

5-1-1935

## Colonic anesthesia

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COLONIC ANESTHESIA

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April, 26, 1935

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## PREFACE

This paper is of necessity a resume' of the literature on the subject of colonic anesthesia. Since the works of James T. Gwathmey dominate the literature on this subject I have borrowed liberally from him. From the many drugs that have been used for this type of anesthesia I have mentioned only those which have been accorded more or less general acceptance.

Section I

HISTORY

General anesthesia is an unconsciousness with a loss of pain sensation, a paralysis of all vital functions of the body except the centers of respiration and circulation. In general analgesia, consciousness is intact, but the sensation of pain is lost in the entire body. This state is produced by some agent acting centrally, as in spinal, or synergistic analgesia. Depending in a great measure upon the amount of the agent given, there may be general analgesia or anesthesia, as when ether is given colonically in conjunction with other agents.

References to attempts at both anesthesia and analgesia co-exist with the history of mankind. General anesthesia is beautifully expressed in the sentence written four thousand years ago: "God caused a deep sleep to fall upon him", while old Egyptian carvings about 2500 B.C. illustrate how analgesia may be produced by pressure. Modern methods of producing the desired state originated primarily with the discovery of the agents or drugs to be used. It is interesting to note however, the length of time that elapsed between the discovery of these agents and their application to surgery. Ether, for example, was discovered and its syntheses and properties noted in 1540, nearly three hundred years before its use in surgery. Oxygen and nitrous-oxide were originally classified over seventy years before they were combined for anesthetic purposes.

Henry Hill Hickman, a member of the Royal College of Surgeons and a country practitioner in Ludlow, Sharpshire, England, between 1820 and 1828, made the first successful experiments rendering animals insensible to pain by the inhalation of gasses, but he did not succeed in impressing his colleagues with the importance of his experiment.

Crawford M. Long, of Georgia, also a country practitioner, was the first to use ether intelligently for anesthetic purposes. He made no secret of his discovery, but unfortunately he did not attempt to make it public until Morton and Jackson claimed priority in 1846.

Almost as soon as the anesthetic properties of ether had been discovered, Roux (1) suggested that it might be introduced through the rectum. Pirogoff (2) in the same year, 1847, injected ether vapor into the rectum. He found that this method had many advantages over inhalation, especially in operations about the head and neck.

In spite of all this, anesthesia by inhalation became more general while anesthesia per rectum was seemingly forgotten. Even Pirogoff, who wrote enthusiastically upon the subject stated his preference for the pulmonary route. For thirty-seven years no mention of the rectal method of anesthesia appears in the medical literature.

In 1884, it was revived with favorable results by Molliere (3) of Lyons, who introduced a new technic by using a Richardson's hand-bellows for forcing the vapor into the rectum and later an india-rubber tube connected with an ether container immersed in hot water. The vapor was generated by heat and forced into the rectum by the pressure incident to its generation. Usually not more than two ounces of ether was used. In five or ten minutes the patient could taste the ether and became drowsy. This procedure was supplemented by inhalation.

In the same year, in this country, Weir (4) recorded, in the Medical Record, the case of an infant in which rectal etherization had proved fatal, death resulting from melena within twenty-four hours after an operation for harelip. Bull (5) also reported adverse results in seventeen cases in which the complications were melena, diarrhea and even profound asphyxial symptoms. An interesting article by Post (6) published May 8, 1884, follows:

"Dr. Abner Post reported three cases at the Boston City Hospital. The Boston Medical and Surgical Journal of April 17, 1884, had a short account of etherization by the rectum as done at Lyons. Molliere (3). Its administration in that manner has been tried at the City Hospital since that publication."



"The ether has been given from a small bottle with a perforated cork, to which is attached a rubber tube, to the other end of which is fastened a catheter. The bottle of ether is placed in a vessel of warm water, and the catheter passed into the rectum. The ether is seen to boil in the bottle, and its vapor is conveyed through the tube into the bowel. The hot water used was drawn from the hot-water pipes, and was so hot as to be uncomfortable to the hands."

"The first case was a patient of Dr. Homans, a man with cellulitis of the arm, who had been vomiting before etherization. After the tube was introduced he first complained of the taste of ether in the mouth. It was then noticeable to the by-standers in his breath. His pulse grew rapid, the pupils dilated, he partially stiffened out, put his hand to his mouth, vomited, and anesthesia was complete at the end of thirteen and a half minutes. The ether was discontinued almost as soon as he was insensible, but the anesthesia continued for nearly thirty minutes, probably not so complete as to allow surgical interference without shrinking during all that time, but so complete that he lay without motion. During the afternoon he had two or three loose discharges, mostly gas, for which he received a starch and opium enema, and which soon ceased."

"The second case was a woman of large size, who had eaten a hearty breakfast before coming to the hospital. She took an ounce and three quarters of ether, and was insensible for thirty-four minutes. During the etherization the ether was administered evidently faster than absorption took place, as her abdomen became sufficiently distended to embarrass respiration; but a little pressure on the abdominal walls caused the gas to issue from both ends of the abdominal tube, and all difficulty ceased."

"On recovering this woman vomited perhaps an ounce of thin, yellowish fluid. Within an hour had a natural movement of the bowels, and afterwards two slight loose operations, one of which was tinged with blood."

"The third case was in every way a most favorable one except in length of time required to produce insensibility. The ether was given more slowly to avoid the distention of the bowels that had occurred in the previous case. A little less than two ounces was given, and etherization was complete in fifteen minutes. The stage of excitement was marked by a laugh and a comical remark or two, but no struggle. Insensibility continued nearly thirty minutes, and no unpleasant symptoms occurred during recovery. This patient was operated on for piles, and her rectum was packed with sponges to provide against hæmorrhage. Slight meteorism

occurred, but no more than might well follow the closure of the anus. The sponges were removed after a few hours, but no diarrhea showed itself."

"So far as it is possible to draw conclusions from present experience, etherization by the rectum differs from inhalation principally by the absence, or rather the diminution, of the stage of excitement."

"If vomiting occurs during the etherization it does not interrupt the administration of the anesthetic."

"The unpleasant after effects seem less marked. Vomiting, if it occurs at all, is slight."

"The secretion of mucus, which so frequently fills the mouth and air passages, has not occurred so far. The spasm of the glottis which sometimes occurs at the commencement of inhalation, and which is the result apparently of the local effects of ether vapor, is not to be expected by this method."

"The feeling of suffocation which is so common when ether is given by inhalation, and which is the cause of most or at least a large number of the struggles which patients sometimes indulge in, is wanting."

"Of course, the constitutional effects of ether, however given, are the same. The use of a much smaller quantity is sufficient to induce anesthesia when given by the

rectum, where all is absorbed, than when given by inhalation; at the same time the effect is slower in most cases. After complete anesthesia is reached it is apt to grow more profound after the supply of ether has been removed - so that its administration should cease when once the patient is asleep."

"The effect of ether upon different individuals varies very widely. It cannot be supposed that no patient will ever struggle if etherized by the rectum. Of course the man who makes a row whenever he is drunk will probably show his ugly disposition when ether is the cause of his excitement, but so far the excitement shown has been very small. The disagreeable effects seem to consist in the possibility of blowing up the rectum. Evidently the power of absorption differs in different individuals; probably the rate at which the vapor is poured into the rectum differs, as it ought to do, where the heat applied is indefinite and variable. It is necessary to watch the abdomen somewhat to see that it does not become ballooned."

"An irritation of the rectum is set up in some cases which, perhaps, corresponds to occasional effects on the air passages when the ether is inhaled, but nothing so far has transpired to cause alarm or anything more than a temporary inconvenience."

"Dr. Webber quoted the account of rectal etherization at Lyons, given in the New York Medical Journal, as stating that the process was finished by the mouth in some of the cases. He asked the experience of Dr. Post." \*

"Dr. Post thought the French surgeon must have been impatient. Etherization was profound."

"Dr. Charles D. Homans said that etherization was slower than in the common way. There was also much less ether used."

"Dr. Post said that there was less excitement as well."

"Dr. H. K. Sabine inquired if this method was used for the first time at Lyons, or had the Swedish surgeon who proposed it there seen it elsewhere."

"Dr. Post said that it was to be inferred from the published account that it had been done at Copenhagen."

\* FOOT NOTE

"Further experience leads me to modify somewhat the favorable opinion here expressed. Certain feeble individuals have taken an unusually long time to recover, insensibility has been occasionally so profound as to cause anxiety, and bloody discharges have been more frequent than is desirable."

On May 3, 1884, Freeman (7) reported three cases in which all had uneventfull recoveries, one patient eating a full meal two hours following etherization, the other two being nausea-free within one hour after completion of the surgery. In all three cases complete anesthesia was reached within fifteen minutes after instillation of the ether in the rectum.

Poncet employed this method five times. In his cases the narcosis took a normal course only once. In two cases it failed and the ordinary inhalation method had to be resorted to. In one case the narcosis persisted even 2 and 1/2 hours after the operation. In his last case the patient collapsed and manifested alarming symptoms, which regressed after protracted attempts at resuscitation. Poncet thereupon tested this method out on dogs and rabbits. He found almost always hyperemia or the entire intestine, hemorrhages of the gastric mucosa, dilatation of the colon, and diarrhea. Usually the animals died on the first day after the experiment. He came to the conclusion that rectal anesthesia, besides having doubtful advantages, harbored serious dangers and should be condemned.

Starcke was the first one in Germany to introduce this method. In his first case (extirpation of submaxillary glands) he gave the patient 0.01 morphine on the evening before the operation. Two minutes after the administration of the anesthetic, the breath of the patient had a strong odor of ether. Tolerance after 8 1/2 minutes. Pulse 60, respiration 28. From time to time

he also gave a few drops of chloroform by mouth. The patient awoke 25 minutes after the operation. Severe meteorism. Repeated slight vomiting. Starcke also published three other cases which pursued an uncomplicated course. He expressed himself as very well satisfied with the method. He recommends it, but warns against careless technique.

These objections - bloody stools, rectal irritation, believed to be due to the effect of pure or diluted ether on the mucous membrane of the gut, inability to control the stages of narcosis and to measure the amount of ether vapor passing into the rectum, caused the second failure of the rectal method to gain serious recognition.

It was not until 1902 that the first real advance was noted in colonic anesthesia. In this year, Cunningham (8) devised an apparatus which would permit of the introduction of ether-laden air only, and in collaboration with Post, it was used in the Boston City Hospital without the complications which so frequently occurred with the old method. It was tried by others and pronounced practicable. However, Cunningham did note "colicky pains and painful distention" as after effects in some cases and in all cases he was forced to start anesthesia by inhalation.

In Switzerland Dumont (9) (1904) was the first to attempt rectal anesthesia in man. He considers this method only as an auxilliary method, especially in operations of the head. He does not believe that it will supplant the usual inhalation method.

Accordingly he first introduced narcosis by mouth. When the patient was completely anesthetized, the operation was started and carried to its termination by rectal anesthesia. He reports on four cases which were successfully anesthetized in this manner. There were no complications.

In 1905, Cunningham and Lahey (10), in the Boston Medical and Surgical Journal, published their first report on 41 cases in which there were no deaths, and no diarrhea or bloody stools. Stucky (11) commended the method in the Journal of the American Medical Association, in 1906, in a report of 4 cases and in the same year, Lombard (12) used rectal narcosis in performing four laparotomies. These demonstrations of the practicality of the Cunningham technique lent new impetus to the adoption of rectal etherization by many surgeons and anesthetists.

Buxton (13) also made use of this method, with the addition of an interceptor to prevent the passage of the liquid ether into the gut, and found that it "answered admirably for operations about the mouth, nose and post-buccal cavities, for staphylorrhaphy, and for operations for the relief of empyema". In the 1907 edition of his famous work, ANESTHETICS, he stated that for the removal of the tongue, for excision of the jaw, or jaws, and for plastic operations about the face, he had found that the method gave greater facilities and freedom to the operator than any other plan he had tried but also reported that he had met with grave complications, "which, although in part due to the physical condition of the patients, were undoubtedly not wholly independent



of irritation caused in the intestines by the entrance of the ether vapor". In discussing the after-effects, he said: "Colicky pains in the intestines, urgent tenesmus, diarrhea sometimes dysenteric in character, painful distention of the intestinal tract with more or less severe collapse, are complications which have been recorded. Deaths have occurred."

In 1907, Leggett (14) perfected the Cunningham apparatus by the addition of an exhaust tube connected with the vapor tube for the relief of intractable pressure and stated his satisfaction with the method in a report on several animal experiments, as well as 31 personally conducted cases which showed incomplete anesthesia in three cases, bloody stools in one case and no fatalities.

Again, in 1908, Dumont (9) published his experiences with rectal etherization for which he used a modified form of the apparatus of Buxton, with the maintenance of smooth narcosis and almost no post-operative complications. Yet he advised against its use in any but exceptional cases without intestinal lesions, under the supervision of an expert anesthetist.

In the following year, Denny and Robinson (15) announced their success in a series of ten cases and Carson (16) published eighteen cases in two of which failure was due to insufficient preparation and in one to bleeding from the rectum. Two extreme cases, an extensive carcinoma of the face and a hyperthyroidism, resulted in death. In anesthetizing a large, delirious man it was necessary to use the mask throughout the operation.

In 1910, there appeared further rectal anesthetic case-reports by Sutton (17) who used a new apparatus and technique in about 140 cases at the Roosevelt Hospital; another very comprehensive paper by Cunningham (18); a new apparatus by Thomas (19) for rectal and pharyngeal anesthesia almost identical with that of Sutton; 47 cases by Churchill (30), using the apparatus of Leggett, and 11 cases by Sanders (20) with a slight modification of Sutton's apparatus in the addition of a chloroform vapor generator to meet the need for accessory inhalation. Of the forty-seven cases anesthetized by Churchill, with ages ranging from six months to seventy-three years, all but seven were satisfactory. Lessening of postanesthetic nausea and vomiting was noted. Alcoholic subjects were more easily anesthetized than by inhalation.

The most marked advance in anesthesia by colonic absorption was that made by Sutton (17), who used the original apparatus of Cunningham plus the branch tube for exhausting the contents of the gut introduced by Leggett as a basis for his new apparatus. Sutton's apparatus consists of a generator in which the mixture of oxygen and ether is produced, an efferent tube system for the purpose of exhausting the contents of the gut and a safety-valve water manometer that automatically blows off at a pressure of twenty millimeters. Sutton reports 140 etherizations with this apparatus, with careful records of the first 100 in the surgical service of George E. Brewer, of Roosevelt Hospital. The other

forty were private cases all of which proved satisfactory. "In only one case was an attempt made to administer the anesthetic per rectum from the beginning. This proved so slow, and was so uncomfortable and distasteful to the patient, that, after about twenty minutes, a cone was used to complete the initial establishment of the anesthesia. Inasmuch as there is no real indication for beginning the administration by rectum, the writer, Sutton, has seemingly made no second attempt to do so." In the 100 cases the ages ranged from 2 to 77 years. The longest operations of the series took two hours and twenty minutes; the shortest, five minutes. The average consumption of ether was 87 grams per hour. 12 of the 100 cases had preliminary injection of morphine and scopolamin and 43 supplementary administrations by inhalation of chloroform. Eructation of gas followed in 12 cases, only 4 of which occurred out of 71 cases in which a maximum pressure of 20 millimeters in the bowel was adopted. There was slight perspiration in 18 cases and postoperative vomiting in 43, but of these several felt no nausea. 12 suffered abdominal pain. In 5 there were bloody stools or blood-streaked returns from the post-operative enemata but without noticeable weakness or abdominal pain. In the most severe case of all there was persistent vomiting and continued passage of small quantities of blood for three days. In this series of cases there were 5 deaths, none of which the operating surgeon considered might be attributed to the method of administration. One other death occurred in Roosevelt

Hospital, when this method was used on a five-year old child during a staphylorrhaphy lasting fifty minutes.

Summarizing his discussion of cases Sutton states:

"This method, safeguarded by such improved apparatus as that described, and by the use of oxygen as a vehicle for the ether vapor, is one of extreme safety in the absence of definite intestinal lesions..... The colonic method of administration of ether is more complex than the pulmonary method in general, and requires from the anesthetist a broader appreciation of the physiological factors involved. For these reasons alone its field of usefulness is limited to cases in which it presents distinct advantage over the pulmonary method. It is, therefore, not a method adapted to the experimental use of the tyro, but rather a valuable addition to the armamentarium of the trained anesthetist..... The only point against the method in cases where its employment is indicated is the occasional difficulty in maintaining profound anesthesia without the use of the supplementary mouth tube."

Although good results were obtained by Sutton under the guidance and supervision of Brewer, the operating surgeon, who was also enthusiastic about the method, others were less successful and the procedure again lapsed into disuse. There was no special reason for abandoning this form of ether-vapor rectal anesthesia except that an extensive and somewhat complicated apparatus was required.

In the 1912 edition of ANESTHETICS AND THEIR ADMINISTRATION, Hewitt (22) says: "If the risk of diarrhea, melena and after-stupor could in any way be greatly reduced rectal etherization would be strongly indicated in certain cases."

Gwathmey (23), in conjunction with Professor Wallace of the Pharmacological Department of the University and Bellevus Hospital Medical College, started a series of experiments with the idea of obtaining a suitable medium for the introduction of ether into the rectum. They first used a saline solution which failed miserably. Gwathmey then suggested an oil, as ether is miscible in all proportions in oil. They determined that the rate of evaporation from all the oils was exactly the same and was constant. Further, the patient did not absorb a sufficient amount of ether immediately upon injection to produce surgical shock, but that he became anesthetized gradually in accordance with the constancy in evaporation of the ether from the mixture in the colon. A 75 per cent ether-oil solution proved to be most satisfactory in these experiments.

The first successful public clinical demonstration of ether-oil colonic anesthesia was made in September 27, 1913, at the Peoples Hospital, New York City, on one of Dr. T. M. Rothenberg's patients, Dr. Rothenberg operating. This work was continued with success at Columbia Hospital, at other hospitals in New York City, and in neighboring cities.

"To keep well within the limits of safety was the controlling factor in our early hospital work with ether-oil injections. We did not immediately adopt for human beings as large a dosage as had proved successful in our laboratory work with dogs. Consequently the lower percentages of ether proved insufficient for surgical anesthesia in some cases and it was necessary to supplement with ether by inhalation, (23)."

By July, 1914, Gwathmey had used the method in 140 cases with satisfactory results and had received similar reports from other surgeons and hospitals on 500 other cases, a resume of which he published in 1915 (23).

Montoya y Florez (24) in 1917 reported 12 cases with three failures and advised against this colonic method of anesthesia due to its irritation of the rectal mucosa. In the same year Page (25) reports highly satisfactory results on thyroidectomies in hyperthyroidism, as does Lathrop (26) in 1918 in a series of 100 thyroidectomies and in 1920 a series of 1002 cases (27).

Gwathmey (28) in 1921 adds another contribution by his development of synergistic colonic analgesia.

"When magnesium sulphate (from 1-2 c.c.) is used with morphine (from 1/12 to 3/8 grain) instead of plain water, and given by hypodermic injection, the value of the morphine is increased from 50 - 100%.....Furthermore, synergistic analgesia is the logical evolution of general anesthesia.

Analgesia with consciousness is present oftener with colonic anesthesia than with other methods of administering general anesthetics."

Chalier and Dunet (29) analyze a total of 2,855 cases in which general anesthesia was induced by injection of ether in oil by the rectum. These figures include 1,500 reported from Russia and 1000 compiled from American Literature, with 253 in France, in addition to 102 from their own practice. In this total there were 6 fatalities for which the method itself seemed to be responsible. Consequently, notwithstanding its undoubted advantage in many cases, they warn against it as too dangerous except for young persons, free from pathologic taint, with their emunctories functioning well.

Thaler and Hubel (30), in 1923 report the results in 100 cases of childbirth with 88 satisfactory results and only 4 absolute failures and in the same year Zalka (31) ascribes the torsion of the mesentery of the small intestine in a surgical case to the rectal administration of ether.

In 1925, Laurie (32) states that he has used rectal etherization in 75% of his surgical practice and is convinced of the many advantages over the inhalation method. Amongst these are the ease of administration; the absence of apprehension on the part of the patient; the absence of coughing, retching, and straining, so frequent when the anesthetist is not expert; the reduction of shock; and the absence of post-operative vomiting.

Deutschman (33) in 1926, in an article titled, "PAINLESS CHILD-BIRTH BY THE SYNERGISTIC METHOD", makes this statement - "It is my firm conviction that the further development of the method (Gwathmey's Synergistic Analgesia) may become the long sought procedure for producing a painless labor in the real sense of the term, i.e., from the beginning of labor to the expulsion of the placenta."

In 1927, Harrar (34) reports 5,800 cases at the New York Lying In Hospital with 85% greatly relieved and Gwathmey (35) in 1928 reports the advantages of the synergistic action of magnesium sulphate and morphine and refutes the arguments of Davis(36) against its use.

Again Gwathmey (37) in his article on, "INHALATION AND COLONIC ANESTHESIA" concludes that the removal of psychic shock, the small amount of anesthetic used, the absence of cyanosis and asphyxial elements, the maintainance of normal blood pressure, pulse and respiration, the decrease in nausea, vomiting and gas pains, are sufficient reasons for using one of the various techniques of oil-ether colonic anesthesia.

Thus far Gwathmey's ether-oil solution has dominated the field as a colonic anesthetic. However, a new substance, tribromethanal (Avertin) has been developed in Germany. It was originally discovered in 1926 by Willstaetter and Duisberg and its anesthetic properties were demonstrated by the pharmacological investigations of Eicholtz. Much interest has been aroused



by this new method of colonic anesthesia as is evidenced by the publication of some 250 articles in European Medical Journals by 1929, the first appearance in American literature.

Bloomfield and Shipway (38) in 1929 report a series of 198 cases in which avertin was used as a colonic anesthetic. They had only two deaths and one of these was probably not due to the avertin. They conclude that it is a valuable contribution to the anesthetic drugs. In 1930 White (39) reports a series of 100 cases with favorable results and in 1931 (40) a series of 1000 cases and states that he uses avertin routinely. Shipley and Kearns (41) report a case of status epilepticus (1100 seizures in one and one-half days), a dose of 60 mg. of avertin per kilo. was given after other measures had failed. In five minutes all seizures stopped, sleep lasted eight hours and the convulsions did not recur.

York and Schork (42) in 1931 report on 400 cases and state that there are two advantages in using avertin for basal anesthesia in children: one is the avoidance of psychic shock, the other a quiet induction of sleep in the patients room. Lundy (42) and Sumner and Burns (43) reach the same conclusion and the later states that avertin should be used as a basal anesthetic, although 16% of their 700 surgical cases developed complete surgical anesthesia.

Greer (44) reports in 1932 on 230 cases operated in the past two years with no fatalities and only one respiratory complication and that in a man of 77. The following year, after a com-

parison of 431 cases of surgery under avertin anesthesia with an equal number of control cases under other types of anesthesia, Field and Pilcher (45) conclude that avertin fluid, used as a basal anesthetic in combination with gas oxygen or gas oxygen and ether, has some advantages not possessed by most other anesthetics and, accordingly, it has a distinctly useful place. This same opinion was expressed by Ransom (46).

At this date, avertin over-shadows ether-oil as a rectal anesthetic and from the enthusiastic literature, it would seem that avertin is destined to entirely replace ether-oil in this type of anesthesia.

Section II

PHYSIOLOGY

All general anesthetics produce a progressive paralysis of the central nervous system, in the following sequence: (1) the higher cerebral centers, involving the intellectual faculties; (2) the lower cerebral centers, involving sensation and motion; (3) the spinal cord, involving reflex action; (4) the medullary centers, involving the vital function of respiration and circulation. These phenomena vary considerably with the different patients and the different methods of administration. Sensation decreases in the following order: (1) in the back and extremities; (2) in the genital organs; (3) in parts supplied by the trigeminal nerve.

When ether is introduced into the body by rectal injection, the course of its circulation in the blood differs markedly from that which follows its introduction by inhalation. Within from two to five minutes after the oil-ether mixture enters the rectum, it is heated from room to body temperature. At the same time a portion of the ether leaves the oil in the form of gas, which is absorbed by the blood circulating in the small capillaries surrounding the colon. From the colon, through the liver, the ether is carried by the greater circulation to the heart, and from the heart it is pumped into the lungs, where part is excreted through the air passages and lost, the remainder being immediately reabsorbed and carried back to the heart and through the brain and the central nervous system. By the time the anesthetic has reached the lungs it has been thoroughly warmed to body temperature.

Administered in this manner, ether causes no irritation to the lungs, and accumulations of mucous and saliva are either absent or present in amounts so small that they are negligible factors in anesthesia.

When avertin is introduced into the rectum, its absorption follows the same course as does ether. Absorption occurs more rapidly than the containing water, 80% in twenty minutes and 95% in two hours. During anesthesia, avertin concentration in the blood is 6 to 9 mg. per cent. There is no stage of excitement in going under, or coming out of, the anesthetic. There is no local irritation of the rectal mucosa.

Section III

ANESTHETIC AGENTS

- 1 Ether
- 2 Avertin
- 3 Paraldehyde

## ETHER

Ether is an inflammable and, under certain circumstances, a highly combustible, colorless, mobile, strongly refractive, neutral liquid, having a penetrating odor and a sharp, burning taste. It is soluble in all proportions in alcohol and chloroform, and a solvent for fats and resins. It is very volatile; its vapor is 2.6 times as heavy as air. It should never be used with the cautery or near an open flame, such as a candle or gas jet, or near a stove or arc light.

## AVERTIN

Tribromethyl alcohol (avertin) is a white, crystalline substance which readily sublimes, and is soluble in water at 104 degrees F. (40 degrees C.) up to 3.5%. It should be protected against light. Avertin fluid (the only available form) is a solution of avertin in amylene hydrate, which dissolves avertin in high concentration and is itself soluble in water. Each 1 c.c. of avertin fluid contains 1 gm. of avertin and 0.5 gm. of the solvent. Avertin disintegrates when exposed to strong light or cold and must be tested with congo red before use. Elimination is by the kidneys (80% in 48 hours) by its combining with glycuronic acid.

Contraindications - Avertin basal anesthesia has been used in practically all branches of surgery. Contraindications are severe organic disease of the liver, serious bilateral disease of the

kidneys, lesions of the rectum, acidosis, starvation, severe blood diseases, and grave cachexia. Caution in the dosage must be exercised in elderly, debilitated, dehydrated and obese patients, in whom a dose of 80 mg. per kilo. should not be exceeded.

#### PARALDEHYDE

Paraldehyde, an ethane derivative, is a product of the polymerisation of acetaldehyde, and is classed with avertin and chloral as a hypnotic. It is a colorless liquid, soluble in water to the extent of 1 in 10, more soluble in ether, and said to have an unpleasant ethereal odor. Though it acts by depressing the cerebral cortex, there appears to be a safe margin between hypnosis and medullary depression. It is excreted mainly through the lungs and kidneys. Death is caused by respiratory failure.

Contraindications - Cases of colitis, ulcerations of the rectum.



Section IV

TECHNIQUE OF COLONIC ANESTHESIA

- 1 Gwathmey - Ether-oil
- 2 Gwathmey - Synergistic
- 3 Avertin

## THE TECHNIQUE OF ETHER-OIL ANESTHESIA (23)

Apparatus - The simplicity of the equipment required for this method is a decided point in its favor. The only apparatus used is a special rectal tube or catheter one-quarter of an inch in diameter and about 28 inches in length; a clamp for this tube; a 3-inch glass funnel with which to introduce the ether-oil solution; a Gwathmey tube about 30 inches long and three-eighths of an inch in diameter with which to flush or remove fluid from the rectum; and a towel which is placed over the face of the patient from time to time to prevent dilution of the anesthetic in the air-passages until narcosis is complete. A pharyngeal air-way tube should be convenient, to lengthen the anesthesia if necessary. Of course, the tubes should be sterilized before use.

Dosage - In using the ether-oil method, the anesthetist must bear in mind the peculiar physiological effects of the ether-oil mixture in order to avoid errors in administration. From a large number of cases we have now deduced the rule of one ounce of a 65 per cent solution of ether in oil for every 20 pounds of body weight in the normal adult and this amount and this percentage should never be exceeded. This amount compares favorably with that employed in all other methods of administering ether. Age, weight, fever, anemia and general weakness modify the dosage as in other methods of general anesthesia, and, by diminishing the amount of the mixture administered in accordance with these factors, over-dosage may be readily controlled. A 50 to 65 per cent solution is sufficient for children and weak, anemic patients.

For Patients Under Six Years - A 50 per cent solution should be employed. This mixture is non-irritating, is easily retained without preliminary medication, and is followed by satisfactory anesthesia in ten to twenty minutes. A child 4 to 6 years of age would probably require just a little more than one ounce for every 20 pounds of body weight. No risk should be incurred with children because the rate of evaporation is much more rapid than in the case of adults. The mixture may be administered very slowly and from one-half to one ounce may be added later, if necessary.

For Patients from Six to Twelve Years - A 55 to 65 per cent solution is used without preliminary medication. One ounce is administered for every 20 pounds of body weight, and twenty to thirty minutes should be allowed for the anesthetic to have full effect.

For Patients From Twelve to Fifteen Years - One ounce of 55 to 65 per cent solution to every 20 pounds of body weight should be administered, with the possible addition of 1-12 grain of morphine and 1-200 grain of atropin given hypodermatically as a preliminary.

For Patients of Fifteen and Upwards - A 65 per cent mixture is injected, the amount and preliminary medication varying with the size and general condition of the patient and the same rule being followed as to quantity, that is, one ounce for every 20 pounds of body weight, except for the obese patient. Six ounces

of a 65 per cent solution, that is, the usual dosage for the average case, will maintain anesthesia from 2 and 1/2 to 3 hours, provided a clear airway is maintained. No more than 8 ounces should ever be given.

For Weak, Anemic Patients - The mixture should consist of olive oil, 35 to 45 per cent, and ether, 55 to 65 per cent.

Preliminary Treatment - A cathartic of castor oil should be given, preferably the night preceding the operation, and repeated the following night, and purging should be avoided. This should be followed the morning of the operation by warm water enemas, one hour apart, until the return is clear, when the patient should be permitted to rest for 2 or 3 hours.

The quantity of preliminary medication depends largely upon the opinion of the surgeon or anesthetist, and will vary with this method as with other methods of administration. No preliminary medication is required for children under 9 years of age, but, in order to obtain the most satisfactory results with adults, preliminary medication is essential, with a rest in bed of two or more hours before injection. As the preliminary, either chloretone or paraldehyde may be used, since both have been found to diminish the amount of the anesthetic required and to assist materially in gauging the susceptibility of the patient to this form of anesthesia. Other hypnotics of equal value may be substituted for them if preferred. Isopral, also, has a slight local analgesic, as well as a general hypnotic effect, and may prove satisfactory.

Administration - The Patient - The administration of ether-oil colonic anesthesia is best accomplished with the patient in his own bed, lying on the left side, in the Sims position. A convenient lifter should be placed under him before beginning the injection. If the bed is in a ward, it should be screened and exposure of the patient avoided by introducing the rectal catheter between two suitably adjusted sheets. A pillow under the hips is sometimes helpful. It is not always necessary that he should even know that an anesthetic is being administered but, in any event, he should be kept perfectly quiet and should never be left alone at any time after having received the injection.

Induction - 20 to 30 minutes before operation the ether-oil mixture is poured very slowly, allowing about one minute for the introduction of each ounce, through the funnel attached to the rectal tube which has been well lubricated, and filled partly with oil, inserted four inches within the rectum and clamped. At the very least 5 minutes should be consumed in administering 6 ounces, which is the usual amount required. Unconsciousness generally follows in from 5 to 10 minutes after the completion of the injection and, except in rare cases, full surgical narcosis is reached in from 10 to 30 minutes.

If the patient goes to sleep before the required amount has been given, STOP! If narcosis is delayed a few whiffs of ether or chloroform may be used.

It is advisable not to withdraw the catheter until the patient is partly unconscious and the muscles are relaxed. From 5 to 20 minutes, in accordance with the percentage used, should be allowed for the anesthetic to take effect before the patient is moved to the operating room.

Maintaining Anesthesia - After the patient has received the mixture a clear airway must be constantly maintained by placing a finger beneath the symphysis of the lower jaw. Care must be exercised to prevent the air-supply from being cut off, either by the head falling forward or sidewise, or by the tongue falling backward. If the breathing is easy and regular, with the reflexes active, the patient will be found to be completely relaxed and in surgical narcosis as long as the operation lasts. Six ounces of the 65 per cent mixture will last from 2 and 1/2 to 3 hours. If the operation is completed before this time the Gwathmey tube should be inserted in the rectum beside the catheter and as much of the mixture drawn off as possible.

The physiological changes incident to this method will be found to result in the automatic maintenance of surgical narcosis. The anesthetist has complete control of the anesthesia at all times, and any error in judgment as to the proper amount of the solution in the first place may be quickly rectified by either the addition or withdrawal of the mixture. If the patient shows undue susceptibility to the ether, part or all of the mixture may be withdrawn immediately, if necessary. On

the other hand, if the patient seems too lightly narcotized with the regulation dose, anesthesia may be deepened by a few drops of ether or chloroform on the towel, which is preferable to increasing the amount of the solution; or it may prove sufficient to prevent the dilution of the anesthetic with the outside air by placing over the face a towel slightly puckered just above the nose and mouth, but held securely to the face around the edges, so as to inhibit the escape of the ether vapor and induce a certain amount of rebreathing. Anesthesia may be concluded at any time by placing a Gwathmey tube in position and massaging over the colon from right to left to expel the remaining mixture. When anesthesia is so terminated, the anesthetic stage merges into one of deep sleep.

It would be safer for a practitioner, who must work unassisted, to use a 55 to a 65 per cent solution of ether and oil, to allow 15 to 30 minutes for the mixture to have its full physiological effect, and then to supplement this dosage, if necessary, with a few drops of ether on a mask. This procedure would be better than inducing profound anesthesia with a 75 per cent solution, with the possibility of having to withdraw some of the mixture if the patient was to deeply narcotized. This combined method would also be a safer one for use by hospital internes and others who have not had extensive experience in the administration of anesthetics.

TECHNIQUE - GWATHMEY'S SYNERGISTIC COLONIC ANESTHESIA

Briefly, the method depends on the synergistic action of morphine and magnesium sulphate aided by colonic oil-ether administration. Meltzer accidentally discovered the strongly anesthetic properties of magnesium sulphate in 1905. Used alone, it is unsafe and toxic, but used for its synergistic properties with ether, nitrous oxid, morphine et cetera it becomes most effective and satisfactory. It seems to prolong the effect of morphine without rendering it dangerously deep, and thereby increasing the efficiency of a single dose by 50 per cent to 100 per cent. Used with ether, the latter may be cut down a third or quarter in amount and with gas and oxygen the former may be much decreased and the latter increased.

At the onset of labor the usual cleansing enema is given some hours before the injection. When the pains are well established and becoming frequent and severe, say, for forty-five seconds every three to five minutes, the patient is given an injection of morpnine 0.015 gramme (one quarter of a grain) into the gluteal muscles, with two cubic centimetres of a 50 per cent solution magnesium sulphate. The room is darkened, the visitors are excluded, eyes bandaged and the ears plugged. Twenty minutes later the dose of magnesium sulphate is repeated and in half an hour or more, according to the severity of the pains, but never within an hour of the first hypodermic, the



following solution is slowly instilled into the rectum:

Ether - 715 cubic centimetres (two and a half ounces).

Quinine sulphate - 1 gramme (fifteen grains).

Chloral hydrate - 0.6 gramme (ten grains).

Warm olive oil ad--120 cubic centimetres (four ounces).

This can be repeated in two and a half to four hours, if the effect wears off too soon and in a long first labor the whole series may be repeated, but the usual period is about five hours. No morphine should be given within two hours of delivery, because of the chance of the child being under its influence at its birth. Chloroform must never be used. If deeper analgesia is required for delivery of the head, a light ether inhalation anesthesia can be used.

Further important points are to instruct the patient to draw up rather than bear down during a pain and to hold a folded towel or tampon over the anus for ten minutes or so after the injection and during pains. No rectal examination should be made for an hour. The patient should be analgesic, sleeping between pains with the jaw not fully relaxed; and she can be roused to answer questions. Contractions are nearly as strong as usual, so the attendant must guard against a precipitate labor. Patients may appear to suffer much, but questioned twenty four hours later, will remember little.

More recent writers (52) eliminate the magnesium sulphate. The intramuscular injection of magnesium sulphate is the largest

factor in preventing a more general acceptance of this method. Then too, the synergistic value of the magnesium sulphate has been questioned.

#### TECHNIQUE - AVERTIN COLONIC ANESTHESIA

##### Preoperative Preparation:

The evening before operation a hypnotic (Phanodorn, Luminal, or Veronal) may be administered and the customary cleansing enema is given, although the latter is not necessary.

Before the operation, a hypodermic injection of morphine and atropine is given, as with other anesthetics.

In obstetrics, the cooperation of the patient is necessary and the time of injection determined by the labor pains and the cervical dilatation.

##### Dosage:

Avertin is recommended solely as a basal anesthetic, to be supplemented by some other general or local anesthetic when necessary.

For basal anesthesia in general and special surgery, the usual dose is 0.1 c.c. (100 mg.) of avertin fluid per kilo. of body weight as determined by Dix and Horsley (47) and Speidel (48) while Widenharn (49) used an average of 60-95 mg. per kilo. and Goldschmidt and Hunt (50) used an average dose of 5.04 c.c. of avertin fluid per patient.

The dose should never exceed 10 c.c. of avertin fluid in man and most of the authors agree that 8 c.c. is sufficient under all conditions. In obstetrical use, small doses (60 mg. per kilo.) are sufficient.

Preparation of Solution:

1. Determine amount of avertin fluid to be used and the amount of distilled water needed to make a 2.5% solution.
2. Heat the measured amount of distilled water to 104 degrees F. (40 degrees C.), using a glass receptacle that can be tightly closed, with a capacity of 500 to 1000 c.c.
3. Measure the dose of avertin fluid with a 10 c.c. graduated Luer syringe or pipet.
4. Add the avertin to the water. Stopper the flask, invert, and shake vigorously until all globules of avertin fluid have disappeared.
5. Do not permit the solution to cool. If precipitation occurs from cooling, discard the solution.
6. Test the solution with congo red just before using.

Congo Red Test:

Place 2-5 c.c. of the solution in a test tube and add 1-2 drops of the 1: 1000 aqueous (not alcoholic) congo red solution. Orange color should develop. If the color becomes blue or violet, the solution should be discarded.

Manner of Use:

The rectal injection of the 2.5% solution of avertin at body temperature is given 20 to 30 minutes before operation,

in a darkened quiet room, preferably the patient's room. The administration is usually made by gravity (using a glass funnel with a rectal tube or male catheter) at a moderate rate of flow.

Whitham and Mungler (51) state:

"Within five minutes after injection of the drug the patient usually goes into a profound sleep, from which he cannot be aroused. Muscular action ceases and the pulse, respirations and color are almost unaltered. There may be some depression of the blood pressure. There is never any preliminary excitement and the patient has no recollection of the induction. Waking occurs in the same uneventful manner, in this series in an average time of 3 hours and 43 minutes. The shortest duration was 1 hour and 10 minutes, the longest 7 hours and 5 minutes. It is said that 80 per cent of the drug is absorbed in the first twenty minutes, and 95 per cent in two hours. Excretion is accomplished by the kidneys after detoxication in the liver by a combination with glycuronic acid."

SUMMARY

The stormy course in the development of colonic anesthesia is responsible for the slow acceptance by the medical profession. Not until Gwathmey, was there an organized and serious attempt to popularize this type of anesthesia and acceptance of his method was delayed, due largely to errors of technique in unexperienced hands and consequent publication of said failures.

The ether-oil mixture of Gwathmey was becoming quite popular until the development of avertin in 1927. This new type of anesthetic quickly became popular and at present over-shadows ether-oil which is rapidly becoming extinct.

Colonic anesthesia has its greatest use in obstetrical and in hyperthyroid cases, and brain surgery, more as an analgesic than an anesthetic.

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