$\text{PaCO}_2\text{-PETCO}_2$.^{8,9} The gradient is dependent not only on physiological dead space but also on the slope of the "alveolar plateau," phase III of single breath test (expired CO_2 versus expired volume). There is a positive relationship between $\text{PaCO}_2\text{-PETCO}_2$ and dead space, that is, increases in the dead space can result in an increase of $\text{PaCO}_2\text{-PETCO}_2$. However, there is a negative relationship between $\text{PaCO}_2\text{-PETCO}_2$ and slope of phase III; an increase in the slope of the phase III reduces the $\text{PaCO}_2\text{-PETCO}_2$. The slope of the phase III is dependent on the emptying patterns of various alveoli with different $\dot{V}/\dot{Q}$ ratios. Simultaneous emptying of alveoli with varying $\dot{V}/\dot{Q}$ ratios results in minimum slope of phase III, whereas late emptying of low $\dot{V}/\dot{Q}$ alveoli with high PCO_2 can result in a steeper phase III slope. Occasionally, this may result in zero or negative $\text{PaCO}_2\text{-PETCO}_2$ even in the presence of a significant dead space. Therefore it implies that the net change in $\text{PaCO}_2\text{-PETCO}_2$ is the final result of changes in dead space and the emptying pattern of the lung with various $\dot{V}/\dot{Q}$ alveoli.^{5,7,10-12}

Thirdly, the authors state that the use of large tidal volumes is associated with an increased $\text{PaCO}_2\text{-PETCO}_2$ and cite a reference.² However, on the contrary, the use of large tidal volumes produces relatively better ventilation of dependent well-perfused alveoli and results in a better overall $\dot{V}/\dot{Q}$ matching. This may result in a reduced $\text{PaCO}_2\text{-PETCO}_2$.^{2,7}

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REPLY

We are grateful to the authors for their critical reading of our paper. We suggested that our use of high tidal volumes might explain the lack of an increase in the arterial to end-tidal CO_2 gradient postbypass which had been observed in another investigation,¹ but then stated that high tidal volumes are associated with an increase in the gradient, incorrectly quoting Fletcher and Jonson.² These latter authors demonstrated a decrease in the gradient with large vs small tidal volumes. In fact, as has been discussed by Hoffman et al.,³ the effect of tidal volume on dead space and the arterial to end-tidal CO_2 gradient may be unpredictable in the critical care setting, possibly depending as much on the duration of expiration as the tidal volume.

Shankar et al. have obtained data, to which they refer, demonstrating "negative" $\text{PaCO}_2\text{-PETCO}_2$ gradients in up to 50% of anaesthetized pregnant young women. The majority of other publications (some of which are quoted in our paper) demonstrate that PETCO_2 is lower than PaCO_2 . We apologize for using the word always instead of usually in this regard. The gradient usually widens with general anaesthesia and mechanical ventilation, and changes in dead space or dead space: tidal volume ratios are usually associated with changes in the gradient. The authors suggest that late emptying of alveoli which contain "high CO_2 " may raise the end-tidal value, independent of changes in dead space. How frequently this occurs during IPPV in postoperative patients is unknown. We did not observe negative gradients whereas, in a similar setting, Russell et al. found such gradients 8.1% of the time.⁴

The clinical use of capnometry in critical care has been hampered by the lack of a consistent relationship between arterial and end-tidal values in patients with respiratory failure.

Perhaps the explanation is in the work of these authors (and Fletcher and Jonson), in that a complex relationship between tidal volume, duration of expiration, alveolar dead space and ventilation inequalities determines the end-tidal CO_2 . In patients with lung disease this appears to be a changing relationship.

We showed that after elective uncomplicated heart surgery the gradient for each patient is relatively constant, and the PETCO_2 can be used to guide ventilator weaning in the majority of patients. As illustrated in the letter by Shankar et al., the potential does exist for unusual gradients and we recommend arterial blood gas determinations in patients with complications, and when the results of capnometry do not fit the clinical picture.

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Errata

Changes are underlined

Guay J. Monitorage du fœtus et réanimation du nouveau-né: ce que l'anesthésiste doit savoir. *Can J Anaesth* 1991; 38: Supp R74–R82.

Page R76, à la 10e ligne (1ère colonne)

tion de la tête de 30° augmente la pCO_2 jusqu'à 2 kPa

devrait se lire

tion de la tête de 30° augmente la PcO_2 jusqu'à 2 kPa

Page R77, Tableau II

Guay J. Fetal monitoring and neonatal resuscitation: what the anaesthetist should know. *Can J Anaesth* 1991; 38: Supp R83–R88.

Page R84, line 19 (2nd column)

age of secretions. A head tilt to 30° increases PCO_2 up to

should read

age of secretions. A head tilt to 30° increases PcO_2 up to

Page R85, Table II

should read