Changes in resuscitation practice at birth

ACL Allwood, RJ Madar, JH Baumer, L Readdy, D Wright

Aim: To investigate secular changes in neonatal resuscitation at birth.


Observations: Rates and modes of ventilatory resuscitation, early neonatal encephalopathy, neonatal convulsions, and meconium aspiration syndrome; 1 and 5 min Apgar scores; maternal age and method of delivery; paediatric attendance at delivery and resuscitation.

Results: The rate of all forms of ventilatory resuscitation fell during the four year period from 11.0% to 8.9%. The rate of intubation fell from 2.4% to 1.2%. A reduced rate of intubation was seen at all gestations of 30 weeks and above. There was no difference in rates of relevant neonatal problems during the period except for a reduction in neonatal convulsions. The introduction of T-piece ventilation did not contribute to the reduction in intubation in a logistic regression model that included time trend.

Conclusion: A marked reduction in the rate of intubation was observed, without any reduction in the efficacy of resuscitation. This may reflect improvements and changing emphasis in resuscitation training.

The provision of adequate ventilation is the cornerstone of resuscitation at birth. The means by which this is best achieved remains contentious. Endotracheal intubation has long been advocated as the definitive method. It has the advantage of providing a secure airway but requires appropriate training and supervised experience. The skill is not easily taught or practiced. Significant complications may arise from intubation. Minor localised trauma to the oropharynx is well described. More serious injuries including vocal cord avulsion and tracheal or oesophageal perforation have been reported. Systemic adverse effects of airway manipulation during laryngoscopy and intubation include tachycardia, hypoxaemia, hypertension, and raised intracranial pressure. Such adverse responses have been implicated as contributory factors in the aetiology of intraventricular haemorrhage. For these reasons non-invasive ventilatory resuscitation using a mask and self-inflating bag valve device or T-piece continues to be the firstline means of newborn ventilatory resuscitation in the United Kingdom.

T-piece ventilation for neonatal resuscitation at birth was described as early as 1913. Despite further publications in the 1920s and 1960s, this method of newborn resuscitation only gained wider acceptance in the late 1980s. The T-piece connects to a facemask to deliver a flow regulated, pressure limited, oxygen supply to the baby, enabling application of prolonged initial inflation breaths. Inflation for at least 2 s has previously been demonstrated to enhance the establishment of functional residual capacity at birth in intubated babies. A physiological study comparing T-piece ventilation with the best bag valve mask systems demonstrated at least similar efficacy. A recent study investigated interoperator performance comparing manual bagging devices with T-piece for ventilation of neonatal manikins. T-piece was found to more consistently deliver target pressures and prolonged inflation independent of the operator’s expertise. A previous review of resuscitation practice at birth cited local clinical experience suggesting that the technique might markedly reduce the need for endotracheal intubation. This has not been formally investigated in any subsequent studies.

Recent data from Canada investigating adherence to standardised neonatal resuscitation training (Neonatal Resuscitation Program) revealed that bag and mask ventilation was performed in 10.6% of deliveries and that intubation was undertaken in 3.6%. Previous population based studies from Scandinavia suggest that unanticipated need for intubation of low risk newborns (defined as those delivered beyond 32 weeks gestation by non-instrumental vertex vaginal delivery without additional staff in attendance prior to birth) is a rare event (1 in 5000 deliveries) and that bag and mask ventilation is adequate in the vast majority of cases. There is no comparable United Kingdom data and little information exists regarding changing trends in resuscitation practice. As part of an ongoing system of monitoring, information about neonatal resuscitation was collected prospectively onto computer for all hospital deliveries during a four year period in which T-piece ventilation was introduced. This provided an opportunity to investigate the associated changes in intubation practice in a large population.

POPULATION AND METHODS
Birth details of all babies born at Derriford Hospital between May 1993 and April 1997 were entered directly into a computerised database within 24 hours of delivery, irrespective of whether the baby was admitted to the neonatal intensive care unit. This included details of maternal age, gestation, birth weight, mode of delivery, 1 and 5 min Apgar scores, presence of medical staff at delivery and/or resuscitation, method of resuscitation and complications (if any), and whether the infant was admitted to the neonatal unit. Normal vaginal delivery was defined as unassisted vertex vaginal delivery through clear liquor at any gestation. The best estimate of gestation was either calculated by the computer when the expected date of delivery was known, or was entered directly. Medical information on neonatal diagnoses, including convulsions in the neonatal period, moderate or severe early neonatal encephalopathy (defined as a clinical course consistent with grade 2 or 3 hypoxic ischaemic encephalopathy in which no other cause could be attributed), and meconium aspiration syndrome (defined as admission to the neonatal unit following delivery through meconium stained liquor with respiratory symptoms and consistent chest x ray appearances), was recorded on all babies. Delivery and diagnostic information was corroborated by medical staff following consultant led
Table 1 Population characteristics during the period under investigation. All figures are means (SD) or percentages

<table>
<thead>
<tr>
<th></th>
<th>Year 1 (n=4471)</th>
<th>Year 2 (n=4415)</th>
<th>Year 3 (n=4402)</th>
<th>Year 4 (n=4602)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age*</td>
<td>27.29 (5.32)</td>
<td>27.34 (5.38)</td>
<td>27.62 (5.38)</td>
<td>27.81 (5.50)</td>
</tr>
<tr>
<td>Gestation</td>
<td>39.33 (2.20)</td>
<td>39.34 (2.29)</td>
<td>39.36 (2.01)</td>
<td>39.34 (2.03)</td>
</tr>
<tr>
<td>Birth weight</td>
<td>3303 (598)</td>
<td>3321 (606)</td>
<td>3330 (591)</td>
<td>3323 (580)</td>
</tr>
<tr>
<td>Presence of doctor at delivery*</td>
<td>35.9%</td>
<td>32.0%</td>
<td>24.5%</td>
<td>22.5%</td>
</tr>
<tr>
<td>Doctor attended after delivery</td>
<td>4.2%</td>
<td>5.9%</td>
<td>5.9%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Non-rotational forceps*</td>
<td>2.2%</td>
<td>4.7%</td>
<td>3.9%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Kielland’s forceps†</td>
<td>0.40%</td>
<td>0.43%</td>
<td>0.23%</td>
<td>0.17%</td>
</tr>
<tr>
<td>Venteuse extraction*</td>
<td>2.7%</td>
<td>3.1%</td>
<td>6.0%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Breech ≤ forceps</td>
<td>0.78%</td>
<td>1.27%</td>
<td>0.86%</td>
<td>0.89%</td>
</tr>
<tr>
<td>Elective caesarean*</td>
<td>6.6%</td>
<td>6.6%</td>
<td>5.7%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Emergency caesarean*</td>
<td>10.3%</td>
<td>9.3%</td>
<td>8.8%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Meconium vaginal delivery*</td>
<td>3.0%</td>
<td>5.6%</td>
<td>6.0%</td>
<td>6.3%</td>
</tr>
<tr>
<td>1 min Apgar</td>
<td>8.4 (1.4)</td>
<td>8.6 (1.2)</td>
<td>8.5 (1.3)</td>
<td>8.4 (1.3)</td>
</tr>
<tr>
<td>Moderate or severe early neonatal encephalopathy*</td>
<td>7 (0.16%)</td>
<td>1 (0.02%)</td>
<td>4 (0.09%)</td>
<td>6 (0.13%)</td>
</tr>
<tr>
<td>Convulsions*</td>
<td>22 (0.49%)</td>
<td>15 (0.34%)</td>
<td>11 (0.25%)</td>
<td>5 (0.11%)</td>
</tr>
<tr>
<td>Meconium aspiration syndrome*</td>
<td>5 (0.11%)</td>
<td>8 (0.18%)</td>
<td>4 (0.09%)</td>
<td>10 (0.22%)</td>
</tr>
</tbody>
</table>

*p<0.001, †p<0.02.

RESULTS

Complete data were available for 17 885 babies born between May 1993 and April 1997. There was a significant increase in mean maternal age (by 0.52 years) from the first to the last of the 4 years in the study period (table 1). Rates of forceps deliveries and elective and emergency caesarean sections fell significantly, while increases in the rate of ventouse extractions and vaginal deliveries through meconium were observed. Progressively fewer deliveries were electively attended by medical staff during the 4 years studied but there was no significant change in the number of babies attended by a paediatrician after delivery. The rates of early neonatal encephalopathy and meconium aspiration syndrome did not change significantly during the study period. However, the rate of neonatal convulsions fell by 78%.

There was a statistically significant temporal reduction in rate of intubation throughout the study period (p=0.016, odds ratio 0.93 for each successive quarter year from the start of the study period). The crude rate of endotracheal intubation (all gestations and modes of delivery) decreased from 2.4% in the first year to 1.2% in the final year, a 51% reduction (χ² test for trend 29.2, p<0.001). The frequency of ventilatory resuscitation using any method likewise fell from 11.0% to 8.9% (χ² test for trend 14.4, p<0.001). The proportion of babies receiving ventilatory support at birth who were managed without endotracheal intubation increased from 76% to 86% (χ² test for trend 19.8, p<0.001). Analysis by gestational subgroups is shown in table 2. There was a significant reduction in rates of intubation of babies of 30 weeks’ gestation and above. Of the 12 473 babies born by normal vaginal delivery throughout the
study period, 3.7% received mask ventilation and 0.6% were intubated. In comparison, 8.3% of babies born by elective caesarean section received mask ventilation — and 0.6% were intubated. In comparison, 8.3% of babies born by elective caesarean section received mask ventilation — and 0.6% were intubated. In contrast, 948 babies received medical attention after birth following delivery in the absence of a paediatrician (5.3% of all deliveries). Four hundred and nineteen (44%) of such babies received some form of ventilation and 133 were intubated — 14% of all newborns attended urgently after delivery. Of 11461 low risk deliveries (defined as delivery at 32 weeks or more gestation by non-instrumental vertex vaginal delivery without paediatric staff present) a paediatrician attended after birth on 477 occasions (4.2%).

Two hundred and seventy five (57.6%) of these babies received mask ventilation (bag valve mask or T-piece) — 2.5% of the low risk group overall. Nine babies were intubated — 1 in 1273 of the low risk group.
management of resuscitation by both midwifery and paediatric staff may have contributed. It is likely that better recognition of babies not in need of ventilatory support at birth resulted in less unnecessary resuscitation. It is also possible that the observed reduction in intubation rate was part of a continuing trend over a much longer period. It is of note that this has occurred despite reduced experience of neonatal resuscitation by individual doctors in training consequent upon changing patterns of junior doctors' working hours.

There was no deliberate change in resuscitation training or change in policy of grade of medical staff attending deliveries during the study period. However, an audit of local resuscitation practice was presented at the end of the first year of the study period, following which paediatric medical staff were no longer required to electively attend instrumental deliveries at term. Additionally, training in the use of T-piece accompanying its introduction at the end of the second year of the study period may have enhanced awareness of newborn resuscitation and influenced its efficacy. Moreover, the increasing uptake of paediatric life support courses by junior paediatric medical staff during the study period may have improved general awareness of effective life support techniques in the newborn. Specifically, the past decade has seen a change in the emphasis of resuscitation training towards improved airway control and effective mask ventilation rather than mandatory early intubation. Notably, this study preceded the introduction of formal training based upon the Northern Neonatal Network's “Resuscitation at Birth” course,11 which has subsequently evolved into the UK Resuscitation Council endorsed Newborn Life Support course.12 Despite the availability of such programmes, recent national surveys have demonstrated persisting inadequacies in neonatal resuscitation training of both midwifery staff13 and paediatric general professional trainees.14 This unit had used 500 ml bag valve mask systems, although 250 ml self-inflating bags are not infrequently demonstrated the most marked relative reduction in intubation rate in this subgroup. Specifically, the past decade has seen a change in the general awareness of effective life support techniques in the newborn. Additionally, training in the use of T-piece accompanying its introduction at the end of the first year of the study period may have enhanced awareness of newborn resuscitation but suggests that other factors, possibly improved education with regard to non-invasive airway support, have contributed more to falling intubation rates.

In conclusion, this study has demonstrated falling intubation rates at birth, particularly marked between 30 and 37 weeks' gestation, during a four year period in a single centre, without accompanying deterioration in 5 min Apgar scores and with reduced rates of neonatal convulsions. The study also provides evidence for the safety and efficacy of T-piece ventilation as an alternative to bag valve mask ventilation in neonatal resuscitation but suggests that other factors, possibly improved education with regard to non-invasive airway support, have contributed more to falling intubation rates.

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REFERENCES
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