Correspondence

CO_2 Absorber Placement Affects Spirometric Measurements of Gas Exchange and Pulmonary Function

To the Editor:—Breathing circuits for measuring pulmonary function and gas exchange frequently employ a spirometer and CO_2 absorber. The location of CO_2 absorption is important, because it affects measurements of minute volume and gas exchange. Several researchers have made small systematic errors by absorbing CO_2 before measuring its volume.[1-6]

In one breathing circuit,[1,2] for example, mixed expired CO_2 tension ($P_{E\bar{C}O_2}$) was measured in gas sampled from the outflow of a Collins respirometer bell. An absorber on the inspiratory side of the breathing circuit removed CO_2 (fig. 1*A*). The Collins respirometer and Reichert ventilometer record inspiratory minute volume ($\dot{V}_I$), but the actual volume inspired by the subject in this circuit design is less than the amount removed from the bell. The absolute error in $\dot{V}_I$ equals the rate of CO_2 excretion ($\dot{V}_{CO_2}$). The percentage error in $\dot{V}_I$ depends on the mixed expired CO_2 concentration, which is the ratio of $\dot{V}_{CO_2}$ to expired minute ventilation. Tidal volume, anatomic deadspace (V_{D_A}), and respiratory exchange ratio (R) are increased by this percentage, usually 3–4 per cent.

Oxygen consumption ($\dot{V}_{O_2}$), measured as the rate of decrease of gas volume in a closed breathing circuit, may also be affected by absorber location. Failure to totally wash out the circuit up to the absorber results in a decrease in measured $\dot{V}_{O_2}$ and also contributes to an erroneously high R. This error occurs

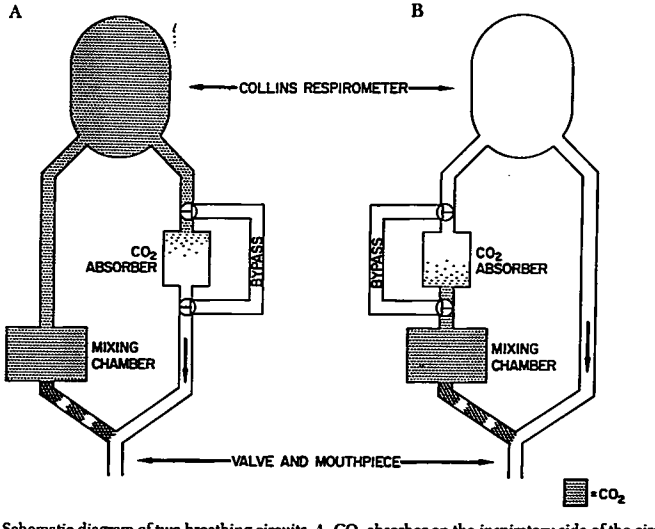

FIG. 1. Schematic diagram of two breathing circuits. *A*, CO_2 absorber on the inspiratory side of the circuit. *B*, CO_2 absorber on the expiratory side of the circuit.

with the absorber in either position (fig. 2), but is greater when more volume must be filled with exhaled, CO_2-containing gas.

Placing the mixing chamber and CO_2 absorber on the expiratory side of the circuit (inflow side of the spirometer), shown in fig. 1B, will minimize this error. We studied six subjects with both circuits and found $\dot{V}_I$ and V_{D_a} were significantly greater when CO_2 was absorbed on the inspiratory side. This circuit design (fig. 1B) also resulted in significant decreases in both $\dot{V}_{CO_2}$ and R. $\dot{V}_{O_2}$ was unaffected, but 10 minutes were allowed for equilibration before measurements. $P_{E_{CO_2}}$'s in the two circuits were identical.

CO_2 absorption before the spirometer bell (fig. 1A) does slow determination of the ventilatory response to accumulating CO_2. A comparison of the effects of absorber location on $P_{I_{CO_2}}$ during measurements of ventilatory response to endogenous CO_2 is shown in figure 3. The sudden abrupt rise in $P_{I_{CO_2}}$ with the CO_2 absorber on the inspiratory side occurs because most of the breathing circuit already contains exhaled gas when the absorber is bypassed. Examination of ventilatory response curves revealed a quicker approach to linear response with the absorber inspiratory. Thus, locating CO_2 absorption on the inspiratory side of a breathing circuit decreases the time to perform a CO_2 response test, but causes errors in measurement of $\dot{V}_I$, V_{D_a}, $\dot{V}_{CO_2}$, and R.

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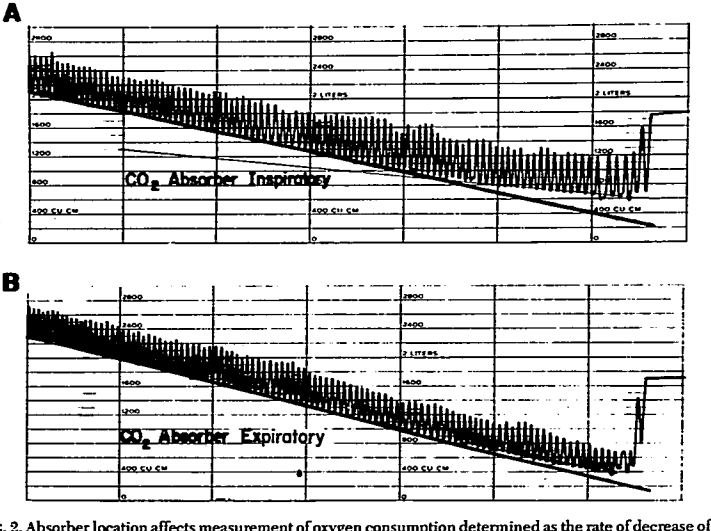

FIG. 2. Absorber location affects measurement of oxygen consumption determined as the rate of decrease of gas volume in a closed breathing circuit. Spirograph begins on right.

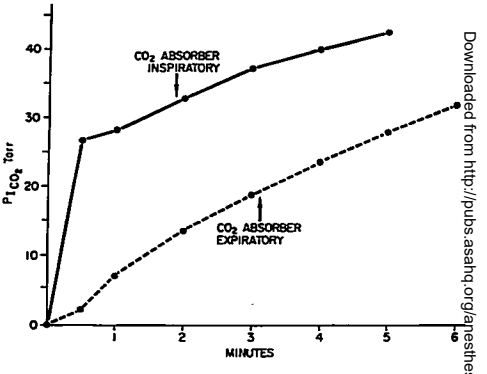

FIG. 3. The effect of CO_2 absorber location on the inspired CO_2 tension (P_{ICO_2}) which develops during measurements of the ventilatory response to endogenous CO_2.

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(Accepted for publication February 12, 1974)

Investigating Acupuncture

To the Editor:—Stoelting, Kim, Peterson, and Haselby ("The Influence of Acupuncture on Halothane MAC in Dogs" ANESTHESIOLOGY 39:661, 1973) are to be commended for taking small steps onto a new frontier. Scientists, however, will wallow in a mire of confusion until they reckon squarely with acupuncture on its own terms; otherwise, they are not studying acupuncture. This study would have been best titled "The Influence of Electrical Stimulation on Halothane MAC in Dogs" In the absence of known acupuncture points, not only for dogs, but for the treatment of response to a tail-clamp stimulus, it could hardly be a study of acupuncture even if sites analogous to known points in other species had been used. As it stands, this investigation showed only that a probably noxious stimulus increases anesthetic requirement.

Consciousness may be essential to the functioning of acupuncture, as psychological phenomena have a large role in the perception of pain.[1] Furthermore, as local anesthetic infiltration of acupuncture points renders them ineffective,[2] the same may be true of general anesthesia, so that the preparation described may not have been suitable for this study.