A TRIAL OF ENFLURANE FOR PAEDIATRIC OUT-PATIENT ANAESTHESIA

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ENFLURANE ($\text{CF}_2\text{H}-\text{O}-\text{CF}_2-\text{C}-\text{Cl}-\text{FH}$), a widely used general anaesthetic, has been recommended for out-patient anaesthesia.¹ Induction is reported to be smooth,² and induction and recovery times to be shorter than with halothane.³ Cardiac and respiratory depression is minimal as are post-operative sequelae.⁴ Thus it would appear to be an ideal agent for the out-patient. The following clinical trial was designed to compare this agent with halothane for paediatric out-patients.

PATIENTS

A series of 86 healthy children were randomly assigned to two groups: 50 of these received enflurane anaesthesia and the remaining 36 received halothane. The ages and weights of the children are listed in Table I. The operation, bilateral myringotomy and insertion of ventilating tubes, was similar in all the patients, as was the duration of surgery (Table I).

METHODS

No patients received premedication. Intravenous thiopentone 5 mg/kg mixed with atropine 0.02 mg/kg was used to induce anaesthesia. Fifty per cent nitrous oxide and oxygen was then administered with a face mask. Either enflurane or halothane was then added to the inspired gases from a temperature compensated calibrated vapouriser* and the concentration was increased as rapidly as tolerated (halothane to 2.5 per cent, enflurane to 5 per cent) to achieve a suitable plane of anaesthesia for the planned surgery. Once the operation had commenced the concentration of inhaled vapour was reduced to maintenance levels until the operation was completed.

Speed of induction was measured by watching for movement of the patient in response to a surgical stimulus (application of the myringotomy knife to the tympanic membrane) at timed half-minute intervals after enflurane or halothane vapour was added to the inspired gases. Recovery time was measured using the simplified post-operative recovery scoring system.⁵ The nurses responsible for assigning recovery scores were not informed which agent had been administered.

Intra-operative and immediate post-operative complications were recorded and the parents were provided with a follow-up questionnaire on which to record details of recovery at home and to report any post-operative complications.

*Fluotec Mark III or Enflurtec, Cyprane Limited, Keighley, England.

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TABLE I

	Enflurane	Halothane
Number	50	36
Age (years)	4.51 ± 2.2	4.72 ± 1.9
Weight (Kg)	18.0 ± 6.1	17.2 ± 4.6
Duration of operation	15.0 ± 3.5	16.4 ± 3.3

RESULTS

Induction of anaesthesia (Figure 1) required almost twice the time (seven minutes) with enflurane as with halothane (four minutes). Six patients who received enflurane developed troublesome coughing or laryngospasm during induction of anaesthesia (Table II). On four occasions this problem was corrected by reducing the inspired concentration of enflurane briefly, for the other two patients it was felt necessary to discontinue the agent and the child was omitted from the remainder of the study. During the early recovery period, scores for the enflurane

FIGURE 1. Response to surgical stimulation during induction with enflurane and halothane in 25 patients. Time refers to interval since commencing administration of the inhalation agent. Percentage responding refers to the percentage of patients showing movement of any part of the body in response to the surgical stimulus at each time-interval.

TABLE II
INCIDENCE OF INTRA-OPERATIVE COMPLICATIONS

	Halothane	Enflurane
Coughing	Nil	2 patients
Laryngospasm	Nil	4 patients

group appear higher on admission to the post-anaesthetic room, (P.A.R.) (see Figure 2), but this difference is not statistically significant. There is no difference in scores thereafter.

Examination of returned questionnaires (Table III) showed that the majority of patients in both groups rapidly returned to a normal status and were considered by their parents to be "bright and alert" and to have a normal appetite. There was, however, a tendency for some of the children given enflurane to have a slightly slower progression back to normal status. Minor post-anaesthetic morbidity is listed for each agent in Table IV.

FIGURE 2. Post-anaesthesia recovery scores. Means and standard deviation for all 86 patients in both groups. No significant difference between any pair of scores.

TABLE III
RETURN TO NORMAL APPETITE (PER CENT OF PATIENTS)

	Enflurane	Halothane
Evening of surgery	84	91
Next day	10	9
Later	6	0
	<hr/> 100	<hr/> 100
Return to "bright and alert" status. (Per cent of patients)		
Evening of Surgery	82	92
Next day	13	8
Later	5	0
	<hr/> 100	<hr/> 100
Return to normal activity (per cent of patients)		
Evening of surgery	76	85
Next day	21	15
Later	3	0
	<hr/> 100	<hr/> 100

TABLE IV
PER CENT INCIDENCE OF POST ANAESTHETIC COMPLICATIONS

	Enflurane	Halothane
Nausea and vomiting	4	6
Headache	18	6
Muscle pains	10	0
Dizziness	6	6
Bad dreams	6	12

DISCUSSION

Ideally out-patients should receive an agent which produces speedy induction of surgical anaesthesia and swift emergence, followed by rapid return to normal activity and appetite with no side effects. For many years halothane has been the most frequently used agent for paediatric out-patients and it has been considered closest to the ideal.⁶ Enflurane, a relatively new agent, has some physical properties which suggest that it might surpass halothane, especially for short surgical procedures and out-patient anaesthesia. The low blood/gas solubility coefficient of enflurane should result in more rapid induction and recovery. The low level of biotransformation of this drug should result in elimination of most of the drug unchanged through the lungs, without the formation of metabolic products which could delay full recovery. Several studies have confirmed the usefulness of enflurane for adult out-patients.

The present study was planned to assess the efficacy of enflurane for very short procedures, where speed of induction and recovery is most important; and to study

the recovery of children to a normal status at home after enflurane and to compare this with halothane.

Speed of induction of anaesthesia as measured in the present series was significantly slower with enflurane than with halothane, a result similar to that reported by Horne and Algren⁷ who also studied children but used only an inhalation induction. No explanation is offered for this observation, but it is considered that the delay is only partly due to the fact that enflurane must be introduced more slowly than halothane if coughing is to be avoided. Govaerts and Sanders³ also used an inhalation induction for children and did find shorter induction times with enflurane; but they were using 80 per cent nitrous oxide in the inspired gases. The present study shows that, even when preceded by a barbiturate induction, surgical levels of analgesia were achieved more slowly with enflurane than with halothane.

It was disappointing that a sleep dose of thiopentone did not facilitate subsequent inhalation of enflurane and remove the problem of coughing and breath-holding during induction. A relatively high incidence of coughing and laryngospasm during induction with enflurane and following extubation has been reported in children by other authors,^{7,8} and though this may become less frequent as experience is gained with the drug, it is a significant disadvantage.

Recovery times following enflurane anaesthesia have been reported by several authors and, while many anaesthetists have a strong clinical impression that these patients awaken more rapidly, objective tests have generally failed to demonstrate very much difference between the agents. An exception is the work of Govaerts and Sanders³ who showed a significantly shorter recovery period with enflurane. The use of the post-operative scoring system permits an accurate assessment of the speed of return of vital functions. After enflurane the patients in this series did achieve higher scores immediately on admission to the P.A.R., but the scores were essentially similar to those after halothane by five minutes post-operatively.

Recovery at home as measured by the responses of the parents to the questionnaire showed little difference between the agents, but certainly indicate no distinct advantage for enflurane. More patients in the enflurane group had delayed return to a normal appetite, which has been reported in at least one other survey.⁸ Such an effect on appetite is quite undesirable in paediatric out-patients and makes it more difficult for the parents to provide adequate post-operative fluid intake. A similar number of patients in the enflurane group showed delays in return to normal active status.

The incidence of post-anaesthesia complications was little different between the two groups. Headache and muscle pains did, however, seem to occur slightly more frequently in the enflurane group. A higher incidence of bad dreams previously reported after enflurane in children⁷ was not demonstrated in the present study.

In conclusion, a study has been made of the efficiency of enflurane as compared to halothane for short surgical procedures in the paediatric out-patient. Enflurane did not demonstrate any significant advantage over halothane and, indeed, showed several possible disadvantages: induction of anaesthesia was slower and more frequently interrupted by coughing and laryngospasm. Recovery at home was slower in some patients. Halothane remains the potent inhalation agent of choice for paediatric patients.

SUMMARY

Enflurane was compared with halothane for anaesthesia for short surgical procedures in paediatric out-patients. Induction of anaesthesia was more prolonged with enflurane and recovery times were similar with both agents. Coughing and laryngospasm during induction occurred more frequently with enflurane. The incidence of post-operative complications was essentially similar in both groups, but there was no evidence that the use of enflurane was followed by rapid recovery at home.

Enflurane has no advantages over halothane in anaesthesia for short procedures for paediatric out-patients.

RÉSUMÉ

Nous avons comparé l'anesthésie à l'enflurane à celle à l'halothane dans les cas de chirurgie pédiatrique effectués sur base externe. L'induction était plus longue à l'enflurane alors que le temps d'éveil était similaire. L'incidence de toux et de laryngospasme était plus élevée avec l'enflurane qu'avec l'halothane. Les complications post-opératoires étaient aussi fréquentes avec l'une qu'avec l'autre technique. Le questionnaire rempli par les parents n'a pas montré de supériorité de l'enflurane, le retour à l'activité normale étant plus lent chez certains enfants.

En conclusion, l'enflurane n'offre pas d'avantages sur l'halothane pour les courtes interventions effectuées sur base externe chez l'enfant.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. David P. Mitchell, Otolaryngologist-in-Chief, The Hospital for Sick Children, for his co-operation with this study, and Dr. R.E. Creighton for his assistance.

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