Title: REPRODUCIBILITY OF END TIDAL CO_2 MEASUREMENTS IN SEDATED PATIENTS RECEIVING SUPPLEMENTAL O_2 BY NASAL CANNULA

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Introduction. Difficulty assuring adequacy of ventilation during a regional anesthetic technique or monitored anesthesia care has prompted the introduction of techniques for monitoring end tidal carbon dioxide tension (E_TCO_2) in the nonintubated patient.[1] While it would be most helpful if an individual E_TCO_2 determination equaled the partial pressure of arterial CO_2 ($PaCO_2$), this is rarely the case even in the intubated patient.[2] However, when V/Q matching and dead space remain relatively constant within a given patient, then the relationship between E_TCO_2 and $PaCO_2$ should remain consistent and trends in E_TCO_2 may be followed to monitor ventilatory status. The present study sought to determine if varying the rate of supplemental oxygen through nasal cannulae in patients being monitored via a transcannula sampling port would alter an otherwise stable $E_TCO_2/PaCO_2$ relationship and thereby potentially distort trend analysis.

Methods. After Human Investigation Committee approval had been obtained, 16 adult patients scheduled for cardiac surgery were selected for study. Each was premedicated with intramuscular morphine 0.08-0.12 mg/kg and scopolamine 0.2-0.4 mg. Supplemental oxygen (4 lpm via nasal cannulae) was maintained during transport and while radial and pulmonary artery catheters were inserted. E_TCO_2 monitoring was accomplished via a 14 gauge intravenous catheter inserted through one prong of the nasal cannula so that its tip extended only 0.5 cm beyond the orifice of the prong (in order to avoid nasal irritation). The hub was attached to the sampling line of a shared mass spectrometer with a continuous infrared CO_2 sensor. In patients with a distinguishable capnogram, the mean E_TCO_2 value was determined during a 20 second steady-state interval, and a simultaneous arterial blood gas sample was obtained. In all cases, oxygenation was adequate and the oxygen flow rate then was reduced to 2 lpm; 5 min later, E_TCO_2 and $PaCO_2$ again were determined. Data were expressed as mean $\pm$ SEM. Changes in paired E_TCO_2 and $PaCO_2$ values with changing flow rates were analyzed using paired sample testing and both tails of the t distribution; significance was taken at the 0.05 level. The 95% confidence intervals for the means of the differences of the measured parameters indicated that the study method was powerful enough to detect a change in E_TCO_2 or $PaCO_2$ of ± 2 mmHg.

Results. In 13 of the 16 patients, the initial capnogram was readily discernible and remained so throughout the study. The relationship between E_TCO_2 and $PaCO_2$ remained consistent for individual subjects; and the mean $E_TCO_2/PaCO_2$ ratio did not change significantly with differing oxygen flow; it was 0.75 at 2 lpm and 0.76 at 4 lpm ($p > 0.05$; Table 1). For reasons independent of oxygen flow, three of the 16 patients were excluded based upon the appearance of the initial capnogram. In one case, an irregular capnogram correctly identified intermittent obstruction secondary to deep sedation. Exclusive mouth-breathing and abnormal external nasal anatomy accounted for exclusion of the other two cases.

Discussion. The data indicate that the relationship between E_TCO_2 and $PaCO_2$ in a given patient is not affected significantly by changing rates of oxygen flow from 4 to 2 lpm. In addition, pilot studies on unmedicated volunteers from whom arterial samples were not obtained noted the same consistency of E_TCO_2 readings over a range of 0 to 8 lpm. The extremes were not employed in the present study since discontinuing oxygen would constitute a significant change from our standard of care and administering high flows causes uncomfortable drying. In summary, we conclude that transcannula CO_2 sampling is a reliable means of monitoring the nonintubated patient. Once a stable discernible tracing is obtained, it should remain consistent. Thus, a change in E_TCO_2 should alert the anesthesia care provider to a possibly significant change in ventilatory status.

References.

1. Goldman JM: A simple, easy, and inexpensive method for monitoring E_TCO_2 through nasal cannulae. Anesth 67:606, 1987.

2. Nunn JF, Hill DW: Respiratory dead space and arterial to end tidal CO_2 tension difference in anesthetized man. J Appl Physiol 15:383, 1960.

END TIDAL VS. ARTERIAL CO_2 TENSION

	2 lpm Nasal Oxygen			4 lpm Nasal Oxygen		
	E_TCO_2	$PaCO_2$	Ratio*	E_TCO_2	$PaCO_2$	Ratio*
1.	40	49	0.81	39	54	0.73
2.	36	43	0.84	33	42	0.79
3.	37	41	0.88	37	42	0.86
4.	37	41	0.91	37	41	0.91
5.	25	47	0.53	28	38	0.74
6.	17	40	0.42	21	39	0.54
7.	31	40	0.87	30	42	0.73
8.	27	42	0.63	33	46	0.71
9.	34	42	0.80	31	41	0.76
10.	37	42	0.88	31	42	0.74
11.	41	50	0.83	40	46	0.87
12.	41	52	0.70	34	54	0.62
13.	33	45	0.73	34	42	0.82
MEAN:	33	44	0.75	33	44	0.76
SEM:	2.0	1.1	0.04	1.4	1.4	0.06

*ratio of $E_TCO_2/PaCO_2$