A comparison of different mask holds for positive pressure ventilation in a neonatal manikin

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ABSTRACT

Background Ventilation during neonatal resuscitation is typically initiated with a face mask, but may be ineffective due to leak or obstruction.

Objective To compare leak using three methods of mask hold.

Methods Medical and nursing staff regularly involved in neonatal resuscitation used the three holds (two-point, two-handed, spider) on a manikin in a random order to apply positive pressure ventilation (PPV) at standard settings each for 1 min while mask leak was recorded.

Results Participants (n=53) varied in experience (1–23 years) and hand size. Combined median (IQR) leak was 14 (2–46)% and was not different among the holds.

Conclusions There was no difference in the leak measured using the three different mask holds.

BACKGROUND

International resuscitation guidelines recommend positive pressure ventilation (PPV) for newly born infants with bradycardia or inadequate respiratory effort. This is usually initially performed using a facemask as the interface, but mask ventilation is not without difficulties and studies have found large and variable leak, airway obstruction and inconsistent tidal volumes, in delivery room and manikin studies. There are a small number of manikin studies which have examined different methods of applying and positioning the mask to deliver PPV. Wood examined different single-handed holds in a manikin study and found the two-point top hold (figure 1A) to be associated with the lowest leak. In another manikin study, Tracy reported a 50% reduction in leak when using a two-handed hold for two-person resuscitation (figure 1B) compared to a single-handed hold. A new method for holding the mask during PPV is the ‘spider hold’ (figure 1C). This method involves placing the stem of the mask between the index and middle fingers, while applying pressure with the palm of the hand to hold the mask onto the infant’s face. The clinician’s finger tips curl around the infant’s jaw to provide chin-lift. This method has not previously been formally examined.

AIM

The aim of this study was to compare three mask holds—two-point top hold, two-handed hold and spider hold—with a primary outcome of leak between the mask and the manikin’s face.

What is already known

Face mask leak during mask positive pressure ventilation (PPV) is common and often goes unrecognised by resuscitators

What this study adds

This study describes a new method for holding a face mask—the spider hold’. Leak measured using this hold was similar to two other commonly used holds.
manikin using the three holds for 1 min each in a random order, using settings of peak inflating pressure 30 cm H2O, peak expiratory pressure 5 cm H2O and a rate of 40–60/min. Hold order was determined using internet-based random number generator.

The sample size was calculated using the mean leak of 70%, as measured by O’Donnell using the same manikin. To detect a 15% difference in mean leak with an α value of 0.05 and power of 80%, at least 50 participants were required. We included 10 participants from each of five professional groups—neonatal consultants, neonatal fellows, neonatal registrars, midwives and neonatal nurses. Participants’ hand size measured by glove size, years of experience and usual hold were also recorded. Neither the Spectra screen nor the Florian monitor was visible to participants while ventilating the manikin.

The primary outcome measure was the median leak between the mask and the manikin’s face. Median leak for each participant and for each hold was calculated and compared. Median and IQRs for the primary outcome measure are displayed as box plots and tables. Results were compared using analysis of variance (ANOVA), p values were calculated using post hoc Bonferroni correction and <0.05 was considered significant.

Secondary outcome was participants’ hold preference. Data were analysed using Stata software (Intercooled 10, Stata Corp, Texas, USA).

RESULTS
Fifty-three participants enrolled in the study: 10 consultants, 10 fellows, 10 registrars, 12 midwives and 11 neonatal nurses. Hand sizes ranged from a glove size of 5.5 to 8 with a median of 7. Participants’ years of experience resuscitating infants ranged from less than 1 to 23 years. All consultants had greater than 5 years of experience. All fellows had between 3 and 5 years of experience. All registrars had less than 2 years of experience, Neonatal nurses and midwives had similar levels of experience ranging from less than 1 year to more than 10 years, with a median of 4 years.

7324 inflations were studied. Median (IQR) leak for all holds was 14 (2–46)%, for the two-point top hold was 19 (2–38)%, for the spider hold 10 (3–49)%, and for the two-handed hold 9 (2–51)% (figure 2). There was no significant difference in leak noted between the different holds.

There were no significant differences found between the holds when examined by participant’s professional group, level
of experience or glove size. All but two participants identified the two-point top hold as their usual hold. Twenty-seven (51%) preferred the two-point top hold, while 19 (36%) and seven (13%) chose the spider hold and the two-handed hold, respectively.

DISCUSSION

Although there was no difference in median leak among the different holds, there was substantial variability within each of the groups suggesting that the participants were unaware of the leak. This finding is supported by previous studies that have shown leak is common and often goes unrecognised and that resuscitators are also unable to accurately estimate the magnitude of their leak. Our study participants demonstrated lower levels of leak than measured in previous, similarly conducted manikin studies. This may have been due to participants having time to practise using each hold. O’Donnell reported a mean (SD) leak of 70 (30)% and Wood reported a mean (SD) leak of 55 (31)% using the same Laerdal round mask. The more recent study by Tracy reported lower levels of leak that were more comparable to our study.

This is the first study that describes the spider hold. It was found to be easy to learn and more than a third ranked it as their favourite hold. Because the resuscitators’ fingers extend beyond the edge of the mask, leak may be palpable and therefore more obvious to the resuscitator. A possible disadvantage of the spider hold is that the infant’s face is largely covered by the resuscitator’s hand. The user’s ability to assess responsiveness in the infant with visual cues from the face may be hampered, although facial movements should be felt. As the edges of the mask are not completely visible, the face mask causing compression to the infant’s eyes may go unnoticed. Compression of the nose may also not be appreciated and may result in inadvertent airway obstruction.

It may be argued that when teaching neonatal resuscitation, it is best to teach one hold so that clinicians can practise and perfect this hold. The two-point top hold is taught and practiced at our unit. One might expect that the two-point top hold would therefore be the method with the lowest leak. In this study, we found that the leak was similar using three different holds: a familiar hold to all (two-point top hold), a familiar hold to some (two-handed hold) and a new hold (spider hold). It may therefore be possible for novice resuscitators to try all three holds and allow them to choose the one they find preferable to use in clinical practice. It is also reasonable to teach more than one hold and advise the trainee to change holds if they feel the baby is ventilating ineffectively.

The limitations of this study are shared by similar studies on manikins. Participants are being asked to resuscitate in an artificial environment. They know they are being assessed on the adequacy of their ventilation. A manikin, while an effective learning tool, can never provide the same cues in relation to clinical deterioration and improvement as a neonate.

CONCLUSION

There was no difference in the leak measured using the three different mask holds.

Contributors EVW recruited participants, collected data and wrote the first draft of the manuscript. JEO wrote the protocol, recruited participants, collected and analysed the data and wrote the subsequent drafts of the manuscript. MT was involved in study design and has reviewed the manuscript. JAD was involved in initial study design, analysed the project and has reviewed the manuscript. PGD was the overall supervisor of the project and has reviewed the manuscript.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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Arch Dis Child Fetal Neonatal Ed published online October 16, 2013
doi: 10.1136/archdischild-2013-304582