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RECTAL ANESTHESIA AND ANALGESIA

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SENIOR THESIS

UNIVERSITY OF NEBRASKA

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FOREWORD

In this paper an attempt has been made to review and summarize the literature pertaining to the practical side of Rectal Anesthesia. No comparison has been made to other methods of anesthesia as to its advantages or disadvantages. The subject matter is derived entirely from the authors included in the bibliography.
Sutton, in Gwathney's (1) Anesthesia states that the high efficiency of the intestinal mucous membrane of vertebrates in general as a transmitter of gases to and from the bloodstream has long been recognized. As early as 1808 Ermen opened the abdomen of cebitus fossilis and observed that when air was swallowed the lumen and the intestinal veins of the fish became bright red, while when nitrogen or hydrogen was used the organs were changed to dark purple. Baumert in 1855 analyzed gas passed by rectum by the same kind of fish and found a marked decrease in the oxygen content and corresponding increase in nitrogen when swallowing of the air had been prevented several hours. Jobert 1877 discovered that in Callichthys Aspen, air swallowing is essential to life, the fish dying in about two hours if prevented from using this form of accessory respiration. In mammals, also, similar phenomena have long been known. Thus Paul Bert 1870 found that if the trachea of a kitten be clamped the animal will die by asphyxias in about thirteen minutes, but if the intestine be inflated with air, life can be prolonged for twenty one minutes. A similar absorption of oxygen by the intestinal circulation in man was shown by Tappeiner 1886. By analysis of gases from various portions of the alimentary canal of an executed criminal he showed 9.19 per cent of oxygen in the stomach, only a trace in the ileum, and none in the colon and rectum, whereas the percentage of carbon dioxide showed a regular increase from stomach to colon.

Recognizing the activity of the intestinal mucosa, the
early experimenters with ether as anesthetic attempted its administration by this route. First mentioned by Pirogoff 1847. His original idea was the introduction of liquid ether into the rectum. Being warned that this could not safely be done, he devised the method of vaporizing the ether by means of heat and administering the drug in this form. He reported good results. In the same year several other men reported various methods of administration but failed to give complete records and the method disappeared from current literature not to reappear until 1884. In this year Holliere revived new interest in the subject by introduction of a bellows for forcing the ether vapor into the intestines. This method he later discarded in favor of an earlier process of placing the ether container in a water bath at 120 F. and employing pressure incident to the generation of vapor to force the latter into the gut.

Before the end of the year 1884 several men had recorded their experience with the method and a number of cases showed diarrhoea and melena, and one death was directly traced to the procedure.

The method again fell into disuse not to be re-

vived until 1903 when Cunningham (2) added to the technique of administration of a new feature in the employment of air as a vehicle for carrying the ether vapor into the intestine.

Stimulated by the records of improved results follow-

ing the use of the Cunningham technique many surgeons and anesthetists tried the new method.
In 1910 Cunningham (3) published his third article on the subject with further case reports. He made the first great advance by using a water bath of temperature below boiling point of ether, and by carrying the ether vapor into the intestine in a vehicle of air. No provision was made for emptying the distended intestine, this being accomplished when necessary by inserting the finger of the anesthetist through the sphincter and alongside the rectal tube.

Since this work there have been minor improvements upon the apparatus in which a generator is used to produce the mixture of oxygen and ether and efferent and afferent tubes employed to carry the vapor to and from the gut.

- Technique -

To obtain the best results it is essential that the bowels be thoroughly cleaned. This is accomplished by a cathartic given the night preceding the operation and followed in the morning by a high soapsuds enema repeated until the return is clear. In most cases morphine sulphate 1/6 - 1/4 grs. and scopolamine 1/120 - 1/100 grs. hypodermically, one hour before operation, are useful (1).

Administration -- The depth of narcosis is determined by the pupils which are usually at maximal contraction in complete anesthesia by this method (unless morphine and scopolamine have been used); by the degree of muscular relaxation, and by the color of the blood in the wound. The character of the respiration is of less value, as the patient may have excellent color though breathing very infrequently. Short shallow, jerky
respirations, especially when associated with a dusky color is a danger sign, just as it is in the pulmonary method.

Muscular tone is best determined from the tension of the jaw muscles and from the presence of voluntary movements of the tongue (1).

After Treatment -- As soon as the patient is returned to bed, a high soapsuds enema is given, the fluid, if necessary being siphoned off after a few minutes. This treatment is repeated on half an hour later. Recovery is usually rapid.

Conclusions -- In general, the colonic method of administration of ether is more complex than the pulmonary method and requires greater skill of the anesthetist as regards the physiological factors involved. For these reasons its field of usefulness is limited to cases in which it presents a distinct advantage over the pulmonary method.

Indications and Contraindications --

Contraindications for use of the colonic method are:

1. Operations upon patients presenting lesions of the alimentary tract.
2. Laparotomies in general.
3. Operations upon patients with incompetent sphincter or large fistula in ano.
4. Operations upon patients with orthopnea.
5. Emergency cases in general, because of lack of preparation of the colon.

Indications are:

1. Operations upon the respiratory tract
2. Operations upon patients in whom absorption must be minimized.
3. Operations upon patients suffering from
Following the works on ether vapor Gwathmey (1) in 1913, presented to the International Medical Congress in London, the results of his observations in the experimental animal of the combination of oil and ether as a rectal anesthetic. In these experiments it appeared that no matter what per cent the mixture of oil and ether, the rate of evaporation remained constant. The significance of these observations is: there is an even plane of anesthesia; the administration of ether oil colonically is a safe procedure.

Colonic Anesthesia was first administered by Gwathmey (1) at the Stuyvesant Square Hospital in 1914. This hospital is a special one devoted to the treatment of skin and cancer. The cancer service is a separate entity dealing with all forms of cancer. The therapy being chiefly surgical. It is believed by Gwathmey and others (4) that the possibilities in safely prolonging the operation and the development of meticulous cancer technique has been greatly enhanced by the employment of colonic ether, the direct result of all this being an improvement in the percentage of apparent cures.

In the administration of this anesthesia two distinct processes take place. The first is the physical separation of the ether from the oil; the second, the physiological absorption of the liberated ether vapor. The dissolution of the mixture in the colon is at a constant rate and the total vapor liberated is limited by the amount of ether used. From a mixture containing
six ounces of ether, the ether is absorbed at a rate of two ounces per hour; this produces the required saturation of the blood for anesthesia. The constant elimination by way of the lungs prevents the cumulative effects which may occur in the inhalation method. In this type of anesthesia, the higher centers of thought, speech, etc., are not so profoundly affected and amnesia is marked. The safe prolongation of the operative time is made possible by the fact that the stage of anesthesia is followed by the stage of analgesia lasting sometimes as long as eight hours. (4).

Since the inception of colonic anesthesia the method of administration has undergone few changes. Gwethmey (1) believes that the most successful amount is five ounces of ether and two and one half ounces of oil. Coleman (5), has successfully used three parts of ether to one part of oil. The mixture is given one hour before operation. Many methods of administration such as the fractional doses, Murphy drip, etc., have been tried and discarded. The use of soapsuds enemata and excessive colonic washings, etc., have been found to be too irritating to the mucous membrane of the bowel and have also been abandoned. With the use of five ounces of ether, or less, it has been found necessary to employ some supplementary anesthesia in sixty-five per cent of the cases (4). Nitrous oxide, ether and chloroform have been used. Small amounts of chloroform are preferred; the ether seemingly counteracts the depressing effect of chloroform (6). No complications from the chloroform have been reported. No supplementary anesthesia is required
unless the patient is actively restless.

The technique as described by Gwathmey (1) is as follows:

On the evening preceding the operation the patient is given a light supper of tea and toast; nothing is allowed by mouth after midnight. No laxatives are given at any time, the cleansing of the bowels being accomplished by tap water enemata. The administration should take place in a quiet and darkened room. At five A. M. on the morning of the operation the tap water enemata are repeated. One and a half hours before the operation a chloroform suppository of ten to fifteen grains is given to be followed in fifteen minutes by a hypodermic of morphine sulphate grain one-sixth to one-fourth.

Fifteen minutes later, with the patient in the left Sims position, the following mixture is instilled into the rectum: ether, (ounces five), olive oil (ounces two and one-half). It is essential that this be thoroughly mixed and given very slowly, at least ten to fifteen minutes being taken. A few patients suffer cramp-like pains in the abdomen and if their cooperation cannot be obtained they will expel the mixture. At the end of an hour in which there has been absolute quiet the patient is taken to the operating room. Immediately on return to the ward a colonic irrigation of tap water is given; followed by a retention enema of six ounces of hot coffee. Throughout the entire preparation and observation the patient should be closely supervised to prevent the danger of the tongue falling back in the throat.
The character of the anesthesia obtained: The patient is analgised and carried on the threshold of surgical anesthesia, reliance being placed on the marked analgesic properties of colonic ether. Analgesia with consciousness is present in the majority of cases. Colonic anesthesia produces relatively more analgesia than anesthesia and often in late stages of an operation the patient is apparently completely conscious, yet the amnesic properties are such that the patient will not remember anything that took place in the operating room. Ether-oil is always safe as a light narcosis and the eye lids and other reflexes are active, the patient relaxed and analgized (7). The ideal colonic anesthesia yields a quiet and peaceful respiration in which the swallowing and respiratory reflexes are retained. Some of the most difficult and time-consuming operations about the head and neck can be successfully carried out as there is no venous congestion and no excessive production of saliva and mucous (8). The patient can be readily aroused by talking sharply to him.

The contraindications for oil-ether colonic anesthesia follow:

It cannot be used with advantage in cases requiring complete muscular relaxation. As the reflexes are not abolished in the throat it is not a good anesthesia for the ordinary tonsilectomy. It is contraindicated in diseases of the gastro-intestinal tract and rectum (4).

The postoperative recovery is smooth and takes place with fewer complications than in the inhalation method. (4) There is little post operative nausea and
vomiting; few cardiac and pulmonary accidents.

Local complications such as colitis, abdominal pain, diarrhoea, irritation of the rectum and aggravation of the hemorrhoids are uncommon (4).

The disadvantages of colonic anesthesia are several:

It is not a universal anesthetic; it does not give complete muscular relaxation; it is a complicated and time consuming method which requires the cooperation of the patient for its administration and a competent person to watch the patient before and after the operation to prevent the swallowing of the tongue. It should not be used in emergency operations as time is required for the proper preparation of the rectum (9).

The advantages are:

It is safe, it is controllable, as the ether can be washed out at any time. The prolonged analgesic properties of colonic ether (it may last from six to eight hours) make it possible to carry out extended operative procedures. Psychic trauma is absent, amnesia marked and the stage of excitement eliminated. The actual cautery can be used in the mouth and throat (8).

It is useful in short-necked, obese individuals in other types of operation (6).

Following the introduction of colonic ether-oil anesthesia to general surgery comes its use in obstetrics as an analgesic. Gwathmey (1) who first used the method was among the first to put it into test in the field of obstetrics and he outlined a technique for its administration (10). The method was one in which the
synergistic action of intramuscular magnesium sulphate
and ether-oil instillation was used.

Ether-oil rectal analgesia in obstetrics has best
been worked out by McCormick (11) He has improved some
upon the Gwathmey technique in order to make it more
applicable to this particular field. His work follows:--

The advantages claimed for ether-oil rectal
analgesia in obstetrics are as follows:

1. It is the safest of all satisfactory analgesias
   used to date. No maternal or infant mortality
   has been attributed to its use.

2. It is the most generally applicable of all
   known methods, and from two considerations:
   (a) Physical contra-indications -- If any, they
       are minor. It may be administered with impunity
       to cardiac, pulmonary, renal, toxic, placenta
gestation, and disproportion cases. In the event
       of rectal pathology it is no more irritating than
       the usual soapsuds enema.
   (b) As to environment. It is given with equal
       facility in the home and hospital.

3. It serves as a satisfactory analgesic in eighty-
   five to ninety-five per cent of the cases, and
   affords equal amnesia and hypnosis (11).

4. It requires but little equipment and experience
   and is readily administered by the general
   practitioner or student nurse.

5. It can be started early in the first stage.

6. The patient is much more cooperative than in the
   case of twilight sleep or sodium amytal analgesia.
7. No unusual attention to the patient is required and the physician does not have to be in constant attendance, the average instillation being effective two to six hours.

8. Of known methods it is least likely to prolong labor.

9. Not infrequently the second stage is shortened.

10. The baby suffers no ill effects, and the number of still-births is not increased.

11. It incurs no complications of labor or post-partum pathology.

12. Forceps deliveries, if anything, are decreased in number, and lacerations are no more frequent.

13. Mental and physical shocks are lessened perceptibly and the convalescence smoothed.

14. It is relatively inexpensive, especially compared with nitrous oxide.

15. It dovetails excellently with gas and inhalation ether as adjuvants during the perineal stage and instrumentation, only fifty per cent or less of the usual amount of ether being necessary.

16. In performing a Cesarean under local anesthesia it affords an excellent preliminary.

"The extreme safety, simplicity, applicability, efficiency, equal facility in home and hospital, and numerous other desirable advantages recommend this form of obstetrical analgesia as nearest the ideal of all known methods" (11).

McCormick (11) has made the following modifications in the technique as outlined by Gwathmey (10), the
originator of the method.

The intramuscular injections of magnesium sulphate, as laid down by the Gwathmey technique afford the largest single factor in preventing the more general adoption of rectal ether analgesia (12). An intramuscular injection is primarily a surgical procedure, and in the hands of the general practitioner much more so than a hypodermic injection. It frequently is sufficiently so that he refrains from using the method altogether.

In dispensing with the magnesium sulphate as prescribed in the Gwathmey (10) technique, McCormick (11) employs the following routine when practical:

Instead of the first two intramuscular injections of the sulphate, the patient is given orally three grains and one and one-half grains respectively of pentobarbital. One-sixth or one-fourth grains of morphine is usually hypodermically given at the second dose of pentobarbital, if the patient is a primipara and the labor active. When the morphine begins to wear off, the rectal ether-oil solution is administered, and repeated as often as required. Usually one instillation suffices. Morphine is omitted if delivery is anticipated within four hours, and is rarely necessary if the patient is multiparous. If delivery is anticipated within four hours, the oral administration of pentobarbital and the rectal ether-oil instillation are promptly given simultaneously.

Pentobarbital sodium seems to offer the following advantages (13):

It is perceptibly more potent and although it is said to be pharmacologically approximately twice as toxic,
only one half the dosage is required. It appears to act quicker. Delirium is of less degree, and its occurrence is greatly reduced. The amnesia is deeper, and the hypnosis much less protracted.

Whereas Gwethney determined the time for administration of the sedatives and rectal ether-oil instillations by the degree of dilatation of the cervix. McCormick finds that the degree of the patients suffering is an adequate guide.

"In addition to saving gloves, sparing the patient the annoyance of the rectal and vaginal examinations, and eliminating the jeopardy of contamination, this modification carries special value by further greatly simplifying the technique." (11)

Minor recommendations are:

1. Substituting a five to ten per cent sodium bicarbonate enema for the soap-suds enema, thereby minimizing the rectal irritation.

2. Omit the warming of the instillation solution.

3. Dispensing with the darkening of the labor room and securing quiet by eliminating noises and stoppering the patients ears (14).

Anesthesia produced by the instillation of various drugs rectally follows closely upon the ether and ether-oil method. Of these drugs, Tribromethanol (Avertin) has been most widely used. Although the literature on avertin is extensive, the use of this anesthetic is not universal. It is therefore relevant to analyze collected data.

It is the opinion of Johnson (15) that avertin and ether-oil colonic anesthesia have about the same degree of
immediate anesthetic safety and that ether by rectum has two disadvantages, namely; (1) secondary pulmonary complications (ether is to a great extent eliminated from the body through the lungs, and (2) the ritual of administering ether makes it objectionable to hospital routine. "The objections raised against rectal anesthesia in general are more theoretical than practical."

The usual induction of avertin is quiet, smooth and rapid. After a few minutes the eyes close, the patient responds languidly to questions and consciousness is frequently lost in the middle of a sentence a few minutes after the injection has been started. It is unusual for its completion to require over ten minutes.

The degree of narcosis obtained from the injection determines the amount of the supplementary anesthetic required to augment the depth of the anesthetic to so-called "surgical anesthesia". This auxiliary anesthetic can be increased, decreased or withdrawn at will. Ether and nitrous oxide, in their influence on blood pressure and respiration are opposed to the action of avertin, while both act in the same direction to secure anesthesia (16).

Only a small amount of additional inhalation anesthesia is used, and local anesthesia works especially well in conjunction with avertin anesthesia (15).

Avertin is absorbed from the rectum very rapidly: Fifty per cent in the first ten minutes and seventy five per cent after twenty minutes and then very slowly. The curve of absorption is therefore very sharp in the beginning, but becomes practically flat later on. The water in which the avertin fluid is mixed, is absorbed
There is unanimity of opinion that elimination takes place almost entirely through the kidneys and liver, and possibly a small amount through the intestinal tract. Pulmonary elimination, if any, is too slight to consider. After from four to eight hours from eighty to one hundred per cent can be demonstrated in the urine.

Avertin is converted in the liver, forms a compound with glycuronic acid and is eliminated through the kidneys (16).

Johnson (15) does not believe that avertin depresses kidney function.

Blood pressure is lowered, usually about twenty points, shortly after administration, but usually begins to rise again in about twenty minutes. The pulse is elevated in proportion to the drop in systolic pressure.

The respirations are made shallow and are slowed in rate.

Muscular relaxation, with the addition of a small amount of ether, is especially noted. In fact, the relaxation approaches that obtained with spinal anesthesia. The eyes become fixed early, the pupils contract, but react to light and the cornea loses its reflex early. Absence of corneal reflex cannot therefore be used as an index of depth of anesthesia.

Because elimination does not occur through the respiratory system there is no irritation of the lungs. (15)

The usual period of unconsciousness varies from two to four hours and reaction is usually smooth. The patients seem to sleep quietly after operation and when awakened they immediately fall into a sleep again. Occasionally a patient becomes irrational and a little later may become
almost unmanageable. Morphine sulphate may be used to prevent these violent reactions.

The post operative complications of avertin anesthesia are comparatively few. One serious accident which may occur is swallowing of the tongue. Because avertin causes an early and prolonged relaxation of the masseter muscles and tongue, and as a consequence a dropping of the lower jaw this must be guarded against. Placing the patient in bed with head turned far to one side and having an attendant present to see that the head is kept in position usually suffices. If the tongue does fall back it must immediately be pulled forward with a tongue clamp or towel clip by the attendant. After the patient has reacted and pharyngeal reflex has returned no further anxiety need be felt on this account.

Respiratory depression, vomiting, gas pains, urinary retention and pneumonia must be considered but do not occur frequently (15).

Broadly speaking avertin anesthesia can be used in the entire domain of surgery. Any anatomic region can be attacked under this form of anesthesia. (19). There are no absolute indications for its use but it would seem to be particularly useful in the following:

1. Highly nervous and overwrought patients
2. Those who have previously suffered from other forms of anesthesia.
3. Patients with cardiac disease.
4. Those who dread an anesthetic.
5. Surgery about the head or neck so that the anesthetist can be kept out of the way.

There are no physiologic reasons for using avertin
as exist, for instance, for spinal anesthesia; therefore there are no absolute indications.

Contraindications for the use of Avertin follow:

1. Renal disease: Calculus disease, definite nephritis, suppurative diseases of either kidney.

2. Hepatic disease, when there is reason to believe that liver function is definitely impaired, as seen in cases of obstructive jaundice, carcinomas of gall bladder or liver, cirrhotic liver and peritoneal ascites.

3. Acute respiratory disease or chronic respiratory disease when the ventilating surface is markedly reduced.

4. Debilitated patients and dehydrated patients and patients in shock all contraindicate Avertin.

5. Diabetic patients.

6. Rectal disease proximal to the internal sphincter contraindicates Avertin. This does not, however, hold true for hemorrhoids, fissures and uncomplicated fistulas.

The dosage of Avertin varies with the body weight of the patient. Johnson (15) believes that it should never exceed one hundred mg. per kilogram of body weight with eight grams as a maximum, ninety mg. doses being the best average. Bourne and others (17) use one hundred and twenty five mg. per kilogram contending that it reduced the number which ordinarily required additional general anesthesia but they sum the entire thing as follows:

The amount of Avertin per kilogram of body weight should be decided upon only after a careful evaluation.
of the patient by considering the following:

Age, the young stand better than old people, just as the strong are more resistant than those who are weak. Habits, those who live active lives may have more avertin than those who are sedentary, just as those who indulge in alcohol or other drugs will be found to be more tolerant to it than those who do not. Weight; marked variations in either direction from standard values should indicate reduced doses. Physical condition; cachectic anemic and wasted individuals, as a rule, may not have large doses of avertin, an exception being that those who suffer from exophthalmic goiter stand large doses of this drug will. In short, one should find out as much as possible about the individual patient before deciding on the amount of avertin to be given and when the amount has been decided upon, it should then be instilled into the rectum very slowly; about ten minutes should be taken.

Barlow (18) and others have made a general survey of one thousand eight hundred and thirty-one records of anesthesias in which the patients were given morphine, atropine and avertin in doses of from 50 to 100 mg. (median 80 mg.) per kilogram of body weight, supplemented with several types of general anesthetics. The dose of the hypnotic was adapted to the age and general condition of the patient.

During the evening preceding the day of operation apprehensive patients received a sedative in order to assure a restful preoperative night. In addition, the colon was cleansed by a warm enema. On the following
morning from 30 to 60 minutes before the scheduled operation, morphine ($\frac{1}{6}$ grain 11 mg.) and atropine ($\frac{1}{150}$ grain 9.5 mg.) or fractional doses of this combination as gaged by the age were administered hypodermically to 88 percent of the patients. The remainder (including the group who were to undergo operations on the brain) received either atropine alone or no supplementary premedication. Ten minutes after the injection of morphine and atropine, avertin -- the dose gaged by the age, weight and general condition of the patient -- was administered rectally over a five minute period as a freshly prepared, warm, 2.5 per cent aqueous solution of avertin fluid. The patients were asleep within from two to ten minutes after the rectal instillation had been completed and could be transported to the operating room. The administration of the supplementary anesthetic was begun from 15 to 30 minutes after the injection of avertin.

The anesthetic supplement used, except in the special surgical groups, was adapted to the patient according to the judgment of the surgeon, but no routine or fixed procedures were established. A nitrous oxide, oxygen and ether supplement was used most frequently (in 55 per cent of the entire series) and represents the anesthetic of choice.

Ninety-two per cent of the patients were asleep on arrival at the operating room, usually well relaxed and satisfactorily analgesic. Occasionally with doses of 70 mg. or less of avertin per kilogram of body weight patients moved slightly on arrival, but this was much
more frequent after doses of from 50 to 60 mg. In general, the reactions on being moved were unimportant, but were observed in the presence of painful stimuli, irrespective of the dose administered.

Respiration:-- The respiratory rate was either unchanged or increased slightly by premedication. As a rule, however, oscillations of one or two respirations on either side of the normal rate occurred.

Pulse Rate:-- The preoperative pulse was irregular and was unchanged, increased from 5 to 25 per cent or decreased from 2 to 10 per cent. The median change with doses of 70 mg. per kilogram or less was a rise of from 3 to 12 per cent above the level on admittance. With larger doses the pulse was either unchanged or depressed slightly (from 3 to 6 per cent). Exceptionally the pulse varied from 12 per cent below to 18 per cent above the normal values even with doses of 100 mg. In patients less than 18 or more than 60 years of age the pulse rate was the least stable and reacted with most variability. Differences due to six (with similar ages and premedication) appeared unimportant.

Blood Pressure:-- The systolic blood pressure following premedication with avertin varied markedly even with the same dose, particularly as to the time at which the change from normal occurred. Occasionally the initial fall was not observed until after the administration of the general anesthetic had been begun, owing probably to individual variability as to the rate of absorption from the rectum. The median picture was one of depression, which varied in degree from 10 to 40 per cent (the latter rarely), with an average fall of 18 per cent. The
systolic fall was proportional to the dose of avertin, as indicated by the extremes in the entire group, but differences in the degree of fall in groups of equal age may be insignificant with a dose ranging from 60 to 100 mg. per kilogram of body weight. Patients in the age range of from 40 to 65 years, particularly the aged, showed the greatest degree of depression. Women showed a greater systolic fall than did men under similar conditions of age and medication.

The diastolic pressure showed a much better correlation with the dose of the hypnotic administered than did the systolic pressure. Depression was the rule, the degree of which was somewhat less than the systolic change with small to medium doses (50 to 70 mg. per kilogram), but closely approximated the systolic change with larger doses. The fall increased with the dose and, irrespective of the dose, increased with age. The diastolic pressure was depressed to a greater degree in females than in males of the same age under similar medication.

Nature of the Anesthesia: -- The induction or transition period between the premedication state and surgical anesthesia was short. From 80 to 85 per cent of the anesthesias were considered good and the remainder fair or poor. Poor anesthesias were more frequent with small doses of avertin (from 50 to 70 mg.) than with large ones (from 85 to 100 mg.) and, so far as the supplements were concerned, were more frequent with ether than with nitrous oxide and oxygen or with nitrous oxide, oxygen and ether. No poor anesthesias were recorded in the group receiving local anesthetics. One disagreeable
feature observed in the use of local anesthesia was that patients reacted by movements, and occasionally complained even when medicated with from 90 to 100 mg. of avertin per kilogram of body weight. The anesthesia was somewhat better and more regular with young patients. Smaller quantities of the supplementary anesthetic were required after large doses than after small doses of avertin. Heavily premedicated patients were simply nearer the stage of basal narcosis. Anesthesia was somewhat less satisfactory in female than in male patients, independent of age or the dose of avertin administered.

Observations During the Following Operations:
Pulse Rate:—During operation the pulse rate increased from 10 to 40 per cent above normal, . . . The increase was grossly proportional to the dose of the hypnotic administered under constant conditions as to age and supplementary anesthetic. Exceptionally, quite wide variations occurred, but generally with minimal doses of avertin. The nature of the supplementary anesthetic administered bore some relation to the changes in the pulse rate; i.e., with the exception of the age group from 1½ to 17 years, the increase was least with ether anesthesia and maximal with local anesthesia. The changes were greatest in young patients and decreased progressively with increasing age. Smaller changes occurred in females than in males.

Postoperatively the pulse rate varied from the level established during the operation with both the dose of the hypnotic and the nature of the anesthetic supplement; i.e., the pulse tended to increase with small doses of avertin (50 to 75 mg.) and to fall after
maximal doses (above 85 mg.). Ether, nitrous oxide, oxygen and ether or local supplements in the main either inhibited a further rise or depressed the postoperative pulse rate.

Blood Pressure:— During the operation the systolic pressure increased as a rule. The degree of recovery was greatest with young and least with aged patients. The depression of the vasomotor center was proportional to the dose of avertin administered. Postoperatively the median systolic pressures were from 4 to 25 per cent below the original normal values; normal levels were exceptional.

Diastolic pressures both during operation and postoperatively were extremely variable. The significance of the data is questionable, but the systolic and diastolic oscillations were grossly parallel.

Respiration:— The respiratory rate increased from 30 to 60 per cent during the course of the anaesthesia. The changes were greatest with nitrous oxide and oxygen and least with an ether supplement. The volume became distinctly more shallow than normal and compensated partly for the change in rate. The respiratory depression was apparent, and although it was possible to maintain surgical anesthesia in the absence of cyanosis in the great majority of patients, the margin of safety was narrow and the responsiveness to carbon dioxide or rebreathing was distinctly diminished during the first thirty to forty-five minutes of anesthesia. These difficulties diminished as the operation progressed owing to the fact that the depressive effects of avertin were wearing off. Postoperatively the respiratory rates
varied on either side of normal, but more frequently remained slightly above normal for from one to two hours. The minute volumes remained below normal for variable periods (duration of postoperative sleep), and occasionally cyanosis developed.

Restlessness:-- Movements during the period of operation rarely occurred, but were noted occasionally even after medication with maximal doses of the hypnotic (100 mg. per kilogram) and morphine (1/6 grain) supplemented with nitrous oxide and oxygen. Such reactions were most frequent after small doses of avertin, but were not unusual in the presence of local anesthesia, irrespective of the dose of avertin administered.

Postoperative restlessness was observed more frequently than would be expected from previous reports. The frequency of occurrence bore an inverse relation to the dose of avertin. The frequency was lower with local than with other supplements. At least part of the postoperative reactions were due to the general anesthetic. Ether exaggerated the reaction to avertin to the greatest degree and nitrous oxide and oxygen least ... The postanesthetic movements noted following medication with avertin, although as frequent as with pentobarbital sodium, were distinctly less troublesome, and the patients required less nursing attention.

Postoperative Sleep:-- The interval between the conclusion of the operative procedures and return of consciousness bore little if any relation to the dose of avertin administered. The depressive effects of avertin have probably largely worn off by the time the surgical
procedures are completed. Patients within the age range of from 1 to 18 years were medicated with from 90 to 100 mg. (median, 100 mg.) of avertin per kilogram of body weight. On the basis of the total time of unconsciousness (operation and postoperative sleep) the immature patients appeared most tolerant to maximal doses of avertin. However, both aged and young patients were more deeply narcotized than were patients of intermediate ages. The quantities of the supplementary anesthetics required in the extremes of age were less than in the intermediate ages (the hypnotic dose and anesthetic being constant), and the operative procedures were of less severity and of shorter duration in the young age group. Young patients were probably not more tolerant to avertin than are other age groups; however, the lower frequency of organic lesions and the greater recuperative capacity of young subjects as compared with other age groups may be of significance during the postoperative as well as later periods.

Nausea and Vomiting:—Nausea was observed postoperatively in approximately 20 per cent of the general surgical patients. No clearcut relation between the frequency of its occurrence and the dose of avertin is apparent from the data. There are, however, indications that nausea occurred more frequently with small than with large doses and was somewhat greater in the presence of ether than with other supplements. Following nitrous oxide and oxygen anesthesia, emesis occurred less frequently (age group below 19 years excepted) than nausea. The majority of patients nauseated following anesthesia with supplements other than nitrous oxide and oxygen also vomited. Nausea
and emesis were more frequent in females than in males in the age extremes, irrespective of the dose of avertin or the nature of the supplementary anesthetic. No difference related to sex was apparent in the group from 18 to 39 years of age. The divergence of this single group may be accidental.

Amnesia:— Eighty-five per cent of patients medicated with avertin had complete amnesia for from two to six hours after operation. The remaining 15 per cent had amnesia of more than six hours duration. The period of amnesia was directly proportional to the dose of avertin. In rare instances, irrespective of age, patients who received small doses of avertin supplemented with local anesthetics talked rationally during the course of the operation, and one patient subjected to a laminectomy remembered the incision being made.

Urinary Findings:— The first specimens of urine taken postoperatively showed traces of albumin in a certain percentage of all types of cases. The frequency was lowest in the orthopedic group, which included immature patients predominantly, and highest in the gallbladder and thyroid groups. In other surgical groups the frequency was intermediate. The albuminuria in patients free from albumin preoperatively ranged from a faint trace to 4 plus. Albuminuria was present in 39 per cent of the entire group studied in detail. Relatively few of the specimens from females were obtained by catheterization; however, 28.7 per cent of the specimens from males likewise showed albumin, so that the incidence remained high. The specimens taken 48 hours after operation were albumin-free as a rule,
but occasionally traces persisted for five or more days. The frequency of albuminuria bore little relation to the nature of the anesthetic supplement used, and the condition was observed with approximately the same frequency after medication with from 50 to 60 mg. as with from 80 to 90 mg. of avertn. The frequency bore a definite relation to the type of surgical case: greatest in the gall-bladder group, next most frequent in the group operated on for hernia and that treated by plastic surgery. The frequency was significantly higher in patients more than 35 years of age.

Hyaline and occasionally granular casts were observed postoperatively in 7 per cent of the total number of specimens studied. More than 90 per cent of the specimens showing casts postoperatively had not shown casts preoperatively. The specimens taken from 48 to 72 hours after operation were as a rule free from casts, but occasionally these persisted for several days. ... Casts were usually absent from the urine of orthopedic patients and those who had undergone operations on the brain or the breast, but the frequency bore little relation otherwise to the type of surgical case. The frequency was no greater with large than with small doses of avertn, but this lack of correlation was only apparent in that older patients were medicated with minimal doses of the hypnotic.

Red and white blood cells were occasionally reported in the urine postoperatively, but in 2 of 3 cases the preoperative conditions remained unchanged. So far as cells were concerned the specimens were considered as containing none.

Traces of sugar were observed postoperatively in s
small proportion of specimens. In one case values of 10 mg. per hundred cc. were observed, and the glycosurias persisted for more than a week. With few exceptions, however, glycosuria following this anesthetic sequence was no more frequent or greater in degree than in the absence of avertin.

In nearly all of the literature it seems that avertin is successful only when followed by one of the forms of inhalation anesthetics. Several men have suggested combined avertin and ether-oil or, avertin and "evipem" (an intravenous anesthetia of the barbital group). These methods have as a rule, been quite unsatisfactory in that the fixed dose is very hard to manage.

Other drugs used rectally to produce anesthesia, or more usually, analgesia include chloral hydrate, paraldehyde and members of the barbital group other than avertin, (tri brom - ethanol). These drugs act in nearly the same way as avertin in their physiological effect but do not produce deep anesthesia as does avertin, without more serious complications.

Many proprietary compounds combining the above drugs have been marketed, none of which have gained any particular place in the field of anesthesia.

Literature on paraldehyde indicates its use as a sedative, given before operation or during the second stage of labor. Stewart (22) gives paraldehyde rectally before operations with a view of inducing in the patient before the operation a state of oblivion, or at least of indifference. The paraldehyde is given in a solution with saline, well shaken together, in the relative proportions of one and a half ounces of saline to each drachm of par-
aldehyde. The adult dose is 8 drachms of paraldehyde -- that is, 12 ounces of solution -- except where the patient's weight is less than 8 stone, when the amount is calculated on a basis of one drachm of paraldehyde for each stone of body weight. The average dose of 8 drachms need rarely be exceeded for any sacrifice of results. The paraldehyde used must be fresh. It undergoes chemical change if kept too long, and the use of such paraldehyde may lead to transient diarrhoea after operation; no irritation occurs if the fresh drug is used.

The procedure is as follows: The evening before operation the patient is given an enema, and a sedative. The following morning, one and a half hours before operation, 1/100 grain of atropine is administered hypodermically (no morphine is given), and immediately afterwards the paraldehyde solution, freshly mixed and thoroughly shaken, is slowly introduced into the rectum by means of a catheter. Retention is rarely difficult; sleep usually intervenes within a few minutes, and this is not disturbed when the time comes for removal of the patient to the operating theatre. The patient remains oblivious to the administration of the anaesthetic, and induction, by any of the usual methods, is easy and rapid, owing to the complete absence of resistance or excitement. The maintenance of anaesthesia is a simple matter and a surprisingly small quantity of anaesthetic agent is required, even where muscular relaxation is called for. After the operation the patient sleeps quietly for a variable number of hours. He can be awakened during this period, but quickly goes off to sleep again. Spontaneous awakening usually occurs.
from five to eight hours after the operation, the patient remaining drowsy and comfortable for a considerably longer period, and securing, in most cases, a restful first night, often without the aid of morphine.

The method appears to offer certain definite advantages, the chief of which, from the patient's point of view, is the total elimination of the unpleasantness associated with his introduction to the operating theatre, and of the still greater unpleasantness of the anesthetic. The drug is so consistent in its action that the nervous patient can, if desired, be confidently promised that he will go to sleep quietly in his own room and that he will know nothing of operating theatre or anesthetic. Post-operative vomiting appears definitely to be reduced. One-half or one-third of the usual quantity of anesthetic will, as a rule, suffice to produce the desired anesthesia—an important advantage in long operations, where the large quantity of a toxic anesthetic agent normally required is a matter of serious consequence to the patient.

From the anesthetist's viewpoint, no greater advantage can be mentioned than the facility with which gas and oxygen can be administered after paraldehyde premedication. Upper abdominal operations are possible without the use of additional ether and with completely adequate muscular relaxation.

Disadvantages are few. The unpleasant odour of paraldehyde appears in the breath shortly after the rectal administration; this, however, is a disadvantage of which the patient remains unaware, and of which only the nursing staff are conscious. The quiet respiration
characteristic of the somnolent period following operation does not appear to increase the risk of respiratory complications. Transient excitement occurs in a small number of cases, either immediately after the drug has been administered or on awakening. The occasional occurrence of this phenomenon, which is always of short duration and is of little significance, is characteristic of any drug given for purposes of premedication.

Paraldehyde has been used as a basic amnesic agent in obstetrics by Colvin (24) with good results. It was found that when combined with sodium amytal or pentobarbital complete amnesia may be obtained in from 90 to 95 per cent of all cases with no increase in uterine inertia, duration of labor, forceps deliveries, fetal apnea, post partum hemorrhage, or fetal or maternal morbidity or mortality, and with minimum of restlessness. When complete anesthesia was desired a supplementary inhalation anesthetic was required.

"Rectidon", a derivative of barbituric acid, is manufactured in the form of suppositories to be applied by the rectum. It acts essentially as paraldehyde and has been found useful as a preliminary to general anesthesia (25). Most of the literature on this drug is unavailable because the work has been done almost entirely in Germany.
CONCLUSION

The recent extensive literature on various forms of rectal anesthesia and analgesia show it to be in a more or less experimental stage. New drugs are being used and new products made as a combination of drugs already studied in an effort to find an ideal anesthetic agent.

It has been shown that rectal administration of anesthetic agents is particularly valuable in certain fields, chiefly among these are obstetrics and surgical procedures upon the head and neck. It is to be remembered that the success of the anesthetic depends often upon the use of supplementary inhalation anesthetics, the technique employed and the skill and experience of the anesthetist.

It is not probable that rectal administration will ever supplant the other methods of anesthesia, however, the relative safety and success of this method promise to establish for it a definite place in the field of medicine.
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