LETTERS TO THE EDITOR

CONFUSION REGARDING THE BAIN CIRCUIT

DEAR SIR:

In a recent paper (Canad. Anaesth. Soc. J., 27: 357-362, 1980), Spoerel writes, "It has been stated that with the Bain circuit the P_{aCO_2} is controlled by rebreathing and Keenan and Boyan have introduced a factor $(\dot{V}_E - \dot{V}_F)/\dot{V}_E$ to indicate rebreathing in a formula designed to predict the P_{aCO_2} with the Bain circuit. This view is incompatible with the finding that the utilization of $\dot{V}_F$ reaches a plateau and remains unchanged with further increases of $\dot{V}_E$ over $\dot{V}_F$." We fail to see any incompatibility here. In fact, the view that the Bain circuit controls the P_{aCO_2} by rebreathing is totally compatible with Rose, Byrick and Froese's finding¹ that the utilization of $\dot{V}_F$ reaches a plateau with increases of $\dot{V}_E$. Once the $\dot{V}_F$ is fully utilized by a $\dot{V}_E$ significantly greater than $\dot{V}_F$ (one could argue that full utilization of $\dot{V}_F$ is never reached, only asymptotically approached, but the practical result is the same), then further increases in $\dot{V}_E$ will not alter the P_{aCO_2} , because with each increment of $\dot{V}_E$ there will be a correspondingly greater degree of rebreathing in the system.

Spoerel goes on to say, "It (the view that P_{aCO_2} is controlled by rebreathing) would also not agree with the observation that rebreathing or mixing within the circuit does not affect F_{ETCO_2} nor F_{ECO_2} ." Again, not so. Spoerel's findings regarding these variables, and their stability in the face of wide changes in $\dot{V}_E$ are what we would have predicted in our "rebreathing" point of view. Indeed, all of Spoerel's findings are compatible with the view that the ratio $\dot{V}_E/\dot{V}_F$ controls the degree of rebreathing in a Bain circuit.

We suggest that the apparent disagreement here is only one of viewpoint. We choose to explain the fact that one does not see disastrously low P_{aCO_2} with a $\dot{V}_E$ of 120 to 160 ml/kg or more as recommended by Bain and Spoerel² because the comparatively low recommended fresh gas flows allow rebreathing to occur. But one could also say, as Spoerel suggests, that the low fresh gas flow limits effective alveolar ventilation. Both statements are true, and are entirely compatible.

Take an extreme example: When $\dot{V}_F$ is zero, we would prefer to say that rebreathing is total. But one could also say that "alveolar ventilation" is zero, provided the term "alveolar venti-

lation" is understood to mean the movement of fresh gas into perfused alveoli. Both statements are true.

We belabour this point because we feel these unrecognized differences in viewpoint, or different ways of expressing the same thing, have led to much unnecessary confusion regarding the Bain circuit.

We wish to take this occasion to express our own dissatisfaction with the factor $(\dot{V}_E - \dot{V}_F)/\dot{V}_E$ which, as Spoerel stated, we introduced to indicate fraction of rebreathing in a formula designed to predict P_{aCO_2} with the Bain circuit.³ We now believe it to be incorrect, even though it yields approximately correct results in clinical ranges. We are currently unable to express "degree of rebreathing" mathematically to our satisfaction. We continue to believe that a precise equation describing carbon dioxide elimination in a Bain circuit is possible and desirable. A satisfactory mathematical description would be proof that the function of the Mapleson D system is truly understood.

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