CHANGES IN BLOOD PRESSURE AND PULSE RATE DURING FLUOTHANE ANESTHESIA: A COMPARATIVE CLINICAL STUDY

JACK MOYERS, M.D., CHARLES B. PITTINGER, M.D.

FROM reports [1-5] of clinical experiences with Fluothane anesthesia it is possible to gain the impression that hypotension and bradycardia are predictably more frequent and severe with this agent than with others commonly used. We challenged this impression by making a comparative study of blood pressure and pulse rate in patients anesthetized for surgical procedures requiring abdominal relaxation. Cyclopropane, ether, nitrous oxide and Fluothane were the primary anesthetic agents.

METHOD

For each of the four agents studied, 50 anesthesia records were taken at random from departmental files for the year 1957. Only those records were selected which were made during the course of anesthesia for intraperitoneal surgical procedures and therefore requiring abdominal relaxation. A variety of gynecological, urological and general surgical procedures was represented. Tables 1, 2, and 3 respectively, indicate anesthetist, age of patients, and duration of anesthesia for each of the four agents.

Systolic, diastolic and pulse pressures, and pulse rates obtained immediately prior to induction of anesthesia were recorded and averaged in terms of the anesthetic agent employed. From the anesthetist's graphs of these functions, values obtained at 15-minute intervals throughout anesthesia were similarly recorded and averaged. Numerical values of systolic, diastolic and pulse pressures, and pulse rates in the preanesthetic and anesthetic periods were thereby available for comparison and interpretation.

TABLE 1

DISTRIBUTION OF PATIENTS ACCORDING TO ANESTHETIST

	Staff	Resident	Other*
Cyclopropane	3	46	1
Ether	0	42	8
Fluothane	2	47	1
Nitrous oxide	1	43	6
	6	178	16

* Refers to interns or medical students.

Accepted for publication April 24, 1959. The authors are in the Division of Anesthesiology, Department of Surgery, College of Medicine, State University of Iowa, Iowa City, Iowa.

TABLE 2

AGE OF PATIENTS

	Range (years)	Average (years)
Cyclopropane	14–81	61
Ether	2–78	50
Fluothane	9–82	52
Nitrous oxide	17–83	51

TABLE 3

DURATION OF ANESTHESIA

	Range (minutes)	Average (minutes)
Cyclopropane	30–360	141
Ether	60–390	176
Fluothane	60–300	134
Nitrous oxide	75–270	152

The lowest systolic blood pressure recorded by the anesthetist during anesthesia was determined from each of the records. These 200 determinations were categorized according to the anesthetic agent used, thus giving 4 groups of 50 each. For each group the lowest value was identified and the average calculated.

Premedication consisted of atropine or scopolamine alone, or in combination with barbiturates and opiates. Generally heavier premedication was used in the patients receiving nitrous oxide. Larger doses of atropine were not employed in the patients given Fluothane; in fact, in several instances no premedication was given.

Intravenous barbiturates, opiates and relaxants were used as supplements in patients inhaling nitrous oxide. In the cyclopropane

group relaxants were used commonly; intravenous induction agents were employed occasionally. Barbiturates and relaxants were not used as induction agents or supplements in the group given ether and Fluothane. Standard vaporizors on Foregger, Heidbrink and Boyle gas machines were utilized for ether and Fluothane administration.

Results

Tables 4, 5, 6, 7 and 8 represent determinations and comparisons. In each table *preanesthetic* refers to values obtained immediately prior to induction; *anesthetic* refers to the averages previously described.

TABLE 4

Average Systolic Pressures (mm. of Mercury)

	Pre-anesthetic	Anesthetic	Difference
Cyclopropane	137.1	135.7	− 1.4
Ether	137.3	124.6	−12.7*
Fluothane	137.5	121.4	−16.1*
Nitrous oxide	129.3	131.5	+ 2.2

* Significant to .05.

TABLE 5

Average Diastolic Pressures (mm. of Mercury)

	Pre-anesthetic	Anesthetic	Difference
Cyclopropane	80.1	82.6	+2.5
Ether	80.2	77.5	−2.7
Fluothane	81.6	77.3	−4.3*
Nitrous oxide	76.3	83.6	+7.3*

* Significant to .05.

TABLE 6

Average Pulse Pressures (mm. of Mercury)

	Pre-anesthetic	Anesthetic	Difference
Cyclopropane	57.0	53.1	− 3.9
Ether	57.1	47.1	−10.0*
Fluothane	55.9	44.1	−11.8*
Nitrous oxide	52.6	47.9	− 4.7

* Significant to .05.

TABLE 7

Lowest Systolic Pressure (mm. of Mercury) According to Agent

	Lowest	Average*
Cyclopropane	60	110.1
Ether	55	99.6
Fluothane	60	101.3
Nitrous oxide	60	104.7

* Each value represents the average of the lowest systolic pressure for each of 50 patients.

TABLE 8

Average Pulse Rates

	Pre-anesthetic	Anesthetic	Difference
Cyclopropane	82.1	76.7	−5.4*
Ether	85.0	84.9	−0.1
Fluothane	83.2	82.1	−1.1
Nitrous oxide	80.6	79.8	−0.8

* Significant to .05.

From table 4 it may be seen that there was significant hypotension when ether and Fluothane were used. However, the difference between these two agents was not significant. The lower initial systolic pressure in the nitrous oxide group is significant and we interpret this to be a result of heavier premedication.

It is interesting to note the changes in diastolic pressures (table 5) in relation to pulse pressure changes (table 6). The elevation of diastolic pressure in the nitrous oxide group did not produce a significant reduction in pulse pressure; nor did lowering of diastolic pressure in the Fluothane group prevent a reduction in pulse pressure. Moreover, the reduction in pulse pressure in the ether group resulted from systolic changes. There were no significant blood pressure changes associated with the use of cyclopropane.

Table 7 represents for each agent the lowest systolic pressure attained and the average of the lowest pressures for 50 patients. The low pressures may have resulted from deep anesthesia, blood loss, positional changes, or other circumstance causing hypotension. However, it is apparent that Fluothane did not provoke or allow any momentary hypotensive episode not seen when other agents were employed.

As seen in table 8, the only significant change in pulse rate was bradycardia with cyclopropane. We were unable to confirm the impression that bradycardia is the rule with Fluothane anesthesia during surgery.

Discussion

The original pharmacologic study by Raventós indicated that Fluothane is a potential cardiovascular depressant.[6] The purpose of our study was to determine the relative extent to which this potential depression is realized in clinical practice. Our results indicate that during Fluothane anesthesia one may expect a degree of hypotension that is moderate and not significantly greater than that occurring during ether anesthesia. We also observed that episodes of severe hypotension are not a distinctive feature of anesthesia with Fluothane when comparison is made with ether, cyclopropane and nitrous oxide. In this comparison, the effect of relative inexperience with Fluothane was probably balanced by the increased vigilance that accompanies the administration of an unfamiliar agent.

Summary

Patients of varying ages were anesthetized for abdominal surgical procedures lasting from one-half to six and one-half hours. Anesthetists were usually residents in training who did not employ specific Fluothane vaporizors. The average systolic pressure during Fluothane anesthesia was 11.7 per cent lower than the average preanesthetic value. This degree of hypotension was not significantly greater than that observed during ether anesthesia. Furthermore, extreme hypotension, however brief, was no more common nor severe with Fluothane than with cyclopropane, ether, or nitrous oxide. Bradycardia need not be identified with Fluothane anesthesia during surgery.

REFERENCES

1. Johnstone, M.: Human cardiovascular response to Fluothane anesthesia, Brit. J. Anaesth. **28**: 392, 1956.
2. Brennan, H. J., Hunter, A. R., and Johnstone, M.: Halothane, clinical assessment, Lancet **2**: 453, 1957.
3. Stephen, C. R., Grosskreutz, D. C., Lawrence, J. H. A., Fabian, L. W., Bourgeois-Gavardin, M., and Coughlin, J.: Evaluation of Fluothane for clinical anesthesia, Canad. Anaesth. Soc. J. **4**: 246, 1957.
4. Chang, J., Macartney, H. H., and Graves, H. B.: Clinical experience with Fluothane, new nonexplosive anaesthetic agent, Canad. Anaesth. Soc. J. **4**: 187, 1957.
5. Brindle, G. F., Gilbert, R. G. B., and Millar, R. A.: Use of Fluothane in anesthesia for neurosurgery: preliminary report, Canad. Anaesth. Soc. J. **4**: 265, 1957.
6. Raventós, J.: Action of Fluothane—new volatile anesthetic, Brit. J. Pharmacol. **11**: 394, 1956.