vaporizer. For draining, the rotary valve should be "Open" after the empty correct bottle is connected in the upright position.

This system uses only one keyed connection, and eliminates the need for the second special connection between the filling adaptor and the filler receptacle that is essential to the Cyprane system. Because there is no flexible tube adaptor being used, liquid flow for filling or draining is almost twice as fast as with the Cyprane system. Once the bottle is directly screwed onto the vaporizer, the bottle can stay in the appropriate position either for filling or for emptying, and no hands are needed to hold the bottle during such procedures. To refill the vaporizer, a liquid anesthetic bottle can stay even at the upside-down position during a long anesthetic case, and just opening the valve (after the vaporizer has been turned off) will do it. All maneuvers are very simple and self-explanatory. We have used this device in daily practice, and, so far, have found that it is satisfactorily efficient and robust over 1 yr.

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Accuracy of Expired Carbon Dioxide Partial Pressure Sampled from a Nasal Cannula. I.

To the Editor:—In the October, 1987, issue of ANESTHESIOLOGY, J. M. Goldman[1] described a system consisting of a 16-gauge angiocath passed through a nasal cannula that was used to monitor "end-tidal P_{CO_2}." He claimed this setup may be useful in determining the "adequacy of ventilation in the sedated or narcotized patient." It was implied that the plateau on the graph of end-tidal carbon dioxide ($ETCO_2$) as a function of time indicated that the sampled gas was end-tidal. This same arrangement has been used in the sedated patient at our institution. It does, indeed, provide information concerning respiratory rate, and may serve as a form of apnea monitor. However, one should be cautious in interpreting the $ETCO_2$ value displayed, as the sampled gas mixture most likely does *not* represent a true end-tidal gas mixture.

When properly measured, $ETCO_2$ can be a useful means of estimating arterial partial pressure of CO_2 (Pa_{CO_2}). True $ETCO_2$ approximately equals the alveolar partial pressure (Pa_{CO_2}). When studied systematically and sampled properly, end-tidal to arterial P_{CO_2} gradients are small.[2,3] However, in previous studies where small gradients were found, a mouth piece, mask, or endotracheal tube was utilized for expired gas sampling (closed system with minimal deadspace). This minimizes gas mixture with ambient air which would act to dilute true end-tidal gas, and yield an artifactually low $ETCO_2$ value.

The open system described by Dr. Goldman, in which nasal cannulas are used for simultaneous oxygen (O_2) administration, does not meet the stated conditions necessary to assure true end-tidal gas sampling. Resulting $ETCO_2$ values can be anticipated to be artifactually low. If one uses this falsely low value as a basis for administering opiates or other drugs with respiratory depressant properties, the potential danger is obvious. Further, as expired minute ventilation is decreased with opiate administration, the bias flow of O_2 through the cannulas comprises a large fraction of sampled gas, thus further diluting true end-tidal gas. For this reason, the system suggested cannot reliably serve as a method for determining *trends* in true $ETCO_2$.

The data shown in figure 1 were gathered using the nasal cannula open system and a closed mask system in a volunteer. Data were collected *via* a mass spectrometer (Perkin-Elmer). A 6.7 mmHg P_{CO_2} difference was seen over a 30-s period, thus illustrating the potential error in designating a sample from such an open system as "end-tidal."

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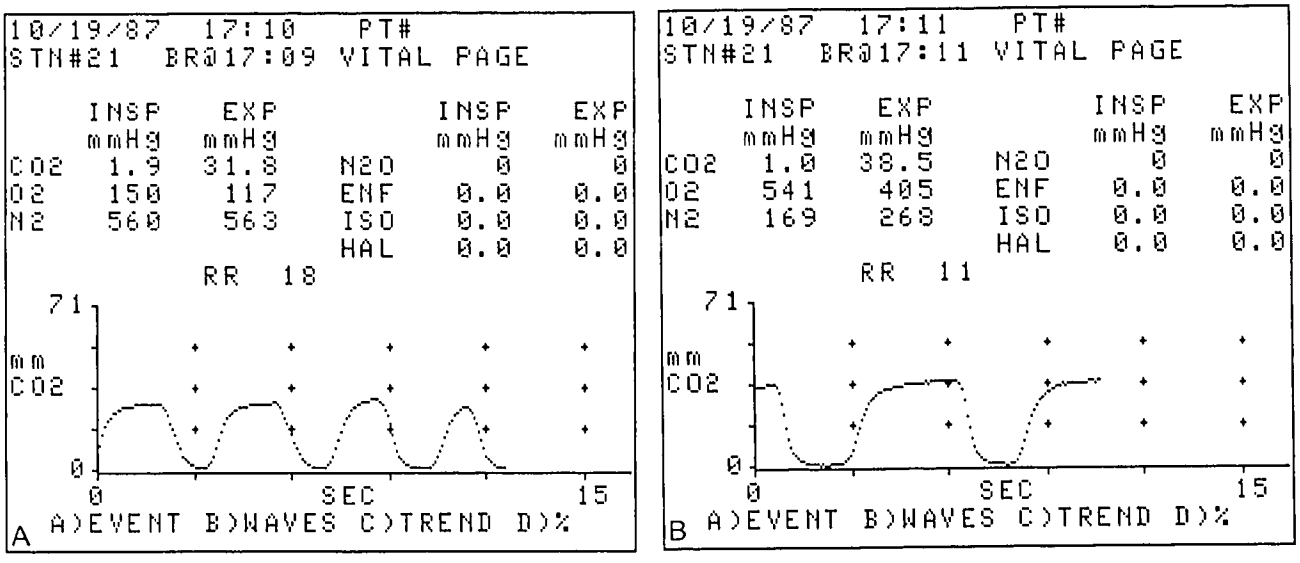

FIG. 1. Expired P_{CO_2} sampled from open nasal cannula system (A), with 300 ml/min O_2 flow as compared with closed mask system (B).

REFERENCES

1. Goldman JM: A simple, easy, and inexpensive method for monitoring $ETCO_2$ through nasal cannulae. ANESTHESIOLOGY 67:606, 1987
2. Nunn JH, Hill DW: Respiratory deadspace and arterial to end-tidal CO_2 tension difference in anesthetized man. J Appl Physiol 15:383–389, 1960
3. Raemer DB, Francis D, Philip JH, Gabel RA: Variation in PCO_2 between arterial blood and peak expired gas during anesthesia. Anesth Analg 62:1065–1069, 1983

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Accuracy of Expired Carbon Dioxide Partial Pressure Sampled from a Nasal Cannula. II.

To the Editor:—Dr. Goldman's method for measuring endtidal CO_2 ($ETCO_2$)[1] *via* nasal cannulae cannot give an accurate value for $ETCO_2$. Only the respiratory rate can be measured by this method.

The expression "end-tidal concentration" is generally accepted to be alveolar concentration. In a recent study at the Mater Misericordiae Hospital, Dublin, Ireland, we compared Pa_{CO_2} and nasal peak CO_2 values obtained by sampling the expired gases in the posterior pharynx of 15 patients who had received intrathecal morphine analgesia for coronary artery surgery. Respiratory depression (maximum 12–14 h post-administration)[2] is a recognized side effect of this therapy.

The trachea of each patient had been extubated post-surgery in the intensive care unit when core temperature was 34° C and respiratory effort and tidal volumes were considered acceptable clinically.

A size 6 nasopharyngeal airway was inserted after spraying with lidocaine 4%. The capnograph sampling tube was inserted 8 cm into the airway. The capnograph (Accucap®, Datascope) was allowed to stabilize for 30 min, after which time the catheter was connected. A further 15 min elapsed before arterial blood was sampled and the capnograph reading noted. The blood was analyzed immediately on the unit's ABL4 gas analyzer. Further samples were compared 10 and 20 min after the initial sampling.

A total of 45 pairs of samples were collected from the 15 patients. The results in S.I. units were analysed by linear regression analysis using a microcomputer. The coefficient of correlation (r) was 0.59 and r^2 was 0.36. The data fitted the equation $Y = 0.55X + 2.38$.

These results indicate that the nasopharyngeal p_{CO_2} does not correlate well with arterial p_{CO_2} and, therefore,