



Prematurely born infants' response to resuscitation via an endotracheal tube or a face mask



Vadivelam Murthy^a, Walton D'Costa^a, Raajul Shah^a, Grenville F. Fox^b, Morag E. Campbell^{c,d}, Anthony D. Milner^a, Anne Greenough^{a,e,*}

^a Division of Asthma, Allergy and Lung Biology, MRC–Asthma UK Centre in Allergic Mechanisms of Asthma, King's College London, UK

^b Evelina Children's Hospital Neonatal Unit, Guy's & St Thomas' Hospital NHS Foundation Trust, London, UK

^c Neonatal Unit, Southern General Hospital, Scotland, UK

^d Neonatal Unit, Yorkhill Hospital, Scotland, UK

^e NIHR Biomedical Centre at Guy's and St Thomas NHS Foundation Trust and King's College London, UK

ARTICLE INFO

Article history:

Received 17 December 2014

Received in revised form 4 February 2015

Accepted 10 February 2015

Keywords:

Resuscitation

Intubation

Preterm infant

Face mask

ABSTRACT

Background: Prematurely born infants may be resuscitated in the labour suite via a face mask or an endotracheal tube.

Aims: To assess prematurely born infants' initial responses to resuscitation delivered via an endotracheal tube or a face mask, to determine if the first five inflations via an endotracheal tube produced expired tidal volumes greater than 4.4 ml/kg (twice the anatomical dead space) and whether the outcome of initial resuscitation via an endotracheal tube or via a face mask differed according to the first active inflation (the infant's inspiratory effort coinciding with an inflation).

Study design: Prospective observational study.

Subjects: Thirty-five infants (median gestational age 25, range 23–27 weeks) requiring resuscitation via an endotracheal tube (n = 20) or a face mask (n = 15) were studied.

Outcome measures: Inflation pressures, inflation times, expiratory tidal volumes, end tidal carbon dioxide (ETCO₂) and leak were recorded.

Results: Before the first active inflation, only 27% of infants receiving resuscitation via an endotracheal tube had expiratory volumes greater than 4.4 ml/kg. During, both endotracheal and face mask initial resuscitations, during the first active inflation the expired tidal volumes (7.7 ml/kg, 5.2 ml/kg) and ETCO₂ levels (4.8 kPa, 3.2 kPa) were significantly higher than during the inflations before the first active inflation (2.8 ml/kg, 1.6 ml/kg; 0.36 kPa, 0.2 kPa respectively) (all p < 0.001).

Conclusions: Initial resuscitation via an endotracheal tube using currently recommended pressures, rarely produced adequate tidal volumes. Resuscitation via an endotracheal tube or a face mask was most effective when the infant's inspiratory effort coincided with an inflation.

© 2015 Elsevier Ireland Ltd. All rights reserved.

1. Introduction

There is a paucity of information on the efficacy of resuscitation of prematurely born infants via an endotracheal tube. Hoskyns and colleagues [1] reported that a tidal volume of greater than two anatomical dead spaces (i.e. 4.4 ml/kg) was only generated in five of 21 intubated, prematurely born infants during the first three inflations when an inflation pressure of 30 cm H₂O and no positive end expiratory pressure (PEEP) were used [1]. That inflation

pressure is higher than the initial peak pressures of 20 to 25 cm H₂O currently recommended [2] and PEEP is now recommended, further reducing the “driving” pressure. In addition, the infants studied by Hoskyns et al. [1] were relatively mature (mean gestational age 31.5, range 25–36 weeks), whereas the current population of prematurely born infants, particularly those who require intubation, are born very prematurely, that is less than 29 weeks of gestation. The effectiveness of the currently recommended pressures in producing adequate tidal volumes in such immature infants, therefore, needs to be assessed.

The majority of infants are initially resuscitated via a face mask as per the UK advisory document on resuscitation of new born infants [2]. There is, however, evidence that initial resuscitation via a face mask may not result in significant gas exchange until the infants make inspiratory efforts during the inflations [3,4]. In one study, the expired carbon dioxide levels rarely exceeded 0.5 kPa during the first five

Abbreviations: ETCO₂, end tidal carbon dioxide; ETT, endotracheal tube; FB, first active inflation; PEEP, positive end expiratory pressure.

* Corresponding author at: NICU, 4th Floor Golden Jubilee Wing, King's College Hospital, Denmark Hill, London SE5 9RS, UK. Tel.: +44 203 299 3037; fax: +44 203 299 8284.

E-mail address: anne.greenough@kcl.ac.uk (A. Greenough).

inflations [3] and in another [4], the median tidal volume delivered in the absence of inspiratory efforts by the infant, was 2.1 ml/kg, which is less than the anatomical dead space. The expired tidal volume, however, was much larger if the infant made an inspiratory effort during the inflation [4], supporting the hypothesis that resuscitation is dependent on stimulating infants to make inspiratory efforts via the Head's paradoxical reflex [1]. Whether there is a similar response during resuscitation via an endotracheal tube has not been assessed.

Our aim, therefore, was to assess prematurely born infants' responses to resuscitation via an endotracheal tube or via a face mask. In particular, we wished to determine if the first five inflations via an endotracheal tube produced expired tidal volumes greater than 4.4 ml/kg. An additional aim was to determine if the outcome of the first active inflation, the infant's inspiratory effort coinciding with an inflation, was similar by resuscitation via an endotracheal tube or a face mask.

2. Methods

Prematurely born infants without congenital anomalies, requiring resuscitation at birth at King's College Hospital NHS Foundation Trust or Guy's and St Thomas' NHS Foundation Trust, London, UK were eligible for entry into the study. The study was carried out between March 2010 and February 2012. Consecutive infants born at less than 29 weeks of gestation requiring resuscitation at birth using either oral intubation with a Cole's endotracheal tube (size 2 or 2.5) or a face mask (Marshall size 0) and who had respiratory monitoring were entered into the study. The decision to proceed to immediate intubation at birth was made by the clinical staff caring for the infants, on the basis that the infant had a heart rate of less than 60/min and no respiratory effort as determined by clinical observation.

The clinicians involved in the resuscitation of infants had all been trained in newborn life support and had received the Resuscitation Council, UK NLS provider certificates. All had completed at least 12 month training on a tertiary level neonatal unit. They had also been trained to operate the respiratory function monitor. During resuscitation the respiratory function monitor was set to display tidal volume, flow and inflation and positive end expiratory pressures. Ethical approval was granted by the Outer North London Research Ethics Committee who required parental written consent only for analysis of the data, which was obtained when the mother was on the postnatal ward.

2.1. Resuscitation protocol

Positive pressure inflations were generated by a t-piece device (Neopuff Infant Resuscitator, Fisher & Paykel Healthcare, Auckland, New Zealand) attached either to the face mask or endotracheal tube. The Neopuff, a continuous flow, pressure-limiting device had a built in manometer, a positive end expiratory pressure (PEEP) valve and a gas flow rate of 5 l/min. The pressure relief valve was set at 30 cm H₂O. The clinicians were advised to follow the UK recommendations, that are to use a peak inflation pressure of 20–25 cm H₂O with a PEEP level of 4–5 cm H₂O and to maintain the first five inflations for 2 to 3 s [5]. The peak inflation pressure was to be increased if chest wall expansion was thought inadequate. All infants were initially resuscitated with an inspired fraction of oxygen (FiO₂) of 0.21 (as is used by more than 40% of UK NICUs [6]). The FiO₂ was subsequently increased to maintain the oxygen saturation levels between 85 and 92%. Surfactant was not administered in the labour suite, but on arrival in the NICU.

2.2. Monitoring equipment

The respiratory function monitor used [3,4] was an NM3 respiratory profile monitor (RPM) (Philips Respironics, Connecticut, USA). The monitor was connected to a Laptop (Dell Latitude, Dell, Bracknell, UK) with customised Spectra software (3.0.1.4) (Grove Medical, London, UK). The NM3 respiratory profile monitor had a combined pressure,

flow and carbon dioxide (CO₂) sensor and this was placed in line between the t-piece and the face mask or endotracheal tube. The NM3 monitor is automatically calibrated for flow, pressure and CO₂ according to the factory stored calibration in the monitor. Flow was measured using a fixed orifice pneumotachograph. One of the tubes from the pneumotachograph was connected to a second pressure transducer to measure airway pressure. The accuracy of the pneumotachograph was confirmed using a calibration syringe. The size of the leak was expressed as the difference between the expiratory and inspiratory volumes as a percentage of the inspiratory volume. Oxygen saturation monitoring was also performed, which recorded oxygen saturation and heart rate.

2.3. Analysis

The inflation pressure (the peak inflation pressure minus the positive end expiratory pressure (PEEP)), inflation time, expiratory tidal volume, and leak and peak expiratory CO₂ levels for each inflation were recorded. The first active inflation (the infant's inspiratory effort coinciding with an inflation) was identified as we have previously described [4]. When the infant makes an inspiratory effort during inflation there is a downward deflection in the airway pressure trace [4]. Data from the first active inflation and the two inflations immediately before and after the active inflations were analysed. The time from the onset of resuscitation to the onset of the first active inflation and, when available, the time from birth to the first active inflation were recorded. Some of the results from infants resuscitated by the face mask have been previously reported [3,4], none of the data collected during resuscitation via an endotracheal tube have been previously reported.

2.4. Statistical analysis

Differences were assessed for statistical significance using either a paired Wilcoxon test or the Mann–Whitney U-test. Analysis was undertaken using IBM SPSS Statistics for Windows, version 20.

3. Results

Data were analysed from thirty-five infants (20 of whom required immediate intubation at birth) with a median gestation of 25 weeks. There were no significant differences in birth weight, gender, and use of antenatal steroids mode of delivery or Apgar scores at 1 and 5 min between the two groups (Table 1). Two of the infants receiving face mask resuscitation, but none of those intubated were observed to make a spontaneous breath before the onset of positive pressure ventilation. Two infants in the intubation group were extubated within 5 min of birth. The median time to intubation was 52 (range 39–78) s. Thirteen infants were intubated at the first attempt, four at the second attempt and three at the third attempt.

Before the first active inflation, only 27% of the infants receiving resuscitation via an endotracheal tube had expiratory tidal volumes

Table 1
Demographics by type of resuscitation.
Data are presented as median (range) or n (%).

	ETT	Face mask	P
n	20	15	
Gestation age (weeks)	25 (23–27)	25 (23–28)	0.98
Birth weight (g)	670 (530–1035)	678 (545–1346)	0.56
Male	9 (45%)	5 (33%)	0.72
Antenatal steroids	17 (85%)	12 (80%)	0.98
Vaginal delivery	17 (85%)	12 (80%)	0.98
Apgar at 1 min	5 (2–8)	6 (2–9)	0.96
Apgar at 5 min	8 (4–10)	8 (5–10)	0.87

Download English Version:

<https://daneshyari.com/en/article/3917007>

Download Persian Version:

<https://daneshyari.com/article/3917007>

[Daneshyari.com](https://daneshyari.com)