Accuracy of Gas Standards Used for Mayo Vapor Analyzer Calibration

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Fluroxene (Fluromar), halothane (Fluothane), ether and methoxyflurane (Penthrane) gas standards are commercially available‡ for calibration of the Mayo Vapor Analyzer. This study compared the concentrations on the calibration standard labels with corresponding concentrations determined in our laboratory for those gas standards purchased before January 1, 1973 and for gas standards purchased after January 1, 1973.

METHODS

Measured amounts of liquid fluroxene (500 μl), halothane (250 μl), ether (500 μl) or methoxyflurane (50 μl) were added to four glass flasks with a Hamilton microliter syringe. Each flask was capped with a rubber stopper through which a needle was inserted to permit addition of the liquid anesthetic and facilitate subsequent gas sampling. Mylar plastic covered the rubber surface exposed to the flask interior. Negative pressure was created in the flasks before adding the liquid anesthetic. After two hours the flasks were equilibrated with barometric pressure by opening a three-way stopcock. Thirty minutes later gas samples (2 ml) from the flasks were injected into a gas chromatograph (flame ionization detector, SE–30 on Chromosorb W) via a gas-sampling valve and the resulting anesthetic gas peak height measured. Knowing the internal volume of the flasks (2,090 ml by water displacement) and the gas vapor (ml) resulting from the liquid anesthetic evaporation (P_B 747 torr, room temperature 22 C), we calculated the concentrations represented by the peak heights. Samples of the commercial standards were also injected into the gas chromatograph and the anesthetic gas concentrations calculated by comparing these peak heights with those of the corresponding laboratory

TABLE 1. Gas Standards Purchased before January 1, 1973*

	Laboratory Concentration (Vol Per Cent)	Label Concentration (Vol Per Cent)
Fluroxene		
1	5.6	5.8
2	5.3	5.7
3	5.3	5.6
4	5.7	6.0
5	5.8	6.2
6	5.9	6.2
7	5.3	5.6
8	5.6	6.3
9	5.5	6.4
Ether		
1	6.4	8.0
2	6.4	7.9
3	6.0	7.8
4	6.2	7.8
5	6.9	8.0
6	7.1	8.2
7	7.1	8.4
8	6.2	8.2
9	6.8	8.1
10	6.4	7.7
Halothane		
1	2.6	2.9
2	2.4	2.9
3	2.8	2.9
4	2.8	3.0
5	2.9	3.0
6	3.1	3.3
7	2.6	2.9
8	2.6	3.1
9	2.8	2.9
10	2.8	2.9
Methoxyflurane		
1	0.60	1.2
2	0.59	1.2
3	0.73	1.2
4	0.74	1.0
5	0.75	1.1
6	0.75	1.1
7	0.66	1.1
8	0.70	1.2
9	0.69	1.1
10	0.69	1.1

* The concentrations determined in the laboratory are compared with the corresponding concentrations stated on the gas standard labels. Every label concentration represents a different gas standard.

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TABLE 2. Gas Standards Purchased after January 1, 1973*

	Laboratory Concentration (Vol Per Cent)	Label Concentration (Vol Per Cent)
Halothane		
1	2.9	3.0 ± 0.2
2	2.8	2.8 ± 0.2
Methoxyflurane		
1	0.76	0.8 ± 0.1
2	0.73	0.8 ± 0.1

* The concentrations determined in the laboratory are compared with the corresponding concentrations stated on the gas standard labels. Every label concentration represents a different gas standard.

standards. The calculated concentration was compared with the concentration stated on the calibration standard label.

The commercial and laboratory standards were compared at the same gas chromatograph attenuation to avoid any changes in linearity that might occur with gain changes. A three-point standard curve was prepared for each gas on one occasion and confirmed the linear response of the gas chromatograph at that attenuation.

Gas calibration standards purchased during a 30-month period before January 1, 1973 and those purchased after this time were studied. All were analyzed before the expiration date indicated on the label. The methoxyflurane standards were reanalyzed two to three weeks after the first measurement and found to be unchanged from the original laboratory values.

RESULTS AND CONCLUSION

In all instances the gas standards purchased before January 1, 1973 were found to have anesthetic concentrations lower than those stated on the label (table 1). For example, methoxyflurane standard number 8 (label concentration 1.2 per cent) was found to contain 0.70 per cent. The same standard analyzed by another investigator was reported to contain 0.66 per cent methoxyflurane. The average of all the laboratory methoxyflurane concentrations was 31 per cent less than the average of the concentrations stated on the labels. Average ether concentrations were 17 per cent less, while fluroxene and halothane differed from the label values by about 7 per cent.

Some inherent error in preparation and analysis of our standards could account for the small differences between the calculated and stated concentrations for the fluroxene and halothane standards. However, the larger differences found for methoxyflurane and to a lesser extent for ether emphasize the need to confirm the concentrations stated on gas standard labels.

Ohio Medical Products has informed us that all gas standards prepared and purchased after January 1, 1973 have been reanalyzed. The concentrations on the labels of halothane and methoxyflurane standards purchased by us after this date agreed with the values determined in our laboratory (table 2).

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