THE PRESENT POSITION OF ETHER ANAESTHESIA

By

JOHN ELAM, M.R.C.S., L.R.C.P.
(General Practitioner)

Ether has been our good friend and trusted helper for one hundred years.

But, to-day, some of our colleagues maintain that this drug should not be used, although many experienced practitioners still consider ether to be one of the best anaesthetic agents.

This difference of opinion arises, I believe, because of the absence of a clear differentiation between the action of the anaesthetic drug and that of the drug used as premedication before the operation. For example: One writer described his "ether patients" as "returning to the ward, snoring, sweating, and gurgling, with relaxed hypertonic muscular system, which results in poor circulating blood volume . . . and stagnant anoxia," and as taking, on an average, over two hours to recover consciousness.

Such is a picture, not of a patient arriving in the hospital ward after an ether anaesthetic, but of a patient who has been given an overdose of some powerful drug to allay his apprehension of his operation.

Before September, 1939, I administered one of the barbiturates to all my patients before operation. But I found that many of them were a long time in recovering consciousness. This delayed recovery threw a heavy burden on the nursing staff, and, with the advent of war, I was forced to abandon this form of premedication because of the shortage of nurses.

After discontinuing the use of the barbiturates, I found that post-operative chest complications were markedly reduced and the condition of the patients greatly improved.

After *deep* ether anaesthesia without heavy premedication, the time of recovery from when the anaesthetic is discontinued, until the patient regains complete consciousness of his surroundings, averages twenty minutes per hour of etherisation.

When light or moderate planes of ether anaesthesia are used, as for a hernia operation, the patient will usually be conscious within ten minutes

of his leaving the theatre. (The nature of the operation has some influence.)

Some reflexes return much sooner than consciousness and after one hour's anaesthesia with ether, the patient will usually be moving his head ten minutes from the time the anaesthetic is discontinued.

I usually give as premedication atropine grs. $\frac{1}{100}$ (hypodermically), and potassium bromide-chloral hydrate (for women 20-30 grains of each, for men, 30-40 grains of each, by mouth). From these drugs the patient obtains relief from anxiety and, if kept waiting in the theatre ante-room, usually falls asleep. Delay in recovering consciousness and many of the undesirable post-operative complications, so often attributed to ether, are due to over-indulgence in the use of the barbiturate group of drugs, or of morphia.

If we are to abandon the use of ether after one hundred years of satisfactory experience with this drug, we must be very sure that the drugs and methods of administration which we intend to use, have in very truth some special advantage.

It is my purpose to show that, compared with other drugs and techniques, ether remains to-day the best and the safest anaesthetic agent, and that the dangers and disadvantages of "Modern Anaesthesia"* do not justify our removal of ether from its place as our foremost anaesthetic drug.

The Failure of "Modern Anaesthesia" to Improve Post-Operative Results, or to Reduce Anaesthetic Mortality

The substitution of what is often called "Modern Anaesthesia" for ether anaesthesia, has not led to improvement in post-operative results, or to a fall in anaesthetic mortality. Indeed, Marston suggests that "modern anaesthesia" is associated with an increasing number of risks.

* By "Modern Anaesthesia" I mean those drugs and techniques now used in place of ether, such as Intravenous Anaesthesia, Spinal Analgesia, or Cyclopropane Anaesthesia, and certain other methods.

In a recent discussion at the Royal Society of Medicine, many new agents and techniques were described as having been used in the surgery of the upper abdomen.

It was a little surprising to find that the post-operative results mentioned, showed little, if any, improvement on those which we, general practitioner anaesthetists, have been obtaining from the use of ether.

There has been a marked increase in the number of anaesthetic deaths reported to the Coroner during the last twenty years.

In 1921—347 deaths under anaesthesia were reported to the Coroner.

In 1931—723 deaths under anaesthesia were reported to the Coroner.

In 1941—835 deaths under anaesthesia were reported to the Coroner.

Thus we find an increase in anaesthetic mortality during those years when new drugs and new techniques were in great part displacing ether in operative surgery.

To explain this upward trend in anaesthetic deaths, it is said that not only are more operations performed to-day than was the case in former times, but that greater surgical risks are now accepted. This statement is not true. Twenty-five years ago, many hazardous* operations were performed which are now rarely seen. The general condition of patients coming to operation now is infinitely better than was frequently the case in the past, and one seldom sees to-day those neglected cases of perforated gastric ulcer and intestinal obstruction which were once so common and which gave so much anxiety to the anaesthetist. And, in addition, we have to-day the tremendous advantage of modern restorative measures.

The Physiology of Ether Anaesthesia

We do not know precisely how ether produces surgical anaesthesia, but it is known that ether has a depressant action and shields the brain from damage by painful stimuli.

Central cortical activity is decreased and lower pathways blocked. The temperature regulating centre is depressed and the voltage and frequency of action potentials decreased.

The vasomotor centre is not directly affected. The carotid sinus reflex is depressed, but ether stimulates breathing by reason of its action on the respiratory tract. The bronchial muscles are relaxed. Salivation and lacrimation occur in the early stages of ether anaesthesia, and, during light anaesthesia, there is an increase in the secretion

* How many of our young anaesthetists have seen the operation for the partial removal of the maxilla for cancer, performed under chloroform?

of saliva and mucus. Not during deep anaesthesia.

Boyd and others are doubtful whether there is an increase in the output of respiratory tract fluids, and maintain that there is no evidence of damage to the cilia lining of the respiratory tract. Ether increases pulmonary ventilation, but increased pressure in the airway may be harmful, on occasions.

Negative pressure caused, for example, by the use of too small an endotracheal tube, may cause pulmonary oedema. Bacteria inspired into the lungs during ether anaesthesia will grow uninhibited by the body defences during the period of unconsciousness.

Liver.—Function decreased, returns to normal in twenty-four hours. Bile secretion is probably decreased. Molitor does not believe that the secretion of bile is decreased.

Kidney.—The volume of urine is decreased and the renal function depressed, although the effect of ether need not be feared in healthy subjects. Changes in the kidney function may be due to the extra-renal action of the anaesthetic added to the operative procedures.

Heart.—The effect of ether on the heart of the healthy patient is slight. There is, however, an increase in the heart volume indicating relaxation of the heart tone.

Stomach and Intestines.—Movements decreased. Action passes off quickly in ten to fifteen minutes.

Lymphatics.—Increased flow and absorption. Ether is not the deadly poison some anaesthetists would have us believe.

Administration

Ether can be administered:—

(A) By Inhalation—

(1) By the open drop technique or—

(2) From some apparatus such as—

(a) Clover's inhaler.

(b) Shipway's apparatus.

(c) Oxford vaporiser.

(3) Added to other anaesthetics, e.g. nitrous oxide oxygen (as in Boyle's apparatus).

(B) Per rectum.

(C) In combination with local analgesia or spinal analgesia.

(I) Open Drop Ether

A protective pad of gauze with a centre hole is placed over the face. A wire mask covered with one layer of house flannel is superimposed. Ethyl chloride is sprayed gently on to the mask until regular automatic breathing is established and the

ethyl chloride snore is heard. (At this stage the pupils of the eyes will be dilated and there will be a characteristic squint.)

Ether is then dropped on to the mask just fast enough to enable the individual drops to be distinguished.

(2) *Ether Inhaler*

There are many inhalers designed to administer ether, among which:—

- (a) Clover's inhaler and
- (b) The Shipway apparatus have proved useful in the past.
- (c) The Oxford vaporiser was designed to administer ether under difficult circumstances which might arise during war.

Definite and constant percentages of ether in air can be given, as the ether is kept at an unchanging temperature by two surrounding jackets, one holding crystalline* calcium chloride, and the other, hot water.

To obtain a pleasant induction, the face-piece of the apparatus is applied and one short spray of ethyl chloride is then sprayed into an induction bag about every two breaths until regular automatic breathing is established. Then the indicator of the machine is turned to 10–15 and the bag turned off. The required plane of anaesthesia is thus quickly obtained.

Endotracheal ether can be administered from this apparatus and there is a device for delivering oxygen. A bellows for inflating the lungs with air or air-oxygen, is attached.

As the ether vaporises losing heat, it borrows the heat held by the molten calcium chloride. Thus the ether remains at a constant temperature until all the molten calcium chloride is reconverted into its crystalline form, that is for about two hours, so that there is no variation in the percentage of ether vapour in air.

The Oxford vaporiser enables ether to be used in very hot climates.

(3) *Gas Oxygen Ether Sequence from the Boyle's Apparatus*

This apparatus has been in use for many years. In addition to the ether bottle a second bottle is usually provided which can be filled with chloroform, vinesthene-ether mixture, or trilene. Vinsthene-ether mixture is valuable both for obtaining a smooth induction and for giving the anaesthetist the power to obtain extra muscular relaxation, should this be required in a difficult case.

* The crystalline calcium chloride takes up the heat from the hot water, being thus transformed into a molten shape.

If a cautery or diathermy is to be used during the operation, chloroform should be placed in the second bottle, and the anaesthetic continued with gas-oxygen-chloroform.

(B) *Rectal Ether*

The administration of ether per rectum was introduced by Gwathmey and is used chiefly in obstetric practice. It holds little advantage over inhalation methods for general surgery.

(C) *Ether Anaesthesia in Combination with Local or Spinal Analgesia*

Harold Dodd and others advocate a technique of infiltration with local analgesia in combination with the very lightest plane of ether unconsciousness. Undesirable effects of deep ether narcosis are avoided and the dangers of local analgesia lessened.

However, it must be appreciated that local analgesia *per se*, will neither prevent circulatory complications nor reduce the incidence of post-operative pulmonary difficulties.

Two types of untoward reaction to local analgesia have been reported: Collapse and convulsions. Sudden collapse may be the result of psychological reaction, or of an idiosyncrasy towards the local anaesthetic. The cause of convulsions is not clear but both types of reaction can be fatal.

Sudden death from allergy to procaine has been reported in the medical literature. Several workers have found that the use of procaine (novocaine), inhibits the action of the "sulpha" group of drugs, to a considerable extent. Ether can also be administered to render a patient unconscious during spinal analgesia, or to make it possible to continue a long operation if the effect of a single dose of spinal analgesia should wear off.

Is Ether Anaesthesia Obsolete for Casualty or Military Surgery?

It has been stated that many practitioners who had to treat air-raid and military casualties during the war, came to the decision that ether anaesthesia should be avoided, and that intravenous pentothal was the anaesthetic indicated. My experience leads me to take a view which is in strong opposition to this precept.

For many years before the war I worked at a hospital which had to deal with a large number of road accidents. During the war years, at this same hospital, we had our share of air-raid casualties and, after Dunkirk, of wounded soldiers. Ether anaesthesia gave excellent results in the surgical treatment of such cases and I have come to believe that ether is the anaesthetic of choice for casualty surgery and that the use of the barbiturates is better avoided.

The barbiturates administered intravenously depress the respiration, lower the blood pressure, poison the heart muscle, and lead to delayed recovery. These drugs cannot, on theoretical or practical grounds, be described as the agents of choice for anaesthetising the gravely injured patient. It was my experience during the war that light ether from the Oxford vaporiser did not appear to "upset" the patient any more than gas and oxygen, and endotracheal ether was found to be specially valuable for grave head injuries and severe burns.

Quick recovery of consciousness is an important consideration when a hospital, often short of staff, has to deal with a number of wounded persons. By means of light ether anaesthesia, I was enabled to ensure that the patients became conscious in the shortest possible time. When I administered an intravenous barbiturate anaesthetic I found that delayed recovery of the patient was a frequent complication and this added greatly to the burdens of an overworked nursing staff.

It is generally admitted that in a high proportion of patients who have received an intravenous barbiturate anaesthetic, a period of excitement and irrationalism will ensue before full recovery of consciousness takes place. This is a most serious administrative consideration in any hospital. I also found that even in the case of patients who might be described as "good operative risks" a post-operative condition indistinguishable from shock, not infrequently occurred after the use of pentothal.

My experience has also led me to believe that the barbiturates are absolutely contra-indicated for those patients who have been badly burned or scalded and for elderly patients who have to undergo some emergency operation, especially that of supra-pubic cystotomy.

A study of the medical journals has brought confirmation of my opinion. For example—Pask considers that insufficient attention has been given to the possibilities of light ether narcosis, in cases of shock, and in the United States of America, the Mayo Clinic estimate ether as one of the best anaesthetic agents that has ever been introduced.

Romberger and Beecher also hold ether in esteem, and Renow considers ether by the open method the anaesthetic of choice for war wounds of the abdominal viscera. Martin believes ether to be one of the safest agents for army surgical procedures; his findings were confirmed by other military observers, i.e., Martele, McCarthy, Archer, Gould, Martin. McCarthy believes that ether remains the best and safest single agent for abdominal injuries, and considers that spinal anaesthesia or basal anaesthesia with the intra-

venous barbiturates has no place in the surgical treatment of patients who are susceptible to shock.

A possible explanation of the unsatisfactory results obtained by some anaesthetists, with ether anaesthesia may be given by Dauna, who calls attention to the unnecessary depth of many ether anaesthetics, and Goldberg, who gives a warning that anaesthetic difficulties and post-operative complications are increased by the pre-operative use of morphia.

Fordyce advocates the use of ether for emergency surgery, and Thomas remarks that ether has never failed to be utilised for overcoming the failures of other methods.

Revell holds that ethyl ether has been the standard comparison for other agents and remains the reliable stand-by where muscular relaxation is required. Flagg, one of the world's most outstanding authorities in anaesthesia, after a personal experience of more than thirty years with ether as an anaesthetic agent, has decided that claims for other agents as basic routine cannot be sustained. He has found that every type of war or civilian surgery can be carried out safely, efficiently, and with a minimum of morbidity and mortality, with ether. He feels that too many anaesthetists have tried too often to avoid the use of ether, and the skill with which it might be used, is not so much in evidence to-day as it should be.

In his textbook, Flagg describes anaesthesia by ether gas as the safest anaesthesia known. Post-operative illness he believes is usually due to anoxia. He also remarks that other anaesthetic agents are seldom compared with ether at its best.

The comparison is usually with ether at its worst.

Ether Anaesthesia and the General Practitioner

My own experience as a general practitioner anaesthetist for over twenty years, has led me to believe that ether, by the open drop technique, from the Oxford vaporiser, or combined with other agents, as from a Boyle's apparatus, is by far the best anaesthetic agent for use by the general practitioner. Many lives might be saved and much distress avoided if general practitioners would confine themselves to the use of this drug, leaving other agents and techniques to the full-time professional anaesthetist.

Anaesthetic Mortality

I agree with the statement of Galley, that the use of unsuitable drugs in unsuitable surroundings by inexperienced administrators, plays no small part in causing the increased mortality already

noted. While it is usual to assess the value of any anaesthetic agent or technique by the standard of immediate mortality, yet this is not the most satisfactory method of evaluation.

When skilled administrators are in charge of the administration, the immediate mortality seems to be about the same, whatever the agent or method used.

Griffiths supports this view and feels that it is the anaesthetist who really creates a department of anaesthesia. The Wisconsin School teach that it is the anaesthetist and not the anaesthetic agent or technique which is of primary importance.

It is, however, very generally admitted that ether has a greater margin of safety than any other drug. For example, if respiratory arrest occurs under ether, the practitioner has ten times more chance of re-establishing breathing than if it occurs under chloroform, and most anaesthetic deaths are caused in the first place by respiratory arrest. We might, with advantage, then, consider certain published records.

Dealy gives us a record of the anaesthetic deaths in Queen's General Hospital, for five years, 1936-1941:—

19,529 anaesthetics were administered.

16,273 were inhalation, with 7 deaths, possibly due to anaesthetic.

3,193 were spinals, with 7 deaths, possibly due to anaesthetic.

63 were rectal, with 4 deaths, possibly due to anaesthetic.

Waters and Gillespie have shown that death during operation and anaesthesia has occurred in 1 in 1,000 cases, in a series of 250,000 cases, in five teaching hospitals.

Kaye gives the statistics in a hospital in Melbourne from 1919-1929. In a series of 13,400 operations on in-patients it was found that 1.6 per 1,000 was the immediate mortality.

During the period 1929-1934, in 17,757 operations 1.3 per 1,000 was the mortality.

An analysis of one series of cases showed that under ether anaesthesia in 8,999 cases there were 8 deaths.

Under NO and ethylene in 2,555 cases 13 deaths.

Under spinal in 907 cases 1 death.

Under local and regional in 2,393 cases 4 deaths.

Two deaths under local analgesia for tonsillectomy were reported.

Fors and Schwalm, compared results in 4,000 cases of which 2,000 were given ether—2,000 were given spinal. Mortality was 6.5 per cent for spinal—6.8 per cent for ether. Pulmonary complications were equal.

Professor Grey Turner, discussing "Modern Anaesthesia," believed that with older methods

the patient was probably more uncomfortable but safer. These statistics are not very helpful, and I think that Jarman points to the true cause of anaesthetic mortality—"The unskilled administrator." He found on studying the details of over 1,000 deaths, *that 80 per cent occurred when the administration was in the hands of the newly qualified house officer.* The general practitioner and the newly qualified house officer would be wise to use only the safest anaesthetic agent—ether—in spite of the attraction of other drugs.

Are "Modern Methods" Associated with Untoward Occurrences?

Apart from death, the administration of an anaesthetic is sometimes associated with extremely unpleasant complications. Untoward reactions do occasionally follow the administration of ether, but the possible disadvantages and complications of other drugs and methods are formidable and should be borne in mind by the local doctor who, unlike the London specialist, has to live in close proximity to his patients.

Intravenous anaesthesia has been associated with many troubles. Pallor, tachycardia and extremely poor radial pulse frequently follow the administration of Pentothal. Thrombosis of vein, injection into an artery with tragic results, have been known to occur. Fall in blood pressure, excitement, local irritation, nausea, vomiting, headache, irritability of the throat, unrest and deplopnia, paralysis, polyneuritis, impairment of vision and albuminuria, and convulsions, have also been reported, after intravenous anaesthesia.

The general practitioner would be wise to consider his own position, should some of these complications occur in one of his near neighbours. The same warning also applies to the use of spinal analgesia, by the patient's own doctor. Spinal analgesia has many ardent supporters to-day, but grave neurological complications do from time to time, follow the use of this technique. Permanent incontinence, mental affliction, and muscular palsies have been reported.

A question was recently asked in Parliament, concerning a young soldier who, having survived an operation for hernia, under spinal analgesia, died seven months later from paralysis and toxæmia. What would Dr. Jones have said to the local Vicar's wife had this young man been her son? Could he have expected to have retained the confidence of his other patients, after such a tragedy?

*Quite recently, in my own county a young man was sent to a London teaching hospital for a cystoscopy. The patient, six months later, still suffers from grave neurological sequelae.

It cannot be maintained that these tragedies are due to errors in the technique of administration because a few, a very few, highly skilled anaesthetists have been honest enough to record their misadventures. Had all our colleagues been equally frank, I doubt very much whether the pre-eminence of ether would be challenged to-day.

In assessing the value of ether, then, we must consider whether the disadvantages of this anaesthetic are greater than those associated with other drugs and techniques: Whether, in fact, weighed in the balance with new methods, ether has been found wanting and its kingdom given to another.

The chief criticisms against ether are that it leads to:—

- (1) Vomiting, following operation.
- (2) Abdominal distension and paralytic ileus after operation.
- (3) Post-operative shock.
- (4) Post-operative chest complications.
- (5) Delayed recovery of consciousness.
- (6) Laryngeal spasm during the induction, and operation.
- (7) Ether convulsions.
- (8) That it is a toxic drug upsetting physiological balances.

Vomiting

Vomiting occurs in about 60 per cent of all etherised patients and can be reduced by preventing the swallowing of ether-laden saliva, and by keeping the depth of the anaesthetic strictly to the plane required by the operation. But vomiting may also be a distressing complication of both spinal analgesia and intravenous anaesthesia, as many observers have shown.

Waters found that nausea or vomiting occurred in 50 per cent of cases after ether and 39 per cent after cyclopropane.

It is better to have a patient who vomits even for forty-eight hours, than a patient who lies quiet and still in the mortuary, or a patient who leaves hospital crippled for life from some injury to his central nervous system.

Abdominal Distension

Abdominal discomfort and distension may occur after ether anaesthesia, but the post-operative administration of morphine is helpful in overcoming this distressing condition, which is not confined to those patients who have been given ether. Waters found that distension developed in 16.5 per cent of cases after ether and 13.5 per cent after cyclopropane.

Post-Operative Shock and Circulatory Complications

It is sometimes stated that ether anaesthesia predisposes towards shock, and that when a condition of shock already exists, or may be expected to develop, the use of some more modern technique such as intravenous anaesthesia is preferable or indeed essential.

Mallinson states that there is no room for doubt . . . that ether should be entirely avoided in dealing with shocked and exsanguinated patients and advises the use of intravenous anaesthesia. I have found that intravenous anaesthesia accentuates shock, even when given for the induction of anaesthesia, and sometimes leads to a fall in blood pressure from which the patient appears to suffer for a considerable period of time.

An Editorial in *Current Researches* tells us that there were six times as many deaths under intravenous in the United States of America's Army, as under any other anaesthetic. Is this then to be the technique of choice for war surgery? Even in relatively minor surgery performed under intravenous anaesthesia, I have found that patients often appear collapsed after an operation such as would give no cause for worry under other methods of anaesthesia.

Harris, Richards, and others report some what similar experiences. Ether—even deep ether anaesthesia, is less likely to contribute to that condition known as shock, than the non-volatile drugs for which such extravagant claims have been made.

The medical journals contain numerous references to the association of intravenous anaesthesia with shock, and to the dangers which may be encountered when the barbiturates are administered (intravenously or otherwise), to the shocked casualty. Minnitt and Gillies consider that in haematogenic shock, stagnant anoxia will be aggravated by the barbiturates, but that in neurogenic shock, they are not contra-indicated.

Woodhall, Madan and Crooke, Morris and Bowler report unsatisfactory condition of patients, following the administration of the barbiturates. Chivers and Evans give a word of caution, and Marston considers that recovery may be retarded and the effects of shock increased by deep basal narcosis. Saklad and others believe that the intravenous barbiturates have no place in the surgery of the shocked casualty and recommend ether anaesthesia.

The Editor of *Anesthesiology* issues a warning to war-time anaesthetists, that untoward complications may follow the administration of intravenous anaesthesia to the shocked battle casualty.

Moon⁷⁸ found that the barbiturates facilitate the

development of shock in experiments on animals and that dogs under barbiturate anaesthesia develop spontaneous shock.

Beecher, McCarrell and Evans* found that there was no significant delay in the onset of shock caused by bleeding when the barbiturates were used, as against ether.

"Shock" is the surgeon's and the anaesthetist's greatest anxiety, and up to the present time no anaesthetic technique has been discovered which will remove this dangerous complication from its association with major surgery.

Adams quotes Reynolds, Veal and Chapman, as finding that the heart muscle is poisoned under continuous Pentothal. Beecher agrees.

Minnitt and Gillies call attention to the possible dangers of the non-volatile agents in elderly subjects or in shock.

If we decide that intravenous anaesthesia is to be avoided in cases where shock is present or is expected to occur, we have as alternatives to the use of ether anaesthesia:—

- (1) Trilene or vinesthene anaesthesia.
- (2) Cyclopropane anaesthesia.
- (3) (a) Spinal analgesia, or
(b) Local analgesia, with or without some method of producing unconsciousness.

Are these methods and combinations so satisfactory that the use of ether has become obsolete?

Vinesthene is an excellent anaesthetic but is at present very difficult to obtain and is associated with some disadvantages, although these are not numerous. The combination of vinesthene with ether, known as V.A.M., is a most valuable anaesthetic. Trilene added to nitrous oxide and oxygen, is satisfactory for many operations, but fails to give adequate muscular relaxation in some cases.

A combination of cyclopropane with spinal analgesia, or cyclopropane with local analgesia, has been found valuable. A comparison of the last-mentioned techniques as against ether anaesthesia will be made later when we have to consider the choice of an anaesthetic for grave major operations of long duration requiring complete muscular relaxation. Shock is particularly likely to occur under such conditions.

Post-operative Chest Complications

There is incontestable evidence to-day that ether plays no part in the production of post-operative chest complications. Over-premedication with sedative drugs, among which the barbiturates are the worst offenders, is a common

* They were referring to the observations of Essex, Seely, and Mann, that shock from intestinal manipulation is delayed under barbiturate anaesthesia, as against ether.

cause of post-operative pneumonia. The most important factor, however, is post-operative and pre-operative nursing care, and the *general hospital ward*. By far the most disappointing feature of our new health service, is the omission to condemn and abolish the general hospital ward. Far more patients lose their lives following operation, from being nursed in a large general ward, than from any other cause.

There was a number of investigations in military hospitals during the war to try to find out why there was such a high incidence of chest complications, following hernia operations. It was found that the anaesthetic agent used made little difference, but the technique of pre-operative sedation was important. Bird and others agree with the findings of the investigations described.

Flagg feels that there is no danger in the use of ether, properly administered, even in pulmonary tuberculosis, and refers to the opinion of the Director of the New York State Tuberculosis Hospitals, who found that no ill effect resulted from the administration of ether to tuberculous subjects. Murphy supports this belief.

Beecher anaesthetised with ether 147 patients suffering from pulmonary tuberculosis, with excellent results.

Balbage and others state that even when no inhalation anaesthetic agent is used, there is certainly no lessening of the incidence of chest complications, following operation.

Griffiths listed pulmonary complications following:—

A.

Upper abdominal surgery under—

(1) General anaesthesia as	9.45 per cent
(2) Regional anaesthesia as	15.15 per cent
(3) Combined anaesthesia as	25 per cent

B.

and those following lower abdominal surgery under—

(1) General anaesthesia as	4 per cent
(2) Regional anaesthesia as	10.3 per cent
(3) Spinal anaesthesia as	15 per cent

and remarked on the important part played by pre- and post-operative sedation.

In another report on abdominal operation on patients with chronic respiratory infection, acute post-operative pulmonary complications occurred in—

13.5 per cent of cases after ether.
17.5 per cent of cases after cyclopropane.
39.5 per cent of cases after spinal,

where no pre-operative infection existed.

Acute post-operative complications were reported in—

- 5.8 per cent of cases after ether.
- 4.9 per cent of cases after cyclopropane.
- 7.5 per cent of cases after spinal.

Stewart believes endotracheal ether the best anaesthetic for upper abdominal surgery. Many other authorities agree that general anaesthesia with ether is of little importance in the causation of post-operative chest complications. Jones and Burford report four cases of collapse of the lung under cyclopropane anaesthesia; a method thought to be particularly suitable when chest complications are to be expected.

It is now established that regardless of the anaesthetic agents used, the incidence of post-operative chest complications increases with the increase of duration of the anaesthesia, with increase in depths of anaesthesia and with increase in grade of surgical risk.

Delayed Recovery of Consciousness

Delayed recovery of consciousness has been stated to occur after ether anaesthesia, but it has been shown that this complication is due not to the use of ether anaesthesia *per se*, but to the practice of administering powerful sedative drugs before operation.

Laryngeal Spasm

Laryngeal spasm occurs during the induction period, in heavy smokers and alcoholics. It may also occur during the course of an operation owing to some action on the part of the surgeon. Pre-medication with morphia seems to predispose to this troublesome condition. But laryngeal spasm is also a frequent and sometimes a very grave complication of intravenous anaesthesia, because if not quickly overcome, it may be fatal.

Ether Convulsions

Ether convulsions are always associated with sepsis and are usually seen in children. The frequency of their occurrence is said to be one in ten thousand cases. I believe, having myself lost patients from this cause, that convulsions are due to anoxia and can be avoided by preventing the slightest trace of oxygen shortage during the operation. It must be remembered that convulsions occur under other agents and techniques.

The Australian Society of Anaesthetists publish a report of such cases received in reply to a questionnaire.

A General Poisoning of the Whole Body

That the human body can well withstand the administration of ether has already been shown in

our discussion on the physiology of ether anaesthesia.

The Use of Ether for Extensive Surgery

It remains now to decide whether ether should be used for long and extensive operations requiring absolute muscular relaxation for their completion, and often associated with a high degree of surgical shock.

Three methods are available for such operations:

- (1) Deep ether or chloroform* anaesthesia.
- (2) Spinal analgesia (with or without unconsciousness).
- (3) A combination of local analgesia with some method of producing unconsciousness, such as cyclopropane anaesthesia.

Deep ether anaesthesia by the endotracheal route has been used for many years, with excellent results. That difficulties and disadvantages are attached to this method, no one will deny. But with other techniques specially grave and tragic complications, never encountered with ether anaesthesia, may be met with.

Spinal Analgesia

Referring to spinal analgesia, Flagg warns that "extremely serious post-operative complications never seen in general anaesthesia, are to be reckoned with," and practitioners submitting their patients to these risks must clearly understand that they are very real and not imaginary. It has been stated that complications are due to errors in technique, but this is clearly not the case. Grave damage to spinal cord, meningitis, respiratory arrest, and collapse have been reported.

Apgar found that in 60 per cent of cases, the state of the circulation was unsatisfactory. There were four cases of irreversible shock and one case of severe neurological reaction, in a series of 422 patients to whom spinal analgesia was administered.

In two other series reported by Pappen, McCulloch, and others, respectively, very serious complications were met with.

Moorhead found that in war surgery, spinal analgesia has a place, but after-headache and bladder involvement are complications.

Hames, Simpson, and Bradford also encountered untoward reactions.

Meningitis is reported by Aikenhead and Kremer. Kremer quotes Siebert, Livingstone, and others, as having had similar experiences.

* Because of the prejudice at present existing against chloroform anaesthesia, the use of this drug will not be discussed.

Downing met with two cases of collapse of intervertebral discs, and Co Tui and others found local nervous tissue changes following spinal analgesia, in experiments on animals.

Kazman, Baker, and others, mention grave neurological sequelae (death of one patient seven months after spinal, from damage to cord), and Van der Post reports three disturbing cases under light percaïne—(two deaths, one narrow escape), while Power adds his quota to the list of misadventures.

McNeil Love writes of ocular palsies and permanent incontinence.

Fairclough recently called attention to the high incidence of sixth nerve palsies. Such palsies were also reported from Manchester in a discussion at the Royal Society of Medicine, thirteen cases being noted between August, 1932, and March, 1934.

Lundy adds other complications to the already alarming and formidable list, while Eid reports a new and remarkable complication recently. Indeed, sufficient evidence is available for the searcher after truth to enable him to realise how grave is the responsibility of the anaesthetist who decides on spinal analgesia as the method of choice for his patients.

The avoidance of shock is the usual reason given by surgeons who choose spinal analgesia for long and difficult operations and shock is a very serious condition. But we have to-day very satisfactory methods of combating this deadly and little understood phenomenon, and in our anxiety to avoid shock we must not forget our resources, nor submit our patients to even greater dangers. It is certainly open to question whether spinal analgesia does help to avoid shock. While the use of spinal analgesia is certainly justified when some special advantage is to be gained, there can be no possible excuse for the anaesthetist or the surgeon who chooses this technique for relatively straightforward operations such as appendicectomy, the repair of a hernia, or even delivery with the midwifery forceps, should some misadventure follow. Neither can the use of spinal analgesia by the general practitioner or the "occasional anaesthetist," be justified under any circumstances whatever. This is the province of the professional anaesthetist, and the professional anaesthetist only (not the surgeon).

A Combination of Local Analgesia with Some Inhalation Agent, as for example Cyclopropane

Local analgesia is not entirely without its dangers and disadvantages, as a number of persons exhibit an allergic reaction to novocaine and similar

substances, sometimes with a fatal result. In my own county, a strong healthy young woman died, without any apparent cause, immediately after a Caesarean operation, performed under procaine analgesia.

It is a great ordeal for a patient to endure a long operation while fully conscious, and some method of producing unconsciousness is usually adopted. Because cyclopropane is a non-toxic gas and can be used with a high percentage of oxygen, it would appear to be the ideal anaesthetic agent for this purpose.

While we are considering the value of a technique in which its use seems particularly indicated, we might with profit discuss the advantages, the disadvantages, and the peculiarities of this valuable drug. A few particularly gifted individuals can obtain from cyclopropane alone a relaxation which is beyond criticism, but many practitioners add ether to the cyclopropane, or make use of novocaine infiltration of the field of operation to enable the surgeon to work in comfort.

Local analgesia in combination with cyclopropane anaesthesia has been found satisfactory for many lengthy and difficult operations. Cyclopropane is also administered to provide unconsciousness in patients undergoing operations under spinal analgesia. But it must be generally acknowledged that this anaesthetic has some dangers and disadvantages. A curious condition known as cyclopropane shock has been reported by Kellogg and Phillips.

Wilkins found that shock of a degree to cause concern may develop in the immediate post-operative period, after cyclopropane anaesthesia, at moderately deep levels.

Cardiac irregularities have frequently been noted, but the addition of ether to cyclopropane promptly abolishes these irregularities. Allergic response to cyclopropane has been known to occur. In healthy patients subject to anaesthesia for upper abdominal surgery the tendency to circulatory complications is greater after cyclopropane than after ether. It is possible that primary cardiac failure of a type resembling that seen under chloroform may be the cause of certain unexplained deaths on the table.

Waters and Gillespie, discussing seven deaths under cyclopropane, consider that five of these were due to abrupt cardiac failure. Cyclopropane is of great value on some occasions. Its bad qualities appear to be of such magnitude that it cannot be safely accepted as a substitute for ether, for most inhalation anaesthesia. It appears likely that its range of usefulness will be much narrower than was first predicted. The use of this new agent in no way reduces the incidence of chest complications.

Wirth considers that it is definitely contra-indicated in all cardiovascular disorders and that ether still remains the best anaesthetic for use in patients with heart disease.

Allen and others make note of cardiac irregularities in experimental animals, and find the addition of ether beneficial in such cases. What greater compliment could be paid to our old friend ether, than that its addition to the anaesthetic mixture should be found helpful in overcoming the shortcomings of our latest and most expensive anaesthetic gas?

In fact, Mousel, Stubbs, and Kreiselman feel that the place of cyclopropane in anaesthesia should be reviewed. This becomes all the more necessary as the advent of the use of curare will probably give us means for obtaining full muscular relaxation under the light planes of ether anaesthesia our safest anaesthetic agent.

Ether in Midwifery

For obstetric operations in country districts chloroform is sometimes the only anaesthetic which can be used, because of the danger of fire or explosion, and accidents with chloroform in domiciliary midwifery are few.

Ether is unquestionably the safest and best anaesthetic for the general practitioner to administer for a forceps delivery, the repair of the perineum, or the removal of an adherent placenta. The vast majority of deliveries other than in our great cities still take place in the patient's own home, with only a midwife to assist the doctor, should some obstetric operation be necessary, and ether can be safely left in the hands of a midwife, once the induction has been accomplished.

Stillbirths and neonatal deaths are frequently attributed to the use of ether in obstetrics, but Lund considers that prematurity, complications of pregnancy, and the method of delivery, play a greater part in the causation of neonatal asphyxia than do the various inhalation agents used.

On the American continent, continuous caudal analgesia (the injection of large quantities of a local anaesthetic, through the sacral hiatus into the extra dural space), has of late gained much popularity and publicity.

Baptisti gives an admirable summary of the dangers and disadvantages of caudal analgesia. Numerous accidents and fatalities have been reported and it is evident that for many years to come, continuous caudal analgesia will have to be restricted to the practice of highly trained specialists, working in special hospitals.

In fact, I believe ether to be the method of choice for obstetric manipulations, and for caesarean section, when there is no danger of fire.

If the anaesthetic is kept at as light a plane as is possible, and heavy premedication with sedative drugs avoided, no trouble will be experienced with either mother or baby.

I have given a great number of ether anaesthetics for caesarean section and only lost one baby, whose death had nothing to do with the anaesthetic.

Some authorities, indeed, consider that the administration of ether to the mother reduces birth shock to the baby.

It has been stated that a baby born under ether is less inclined to lose weight and recovers its weight loss more quickly than a baby whose mother was given no anaesthetic drug.

One word of warning is necessary, however. Ether should not be administered after a heavy meal, and no practitioner should leave his patient alone in her home until she is conscious. A surprising number of deaths have been caused by obstetric patients inhaling vomited material and choking when no assistance was immediately available.

Relief of Pain in Labour

Ether analgesia can be administered by the inhalation method if due care is taken. The patient soon becomes accustomed to the smell of ether and makes no objection to its use. The technique of administration is difficult and there lies only a narrow gulf between analgesia, and a normal spontaneous delivery, and anaesthesia with all its possible complications. A more satisfactory method is that of Gwathmey who developed the rectal administration of ether during the war, 1914-18.

McCormic describes a modified Gwathmey technique from which complete relief from pain is obtained, which can be used in the patient's own home, and from which there is no danger to mother or child.

With a little co-operation this technique might be made available to mothers in our own empire. The neglect of the woman in labour and our national attitude of indifference to her suffering, constitutes one of the gravest sociological scandals of the present time.

Ether Anaesthesia in the Aged

I have found ether satisfactory for elderly patients, up to the age of 92. The elderly male patient who is admitted to hospital with acute retention of urine, due to prostate enlargement, tolerates ether better than most other anaesthetics, except chloroform. The intravenous barbiturates are particularly deadly, and gas and oxygen are unsatisfactory for these patients. Indeed,

Hubbard goes so far as to say that there are more deaths from nitrous oxide oxygen, in the hands of the so-called expert, than occur from ether, no matter by whom administered.

I work at a rate-supported hospital where we frequently have to deal with patients between 80 and 90 years of age, who come to us for intestinal obstruction, or retention of urine. In one afternoon I administered ether successfully to four patients over 80 years of age, for serious operations.

I have experienced no anxiety with regard to renal function which could in any way be ascribed to the use of ether, and Collen and others have cast doubts on the accepted theory that ether *per se*, has a damaging effect on the kidney.

Beecher considers, however, that age is an important factor in determining kidney response to ether (p. 284).

Ether in Heart Disease

With the exception of vinesthene, ether is quite as suitable as any other anaesthetic in cases of heart disease. Cyclopropane causes cardiac irregularities, and the barbiturates poison the heart muscle.

Local analgesia I believe to be unsatisfactory in patients with a damaged myocardium. I recently watched the attempt to remove the tonsils from a patient whom, the cardiologists had stated, could tolerate only local analgesia. The patient collapsed after the injections, before the operation started. Yet he underwent the operation quite satisfactorily a week later under ether anaesthesia.

I was called one night to a maternity hospital and told that a primagravida at full-term was suffering from a coronary occlusion and was on the point of death. The consulting physician held out no hope of saving the mother's life, but it was felt that an attempt should be made to obtain a live baby, by caesarean operation. Oxygen-ether-chloroform sequence was administered; a live baby was born and the mother made a complete recovery.

It is high time that consulting physicians and cardiologists refrained from giving advice as to the choice of an anaesthetic or its method of administration.

Conclusions

Ether which has been the basic anaesthetic agent for general use for one hundred years, still retains its position as the safest and most satisfactory anaesthetic drug. Although new drugs and new techniques of administration have been developed of recent years, these are associated with disadvantages of such magnitude that the pre-eminence of ether is not challenged. It is particularly in the treatment of war casualties that the use of ether has been deprecated.

Many practitioners have given us glowing accounts of their successes from the use of modern anaesthesia in war surgery. They have been silent on their failures. It is only from the reports of the United States of America Army authorities that we have learned of the not infrequent misadventures. During those years when new drugs and methods of administration have been replacing the use of ether anaesthesia, there has been a great increase in the number of fatalities reported to the coroner. It is untrue to say that this increase in mortality is due to the acceptance of greater surgical risks.

The general practitioner anaesthetist would be well advised to choose ether as the anaesthetic agent likely to give the best results in those operations for which he is called upon to administer the anaesthetic. Many modern anaesthetic techniques are outside the province of the general practitioner and are unsuitable for general use.

The difficulties and limitations of anaesthetic practice in provincial or rural England are unknown to many practitioners, who never appear to take into consideration the conditions which may be met with in our vast Empire.

It may well be that in some London hospitals, as good, or even better results are obtained from the use of "modern anaesthesia" as from ether anaesthesia. But while some specially gifted individual in some specially favoured surroundings may obtain excellent results from one or other of the newer methods now in use, yet for the great majority of medical practitioners who have to administer an anaesthetic under whatever circumstances may exist at the time of operation, ether remains and is likely to remain, the safest and the best anaesthetic agent.

I should like to take this opportunity of making a protest against the lamentable fact, that many newly qualified practitioners go out into the world without even having seen ether administered by the open drop method, or chloroform by any method at all.

There are many conditions under which open ether may be the only possible method of administering an anaesthetic, and, in country practice, circumstances may be such that the practitioner has no choice but to administer chloroform; a most excellent anaesthetic, the dangers of which have been wildly exaggerated.

On occasions, chloroform may kill a patient, but under no circumstances does this drug render a strong young man or woman a permanent cripple or a jibbering idiot, which is far from being the case with some of our modern anaesthetic techniques.

Let the general practitioner anaesthetist remain faithful to his well tried and trusted friend—ether. He will have no cause to regret his trust.