J Anesth (1998) 12:41–42

Journal of
Anesthesia

Short communications

Solubility and preparation of volatile anesthetic solution

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Key words: Volatile anesthetics, Solubility, Concentrations, Preparation

This communication provides the reader with a technical standard for preparation of volatile anesthetic solutions of definite concentration. Volatile anesthetic concentrations reported have varied and their reliability remains questionable. However, the concentrations are essential for analysis of data to elucidate quantitative consequences of anesthetic effects on the concerned system. We investigated the cause of those discrepancies between reports and developed accurate quantification using ^{19}F-nuclear magnetic resonance [1]. This report provides a standard preparation technique and saturated concentration in solution.

Preparation 1. 0.5 ml of distilled water was added to a 5.0-mm o.d. test-tube, and this test-tube was placed in an apparatus [1] (Fig. 1a). High-purity nitrogen was bubbled through the liquid anesthetic and water for 20 min at a rate of 100 ml·min^{-1}. The whole apparatus was kept in a 25.0°C water bath. Nitrogen was saturated with anesthetic and water passing through the outer tube, and saturated solution was prepared in the inner tube. The gas outlet was connected to the outside through a much thicker duct that opened to the atmosphere. Pressure inside was kept to 1 atm. Solution was removed from the inside tube.

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Received for publication on May 21, 1997; accepted on September 1, 1997

Preparation 2. Anesthetic and solution for an experiment was transferred to a serum bottle and sealed with a teflon-layered silicon rubber stopper [2] (Fig. 1b). The bottle was incubated in a temperature-controlled water bath shaker for 3 days. The seal was opened to the atmosphere once every 6 h with a 25-gauge needle. The

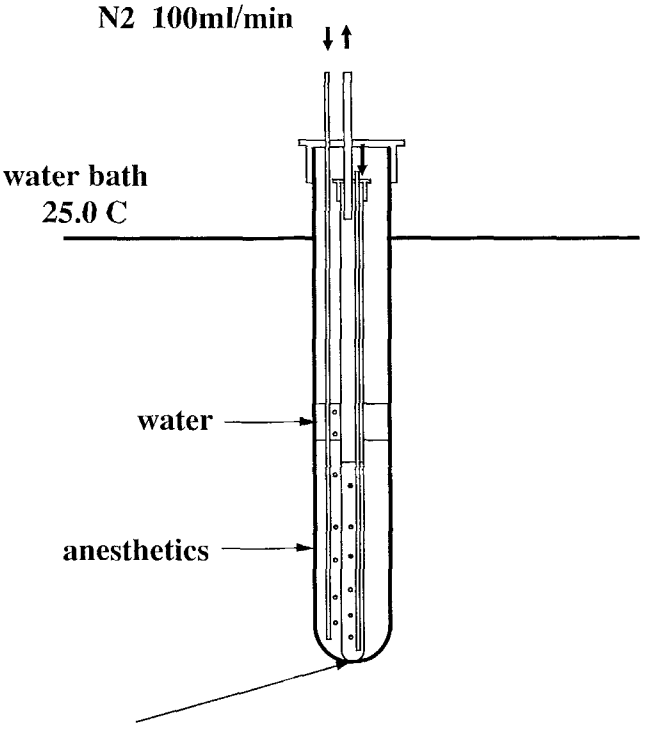
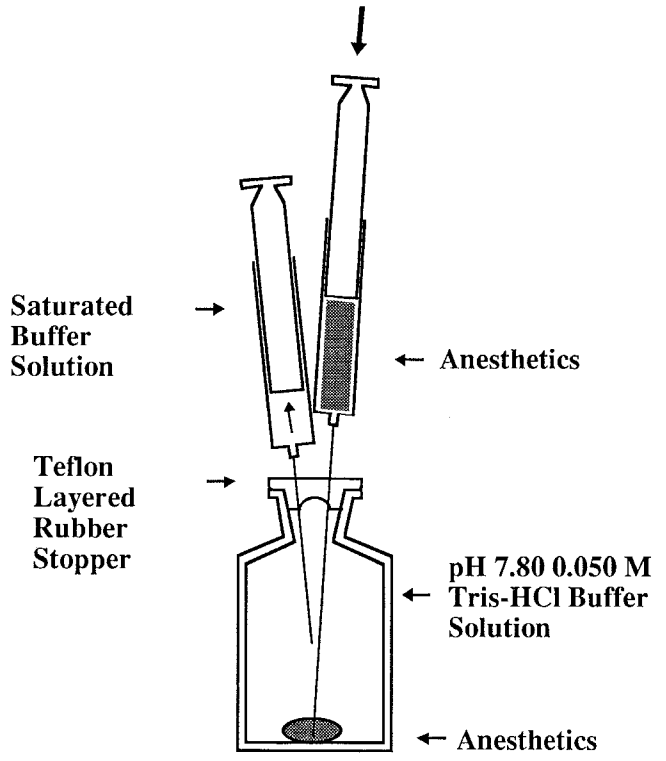


Fig. 1a–c. Preparation of saturated solution of volatile anesthetics. **a** Anesthetic saturated nitrogen gas was bubbled [1]. **b** Liquid volatile anesthetic was incubated with a buffer in closed bottle system [2]. **c** Liquid volatile anesthetic was incubated with a buffer in an open system



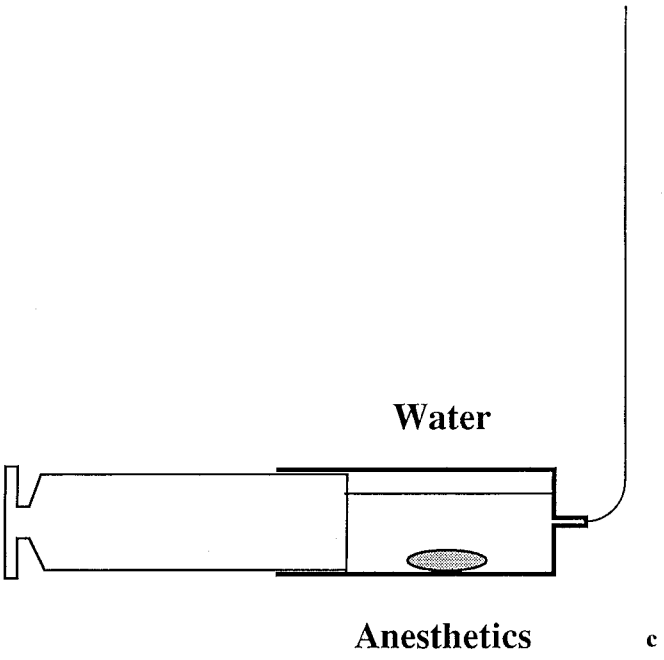


Fig. 1a–c. *Continued*

Table 1. Saturated concentrations of volatile anesthetics in water [mM (SD)], $n = 8$

Temperature (°C)	Halothane	Enflurane	Isoflurane	Methoxyflurane
15.0	18.9 (0.5)	13.9 (0.2)	—	10.1 (0.3)
20.0	19.7 (0.3)[a]	13.3 (0.3)	—	10.5 (0.2)
25.0	19.0 (0.4)	12.5 (0.5)	15.3 (0.4)	10.9 (0.2)
30.0	19.3 (0.5)	12.7 (0.2)	14.3 (0.4)	11.1 (0.1)
37.0	19.2 (0.4)	11.9 (0.3)	14.1 (0.3)	11.2 (0.2)

[a] $n = 4$.

anesthetic and the solution reached saturation in 3 days. The solution was used with dilution.

Preparation 3. Solutions were prepared in a 25-ml gastight syringe (Hamilton, Reno, Nevada, USA) with a 20-cm long 22-gauge needle (Fig. 1c). Two milliliters of anesthetic, 15 ml of distilled water, and 8 ml of air were added to this syringe and incubated for 2 h at 25.0°C in a water bath shaker at the rate of 120 Hz. Pressure inside was always released to atmosphere through a thin needle, and anesthetic and water was saturated under 1 atm. Pushing the piston of the syringe, the solution prepared was transferred to the experimental system without reducing the pressure of the solution. Saturated concentrations of anesthetics in water are shown in Table 1.

References

1. Seto T, Mashimo T, Yoshiya I, Kaneshiro M, Taniguchi Y (1992) The solubility of volatile anesthetics in water at 25.0°C using ^{19}F NMR spectroscopy. J Pharm Biomed Anal 10:1–7
2. Seto T, Makimoto S, Mashimo T, Yoshiya I, Taniguchi Y (1992) Volatile anesthetics-induced activation phenomena of α-chymotrypsin-catalized hydrolysis. Biochim Biophys Acta 1116: 204–209