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# Usefulness of midazolam premedication for volatile induction of anesthesia in adults

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Induction of anesthesia can be achieved rapidly using the vital capacity ("single breath") technique with 8% sevoflurane, which typically produces loss of consciousness in 45–55 s [1–3]. This technique using sevoflurane is associated with minimal complications compared with those using halothane [4,5] or isoflurane [6]. Although sevoflurane has little pungency, patients sometimes complain about the discomfort of the induction. We therefore investigated the effect of premedication with midazolam for smoother induction and for the patient's comfort.

One hundred adult patients with ASA physical status I or II who required general anesthesia for minor surgery were enrolled in this study. Patients with a history of, or evidence from laboratory or physical examination indicating, hepatic, renal, or significant respiratory or cardiovascular disease were excluded from the study. The patients were randomly divided into two groups (by the coin technique): control ($n = 48$) and midazolam ($n = 52$) groups. Intramuscular injection of midazolam (2–3 mg) was given to the midazolam group 1 h before anesthesia, whereas no premedication was given to the control group. While the patients were breathing room air before the induction of anesthesia, the anesthetic circuit was circulated with 10 l·min$^{-1}$ oxygen and 5% sevoflurane for 1 min. The patients were instructed to breathe out to residual volume, and then the anesthetic mask was fitted tightly. They were then told to take repeated vital capacity breaths as deep as possible, and anesthesia was induced by 5% sevoflurane in oxygen (10 l·min$^{-1}$) via the mask. After three vital capacity breaths, the fresh gas was changed to oxygen at 3 l·min$^{-1}$ and nitrous oxide at 6 l·min$^{-1}$. Loss of consciousness was defined as loss of eyelash reflex. The eyelash reflex was checked at 5-s intervals. After loss of consciousness had been confirmed, the fresh gas flow rates of oxygen and nitrous oxide were decreased to 2 and 4 l·min$^{-1}$, respectively, and the patient's breathing was assisted thereafter. The induction time, specific induction side effects, and acceptability of this technique by the patients were recorded by an independent observer. Induction time was defined as the time from sevoflurane exposure to loss of consciousness. Definitions of induction side effects were those reported by Lamberty and Wilson [6] and by Philip et al. [7]. Briefly, possible side effects were categorized in six groups: hypotension (below −20% of preanesthetic systolic blood pressure), coughing, laryngospasm, breath holding, movement of limbs, and excessive secretions. The acceptability of this technique was assessed on the day after the operation by asking the patients to characterize the smell of the anesthetics and state whether they would be willing to submit to the technique again. All data are expressed as means ± SD or numbers (percentages). Statistical analyses were performed by the unpaired *t*-test or $\lambda^2$-test. A $P$ value less than 0.05 was considered statistically significant.

Both groups were comparable with respect to sex, age, height, weight, and ASA physical status (Table 1). The induction time, details of the specific side effects during induction, and acceptability of this technique are shown in Table 2. The induction time of the midazolam group was 55 ± 5 s, which was slightly but significantly shorter than that of the control group (65 ± 6 s). Coughing or hypotension occurred in 2 patients (4%) in the midazolam group, and coughing, movement, or hypotension occurred in 6 patients (13%) in the control group. None of the patients showed percutaneous arte-

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**Table 1.** Demographics of the subjects in each group

| Characteristic | Control group ($n = 48$) | Midazolam group ($n = 52$) |
|---|---|---|
| Sex (F/M) | 22/26 | 23/29 |
| Age (yr) | 47 ± 10 | 45 ± 9 |
| Height (cm) | 162 ± 18 | 160 ± 16 |
| Weight (kg) | 61 ± 11 | 59 ± 12 |
| ASA physical status I | 34 | 39 |

Data are expressed as means ± SD or numbers

**Table 2.** Induction time, side effects during induction of anesthesia, and acceptability of this technique

| Variable | Control group ($n = 48$) | Midazolam group ($n = 52$) |
|---|---|---|
| Induction time (s) | 65 ± 6* | 55 ± 5 |
| Side effects during induction | | |
| Cough | 2 | 1 |
| Hypotension | 1 | 1 |
| Laryngospasm | 0 | 0 |
| Breath holding | 0 | 0 |
| Movement of limbs | 3 | 0 |
| Excessive secretions | 0 | 0 |
| Total | 6 (13%)* | 2 (4%) |
| Acceptability of smell | 33 (69%)* | 50 (96%) |
| Acceptability of repeated anesthesia | 45 (94%) | 51 (98%) |

Data are expressed as means ± SD or numbers (percentages). *$P < 0.05$ *vs.* midazolam group

rial oxygen saturation ($SpO_2$) below 95%. The acceptability of the smell of sevoflurane was significantly higher in the midazolam group [50 patients (96%)] than in the control group [33 patients (69%)]. Most of the patients in both groups expressed willingness to submit to the technique [45 patients (94%) in the control group and 51 patients (98%) in the midazolam group].

This study revealed that the technique with 5% sevoflurane resulted in a sufficiently short duration of induction, with few complications during the induction. Many investigators have reported volatile induction with sevoflurane using normal breathing [8,9], single vital breathing [2,10,11], and triple vital breathing techniques [12]. They used sevoflurane concentrations in the range of 3.5% and 8%, and induction times ranged from 41 to 84 s. Yurino and Kimura [13] investigated an efficient inspired concentration of sevoflurane for the vital capacity rapid inhalation induction technique. They concluded that 6% sevoflurane is the optimal concentration for this technique and that increasing the concentration higher than this did not markedly shorten the induction time. In our simple technique, we therefore used 5% sevoflurane and repeated vital capacity breathing.

We investigated the usefulness of hypnotic premedication by midazolam for smoother and more comfortable induction of anesthesia. The induction time in the midazolam group (55 ± 5 s) was slightly but significantly shorter than that in the control group (65 ± 6 s). Only 4% of the patients in the midazolam group showed specific side effects, whereas coughing, movement, or hypotension occurred in 13% of the patients in the control group. The acceptability of the smell of sevoflurane was significantly higher in the midazolam group (96%) than in the control group (69%). This effect of midazolam should be due to its anxiolytic and amnesic effects [14]. All patients, including those in the midazolam group, met the requirements for our institutional criteria of discharge on the day after the operation [15].

In conclusion, hypnotic premedication using a drug such as midazolam is recommended for smoother induction and for the patient's comfort.

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