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Comparison of induction and recovery between sevoflurane and halothane supplementation of anaesthesia in children undergoing outpatient dental extractions

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Summary

We have compared sevoflurane and halothane in a double-blind controlled study for supplementation of nitrous oxide and oxygen anaesthesia in 80 children undergoing dental extraction as outpatients. Induction of anaesthesia was more rapid in those who received sevoflurane compared with those who received halothane (89 s compared with 127 s for loss of eyelash reflex). In both groups, mean duration of administration of anaesthesia was less than 4 min. Those who received sevoflurane were slower to awaken (167 s compared with 102 s), although discharge times from hospital were similar. The incidence of complications during induction and maintenance was low in both groups and return to normal appetite and activity occurred in the majority of children on the same day. More children who received halothane suffered nausea after leaving hospital. We conclude that sevoflurane is a suitable alternative to halothane, with more rapid induction of anaesthesia, but in these short procedures, awakening time was slower than after halothane. (*Br. J. Anaesth*. 1997; **78**: 157–159)

Key words
Anaesthesia, paediatrics. Anaesthetics volatile, halothane. Anaesthetics volatile, sevoflurane. Surgery, dental. Children.

The majority of patients who require anaesthesia for dental extraction are children who are unwilling to accept needles and request inhalation induction. Rapid induction and swift recovery are desirable characteristics of anaesthesia for these short procedures which are performed on an outpatient basis. The low blood:gas partition coefficient of sevoflurane[1] and its lack of airway irritability suggest that it has many features of the ideal inhalation agent[2] and that it may be preferable to halothane for short procedures in children.[3–9] Although more rapid recovery from anaesthesia with less soluble agents may be anticipated, a previous study[10] comparing isoflurane with halothane did not show this to be the case in paediatric dental outpatients.

We have compared induction, maintenance and recovery from brief anaesthesia when either sevoflurane or halothane was the sole supplement to anaesthesia with nitrous oxide and oxygen in unpremedicated children undergoing outpatient dental extractions.

Patients and methods

After obtaining local Ethics Committee approval and written parental consent, we studied 80 healthy children, not receiving any medication, aged 5–12 yr, undergoing dental extraction as outpatients for which inhalation induction of anaesthesia was requested. Children were allocated randomly to one of two groups to receive either sevoflurane or halothane supplementation of 66% nitrous oxide in oxygen, in approximately equipotent inspired concentrations.[2 11]

No premedication was used. Induction of anaesthesia was by inhalation of 2% sevoflurane or 0.75% halothane and 66% nitrous oxide in oxygen for five breaths before maintenance with 4% sevoflurane or 1.5% halothane until the teeth had been extracted. The vaporizer settings were controlled behind a screen by a second anaesthetist, such that the administering anaesthetist was unaware which volatile agent was being given. Anaesthesia was given with the child sitting in the dental chair, via a close-fitting nasal mask using a Mapleson A system with active scavenging. Routine digital pulse oximetry was used to monitor oxygen saturation. The times at which loss of eyelash reflex occurred and at which jaw tone became sufficiently relaxed to permit insertion of a dental gag and mouth pack were recorded. These times and the presence or absence of complications were assessed by the administering anaesthetist.

Recovery from anaesthesia was assessed by the time taken from discontinuation of anaesthesia until the child opened his/her eyes. In the recovery room, experienced recovery nurses, who were also unaware of the agent used, recorded when the child was able to stand unaided without swaying and was able to walk in a straight line. The presence or absence of nausea, vomiting, shivering, headache and coughing

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in recovery and when the child was ready to leave hospital were also recorded.

Return to normal activity and normal appetite in addition to the presence or absence of headache, nausea, vomiting, dizziness, muscle aches and bad dreams were sought using a questionnaire completed and returned by the accompanying parent.

Statistical comparisons of patient characteristics, operative details, and induction and recovery times were made by unpaired Student's *t* test. Complications during induction of anaesthesia, while recovering in hospital and after going home were compared by chi-square test.

Results

Both groups were comparable in age, weight, number of teeth extracted, duration of administration of anaesthesia and duration of surgery (table 1). Induction of anaesthesia was significantly shorter ($P<0.05$) in children who received sevoflurane in whom the mean time to loss of eyelash reflex was 89 s compared with 127 s in those who received halothane (table 1). There were notably few airway complications during induction and maintenance of anaesthesia (table 2). Although movement was noted in some children, this did not interfere with dental extraction.

Mean duration of administration of anaesthesia was similar in both groups and was less than 4 min (table 1). While those children who received halothane awakened significantly more rapidly than those who received sevoflurane, there was no difference in the times taken to stand without swaying and to walk in a straight line unaided. The times at which the children were considered ready for discharge from hospital were similar in both groups.

Table 1 Patient characteristics, clinical data and induction and recovery times for sevoflurane and halothane anaesthesia (mean (SD or range)). * $P<0.05$ (unpaired Student's *t* test)

	Sevoflurane ($n=40$)	Halothane ($n=40$)
Age (yr)	8.0 (5–12)	7.9 (5–12)
Weight (kg)	27.1 (9.2)	26.5 (8.6)
Teeth extracted (*n*)	3.1 (2.0)	2.9 (1.9)
Duration of anaesthetic administration (s)	224 (82)	232 (61)
Duration of surgery (s)	99 (74)	87 (52)
Loss of eyelash reflex (s)	89 (26)	127 (32)*
Loss of jaw tone (s)	125 (47)	146 (31)*
Eye opening (s)	167 (98)	102 (70)*
Standing (min)	16.8 (4.4)	14.8 (4.4)
Walking (min)	18.0 (4.9)	17.0 (5.5)
Discharge time (min)	23.5 (6.4)	23.7 (6.3)

Table 2 Complications during induction and maintenance of anaesthesia (number of children)

	Sevoflurane ($n=40$)	Halothane ($n=40$)
Coughing	1	0
Salivation	1	1
Laryngospasm	2	2
Oxygen saturation <95%	0	0
Intraoperative movement	18	13

Table 3 Complications during recovery in hospital (number of children)

	Sevoflurane ($n=40$)	Halothane ($n=40$)
Nausea	10	4
Vomiting	4	1
Coughing	1	0
Shivering	1	0
Headache	10	13
Intraoperative recall	0	0

Table 4 Reported complications after discharge from hospital. *$P<0.05$ (chi-square test)

	Sevoflurane ($n=31$)	Halothane ($n=32$)
Nausea	3	10*
Vomiting	1	3
Headache	4	4
Dizziness	3	5
Bad dreams	2	0
Muscle aches	5	4

Table 5 Postoperative return to normal activity and appetite (number of children)

	Sevoflurane ($n=31$)	Halothane ($n=32$)
Normal appetite		
Same day	24	22
Next day	7	9
Later	0	1
Normal activity		
Same day	22	20
Next day	8	12
Later	1	0

Headache and nausea were the most frequent complications in the recovery room: there was no significant difference between groups (table 3). After discharge from hospital parents returned questionnaires for 31 children who received sevoflurane and 32 who received halothane. Significantly more children who received halothane suffered nausea after leaving hospital (table 4). The majority of children returned to normal activity and appetite the same day and all except one in each group did so by the following day (table 5).

Discussion

The most surprising finding was that despite more rapid induction of anaesthesia with sevoflurane, the time to awaken was faster with halothane. This was similar to the finding in a previous study comparing isoflurane and halothane under almost identical conditions.[10] The more rapid induction of anaesthesia with sevoflurane (and isoflurane) is expected from published wash-in curves[12] and is confirmed in clinical practice.[3–9] However, published wash-out curves[12] and initial clinical experience[3–6 8 13] also suggest that early recovery is more rapid after sevoflurane than after halothane. The important difference in our study was the short duration of anaesthesia. At the end of 4 min, children who received sevoflurane were nearer the stage of full saturation than those who received halothane. Consequently, when

surgery ended and sevoflurane was discontinued, serum concentrations decreased mainly by excretion whereas for those receiving halothane, considerable scope was available for serum concentrations to decrease by redistribution, in addition to excretion through the lungs. Thus because the volatile agents were discontinued before a state of "plateau" pharmacokinetics had been reached, the relative behaviour of the usually published wash-out curves cannot be expected.

The potentially distressing time for children is during induction of anaesthesia and the fact that sevoflurane reduced the time to loss of eyelash reflex by an average of 38 s (or by 30%) was both statistically and clinically significant. The study was designed to make a direct comparison between sevoflurane and halothane and we accept that higher initial concentrations of sevoflurane or other techniques of induction can further reduce induction times.[14] The absence of respiratory complications on induction is also important to the acceptability of volatile agents for inhalation induction, and both sevoflurane and halothane were well accepted and non-irritant. Notably, there were no episodes of hypoxia.

As in a previous study,[10] the majority of children resumed normal activity and appetite on the same day. This reflects rapid recovery from anaesthesia and minimal effects of minor surgery. The incidence of nausea after leaving hospital was greater in those children who received halothane, but if the results are combined for those who suffered nausea while still in hospital, there was no difference between the agents. The irritant effects of swallowed blood after dental extraction may not make this study comparable with others in children undergoing other types of surgery.

In summary, we found sevoflurane to be a suitable alternative to halothane for dental outpatient surgery in children, having a significant advantage in the speed of induction. The slower awakening time after sevoflurane did not delay discharge from hospital. Recovery to normal activity and appetite was good, and there was a low incidence of adverse effects during induction, maintenance and recovery.

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