

## Current Comment

S. G. HERSHEY, M.D., *Editor*

### Flammability of Fluoroxene

JOSEPH F. PATTERSON, M.D.,\* JOHN G. ADAMS, JR., M.D.,†  
CAROL G. JOHNSON, D.D.S.†

The flammable level of trifluoroethylvinyl ether (fluoroxene, Fluoromar) has been found to be 4.0 per cent in dry oxygen.<sup>1, 2</sup> Published reports differ, however, concerning its flammable level in a circle absorption system utilizing a closed technique.<sup>2, 3</sup> Miller and Dornette,<sup>2</sup> using the bromine uptake method of analysis of fluoroxene samples, found that under these conditions the agent was not flammable until a concentration of 7.5 per cent was reached. This higher level of flammability was thought to be due to the presence of water vapor in the system from the patient's expirations, and from moisture produced by the soda lime when CO<sub>2</sub> was absorbed. These results were not confirmed by Gramling and Volpitto,<sup>3</sup> who, using gas chromatography for analysis and likewise utilizing a closed circle absorption technique, found concentrations of 4.5 per cent and above flammable.

Since concentrations of fluoroxene required for induction and maintenance of anesthesia may involve use of flammable levels of this agent,<sup>2, 4-7</sup> further study to determine levels of its flammability seemed indicated.

#### METHOD

Gas chromatography was used for all fluoroxene determinations. The technique utilized, and that of preparing samples of flu-

roxene of known concentrations, followed closely the one outlined in 1963 by Rutledge *et al.*<sup>8</sup> for the analysis of halothane by gas chromatography.

Samples of fluoroxene in dry nitrous oxide and oxygen were taken from two sources, under laboratory conditions. In one instance a Fluotec Mark 2 vaporizer was employed, with gas flows varying from 1 to 5 liters per minute, and vaporizer settings varying from 0.5 to 4.0; the samples were removed from the expiratory arm of the Fluotec at some distance from the outlet. The other source consisted of a circle system, employing fluoroxene in an in-circle no. 8 Ohio Vaporizer, and a test lung, with flows of nitrous oxide and oxygen from 1 to 4 liters per minute, and at various settings on the vaporizer; samples were removed from the corrugated tubing on the expiratory side of the circle.

Samples were also taken from a circle absorption system in clinical use, employing fluoroxene in an in-circle no. 8 Ohio Vaporizer, in the case of a healthy young female patient undergoing an orthopedic procedure. The gas flow was 1.4 liters per minute (700 ml. N<sub>2</sub>O, 700 ml. O<sub>2</sub>), and specimens for analysis were removed from the corrugated tubing on the inspiratory side of the circle, and from the rebreathing bag on the expiratory side.

Flammability was determined by using a 20 ml. plastic syringe filled with the sample to be tested, removing the plunger, and holding the open end of the syringe over an alcohol lamp flame.<sup>2</sup> The testing was done in a darkened area so that weak flames would not be missed.

\* Department of Anesthesiology, Baltimore City Hospitals, Baltimore.

† Department of Anesthesiology, The Children's Hospital Medical Center, Boston.

The study was performed in the Department of Anesthesiology, The Children's Hospital Medical Center, Boston. This work was presented at the meeting of the Southern Society of Anesthesiologists, Houston, Texas, April, 1965.

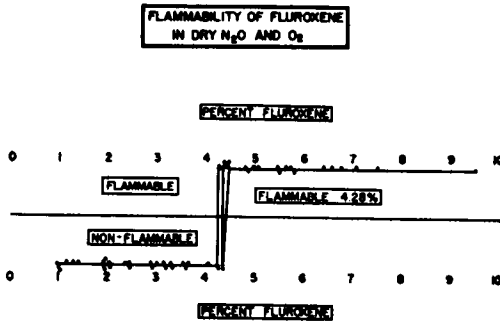


FIG. 1. Each dot represents one fluoxetine sample analyzed for concentration and flammability.

### RESULTS

*Flammability of Fluoxetine in Dry Nitrous Oxide and Oxygen in Clinical Use.* Forty-eight samples were tested (fig. 1), with concentrations of fluoxetine ranging from 0.94 to 9.52 per cent. The lowest level of flammability was found to be 4.28 per cent, and, with one exception, all samples above this were flammable. This one exception was a sample of 4.38 per cent. However, other samples of 4.32 and 4.36 per cent were found to be flammable.

*Flammability of Fluoxetine in Nitrous Oxide and Oxygen from a Circle Absorption System.* Eleven samples were investigated in this study (fig. 2). Concentrations of fluoxetine ranged from 2.27 to 6.13 per cent. Concentrations of 4.26 per cent and below were found to be non-flammable, and concentrations of 4.5 per cent and above were found to be flammable.

### SUMMARY

In this study, employing gas chromatography for analysis, the flammable level of fluoxetine in mixtures of dry nitrous oxide and oxygen was found to be 4.28 per cent, and in mixtures of these gases taken from a circle absorption system in clinical use, and utilizing a low flow, the lower level of flammability was found to be 4.5 per cent. These results would

FLAMMABILITY OF FLUOXENE IN  $N_2O$  AND  $O_2$   
FROM CIRCLE ABSORPTION SYSTEM

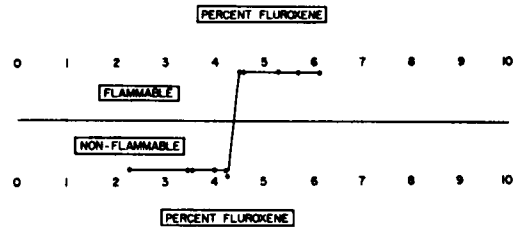


FIG. 2. Each dot represents one fluoxetine sample analyzed for concentration and flammability.

indicate that utilization of fluoxetine in a circle absorption system with low or moderate gas flows does not significantly alter its flammability.

### REFERENCES

1. Lawrence, J. S., and Bastress, E. K.: Combustion characteristics of anesthetics, *ANESTHESIOLOGY* 20: 192, 1959.
2. Miller, G. L., Jr., and Dornette, W. H. L.: Flammability studies of Fluoromar-oxygen mixtures used in anesthesia, *Anesth. Analg.* 40: 232, 1961.
3. Gramling, Z. W., and Volpitto, P. P.: Flammability of Fluoromar in the circle absorption system, *ANESTHESIOLOGY* 24: 194, 1963.
4. Sadove, M. S., Balagot, R. C., and Linde, H. W.: Trifluoroethylvinyl ether (Fluoromar), preliminary clinical and laboratory studies, *ANESTHESIOLOGY* 17: 591, 1956.
5. Dornette, W. H. L., Miller, G. L., Sheffield, W. E., Cavallaro, R. J., and Poe, M. F.: Clinical experiences with trifluoroethylvinyl ether anesthesia, *Anesth. Analg.* 41: 605, 1962.
6. Munson, E. S., Saidman, L. J., and Eger, E. I., II: Fluoxetine uptake in man at constant alveolar and constant inspired concentration, *ANESTHESIOLOGY* 26: 8, 1965.
7. Munson, E. S., Saidman, L. J., and Eger, E. I., II: Effects of nitrous oxide and morphine on the minimum concentration of Fluoxetine, *ANESTHESIOLOGY* 26: 134, 1965.
8. Rutledge, C. O., Seifen, E., Alper, M. H., and Flacke, W.: Analysis of halothane in gas and blood by gas chromatography, *ANESTHESIOLOGY* 24: 862, 1963.