Anesthesiology
67:283, 1987

Inexpensive Stethoscopic Transmitter

To the Editor:—Short-range transmitters are useful in teaching and supervisory environments in the operating room to allow multiple listeners to maintain vigilance of heart and breath sounds. We wish to report the construction of a simple and inexpensive device for this purpose.

A cordless, battery-operated FM microphone (RadioShack #33-1076, $19.95) may be modified for connection to standard iv extension tubing by removing the cover and drilling a ¼″ diameter hole directly over the sound port to accept a ¼″ O.D. × ⅛″ I.D. rubber grommet (fig. 1). Acoustic coupling of the miniature transmitter is then easily made to any standard precordial or esophageal stethoscope. Unwanted noise coupling through the case may be damped by injecting 3 ml of silicone cement into the screw hole at the top of the unit, maintaining it inverted until the cement gels.

Any of several pocket FM receivers, including the Sony Walkman™, can be used to monitor vital sounds up to several feet away, and multiple sets may easily "listen in." We have found sound quality and lack of electrocautery interference with this device to be comparable to much more expensive, commercially marketed products.

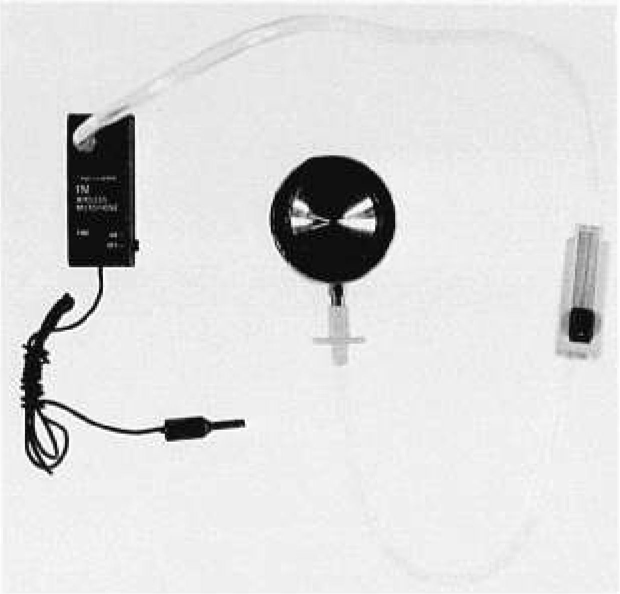

FIG. 1. FM microphone with attached precordial stethoscope.

DAVID REDON, B.S.
Anesthesia Research Coordinator

MICHAEL C. DETRAGLIA, M.D., PH.D.
Fellow in Anesthesiology

Department of Anesthesiology
University of Wisconsin
Madison, WI 53792

(Accepted for publication April 30, 1987.)

Anesthesiology
67:283–284, 1987

Rapid Calculation of Isoflurane Unit Doses for Closed-Circuit Anesthesia

To the Editor:—The recent letter by Frenette *et al.*[1] proposes an elegant simplification for calculation of those parameters in closed-circuit anesthesia which are derived from the exponential $kg^{3/4}$. The mathematical substitution $kg^{3/4} = 0.3 \times kg + 3$ is proposed, which approximates the exponential and eliminates the need for a slide rule computation. Employing this mathematical substitution in the calculation of anesthetic doses by the square root of time model[2] permits rapid and reasonably accurate anesthetic unit doses, as we show below. A unit dose is that quantity of anesthetic which is taken up by the patient in the first minute. The square root of time model predicts that equal amounts of anesthetic are taken up between squares of time; hence, equivalent doses are administered for the time intervals 0–1 min, 1–4 min, 4–9 min, 9–16 min, etc., and these are, by definition, unit doses.

The calculation, by the square root of time method, of the unit dose of isoflurane required to provide a 1% alveolar concentration ($C_A = 1$) is presented here:[2]

$$\text{unit dose (vapor)} = 2 \times C_A \times \lambda_{B/G} \times \text{cardiac output}, \qquad (1)$$

where $C_A = 1\%$; $\lambda_{B/G} = 1.48$; and cardiac output $= 2 \times kg^{3/4}$ (dl/min).

TABLE 1. Unit Doses (ml of Liquid) of Isoflurane Calculated by Three Methods

Weight (kg)	0.0287 $\times$ kg$^{3/4}$	1/100 $\times$ (0.9 $\times$ kg + 9)	1/100 $\times$ (kg + 9)
10	0.16	0.18	0.19
20	0.27	0.27	0.29
30	0.37	0.36	0.39
40	0.46	0.45	0.49
50	0.54	0.54	0.59
60	0.62	0.63	0.69
70	0.70	0.72	0.79
80	0.77	0.81	0.89
90	0.84	0.90	0.99
100	0.91	0.99	1.09

Hence:

$$\text{unit dose (vapor)} = 2 \times 1 \times 1.48 \times 2 \times \text{kg}^{3/4} = 5.92 \times \text{kg}^{3/4} \quad (2)$$

To convert to ml of liquid anesthetic, where 1 ml liquid = 206 ml vapor, the equation becomes:

$$\text{unit dose (ml of liquid)} = 1/206 \times 5.92 \times \text{kg}^{3/4} = 0.0287 \times \text{kg}^{3/4} \quad (3)$$

If the Frenette substitution is employed, then unit dose (ml of liquid) = 0.0287 $\times$ (0.3 $\times$ kg + 3) = 0.0086 $\times$ kg + 0.086; represented more simply as:

$$\text{unit dose (ml of liquid)} = 1/100 \times (0.9 \times \text{kg} + 9) \quad (4)$$

An approximation is given by:

$$\text{unit dose (ml of liquid)} = 1/100 \times (\text{kg} + 9), \quad (5)$$

which is a calculation that can be rapidly and easily performed.

The calculated unit dose, applying equation 5 above, gives a reasonable approximation of the correct unit dose, as determined by the more traditional calculation represented by equation 3, but tends to slightly overestimate the correct unit dose in larger patients. For example, in a 100-kg patient, the true unit dose is overestimated by approximately 0.18 ml. A comparison of the unit doses determined by equations 3, 4, and 5 appears in table 1. We routinely use equation 5 because of the simplicity of the arithmetic, and have been able to measure end tidal anesthetic concentrations corresponding quite closely to the concentrations predicted by equation 5.

Correct application of equation 5 will give a unit dose of isoflurane (in ml of liquid) that, when injected into the circuit, produces an alveolar concentration of 1%. As discussed above, unit doses are injected according to a schedule determined by squared intervals of time. Doses are adjusted up or down according to clinical needs. For example, a 70-kg patient requiring 2% alveolar concentration of isoflurane would receive a double unit dose, or approximately 0.79 × 2 = 1.58 ml of liquid isoflurane. The calculation is rapid, and allows the practice of closed-circuit anesthesia without requiring a slide rule or complex dosage tables.

VICTOR C. LEE, M.D.
Assistant Professor
Department of Anesthesiology
University of Virginia
Charlottesville, Virginia 22908

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(Accepted for publication May 3, 1987.)

Anesthesiology
67:284-286, 1987

Is Isoflurane Dangerous for the Patient with Coronary Artery Disease? Another View. I.

To the Editor:—Anesthesia and surgery are dangerous for patients with coronary artery disease.[1-3] However, careful monitoring and control of the determinants of myocardial oxygen balance can markedly decrease this danger.[4] In my opinion, potent inhaled anesthetics are uniquely suited for this purpose for the following reasons: 1) they can control all the major determinants of myocardial oxygen demand; heart rate, myocardial contractile performance, and ventricular wall stress (arterial blood pressure); 2) dangerous increases in heart rate and blood pressure in the clinical situation are most often related to noxious surgical stimulation, and potent inhaled anesthetics can also block this stimulus at the same time that they treat the hemodynamic conse-