Can all neonatal resuscitation be managed by nurse practitioners?

L C Chan, E Hey

Aim: To assess the ability of nurse practitioners to manage the care of all babies requiring resuscitation at birth in a unit without on site medical assistance.

Method: A prospective review, and selective external audit, of the case records of all 14,572 babies born in a maternity unit in the north of England during the first eight years after nurse practitioners replaced resident paediatric staff in 1996.

Results: Every non-malformed baby with an audible heart beat at the start of delivery was successfully resuscitated. Twenty term babies and 41 preterm babies were intubated at birth. Eight term babies only responded after acidosis or hypovolaemia was corrected following umbilical vein catheterisation; in each case the catheter was in place within six minutes of birth. Early grade 2–3 neonatal encephalopathy occurred with much the same frequency (0.12%) as in other recent studies. Independent external cross validated review found no case of substandard care during the first hour of life.

Conclusion: The practitioners successfully managed all the problems coming their way from the time of appointment. There was no evidence that their skill decreased over time even though, on average, they only found themselves undertaking laryngeal intubation once a year. It remains to be shown that this level of competence can be replicated in other settings.

ORIGINAL ARTICLE

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RESULTS
Management of the term baby at birth
Problems associated with delivery were encountered in 46 babies (summarised in fig 1). Mask inflation of the lung was used to initiate breathing in an estimated 6% of all the babies born at term, but few needed any further respiratory support once lung aeration had been achieved. Practitioners would still have been present for every baby managed by intubation (other than one child with shoulder dystocia) had they only attended operative deliveries for fetal distress. Such a policy would have freed them from attending four fifths of the term deliveries they did attend.

Babies in terminal apnoea at birth
Seven babies were judged, in retrospect, to have been in terminal apnoea at birth. One had no detectable heart beat for 12 minutes after birth. The others had a heart rate of less than 60 beats/min at delivery which did not rise until after the lung had been aerated. All only gasped for the first time after the heart rate had returned to normal. Chest compression was used in six, and in five of these the circulation only responded after sodium bicarbonate as well as adrenaline had been given down an umbilical vein catheter. They continued to gasp intermitently for at least one to two minutes before normal breathing movements were seen, and continued to gasp regularly for a further period after that. All had an umbilical blood pH below 6.8 and a base deficit of 16 or more at delivery. With one exception, all went on to develop a severe (grade 2–3) neonatal encephalopathy. Five have since died, three have spastic quadriplegia, and another is deaf. No baby of less than 37 weeks gestation developed a severe encephalopathy during the years in question; prevalence among all term deliveries in the unit (0.12%) is therefore much the same as in other recent case series.8–10 The rate for the 255 000 babies of 35 or more weeks gestation born in the Trent region in England between 1998 and 2002 was 0.14% in 2000–02.11

Hypovolaemic collapse at birth
Three very pale bradycardic babies failed to respond to lung aeration and mask ventilation even though the specimen of cord blood showed no evidence of acidosis. All three gasped intermittently, but none breathed regularly after birth. In each case the heart rate remained below 70 beats/min even after lung aeration was achieved, but doubled within a minute as soon as the baby was given a bolus of at least 20 ml/kg saline, plasma, or blood through an umbilical catheter. All three babies were breathing normally within 22 minutes. In each case it was established retrospectively that the baby had almost certainly been acutely hypovolaemic at birth (as judged by a low red blood cell volume), the problem being due to cord prolapse in one baby, to shoulder dystocia in a second, and to a tight nuchal cord in a third. None of these babies went on to develop any serious features of an encephalopathy.

Laryngeal intubation during initial resuscitation
Only 20 term babies were intubated during resuscitation, although another 14 were intubated soon after the circulation had been restarted and breathing movements had been seen in order to facilitate continuing care. Early reintubation proved necessary in two babies because of tube dislodgement,

Figure 1  Problems encountered during resuscitation in 13 514 term babies. Twenty babies were intubated, 18 developed grade 2–3 encephalopathy, 12 developed symptoms of meconium aspiration syndrome, and three had life threatening hypovolaemia at birth.
and, in one baby, where there was a lot of blood stained fluid in the posterior pharynx obscuring the larynx, the anaesthetist in theatre came to the practitioner’s assistance. Five babies were intubated at birth in the first half of 1996 (the year when nurse practitioners first assumed responsibility for all aspects of neonatal resuscitation). After 1996, intubation was only used in 0.13% (15/11 518) of term births.

Meconium was present in the liquor of eight of the 20 babies managed by direct laryngeal intubation at birth, but particulate matter was only found below the larynx in three. These three babies became oxygen dependent for at least 48 hours, as did another nine who had meconium in their liquor at birth, but who breathed within moments of delivery, and required no resuscitation. None of the other intubated babies remained oxygen dependent for more than four hours. In one other baby, with good cord gases, it proved impossible to elicit any chest movement at first, although the baby did respond rapidly once the trachea was intubated and a lot of thick creamy white material was removed. This baby (who had probably inhaled vernix) went on to make a rapid and uninterrupted recovery.

**Delayed onset of regular respiration**

Forty eight babies subjected to mask resuscitation only started to breathe regularly six or more minutes after birth, even though bradycardia never persisted for more than two minutes. In 17 cases, no problem had been expected, and no nurse practitioner was present at delivery. Another eight cases followed delivery under general anaesthesia. Maternal sedative medication may have been a factor in another three cases, and three other mothers were receiving methadone. None of these babies was seriously acidic at birth, and none went on to develop fits or any other sign of an encephalopathically ill after birth, although two of the babies born to mothers receiving methadone later developed withdrawal symptoms.

**Management of the preterm baby at birth**

Figure 2 summarises the initial management of the 1058 preterm babies born in the hospital between 1996 and 2003.

Forty one preterm babies were intubated, including 29 of the 73 babies born at less than 30 weeks gestation. In only two of the preterm babies in whom intubation was the strategy adopted from the outset did it take more than two minutes to place an endotracheal tube. All but one of the 397 preterm babies managed by mask resuscitation at delivery was centrally pink within two minutes, and had a heart rate above 100 beats/min, although in 12 it took more than five minutes for the baby to start breathing regularly. Medical staff from the region’s neonatal transfer service had, as a matter of policy, tried to be present in time to assist with the immediate post-delivery care of all babies born before 30 weeks gestation in the years before nurse practitioners first came into post but, by 1999, it was clear that this policy was no longer as necessary as it had originally been.

**Intrapartum and neonatal death**

Two term and three preterm babies died during labour but, with one exception, death occurred at least two hours before delivery, and this knowledge had been shared with the mother before delivery. In the remaining case, the fetal heart was detected beating on ultrasound immediately before caesarean delivery (~35 beats/min), but no heart beat could be detected at birth, and the cord blood had a pH of 6.65.

Neonatal mortality among babies actually born in the unit (31/14 572) was comparable to that for the other 10 units in the region (2.1  v 2.3 deaths/1000 births). One term baby with a complex heart defect could not be resuscitated, one died with an intracranial bleed two days after an uneventful vertex delivery, and five died with features of intrapartum asphyxia (see above). Eighteen preterm babies died with hyaline membrane disease or its secondary consequences. Two of these were born at 29 weeks gestation; all the others were less than 28 weeks gestation at birth. Two preterm babies died of asphyxia following placental abruption. Two others died with lethal malformations, one died when the airway became compromised during transfer, and one baby, who needed no resuscitation at birth, died from delayed bleeding into the peritoneal cavity from a liver haematoma. Audit failed to find significant fault with the resuscitation and stabilisation of any of these babies before their transfer to a tertiary centre for continuing care.

**DISCUSSION**

Our data confirm that nurse practitioners working in an obstetric unit where there are no resident paediatric staff can become and remain proficient in neonatal resuscitation. The change in staffing had no detectable impact on neonatal mortality either among the babies actually delivered in the unit (as reported here), or among all the babies originally booked for delivery in the unit.12 More convincingly, independent external audit showed that resuscitation was being undertaken in an appropriate, timely, and efficient way.

The frequency with which laryngeal intubation is undertaken in the term baby is probably a reflection of the confidence that staff have in the efficacy of mask resuscitation at birth. The UK’s first training manuals all focused on intubation as being the most effective method of securing lung aeration, mainly because most face masks in use before 1984 provided a very poor face seal. However, after the development of the Laerdal face mask,1 a study in Sweden found that, among babies weighing 2500 g or more at birth, skilled staff only judged one baby in every 600 to need intubation at birth.14 This finding has been confirmed in this study, where only one term baby in 800 was managed by intubation at birth.

A small minority of babies are always going to need intubation at birth, however, and it is reassuring to see that staff found that they had the skill to do this when necessary, even though they came into post with little previous experience of laryngeal intubation. It is equally important
to record that there is no evidence to suggest that this skill later deserted them even though individual staff only found themselves intubating an average of one baby a year. Confident waned when this skill was not called on often, but competence did not—the reverse of what studies using simulation rather than an audit of actual practice to assess skill retention have reported until now.15–20 If this finding can be replicated in other settings, it has important implications for the many midwives who have progressively lost confidence in their ability to sustain this skill in the last 30 years.

In the first few years after nurse practitioners first replaced resident paediatric staff in Ashington, they assumed responsibility for stabilising all the sickest babies at delivery. Once this training became more widely available, this responsibility came to be shared flexibly with the midwives, and this team approach may well account, at least in part, for the speed with which umbilical vein catheterisation was always achieved when judged necessary. An anaesthetist was present in theatre during the delivery of many of the illest babies, but they only took an active part in the resuscitation of three of the babies in this study (all born in the first third of the study period). Although an anaesthetist assisted with laryngeal intubation on two occasions, this reversal of responsibility does not seem to have been critical to successful case management. In two thirds of the preterm babies of more than 29 weeks gestation, early lung expansion was optimised by gentle controlled mask inflation at birth,21 and in some this was then sustained by offering early nasal continuous positive airway pressure. Only 1.6% were judged to need intubation at birth.

Learning how to intubate the trachea seems to be rather like learning to ride a bicycle. It looks somewhat improbable to the onlooker, and it is a skill that cannot be learnt from a book. It can only be acquired by trying to do it while—with luck—a supportive colleague stands by. It is, however, a skill that, once acquired, is never lost.

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What is already known on this topic
- Staff take time to become skilled in neonatal resuscitation
- There is a widespread perception that this skill wanes when not put to regular use

What this study adds
- Experienced nurses were externally judged to have managed all the care required by the 14 500 babies born in an obstetrically staffed maternity unit to a high standard over an eight year period even though the unit lacked any on site paediatric staff
- Laryngeal intubation was only used in the initial resuscitation of 61 (0.4%) of these term and preterm babies, and staff found that, although confidence in their ability to do this waned when it was seldom needed, competence did not

Competing interests: LCC has worked in the unit where this work was undertaken since 1998. ENH was the first to suggest that nurse practitioners might be used to replace resident medical staff when the unit first faced closure in 1993, but he had retired before the practitioners came into post in 1996.

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