Improving neonatal care in rural areas: an approach to common causes of neonatal mortality

Lloyd LG, MBChB, DCH(SA), FCPaeds(SA), MMed(Paeds)
Neonatology Fellow, Department of Paediatrics, Steve Biko Academic Hospital; University of Pretoria
Correspondence to: Lizel Lloyd, e-mail: lizel.lloyd@up.ac.za
Keywords: neonatal care, rural areas, neonatal mortality

Abstract

Neonatal mortality constitutes approximately 40% of all under-five deaths. In order to achieve Millennium Developmental Goal 4 (MDG 4) by 2015, a drastic intervention is required. Empowering medical personnel in rural areas to improve care in certain critical neonatal conditions might result in a much-needed reduction in neonatal mortality. The most common causes of neonatal mortality are prematurity, birth asphyxia, infections and congenital anomalies. This review article highlights the newest neonatal resuscitation guidelines, as well as evidence-based management of neonatal encephalopathy, meconium aspiration syndrome, prematurity-related conditions and common neonatal infections. By implementing simple cost-effective improvements in neonatal care, neonatal mortality can be reduced, and ultimately, MDG 4 can be reached.

Ⓟ **Peer reviewed. (Submitted: 2012-02-08. Accepted: 2012-06-06.)** **S Afr Fam Pract 2012;54(4):297-301**

Introduction

Improving neonatal care in rural areas is only one of many ways to reach Millennium Development Goal 4 (MDG 4), which calls for a two-thirds reduction in the under-five mortality rate and infant mortality rate.[1] However, it is estimated that only nine of 137 developing countries are likely to achieve this goal by 2015.[2] More than 40% of all under-five deaths occur in the neonatal period.[3] Therefore, improving neonatal care, especially in rural areas, will contribute towards achieving MDG 4 sooner.

The most common causes of neonatal death are prematurity, birth asphyxia, infections and congenital anomalies. This review will focus on a few of these, in order to empower the doctor in a rural hospital to improve neonatal care and ultimately reduce the neonatal mortality rate.

Delivery room management of the neonate[4]

The neonatal resuscitation guidelines were revised in 2010 (Figure 1). Although the principles of resuscitation remain the same, there have been some important changes.

Assessment of the need for resuscitation no longer includes observation of whether the amniotic fluid is clear or meconium stained. The presence of meconium-stained amniotic fluid (MSAF) does not change the management of the infant, except in the case of a non-vigorous baby, where tracheal suctioning is still to be continued. There is no evidence that supports or refutes tracheal suctioning of MSAF, but if tracheal intubation is unsuccessful or there is severe bradycardia, positive-pressure ventilation should be initiated immediately.

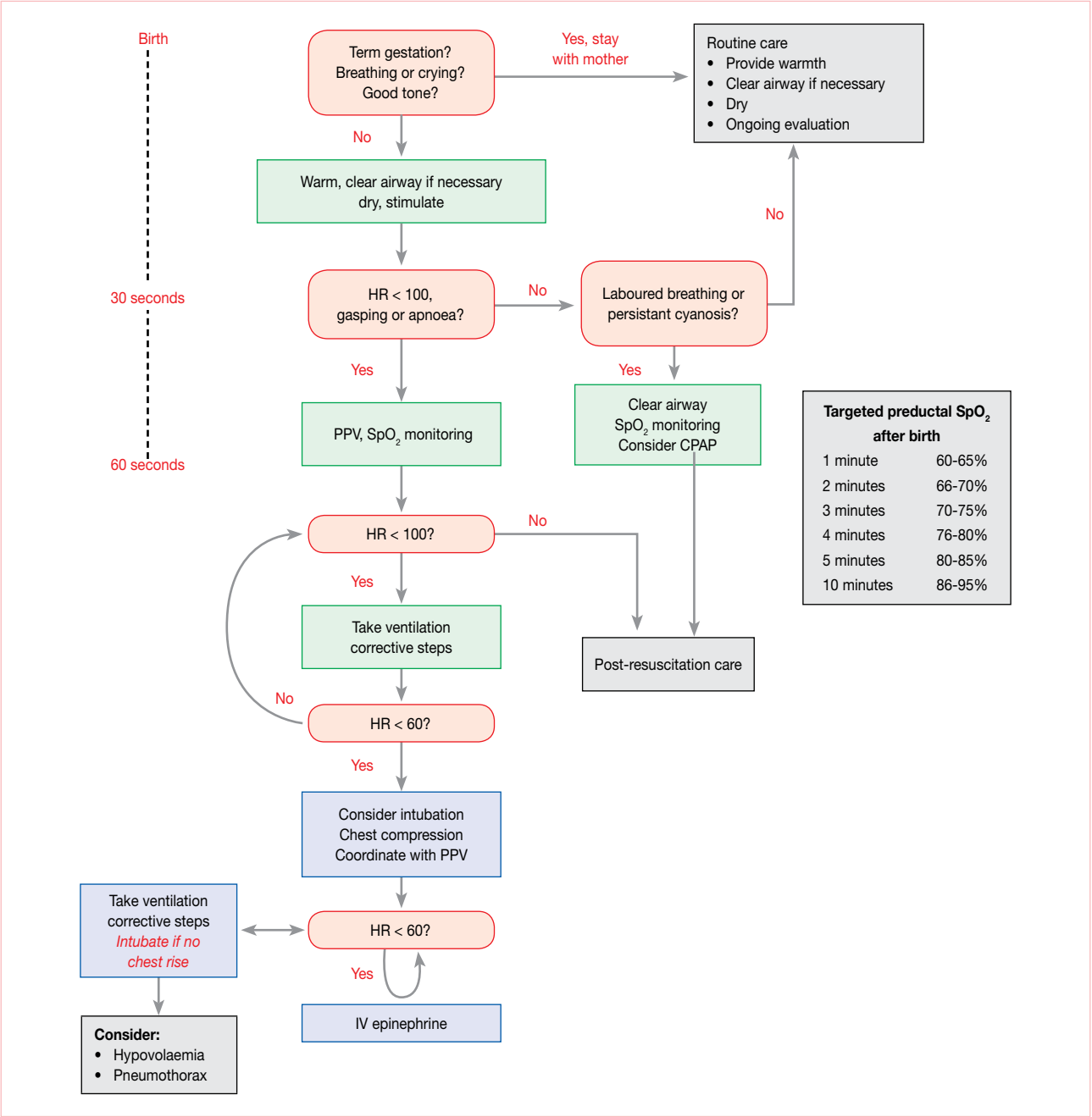
Auscultation of the precordium is more accurate than palpation of the umbilical cord in detecting heart rate.

The use of a saturation monitor during resuscitation is recommended. Specific target saturations are included in the diagram (Figure 1).

Resuscitation in term babies should start with room air (21% oxygen content). If no improvement in heart rate or oxygenation is noted, blended air oxygen may be started and increased gradually up to 100% to attain target saturations. In preterm infants, resuscitation may be started with 30-90% oxygen, and then increased or decreased according to the infant's response. There is no evidence for initial oxygen use in infants aged 32-37 weeks.

The T-piece resuscitator is superior to the traditional bag and mask devices, as it provides positive end-expiratory pressure (PEEP) in preterm infants, and some control over the amount of positive inspiratory pressure given to the infant.

If cardiac compressions are commenced, the two-thumb technique with the hands encircling the torso at the nipple line is superior to the two-finger technique. Chest compressions should be delivered in a ratio of 3 compressions:1 breath.



CPAP: continuous positive airway pressure, HR: heart rate, IV: intravenous, PPV: positive-pressure ventilation

Figure 1: The neonatal resuscitation guidelines (Adapted from Kattwinkel et al[4])

The use of naloxone and sodium bicarbonate is no longer recommended in the delivery room.

Post-resuscitation care should be provided to all infants who require resuscitation, as they are at risk of deterioration. After adequate ventilation and circulation have been established, these infants should be transferred to an environment where close monitoring can be provided.

Neonatal encephalopathy

Foetal hypoxaemia and hypercarbia occur secondary to impaired gas exchange during the first and second stages of labour. Many aetiological factors are involved in this process, including maternal, placental and foetal reasons.

Newborn babies have the highest risk of developing hypoxic ischaemic encephalopathy when the following risk factors are present:

- Foetal heart rate < 60/minute
- Apgar score ≤ 3 at ≥10 minutes
- Need for positive pressure ventilation for > 1 minute or first cry delayed > 5 minutes
- Seizures within 12-24 hours of birth
- Suppressed background pattern or burst suppression on electroencephalogram.

Foetal hypoxaemia can lead to multi-organ dysfunction, most commonly of the kidneys and heart, with acute tubular necrosis and transient myocardial ischaemia, respectively.

Management of the patient starts in the delivery room with effective resuscitation. Convulsions should be treated promptly. Phenobarbitone 20mg/kg intravenously is still the initial drug of choice. This may be followed by an additional dose of 10 mg/kg if convulsions persist. Referral to a tertiary centre for neuroprotective strategies, such as whole body hypothermia, should occur within the first six hours of life.

Meconium aspiration syndrome

MSAF occurs in 12.5% of term and post-term deliveries. Twenty to 30% of these infants will be depressed at birth, and 5% will develop meconium aspiration syndrome (MAS). More than 4% of these infants will die.[5]

The foetus can aspirate meconium in utero, but mostly it occurs directly after delivery, with the first breath. Based on this observation, suctioning after the infant has already started breathing is no longer advised, as the infant has already aspirated. Suctioning will only further delay oxygenation. In the non-vigorous baby, tracheal suctioning may be attempted in the first 30 seconds of life, but this should not delay resuscitation and oxygenation.

An infant with meconium aspiration will present with tachypnoea, hypoxia and hypercapnoea. A chest X-ray will reveal areas of hyperinflation and atelectasis, due to small airway obstruction and the ball-valve effect (Figure 2). Air leak syndromes, e.g. pneumothorax, can also occur. After 24-48 hours, a chemical pneumonitis will develop.

As a result of the oxygenation problem, these infants often revert back to foetal circulation and develop persistent pulmonary hypertension of the newborn baby (PPHN). This is a life-threatening condition with a very high mortality rate, even in tertiary centres.

A patient with severe MAS may need ventilatory support. The ideal mode of ventilation is high-frequency oscillatory ventilation with or without nitric oxide, which should be available in most tertiary centres. If the infant complicates with PPHN, the treatment involves correction of the hypotension with inotropes, ventilation to correct the respiratory acidosis and urgent referral to a tertiary centre. The use of fluid boluses in these patients is not advised.

Prematurity and small-for-gestational-age infants

The premature infant represents the most vulnerable group of patients. These infants are physiologically immature and are sensitive to the smallest changes in their environment.

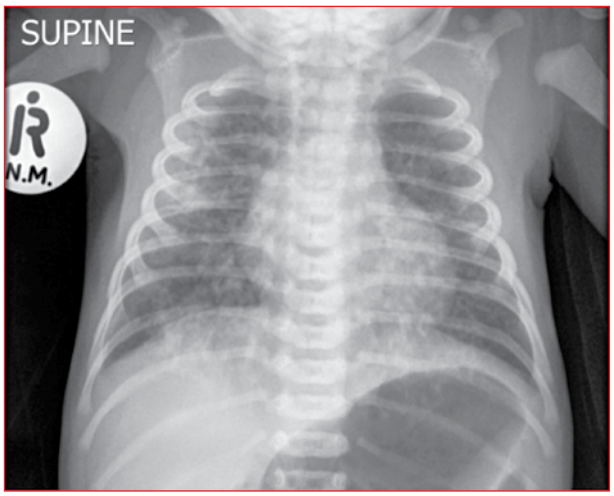


Figure 2: A chest X-ray with the typical appearance of meconium aspiration syndrome

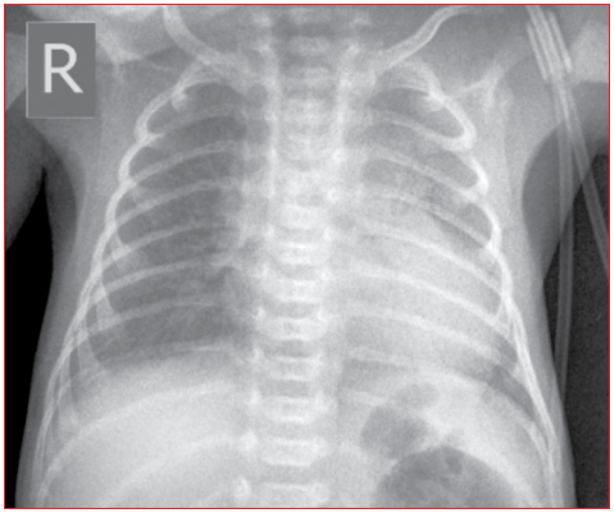


Figure 3: Ground-glass appearance on chest X-ray of a patient with hyaline membrane disease

The use of steroids antenatally should be the standard of care for women at risk of preterm delivery before 32-34 weeks gestation, as this reduces the incidence of respiratory problems in these premature infants.[6] Delayed cord clamping is an important intervention for all newborn babies, including premature infants. When an infant does not require immediate resuscitation, delaying the clamping of the cord by at least one minute significantly reduces the incidence of iron deficiency anaemia in the first year of life.[7] It also reduces the amount of blood transfusions required later.

Infants < 1 500 g are prone to hypothermia. Although the standard delivery room practice is to immediately dry the baby, in extreme and very low birthweight infants, this may damage the immature skin. Currently, the practice is to place the undried baby in a plastic wrap or in a plastic bag, with the face open and the head covered either in plastic or with a woollen cap. This is a simple cost-effective method of

preventing hypothermia, and thereby improving the ultimate outcome of these infants.

Respiratory support for hyaline membrane disease should be gentle and preferably noninvasive. The use of a T-piece resuscitator to provide PEEP in the delivery room is advised when available. These infants should receive continuous positive airway pressure (CPAP) as soon as possible. This ensures alveolar inflation and reduces the use of surfactant therapy (Figure 3). If the infant requires more than 40% of inspired oxygen, surfactant is advised. Where CPAP is not available, high-flow nasal cannula oxygen or intubation and gentle ventilation can be used while awaiting transfer to a tertiary centre. The use of excessive pressure and volume with a bag and mask device can lead to lung injury by barotrauma and volutrauma in premature infants. This predisposes the infant to chronic lung disease, so utmost care should be taken to limit the pressure and volume applied to the bag when ventilating the patient. A T-piece resuscitator is an alternative and safer method of ventilation.

Premature infants have increased fluid needs, due to increased surface area to body weight and skin immaturity. Renal immaturity may also lead to increased fluid losses. Ideally, an umbilical venous catheter should be placed shortly after birth, and can then be used for 7-14 days.[8] The rate of fluid administration differs between centres, but the principle of giving additional fluids to compensate for these losses remains the same. A standard neonatal solution with balanced electrolytes and 10% dextrose should be used.

Hypotension in premature infants remains a controversial topic. There is no consensus regarding normal blood pressure values in these infants. Mean blood pressures, as low as 23 mmHg, may be acceptable provided that the peripheral perfusion is adequate. As the hypotension is mostly due to altered vasoreactivity rather than hypovolaemia, the use of fluid boluses may not be appropriate. Usually, inotropic support with either dopamine or dobutamine is effective.

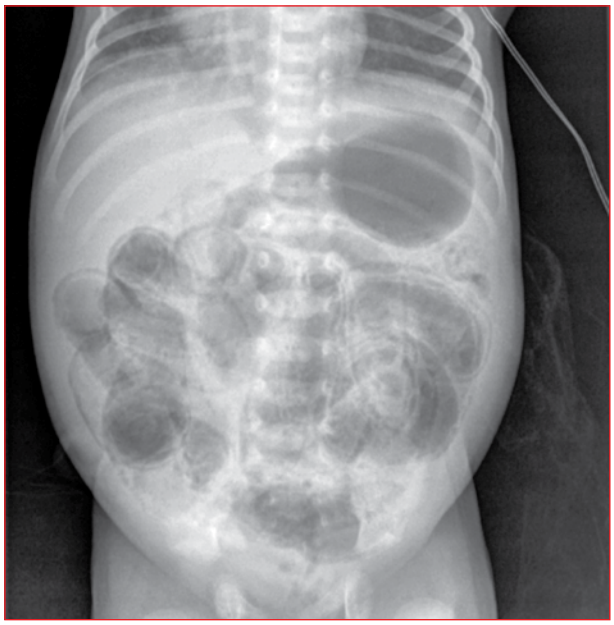


Figure 4: An abdominal X-ray of a patient with severe necrotising enterocolitis with pneumatosis intestinalis

Kangaroo mother care reduces the mortality of premature infants and should be practised as soon as possible if it is feasible. Human breast milk feeds should be initiated on day one of life with colostrum, and increased in increments until full-calorie requirements are reached. The use of preterm formula is associated with an increased risk of necrotising enterocolitis (Figure 4), and should be avoided for the first two weeks of life at least, until gut maturity is reached. Donated human breast milk is available as a safe alternative feed in some institutions.

Retinopathy of prematurity (ROP) remains a problem in premature infants who need to receive oxygen therapy over a prolonged period. The Benefits of Oxygen Saturation Targeting Trials (BOOST II) recommend oxygen saturations of 91-95%. This both reduces the incidence of ROP and increases survival rates at 36 weeks postmenstrual age.[9] All premature infants < 1 300 g, especially those who have to receive prolonged oxygen therapy, should undergo ophthalmological screening at 4-6 weeks after birth.

Common neonatal infections

Bacterial septicaemia and meningitis remain a common cause of morbidity and mortality in this group of patients. Group B streptococcus can cause life-threatening disease. Ideally, it should be prevented by obstetric screening and prevention. Unfortunately, this is not cost-effective in developing countries.[10] *Listeria monocytogenes* and *Escherichia coli* are pathogens that can also cause bacteraemia in this age group. Risk factors for infection include maternal intrapartum fever > 38°C, chorioamnionitis and prolonged rupture of membranes > 18 hours. The clinical presentation is nonspecific and newborn babies may even be asymptomatic. Respiratory distress, irritability, lethargy, temperature instability, poor perfusion and hypotension are often present. A positive blood culture remains the gold standard for the diagnosis of neonatal septicaemia.

Empirical antibiotic cover with a β-lactam antibiotic and an aminoglycoside is recommended, for example penicillin and gentamycin or amikacin.

Neonatal meningitis can occur in the absence of bacteraemia and with normal cerebrospinal fluid (CSF) values. The CSF culture is critical to the diagnosis, regardless of other laboratory tests. However, a lumbar puncture should always be included in the work-up of a patient with suspected sepsis.[11]

Conclusion

In order to achieve MDG 4, improved neonatal care is vitally important. By preventing birth asphyxia with improved obstetric care and by performing adequate resuscitation in the delivery room, many deaths due to asphyxia can be prevented. Increased survival of premature infants requires low-cost interventions, such as preventing hypothermia, human milk feeds and kangaroo mother care. Neonatal infections require basic antibiotics that should be freely available in most hospitals. If management can be improved in these areas, the neonatal mortality rate can be dramatically reduced.

References

1. You D, Wardlaw T, Salama P, Jones G. Levels and trends in under-5 mortality, 1990-2008. Lancet. 2010;375(9709):100-103.
2. Lozano R, Wang H, Foreman KJ, et al. Progress towards Millennium Development Goals 4 and 5 on maternal and child mortality: an updated systemic analysis. Lancet. 2011;378(9797):1139-1165.
3. Black RE, et al. Global, regional and national causes of child mortality in 2008: a systematic analysis. Lancet 2010;375(9730):1969-1987.
4. Kattwinkel J, Perlman JM, Aziz K, et al. Special report: neonatal resuscitation: 2010 American Heart Association Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Pediatrics. 2010;126(5):e1400-e1413.
5. Wiswell TE, Tuggle JM, Turner BS. Meconium aspiration syndrome: have we made a difference? Pediatrics. 1990;85(5):715.
6. Crowley P. Prophylactic corticosteroids for preterm birth. [Cochrane review]. In: The Cochrane Library, Issue 3, 2001. Oxford: Update Software.
7. Cernadas JM, Carroli G, Pellegrini L, et al. The effect of timing of cord clamping on neonatal venous haematocrit values and clinical outcome at term: a randomized controlled trial. Pediatrics. 2006;117(4):e779-786.
8. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention [homepage on the Internet]. 2011. Available from: http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html
9. Stenson B, Brocklehurst P, Tarnow-Mordi W. Increased 36-week survival with high oxygen saturation target in extremely preterm infants. N Eng J Med. 2011;364(17):1680-1681.
10. Kaambwa B, Bryan S, Gray J, et al. Cost-effectiveness of rapid tests and other existing strategies for screening and management of early-onset group B streptococcus during labour. BJOG. 2010;117(13):1616-1627.
11. Garges HP, Moody A, Cotton CM, et al. Neonatal meningitis: what is the correlation among cerebrospinal fluid cultures, blood cultures, and cerebrospinal fluid parameters? Pediatrics. 2006;117(4):1094-1100.