

# Comparison of alfentanil and halothane anaesthesia in paediatric ambulatory ENT surgery

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Forty children undergoing adenoidectomy were randomized to receive halothane (0.5-1.5%) or alfentanil (50 µg bolus followed by 0.5-1.5 µg kg<sup>-1</sup> min<sup>-1</sup> infusion) anaesthesia. All patients received N<sub>2</sub>O and vecuronium. All patients in the alfentanil group required supplemental boluses of alfentanil (10 µg kg<sup>-1</sup>) to control intraoperative hypertension. Emergence, recovery and discharge times as well as postoperative analgesic requirements were not significantly different between the two groups. We conclude that both techniques are suitable for paediatric ambulatory surgical patients.

Key words: Anaesthesia, paediatrics, ENT

## Introduction

Alfentanil is a synthetic opioid analgesic with a rapid onset and short duration of action. It differs from fentanyl in its more rapid equilibration between blood and brain, with a half life of 1-2 min as opposed to 5-7 min for fentanyl<sup>1</sup>. Alfentanil's short duration of action is due to its rapid redistribution to other tissues and its short terminal elimination half life<sup>2</sup>. Such a short-acting opioid may be particularly useful in ambulatory paediatric anaesthesia. This study compares the effect of alfentanil and halothane anaesthesia on postoperative pain and rate of recovery from anaesthesia in children undergoing brief ear, nose and throat (ENT) procedures.

## Materials and methods

Forty ASA physical status I or II ambulatory patients (ages 2-10 yr) undergoing adenoidectomy were the subjects of this single blind study. The protocol was approved by the Institutional Review Board and written informed consent was obtained from the parents in every case. None of the children received preoperative medica-

tion. Anaesthesia was induced with 70% nitrous oxide, oxygen, and halothane (1-4%) administered via a face mask. Patients received 0.1 mg kg<sup>-1</sup> of vecuronium intravenously to facilitate tracheal intubation. Following intubation patients were randomized to one of two study groups using a sealed envelope technique.

In group 1 patients halothane was discontinued following tracheal intubation. Alfentanil 50 µg kg<sup>-1</sup> bolus iv was administered, followed by an alfentanil infusion at a rate of 0.5-1.5 µg kg<sup>-1</sup> min<sup>-1</sup>. The infusion rate was adjusted to maintain arterial blood pressure within ± 20% of preoperative baseline. If, despite the maximum infusion rate of 1.5 µg kg<sup>-1</sup> min<sup>-1</sup>, blood pressure was higher than 20% of preoperative values, additional boluses of alfentanil (10 µg kg<sup>-1</sup>) were administered.

In group 2 patients anaesthesia was continued with halothane, nitrous oxide and oxygen. The inspired halothane concentration was adjusted between 0.5 and 1.5% to maintain arterial blood pressure within ± 20% of baseline values.

In either group if the heart rate decreased to below 20% of baseline values, atropine 0.01 mg kg<sup>-1</sup> was administered intravenously. All patients received an intravenous infusion of lactated Ringer's solution during surgery equal to four times the calculated hourly maintenance requirement.

Intraoperative monitoring included precordial stethoscope, noninvasive blood pressure, electrocardiography, pulse oximetry, axillary temperature and respiratory gas analysis by mass spectrometry.

Accepted: 16 March 1994

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**Table 1.** Study demographics and recovery variables

Variable	Group 1 (n = 20)	Group 2 (n = 20)	P
Age (yr)	3.6 ± 1.2	3.2 ± 1.0	NS
Weight (kg)	17.3 ± 5.1	17.7 ± 2.8	NS
Anaesthesia (min)	50.2 ± 14.0	47.6 ± 7.1	NS
Surgery (min)	25.6 ± 12.0	23.1 ± 9.3	NS
Emergency (min)	7.0 ± 3.8	8.9 ± 3.3	NS
Recovery (min)	12.8 ± 12.4	8.7 ± 7.2	NS
Discharge (min)	129 ± 52	123.7 ± 48.6	NS
Lowest SPO <sub>2</sub>	90.9 ± 6.7	91.8 ± 3.7	NS

NS = not significant.

After the completion of surgery, halothane or alfentanil infusion was discontinued. Residual neuromuscular blockade was antagonized by the intravenous administration of neostigmine 0.06 mg kg<sup>-1</sup> and atropine 0.02 mg kg<sup>-1</sup>. The nitrous oxide was then discontinued and the trachea was extubated when the child was breathing spontaneously, able to cough or gag, and made purposeful movements (emergence). After extubation the patients were transferred to the Postanaesthetic Care Unit (PACU). All the anaesthetic records were kept in a sealed envelope by the bedside to protect the blinded nature of the study.

Upon arrival in the PACU, objective pain assessments and recovery variables were assessed every 5 min by a research nurse blinded to the type of anaesthetic technique employed. Patients' recovery was assessed and recorded using the Steward recovery score<sup>3</sup>. Objective pain assessments were carried out every 5 min using a 10 point objective pain score<sup>4</sup>. Intravenous fentanyl 1–2 µg kg<sup>-1</sup> was administered to any patient who achieved a pain score of six or more points on two consecutive 5 min observations in PACU, and patients with less severe pain were treated with acetaminophen. All patients were observed in PACU and subsequently in a Short Stay Recovery Unit (SSRU) to determine the time they met predetermined discharge criteria. Home discharge criteria included stable vital signs, absence of respiratory distress, bleeding or pain, ability to ambulate appropriate for age, minimal nausea and vomiting, and the ability to tolerate clear liquids. All patients were monitored for a minimum of 3 h before being discharged from the hospital, to detect any possible delayed respiratory depression.

Parents of all patients were contacted by phone within 24 h of discharge to determine the child's return of normal appetite, need for additional analgesics at home, occurrence of nausea and/or vomiting and degree of alertness.

Demographic data of the groups were compared using Student's *t* test. Differences in recovery scores, pain scores, analgesic requirements, incidence of nausea and vomiting were compared using Pearson's  $\chi^2$  test. Repeated measurement of analysis of variance (ANOVA) was also used to compare pain scores in both groups.

## Results

Twenty children received alfentanil, oxygen and nitrous oxide as their maintenance anaesthetic (group 1). Twenty children received halothane, oxygen and nitrous oxide (group 2). Patients in both groups were comparable with regard to age, weight, preoperative heart rate, arterial blood pressure, and duration of anaesthesia and surgery (Table 1).

All patients who received alfentanil infusion required supplemental boluses of alfentanil to control intraoperative hypertension. The number of patients who required 1, 2, 3, or 4 boluses each to supplement the infusion was six, seven, four and three respectively. Six patients in group 1 required atropine for treatment of sinus bradycardia perioperatively, but this was not statistically different from those in group 2 (*n* = 4).

Emergence, recovery and discharge times were not significantly different between the two groups (Table 1).

No statistically significant difference was found between the percentage of patients in each group who received fentanyl and acetaminophen in the PACU or SSRU. The number of patients who had decreased SPO<sub>2</sub> (<90% for 30 s) or vomited in the recovery period did not differ between the two groups.

Using repeated measures analysis of variance (ANOVA) no difference was detected in overall pain scores or in changes in pain scores over time for each group. However, there was a significant decrease in pain scores for both groups over time (*P* < 0.0001).

There was no difference in the parents' report on the course of recovery after discharge from the hospital or their satisfaction with the anaesthetic experience.

## Discussion

This study was undertaken to investigate postoperative analgesia and recovery after two different general anaesthetic techniques for adenoidectomy in ambulatory paediatric patients.

The purpose of general anaesthesia is to abolish the conscious appreciation of pain during surgery and to provide good operating conditions without compromising vital functions<sup>5</sup>. Each of the two anaesthetic techniques provided good operating conditions. As a predominantly intravenous technique was being compared

with an inhalational one, it was not possible objectively to compare depths of anaesthesia; the depth of anaesthesia was judged on clinical grounds and the minimum concentration of anaesthetics which satisfied these conditions was administered<sup>5</sup>. In healthy children undergoing adenoidectomy, 50  $\mu\text{g kg}^{-1}$  bolus of alfentanil provided a short-lived (10–15 min) suppression of the haemodynamic response to surgical stimulation even when supplemented with  $\text{N}_2\text{O}$  and up to 1.5  $\mu\text{g kg}^{-1} \text{min}^{-1}$  of alfentanil infusion. Other investigators have shown that the same dose of alfentanil (50  $\mu\text{g kg}^{-1}$ ) combined with  $\text{N}_2\text{O}$  was effective for 15 min only; additional increments of 12.5  $\mu\text{g kg}^{-1}$  were required to control the hypertensive response to surgical stimulation<sup>6</sup>. It appears that for procedures lasting less than 1 h either a higher initial bolus dose, a higher infusion rate of alfentanil, or both should be considered.

The emergence and recovery findings in this study are different from previous studies in children and adults<sup>6,7</sup>. Whereas those studies found that recovery was more rapid after alfentanil than after halothane, the time to extubation (emergence) and recovery was not significantly different in our patients. It is possible that the need for repeated boluses of alfentanil may have delayed emergence in our patients. One can only speculate that a higher initial bolus or infusion rate may have allowed lower infusion requirements towards the end of surgery, and would possibly have promoted faster emergence.

In the recovery period nausea and vomiting were more frequent in the alfentanil group and although these differences were not statistically significant, this may have prevented early discharge of these patients according to our predetermined criteria.

Studies carried out to compare recovery after general anaesthesia using psychomotor testing found no differences between those who received alfentanil or halothane, and in both groups there was a delay in return to

normal for some hours after either technique<sup>5</sup>. There is a need to warn parents that even though children are being discharged home 2–3 h after anaesthesia, they should not be allowed to perform these tasks requiring serious motor coordination such as riding a bicycle.

This study demonstrated that both anaesthetic techniques result in rapid awakening from anaesthesia, and also rapid recovery, so that patients in both groups met the criteria to be discharged from hospital in similar times. Both techniques are therefore suitable for paediatric ambulatory patients.

#### Acknowledgements

Supported in part by a research grant from Janssen Research Foundation

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