TITLE: INDIRECT CALORIMETRY: COMPARISON OF TWO METHODS IN VENTILATED PATIENTS

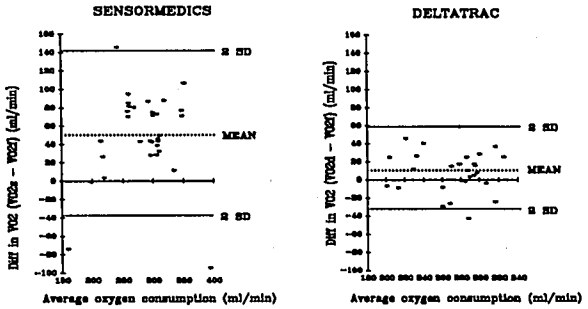
AUTHORS: G. Oschmann, U. Föhring, M.D., M. Schäfer, M.D., L. Hannemann, M.D., K. Reinhart, M.D.

AFFILIATION: Dep. of Anesthesiology and Intensive Care Medicine, Klinikum Steglitz, Free University of Berlin, Hindenburgdamm 30, D-1000 Berlin 45

Indirect calorimetric methods and continuous monitoring of oxygen uptake are becoming increasingly important in research as well as on intensive care units. Priority must be given to methodological problems (FIO_2, PEEP, moisture, changing minute volumes), particularly with in vivo measurements. Our study examines the validity of two measurement principles and their reliability in predicting derived parameters.

In operative intensive care patients (n=15) with pulmonary-artery catheters on controlled ventilation, 255 measuring cycles were simultaneously evaluated with the Deltatrac™ Metabolic Monitor (Datex Instrumentarium, Helsinki, Finland) and the MMC Horizon™ (SensorMedics, Anaheim, California). All measurements were performed under steady-state conditions. For artifical respiration (PEEP 0-10cm H_2O, I:E-quotient 1:1.5 to 1:2, FIO_2 between 0.21 and 0.6) a Servo Ventilator 900C was used. During 40 measurements, we additionally recorded a hemodynamic profile and calculated VO_2 and DO_2 according to the Fick principle from the arteriovenous O_2 difference and the cardiac output measured by thermodilution.

Both devices measure the VO_2 too high compared to calculations according to the Fick principle (Mean ±2SD: Deltatrac +10.7 ml/min ±48; MMC Horizon +50.7 ml/min ±92), the MMC Horizon measurements being disproportionately high with increasing values. FIO_2 measurements are the same with both apparatuses (r^2=0.996). FeO_2, however, is likewise measured too high by MMC; the Deltatrac to MMC ratio for FIO_2-FeO_2 shows increasing deviations at higher values (y = 0.28 + 0.798x, r^2=0.944). We observed the same tendency in comparing the volume measurement (y=-0.157 + 0.961x, r^2=0.97). Thus higher values are measured for VO_2 with the MMC than with the Deltatrac (y=35.07 + 1.02x, r^2=0.648). The same is true for the VCO_2 of MMC, again with a disproportionate increase in the upper range.



Measurement of direct and indirect oxygen consumption

Compared to Deltatrac and calculated values for VO_2 and VCO_2 the results from MMC Horizon were too high. Measured against the standard, the mixing-chamber principle (Deltatrac) has proven to be more precise and less susceptible to trouble than the breath-by-breath system (MMC Horizon), though, in accordance with the literature [1,2], the values observed here were too high as well. A clinical and scientific application of the MMC Horizon is not justifiable in ventilated patients.

References: 1. Crit. Care Med 1987; 15 (2) 144-7
2. Crit. Care Med 1989; 17 (10) 1041-7

TITLE: DETECTION AND QUANTIFICATION OF MIXED VOLATILE ANESTHETICS BY POET®II AND A MASS SPECTROMETER

AUTHOR: L.C. Jameson, M.D.

AFFILIATION: Anesthesia Department, University of Wisconsin, Madison, WI 53792

Measurement of volatile anesthetic vapor (VA) has become a common occurrence. Until recently only the multiplexed mass spectrometer could differentiate between and quantitate mixtures of volatile anesthetics. The risks of unknown VA mixtures in agent specific vaporizers is well documented (Bruce DL, Anesthesiology 60:342-346, 1984). This risk may be increased since non-agent specific spectrometers will report erroneous values when an unexpected VA is present. This study was performed to compare the infrared POET®II Multigas Analyzer's (CritiCare Systems) ability to identify and quantitate mixed VA with a stand-alone mass spectrometer (Medical Gas Analyzer 1100, Marquette Gas Analysis Corp.) (MGA).

METHODS: A vernitrol vaporizer was filled with 1:1 volumetric mixtures of halothane (H), isoflurane (I), and enflurane (E) in the following combinations: E:I, E:H, H:I, and E:H:I. Oxygen flow through the vaporizer was set at 100 cc/min and the background gas flow (BGF) set on the OHIO Heidbrink Compact anesthesia machine was 2 and 5 l/min of O2. The POET®II (software vers. 2.3) and MGA were calibrated as directed by the manufacturer. MGA was used as the standard thus 3 additional VA calibration points (Scott Corp.) (0.5%, 1.0%, 1.5%) were used. The test gas flow was through 100 cm suction tubing, a modified respiratory gas sampler and into a vented anesthesia bag. The delay from turning the vaporizer on to its appearance at the sample port was <0.5 sec. Each instrument used its standard sampling attachments and sampling locations were the same distance from the gas inlet. Ten value points were recorded on 10 separate occasions (n=100 points) for each VA combination. The following data was obtained: 1) MGA 1100 VA readings at time the POET®II reported the VA values, 2) time to POET®II report, 3) POET®II reported values. Significance was p<0.05 using paired T-test for repeated values.

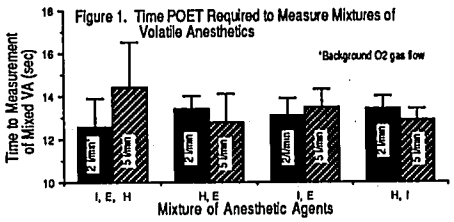
RESULTS: In this laboratory situation, there were no differences between units in the reported VA values for either of the BGF (Table 1). The

Table 1: Volatile Anesthetic Values Reported at Time of Identification

	VA Mix	Background flow: 2 L/min Value Reported (%) E	H	I	Background flow: 5 L/min Value Reported (%) E	H	I
MGA 1100	E,H	0.68±0.01	1.22±0.01		0.35±0.003	0.51±0.01	
POET	E,H	0.6±0.0	1.3±0.0		0.3±0.0	0.6±0.0	
MGA 1100	E,I	0.93±0.01		1.02±0.01	0.35±0.02		0.40±0.04
POET	E,I	0.9±0.0		1.0±0.0	0.4±0.05		0.4±0.05
MGA 1100	H:I		1.47±0.01	1.15±0.01		0.55±0.06	0.45±0.05
POET	H:I		1.5±0.03	1.1±0.05		0.6±0.09	0.5±0.05
MGA 1100	E,H,I	0.63±0.01	0.93±0.01	0.85±0.01	0.25±0.01	0.38±0.02	0.35±0.02
POET	E,H,I	0.6±0.03	1.0±0.1	0.9±0.05	0.1±0.1	0.4±0.0	0.4±0.1

VA-Volatile Anesthetic, E-Enflurane, H-Halothane, I-Isoflurane

POET®II's overall mean time to identification and measurement of the VA's was 13.3±0.5 sec. The time was not affected by the specific VA mix even when 3 agents were present. The time was not affected by the BGF (Fig. 1).



DISCUSSION: Under these experimental conditions the POET®II provided accurate rapid identification and measurement of mixed VA. The VA mixture used provided very similar concentrations for all vapors present. Large differences between individual VA in the mix may change results. This study did not examine the significant effect ventilation waveform could have on the POET®II's performance.

Downloaded from http://asa2.silverchair.com/anesthesiology/article-pdf/73/3A/NA/665535/0000542-199009001-00440.pdf by guest on 13 March 2024