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## *The Interaction between Alcohol and the Residual Effects of Thiopental Anesthesia*

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**Background:** During ambulatory surgery, barbiturates, such as thiopental, may impair psychomotor performance several hours after administration. It was hypothesized that if patients drink alcohol 4 h after thiopental injection, the increase in psychomotor impairment would be greater than that seen after alcohol ingestion alone.

**Methods:** Twelve healthy men volunteered to participate in a double-blind, placebo-controlled, crossover study with a Latin square design. On each testing day, the subjects received intravenous injections of either 5 mg/kg of 2.5% thiopental or an equal volume of saline for 30 s. Four hours after injection, the subjects consumed a beverage with or without 0.7 g/kg alcohol. Psychomotor performance and mood were assessed at five times: prior to injection, at 1 h and 3 h after injection, and at 1 h and 3 h after consumption of beverage.

**Results:** Both thiopental and alcohol had strong independent effects on the dependent measures in this study. In addition, body sway, one of the nine psychomotor tests used to assess impairment, was greater after thiopental and alcohol than after alcohol alone. Of eleven adjectives used to assess mood, lightheadedness was cited most frequently after a combination of thiopental and alcohol than after each alone.

**Conclusions:** Based on our tests of performance and mood,

an interaction between thiopental and alcohol is evident; in addition, the interaction between both drugs may exert deleterious effects on higher levels of central nervous system integration. (Key words: Alcohol: psychomotor functioning; with thiopental. Ambulatory surgery. Anesthesia: general.)

THE number of operations performed in ambulatory care settings in the United States is increasing. A recent study by the American Hospital Association revealed that in 1990 more than 50% of operations were performed in ambulatory centers; by the end of the century this number may increase to 85%.|| Patients discharged from these centers may drive or even drink alcohol once they arrive home despite being advised against doing so.<sup>1,\*\*</sup> Therefore, it is important to understand both the extent to which drugs given before ambulatory surgery procedures may interfere with a patient's routine functioning afterward and the potential duration of these effects. Alcohol impairs psychomotor function<sup>2</sup>; benzodiazepines<sup>3-6</sup> and barbiturates<sup>7,8,††</sup> given with alcohol potentiate this impairment. To date, the effect of alcohol given several hours after an anesthetic has not been examined.

In previous studies, we showed that, when healthy young adult volunteers were injected with midazolam<sup>9</sup> or midazolam and fentanyl,<sup>10</sup> they demonstrated psychomotor impairment. A moderately large dose of ethanol given to volunteers 4 h after they had been injected also resulted in impairment. However, neither drug increased the impairment seen after alcohol ingestion.

Barbiturates may impair psychomotor performance longer than midazolam or fentanyl. In one study of healthy volunteers, simulated driving skills and psychomotor performance were impaired for as long as 6 h after thiopental.<sup>11</sup> Barbiturates, therefore, may interact with alcohol consumed shortly after a barbiturate injection.<sup>12</sup> Although thiopental usually is given in combination with other drugs during ambulatory surgery, it is the drug frequently associated with the longest recovery, especially in comparison with other in-

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duction agents.<sup>13</sup> The purpose of this study was to determine the effect of alcohol consumed several hours after a dose of thiopental on psychomotor and cognitive functioning.

### Methods

This study was approved by our Institutional Review Board, and informed written consent was obtained from subjects. The subjects were 12 healthy men ( $24.4 \pm 3.8$  yr,  $74.0 \pm 7.4$  kg,  $182.1 \pm 3.0$  cm; mean  $\pm$  SD) who drank between 5 and 15 drinks per week. An anesthesiologist took a history and performed a physical examination on each subject. Excluded from this study were persons who had experienced an adverse reaction to anesthesia, sedation, or analgesia or who had systemic diseases that became apparent during physical examination. Persons eligible for the study were not allowed to take prescription or over-the-counter medication during the 3 weeks of the study. Subjects fasted the night before testing sessions and abstained from alcohol for 24 h before sessions. Abstinence from alcohol was verified by measuring exhaled alcohol concentration. Subjects were paid for their participation upon completion of the study.

The study was double-blind, and a Latin square design was used to designate the order of conditions. Each subject was tested in four different sessions; each session was separated by at least 1 week. Blood pressure, heart rate, and arterial hemoglobin oxygen saturation were measured before and monitored for at least 30 min after injection. Subjects received intravenous injections of either 5 mg/kg of 2.5% thiopental or of saline for 30 s. Four hours later, each subject consumed a beverage that either did or did not contain 0.7 g/kg alcohol. Subjects were given a maximum of 20 min to consume the beverage, which was served in cold cups. The alcoholic lime-flavored beverages contained 10% ethyl alcohol in a volume of 450 ml (per 70 kg). That dose of alcohol is approximately equivalent to that found in 1,400 ml beer (3.2% alcohol by volume), 410 ml wine (11% by volume), or 110 ml of 80-proof liquor and was expected to increase the concentration of exhaled alcohol in a fasted 70-kg man to approximately 0.6 g/100 ml. Using an Alco-sensor 3 breath analyzer (Intoximetrics, St. Louis, MO), concentration of blood alcohol was measured from breath air 1 h and 3 h after ingestion.

Subjects had three practice sessions with the test apparatus to reduce their ability to learn the tasks that

would be used during the actual testing. Psychomotor performance and subjective effects were measured at the following times: before intravenous injection, and at 1, 3, 5, and 7 h after injection. Concentrations of exhaled alcohol were measured before the intravenous injection and at 5 and 7 h after injection (1 and 3 h after beverage consumption). A snack was served approximately 2 h after injection of drug, and lunch was served approximately 6 h after injection (1.5 h after alcohol ingestion).

### Dependent Measures

**Psychomotor Performance.** Nine psychomotor tests were administered and took approximately 25 min to complete; they were always performed in the same order. The Maddox wing test was used to measure esophoria and exophoria (*i.e.*, motor function of the eyes).<sup>14</sup> A critical flicker fusion (CFF) test, shown to be sensitive to the effects of barbiturates,<sup>15</sup> was used to measure changes in integrative activity of the central nervous system. Subjects first performed three ascending series of trials (from flicker to fusion) and then three descending series of trials (from fusion to flicker). Body sway was measured with a computerized strain gauge. Subjects stood on a force plate for 60 s with their eyes closed; variations in movement in the anterior-posterior and lateral directions were recorded. Auditory reaction time was determined by measuring the time it took the subject to press a button after hearing a sound.<sup>16</sup> Visual reaction time was determined by measuring the time it took to press a button after seeing a letter on a computer screen.<sup>16</sup> Eye-hand coordination was measured by having the subject track a moving circle on a computer screen with a "mouse"-controlled cross for 2 min.<sup>16</sup> Coordination was determined by measuring the mean distance in pixels between the cross and the target circle during the test (mean distance from circle) by counting the number of times that the cross extended 1 cm beyond the target circle (mistakes), and by measuring the seconds that the cross extended 1 cm beyond the circle (seconds outside circle). Divided attention was determined after the subject pressed a designated key when a target stimulus appeared in a background of false stimuli.<sup>16</sup> Correct and incorrect responses and reaction times were recorded. Multiple reaction time was determined after the subject pressed designated keys when a particular letter appeared on a preselected side of the computer screen, a particular tone was sounded, or a combination of visual and auditory stimuli was given.<sup>16</sup> On each test

Table 1. Psychomotor Performance (Mean  $\pm$  SE) at Baseline (0 h) and 1 and 3 Hours after Injections of Either Saline or Thiopental

	Saline Injection			Thiopental Injection			P Value*
	0 h	1 h	3 h	0 h	1 h	3 h	
Body sway (lateral)	684.8 $\pm$ 47.0	716.0 $\pm$ 59.3	660.0 $\pm$ 46.7	717.6 $\pm$ 47.0	891.1 $\pm$ 84.6†	711.5 $\pm$ 60.2	0.02
DSST (no. correct)	54.8 $\pm$ 2.1	55.5 $\pm$ 1.9	55.7 $\pm$ 2.1	54.1 $\pm$ 1.9	47.9 $\pm$ 2.1‡	53.5 $\pm$ 2.1§	0.0001
Eso/exophoria (diopters)	3.4 $\pm$ 1.2	3.9 $\pm$ 1.4	4.0 $\pm$ 1.3	3.6 $\pm$ 1.3	7.0 $\pm$ 1.3‡	4.8 $\pm$ 1.3	0.0001
Eye-hand coordination (mistakes)	13.8 $\pm$ 1.5	14.8 $\pm$ 1.6	15.6 $\pm$ 1.9	12.5 $\pm$ 1.3	22.0 $\pm$ 2.0‡	17.0 $\pm$ 1.9	0.005
Eye-hand coordination (s outside circle)	3.9 $\pm$ 0.4	4.4 $\pm$ 0.4	4.8 $\pm$ 0.9	3.5 $\pm$ 0.3	6.1 $\pm$ 0.6‡	4.7 $\pm$ 0.6	0.05
Visual reaction (s)	0.345 $\pm$ 0.016	0.351 $\pm$ 0.016	0.342 $\pm$ 0.015	0.353 $\pm$ 0.019	0.401 $\pm$ 0.027‡	0.353 $\pm$ 0.013	0.003

DSST = digit-symbol substitution test.

\* Significance is based on repeated-measures analysis of variance comparing thiopental with saline, using hours 0, 1, 3, 5, and 7 after injection as time points.

† Significantly different ( $P \leq 0.005$ ) from placebo at the equivalent time point, using paired *t* test.‡ Significantly different ( $P < 0.0001$ ) from placebo at the equivalent time point, using paired *t* test.§ Significantly different ( $P \leq 0.01$ ) from placebo at the equivalent time point, using paired *t* test.¶ Significantly different ( $P \leq 0.001$ ) from placebo at the equivalent time point, using paired *t* test.

occasion, 40 stimuli were presented and the number of correct and incorrect responses was recorded. Subjects also completed the digit-symbol substitution test (DSST), during which they were given 1 min to replace a number with a corresponding symbol; the number of correctly matched symbols was recorded.<sup>17</sup>

**Subjective Effects.** Subjective effects were measured before injection, at 15, 30, and 45 min, and at 1, 3, 5 and 7 h after injection using a visual analog scale (VAS) and a questionnaire that assessed subjective ratings for drugs. The VAS consists of 11 100-mm lines, labeled with one of the following adjectives: stimulated, happy, sick, high, anxious, sedated, down, hungry, nauseous, dizzy, and lightheaded. Subjects were instructed to place a mark on each line indicating how they felt at the moment, ranging from "not at all" to "extremely." The drug effects/liking questionnaire, which was also administered, was used to assess the following: first, the extent to which subjects perceived a drug effect on a scale from 1 ("I feel no effect at all") to 5 ("I feel a very strong effect"); and second, the extent to which subjects liked the effect from 0 (disliked a lot) to 100 (liked a lot), where 50 indicated a neutral experience.

#### Data Analysis

For each test, three repeated-measures analyses of variance (ANOVAs) were used, and  $P \leq 0.05$  was considered significant. To determine the effect of thiopental, one ANOVA was performed using thiopental (present or absent) for all time-points. To determine the effect of alcohol and the interaction of alcohol with thiopental, a second ANOVA was performed using alcohol (present or absent), thiopental (present or absent), and the time-points of 0, 5, and 7 h after injection (5 and 7 h after injection were equivalent to 1 and 3 h, respectively, after ingestion of alcohol). *Post hoc* tests were used to determine the duration of impaired psychomotor performance. To determine whether any learning effects existed, a third ANOVA was performed using week of testing as a factor.

## Results

### Thiopental Effects

After receiving thiopental, subjects took  $14.8 \pm 11.9$  min (mean  $\pm$  SD) to awaken and state their names. Thiopental reduced eye-hand coordination and performance on the DSST and increased exophoria (table 1). Drug effects on psychomotor performance were max-

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imal at the first test following thiopental injection (1 h), but 2 h later they had partly or completely dissipated. Subjective effects were distinct (table 2). Based on the VAS ratings, subjects were more dizzy, lightheaded, high, and sedated after drug injection. On the drug effects/liking questionnaire, strength of drug effect was rated as strong for up to 3 h after injection. Subjects liked the drug for up to 1 h after injection. Subjects neither liked nor disliked the effects of saline.

#### Alcohol Effects

Concentration of exhaled alcohol 1 h after ingestion (5 h after injection of drug or saline) was  $0.99 \pm 0.11$  g/100 ml (mean  $\pm$  SD). Two hours later, the mean  $\pm$  SD concentration of exhaled alcohol had decreased to  $0.40 \pm 0.07$  g/100 ml. In most of the United States, a motorist with a concentration of blood alcohol of 1.0 g/100 ml is considered to be driving under the influence of alcohol. Table 3 presents psychomotor performance obtained at baseline (0 h) and 1 and 3 h after ingestion of either placebo or alcohol. In table 3, the four study groups have been reduced to two: results from the two groups receiving placebo beverage (saline injection with placebo beverage or thiopental injection with placebo beverage) were averaged, as were the results from the groups receiving alcohol beverage (placebo injection with alcohol beverage or thiopental injection with alcohol beverage). Test performances significantly affected by alcohol are indicated.

Alcohol impaired performance on both the eye-hand coordination test and the DSST. Exophoria, visual reaction time, and lateral and anterior-posterior body sway were increased by the drug. Drug effects peaked 1 h after injection and were still present 2 h later.

Table 4 presents subjective effects data. On the VAS,

subjects rated themselves as more dizzy, lightheaded, high, happy, and stimulated after alcohol ingestion. On the drug effects/liking questionnaire, alcohol effect was rated as strong for up to 3 h after consumption. The duration for which subjects liked the effect of alcohol was not as long as that for thiopental. Subjects neither liked nor disliked the effects of the placebo beverage.

#### Drug-Alcohol Interaction Effects

Body sway and the VAS rating lightheaded (figs. 1 and 2) were the only measures significantly affected by interaction of drug and alcohol in subjects in the study, and their values were as follows lateral body sway,  $P \leq 0.01$ ; anterior-posterior body sway,  $P \leq 0.02$ ; and lightheadedness,  $P \leq 0.01$ . For both body sway and the lightheaded rating, the alcohol effects were more potent after the thiopental injection than after the saline injection. This effect had dissipated within 3 h after beverage consumption.

#### Learning Effects

On the DSST, the average number of correct responses in the first week was  $51.8 \pm 1.4$  (+SE); this rate gradually increased to  $56.1 \pm 1.2$  in the 4th week session ( $P < 0.005$ ).

#### Discussion

Both alcohol and thiopental have strong effects on psychomotor performance and mood, and when alcohol is consumed within 4 h after thiopental injection, an interaction can occur. Of the possible drug interaction effects for which we tested, body sway, and lightheadedness were found to be accentuated by the combination of thiopental and alcohol.

**Table 2. Mood and Rating of Drug Effect and Liking (Mean  $\pm$  SE) at Baseline (0 h) and 1 and 3 Hours after Injection of Either Saline or Thiopental**

	Saline Injection			Thiopental Injection			P Value*
	0 h	1 h	3 h	0 h	1 h	3 h	
Dizzy (mm)	$2.3 \pm 0.9$	$1.0 \pm 0.4$	$1.5 \pm 0.6$	$1.5 \pm 0.5$	$24.7 \pm 6.0†$	$4.1 \pm 1.4$	0.0001
High (mm)	$2.8 \pm 2.2$	$0.8 \pm 0.3$	$0.7 \pm 0.3$	$0.7 \pm 0.2$	$34.7 \pm 6.0†$	$7.2 \pm 4.2‡$	0.0001
Lightheaded (mm)	$3.7 \pm 1.6$	$3.1 \pm 1.6$	$1.8 \pm 1.0$	$1.5 \pm 0.6$	$38.6 \pm 5.7†$	$8.2 \pm 2.6$	0.0001
Sedated (mm)	$6.2 \pm 2.8$	$3.5 \pm 1.7$	$5.6 \pm 3.2$	$5.2 \pm 2.0$	$36.3 \pm 6.9†$	$12.4 \pm 3.6$	0.0001
Liking of drug effect (mm)	$48.8 \pm 0.3$	$49.7 \pm 1.1$	$48.1 \pm 0.5$	$48.9 \pm 0.3$	$63.9 \pm 4.4†$	$51.6 \pm 2.7$	0.001
Strength of drug effect (score)	$1.0 \pm 0.0$	$1.1 \pm 0.1$	$1.0 \pm 0.0$	$1.0 \pm 0.0$	$3.7 \pm 0.2†$	$2.0 \pm 0.2†$	0.0001

\* Significance is based on repeated-measures analysis of variance comparing thiopental with saline, using hours 0, 1, 3, 5, and 7 after injection as time points.

† Significantly different ( $P \leq 0.0001$ ) from placebo at the equivalent time point.

‡ Significantly different ( $P < 0.05$ ) from placebo at the equivalent time point.

**Table 3. Psychomotor Performance (Mean  $\pm$  SE) at Baseline (0 h) and 1 and 3 Hours after Either Placebo or Alcohol Beverage (5 and 7 Hours after Injection of Saline or Thiopental)**

	Placebo Beverage			Alcohol Beverage			P Value*
	0 h	1 h	3 h	0 h	1 h	3 h	
Body sway (anterior)	722.5 $\pm$ 46.1	733.2 $\pm$ 44.5	706.5 $\pm$ 39.5	704.5 $\pm$ 39.4	960.9 $\pm$ 86.1†	867.0 $\pm$ 71.0‡	0.007
Body sway (lateral)	728.3 $\pm$ 49.9	713.6 $\pm$ 46.8	679.8 $\pm$ 49.3	674.1 $\pm$ 43.4	851.2 $\pm$ 56.8§	844.9 $\pm$ 71.7‡	0.008
Divided attention (correct)	89.5 $\pm$ 3.2	89.4 $\pm$ 3.0	89.4 $\pm$ 2.4	88.3 $\pm$ 2.6	84.7 $\pm$ 3.3§	85.5 $\pm$ 3.8¶	0.03
DSST (no. correct)	53.9 $\pm$ 2.2	54.6 $\pm$ 1.9	56.9 $\pm$ 1.8	55.0 $\pm$ 1.8	48.9 $\pm$ 1.9**	54.8 $\pm$ 2.1¶	0.0002
Eso/exophoria (diopters)	3.5 $\pm$ 1.3	3.4 $\pm$ 1.5	4.0 $\pm$ 1.3	3.5 $\pm$ 1.2	5.6 $\pm$ 1.4†	4.9 $\pm$ 1.4	0.04
Eye-hand coordination (mistakes)	13.9 $\pm$ 1.5	14.4 $\pm$ 2.0	14.9 $\pm$ 1.6	12.4 $\pm$ 1.4	24.5 $\pm$ 2.3**	16.8 $\pm$ 2.1	0.0001
Eye-hand coordination (s outside circle)	4.0 $\pm$ 0.4	4.1 $\pm$ 0.5	4.0 $\pm$ 0.5	3.4 $\pm$ 0.3	6.8 $\pm$ 0.8**	4.5 $\pm$ 0.6	0.002
Eye-hand coordination (MDFC)	11.7 $\pm$ 0.4	11.4 $\pm$ 0.4	11.5 $\pm$ 0.4	11.1 $\pm$ 0.3¶	13.0 $\pm$ 0.5**	11.8 $\pm$ 0.4	0.0001
Multiple RT (no. correct)	38.7 $\pm$ 0.2	38.2 $\pm$ 0.3	37.8 $\pm$ 0.3¶	38.0 $\pm$ 0.3	37.1 $\pm$ 0.6§	37.7 $\pm$ 0.4	0.04
Multiple RT (no. incorrect)	2.5 $\pm$ 0.5	3.4 $\pm$ 0.6	4.5 $\pm$ 0.7¶	3.8 $\pm$ 0.6	5.5 $\pm$ 1.0§	4.0 $\pm$ 0.6	0.04
Visual reaction (s)	0.348 $\pm$ 0.016	0.345 $\pm$ 0.014	0.330 $\pm$ 0.010	0.350 $\pm$ 0.019	0.390 $\pm$ 0.029‡	0.366 $\pm$ 0.024§	0.05

DSST = digit symbol substitution test; RT = reaction time; MDFC = mean distance from circle.

Results for tests in boldface type indicate that an interaction between alcohol and thiopental was also measured.

\* Significance is based on repeated-measures analysis of variance comparing thiopental with saline, using hours 0, 1, 3, 5, and 7 after injection as time points.

† Significantly different ( $P \leq 0.0005$ ) from placebo at the equivalent time point.

‡ Significantly different ( $P \leq 0.005$ ) from placebo at the equivalent time point.

§ Significantly different ( $P \leq 0.01$ ) from placebo at the equivalent time point.

¶ Significantly different ( $P \leq 0.05$ ) from placebo at the equivalent time point.

\*\* Significantly different ( $P \leq 0.0001$ ) from placebo at the equivalent time point.

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**Table 4. Mood and Rating of Drug Effect and Liking (Mean  $\pm$  SE) at Baseline (0 h) and 1 and 3 Hours after Ingestion of Either a Placebo or Alcohol Beverage**

	Placebo Beverage			Alcohol Beverage			P Value
	0 h	1 h	3 h	0 h	1 h	3 h	
Dizzy (mm)	2.5 $\pm$ 0.9	2.0 $\pm$ 1.0	1.5 $\pm$ 0.5	1.4 $\pm$ 0.5	24.3 $\pm$ 4.9†	10.4 $\pm$ 3.0§	0.001
Happy	29.2 $\pm$ 4.6	29.5 $\pm$ 5.2	33.7 $\pm$ 5.5	32.1 $\pm$ 5.2	56.8 $\pm$ 6.3‡	35.3 $\pm$ 4.4	0.006
High (mm)	2.9 $\pm$ 2.2	1.2 $\pm$ 0.4	1.1 $\pm$ 0.4	0.6 $\pm$ 0.2	38.9 $\pm$ 7.0‡	13.3 $\pm$ 4.2§	0.0002
Lightheaded (mm)	3.6 $\pm$ 1.6	3.3 $\pm$ 1.3	2.8 $\pm$ 1.0	1.6 $\pm$ 0.6	34.4 $\pm$ 6.3‡	12.8 $\pm$ 3.9	0.002
Stimulated (mm)	6.4 $\pm$ 3.1	6.9 $\pm$ 2.9	5.9 $\pm$ 2.6	5.8 $\pm$ 2.9	29.0 $\pm$ 6.6‡	11.5 $\pm$ 3.5	0.05
Liking of drug effect (mm)	48.7 $\pm$ 0.3	46.5 $\pm$ 1.9	48.0 $\pm$ 1.2	49.0 $\pm$ 0.3	66.8 $\pm$ 3.5‡	48.0 $\pm$ 1.9	0.0001
Strength of drug effect (score)	1.0 $\pm$ 0.0	1.2 $\pm$ 0.1	1.0 $\pm$ 0.0	1.0 $\pm$ 0.0	3.8 $\pm$ 0.1‡	1.9 $\pm$ 0.2‡	0.0001

Results for tests in boldface type indicate that an interaction between alcohol and thiopental was also measured.

\* Significance is based on repeated-measures analysis of variance comparing thiopental with saline, using hours 0, 1, 3, 5, and 7 after injection as time points.

† Significantly different ( $P \leq 0.001$ ) from hour 0, using paired  $t$  test.

‡ Significantly different ( $P \leq 0.0001$ ) from hour 0, using paired  $t$  test.

§ Significantly different ( $P \leq 0.05$ ) from hour 0, using paired  $t$  test.

Few studies have examined the accentuation of psychomotor and cognitive performance impairments when alcohol is consumed after injection of a barbiturate. In one study, healthy young men made more errors on a typing test 3 h after ingesting both alcohol and phenobarbital than after ingesting either drug alone.<sup>††</sup> In another study, which examined the effects of a 2-week treatment with amylobarbitone (a barbiturate) and acute administration of ethanol on eye-hand and multilimb coordination, alcohol was found to impair coordination skills.<sup>7</sup> Using electroencephalography and a series of psychomotor tests, a third study found that alcohol ingested 1 or 2 h following the administration of methohexital or thiopental anesthesia interacted with the barbiturates.<sup>8</sup> Although we demonstrated a synergistic effect, the lack of intensity of effect compared to that noted in other studies probably can be attributed to differences in drug-administration intervals. In the other studies, barbiturates and alcohol were given together, whereas in our study, the interval between sedation and alcohol ingestion was 4 h. Furthermore, in a previous study from our laboratory, impairment after thiopental was noted 5 h after injection,<sup>11</sup> whereas in the current study, impairment after thiopental alone was noted up to 3 h after injection. In the previous study, the volunteers received a top-up dose of 2 mg/kg thiopental 3 min after the initial injection of 5 mg/kg, whereas in the current study, the volunteers received only the initial 5-mg/kg dose of thiopental. Dose, then, also may account for the fact

that a greater degree of impairment was not noted in the current study.

The simulated "clinical reality" in our study was based on the following time intervals and dosages: patients receive a short-acting anesthetic in an ambulatory care facility, undergo a surgical procedure, recover until judged "street-ready," and then go home. In clinical practice, however, thiopental usually is not the sole anesthetic used. Because of this fact, it is possible that a greater interaction between alcohol and drugs used for ambulatory surgery than that found in our study could occur.

Several caveats regarding our findings must be noted. First, many procedures in ambulatory care facilities are performed on patients who are older than the volunteers in our study; therefore, our results may not be applicable to an older population. Another limitation of the study is that the interval between thiopental injection and alcohol ingestion was fixed at 4 h. It is possible that more significant interactions may have been observed if a shorter interval had been used. (A shorter interval, however, would not be typical; patients ordinarily would not have returned home until at least 3 or 4 h after a procedure.) Another variable not analyzed in our study was that of dosage level. However, although we did not vary the amount of either alcohol or thiopental, we attempted to use clinically relevant doses. Finally, our study did not include women as volunteers, although they represent a significant portion of the patient population. It must be

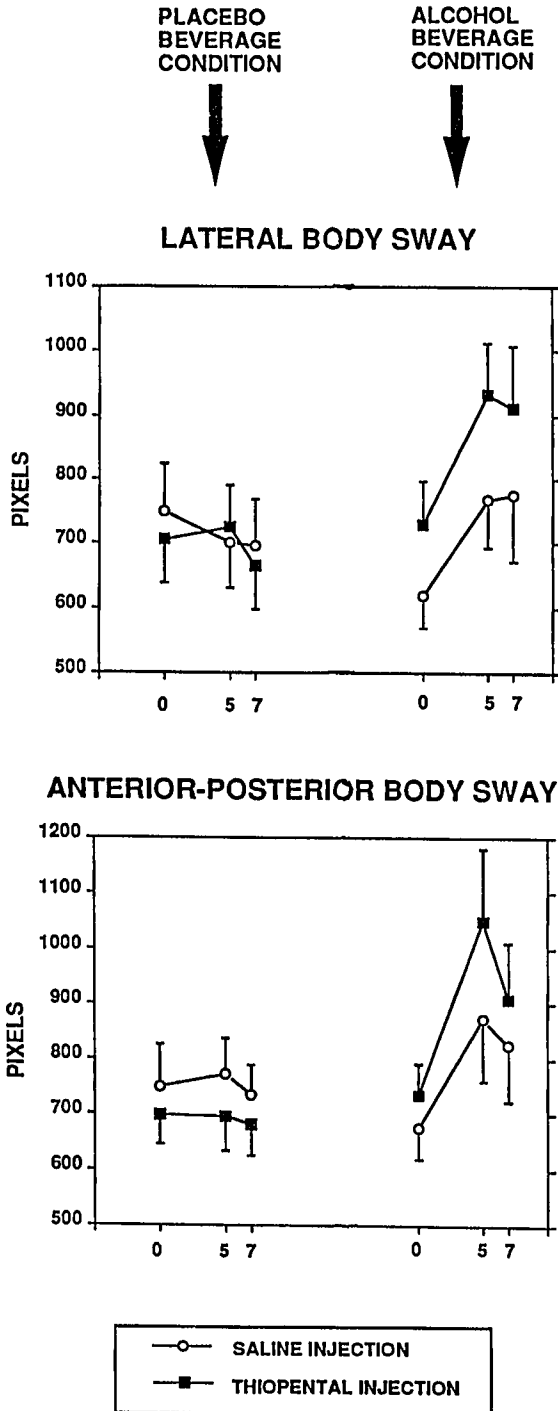


Fig. 1. Lateral (*top*) and anterior-posterior (*bottom*) body sway at times of designation after injection of thiopental. Injection of thiopental occurred at time 0 h. Five and 7 h after injection of thiopental is the same as 1 and 3 h after ingestion of alcohol, respectively. Brackets indicate SEM.

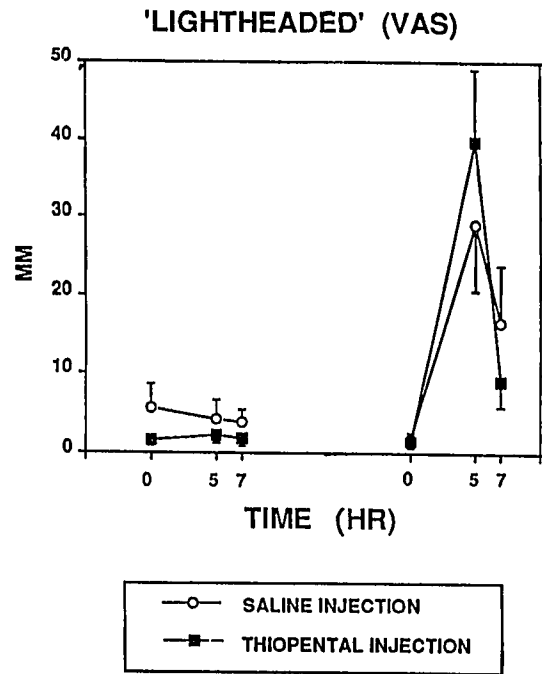


Fig. 2. Lightheaded ratings of the visual analog scale at times of designation after injection of thiopental. Injection of thiopental occurred at time 0 h. Five and 7 h after injection of thiopental is the same as 1 and 3 h after ingestion of alcohol, respectively. Brackets indicate SEM.

noted, though, that although alcohol pharmacokinetics differ as a function of gender, gender does not affect psychomotor, cognitive, and subjective responses to alcohol.<sup>18-20</sup>## Thiopental pharmacokinetics in young men differ slightly from those in women.<sup>21</sup>

In conclusion, our study suggests that, if a patient drinks alcohol within 4 h after receiving a single induction dose of thiopental, an interaction may occur. In addition, both drugs may exert longer-lasting effects on higher levels of central nervous system integration, as measured by electroencephalogram, and including vigilance, or driving, although we did not measure these higher-order central nervous system parameters. Patients should be cautioned not to drink alcohol following anesthesia and surgery.

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