PostScript

LETTERS

Free-flow oxygen delivery using a T-piece resuscitator

T-pieces are increasingly used for administering intermittent positive pressure ventilation (IPPV) during neonatal resuscitation.[1] They can also be used to provide free-flowing oxygen to babies who are breathing but remain cyanosed.[2] The Neonatal Resuscitation Program (NRP) guidelines recommend that when using a T-piece resuscitator the mask should be loosely placed on the infant's face with the positive end expiratory pressure (PEEP) valve occluded to allow delivery of a reliable amount of oxygen.[2] There are no reports documenting the percentage of oxygen delivered when the PEEP valve is, or is not, occluded. The aim of this study was to determine the oxygen concentration delivered from a T-piece resuscitator and mask when the PEEP valve is occluded and when it is left open.

Method

We simulated delivering free-flowing oxygen with a Neopuff Infant Resuscitator (Fisher and Paykel, New Zealand) fitted with a size 0/1 mask (Laerdal, Stavanger, Norway) held 1 cm above the face of a Laerdal neonatal manikin (Laerdal, Stavanger, Norway), using 100% oxygen flowing into the Neopuff. Oxygen concentrations were measured with an oxygen analyser (Hudson RCI, Durham, North Carolina, USA) fitted inside the manikin's mouth, with the sensor level with the lips. The analyser was calibrated with air and 100% oxygen before each study. Five Neopuffs were tested. The oxygen concentration at 30 s was recorded with oxygen flow rates ranging from 5 l/min to 8 l/min.

Results

Table 1 shows the mean (SD) percentage of oxygen delivered to the face at different flow rates. At 5–8 l/min with the mask 1 cm above the face, on average 97% oxygen was delivered when the PEEP valve was occluded and 95% when the valve was not occluded. The difference between the percentage of oxygen delivered when the valve was occluded or open was statistically significant (see table 1 for p values) but probably not clinically important.

Discussion

This is the first published report on the amount of oxygen delivered by a T-piece resuscitator with the PEEP valve occluded or open. The device delivers close to 100% oxygen in both situations. We have previously shown that high concentrations of free-flow oxygen can be provided either by a self-inflating bag, or with oxygen tubing in a cupped hand, held close to the infant's face.[3] The percentage of oxygen delivered by the Neopuff is similar to that delivered by these two methods. The benefits of using the Neopuff Infant Resuscitator rather than the other free-flow oxygen delivery methods include the ability to provide continuous positive airway pressure to spontaneously breathing infants as well as providing IPPV with PEEP, without having to change equipment during resuscitation.

Conclusion

The Neopuff is able to deliver close to 100% free-flow oxygen with the PEEP valve occluded or open.

Jennifer A Dawson
Neonatal Services, Royal Women's Hospital, Carlton, Victoria, Australia

Peter G Davis
Department of Obstetrics and Gynaecology, University of Melbourne, Melbourne, Victoria, Australia

C Omar F Kamlin, Colin J Morley
Neonatal Services, Royal Women's Hospital, Carlton, Victoria, Australia

Correspondence to: Jennifer Dawson, Neonatal Nurse Researcher, Division of Newborn Services, Royal Women's Hospital, Carlton, Victoria 3053, Australia; jennifer.dawson@rwh.org.au

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Table 1 Mean (SD) oxygen concentration, measured at a manikin's mouth after 30 s, when 100% oxygen was delivered using a Neopuff Infant Resuscitator with 100% oxygen flowing into the inlet at different flow rates, when the positive end expiratory pressure (PEEP) valve was occluded and when it was open

	Flow of 100% oxygen							
	5 l/min		6 l/min		7 l/min		8 l/min	
PEEP valve	Occluded	Open	Occluded	Open	Occluded	Open	Occluded	Open
Mean (SD) percentage of oxygen measured at manikin's mouth	97 (2.1)	95 (2.3)	97 (2.3)	96 (2.7)	97 (2.5)	95 (3)	97 (2.4)	95 (2.5)
Paired t test	p = 0.0035		p = 0.0701		p = 0.0100		p = 0.0026	

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N-terminal pro-B-type natriuretic peptide as a marker of ductal haemodynamic significance in preterm infants: a prospective observational study

The diagnosis of a haemodynamically significant patent ductus arteriosus (sPDA) in preterm infants is often difficult, with echocardiography remaining the gold standard.[1] However, availability and cost pose some difficulties. B-type natriuretic peptide (BNP) may assist diagnosis, but cut-off levels vary widely in the literature. No data exist on the applicability of the byproduct N-terminal pro-B-type natriuretic peptide (NTpBNP), which is more stable and has a longer half life.[2] We hypothesised that NTpBNP may be useful in the management of preterm infants with sPDA and aimed to investigate its usefulness as a marker of sPDA and treatment success.

Method

The local ethics committee approved the study, and informed written parental consent was obtained from all parents prior to enrolment in the study.

We carried out echocardiographic and NTpBNP determinations at 12 h and 48 h of life, including measurements of PDA absolute and Doppler jet diameters, shortening fraction, descending aorta end-diastolic velocity, and left atrial to aortic ratio, in 48 preterm infants.[3] The cohort was divided in to two groups based on the presence or absence of an sPDA. Infants with sPDA were treated with two courses of ibuprofen, which was followed by surgical ligation if the medical treatment was unsuccessful. Both groups of infants underwent another assessment following successful treatment. The results were analysed using Mann–Whitney U test for non-parametric data, and correlations were tested using Spearman's correlation coefficient.

Results

We carried out 131 echocardiographic examinations coupled with NTpBNP determinations (table 1). Table 2 summarises the NTpBNP levels in the two groups on days 1, 3 and after treatment. On day 3, NTpBNP significantly correlated with PDA absolute and jet diameters ($r = 0.48$ and $r = 0.51$, respectively ($p<0.001$)), left atrial to aortic ratio ($r = 0.46$, $p = 0.001$), and descending aorta end-diastolic velocity ($r = 0.73$, $p<0.001$). There was no correlation between NTpBNP and shortening fraction. NTpBNP levels were significantly higher in the PDA group compared with controls on day 3 ($p<0.001$) and fell significantly from 6792 pmol/l to 1199 pmol/l after successful PDA closure ($p = 0.001$). A receiver operating characteristic

Table 1 Characteristics of the study cohort*

	Control group n = 23	PDA group n = 25
Gestation (weeks)	28 (26.1–29.5)	27 (25.9–28.3)
Birth weight (g)	1121 (948–1253)	980 (823–1220)
Antenatal steroids	10 (43)	7 (28)
Apgar at 1 min	5 (3–7)	4 (3–7)
Apgar at 5 min	7 (5–8)	7 (6–8)
Caesarean section	11 (48)	9 (36)
Maternal pre-eclampsia	2 (9)	4 (16)
Chorioamnionitis	3 (13)	6 (24)
Ventilation at birth	17 (74)	23 (92)
Surfactant at birth	17 (74)	23 (92)
Ibuprofen		
One course	NA	17 (68)
Two courses	NA	8 (32)
Surgical ligation	NA	5 (20)

NA, not applicable; PDA, patent ductus arteriosus.
*Data are median (interquartile range or percentage).
There were no significant differences between the two groups.

Table 2 Median N-terminal pro-B-type natriuretic peptide (NTpBNP) levels (pmol/l) in the two study groups on days 1, 3 and after treatment for the patent ductus arteriosus (PDA)

	Day 1		Day 3		Post-treatment	
	Control	PDA	Control	PDA	Control	PDA
NTpBNP	1435	1267	1127	6792	279	1199
25–75th centiles	894–2550	531–2398	509–2884	3250–17309	93–484	401–2998
Range	185–5407	98–10700	94–8030	402–35353	36–18989	188–9478
p Value	0.735		<0.001		0.001	

Levels were significantly higher in the PDA group on day 3 and post treatment.
Mann–Whitney U test was used to compare the medians.

curve was constructed for NTpBNP and the presence of a PDA with an area under the curve of 0.866 (95% CI 0.763 to 0.969, $p<0.0001$). A cut-off value of 5000 pmol/l had a sensitivity of 70% and a specificity of 87%.

Discussion

Our study shows the potential use of NTpBNP in the management of a PDA in preterm infants. Several studies have established NTpBNP reference values for healthy term newborns at day 1 of life, ranging from 65 pmol/l to 641 pmol/l.[2] The higher levels in our cohort are probably multifactorial and reflect the demands placed on the preterm heart during the transitional phase. The lack of correlation between NTpBNP and the presence of a PDA at 12 h of age probably reflects the low degree of shunting during this transitional period. Validation in larger samples is needed to establish NTpBNP as a diagnostic and follow-up tool for PDA. The clinical applicability of NTpBNP may stem from its role in screening infants for the possible presence of an sPDA, with a high level indicating the need for echocardiographic evaluation, and may be of benefit at centres without onsite echocardiography.

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Afif F El-Khuffash
Department of Neonatology, National Maternity Hospital, Dublin, Republic of Ireland

Michele Amoruso, Mary Culliton
Department of Biochemistry, National Maternity Hospital, Dublin, Republic of Ireland

Eleanor J Molloy
Department of Neonatology, National Maternity Hospital, Dublin, Republic of Ireland

Correspondence to: Dr Afif Faisal El-Khuffash, Department of Neonatology, National Maternity Hospital, Holles Street, Dublin 2, Republic of Ireland; afif_faisal@hotmail.com

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Routine mechanical ventilation for transferred neonates with duct-dependent congenital heart disease

Browning Carmo *et al* showed that neonates with duct-dependent congenital heart disease (CHD) treated with low-dose prostaglandin E_1 (PGE_1) may not require mechanical ventilation for safe transport.[1] The Pediatric Department, University of Padova Neonatal Emergency Transport Service undertakes about 200 neonatal transports every year in the East-Veneto Region, Italy. The service has a population referral base of 2.3 million people over a radius of approximately 150 km. In the referral area, there are approximately 25 700 births/year in 25 units. The transfers are generally undertaken by ground ambulance and the average time for each transport is about 185 min (range 60–346 min).[2] According to the transport protocol, babies with known or suspected CHD with ductal dependency or with signs of circulatory or respiratory failure are suitable to be cared for by the dedicated transport team (a neonatologist, a nurse and paramedic ambulance personnel). The transport protocol does not recommend routine intubation for prevention of apnoea during PGE_1 infusion.

Between 1 January 2002 and 31 December 2006, 115 transferred neonates had cardiovascular problems; 51 (44%) were treated with PGE_1 infusion for CHD (59% cyanogen, 41% left outflow obstruction) and 9 (18%) were intubated as they had severe hypoxia or acidosis before the arrival of the transport team. Our PGE_1 starting dose (25–50 ng/kg/min) was higher than that reported by Browning Carmo *et al*.[1] Among the spontaneously breathing neonates, none required ventilation or emergency intubation and no adverse events were recorded. In agreement with Browning Carmo *et al*,[1] our data show that for short distances, ground transport transfer of otherwise stable newborns with CHD needing PGE_1 infusion may be safe without routine mechanical ventilation, even with higher PGE_1 doses. An improved prenatal diagnosis (only 14% in our population) could help to prevent haemodynamic instability after birth, ensuring earlier and safer transfer. However, because of the potential deleterious effects of physiological derangements in these patients, the presence of personnel with expertise in neonatal resuscitation is advisable.[3]

Paola Ferrarese, Anna Marra, Nicoletta Doglioni, Vincenzo Zanardo, Daniele Trevisanuto
Pediatric Department, Medical School, University of Padova, Padova, Italy

Correspondence to: Dr Paola Ferrarese, Pediatric Department, Medical School, University of Padova, Azienda Ospedaliera—Padova, Padova, Italy; ferrarese@pediatria.unipd.it

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