120 DOES TRAPPED GAS EXIST IN THE LUNGS OF HEALTHY, FULLTERM, NEWBORN INFANTS?

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Trapped gas (TG), defined as the difference between thoracic gas volume at end expiration (TGV) and functional residual capacity (FRC), has been reported to be of considerable magnitude in the neonatal period. In a previous investigation we found TG to average 20 ml in 26 full term infants 2 hours after birth, and 17 ml 24 hours later. The study to be reported was performed to assess how much of the TG that could be mobilized from the lungs by hyperventilation. Fifteen fullterm, healthy newborn infants were studied 1 to 4 days after birth by a modified nitrogen wash-out method. A face mask with its outlet connected to an opening in the side of a wide tube was gently applied to the sleeping baby. Air at high flow rate was continuously flushed through the tube which had a pneumotachygraph mounted at the outlet. The probe of a fast nitrogen analyzer was inserted into the mask. During an expiration the gas flow was instantanously shifted to 100% oxygen. After the expired nitrogen concentration reached below 2% the baby was stimulated to cry with the face mask still in place. Flow and nitrogen concentration signals were sampled at high rate by a computer and the lung nitrogen content before the wash-out was calculated. No rise in nitrogen output was detected during hyperventilation after the wash-out in any infant. We conclude, that the difference between TGV and FRC found by other investigators and ourselves in newborn infants most likely does not represent gas trapped in the lungs but is either an artifact due to methodological inaccuracy, or is due to gas localized in other organs.

121 SINGLE-BREATH LUNG MECHANICS DURING NEONATAL MECHANICAL VENTILATION: CLINICAL VALUE OF RESPIRATORY RESISTANCE.

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Because the time constant of the respiratory system (T_{rs}) is very short (<0.15s) in infants with hyaline membrane disease (HMD), severe obstruction due to airway secretions is almost undetectable. We made serial measurements of single-breath lung mechanics (Thomson et al, Crit Care Med 1985;13:4-8) in intubated newborns during mechanical ventilation. On the first day of life (before airways secretions developed) the mean total respiratory resistance (R_{rs}) for all ventilated infants was 213 $cmH_20.l^{-1}.sec$. Serial measurements were made subsequently, before and after tracheal suction or bronchial lavage.

R_{rs} fell significantly (*) after bronchial suction and lavage (Table), particularly in infants from whom secretions were obtained. T_{rs} was also shortened. In many cases there had been no change in clinical state to suggest the degree of airways obstruction which was found. Clinical care as well as clinical research could be improved by monitoring respiratory resistance by this technique, during mechanical ventilation.

		R_{rs} $cmH_20.l^{-1}.sec$			T_{rs} sec	
	n	Pre		Post	Pre	Post
Suction: all babies	19	215	*	188	0.16*	0.13
secretions	8	240	*	184	0.23*	0.17
Lavage: all babies	13	361	*	244	0.17	0.13
secretions	6	525	*	199	0.24*	0.14

122 ASSESSMENT OF COMPLIANCE AND LUNG VOLUME IN YOUNG CHILDREN - PRACTICAL? ACCURATE? USEFUL?

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Although inspiratory illness is an important cause of morbidity in young children (aged 2-6years), very little data on the functional growth of lung exists for this age group. We have adapted the weighted spirometer technique for measuring total compliance (CRS) in such children. Seated children breathed through a face mask attached to a spirometer. After establishing a constant end - expiratory level, weights were intermittently added and then removed from the spirometer bell while recording the relevant changes in pressure and volume. Compliance was obtained by dividing the change in volume by the change in applied pressure.
Functional residual capacity (FRC) was also measured using the helium dilution technique. The techniques were well tolerated in both sick and healthy children. Satisfactory results being obtained in 58 of 63 children tested. Duplicate estimates of both FRC and CRS were obtained in less than 10 minutes in each child. Both techniques were shown to be highly reproducible, the mean difference in the 2 FRC measurements was 0.01 litres (range -0.02 to +0.07) and for CRS was 3.3 mls/cmH_20 (range -7.0 to +10.0). Amongst healthy children significant correlations were found both between CRS and length (log^{10} CRS = length x0.0099 + 0.6154) and CRS and FRC (CRS = FRC x 1.01 - 59.8). This enabled the effects of diseases such as cystic fibrosis and BPD, which resulted in significant reductions in CRS and FRC, to be distinguished from those of growth.

123 THE DIAGNOSTIC VALUE OF PARTIAL FLOW-VOLUME CURVES IN INFANTS WITH AIRWAYS OBSTRUCTION

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The performance of flow-volume (FV) curves in infants is usually associated with considerable expense, in order to achieve a controlled forced expiration. The inspiratory portion of FV curves is usually neglected.
In our lung function laboratory FV curves were recorded in slightly sedated infants during spontaneous breathing. Furthermore, FV curves were recorded immediately after a short artificial interruption of breathing, at the end of inspiration, resp. expiration. In addition, body plethysmography was done.
The findings were compared with the results of clinical and - in 18 cases - endoscopical examinations.

Tests in 108 infants with and without cardiorespiratory disease showed that the configuration of FV curves allows conclusions on the kind and extent of airways obstruction similar to those in adults: Distinct limitation of inspiratory flow is caused by an extrathoracic stenosis; a low expiratory flow with a very strict linear or a curvilinear course suggests an intrathoracic impairment of airways.
The sensitivity in the diagnosis of an airways obstruction is inferior to that of body plethymography. Specifity is high, if the results are compared with clinical and endoscopical findings.
Thus, valuable information on ventilation is obtained by means of a simple method.

124 ASSESSMENT OF SMALL AIRWAYS OBSTRUCTION IN INFANCY

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We combined two recently developed methods to assess lung function in 6 healthy infants on 4 occasions between 1 and 12 months and in 14 infants with bronchiolitis during the acute phase and 3 months later. We used a modified rapid chest compression technique to obtain partial expiratory flow-volume (PEFV) curves and $\dot{V}maxFRC$. Passive respiratory mechanics were assessed by brief occlusion at end inspiration and calculation of time constant(Trs), respiratory compliance(Crs) and resistance(Rrs) from the subsequent passive expiration. During the acute phase 13/14 patients had markedly concave PEFV curves and 5 infants showed flow limitation during tidal breathing. $\dot{V}maxFRC$ was significantly reduced, Rrs and thoracic gas volume(TGV) were elevated. No difference was found for Crs and Trs. In 3 infants the normally straight passive expiratory flow-volume curve showed curvilinearity approaching end expiration. This curvilinearity was also found in 2 ventilated and paralysed infants with bronchiolitis and explained by increasing Rrs and decreasing Crs. This suggests small airway closure during tidal breathing. Despite some improvement after the acute phase, $\dot{V}maxFRC$ was still significantly reduced after 3 months, whereas Rrs was no longer different from the healthy controls. TGV was still elevated and therefore $\dot{V}maxFRC/TGV$ and specific conductance reduced. These result suggest that $\dot{V}maxFRC$ is a more sensitive parameter for the abnormalities in bronchiolitis than Rrs and should be included in follow up studies.

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125 USE OF FLOW VOLUME CURVES IN INFANCY TO STUDY AIRWAYS RESPONSIVENESS TO HISTAMINE.

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Wheeze in infancy is very common, but, little is known about airway function in this age group. We have adapted a technique (Taussig et al, J Appl Physiol 1982; 53: 1220-27) for producing partial maximum expiratory flow-volume curves in infants after light sedation. The infant sleeps supine inside an inflatable jacket which, when inflated rapidly to 3-4kPa (<100m.sec) at end inspiration, leads to forced expiration with flow limitation. Flow (integrated digitally to provide a volume signal) is measured at the facemask by pneumotachography. From the flow-volume curve, two indices are derived: (i) peak expiratory flow rate (PEF); (ii) maximum expiratory flow rate at the previously stable end-expiratory volume ($\dot{V}_{maxFRC}$). The median within-subject coefficients of variation of PEF and $\dot{V}_{maxFRC}$ for normal infants were 6% and 11% and for wheezy infants were 8% and 11% respectively.

Histamine responsiveness was measured as the change in PEF and $\dot{V}_{maxFRC}$ after doubling concentrations of histamine acid phosphate solution, administered for 1 min by Acorn nebuliser at 5 min intervals in 10 infants with recurrent or persistent wheeze. Where possible, tests were repeated after 24 hours. Rapidly reversible dose-dependent responses to histamine were shown at concentrations of about 4 $g.l^{-1}$. The responses were reproducible and were partly preventable by nebulised salbutamol (2.5mg). Acute reversible airways obstruction, modified by bronchodilators, may play a part in the pathophysiology of wheezy infants.