pressure support ventilation. The ventilator manufacturers use different strategies to achieve VTV and this influences the airway pressure waveform and delivered mean airway pressure.¹⁰ More recently, there have been two more randomised trials, one showing that VTV, except in very immature infants, reduced the occurrence of hypocarbia¹¹ and the other showing that VTV was associated with a marked reduction in the time to reach a predefined level of oxygenation/mean arterial pressure in extremely low birth-weight infants.¹² Before introducing VTV into routine practice the most appropriate starting volume level must be determined. Current data suggest higher rather than lower volumes should be used: 3 ml/kg rather than 5 ml/kg was associated with higher levels of lung inflammation,¹³ whereas 6 ml/kg rather than 4.5 ml/kg reduced the duration of hypoxaemic episodes during SIMV.¹⁴ Further research is required and is part of our programme.¹⁵

High frequency oscillatory ventilation

Data from animal studies have shown that high volume strategy HFOV might be a less damaging respiratory support mode. This has now been tested in at least 11 randomised trials in which HFOV has been compared with conventional ventilation, and the infants usually recruited within 12 h of birth.¹⁶ Meta-analysis of the results of those trials showed prophylactic HFOV resulted in a significant but only modest reduction in BPD (RR 0.58 (0.34, 0.98)). The trials, however, differed markedly in study design and patient inclusion, which may have influenced their results. Also note that in the very premature population, BPD does not correlate well with long-term pulmonary outcome,¹⁷ and this is better determined by respiratory assessment at follow-up. Unfortunately, researchers have rarely incorporated lung function assessment in the follow up of randomised HFOV trials and the results obtained are conflicting, perhaps because different pulmonary function techniques were used. There is evidence from a non-randomised study that use of HFOV may be associated with a smaller decline in small airway function over the first year. At follow-up, infants supported by HFOV had a smaller decline in VmaxFRC (small airway function) than those supported by conventional ventilation, despite the HFOV group having more severe initial disease.¹⁸ Thus, only comprehensive respiratory assessment at long-term follow-up of infants who had been entered into a large randomised trial will appropriately inform whether prophylactic HFOV is of benefit.

We, as colleagues worldwide, use high volume strategy HFOV in both preterm and term born infants whose severe respiratory failure is unresponsive to conventional ventilation. Yet, there have only been two randomised trials examining the efficacy of HFOV in infants with severe respiratory failure. One, in prematurely born infants, showed that HFOV was associated with a reduction in the development of airleaks, but this was at the expense of a marked increase in intracranial haemorrhage.¹⁹ In the other trial, infants born at or near term were recruited. Although HFOV was shown to be a more effective rescue respiratory support than conventional ventilation, there were no significant differences according to ventilation mode with regard to requirement for extracorporeal membrane oxygenation (ECMO) or duration of ventilator or oxygen dependency.²⁰ Both studies were small and conducted over 10 years ago, so isn't it time for a multicentre international study to determine whether rescue HFOV is appropriate?

Extracorporeal membrane oxygenation

There are no recent randomised studies of ECMO. Since the UK ECMO study was conducted,²¹ other respiratory support modes have become available with a reduction in referrals for ECMO—is this appropriate? On the evidence available, I do recommend

ECMO in term born infants with severe respiratory failure unresponsive to other treatments, except those with congenital diaphragmatic herniation. In the UK trial none of the 17 infants randomised to the conventional arm survived, three of 17 randomised to the ECMO arm survived, but with problems.

PULMONARY VASODILATORS

My clinical practice has changed regarding use of pulmonary vasodilators. We have stopped using systemically administered pulmonary vasodilators such as tolazoline, because of their side effects and lack of appropriate evidence to support their efficacy. In contrast, the efficacy of inhaled nitric oxide has been vigorously investigated. Meta-analysis of randomised trials has shown that inhaled nitric oxide reduced the need for ECMO in infants born at term.²² In prematurely born infants with severe respiratory failure, similar analysis highlighted inhaled nitric oxide had no advantages other than short-term improvements in oxygenation.²³ However, recently reported randomised trials have found that early and prolonged use of low dose inhaled nitric oxide may reduce the incidence of BPD (29.8% versus 59.6%) in infants with a birth weight between 1000 g and 1250 g.²⁴ When used for at least 24 days started at between 7 days and 21 days, the rate of survival without BPD increased from 36.8% to 43.9%.²⁵ In addition, infants who received inhaled nitric oxide were discharged much sooner and received supplementary oxygen for a shorter time.²⁵ Consequently, our routine use of inhaled nitric oxide is restricted to the term infant with pulmonary hypertension contributing to severe respiratory failure. We are using inhaled nitric oxide in prematurely born infants in a multicentre randomised trial to determine whether early and prolonged administration improves long-term respiratory and neurological outcomes.

POSTNATAL STEROIDS

In our four centre BPD cohort born between 1994 and 1997, approximately 40% of the infants received postnatal dexamethasone.²⁶ Since then, systematic review of randomised trials have shown that early administration of postnatal steroids is associated with an increased risk of adverse neurodevelopmental outcome.²⁷ Administration at older postnatal ages has not been associated with such an outcome, but many of the trials allowed crossover with use of open label corticosteroids in the control groups.^{28 29}

I now restrict prescription of systemically administered dexamethasone to infants who have severe respiratory failure and remain ventilator dependent after 2 weeks of age. I also no longer prescribe inhaled steroids for babies on the neonatal unit. Systematic review of five randomised trials of inhaled steroids given in the first 2 weeks after birth did not show that inhaled steroids resulted in a reduction in BPD.³⁰ Even though another systematic review of trials including infants who had BPD and were ventilator dependent showed that infants who received inhaled steroids were extubated earlier without an excess of adverse effects,³¹ randomised comparisons of inhaled and systemically administered steroids highlight that infants who received inhaled steroids had longer time on the ventilator and supplementary oxygen.^{32 33}

OXYGEN SATURATION LEVELS

My policy had been to maintain oxygen saturation in infants with BPD at 95% oxygen saturation. Publication of the Supplemental Therapeutic Oxygen for Prethreshold Retinopathy of Prematurity (STOP-ROP) and the Benefits of Oxygen Saturation targeting (BOOST) trials led me to rethink this.^{34 35} In the STOP-ROP trial, infants maintained at saturations of 96–99% rather than 89–94% had an increased risk of

adverse pulmonary events, including pneumonia and/or exacerbations of BPD. In the BOOST trial, higher oxygen saturations were associated, not surprisingly, with more infants being oxygen dependent at term and requiring home oxygen, but importantly there were no advantages. Now I request an echocardiography examination for babies who remain oxygen dependent after 1 month of age, and only those with pulmonary hypertension (indicated by tricuspid regurgitation, although note that if tricuspid regurgitation is absent this does not always exclude pulmonary hypertension) are kept at oxygen saturation levels at 95%, otherwise a level of 90–92% is used.

SLEEPING POSITION

Our policy since the Back to Sleep campaign had been to recommend supine sleeping on discharge from the neonatal unit. It has been well publicised that prone compared with supine sleeping is an important risk factor for sudden infant death syndrome (SIDS), particularly in prematurely born infants.³⁶ Surprisingly, babies, including those born prematurely, are still being slept prone at the high risk age for SIDS.³⁷ Several studies have highlighted that parents are strongly influenced by practitioners with regard to their sleeping position for their infant.^{38–39} Worryingly, the results of a national survey we undertook in 2001–2⁴⁰ revealed that, after neonatal unit discharge, only 58% of units positively discouraged prone sleeping and 29% additionally recommended side sleeping, yet the odds ratio for SIDS for side compared with supine sleeping is 40.5. We were concerned that this reflected a large literature showing the prone position in prematurely born infants with respiratory distress and those in the recovery stage is associated with superior lung function and oxygenation and a relative paucity of data to determine when any advantages of the prone position ceased.

Over the past 5 years, we have undertaken a series of studies to investigate the effect of position on sleep, respiratory function and apnoeas in convalescent prematurely born infants. We examined infants at 36 weeks' postmenstrual age and found them to sleep more efficiently, spend more time in quiet sleep, have more central apnoeas, and less arousals and awakenings in the prone position.⁴¹ Lung volumes and oxygenation were higher in the prone compared with the supine position in infants studied, but the differences in functional residual capacity and oxygen saturation only reached statistical significance in the infants who were oxygen dependent.⁴² Improvements in oxygenation in the prone compared with the supine position are determined by lung volume and changes in thoracoabdominal synchrony, ventilation perfusion heterogeneity and/or intrapulmonary shunting. The latter abnormalities reduce as respiratory distress lessens and postmenstrual age increases. We therefore argued that infants without respiratory distress, as evidenced by their lack of oxygen dependency, would not benefit from the prone position with regard to their oxygenation even from 32 weeks' postmenstrual age and indeed have shown this by undertaking serial measurements.⁴³ Consequently, we now start to sleep prematurely born infants without contraindications, such as Pierre Robin sequence, supine at least 2 weeks prior to their discharge from the neonatal unit.

However, in our study,⁴³ the infants were monitored in each position for only an hour. Thus, we recommend continuing monitoring oxygen saturation after 32 weeks' PMA to determine whether longer periods of supine sleeping are associated with loss of lung volume and hypoxaemia and whether supplementary oxygen is required. We explain to parents that infants who are oxygen dependent will require more supplementary oxygen when sleeping supine, while emphasising the

importance of supine sleeping with respect to reducing the risk of SIDS. We hope that parents seeing their baby being nursed supine for several weeks before neonatal unit discharge will reinforce to them the importance of sleeping their baby supine at home.

ACKNOWLEDGEMENTS

I thank Mrs Deirdre Gibbons for secretarial assistance.

Funding: Research on the Newborn Unit at King's College Hospital is supported by the WellChild Trust and Foundation for the Study of Sudden Infant Death.

Competing interests: AG has held grants from various ventilator manufacturers; AG had received honoraria for giving lectures and advising various ventilator manufacturers.

REFERENCES

- 1 Kamper J, Wulff K, Larsen C, *et al.* Early treatment with nasal continuous positive airway pressure in very low-birth-weight infants. *Acta Paediatr* 1993;**82**:193–7.
- 2 Avery ME, Tooley WH, Keller JB, *et al.* Is chronic lung disease in low birthweight infants preventable? A survey of eight centers. *Pediatrics* 1987;**79**:26–30.
- 3 Subramaniam P, Henderson-Smart DJ, Davis PG. Prophylactic nasal continuous positive airways pressure for preventing morbidity and mortality in very preterm infants. *Cochrane Database Syst Rev* 2005;**3**:CD001243.
- 4 Greenough A, Milner AD, Dimitriou G. Synchronized ventilation. *Cochrane Database Syst Rev* 2004;**4**:CD000456.
- 5 Chan V, Greenough A. Randomised controlled trial of weaning by patient triggered ventilation or conventional ventilation. *Eur J Pediatr* 1993;**152**:51–4.
- 6 Chan V, Greenough A. Comparison of weaning by patient triggered ventilation or synchronous intermittent mandatory ventilation in preterm infants. *Acta Paediatr* 1994;**83**:335–7.
- 7 Dimitriou G, Greenough A, Giffin F, *et al.* Synchronous intermittent mandatory ventilation modes compared with patient triggered ventilation during weaning. *Arch Dis Child Fetal Neonatal Ed* 1995;**72**:F188–90.
- 8 Roze JC, Liet JM, Gournay V, *et al.* Oxygen cost of breathing and weaning process in newborn infants. *Eur Respir J* 1997;**10**:2583–5.
- 9 McCallion N, Davis PG, Morley CJ. Volume-targeted versus pressure-limited ventilation in the neonate. *Cochrane Database Syst Rev* 2005;**3**:CD003666.
- 10 Sharma A, Sylvester K, Milner AD, *et al.* Performance of neonatal ventilators in volume guarantee mode. *Acta Paediatr* 2007 (in press).
- 11 Cheema IU, Sinha AK, Kempley ST, *et al.* Impact of volume guarantee ventilation on arterial carbon dioxide tension in newborn infants: a randomized controlled trial. *Early Hum Dev* 2007;**83**:183–9.
- 12 Singh J, Sinha SK, Clarke P, *et al.* Mechanical ventilation of very low birth weight infants: is volume or pressure a better target variable? *J Pediatr* 2006;**149**:308–13.
- 13 Lista G, Castoldi F, Fontana P, *et al.* Lung inflammation in preterm infants with respiratory distress syndrome: effects of ventilation with different tidal volumes. *Pediatr Pulmonol* 2006;**41**:357–63.
- 14 Polimeni V, Claude N, D'Ugard C, *et al.* Effects of volume-targeted synchronized intermittent mandatory ventilation on spontaneous episodes of hypoxemia in preterm infants. *Biol Neonate* 2006;**89**:50–5.
- 15 Sharma A, Rafferty G, Milner A, *et al.* Volume guarantee level and work of breathing during neonatal ventilation. *Eur Respir J* 2006;**28**(Suppl 50):P2833, P491S.
- 16 Henderson-Smart DJ, Bhuta T, Cools F, *et al.* Elective high frequency oscillatory ventilation versus conventional ventilation for acute pulmonary dysfunction in preterm infants. *Cochrane Database Syst Rev* 2003;**4**:CD000104.
- 17 Davis PG, Thorpe K, Roberts S, *et al.* Evaluating "old" definitions for the "new" bronchopulmonary dysplasia. *J Pediatr* 2002;**140**:555–60.
- 18 Hoffhuis W, Huysman MW, van der Wiel EC, *et al.* Worsening of V'max FRC in infants with chronic lung disease in the first year of life: a more favourable outcome after high frequency oscillation ventilation. *Am J Respir Crit Care Med* 2002;**166**:1539–53.
- 19 HFO Study Group. Randomized study of high-frequency oscillatory ventilation in infants with severe respiratory distress. *J Pediatr* 1993;**122**:609–19.
- 20 Clark RH, Yoder BA, Sell MS. Prospective, randomized comparison of high-frequency oscillation and conventional ventilation in candidates for extracorporeal membrane oxygenation. *J Pediatr* 1994;**124**:447–54.
- 21 UK Collaborative ECMO Trial Group. UK collaborative randomized trial of neonatal extracorporeal membrane oxygenation. *Lancet* 1996;**348**:75–82.
- 22 Finer NN, Barrington KJ. Nitric oxide for respiratory failure in infants born at or near term. *Cochrane Database Syst Rev* 2006;**4**:CD000399.
- 23 Barrington KJ, Finer NN. Inhaled nitric oxide for respiratory failure in preterm infants. *Cochrane Database of Syst Rev* 2006;**1**:CD00509.
- 24 Kinsella JP, Cutter GR, Walsh WF, *et al.* Early inhaled nitric oxide therapy in premature newborns with respiratory failure. *N Engl J Med* 2006;**355**:354–64.
- 25 Ballard RA, Truog WE, Ncnaa A, *et al.* Inhaled nitric oxide in preterm infants undergoing mechanical ventilation. *N Engl J Med* 2006;**355**:343–53.
- 26 Greenough A, Alexander J, Burgess S, *et al.* Health care utilisation of chronic lung disease infants related to hospitalisation for respiratory syncytial virus infection. *Arch Dis Child* 2001;**85**:463–8.

- 27 **Halliday HL**, Ehrenkranz RA, Doyle LW. Early postnatal (<96 hours) corticosteroids for preventing chronic lung disease in preterm infants. *Cochrane Database Syst Rev* 2003;1:CD001146.
- 28 **Halliday HL**, Ehrenkranz RA, Doyle LW. Moderately early (7–14 days) postnatal corticosteroids for preventing chronic lung disease in preterm infants. *Cochrane Database Syst Rev* 2003;1:CD001144.
- 29 **Halliday HL**, Ehrenkranz RA, Doyle LW. Delayed (>3 weeks) postnatal corticosteroids for chronic lung disease in preterm infants. *Cochrane Database Syst Rev* 2003;1:CD001145.
- 30 **Shah V**, Ohlsson A, Halliday HL, *et al*. Early administration of inhaled corticosteroids for preventing chronic lung disease in ventilated very low birth weight preterm neonates. *Cochrane Database Syst Rev* 2000;2:CD001969.
- 31 **Lister P**, Iles R, Shaw B, *et al*. Inhaled steroids for neonatal chronic lung disease. *Cochrane Database Syst Rev* 2000;3:CD002311.
- 32 **Shah SS**, Ohlsson A, Halliday HL, *et al*. Inhaled versus systemic corticosteroids for preventing chronic lung disease in ventilated very low birth weight preterm neonates. *Cochrane Database Syst Rev* 2003;1:CD002058.
- 33 **Shah SS**, Ohlsson A, Halliday HL, *et al*. Inhaled versus systemic corticosteroids for the treatment of chronic lung disease in ventilated very low birth weight preterm infants. *Cochrane Database Syst Rev* 2003;2:CD002057.
- 34 **The STOP-ROP Multicenter Study Group**. Supplemental therapeutic oxygen for prethreshold retinopathy of prematurity (STOP-ROP). A randomised controlled trial. I: Primary outcomes. *Pediatrics* 2000;105:295–310.
- 35 **Askie LM**, Henderson-Smart DJ, Irwig L, *et al*. Oxygen saturation targets and outcomes in extremely preterm infants. *N Engl J Med* 2003;349:959–67.
- 36 **Oyen N**, Markestad T, Skaerven R, *et al*. Combined effects of sleeping position and prenatal risk factors in sudden infant death syndrome: the Nordic Epidemiological SIDS Study. *Pediatrics* 1977;100:613–21.
- 37 **Adams MM**, Kugener B, Mirmiran M, *et al*. Survey of sleeping position after hospital discharge in health preterm infants. *J Perinatal* 1998;18:168–72.
- 38 **Colson ER**, Bergman DM, Shapiro E, *et al*. Position for newborn sleep: associations with parents' perceptions of their nursery experience. *Birth* 2001;28:249–53.
- 39 **Vernacchio L**, Corwin MJ, Lesko SM, *et al*. Sleep position of very low birthweight infants. *Pediatrics* 2003;111:633–40.
- 40 **Bhat RY**, Leipala JA, Rafferty GF, *et al*. Survey of sleeping position recommendations for prematurely born infants on neonatal intensive care unit discharge. *Eur J Pediatr* 2003;162:426–7.
- 41 **Bhat RY**, Hannam S, Pressler R, *et al*. Effect of prone and supine position on sleep, apneas and arousal in preterm infants. *Pediatrics* 2006;118:101–7.
- 42 **Bhat RY**, Leipala JA, Singh NR, *et al*. Effect of posture on oxygenation, lung volume, and respiratory mechanics in premature infants studied before discharge. *Pediatrics* 2003;112:29–32.
- 43 **Kassim Z**, Donaldson N, Khatriwal B, *et al*. Sleeping position, oxygen saturation and lung volume in convalescent, prematurely born infants. *Arch Dis Child Fetal Neonatal* Ed 26 September 2006 [Epub ahead of print].

IMAGES IN NEONATAL MEDICINE.....

doi: 10.1136/adc.2006.112367

Neonatal gastric perforation following inadvertent connection of oxygen to the nasogastric feeding tube

An 3-day-old baby, who was being treated for probable sepsis, developed acute abdominal distension. On examination he was pale, and had tachycardia and tachypnoea and cold, dusky extremities. He responded only to pain. The abdomen was distended, tense and tender with absent bowel sounds. The scrotum was distended, translucent and non-erythematous. He had been on nasogastric tube feeds (NGT), with concomitant oxygen administration via a feeding tube inserted at 5 cm into the left nostril. It transpired that a few minutes earlier, the oxygen tube had got disconnected and has been inadvertently connected to the NGT. This error was detected because of the dramatic, translucent scrotal swelling. A laparotomy after initial stabilisation revealed a 1.5×0.5 cm perforation in the greater curvature, which was successfully sealed.

Spontaneous gastric perforation in a newborn is rare, but has been reported.¹ It is different from the ileal perforations seen in necrotising enterocolitis. Gastric perforation has been reported previously in association with nasogastric feeding.² Oxygen is commonly administered through a nasal catheter in resource-poor settings, because it is effective, inexpensive and achievable at low oxygen flow.³ However, it is a potential source of error because these infants are also often receiving nasogastric feeds, and the tubes are indistinguishable. Such errors can perhaps be minimised by labelling the tubes and ensuring that oxygen flow is kept below 2 l/min if low-range flow meters are not available. In our case, the perforation of the stomach wall caused marked distension of the scrotum in just a few minutes, via the patent processus vaginalis. An acute scrotal swelling in a neonate, as described here, should prompt suspicion of gastric perforation.

Figure 1 Erect film of abdomen showing saddle-bag appearance of pneumoperitoneum.

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Competing interests: None.

References

- 1 **Im SA**, Lim GY, Hahn ST. Spontaneous gastric perforation in a neonate presenting with massive hydroperitoneum. *Pediatr Radiol* 2005;35:1212–4.
- 2 **Karunakara BP**, Ananda Babu MN, Maiya PP, *et al*. Nasogastric feeding tube perforation in a neonate. *Indian J Pediatr* 2004;71:661–2.
- 3 **Frey B**, Shann F. Oxygen administration in infants. *Arch Dis Child Fetal Neonatal* Ed 2003;88:F84–8.

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