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Sources of Nitrogen in the Anesthesia Circuit

To the Editor:—Operating room mass spectrometers are in common use, and monitoring end-tidal nitrogen (ET_{N_2}) has been reported to be of value in venous air embolism detection.[1] Increases in nitrogen concentration in the anesthesia circuit have been observed in clinical circumstances unrelated to venous air embolism (VAE).[2]

In an anesthetized, paralyzed subject breathing oxygen, there should be only minimal amounts of nitrogen present in exhaled or inhaled gas, provided the endotracheal tube cuff seal is intact and the anesthesia circuit is air tight. Figure 1 was obtained in an anesthetized dog intubated with a Portex® blue line 8 mm ID, 10.9 mm OD endotracheal tube. Muscle paralysis was no longer complete, and very slight diaphragmatic movements could be observed. This same pattern and etiology have been observed in partially paralyzed patients. As the subject breathes out of phase with the ventilator, air may enter the trachea around a now functionally incompetent endotracheal tube cuff. Sudden, large increases in inspired nitrogen and ET_{N_2} can be observed. This may be confusing in the patient at risk for VAE, particularly when gas sampling is discontinuous. Because air can freely move into the trachea under the conditions described, gastric or pharyngeal contents may do so as well. Studies are under way to determine the effect of endotracheal tube cuff characteristics on this phenomenon.

In an adult circle anesthesia circuit, fresh gas flows higher than 1 l/min result in ET_{N_2} concentrations from 0.0% to 0.5%. Even after several h of denitrogenation, reduction in the fresh gas flow will result in increases in inspired nitrogen and ET_{N_2} because body stores are not depleted. The magnitude of this change will be greatest if the system is closed abruptly, as shown in figure 2. After denitrogenation, closed-system anesthesia usually results in a stable ET_{N_2} of 2.0–3.0%. Changing fresh gas flow rates is inadvisable at times when patients are at the highest risk for VAE. If increases in ET_{N_2} are to be specific for VAE detection in patients, it is imperative that all potential sources of sudden increases in nitrogen concentration in the circuit be recognized and controlled.

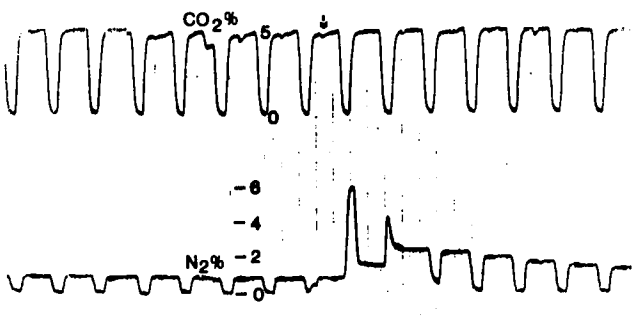

FIG. 1. End-tidal carbon dioxide and nitrogen obtained from Med Spec® mass spectrometer. As diaphragm contractions begin, notched CO_2 waveforms appear (*arrow*), followed by an abrupt increase in nitrogen.

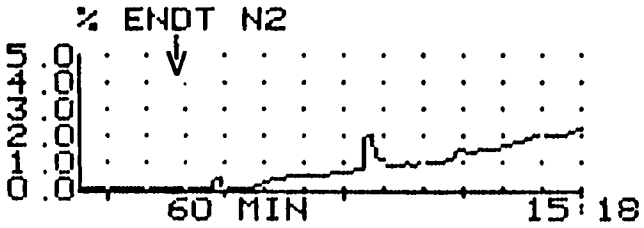

FIG. 2. End-tidal nitrogen trend in an adult patient, adult circle system. At *arrow*, fresh gas flows were reduced from 1.5 l to 0.35 l. Nitrogen concentration abruptly increases.

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2. Lanier W: Intraoperative air entrainment with Ohio® Modulus® anesthesia machine. ANESTHESIOLOGY 64:266–268, 1986

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