Alveolar partial pressures of carbon dioxide and oxygen measured by a helium washout technique

The estimation of arterial carbon dioxide pressure (Paco₂) by Professor J. Jordanoglou and colleagues [1] (October 1990:45:520–4) assumes the equivalence of Bohr-Enghoff deadspace [2] with the heliox deadspace by multiple breath washout (the "ventilatory deadspace" of Cumming and Guyatt) [3]. In a letter to Clinical Science following their previous paper [4] I pointed out the fallacy of this assumption. [5]

I note that in their Thorax paper the authors mention pulmonary embolism as a cause of discrepancy and took steps to exclude this in their patients. Any kind of ventilation-perfusion (V/Q) mismatch, however, does not seem to be associated in the literature published on ventilation-perfusion mismatch in lung disease. [6]

The ventilatory deadspace for helium increases, during washout, with breath number if V/V mismatching is present. The choice of first breath deadspace by Professor Jordanoglou and colleagues is quite arbitrary. This criticism is not merely about inaccuracies. The rebreathing method for oxygenated mixed venous carbon dioxide tension (PvCO₂) is not accurate, as all methods are. But the target is the intended one. The authors shoot at a physiologically different target on the pretext that it often coincides with the one they wish to hit.

There are other statements in this paper with which I do not agree. Right to left shunts, although enormous, will not affect the relation between the two deadspaces at rest. Membrane diffusion defects will, in theory, but in practice the effect would never be measurable. The ventilatory deadspaces for helium and SF₆ are not equal; they differ systematically and very significantly, though this fact has been bearing on the question of whether helium and carbon dioxide deadspaces are equivalent.

M C PAUL BRAAT
CAREL M ROOS
Pulmonary Department, Academic Medical Centre, University of Amsterdam, 1105 AZ Amsterdam-ZO, The Netherlands


I greatly enjoyed the article by Dr A D Gascoigne and others (August 1990:45: 637–8) on the biphasic spirogram, which the authors thought had not been described previously. They will find an earlier example in a book edited by Tim Clark. [7]

DAVID DENISON
National Heart and Lung Institute, London SW3 6LY


AUTHOR'S REPLY The calculation of the alveolar carbon dioxide and oxygen concentration during quiet breathing presumes the measurement of the physiological deadspace: tidal volume ratio by an inert gas washout method (helium) (Vd/Vt) and of the mixed expired carbon dioxide and oxygen concentration (FeCO₂, FeO₂). The heliox washout method, as developed in our laboratory, was applied in healthy subjects and in patients. In these subjects the classical carbon dioxide method for measuring the physiological deadspace: tidal volume ratio (Vd/Vt) was also applied. The comparison between these two indices showed that wVd/Vt was well correlated with Vd/Vt. This assumption was made about the relation between these two ratios.

Theoretically, wVd/Vt and Vd/Vt are equal to each other when the alveolar carbon dioxide concentration is measured in the Bohr equation, as explained in the paper. So by transformation of this equation and using the wVd/Vt ratio, measured by our technique, we calculated the alveolar carbon dioxide concentration or tension (paco₂). It is also mentioned here that no assumption was made for the calculation of paco₂.

wPaco₂ was compared with Paco₂ and it was found that there was 0.06 mmHg correlation, as shown in the paper. The deviation of wPaco₂ from Paco₂ may reflect the real difference between these two measures in the patients studied and/or to some extent an error in the measurement of these two terms. Accordingly, we do not postulate that wPaco₂ is equal to Paco₂ in general but we are entitled to say that wPaco₂ is a good estimate of Paco₂ for practical purposes, as the mean of the differences (wPaco₂–Paco₂) is 0.01 kPa, the standard deviation of the differences is 0.7 kPa, and the limits of agreement are ±1.4 kPa.

The first breath deadspace is not referred to anywhere in the paper.

The helium washout deadspace as measured by our technique may be equal to the ventilatory deadspace of Cumming and Guyatt, as Dr Harris mentions in his letter. These two tests differ from each other, however, in theory and method.

JORDANOGLOU JTATIS JDANOS SOUOGOULAKIS NEFORPIDIOU M GAGA
Pulmonary Unit, Medical School of Athens, University, Sotiria Hospital of Diseases of the Chest, 152 Mesogion Avenue, 115 27 Athens, Greece

The biphasic spirogram: a clue to unilateral narrowing of a mainstem bronchus

Dr A D Gascoigne and his colleagues (August 1990:45:637–8) confirm our finding of the two compartment phenomenon, caused by unilateral airway obstruction and manifested as end inspiratory (and end expiratory) slowing of the maximum inspiratory flow–volume curve. The phenomenon was first described by Williams et al [1] in a patient with severe stenosis of the left main bronchus. We described two patients; one with almost complete obstruction of the left main bronchus caused by bronchial carcinoma and the other with unilateral lung emphysema (Macleod’s syndrome), as suggested by Dr Gascoigne and colleagues.

We also showed that the two compartment phenomenon, when there is doubt, can easily be recognised with a partial volume lung function manoeuvre. [2]

We thank Dr JH Dennis and colleagues (October 1990:45:728–32) for highlighting the considerable limitations in using the weight loss of a nebuliser as an index of the amount of solute (for example a drug) released in an aerosol. We agree that it is necessary to measure the amount of solute which is leaving the nebuliser directly and have used such a technique where the sampling filters were weighed after drying to determine the weight of solute nebulised. [3]

Jet and ultrasonic nebuliser output: use of a new method for direct measurement of aerosol output


