

Training Opportunities for Intubation of Very Low Birthweight Infants in a Tertiary Neonatal Centre

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Abstract

Aims

Endotracheal intubation is a mandatory skill for paediatric training in Ireland. There is international concern that trainees do not have sufficient opportunities to develop proficiency in intubation¹. Advances in care, including increased use of non-invasive ventilation, have reduced rates of endotracheal intubation in preterm infants^{2,3}.

The aim of this project was to quantify the training opportunities for intubation of very low birthweight (VLBW) infants in a tertiary neonatal intensive care unit (NICU).

Methods

This was a retrospective chart review of babies ≤ 1500 g born in the Rotunda hospital between January–December 2023.

Results

A total of 101 babies were included, with a median gestational age of 25⁺⁶ weeks (23⁺¹ – 32⁺⁵ weeks). There were 141 intubation episodes comprising 226 intubation attempts. 78/141 (55%) intubations were successful on first attempt. 102/141 (72.3%) intubations occurred in the NICU, and 65/141 (46.1%) happened during normal working hours. Surfactant was given in 67/141 (47.5%) and the baby remained intubated after surfactant in 108/141 cases (76.5%). Adverse events were documented in 15/141 episodes (10.6%).

Discussion

Despite falling preterm intubation rates worldwide, there remains ample opportunities for obtaining this skill in our unit. While increasing use of laryngeal mask airways (LMAs) for surfactant administration would impact these training opportunities, most babies receiving surfactant remained intubated and ventilated.

Introduction

Endotracheal intubation is an important procedure in neonatal intensive care, and a mandatory skill for both paediatric and neonatal training in Ireland. There is international concern that trainees do not have sufficient opportunities to develop or maintain proficiency in intubation¹. Advances in care, including increased use of non-invasive ventilation, have reduced rates of endotracheal intubation in preterm infants^{2,3}. The number of premature births in a centre may not reflect intubation opportunities. Additionally up to 40% of extubated preterm infants require reintubation⁴. The British Association of Perinatal Medicine (BAPM) described how these factors, increased numbers of trainees requiring procedural experience⁵ and reduced working hours⁶ may contribute to lower intubation success rates¹. This is concerning due to the increased risk of adverse events with repeated intubation attempts. Video laryngoscopy has been shown to improve intubation success in a NICU setting⁷ but is not currently available in all paediatric centres. Current higher specialty training curricula in Ireland expect paediatric and neonatal trainees to complete a minimum of 4 or 20 intubations respectively over a 12-month neonatology rotation^{8,9}.

The growing use of LMAs in term and larger preterm infants as an alternative to intubation may provide a solution, but paradoxically may reduce direct intubation experience even further. Evidence is growing for LMA surfactant administration¹⁰, and continues to be examined in the ongoing SUFRSUP trial (ACTRN12620001184965). Current LMAs are not designed for the smallest and most premature infants by virtue of their size, although these infants are at greatest risk of needing intubation. This presents a dilemma for smaller maternity units experiencing unexpected preterm deliveries as a rare event.

The majority of trainees in neonatal rotations are preparing for a career in paediatrics. Consultants in smaller centres may not be in a position to maintain neonatal airway skills¹ without adjunctive supports such as video laryngoscopy or LMA use. However, neonatal intubation remains a mandatory skill for general paediatric training and the number of training opportunities for endotracheal intubation of at-risk premature infants has not been described in an Irish tertiary neonatal centre.

The aim of this project was to quantify the number of training opportunities for intubation of VLBW infants in a tertiary NICU over a one-year period.

Methods

This was a retrospective chart review examining intubation of VLBW infants over a one-year period. Ethical approval was obtained from the hospital's Research Advisory Group prior to data collection. Inclusion criteria included birth in the Rotunda Hospital between January – December 2023, and birth weight $\leq 1500\text{g}$. Data collected included gestational age, weight and day of life at time of intubation, as well as the location and time of day intubation was performed. We also collected data on number of intubation episodes, number of attempts per episode, grade of staff member attempting intubation, whether surfactant was administered and whether rapid sequence induction was used. All intubation attempts, including transient intubation for surfactant administration, were included.

Results

A total of 101 babies were included in the study. Median gestational age was 25^{+6} weeks (range 23^{+1} – 32^{+5} weeks). The median age at intubation was 2 days (range 1 – 61 days). Median birth weight was 860g (range 530 – 1500g). Weight at intubation was less than 2kg in all cases and less than 1kg in 75/141 (53.2%) cases. There were 141 intubation episodes comprising 226 intubation attempts (mean of 1.6 attempts per episode, median 1, range 1 – 5). 78/141 (55%) intubations were successful on first attempt. 35/141 episodes (24.8%) required 2 attempts, 12/141 (8.5%) required 3 attempts, 8/141 (5.7%) required 4 attempts and 2/141 (1.4%) required 5 attempts.

The median number of individuals attempting intubation per episode was 1 (range 1 - 4). The staff grade attempting each episode is outlined in figure 1.

The majority (102/141, 72.3%) of intubations occurred in the NICU, with the remainder occurring in the delivery suite or theatre. 65/141 (46.1%) intubation episodes happened during normal working hours (8AM – 5 PM), with 26/141 (18.4%) taking place between 5PM – 8PM and 50/141 (35.5%) overnight.

Rapid sequence induction occurred prior to 69/141 (48.9%) intubation episodes, while other drugs (morphine, atropine) were given in 4/141 (2.8%) cases. Surfactant was given in 67/141 (47.5%) and the baby remained intubated after surfactant in 108/141 (76.5%) cases.

There were 19 recorded adverse events during 15/141 (10.6%) intubation episodes, with 2 adverse events occurring in 4/141 (2.8%) episodes. These included 4 cases of bradycardia (2.8%), 6 desaturations (4.3%), 1 apnoea (0.7%), 1 need for chest compressions (0.7%), 2 cases of upper airway bleeding (1.4%), 2 of lip bleeding (1.4%), 1 hypotension (0.7%), 1 chest wall rigidity secondary to fentanyl (0.7%) and 1 inability to intubate (0.7%), in which case a LMA was placed pending ENT review. In three cases, adverse events (upper airway bleeding, inability to intubate) occurred during multiple-attempt intubations. The remainder of adverse events occurred during a first intubation attempt. Where an attempt was unsuccessful, appropriate escalation to senior intubation practitioner was noted (Table 1).

	SHO	Registrar	ANP	Consultant
Attempt 1 (n=134)	6 (4.5%)	112 (83.6%)	10 (7.5%)	6 (4.5%)
Attempt 2 (n=52)	0 (0%)	38 (73.1%)	5 (9.6%)	9 (17.3%)
Attempt 3 (n=22)	0 (0%)	10 (45.5%)	3 (13.6%)	9 (40.9%)
Attempt 4 (n=10)	0 (0%)	1 (10%)	1 (10%)	8 (80%)
Attempt 5 (n=2)	0 (0%)	0 (0%)	0 (0%)	2 (100%)

Table.1. Staff grade of individual performing intubation per attempt. Grade may reflect varying seniority (e.g. neonatal higher specialist trainee within registrar grade).

Documentation was incomplete in 6 cases, not outlining staff grade.

Of note, documentation was incomplete for 6/141 (4.3%) intubation episodes. In these cases standardised procedure notes were not completed, and so the number of attempts and staff grade attempting were unclear.

Discussion

This study outlines the opportunities for intubation training in a tertiary NICU in Ireland. Despite falling rates of endotracheal intubation of preterm infants worldwide, there remains ample opportunities for obtaining this skill in our unit. While opportunities for intubation are often unpredictable, almost half occurred within a normal working day. There are 12 registrars working in our unit, corresponding to 12 intubation episodes per trainee in VLBW infants alone. While shift working patterns may affect middle grade availability for training, these numbers are reassuring. Our study did not include babies with birth weight >1500g, and so underestimates the total number of intubation episodes. Whether these opportunities are

used for training in direct or video-assisted laryngoscopy is a matter for discussion. Video laryngoscopy improves successful first attempt intubation rates⁷ in neonates and is a useful tool for teaching, however, is not available in all paediatric centres.

Using LMAs to deliver surfactant may be less technically challenging for practitioners, which is of particular relevance to those working in non-tertiary centres with less opportunity to maintain endotracheal intubation skills. However, LMA insertion does not help trainees to learn to intubate, which is still an essential skill in neonatology. While the increasing use of LMA for surfactant administration could impact these training opportunities, in our study 76% of babies receiving surfactant remained intubated and ventilated. In these cases, the ETT was kept in place due to concerns regarding the child's clinical condition, so these babies would not have been suitable for LISA or LMA surfactant delivery.

Neonatal endotracheal intubation is an essential skill for Paediatric trainees in Ireland, many of whom will work outside the tertiary NICU setting in their future careers. Our study demonstrates that there remains sufficient opportunity to develop these skills in our unit. Future research is required on training opportunities as intubation practices evolve.

Declaration of Conflicts of Interest:

None declared.

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References:

1. British Association of Perinatal Medicine. (2024). Neonatal Airway Safety Standard - A Framework For Practice. BAPM, April 2024. Available from: https://hubble-live-assets.s3.eu-west1.amazonaws.com/bapm/file_asset/file/2785/BAPM_Airway_Standards_Full_July24.pdf

2. Committee on Fetus and Newborn, Papile LA, Baley JE, Benitz W, Cummings J, Eichenwald E, Kumar P, Tan RC, Wang KS. Respiratory support in preterm infants at birth. *Pediatrics*. 2014 Jan 1;133(1):171-4.
3. Poets CF, Sens B. Changes in intubation rates and outcome of very low birth weight infants: a population-based study. *Pediatrics*. 1996 Jul;98(1):24-7. PMID: 8668407.
4. Gaertner VD, Rüegger CM. Optimising success of neonatal extubation: Respiratory support. In *Seminars in Fetal and Neonatal Medicine* 2023 Oct 1 (Vol. 28, No. 5, p. 101491). WB Saunders.
5. Mason NC, Chaudhuri E, Newbery N, Goddard AF. Training in general medicine—are juniors getting enough experience?. *Clinical medicine*. 2013 Oct 1;13(5):434-9.
6. Murphy JF. Hospital Residents Working Medical Shifts Longer than 16 Hours. *Irish Medical Journal*. 2019 Apr 11;112(4):907-.
7. Geraghty LE, Dunne EA, Ní Chathasaigh CM, Vellinga A, Adams NC, O'Curraín EM, McCarthy LK, O'Donnell CP. Video versus direct laryngoscopy for urgent intubation of newborn infants. *New England Journal of Medicine*. 2024 May 30;390(20):1885-94.
8. Royal College of Physicians in Ireland. (2023). Higher Specialist Training in Paediatrics - Outcome Based Education Curriculum. Available at:
https://www.rcpi.ie/Portals/0/Document%20Repository/Training/Higher%20Specialist%20Training/Curricula%202023/Faculty%20of%20Paediatrics/Training_HST%20Paediatrics%20OBE_2023.pdf?ver=TIloOzC_HijuuLuuhkzeSg%3d%3d
9. Royal College of Physicians in Ireland. (2024). Higher Specialist Training in Neonatology - Outcome Based Education Curriculum. Available at:
https://www.rcpi.ie/Portals/0/Document%20Repository/Training/Higher%20Specialist%20Training/Curricula%202024/Faculty%20of%20Paediatrics/Training_HST%20Neonatology%20OBE%20Curriculum%202024.pdf?ver=QVeckdZi74HHluVyrk6JA%3d%3d
10. Gallup JA, Ndakor SM, Pezzano C, Pinheiro JMB. Randomized Trial of Surfactant Therapy via Laryngeal Mask Airway Versus Brief Tracheal Intubation in Neonates Born Preterm. *J Pediatr*. 2023 Mar;254:17-24.e2. doi: 10.1016/j.jpeds.2022.10.009. Epub 2022 Oct 12. PMID: 36241051.