TITLE: FLUMAZENIL AFTER SUFENTANIL-MIDAZOLAM ANESTHESIA
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Flumazenil is an imidazobenzodiazepine which functions as a specific competitive benzodiazepine antagonist.[1] The objective of this study was to evaluate the efficacy of intravenous flumazenil in the reversal of the effects of midazolam after a general anesthetic induced and maintained using midazolam and sufentanil.

This was a double-blind, randomized, unbalanced (randomized 2:1), placebo-controlled trial. After approval by the Human Subjects committee, thirty patients ASA I & II received an anesthetic induced and maintained with midazolam, sufentanil, N_2O, and vecuronium. After admission to Post-Anesthetic Care, each patient was randomized to receive either flumazenil 1mg or placebo. Patient sedation, memory, and motor function were assessed pre-operatively, immediately post-operatively (before test drug administration), and at specific time intervals after administration of the test drug. Alertness was quantitated 0 (least alert) to 5 (most alert) and finger-to-nose was quantitated 0(unable to do) to 4 (done with ease). Patients were also shown common pictures (chair, bird, bicycle, shoe, tree, and dollar bill) to identify at each test period. At the end of the test period, the patient was asked to recall as many pictures as possible. Pulse, ventilatory rate, and blood pressure were also monitored. Results were compared using Student's grouped t-test and Chi-square analysis. Significance was defined at $p<0.05$.

Twenty-one patients were randomized to the Flumazenil Group; nine patients to the Placebo Group. There was no significant difference in ASA physical status, sex, age, body weight, procedure duration, narcotic dose, and midazolam dose between groups. Procedures ranged in duration from 30 to 159 min. The Placebo Group received a total of 0.689±0.056 microgms/kg sufentanil and 0.414±0.019 mg/kg midazolam; the Flumazenil Group received a total of 0.786±0.059 microgms/kg sufentanil and 0.433±0.028 mg/kg midazolam. Significant differences were found in alertness and finger-to-nose performance at 5 min, 15 min, and 30 min after injection of the test drug ($p<0.05$). No differences were found at 60, 120, and 180 minutes. At 5 and 15 min after test drug, significantly more of the Placebo Group were too sedated to identify the pictures than in the Flumazenil Group (2/21 vs 7/9 and 3/21 vs 4/9)($p<0.05$). At 180 min, the Placebo Group recalled 0.9±0.1 pictures, while the Flumazenil Group recalled 1.7±0.25 pictures ($p<0.01$). At 24 hrs, the Placebo Group recalled 0.9±0.1 pictures, compared to 2.0±0.27 pictures recalled by the Flumazenil Group ($p<0.001$). Vital signs were not significantly different between groups, with the exception of a small but significant difference in ventilatory rate at 5 minutes (14.9±0.8/min for Placebo; 17.3±0.9/min Flumazenil, $p<0.05$). Nausea was the most common adverse clinical reaction (11.1% in Placebo; 4.8% in Flumazenil), but there was no significant difference between groups.

Use of midazolam as an induction agent and maintenance sedative has been avoided in the past due to the degree of somnolence the patients exhibited during recovery. In this study, an anesthetic technique involving the use of midazolam as the sole induction agent and sedative was utilized and recovery for those patients who received flumazenil in the recovery area was excellent. Thus, with the use of flumazenil to achieve rapid wake-up, the hemodynamic advantages of a nitrous/narcotic anesthetic with midazolam induction can be exploited. This also allows utilization of the excellent sedative qualities of midazolam in the outpatient arena.

[1]Hunkeler W., Mohler H., Pieri L., et al. Nature 290:514-516, 1981.

TITLE: AN ADAPTABLE COMPUTER MODEL OF THE ECONOMIC EFFECTS OF ALTERNATIVE ANESTHETIC REGIMENS IN OUTPATIENT SURGERY
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Industry statistics indicate that the *real* cost per outpatient surgical procedure performed in the United States doubled between 1983 and 1987,[1] while the number of procedures tripled.[2] These trends illustrate the importance of understanding the cost effects of alternative ways to provide such services. Indirect cost effects are much harder to estimate than are direct effects, but may be large. Recovery room nursing is a significant component of outpatient surgery costs, accounting for as much as 16 percent of total operating costs at one of our study sites. In a previous study we compared alternative anesthetic regimens and identified a potential for significant cost reduction due to reduced recovery room staffing with propofol[3] (P) compared to thiopental-isoflurane (TI).

In the present study we describe an adaptable computer model that extends our previous work on recovery room staffing in several ways. First, our computer simulation permits the entry of site-specific anesthesia variables such as the duration of typical anesthesia and the recovery room staffing policy in order to determine the effect of alternative anesthetic regimens on costs and staffing for that institution. Second, we develop a statistical method for extrapolating effects from clinical trial samples to the general patient population at a given center. We illustrate our methods using new clinical trial data including more refined measures of the duration of post-anesthesia recovery than were available for our previous study.

We implemented the adaptable computer simulation of the flow of patients as a SLAM II model.[4] The post-anesthesia recovery data were collected (with informed consent and with the approval of institutional review committees) in clinical trials at the Methodist Medical Center in Peoria, IL and at the Emory Clinic in Atlanta, GA. These trials were designed to compare post-anesthesia recovery with P to that with TI. For a given ratio of recovery room nurses to patients, we estimate a potential reduction of the required recovery room staffing with P on the order of 22 to 25 percent at each site.

We find that the model's staffing "predictions" are consistent with actual staffing patterns at the study sites. The model can also project other economic effects including the number of patients on the operating room schedule and recovery room nursing overtime resulting from recovery room congestion. We conclude that our method provides informative assessments of the economic effects of alternative methods in outpatient surgery.

References
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