anesthesia with midazolam (0.25–0.30 mg/kg) in patients premedicated with morphine and glycopyrrolate. The fact that sedation lasted several hours after the discontinuation of inhaled anesthetics and was not reversed by naloxone in two cases suggests that the sedation was caused by midazolam. The subsequent rapid reversal of the sedation with physostigmine suggests that a central anticholinergic mechanism may be involved.

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Anesthesiology
57:127–129, 1982

Low-dose Enflurane Does Not Increase Blood Loss during Therapeutic Abortion

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Therapeutic abortion is a common outpatient procedure which is performed frequently with local anesthesia.[1] However, many patients and physicians prefer general anesthesia to minimize the discomfort and anxiety associated with the operation. Volatile anesthetics, as opposed to intravenous anesthetics, are ideal for outpatient procedures because they allow faster recovery[2]; however, their usage for therapeutic abortion is limited because of their propensity at concentrations of one MAC or above, to cause myometrial relaxation and an increase in blood loss.[3] We undertook the following study to determine if uterine blood loss during therapeutic abortion could be kept to a minimum by utilizing relatively low concentrations of enflurane. The blood loss was compared to that observed when patients were anesthetized with a more routinely accepted nitrous oxide/narcotic technique.

Method

Thirty-four healthy, *unpremedicated*, women undergoing elective suction therapeutic abortion were studied. This study was reviewed and approved by the Human Subject Committee of the University of California, Irvine. Patients ranged in age from 16–29 years, and were at 8 to 13 weeks gestation. After informed consent was obtained, the patients were anesthetized with one of two anesthetic techniques.

Patients in Group 1 (n = 18) were given 50–100 μg of fentanyl intravenously. Anesthesia was then induced with thiopental (4–5 mg/kg) and maintained with 70 per cent nitrous oxide in oxygen. Additional thiopental was administered during the procedure in response to the patient moving, swallowing, breath holding, or exhibiting other signs of inadequate anesthesia. No additional fentanyl was required.

Patients in Group 2 (n = 16) had anesthesia induced with a small dose of thiopental (3–4 mg/kg) and maintained with 1 per cent inspired enflurane and 66 per cent nitrous oxide in oxygen. At no point was the concentration of inspired enflurane increased to more than 1 per cent. Additional thiopental was administered in response

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Key words: Anesthetics, intravenous: fentanyl; thiopental. Anesthetics, volatile: enflurane. Blood: loss. Pregnancy: abortion.

TABLE 1. A Comparison of Anesthetic Technique and Blood Loss for Patients Undergoing Therapeutic Abortion

	Anesthetic Technique		
	Thiopental, Fentanyl, N_2O (70 Per Cent)	Thiopental, Enflurane (1 Per Cent Inspired) N_2O (66 Per Cent)	*P* value
Number of patients	18	16	
Gestational age (weeks)	8.8 (±2.2)	9.5 (±1.8)	>0.2
Thiopental (mg/kg)	7.5 (±1.1)	5.8 (±1.1)	<0.001
Fentanyl (μg/kg)	1.8 (±0.9)		
Blood loss (ml)	62 (±46)	66 (±34)	>0.5
Duration of anesthesia (min)	16.2 (±3.3)	17.4 (±2.9)	>0.5

* Values represent means ± SD.

to the same criteria as described above for patients in Group 1.

All patients were anesthetized utilizing a face mask and allowed to breathe spontaneously. All abortions were performed by the same obstetrician, utilizing suction curettage. The obstetrician was not aware of the anesthetic technique employed.

Blood loss was measured according to the technique reported by Cullen *et al.*[3] All blood and products of conception were aspirated into a trap bottle. Fetal parts were collected in a gauze filter. Blood loss was calculated by measuring the total amount of fluid in the trap bottle and subtracting a volume of amniotic fluid appropriate for the patient's gestational age.

All patients received a continuous infusion of diluted oxytocin (20 units of 1000 ml) during the procedure. Data were subjected to statistical analysis utilizing Student's *t* test and the results were considered significant at a *P* value less than 0.05.

RESULTS

A summary of the data is presented in table 1. There was no significant difference between the two groups in terms of the patient's gestational age (8.8 weeks for Group 1 *vs.* 9.5 weeks for Group 2) or mean blood loss (62 ml for Group 1 and 66 ml for Group 2). Patients in Group 2 received approximately 1.7 mg/kg less thiopental than patients in Group 1. No patient in Group 2 received fentanyl. The mean duration of anesthesia was 16.2 min for Group 1 patients and 17.4 min for Group 2 patients.

No patient in either group lost more than 180 ml of blood. There were no immediate postoperative complications and all patients were discharged from the hospital, accompanied by an adult, approximately two hours after the procedure.

DISCUSSION

The myometrial depressant properties of volatile anesthetic agents have been demonstrated both *in vitro*[4,5] and *in vivo*.[3,6] Munson *et al.*[4] compared the effects of cyclopropane, nitrous oxide, and halothane on nongravid myometrial strips and found halothane to be a potent myometrial relaxant. In a similar comparative study, enflurane, isoflurane, and halothane were found to be equally depressant at comparable MAC values.[5] The depression was dose-related and resting uterine tension was not decreased significantly at 0.5 MAC with any of the anesthetics.

Cullen *et al.*[3] measured uterine blood loss during therapeutic abortion while patients were anesthetized with a variety of anesthetics. They found that the average blood loss was 283 ml when patients were anesthetized with 1 per cent halothane (end-expired) in oxygen, 169 ml with 0.5 per cent halothane in 75 per cent nitrous oxide, and 58 ml with 80 per cent nitrous oxide supplemented with intravenous anesthetics. A similar study using 0.5 to 1.0 per cent (end-expired) isoflurane with 70 per cent nitrous oxide yielded a mean blood loss of 262 ml.[6]

Our study differs from that of Cullen *et al.* in that they used a 0.5 per cent end-expired halothane concentration, whereas we used 1 per cent *inspired* enflurane. Also the duration of anesthesia in our study was much shorter (17.4 ± 2.9 *vs.* 28.3 ± 3.3 min). It is probable that our patients had no greater than 0.5 per cent enflurane in the alveoli at any time and this concentration is insufficient to cause any clinically significant blood loss. The mean gestational age of the patients in the halothane study was somewhat higher than in ours, which may also account for some of the difference in observed blood loss.

The administration of a low concentration of halothane with nitrous oxide and oxygen during cesarean section has been demonstrated to produce no appreciable depression of uterine contractility.[7] During cesarean section, up to 0.8 per cent halothane[8] or up to 1.5 per cent enflurane[9] with nitrous oxide in oxygen can be administered without any increase in blood loss. Marx *et al.*‡ have also shown that the administration of 0.5 per cent halothane or 1 per cent enflurane does not interfere with

‡ Marx GF, Kim YI, Lin CC, et al: Postpartum uterine pressures under halothane or enflurane anesthesia. Abstracts of Scientific Papers, Annual Meeting, American Society of Anesthesiologists, 1975, pp 101–102.

spontaneous uterine activity in the postpartum period of primi- or secundiparae.

Despite the fact that enflurane is known to relax uterine muscle, we have shown that enflurane can be used safely for patients undergoing therapeutic abortion, in that it does not increase blood loss when compared to a nitrous oxide/narcotic technique. The use of enflurane in low concentrations as an anesthetic for this outpatient procedure is advantageous because it obviates the need for narcotics or large doses of thiopental. It thus may allow more rapid recovery from anesthesia[2] and, although not examined in this study, earlier discharge from the hospital.

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Anesthesiology
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Anesthesia for the Patient with Pulmonary Lobar Torsion

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Torsion of a segment, a lobe,[1,2] or an entire lung[3] following an intrathoracic surgical procedure is a rare event. Its occurrence can lead to pulmonary infarction with secondary gangrene if not recognized. Any patient with atelectasis or an expanding intrathoracic mass following thoracotomy should have lung torsion included in the differential diagnosis. During surgical correction of this condition, massive hemorrhage may occur into the airways, drowning the dependent lung and producing severe hypoxia or death. Because of this, a double-lumen endotracheal tube should be inserted prior to surgery if lung torsion is suspected.

Report of a Case

A 20-year-old man with a history of recurrent, spontaneous left pneumothorax was scheduled for a left parietal pleurectomy. Preoperative laboratory studies were normal with the exception of the chest roentgenogram which revealed a 10 per cent left pneumothorax. Following induction of anesthesia with thiopenthal, pancuronium, and halothane a #36-French disposable left Robertshaw double-lumen tube was inserted into the trachea. Before pleurectomy with a $F_{I_{O_2}}$ of 1.0, pH_a was 7.48, Pa_{CO_2} 34 mmHg, Pa_{O_2} 571 mmHg, and HCO_3^- 25 mEq/l. In the right lateral decubitus position an 80 per cent pleurectomy was performed with oversuturing of a number of small blebs in the left superior and inferior lobes. The tracheal tube was removed at the end of the procedure and in the immediate postoperative period on a $F_{I_{O_2}}$ of 0.4 pH_a was 7.38, Pa_{CO_2} 43 mmHg, Pa_{O_2} 194 mmHg, and HCO_3^- 26 mEq/l. Breath sounds were reduced in the bases, but were otherwise normal as was the postoperative chest roentgenogram. A reduction in the left upper lobe breath sounds was noted for the first time seven hours postsurgery and 18 hours postsurgery the chest roentgenogram shown in figure 1 was obtained. The respiratory rate was 36/min and arterial blood pressure 140/100 mmHg. He complained of severe chest pain and at a $F_{I_{O_2}}$ of 0.4, pH_a was 7.4, Pa_{CO_2} 44 mmHg, Pa_{O_2} 89 mmHg, and HCO_3^- 28 mEq/l. A diagnosis of intrathoracic hematoma and accumulated clot in the left pleural space was made and the patient was taken to the operating room for evacuation of the clot. Following induction of anesthesia with thiopental and succinyl-

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