

Non-invasive breathing assistance for newborn infants with respiratory distress

In this issue of *SAJCH* the study by Ballot and co-workers (p. 146) shows that although a non-invasive chest wall suspension splint could support a compliant, retracting chest wall, it was only as effective as head-box oxygen management of premature infants with respiratory distress syndrome (RDS) in avoiding invasive mechanical ventilation (MV). This finding is surprising, because the opposite would be expected; however, this lack of difference could be the effect of the very small number of participants in this study. Perhaps further research should compare this modality with nasal continuous positive airway pressure (NCPAP) rather than head-box oxygen. Head-box oxygen may relieve hypoxaemia, but does nothing to assist breathing or to prevent atelectasis. Pieper and co-workers investigated the efficacy of NCPAP versus head-box oxygen in 22 infants with RDS weighing less than 1 200 g and/or of a gestational age below 28 weeks.¹ Although neither group was treated with surfactant, compared with head-box oxygen therapy NCPAP significantly improved the arterial-alveolar oxygen ratio between days 1 and 3 of life as well as survival at the time of hospital discharge.

Since the early 1990s, early NCPAP re-emerged as an effective non-invasive treatment modality for premature infants with respiratory distress.^{2,3} Early NCPAP is effective in lowering the need for MV in immature as well as more mature infants at risk of RDS or with established RDS. In addition,⁴ the highest survival rates and lowest incidences of bronchopulmonary dysplasia were associated with a respiratory support policy of early CPAP and tolerance of higher PaCO₂ levels.

Early surfactant replacement therapy with extubation to NCPAP compared with later, selective (rescue) surfactant replacement and continued MV with extubation from low ventilator support is associated with a reduced need for MV, but increased utilisation of surfactant therapy.⁵ A small study enrolling very low birth weight (VLBW) infants between the ages of 0 and 6 hours after birth found that in infants treated with NCPAP for RDS, the immediate reinstitution of NCPAP after surfactant administration was safe and beneficial, as evidenced by the decreased need for mechanical ventilation and reduced need for retreatment with surfactant compared with infants who received continuing MV after surfactant treatment.⁶

A novel way in which to administer surfactant is the so-called 'INSURE' treatment strategy (INTubation SURfactant Extubation), used to treat preterm infants with RDS in Stockholm County.⁷ This strategy involves commencing treatment of infants at risk of RDS with NCPAP in the delivery room, followed by brief intubation under sedation and administration of 100 - 200 mg/kg birth weight of porcine-derived surfactant when RDS is established. The infant is then briefly ventilated and extubated within 4 - 6 minutes. The results achieved in this study suggest that transient intubation during CPAP reduces the need for MV without adverse effects on outcome.

Neonatal intensive care units in developing countries are constantly struggling to optimise limited resources. The problem is further compounded by the limitations placed on the use of costly but life-saving medications such as exogenous surfactant. There is therefore a need to explore cost-effective ways in which to manage the burden of limited resources without compromising patient care. Because of cost constraints the unofficial limits of viability in South African public sector hospitals are set at between 900 g and 1 000 g birth weight and/or 28 weeks' gestation.

Faced with these dilemmas, clinicians at Tygerberg Children's Hospital (in a level 2/medium-care neonatal ward) commenced

managing VLBW and extremely low-birth-weight (ELBW) infants with RDS with NCPAP with increasing frequency between 1995 and the present.¹ Since its introduction, NCPAP has significantly improved the survival rates of ELBW infants at our institution without increasing morbidity, despite a significant increase in the number of ELBW infants admitted over the past 5 years. Between 1994 and 2004, the survival rate of the birth weight category 500 - 999 g improved from 43% to 73% ($p < 0.05$) (Kirsten GF, van Zyl JJ, personal communication). Currently VLBW infants at risk of RDS, but who do not require intubation in the labour ward, are managed with facial mask NCPAP (Neopuff system) which is commenced in the delivery room and continued during transport to the medium-care neonatal ward. Infants with confirmed radiological RDS who are not improving on NCPAP (4 - 5 cm H₂O) alone (defined as a FiO₂ >0.4 to maintain preductal arterial oxygen saturation (SaO₂) levels of 88 - 92%, severe recession and/or apnoea) receive surfactant treatment via a modified INSURE strategy, namely, 'in-out' surfactant. Although this approach is yet to be evaluated in a controlled study, our experience suggests that it has decreased the need for MV in the ELBW category group, as well as facilitated early establishment of kangaroo mother care.

Non-invasive easy-to-use technologies are needed in order to alleviate the health burden of managing infants with RDS in developing countries. Ballot *et al.* present an invention that seems safe; however, the splint's role in the management of RDS remains speculative. Large well-designed controlled studies are needed to compare this new technology with NCPAP, with or without surfactant treatment.

Johan Smith

Division of Neonatology
Department of Paediatrics and Child Health
Stellenbosch University and
Tygerberg Children's Hospital
Tygerberg, W Cape

References

1. Pieper CH, Smith J, Maree D, Pohl FC. Is nCPAP of value in extreme preterms with no access to neonatal intensive care? *J Trop Pediatr* 2003; 49: 148-152.
2. Kamper J, Wulff K, Larsen C, Lindequist S. Early treatment with nasal continuous positive airway pressure in very low birth weight infants. *Acta Paediatr* 1993; 82: 193-197.
3. Jonsson B, Katz-Salamon M, Faxelius G, Broberger U, Lagercrantz H. Neonatal care of very low birth weight infants in special care units and neonatal intensive care units in Stockholm. Early nasal continuous positive airway pressure versus mechanical ventilation: gains and losses. *Acta Paediatr Suppl* 1997; 419: 4-10.
4. Avery ME, Tooley WH, Keller JB, *et al.* Is chronic lung disease in low-birth-weight infants preventable? A survey of eight centers. *Pediatrics* 1987; 79: 26-30.
5. Stevens TP, Blennow M, Soll RF. Early surfactant administration with brief ventilation vs selective surfactant and continued mechanical ventilation for preterm infants with or at risk for RDS. *Cochrane Database Syst Rev* 2002; (2): CD003063.
6. Dani C, Bertini G, Pezzati M, Cecchi A, Caviglioli C, Rubaltelli F. Early extubation and nasal continuous positive airway pressure after surfactant treatment for respiratory distress syndrome among preterm infants < 30 weeks' gestation. *Pediatrics* 2004; 113: e560-e563.
7. Bohlin K, Gudmundsdottir T, Katz-Salamon M, Jonsson B, Blennow M. Implementation of surfactant treatment during continuous positive airway pressure. *J Perinatol* 2007; 27: 422-427.