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## INSPIRATORY TO EXPIRATORY RATIOS DURING POSITIVE PRESSURE VENTILATION OF PRETERM INFANTS

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In the U.K. reversed inspiratory to expiratory (I/E) ratios remain popular as a method of raising  $PaO_2$  during ventilation for I.R.D.S. Data is accumulating that infants currently developing I.R.D.S. are less mature than ten years ago<sup>(1,2)</sup>. We have assessed the effect of a reversed I/E ratio on oxygenation in 33 infants ventilated for I.R.D.S. All babies were ventilated on Draeger Babylog ventilators. Ventilator changes were made using the ventilator controls but the accuracy of these changes were confirmed by a pressure transducer in the proximal portion of the endotracheal tube which measured the applied pressure, and a pneumotachograph/integrator/differential pressure transducer in series with the endotracheal tube which measured tidal volume. Improvements in  $PaO_2$  were very variable but most consistent in infants >1800 grams and <860 grams. The effect on  $PaO_2$  for infants of 851-1799 grams was disappointing (mean changes -0.1 mmHg n = 16). For many infants the use of the reversed I/E ratios needlessly raises mean airways pressure.

## References

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## VENTILATORY RESPONSE TO ADDED DEAD SPACES IN PREMATURE INFANTS

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The ventilatory response to added dead spaces in a group of well, premature infants was assessed using a tidal volume measurement system. This comprised a nasal mask connected by wide-bore tubing to a 50 litre rigid container, linked to a pressure transducer and recording equipment. With the infants asleep and lying in the right lateral position, baseline recordings of two minutes duration were obtained. Similar recordings were made with increased dead spaces by the sequential addition of tube volumes equivalent to 1, 2 and 3 anatomical dead spaces (2.2 ml/kg body weight). The system was calibrated against a 5 ml syringe. The overall frequency response was >5 Hz. The recordings were analysed manually and by computer. Results obtained to date (16 studies) in a group of premature infants (birthweight 910g - 1600g) revealed both individual variations and age-related increases in baseline minute volumes. All the babies responded to added dead spaces by increasing their minute ventilation. The minute volumes achieved in response to the added dead spaces (1, 2 and 3) were 53%, 96% and 133% of baseline recordings respectively. These increases were achieved in almost equal part by rises in both tidal volume and respiratory rate.

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## TRACHEAL BAROTRAUMA IN VERY PRETERM NEONATES. Vinod K. Bhutani, Thomas H. Shaffer, and Soraya Abbasi. Section on

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Proximal airways of very preterm neonates (<32 weeks of gestation) are highly compliant structures and are susceptible to pressure-induced deformation. In previous studies we have documented tracheal barotrauma in the preterm animal model (rabbit pups and lambs). These studies have defined increases in tracheal dimensions and decreases in tracheal compliance consequent to positive pressure application. These changes are associated with a propensity towards collapsibility and are similar to those observed with tracheomalacia. Tracheal volume deformation was measured in 16 very preterm neonates 6-8 days after extubation. The mean  $\pm$  SD values of birthweight and gestational age were 847 $\pm$ 68 gms and 27 $\pm$ 0.6 weeks, respectively. The study group was individually control-matched for weight and gestational age. The study group received ventilatory support for a mean of 25.4 $\pm$ 4.9 SD days with a BP200 pressure-limited, time-cycled ventilator<sup>®</sup>. The control group did not receive ventilatory support beyond the first hour of resuscitative efforts. By roentgenographic evaluation, the mean  $\pm$  SD intrathoracic tracheal width was 2.74 $\pm$ 0.31mm in the control group compared to 3.79 $\pm$ 0.29mm in the study group (38%, p<0.001). A tracheal volume deformation of 91% (p<0.001) was calculated in the study group. These data are suggestive of underlying mechanical deformation of the immature tracheal wall. The resultant tracheomalacia and associated tracheomalacia would lead to increased dead space ventilation and increased work of breathing.

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## GASTRO-OESOPHAGEAL REFLUX AND CARDIORESPIRATORY EVENTS IN INFANTS

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Gastro-oesophageal reflux (GOR) has been reported in infants presenting as 'near-miss' for SIDS. We have investigated the occurrence of GOR in 70 infants after the newborn period - sibs of SIDS (12), suspected tracheo-bronchial aspiration (7), troublesome possetting or choking (29), and 'near-miss' for SIDS (22). A subgroup with proven GOR was then studied polygraphically during sleep to assess the relationship between GOR and cardiorespiratory events.

Radionuclide gastro-oesophageal scintigraphy was the initial method used to detect GOR over a 2-hour period following a feed. We observed GOR without vomiting, to the upper oesophageal/pharyngeal area in 48 infants (68%), evenly distributed among the groups studied.

Fourteen infants with severe GOR were monitored polygraphically for 4 hours during sleep at night. Simultaneously, oesophageal pH was monitored to detect acid GOR. Fifty-one episodes of acid reflux were recorded. There were no episodes of prolonged central apnoea (> 15 seconds), or significant bradycardia (< 80 bpm). In 2 infants GOR coincided with obstructive apnoea > 6 seconds on 5 occasions, with coincidental fall in transcutaneous oxygen tension.

This study confirmed that GOR is common in the groups selected and that acid reflux during sleep is sometimes associated with significant obstructive apnoea and hypoxaemia.

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## CARDIORESPIRATORY PATTERNS OCCURRING IN INFANTS DURING AND AFTER RECOVERY FROM RESPIRATORY TRACT INFECTION.

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Twelve cardiorespiratory measurements were taken from 24 hour recordings of ECG and respiratory activity in 29 infants during and after respiratory tract infections that involved admission to hospital. These measurements were compared to similar data obtained from 117 age matched control infants without infection. Respiratory and heart rate levels during the state of regular breathing were elevated during infection, compared with recordings made after recovery. The numbers of short apnoeic pauses 3.6 - 6.0 seconds and >6.0 to 12.0 seconds in duration, together with the duration of the overall longest apnoeic pause per recording, were reduced during infection compared with recovery. The total durations of periodic breathing and of periodic apnoea per recording also appeared to be reduced during infection compared with recovery. These effects were consistent in 27 of the 29 cases but, in two, periodic breathing levels during infection exceeded the 90 centile in age matched controls and were reduced on recovery. Measurements made after recovery tended to conform more closely to values in the control infants. None of the 29 infants studied subsequently died or suffered chronic respiratory problems. This study suggests that prolonged apnoeic pauses or increased numbers of short pauses are not usually a consequence of respiratory tract infections in normal infants.

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ESTIMATION OF ARTERIAL  $CO_2$  FROM SURFACE ELECTRODESG Cheriyan, R Chiu, P Helms, D Marsden, F Packy.  
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Transcutaneous oxygen electrodes are widely used in neonatal intensive care and are gaining acceptance in paediatric and adult intensive care. Transcutaneous  $CO_2$  electrodes are less well established.

We measured transcutaneous arterial  $CO_2$  ( $TcCO_2$ ,  $PaCO_2$ ) in 57 critically ill children aged 10 days to 14.3 years. Two electrodes (Roche 632) were used in an overlapping design to provide 16 - 24 studies at 4 electrode temperatures, 45, 44, 43, and 42 centigrade. Mean calibration time with 5 and 10%  $CO_2$  was 43 range 36-58 minutes. Mean arterialisation time was 10.5 range 3 - 30 minutes.

Electrodes were left for 4 hours with duplicate hourly samples from indwelling arterial lines.  $TcCO_2$ / $PaCO_2$  correlation was independent of electrode temperature and child age; over the electrode temperature range 44 - 42°C. At one hour  $TcCO_2 = PaCO_2 \times 1.41 + 1.00$ . Recalibration demonstrated baseline drift of more than 5 torr during 22% of studies. For prediction of  $PaCO_2$ , 95% confidence limits around the regression mean rose from  $\pm 7.8$  torr at one hour to  $\pm 11.7$  torr at four hours. For a drift of less than 5 torr respectively, values were 6.5 and 8.4 torr.

Arterial  $CO_2$  can be estimated from surface electrodes. Improved electrode stability and speed of calibration should make this a valuable monitoring technique.