FLUOTHANE FOR PAEDIATRIC ANAESTHESIA*

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A CLINICAL EVALUATION of Fluothane as applied to paediatric anaesthesia was carried out. No special metabolic studies were done. Fluothane was administered to 300 patients, ranging in age from 5 hours to 18 years (Table I), and in weight from 5½ to 184 pounds. This agent was used in the anaesthetic management of almost every type of surgery (Table II). Patients undergoing cardiovascular surgery were omitted from this study.

TABLE I
DISTRIBUTION OF CASES ACCORDING TO AGE

Age	Number
During 1st week of life	3
1 week to 6 months	31
6 months to 2 years	57
2 years to 5 years	74
5 years to 10 years	86
Over 10 years	49
Total	300

TABLE II
TYPES OF SURGERY

Type	Number
Head and neck (excluding intracranial)	91
Intracranial	5
Thoracic	3
Abdominal	62
Plastic (excluding head and neck)	50
Orthopaedic	25
Adenotonsillectomy (induction only)	25
Endoscopy	17
Cystoscopy	9
Neurological investigation	13
Total	300

PREMEDICATION (Table III)

Bradycardia has been reported during the administration of Fluothane. Premedication with atropine sulphate has been recommended for its prevention (1). With a routine dose of atropine sulphate (2) an average of the slowest cardiac rates observed by us during operation was 122 beats/min. The average of the slowest rates in the unpremedicated cases was 105 beats/min. Atropine also rendered the cardiac rate less labile. Changes in rate subsequent to changes in

*Fluothane used in this study was supplied by Ayerst, McKenna and Harrison Ltd., through the courtesy of Dr. Leighton Smith.

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TABLE III
PREMEDICATIONS USED

Premedication	Number
Unpremedicated	78
Atropine sulphate	123
Demerol and atropine sulphate	97
Other combinations	2
Total	300

vapour concentration were of a smaller magnitude than those observed when premedication was omitted

The inclusion of Demerol in the premedication did not appreciably alter the concentration of Fluothane required for maintenance, and resulted only in a slight prolongation of recovery time.

METHODS OF ADMINISTRATION

The open drop technique provided rapid induction and an easily controlled maintenance phase.

Insufflation of the airway with Fluothane vapour, nitrous oxide, and oxygen was the technique used in bronchoscopy and for most infants and younger children. Four methods of insufflation were employed (*a*) under an open mask, (*b*) with an oropharyngeal airway, (*c*) through the side arm of a bronchoscope, and (*d*) by means of a modified Ayer's tube

A non-rebreathing technique employing the Stephen-Slater valve was used in most of the older children.

The closed technique with carbon dioxide absorption was not employed in this series.

EQUIPMENT

Fluothane was vaporized by passing mixtures of nitrous oxide and oxygen over its surface in several standard types of ether and trichlorethylene vaporizer. Although these methods proved adequate, the extreme potency of the agent necessitated a considerable amount of practice to establish the range of settings that would give reproducible clinical effects. Once stabilized, the depth of anaesthesia could be markedly altered by minute changes in the vaporizer setting.

A "Fluotec"¹ vaporizer was employed in 128 cases. Designed especially for the administration of Fluothane, this vaporizer delivers a fixed concentration of vapour over a broad range of temperatures and gas flows for periods up to one hour. The 0.1 per cent intervals with which the apparatus is calibrated rendered the administration of Fluothane dependable and easy. All percentage concentrations mentioned in the body of this paper will refer to settings on the Fluotec Vaporizer.

¹Manufactured by Cyprane Ltd., Keighley, England. Loaned for this study by Canam Surgical Services Ltd., Toronto, through courtesy of Mr. Fraser Sweatman.

INDUCTION

Anaesthesia was induced on 44 occasions with the open drop technique. Fluothane was comparable to chloroform in the amount required and the rapidity of induction. Patients passed rapidly through the first and second stages with less excitement than seen with other commonly used volatile agents. Although several children objected to the odour of the vapour, irritation was minimal, and coughing occurred in only one case. Salivation was depressed, even in unpremedicated patients. The transition to open ether, when used, was very smooth with quiet respiration free from laryngospasm, coughing, retching, or salivation.

Anaesthesia was induced on 71 occasions with 60–80 per cent nitrous oxide, oxygen, and Fluothane, administered by either the insufflation or non-rebreathing technique. The effects were the same as those seen with open drop induction. A gradual increase in the concentration of Fluothane vapour was most easily obtained with the Fluotec vaporizer. Patients on whom this apparatus was used exhibited the smoothest induction that the writers have encountered. A 2 per cent concentration was required for almost all patients and exceeded 2.5 per cent on only one occasion.

MAINTENANCE

(1) *With inhalation agents only* During the initial investigation of Fluothane we made a habit of adding a little ether vapour to the mixture of gases for about three or four minutes before intubation or incision. This was done in order to avoid any reflex movement of the patient and the inevitable "surgical" condemnation of a new drug. Broader experience and greater confidence has enabled us to omit this addition for certain patients.

Fifty-one procedures were performed under Fluothane alone or in combination with nitrous oxide and oxygen. Only moderate relaxation was required for this group: incision of abscesses, reduction of simple fractures, soft-tissue orthopaedics, plastic procedures, mastoidectomies, and bronchoscopic *suctions*. The latter required insufflation of up to 3 per cent Fluothane through the bronchoscope. The other procedures required only 0.7–1.0 per cent for maintenance.

We have continued to add ether for opening and closing peritoneum and for bronchoscopies other than simple *suctions* in order to avoid over-dosage with Fluothane.

(2) *With relaxants and/or barbiturates for induction* Fluothane was the principal agent following induction with a variety of barbiturates: thiopental in 91 cases, methitural in 42 cases, and buthalitone in 18 cases. Relaxation appropriate to the procedures was achieved with succinylcholine, decamethonium, or d-tubo curare. Although a few patients required up to 1.5 per cent Fluothane to establish anaesthesia, the majority were readily established with 1.0 per cent. Subsequent reductions in concentration were made in all cases. Almost all patients were easily maintained with 0.7–0.8 per cent settings.

Fluothane following d-Tubo Curare

Bryce-Smith and O'Brien have warned against the administration of curariform agents to patients under Fluothane anaesthesia (3). The reported effects have

been bradycardia and profound hypotension. Fluothane was administered to 48 patients in this series *following* the injection of d-tubo curare. Abdominal relaxation was achieved with doses of 1 mg./10 lbs. Patients requiring only moderate relaxation received 1 mg./15 lbs. A bradycardia of 72 beats/min. was observed in only one patient. The systolic pressure of one patient fell from 110 to 60 mm. Hg when 2.5 per cent Fluothane was administered following the larger dosage of d-tubo curare. Reducing the Fluothane concentration to 1.5 per cent resulted in a prompt return of pressure to normal levels.

Use of Adrenalin with Fluothane

Varying volumes of procaine 1.0 per cent with added adrenalin (1:60,000) were injected subcutaneously in 21 patients undergoing plastic surgery. The only effects noted were a slight increase in cardiac rate (10–20 beats/min.) accompanied by a slight increase in respiratory rate. No arrhythmias were observed clinically. Continuous monitoring with the electrocardiograph was not done.

RECOVERY FROM ANAESTHESIA

Recovery from anaesthesia was characterized by a complete return of the sensorium at an extremely rapid rate. The average time for complete recovery with various anaesthetic combinations was observed by one of us (C.S.) (Table IV). A tendency to fall asleep following recovery was rarely observed.

Although no records were kept of the number of postoperative emeses, the absence of vomiting was a noticeable feature of the recovery period.

TABLE IV
AVERAGE RECOVERY TIMES FOLLOWING FLUOTHANE

Anaesthetic combinations	Average time (min)	Number of cases
Fluothane (alone and with N ₂ O O ₂)	7 2	35
Fluothane with added ether	10 4	55
Thiopental induction+Fluothane	11 4	14
Methitural induction+Fluothane	7 7	38
Buthalitone induction+Fluothane	8 7	18

ASSESSMENT

Fluothane can be administered by simple techniques. Because of its potency a method of obtaining precise concentrations is preferred.

As salivary secretions are diminished, premedication with drying agents may be omitted. Atropine is advisable, however, for the prevention of bradycardia resulting from higher Fluothane concentrations.

The absence of irritation rendered Fluothane highly acceptable to the great majority of children. This acceptance together with its rapid action and freedom from side effects makes Fluothane a very useful induction agent. Induction by the open drop technique should be *drop by drop* to avoid over-dosage which can easily occur.

Relaxation of the jaw occurs early. Intubation or endoscopy can be readily performed providing anaesthesia has been maintained for about five minutes. With shorter induction periods recovery is so rapid that difficulties may be experienced both during and immediately following intubation.

Levels of anaesthesia deeper than stage III, plane 2, were attended by respiratory depression and bradycardia. Supplementation with either relaxants or ether is recommended for abdominal relaxation.

Insufflation of Fluothane is effective for bronchoscopic suctions in which some degree of coughing is desirable. Other endoscopic procedures, such as removal of foreign body and bronchography, require the addition of ether for a quiet operating field.

Formerly, intravenous cut-downs were employed in some infants for the sole purpose of administering non-explosive agents. The non-inflammable quality of Fluothane offers a useful alternative wherever explosion hazards are encountered.

The rapid uncomplicated recovery following out-patient procedures is advantageous.

Changes in the size of the pupils provide a guide to anaesthetic depth. The myosis of the upper third stage is more intense than that seen with any other agent.

As a drug, Fluothane is an excellent hypnotic, a good analgesic, and a moderate relaxant.

SUMMARY

Fluothane was administered to 300 patients ranging in age from 5 hours to 18 years, and in weight from 5.5 to 184 pounds. It was used in all types of operations, either alone or in combination with all other agents in routine use.

All inhalation techniques other than closed were used. The preferred method of administration was by means of a "Fluotec" vaporizer, but other standard types of vaporizers and open drop methods were satisfactory.

Unconsciousness could be produced rapidly and smoothly, without laryngospasm or vomiting.

Good first and reasonably satisfactory second plane surgical anaesthesia could be produced. For deeper planes of anaesthesia supplementation by other agents was preferred to the use of greater concentrations of Fluothane.

A rapid return of a clear sensorium, even after prolonged anaesthesia, was a dominant feature of the recovery period. Nausea and vomiting were minimal.

The side effects noted were marked myosis, decrease in salivation, decrease in cardiac rate with increasing depth of anaesthesia, absence of sweating, and frequent tearing. Hypotensive effects were infrequent and not severe.

Fluothane is an excellent hypnotic, a good analgesic, but only a moderate relaxant. The extreme potency of the agent recommends it for use by the qualified anaesthetist only.

RÉSUMÉ

Nous avons administré le Fluothane à des malades dont l'âge variait de 5 heures à 18 ans et dont le poids allait de 5½ livres à 180 livres. Nous l'avons employé

pour toutes sortes d'opérations. Nous l'avons employé seul ou associé à tous les agents d'usage courant.

Nous avons employé toutes les techniques pour inhalation sauf le circuit fermé. La méthode que nous préférons est celle du vaporisateur "Fluotec" quoique les autres sortes de vaporisateurs et le goutte à goutte nous ont donné de bons résultats.

Nous avons pu produire l'inconscience de façon rapide et douce, sans spasmes laryngés et sans vomissements

Nous avons atteint comme niveau d'anesthésie un premier plan et même un deuxième plan chirurgical. Quand un plan plus profond était nécessaire, nous avons préféré associer d'autres agents plutôt que d'augmenter les concentrations du Fluothane.

La période du réveil a été caractérisée par un retour rapide à la lucidité même après des anesthésies de longue durée. Les nausées et les vomissements sont réduits au minimum.

Les effets secondaires observés sont un myosis marqué, une diminution de la salivation, un ralentissement du rythme cardiaque à mesure que s'approfondit l'anesthésie, une absence de transpiration et du larmolement fréquent. Nous n'avons observé de l'hypotension qu'occasionnellement et elle n'a pas été prononcée.

Le Fluothane est un hypnotique de première qualité, un bon analgésique mais il ne donne qu'un faible relâchement musculaire. Le fort pouvoir anesthésique de cet agent nous incite à recommander que des anesthésistes qualifiés seulement en fassent usage.

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