CLINICAL OBSERVATIONS ON FLUOTHANE ANAESTHESIA*

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THE DEPARTMENT OF ANAESTHESIA at the Hôtel-Dieu Hospital in Quebec City has used Fluothane in many different types of anaesthetic machine with various techniques in a total of 1,112 surgical patients of all ages.

Fluothane is a volatile anaesthetic agent; it is a halogenated ethane, 2-bromo-2-chloro-1,1,1-trifluoroethane, with the structural formula:

PHYSICAL, CHEMICAL AND PHARMACOLOGICAL PROPERTIES

It is a clear, colourless liquid, with a specific odour. It is non-inflammable and non-explosive. It is a stable compound but theoretically, when exposed to air, moisture or light, it may in time break down into various acids of the halide group. The decomposition products may affect certain metals, such as tin and aluminum. Liquid Fluothane may attack rubber, producing softening and swelling. The rubber reverts to normal when withdrawn from the Fluothane. Clinically, the decomposition products have no toxic effects even though they are theoretically harmful. Thymol added to Fluothane, in a proportion of 0.01 per cent, protects Fluothane from the effects of light. Storage in a cool place, in amber-coloured bottles, also retards decomposition indefinitely. Fluothane is stable in contact with warm or cold soda lime, and it may be used safely in a closed circuit with a CO₂ absorber. On the skin, this anaesthetic does not produce the burning sensation which is felt after the application of ether or chloroform. It is non-irritating to the buccal, laryngeal or tracheal mucosa. It does not cause pulmonary oedema. Its therapeutic index is twice that of ether, and it is four times more potent. The anaesthetic ratio is from 1 to 3 per cent (1-3).

Table I shows the physical and chemical characteristics of Fluothane as compared with those of chloroform, ether, Vinethene, Vipamar and Fluoromar.

STATISTICAL DATA

In these studies, Fluothane has been administered using various types of anaesthetic apparatus: the Heidbrink No. 7 bottle with the wick atomizer, on

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Anaesthetic	Type	Chemical formula	Molecular weight	Boiling point	Specific gravity—liquid (water = 1)	Solubility in 100 parts water	Solubility oil—water 37° C.	Limits of flammability — Air Oxygen	Vapour tension at 20° C. mm. Hg
Chloroform	Chlorinated hydrocarbon	CHCl_3	119.39	61.26	1.49	0.822	100		160.5
Ether	Diethyl-ether	$(\text{C}_2\text{H}_5)_2\text{O}$	74.12	34.6	0.713	7.5	3.2	1.85–2.10–36.5 82.0	439
Vinethene	Divinyl-ether	$(\text{C}_3\text{H}_5)_2\text{O}$	70.9	28.3	0.774	4.0	41.3	1.7 27.0 85	—
Vinamar	Ethyl-vinyl-ether	$\text{C}_3\text{H}_5\text{—O—C}_2\text{H}_5$	72.10	35.8	0.759		45	— 2.1	4.85
Fluoramar	Fluorinated hydrocarbon	$\text{CF}_3\text{—CH—O—CH—CH}_2$	126.0	42.7	1.13	0.4	94	3.0	—
Fluothane	Halogenated ethane	$\text{CF}_3\text{—CH—Br—Cl}$	197.39	50.2	1.86	0.345	330	Non-inflammable with O_2 0.5–50.0	243

inspiration and expiration, the Marrett and Boyle, in closed and semi-closed circuits, the McKesson, E M O, Friedman apparatuses, and the M I.E. paediatric machine. The Fink valve was used for measuring pulmonary ventilation during anaesthesia.

Fluothane has been used alone with a nitrous oxide-oxygen mixture and in various other combinations.

Combined Anaesthetics

N ₂ O+O ₂ +Fluothane	817
Neraval+N ₂ O+O ₂ +Fluothane	92
Pentothal+N ₂ O+O ₂ +Fluothane	181
N ₂ O+O ₂ +Fluothane+C ₃ H ₈	7
N ₂ O+O ₂ +Fluothane+(C ₂ H ₅) ₂ O	4
Fluothane+local (knee)	1
Fluothane+brachial block	4
Fluothane+spinal	3
Fluothane+caudal	1
Fluothane+Viadril	2

1,112

Fluothane has been employed in 1,112 surgical cases for different lengths of time, in patients of all ages and of both sexes (514 male, 598 female). Several patients were anaesthetized with Fluothane more than once, the intervals between anaesthesia varying from a few days to a few weeks (57 twice, 5 three times, and one four times).

Many patients received no pre-anaesthetic medication, for others, premedication did not differ from that currently used with other methods of general anaesthesia.

Preoperative clinical examinations demonstrated certain disease processes in some patients. pulmonary emphysema, pulmonary sclerosis, bronchitis, asthma, mitral stenosis, chronic endocarditis, coronary sclerosis, old infarct, bronchial obstruction, ventricular strain, diabetes, and vascular disorders of the extremities

CLINICAL STUDIES

Studies of the effect of anaesthesia and of the action of Fluothane on the autonomic and central nervous systems, as well as on the cardio-respiratory and renal systems, give quite a clear concept of the clinical value of this new, volatile, anaesthetic agent.

Induction and Maintenance of Anaesthesia

Induction with Fluothane and nitrous oxide-oxygen (5.5 litres or 3.3 litres, according to the apparatus and the technique employed) should be slow and gradual rather than rapid, so that the concentration is kept within 1-3 per cent and adequate pulmonary ventilation maintained, while the pulse and blood pressure are kept under observation. Because a percentage-calibrated vaporizer was not available, an ether vaporizer bottle No 7 with wicks was used in the Heidbrink machine. The control is opened gradually up to No. 4 and, for maintenance, it is turned back to Nos 2 or 3. With both the Marrett and Boyle's

General Type of Surgery Involved

Ophthalmology	33
Otorhinolaryngology	467
General surgery	335
Gynaecology	95
Urology	64
Orthopaedics	118
	1,112

Ophthalmology

Corneal cauterization	2
Correction of strabismus	8
Retinopexy	2
Dilatation of lacrymal ducts	4
Ptosis of eyelids	3
Removal of chalazion	2
Dacryocystorhinostomy	1
Ocular tension	2
Resection of sclera	1
Enucleation	4
Cutting of synechiae (iris)	1
Discission of eye	1
Plastic surgery of orbit	2
	—
	33

Otorhinolaryngology

T+A	324
Sinus washing	12
Paracentesis	13
Submucous resection	21
Plastic surgery of nose	9
Caldwell-Luc	9
Œsophagoscopy	11
Mastoidectomy	9
Fenestration	8
Bronchoscopy	5
Laryngoscopy	4
Radical frontal sinus operation	1
Suture tonsillar fossa	2
Plastic surgery of ear	4
Tracheotomy	3
Removal of mastoid packing	6
Removal of cerumen	2
Oro-pharyngeal abscess	7
Removal of salivary glands	3
Resection of œsophageal diverticulum	1
Bronchial aspiration	5
Dental extraction + filling	8
	—
	467

General Surgery

Appendectomy	34
Cholecystectomy	23
Cholecystoduodenectomy	1
Inguinal hernia	20
Gastrectomy	8
Gastroenterostomy	2
Gastrotomy	2
Vagotomy	1
Artificial anus	4
Sigmoidectomy	3
Adhesions	1
Duodenojejunostomy	1
Intestinal resection	2
Hemicolectomy	2
Diverticulectomy	1
Abdomino-perineal	2
Biopsy of omentum	1
Partial hepatectomy	1
Resection of intestinal polyps	1
Closure artificial anus	1
Removal abdominal drainage	8
Umbilical herniotomy	6
Eventration	11
Removal superficial sutures	2
Crural herniotomy	1
Hæmorrhoidectomy	6
Abscess of anus	8
Rectoscopy	3
Mastectomy	20
Staphyloplasty	17
Thyroidectomy	13
Biopsy of breast	9
Abscess of breast	4
Stripping	8
Lumbar sympathectomy	2
Suprarenalectomy	1
Face wound repair	12
Removal skin tumour	10
Temporal abscess	2
Paronychia	40
Anthrax	10
Lymphadenitis	9

General Surgery (continued)

Biopsy gland of neck	6
Radical excision of neck	5
Cyst of neck	1
Ligation occipital artery	1
Biopsy of tongue	2
Pilonidal cyst	2
Skin graft	5

	335

Gynaecology

Gynaecological examination and uterine curettage	47
Hysterectomy	29
Colpoperineorrhaphy	10
Wertheim	2
Vulvectomy	1
Oophorectomy	3
Bartholinian abscess	1
Cotte's operation	1
Salpingo-oophorectomy	1

	95

Urology

Cystostomy	3
Castration	1
Cystectomy	1
Inversion of tunica vaginalis (hydrocele repair)	3
Ureterosigmoidostomy	1
Prostatectomy	3
Nephrectomy	2
Pyelotomy	1
Pyelography	1
Lumbotomy	1
Cystoscopy	23
Circumcision	24

	64

Orthopaedics

Bone marrow puncture	3
Bursectomy	5
Costotomy thoracic drainage	4
Open reduction	31
Club foot stretching of tendons	9
Finger repair	5
Torticollis	1
Resection of bone	12
Leg cast	9
Synovial cyst (wrist)	4
Dislocation of maxilla	1
Menisectomy of knee	7
Saucerisation of femur	1
Amputations	8
Removal Kirschner wire	5
Plaster corset	2
Laminectomy	1
Hallux valgus	1
Wound débridement	9

	118

Age

0-6 mo	7
6 mo -1 year	23
1-5	134
5-10	154
10-15	56
15-25	161
25-35	144
35-45	133
45-65	220
65-75	70
75-85	10

	1,112

Duration of Anaesthesia

0-30 minutes	246
30-45	378
45-60	128
1-2 hours	233
2-3	84
3-4	28
4-5	10
5-6	5

	1,112

machine, Fluothane is placed in the Trilene bottle, this is opened to approximately the same figures, the plunger in the Trilene bottle with the Boyle apparatus being completely withdrawn.

There seems to be no analgesic period. The second phase differs from that of ether, there being no mental confusion, delirium, tears, cries, coughing, sneezing, eructation, nausea, vomiting, salivary or tracheo-bronchial secretions or convulsions noted. Surgical anaesthesia resulted in four to eight minutes. Intubation could be done easily without producing coughing or bucking movements and, usually, without using a relaxant.

Premedication

None	111
Atropine only	16
Codeine + atropine	2
Morphine + atropine	417
Morphine + atropine + Benadryl	13
Morphine + atropine + Pacatal	6
Morphine + atropine + Stemetil	1
Demerol only	3
Demerol + atropine	459
Demerol + atropine + Benadryl	3
Levodromoran only	1
Levodromoran + atropine	16
Levodromoran + atropine + Benadryl	43
Levodromoran + atropine + Pacatal	20
Levodromoran + atropine + Sparine	1
	1,112

When Pentothal or Neraval is used, with or without relaxants, for the induction of anaesthesia, Fluothane should not be administered until the blood pressure has stabilized and the respiratory rate has become regular and adequate for proper inhalation of the anaesthetic.

On the basis of certain obvious anaesthetic signs, it would seem that Fluothane has some "ganglioplegic" activity. Whether or not the patient has received premedication, the pupils remain small and do not dilate progressively as they do during deep anaesthesia with ether. The conjunctivae become congested. There is absolutely no perspiration and salivary and tracheo-bronchial secretions are inhibited. The skin is warm and dry and the peripheral vaso-dilatation is present (4). There are no hiccoughs and no spasm of the larynx or of the bronchi. Stridor of the larynx has occurred in a non-intubated patient under deep anaesthesia for osteosynthesis of the tibia. When the concentration of the anaesthetic was reduced, this symptom disappeared. Fluothane did not produce

No intubation	377
Intubation with N ₂ O + O ₂ + Fluothane	486
Intubation with N ₂ O + O ₂ + Fluothane + relaxant	249
	1,112

hiccoughs which sometimes occur during gastrectomy under anaesthesia with the thiobarbiturate-curare-nitrous oxide-oxygen combination.

Respiration

During induction and maintenance of anaesthesia with Fluothane, a decrease in depth or rate of respiration should be avoided. Whereas the rate and depth of respiration are likely to be depressed during induction, it is the depth which is most likely to become inadequate during maintenance. This respiratory depression may lead to hypoxia, CO₂ retention, cyanosis (due to inadequate ventilation rather than to broncho-constriction), and to cardiac irregularities. In our cases of fenestration, operations during which the surgical stimulus affects only slightly the rate of respiration, the minute volume was maintained at 4½ litres. This means that respiration must be assisted in many patients.

The depth of respiration should be watched closely and assisted respiration should be used with proper care. At the onset of anaesthesia, if respiration is assisted too forcibly, especially in children, this may cause an excessive concentration which is toxic to the heart. With Fluothane the heart appears to be saturated sooner than the brain, as it does with chloroform, and contrary to that which occurs with ether which saturates the brain first (6). Excessively prolonged assisted respiration or five to six movements of controlled respiration with a high concentration of Fluothane may produce a drop in blood pressure. Therefore, the concentration of Fluothane should be reduced during assisted or controlled respiration.

Bladder distension and certain surgical stimuli may cause tachypnoea, which is more apparent in young adults. The central respiratory reflexes do not seem to be abolished. Small doses of Demerol will relieve tachypnoea due to surgical stimuli. Assisted respiration is free and easy with Fluothane, resistance to assisted respiration was never present during induction, maintenance or recovery from anaesthesia.

Circulation

Fluothane has a characteristic action on the circulation. The pulse rate was often lowered to 70 or less. There was a 20 per cent decrease in blood pressure in the majority of patients. This hypotension is related to the degree of sympathetic-otonia present and to the depth of anaesthesia, however, it is reduced in intensity as anaesthesia is prolonged, and thereafter the blood pressure remains only slightly below normal.

With Fluothane, vagal action on the heart predominates. This predominance increases the movement of the pacemaker and contributes to the occurrence of a nodal rhythm. Depression of the sino-auricular node may cause discharges from ectopic centres. These arrhythmias occur during rapid induction and during the deep stages of anaesthesia. They disappear if the concentration of Fluothane is decreased and ventilation hypoxia corrected, if present. These arrhythmias have occurred in 14 per cent of our electrocardiograms.

A vaporizer which gives a controlled concentration of Fluothane is therefore

not only useful but essential. The concentration should be limited to 3.5 per cent as a maximum (5). The following arrhythmias were found in our series of 1,112 patients: nodal, superior nodal, slight bradycardia, bigeminal and trigeminal pulse and extrasystoles of ventricular origin.

Our patients with old infarcts, cor-pulmonale and coronary artery disease did not appear to be adversely affected by the administration of Fluothane. Patients with emphysema accompanied by venous hypertension seemed to improve temporarily while under anaesthesia and for some time after.

ECG tracings were taken during prolonged anaesthesia with Fluothane, that is, during the fenestration operations.

A report on the "Summary of findings from 30 ECG's taken during anaesthesia with Fluothane," by Drs. Georges Saulnier and Jean Beaudoin, cardiologists in the Department of Medicine at Hôtel-Dieu Hospital, is presented here:

1 *Graphs taken preoperatively*

I. 21 strictly normal graphs.

II. 9 abnormal graphs, distributed as follows

(a) 1 case sinus tachycardia rate 142

(b) 1 case extrasystole

(c) 1 case deeper *P* wave, possibly hypertrophy of right auricle

(d) 6 cases non-specific changes of terminal phase, giving so-called "borderline" graphs

2 *Graphs taken during surgery*

I. A moderate slowing of cardiac rhythm was found in most cases

II. The abnormal graphs were not modified during anaesthesia.

III. Four electrical modifications are worthy of mention

(a) Development of a nodal rhythm, 58/minute, 10 minutes after onset of anaesthesia. A graph taken 20 minutes after onset of anaesthesia shows that everything is back to normal (Fig 1)

FIGURE 1

FIGURE 2

traction on the bladder (distension), Fowler's position, and hyperventilation. Capillary oozing is markedly reduced, even after a three-hour period of anaesthesia with Fluothane. The use of adrenalin is dangerous and must be avoided during anaesthesia with Fluothane. Bladder distension may cause a blood pressure rise of 30–50 millimetres of mercury.

Adjuvant Medication

Various drugs have been used to counteract the side effects of Fluothane on the circulation and cardiac rhythm (hypotension, extrasystoles); these drugs were central vagolytics and tranquilizers, that is, Pacatal, Benadryl, Centrine, atropine and Demerol.

<i>Supporting Medication</i>	
None	905
Demerol	23
Atropine	38
Benadryl	78
Pacatal	55
Arfonad	4
Diparcol	3
Centrine	4
Benatrol	2
	1,112

With the exception of atropine and Benadryl given intravenously, which increased blood pressure and heart rate but did not entirely control pulse irregularities, adjuvant medication did not give the expected results. Demerol has decreased the respiratory rate, this depression is partly compensated for by an increase in depth but the compensation remains inadequate. Such medication is not an adequate substitute for proper anaesthetic technique. In some patients, pulse irregularities were controlled only by reducing the concentration or briefly stopping the administration of Fluothane.

Renal System

Experiments in rats have shown that renal function was not impaired by the repeated administration of Fluothane (2). In eight cases of fenestration, which were kept under Fluothane anaesthesia for approximately 4½ hours, urinalyses made on the day of the operation and on the third postoperative day have shown no sign of any pathological condition—that is, albumin, casts, or abnormal specific gravity.

Muscular Relaxation

Fluothane gives good muscular relaxation for lower abdominal operations. In upper abdominal operations, the relaxation obtained is not always satisfactory and, with Fluothane alone, adequate relaxation may occasionally be secured only at the cost of marked hypotension or cardiac arrhythmia. Twenty to forty milligrams of Flaxedil are usually needed, this dose changes pulmonary ventilation

very slightly or not at all, and it provides adequate relaxation without increasing concentration of Fluothane.

<i>Relaxants</i>	
None	837
Anectine	47
Anectine + syn curine	29
Brevidil	37
Brevidil + syn curine	20
Syn curine	2
Tubo curare	11
Flaxedil	129
	1,112

It is not always necessary to repeat this dose in closing the peritoneum. Experience should determine the proper administration of a relaxant, as required. Tubo-curare, which has "ganglioplegic" activity, is not recommended. Succinylcholine and decamethonium, having no hypotensive activity, are well suited to anaesthesia with Fluothane, with the understanding, however, that they should be used in small doses, either to increase muscular relaxation or to facilitate intubation.

Recovery

Consciousness returned from five to twenty minutes postoperatively. The patients awakened quietly, nausea was infrequent and might have been due to various other factors. The blood pressure remained exactly as if the patients had not been anaesthetized. The postoperative circulation was better than that observed after the use of other anaesthetics. This may be due to the fact that with other anaesthetics a depression in circulation follows the circulatory stimulation concurrent with anaesthesia, or it may be attributed to postoperative blood accumulation in the splanchnic area. On the other hand, with the use of Fluothane, there may be better circulation in the smaller blood vessels or the drug may have a superior action on the autonomic nervous system. There is no cyanosis of the extremities, no shivering or anything else which might resemble cyclo-shock. The blood pressure and peripheral circulation tend to remain normal; these facts support the statement that Fluothane has anti-shock activity (4).

If excessive muscular relaxation persists after the anaesthesia, and especially if 80 milligrams or more of Flaxedil have been used, 1 milligram of prostigmine and 0.4 milligram of atropine should be given, and while assisted respiration is maintained, Fluothane is eliminated.

Postoperative Period

It is our impression that postoperative pulmonary complications are less and that respiratory function in emphysema is improved in the beginning of anaesthesia. It is generally considered that the postoperative pulmonary complications which occur during the first few days have really started soon after awakening and may be due to the retention of respiratory secretions caused by the

anaesthetics, a muscarinic effect of the relaxants, the parasympathomimetic drugs, or painful reflexes. On the other hand, Fluothane depresses the cough and bronchoconstrictor reflexes, even those generally induced by the induction of a laryngoscope or endotracheal tube. This beneficial effect is seen during bronchial aspiration carried out during Fluothane anaesthesia. Since salivary and tracheo-bronchial secretions are minimal with Fluothane, even without premedication, it is easy to understand that postoperative pulmonary atelectasis should be decreased. Our study of 1,112 cases would seem to substantiate this impression.

Ten patients, who had another type of anaesthetic a few days previously, had a bronchial aspiration under Fluothane anaesthesia. As soon as the aspiration was completed and the irritation caused by the catheter had subsided, the patients returned spontaneously to normal respiration, there was no cough, spasm, or any production of fresh secretions. This procedure, which completely oxygenates the patient before aspiration, facilitates the technique to such an extent that in our Department of Anaesthesia it is preferred to all other methods used previously, including trans-tracheal, thiobarbiturates, $N_2O-O_2-C_3H_6$, and topical anaesthesia.

No postoperative mental depression occurred in our series of patients. Patients who had been anaesthetized twice for fenestrations, once with Pentothal-nitrous oxide-oxygen and once with nitrous oxide-oxygen-Fluothane, stated that with Fluothane they felt less depressed the next day. This reaction might indicate a lower degree of toxicity—a sympathetoconic state which might explain the anti-shock effect and the improvement in pulmonary function.

Cardiac Arrest

Two cases of cardiac arrest occurred early in this series but, with the use of appropriate therapeutic measures, recovery was complete.

1 *Female patient, 40 years of age*, in a state of severe vagotonia, scheduled for radical mastectomy. Premedication: levo-dromoran 2 milligrams, atropine 0.4 milligram. Induction: Pentothal 250 milligrams, succinylcholine 60 milligrams. Intubation followed by controlled respiration with N_2O-O_2 -Fluothane. The patient was placed in the reverse Trendelenburg position. Suddenly, the heart stopped beating. Four minutes later, cardiac massage was carried out through a thoracotomy. The heart had stopped in the diastolic phase. Heart beats were resumed with the first massage movements. Some indication of cortical irritation was present. Treatment consisted of hypertonic glucose solution, repeated stellar infiltrations, and plasma. Consciousness returned during the evening, mental alertness did not seem impaired, with the exception of some mental confusion of 24-hour duration, and loss of memory for recent events which returned in a few days.

Seven days later, the patient was operated on for radical mastectomy, the operation lasted two hours and was uneventful. Premedication: levo-dromoran 2 milligrams, atropine 0.4 milligram, Pacatal 25 milligrams. Supporting medication: Pacatal 50 milligrams, Benadryl 50 milligrams. Induction and maintenance: N_2O-O_2 -Fluothane-succinylcholine 40 milligrams. Postoperative period, normal.

2 *Female patient, 10 years of age*, obese, presented for emergency appendectomy. Premedication: Demerol 50 milligrams, atropine 0.3 milligram. Induction: Pentothal 250 milligrams, succinylcholine 60 milligrams. Maintenance: intubation, N_2O-O_2 -Fluothane under controlled respiration with hyperventilation. When the caecum was drawn out, the blood pressure which was 120/80 fell suddenly and the heart stopped beating. Since marked resistance to respiration was present, the anaesthetist had just given 0.2 milligram atropine.

intravenously Cardiac massage was carried out through a thoracotomy. Appendectomy was performed No postoperative complications occurred. What is the explanation for this cardiac arrest? The dose of Pentothal was a factor, the succinylcholine used was a month old, there was a possible muscarinic effect, the resistance to ventilation may have been due to spasm or a muscarinic effect of the relaxant, controlled respiration with marked positive pressure decreasing venous return, some hypoxia due to broncho-constriction, an effect on the heart due to the high concentration of Fluothane; or, finally, a reflex action from traction on the caecum All these factors may have contributed to the cardiac arrest, especially the controlled respiration combined with the high concentration of Fluothane The heart was dilated and it was necessary for the surgeon to massage it ten times before cardiac action was re-established No drugs were used.

Both these incidents occurred under the same conditions, with the use of the same drugs and the same anaesthetic machine, this machine was later inspected and its oxygen outlet was found defective. Therefore, there was an error in technique and this would have passed unnoticed with the use of another anaesthetic.

Since then, controlled respiration, especially with hyperventilation, has been abandoned in favour of assisted respiration, which is the only type employed at the present time. Use of relaxant agents has also been changed, our most current method is now to employ only small doses of Flaxedil.

CONCLUSIONS

Fluothane has been used for anaesthesia in 1,112 surgical cases. No fatalities have occurred either during surgery or during fifteen days after the operation.

Death occurred in three patients with cancer and in one with spinal trauma at a late postoperative date. Any reasonable connection with the anaesthetic can be disregarded.

1 *Male, 53 years of age* Fracture of L1-L2, section of terminal cord, intestinal and bladder disorders

November 18, 1956 Laminectomy Anaesthetics Pentothal 325 mg, Flaxedil 60 mg, N₂O-O₂-Fluothane

December 3, 1956 15 days later. bronchopneumonia

December 3-4, 1956 Bronchial aspiration

December 4, 1956 Patient died, 16 days after operation Terminal bronchopneumonia

2 *Male, 47 years of age* Rectal neoplasm dating back to January, 1956

February 8, 1957 Artificial anus Anaesthetics N₂O-O₂-Fluothane, Flaxedil 20 mg

February 21, 1957. Second operation Anaesthesia without Fluothane

March 5, 1957. Patient died, 25 days after anaesthesia with Fluothane Generalized metastases

3. *Female, 48 years of age* Bladder neoplasm

November 28, 1956 Removal of bladder clots Anaesthetic N₂O-O₂-Fluothane

January 21, 1957 Patient died, 54 days after anaesthesia Metastases

4. *Male, 75 years of age* Achromic melanoma

December 4, 1956. Cystostomy Anaesthetics Neraval 625 mg, N₂O-O₂-Fluothane

February 3, 1957. Patient died, 61 days after anaesthesia with Fluothane Cerebral metastases

The following conclusions may be drawn from this study of 1,112 cases of anaesthesia with Fluothane:

Fluothane has many advantages. Its disadvantages are easily controlled. It is a potent, volatile anaesthetic, its action is easily reversible, it is non-explosive and non-inflammable (it can even put out a flame). It produces smooth and easy induction, and is well tolerated by the patient. Induction should be slow, gradual and progressive. The patient should be maintained quietly without hyperventilation and without sudden increases in concentration; a properly calibrated vaporizer should be used. This is the best way to avoid a sudden hypotension, cardiac arrhythmias and respiratory depression which this anaesthetic may produce (7).

The fact that there is no broncho-constriction and no laryngospasm, and that tracheo-bronchial secretions are diminished, facilitates pulmonary ventilation and contributes somewhat to less postoperative pulmonary atelectasis. Fluothane may be used with soda lime. It decreases capillary oozing and blood loss during surgery. It appears to have anti-shock activity, in the manner of the "ganglioplegic" agents. It has a mild postoperative ataraxic effect. Clinically, it seems to be non-toxic; there are no urinary disorders, fatigue or anorexia.

Possibly Fluothane is the equal of ether and cyclopropane, but has advantages which are lacking in both these agents: non-explosibility, non-inflammability, inhibition of tracheo-bronchial secretions, anti-shock, potency, and easy reversibility.

REFERENCES

1. BRYCE-SMITH, R & O'BRIEN, H D Fluothane, a Non-Explosive Volatile Anaesthetic Agent *Brit Med J*, 969 (October 27, 1956)
2. RAVENTOS, J The Action of Fluothane, a New Volatile Anaesthetic *Brit. J Pharmacol*, 11(4) 394-409 (1956)
3. GOODALL, R R Estimation of Fluothane in Blood *Brit. J Pharmacol*, 11(4) 409-11 (1956).
4. JOHNSTONE, M The Human Cardio-Vascular Response to Fluothane Anaesthesia *Brit J Anaesth*, 28(9). 392-411 (1956).
5. HILL, E. FALKNER Percentages of Fluothane Vapour Delivered from a Trilene Bottle. *Brit. J. Anaesth*, 29(1) 12-16 (1957).
6. HARRIS, T A B The Mode of Action of Anaesthetics Pp 177 Pp 577 Edinburgh E & S Livingstone (1951).
7. JOHNSTONE, M Correspondence *Brit J Anaesth*, 29(3) 135-6 (1957)