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Recovery, Psychomotor Skills, and Simulated Driving after Brief Inhalational Anesthesia with Halothane or Enflurane Combined with Nitrous Oxide and Oxygen

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Recovery from anesthesia was assessed in a controlled manner in 34 healthy student volunteers, using a psychomotor test battery 1 and 5 hours and a driving simulator 2, 4.5, and 7 hours after 3.5 minutes of anesthesia with halothane or enflurane combined with nitrous oxide and oxygen. Psychomotor performances remained significantly ($P < 0.05$ to $P < 0.001$) worse than in an unanesthetized control group for 5 hours after both halothane and enflurane. However, impairment of driving skills 4.5 hours after anesthesia was measurable only after halothane ($P < 0.05$). It is concluded that after even brief periods of halothane or enflurane anesthesia patients should not drive or operate machinery for at least 7 hours. The magnitudes and durations of the residual effects of both agents on psychomotor performance were, however, less than those previously found after thiopental, methohexital, or diazepam. (Key words: Anesthetics, volatile, halothane; Anesthetics, volatile, enflurane; Anesthesia, outpatient; Psychomotor function, driving skills.)

OUTPATIENT GENERAL ANESTHESIA is currently undergoing extensive scrutiny in an attempt to increase efficiency and decrease costs.[1,2]

In a survey of 100 patients receiving outpatient anesthesia,[3] it was discovered that, despite clear instructions to the contrary, 31 patients went home unescorted by a responsible person, four patients drove themselves home, and 30 drove within 24 hours. Consequently, knowledge of the durations of the residual effects of anesthetic agents on human psychomotor and driving skills is essential.

There are a few reports describing times of recovery and psychophysiologic function after brief halothane anesthesia,[4–7] but we did not find any report of measurements of psychomotor performance such as driving ability after halothane anesthesia. However, brief halothane anesthesia is suggested as a method of choice for outpatient general anesthesia.[8]

The present study was conducted to examine clinical recovery and psychomotor and driving skills after short-duration anesthesia with halothane or enflurane in combination with nitrous oxide and oxygen.

Material and Methods

SUBJECTS AND TRIAL DESIGN

Thirty-four student volunteers from the city of Helsinki participated in the study. All were in good health, and none had been taking medication for at least a month prior to the experiment. Most subjects used alcohol, but only occasionally. Each subject held a valid driver's license and maintained good driving ability by driving a car often. Informed consent for the procedure was obtained from each subject.

The subjects were randomly allocated into three groups, two women in each. One group of 11 subjects (means ± SD: age 23 ± 3.2 years, weight 67 ± 6.4 kg, height 176 ± 11 cm) received halothane–nitrous oxide–oxygen anesthesia. The second group of 11 subjects (characteristics: 23 ± 2.5 years, 66 + 7.5 kg, 173 ± 5 cm) were anesthetized with enflurane–nitrous oxide–oxygen. A third group of 12 subjects (24 ± 2.3 years, 75 ± 8.2 kg, 181 ± 5 cm) served as a control group and received no anesthesia.

The same person introduced the driving simulator to all the subjects in the same way. After the introduction, subjects made one practice run of approximately 10 minutes, after which the actual test was driven and the preanesthesia results were recorded. After the driving test the perceptual and psychomotor tests were similarly introduced and the preanesthesia results recorded.

Anesthesia was administered the next morning, and the subjects were tested in a double-blind manner 2, 4.5, and 7 hours and 1 and 5 hours afterwards with the driving simulator and the psychomotor test battery, respectively. The unanesthetized control subjects were tested similarly in a single-blind manner. Subjects abstained from eating, drinking, and smoking for 8 hours before and for 2.5 hours after anesthesia. Control subjects spent their spare time with the other subjects and were

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tested in the same manner as the anesthetized subjects, but they did not receive any medication.

Anesthesia and Immediate Recovery

Atropine sulfate, 0.5 mg (Atropin, Orion, Helsinki) was given intravenously 5 minutes before administration of the anesthetics.

Halothane (Fluothane, ICI, Chesire) and enflurane (Ethrane, Abbott, Chicago) were administered in 2 l of oxygen and 4 l of nitrous oxide per minute by means of vaporizer (Fluotec or Ethranetec) in a semiclosed system, the subjects breathing spontaneously. Both vaporizers were calibrated shortly before the trial spectrofluorometrically with a refractometer tube (Karl Zeiss). Induction was started with 0.5 per cent halothane or enflurane in the mixture of nitrous oxide and oxygen, after which the concentration of halothane was increased by 0.5 per cent every eight breaths to 1.5 per cent, the concentration of enflurane being increased by 0.5 per cent every fourth breath to 3.0 per cent. When the subjects no longer reacted to lower-abdominal pinching, repeated at approximately 15-sec intervals after termination of the excitation phase, the concentrations of halothane and enflurane were lowered to 0.75 and 1.5 per cent in the same mixture of nitrous oxide and oxygen. Thereafter these concentrations were maintained for 3.5 minutes. The lungs were then flushed twice with oxygen, also given in the same semiclosed system, until the subjects opened their eyes.

Duration of analgesia was recorded as the time during which the subject did not react to abdominal pinching. Immediate recovery was assessed by recording the time (counted from the time when the subjects again reacted to pinching) until the subject opened his eyes after repeated commands, as well as the time until he could sit or stand steadily with hands held forward and eyes closed. Amnesia was evaluated 1 hour after the anesthesia on the basis of the subject's ability to recall events during the recovery period.[9]

Side-effects were recorded and the subjects were asked how quickly their driving ability normalized after anesthesia.[9] After the experiment they were also asked whether the anesthesia had been pleasant or not.

Psychomotor Skills

Perceptual Speed

The Bourdon-Wiersma test of perceptual speed was used according to a modification by Hänninen.[10,11] The number of lines completed in 8 minutes and the number of errors when drawing lines through groups of four dots on a paper were recorded. The time variation in completing a row was also assessed.

TABLE 1. Durations of Anesthesia with Halothane–N_2O–O_2 or Enflurane–N_2O–O_2 and Times to Immediate Clinical Recovery of 11 Subjects (Means ± SD)

	Halothane (Min)	Enflurane (Min)
Duration of analgesia	5.8 ± 0.7	5.7 ± 0.7
Eyes open*	1.3 ± 0.9	2.3 ± 1.1†
Sitting steadily*	2.3 ± 0.8	3.4 ± 1.1†
Standing steadily*	4.0 ± 0.9	4.7 ± 1.3
Amnesia*	2.2 ± 0.7	2.8 ± 0.9

† $P < 0.025$ *vs.* halothane.
* Counted from the time when the subject reacted to pinching during emergence from anesthesia.

Santa Ana Dexterity Test

Hand coordination was measured with a peg board.[10] The test results were recorded as the number of pegs turned in 30 seconds, repeated twice with the right, twice with the left, and once with both hands at the same time.

Tapping Speed

Holding a stopwatch-like counter in one hand, the subjects were asked to tap with one finger as many times as possible in 10 seconds. The mean number of taps for four 10-second periods was calculated for both the right and the left hand.

Reaction Skills

Reaction skills were measured with two choice-reaction tests. First the subjects had to react to 25 consecutive light stimuli from two different lights (program I). Then they had to react to 25 stimuli from two different lights or two sounds (program II). In both programs there was a special light to which the subjects were told not to react. With both techniques reaction times were recorded as the cumulative totals, and the inaccuracy of responses was recorded as the incorrect responses.

Simulated Driving

Driving skills were measured with a driving simulator, Sim-L-car.[12] The main features recorded during an average of 35 minutes of driving in densely populated and rural areas were brake reaction times in simulated accident situations and performance errors (neglected instructions, driving off the road, and collisions). We have previously described the apparatus and the testing procedure in detail.[9,12]

Concentrations of Anesthetics in Blood and End-tidal Air

Concentrations of the anesthetic gases were measured in both blood and end-tidal air (corresponding alveolar air). Blood samples were drawn into heparinized glass tubes from a cubital vein after the

TABLE 2. Results of Bourdon-Wiersma Test: Means ± SD of Preanesthesia Values and Changes ± SD 1 and 5 Hours after Anesthesia

	Halothane Group (n = 11)	Enflurane Group (n = 11)	Control Group (n = 11)
Number of lines completed			
Before anesthesia	39.0 ± 5.3	41.9 ± 5.5	40.8 ± 4.7
1 h after anesthesia	+0.7 ± 1.9	+0.6 ± 2.0	+2.9 ± 3.9
5 h after anesthesia	+2.5 ± 1.4	+1.7 ± 3.1	+3.7 ± 2.8
Number of errors			
Before anesthesia	21.7 ± 15.3	29.7 ± 20.1	24.0 ± 18.0
1 h after anesthesia	−12.0 ± 10	−16.0 ± 14	−12.0 ± 9
5 h after anesthesia	−9.0 ± 9	−13.0 ± 15	−17.0 ± 13
Time variation in completing a row			
Before anesthesia	52.2 ± 14.2	41.0 ± 8.4	41.1 ± 15.4
1 h after anesthesia	−3.8 ± 15	−1.5 ± 9	−9.0 ± 10
5 h after anesthesia	−6.6 ± 11	+5.0 ± 11*	−6.0 ± 10

* $P < 0.05$ *vs.* halothane or control, by t test.
Two-way analysis of variance: number of lines, halothane or enflurane *vs.* control, $P < 0.05$; time variation, enflurane *vs.* control, $P < 0.01$.

TABLE 3. Tapping Speeds: Means ± SD of Preanesthesia Values and Changes ± SD 1 and 5 Hours after Anesthesia

	Halothane Group (n = 11)	Enflurane Group (n = 11)	Control Group (n = 12)
Number of taps with right (dominant) hand			
Before anesthesia	53.5 ± 4.0	53.9 ± 6.5	54.7 ± 6.5
1 h after anesthesia	−3.7 ± 2.4*	−3.4 ± 3.7*	−0.6 ± 2.4
5 h after anesthesia	+0.6 ± 3.3	+0.6 ± 3.8	+1.5 ± 3.5
Number of taps with left (nondominant) hand			
Before anesthesia	50.6 ± 1.8	49.6 ± 6.4	51.3 ± 4.3
1 h after anesthesia	−3.2 ± 2.6*	−2.4 ± 2.4*	+0.2 ± 1.8
5 h after anesthesia	0.0 ± 2.4	+1.0 ± 2.2	+1.8 ± 2.5

* $P < 0.01$ *vs.* control, by t test.
Two-way analysis of variance: right hand, halothane *vs.* control, $P < 0.05$; left hand, halothane *vs.* control, $P < 0.001$, enflurane *vs.* control $P < 0.05$.

TABLE 4. Results of Santa Ana Dexterity Test: Means ± SD of Preanesthesia Values and Changes ± SD 1 and 5 Hours after Anesthesia

	Halothane Group (n = 11)	Enflurane Group (n = 11)	Control Group (n = 12)
Right (dominant) hand performance			
Before anesthesia	50.7 ± 4.9	48.1 ± 2.8	53.2 ± 3.5
1 h after anesthesia	−1.1 ± 5.5*	−1.1 ± 4.1*	+3.8 ± 2.7
5 h after anesthesia	+1.4 ± 3.7†	+2.4 ± 4.9	+5.0 ± 2.1
Left (nondominant) hand performance			
Before anesthesia	45.9 ± 3.0	45.9 ± 4.2	48.8 ± 3.8
1 h after anesthesia	+0.3 ± 2.6†	−2.7 ± 5.1‡	+4.6 ± 3.7
5 h after anesthesia	+2.7 ± 4.3	+0.1 ± 2.9†	+5.9 ± 3.6
Both hands simultaneously			
Before anesthesia	32.3 ± 4.8	30.9 ± 4.7	35.1 ± 3.8
1 h after anesthesia	+0.7 ± 4.7	+0.2 ± 4.1*	+4.3 ± 5.0
5 h after anesthesia	+2.1 ± 3.8*	+2.5 ± 2.6*	+6.6 ± 4.3

* $P < 0.05$ *vs.* control, by t test.
† $P < 0.01$ *vs.* control, by t test.
‡ $P < 0.001$ *vs.* control, by t test.
Two-way analysis of variance: right hand, halothane *vs.* control, $P < 0.001$, enflurane *vs.* control, $P < 0.05$; left hand, halothane *vs.* enflurane, $P < 0.05$, halothane or enflurane *vs.* control, $P < 0.001$; both hands, halothane or enflurane *vs.* control, $P < 0.01$.

first driving period. End-tidal air samples were blown into plastic laminated bags after each driving period, *i.e.*, approximately 2, 4.5, and 7 hours after the anesthesia. Concentrations of halothane, enflurane and nitrous oxide were assayed gas-chromatographically within at least 24 hours according to the method of Pfäffli and others.[13]

Statistics

The Fisher exact-probability test[14] was used to compare the side-effects, subjective assessments, and the incidences of performance errors during the simulated driving because of the nonparametric nature of these data. Other results were treated with Student's t test and the two-way analysis of variance, including the checking of additivity and within-cell variances.

Results

In general, the anesthetized subjects' psychomotor performances were significantly worse than the performances of the control subjects, but no difference between effects of halothane and enflurane was observed.

Anesthesia and Immediate Recovery

Durations of analgesia were similar with halothane and enflurane. With both anesthetics it took approximately 5 minutes after the start of induction until the subjects no longer reacted to abdominal pinching and 2 to 3 minutes after the anesthetics were discontinued until subjects again showed withdrawal reactions to pinching.

Awakening and immediate recovery were faster after halothane than after enflurane, but durations of amnesia and times needed until the subjects could stand steadily were similar after the two anesthetics (table 1).

Excitation during induction was observed six times with halothane and seven times with enflurane.

Subjective Assessments of Recovery

Two hours after anesthesia most of the subjects considered their driving ability impaired and felt dizzy, but at 4.5 hours only two of 11 subjects anesthetized with either halothane or enflurane still considered their driving ability imparied. Enflurane anesthesia was considered pleasant significantly

TABLE 5. Cumulative Reaction Times and Errors in Two Choice-Reaction Tests: Means ± SD of Preanesthesia Values and Changes ± SD 1 and 5 Hours after Anesthesia

	Halothane Group (n = 11)	Enflurane Group (n = 11)	Control Group (n = 12)
Program I			
Reaction time			
Before anesthesia	7.39 ± 1.0	7.65 ± 1.3	7.88 ± 1.0
1 h after anesthesia	+0.15 ± 0.4†	+0.26 ± 0.9*	−0.49 ± 0.5
5 h after anesthesia	−0.19 ± 0.4	−0.21 ± 0.0	−0.39 ± 0.6
Errors			
Before anesthesia	0.3 ± 0.5	0.6 ± 0.7	0.7 ± 0.6
1 h after anesthesia	−0.1 ± 0.3	+0.3 ± 1.4	−0.5 ± 0.7
5 h after anesthesia	0.0 ± 0.4	−0.1 ± 0.7	−0.5 ± 0.8
Program II			
Reaction time			
Before anesthesia	12.3 ± 1.7	12.3 ± 2.0	15.6 ± 3.3
1 h after anesthesia	+0.05 ± 1.3†	+1.31 ± 1.9‡	−2.90 ± 2.8
5 h after anesthesia	−0.42 ± 1.3*	−0.69 ± 1.7*	−3.17 ± 3.6
Errors			
Before anesthesia	0.9 ± 0.8	0.9 ± 1.0	2.1 ± 1.5
1 h after anesthesia	+0.5 ± 1.3†	+0.3 ± 1.3†	−1.3 ± 1.2
5 h after anesthesia	+1.1 ± 1.7‡	+0.5 ± 1.9†	−1.5 ± 1.5

* $P < 0.05$ *vs.* control, by t test.
† $P < 0.01$ *vs.* control, by t test.
‡ $P < 0.001$ *vs.* control, by t test.
Two-way analysis of variance:
Program I:
Reaction time
Halothane *vs.* control, $P < 0.001$
Enflurane *vs.* control, $P < 0.05$
Errors
Halothane *vs.* control $P < 0.05$
Program II:
Both reaction times and errors, halothane or enflurane *vs.* control, $P < 0.001$

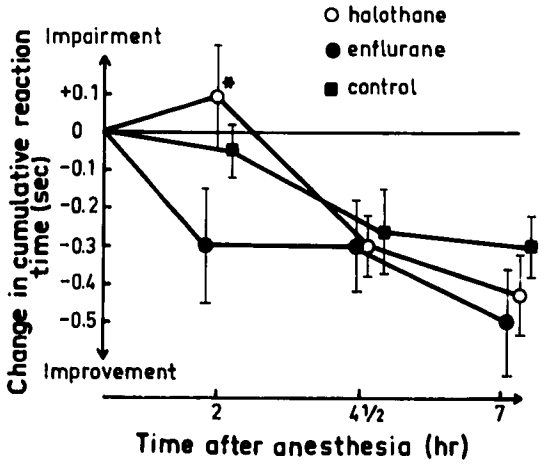

FIG. 1. Changes in the cumulative brake reaction times in three emergency situations during 30 minutes of simulated driving after 2, 4.5, and 7 hours in unanesthetized control subjects and in subjects after brief anesthesia with halothane–N_2O–O_2 and enflurane–N_2O–O_2. Means ± SE for 11 to 12 subjects. t test: *$P < 0.05$ *vs.* enflurane.

($P < 0.05$) more often (eight subjects) than was halothane (three subjects).

PSYCHOMOTOR SKILLS

Perceptual Speed

Subjects' performances on the Bourdon-Wiersma test improved in all three groups when the test was repeated (table 2). During the period of observation the number of lines completed increased significantly ($P < 0.05$) less in the anesthetized groups than in the control group. The time variation in completing a row was greater 5 hours after than before enflurane anesthesia ($P < 0.05$ *vs.* halothane or control), and during the whole observation period after enflurane anesthesia the change in time variation differed significantly ($P < 0.01$) from the decreased variation observed in the control group.

Tapping Speed

Both halothane and enflurane anesthesia impaired tapping speed in comparison with the control group (table 3).

Santa Ana Dexterity Test

Each modality assessed in the Santa Ana test improved significantly ($P < 0.05$ to $P < 0.001$) less in the anesthetized subjects after the anesthesia than in the control subjects when the pre- and postanesthetic values were compared (table 4).

Reaction Skills

Residual effects of the anesthetics were seen more clearly in the choice-reaction test when two light and two sound stimuli with a disturbance stimulus (program II) were used (table 5). With this program both halothane and enflurane significantly ($P < 0.001$) increased the cumulative reaction times and the number of errors compared with the improved performance of the control group. The slight improvement in reaction times 5 hours after halothane or enflurane (program II) was significantly ($P < 0.05$) less than the distinct improvement in the control group. The increase in the number of errors 5 hours after halothane or enflurane was significant ($P < 0.001$ and $P < 0.01$, respectively) compared with the decrease in the number of errors in the control group.

SIMULATED DRIVING

As calculated for the whole observation period, there was no significant difference between cumulative brake reaction times of anesthetized and control subjects (fig. 1). However, the increases in reaction times 2 hours after halothane differed significantly ($P < 0.05$) from the improvement in reaction times noticed 2 hours after the administration of enflurane.

Four and a half hours after anesthesia, subjects anesthetized with enflurane did not make significantly more performance errors than did the control subjects, but subjects who received halothane made significantly ($P < 0.05$) more errors than the control subjects (table 6).

All groups, including the control group, drove significantly faster upon repeated testing, but other variables measured during simulated driving did not change significantly compared with the control group.

TABLE 6. Numbers of Subjects Making Performance Errors* (Collisions, Neglected Instructions, Driving Off the Road) on the Driving Simulator

Time of Drive after Anesthesia	Halothane Group (n = 11)	Enflurane Group (n = 11)	Control Group (n = 12)
2 h	2	4	4
4.5 h	5†	2	0
7 h	2	2	0

* Only one subject made two errors.
† $P < 0.05$ *vs.* control, Fisher exact-probability test.

TABLE 7. Blood Levels of Halothane, Enflurane, and Nitrous Oxide Two Hours after Anesthesia, 11 Subjects (Means ± SD)

	Concentration in Blood (μg/100 ml)		
	Halothane	Enflurane	N_2O
Halothane–N_2O–O_2	228 ± 43	—	370 ± 68
Enflurane–N_2O–O_2	—	464 ± 66*	398 ± 66

* $P < 0.005$ in comparison with halothane.

Concentrations of Anesthetics in Blood and End-tidal Air

The concentration (means ± SD) of enflurane in venous blood (464 ± 66 μg/100 ml) was twice as high as the concentration of halothane (228 ± 43 μg/100 ml) 2 hours after anesthesia (table 7). Concentrations of nitrous oxide in blood 2 hours after halothane and enflurane were similar (370 ± 68 and 398 ± 66 μg/100 ml). Figure 2 shows that the concentrations of both gases declined with time, but were still measurable 7 hours later. At each sampling period the concentrations of halothane in end-tidal air were significantly ($P < 0.05$ to $P < 0.01$) less than those of enflurane, but the concentrations of nitrous oxide were the same regardless of whether halothane or enflurane had been used (fig. 2).

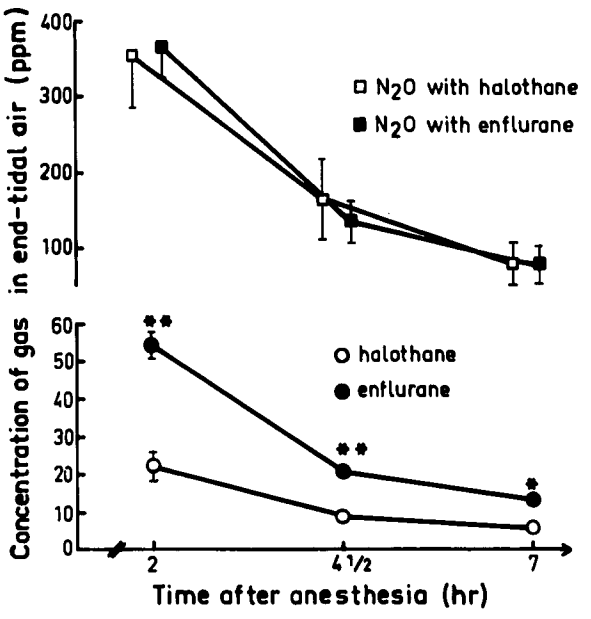

FIG. 2. Concentrations of halothane, enflurane, and nitrous oxide in expired end-tidal air of 11 subjects (means ± SE) 2, 4.5, and 7 hours after brief anesthesia with halothane–N_2O–O_2 and enflurane–N_2O–O_2. * = $P < 0.005$, ** = $P < 0.001$ in comparison with halothane.

Discussion

We decided to investigate the effects of brief halothane and enflurane anesthesia on psychomotor and driving skills because both agents have been suggested for outpatient general anesthesia.[8,15,16]

Experimental Design and Tests

Since it was not desirable to repeat the anesthesia, the study was not done in a cross-over fashion. However, the criteria applied for choosing subjects were adequate to provide a homogeneous subject material for this type of study.[17] A control group was included to determine the possible effect of training on test performance. Because of the effect of training in some of the tests, the worse performance of the anesthetized subjects, in comparison with the control subjects, 5 hours after anesthesia could be due in part to the detrimental effects of the anesthetics on the ability to cope with the tests 1 hour after anesthesia.

The small dose (0.4 to 0.5 mg) of atropine used as premedication is unlikely to affect human psychomotor performance an hour or more later.[9,18] The contribution of nitrous oxide to the residual effects observed after anesthesia in this study should have been minimal, since administration of nitrous oxide and oxygen alone has resulted in rapid recovery and negligible residual effects.[4,19,20]

Our decision to use a concentration of enflurane (3.0 to 1.5 per cent) twice that of halothane (1.5 to 0.75 per cent) was based on data found in the literature.[21,22] These data indicate that the minimal alveolar concentration of enflurane is twice that of halothane.

Halothane and enflurane were comparable as regards side effects, induction times, and durations of analgesia.

The tests used have been discussed previously.[10,12] Most of them have been shown to be sensitive measures of psychomotor performance or driving skills. Hänninen's modification of the Bourdon-Wiersma test has proven to be a sensitive measure of perceptual speed in evaluation of carbon disulfide poisoning[10] and in evaluation of the effects of anesthetic gases on psychomotor performance of operating room personnel.[23] A choice-reaction test similar to the one used in this study was a sensitive measure of the effects of anesthetics or adjuvants on reaction skills[24,25,26] and performance in it has been shown to correlate with real traffic behavior.[17] The driving simulator used is a sensitive indicator of the effects of intravenously administered anesthetics[9] or drugs and alcohol on driving skills.[12,17]

Effects of Halothane

Hannington-Kiff[5] reported that the time required after brief halothane–nitrous oxide–oxygen anesthesia until ocular imbalance as measured by the Maddox-Wing method returned to preanesthetic control values (4.5 min) was distinctly shorter than corresponding times after propanidid or methohexital. Kreusher and Frey,[4] after reviewing the relevant medical literature, warned that patients should refrain from driving for at least 3 hours after brief halothane–nitrous oxide–oxygen anesthesia. Furthermore, Bruce and others[28] showed significant decreases in the performances of healthy volunteers on tests of perception, cognition, and motor skills after 4 hours of exposure to trace concentrations of halothane and nitrous oxide.

In this study clinical recovery was rapid at first, but hand coordination on the Santa Ana test, reaction times on the choice-reaction test, and performances during simulated driving remained significantly modified for 5 hours after brief halothane anesthesia compared with the respective performances of control subjects. These results suggest that patients should refrain from driving for at least 7 hours after short-duration halothane–nitrous oxide–oxygen anesthesia.

Effects of Enflurane

Doenicke and Kugler[29] maintained anesthesia with 1.5 per cent enflurane or 1.0 per cent halothane for 20 minutes after etomidate induction and noticed that electroencephalographic sleep patterns disappeared 36 min and 41 min after the beginning of anesthesia with enflurane and halothane, respectively. Bruce and Bach[30] found psychomotor performance to be adversely affected in healthy volunteers by exposure to trace concentrations of enflurane, as well as by similar exposure to halothane.[28]

In the present study the residual effects of brief enflurane anesthesia were approximately the same as those observed after halothane anesthesia. This agrees with the reports of Bruce and others.[28,30] Some modalities in our tests of perception, coordination, and reaction were still adversely affected 5 hours after anesthesia. The impairment in psychomotor skills after enflurane anesthesia in comparison with the control group was, however, less than that found after halothane anesthesia, and driving skills were less impaired by enflurane than by halothane.

The rapid induction of and clinical recovery from enflurane agree with the report of Dobkin *et al.*[31] Helrich[32] reported that induction and awakening times were similar when halothane and enflurane were given without nitrous oxide for 4 minutes to healthy volunteers. In the present study, when halothane and enflurane were administered with nitrous oxide and oxygen, awakening and immediate recovery were slower after enflurane than after halothane. This could be due to a deeper level of anesthesia presumably reached during the 3.5-minute maintenance period with enflurane as compared with halothane, which is in accordance with the greater decrease in systolic blood pressure at the end of maintenance period with enflurane than with halothane.

The observation that enflurane anesthesia was considered significantly more pleasant than halothane anesthesia agrees with the report of Lebowitz and others.[33] They noticed that patient acceptance was exceptionally high after enflurane anesthesia.

Concentrations of Anesthetics in Blood and End-tidal Air

In the present study we administered enflurane in twice the concentration of halothane and, not surprisingly, twice as much enflurane as halothane was found in the blood 2 hours after anesthesia and in end-tidal air throughout the entire period of observation. This finding indicates that residual amounts of the two agents apparently disappear at approximately equal rates from man, as also found by Torri *et al.*[34] during the first 60 minutes of elimination.

Conclusions

The magnitude and duration of impairment of psychomotor performance after halothane or enflurane anesthesia are greater than after propanidid but less than after drugs such as thiopental, methohexital, or diazepam. Anesthesia with halothane or enflurane with nitrous oxide and oxygen should be preferred when brief outpatient general anesthesia is needed.

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