ANESTHESIA

I.

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This thesis does not attempt to cover the whole field of "Anesthesia"; it only gives the material of interest to nurse anesthetists.

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Definition---An anesthetic is an agent under the influence of which a patient is able to undergo a painful experience without perception of pain.

Anesthetic agents may be divided into three types:

1. Gases such as nitrous oxide, ethylene, and carbon dioxide.
2. Liquids such as ether, chloroform, and ethyl chloride.
3. Solids such as cocaine, hypnotics used as anesthetics,etc.

The various methods of administration include inhalation, oral, rectal, intravenous, hyperdermic, intraspinal, and application to the mucous membranes.

Anesthetics may be classified by their effects.

1. Regional anesthetics are those which effect a particular part of the body and do not necessitate the loss of consciousness. These include local anesthetics, spinal anesthetics, and extradural injections.
2. General anesthetics are those which cause a complete loss of consciousness. This is effected by the agent entering the general circulation of the blood. Two methods may be used to bring this about. The direct method is the introduction of the agent directly into the vein. The indirect method is by introduction thru the respiratory or gastro-intestinal tract.

HISTORY

Until 1846 the word "anesthesia" was unknown. It was unbelievable that operations could be performed without pain. History tells of attempts to accomplish that, attempts by each different civilization, But the realization of that did not come until 1846.

Several instances of attempts to dull consciousness to pain are mentioned in literature. The popular methods used were internal and external application of drugs, inhalation of fumes, or the "laying on of hands". The latter included both the application of pressure to important nerves and blood vessels and the utilization of mesmerism and hypnotism.

Interesting to note is the fact that often sleep was caused by what we would call vicious methods. For example, the gas that was inhaled by the Romans was carbon dioxide; the patient would breathe the gas until he was stupified by its overpowering effect. The Egyptians, Chinese, and Greeks each used their own products of hemp in their attempts to relieve suffering.

In the thirteenth, fourteenth, and fifteenth centuries it was common for a sponge saturated with sleep producing drugs to be held over the patient's face, the

fumes of the "spongia somnifers" being effective in proportion to the strength of the drugs used.

In 1798 Dr. Thomas Beddoes, in England, opened a Pneumatic Institute to study the therapeutic effect of gases. Sir Humphry Davy, who was in charge of the experimental department, issued a statement in 1800 that "as nitrous oxide seems capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place." It was Michael Faraday who said that "the vapor of ether, when mixed with air, produces effects very similar to those occasioned by nirous oxide".

At a famous quilting party in Georgia in 1839 where, as was customary at that time, ether was inhaled for its exhilerating effects, a negro was forced to inhale the fumes. Due to the struggle he inhaled a large amount of the fumes and was overcome; help was needed to resusitate him. However, no conclusions were drawn from that incident.

The first person to draw any conclusions from the lack of complaints about pain being felt when injuries were received during ether frolics was Crawford W. Long. He applied his observations to surgical work, but

his results were not made public until after several others had published their work.

Two years after this, Horace Wells failed to demonstrate publicly the effects of nitrous oxide for anesthesia because of insufficient gas. He became discouraged and failed when he was very close to success.

The date of the first successful public demonstration of an anesthetic was October 16, 1846. William T. Green Morton, a young dentist, made his demonstration in the famous Massachusetts General Hospital. A friend named Jackson had suggested the possibilities and its practicability to him; Jackson was a chemist by profession. Morton receives credit not only for his discovery, but also for the devotion of his life and fortune to its development.

The use of anesthetics spread from the United States to the rest of the world. Some agents were not accepted here until after having been used elsewhere. For example, Ives of New Haven had used chloroform as early as 1832, but it was not accepted in general until after Simpson had used it in England.

There has been a continuous search for a new and better anesthetic. It was with this hope that

chloroform was used. Ethyl chloride was used hoping that it would be better than the preceeding agents. In recent years ethylene was introduced as the long expected perfect anesthetic. Today many agents are being tried out; each one having certain advantages, some survive the test of time and some fade away.

The history of local anesthesia is indeed dramatic. In 1884 a young doctor while working with Freud, the psychologist, in treating morphine addicts by the substitution of cocaine, noticed the numb sensation produced thereby. Carl Koller made this discovery and applied it to eye surgery. Other cocaine derivatives have come into use, of these novocaine is the most popular. A few years later adrenalin was added to aid in controlling bleeding. It was Corning who accidentally introduced some cocaine into the epidural canal and thus discovered spinal anesthesia.

At this very time experiments are being conducted with substances that tomorrow may become valuable in the realm of anesthesia. Continually the search for the perfect anesthetic is being made.

SELECTION OF THE ANESTHETIC

In selecting an anesthetic there are many factors to consider. The most important is the mortality of the agent; next is the morbidity associated with that agent. Its factors of danger and factors of safety include the pharmacologic effects, the method and skill of administration, as well as the physical condition of the patient. The requirements of the operation must be considered. The anesthetic should cause a minimum of anxiety and discomfort to the patient.

The immediate untoward effects and the delayed untoward effects must be considered. There are other considerations also, does this anesthetic make the operation easier? Is it contra-indicated by the presence of some disease? Is cautery to be used? If so, is the agent inflammable? Is carbon dioxide able to be administered, if the patient is a "bleeder", in order to increase the coagibility of the blood?

These are some of the factors that are considered in the choice of an anesthetic.

ETHER

A generalized anesthesia may be produced by the administration of ether. The usual method of administration is by inhalation; however, it may be given by rectum, by mouth, or intravenously. Within five minutes from the time the anesthetic is ended, one half of the amount of ether is eliminated; most of the remainer is eliminated within the next forty five minutes.

During an induction ether vapor may be irritating to the mucous membranes, depending upon the concentration used. An overconcentration may cause coughing and a feeling of suffication and also causes mucous to be secreted.

Ether has a stimulating effect upon both the heart and respirations, when given within certain limits. An overdose will cause the respirations to become irregular and later shallow and weak. After the respiratory tract is effected, the heart will show signs of an overdose---but the resiprations show the effects first. The symptoms of an overdose of ether resemble surgical shock, the cold moist skin, small and rapid pulse, and shallow breathing.

The glands of the body are stimulated by ether. A previously administered injection of atropine usually inhibits the mucous producing glands of the air passages. The thyroid gland is stimulated. Kidney secretion is first stimulated and then depressed. If nephritis is present, suppression may follow. Albuminuria usually lasts for about a week. The liver is stimulated to produce sugar which results in a hyperglycemia.

As to the effects upon the nervous centers, stimulation is the first, then depression. Sight is the first sensation to be lost, hearing the last.

Muscular relaxation is produced when the blood is saturated with the anesthetic, unless anoxemia (lack of oxygen) or a very acute condition is present.

The main advantages of ether are its wide margin of safty and the simplicity of its administration. Considering the enormous number of times it has been used, often improperly administered at that, the number of fatalities is few.

The main disadvantages of ether are its effects upon the lungs, kidneys, and pancreas if diabetic. There is a tendency to nausea and the taste and odor are usually considered unpleasant.

NITROUS OXIDE

Nitrous oxide, also known as laughing gas, is practically odorless and does not have an unpleasant taste. In administrations of this gas for any length of time, oxygen must be given simultaneously to prevent the development of asphyxia.

A state of analgesia is reached thirty seconds after the gas is first breathed. The time is longer if it has been necessary to give oxygen with the initial breathes, as in the case of children, old, or debilitated patients. It is usually possible to administer nitous oxide for an induction to the average patient and not have the patient become cyanotic----then as soon as consciousness is lost, enough oxygen is added to prevent cyanosis.

Nitrous oxide is not irritating to the mucous membranes of the respiratory tract. It raises the blood pressure; this fact is utilized sometimes in cases where the patient has a tendency to go into shock. The heart, lungs, and kidneys are not effected by nitrous oxide. The excretion of this agent is rapid; recently it has been found that the skin plays its part in this excretory process.

The advantages of this anesthetic are that the induction is comfortable and that the anesthetic lasts for the shortest possible time. The absence of respiratory and renal after-effects is very desirable.

The disadvantages of nitrous oxide are the lack of relaxation obtained and the liability to anoxemia(lack of oxygen).

In the analgesic stage the patient is sensitive to touch and may move and hear noises. Dreams and hallucinations may occur. If the anesthetic is pushed too rapidly, ringing in the ears or a sensation of smothering may be experienced.

Patients awakening from this anesthesia aften tend to continue sleeping and not infrequently they remark about having had pleasant dreams. In a few cases patients will awaken laughing which bears out the name of laughing gas.

ETHYLENE

Ethylene has become popular as an anesthetic because of its rapid action. As it is explosive, caution should be taken whenever it is administered; it must not be used around an open flame, cautery, nor x-ray.

Ethylene requires the administration of oxygen with it. It causes a slight increase in the clotting time of blood; this causes a little more oozing but tends to decrease the incidence of embolism and thrombosis. It is non-irritating to the mucous membranes of the respiratory tract and is non-toxic to the kidneys. For these reasons it is used for operations upon the urinary tract and is given to those suffering from respiratory diseases.

More relaxation is obtained from this gas than from nitrous oxide and also a larger percentage of oxygen is able to be administered. Another advantage is the lack of excessive perspiration and the secretion of mucous. Usually recovery is rapidly effected without protracted nausea or vomiting.

The main disadvantages are the difficulty in securing relaxation and the liability to anoxemia. The danger of explosion must be borne in mind continually.

CHLOROFORM

In 1912 chloroform was denounced by the Committee on Anesthesia of the American Medical Association who reported that its use was no longer justifiable because of its narrow margin of safety and because liver necrosis followed in a considerable number of cases. The committee said that its use had been replaced by safer anesthetics, especially in minor surgery; however, the committee allowed that it was sometimes convenient to use during an induction of an alcholic or other difficult subjects.

Chloroform is not explosive, but it decomposes readily to form phosgene, an irritating gas. A fresh solution of chloroform is colorless and has a pleasing taste and odor. It is a powerful anesthetic and gives complete muscular relaxation.

Chloroform is a heart depressant; in cases of overdose it causes paralysis of the cardiac muscle and dilitation. The pulse must be watched and kept full and regular, a change in the rhythm or quality being a sign of danger.

Sufficiently diluted chloroform vapor is not irritating to the mucous membranes. Diluted to one per

cent, per volume, chloroform is sufficient to maintain an anesthetic; five per cent is enough to induce it. Muscle spasm may occur during the induction, but there is complete muscular relaxation during the anesthetic.

Chloroform first stimulates the functioning of the kidneys, but later suppresses them. Albuminuria is not an infrequent sequelae. The hepatic cells are so effected that there may be a severe disturbance in the fat metabolism. The so-called chloroform poisoning is a fatty degeneration of the liver, heart, and kidneys.

The advantages of chloroform are the pleasant odor and the small bulk of the agent needed. The complete muscular relaxation and the lack of respiratory irritation are desirable. The fact that it is non-explosive has proved advantageous(before the Maggill method of endotrachael anesthesia was perfected, chloroform was the anesthetic of choice for operations upon the face and neck when cautery was being used.)

The disadvantages are the possibility of cardiac failure and the toxicity of the drug.

CARBON DIOXIDE

Carbon dioxide is a respiratory stimulant. A condition of respiratory depression exists with a decrease in the carbon dioxide content of the body; this condition is counteracted by the inhalation of carbon dioxide.

Carbon dioxide may be used as an induction for anesthesia; about thirty per cent is used with seventy per cent of oxygen. This induction takes from one to two minutes and is smooth and pleasant. The muscles are relaxed and the respirations are deep but not rapid. The pulse rate and blood pressure are increased but soon drop to the normal level during the consequent anesthesia.

In an induction with some other agent, a mixture of about five or ten per cent carbon dioxide is used. This makes the anesthetic smoother and raises the blood pressure temporarily.

During an anesthetic carbon dioxide is frequently given by the use of rebreathing apparatus, the carbon dioxide of exhaled air being rebreathed. Anemic persons and debilitated ones are improved by rebreathing, full blooded and plethoric patients do not tolerate much. After the anesthetic is completed, oxygen plus carbon dioxide is frequently given to hasten the

elimination of the agent. By causing deeper breathes to be taken, carbon dioxide ventilates the lungs and prevents a great many post-operative lung complications.

If the patient has a cold, or has any symptoms of respiratory infection, it is not infrequent that the doctor will order inhalations of carbon dioxide at regular intervals for two to three days, or longer even.

ETHYL CHLORIDE

Ethyl chloride is an inflammable gas having a sweet, agreeable odor. It is a liquid but vaporizes as soon as it is released at room temperature. It is used both for local and general anesthetics.

A dilute inhalation of ethyl chloride rapidly induces anesthesia. At causes muscular relaxation very rapidly, especially of the jaw which necessitates watching lest the air way become obstructed.

Ethyl chloride does not cause respiratory irritation but it increases the depth and frequency of the breathes. An overdose results in respiratory failure with circulatory depression. It has an immediate toxic effect upon the heart. A dose which secures good muscular relaxation is close to the toxic dose. Elimination is rapid and takes place thru the lungs. The liver and the kidneys are not effected.

Ethyl chloride may be used to induce anesthesia, ether being substituted after unconsciousness is obtained. It is used as a local anesthetic as it freezes the skin upon contact.

The advantages of ethyl chloride are that the induction is rapid and pleasant without unpleasant after-effects. The disadvantages are the lack of muscular relaxation unless the toxic dose is approached and there is a tendency to syncope.

AVERTIN

Avertin is a colorless fluid that is administered in an aquous solution per rectum. The dosage is based upon body weight. It has been used as a general anesthetic; however, too large a dose is not desirable. Avertin has been used very successfully as a basal anesthetic and is supplimented by nitrous oxide and occasional whiffs of ether, if necessary. Occasionally there has been a patient with an idiosyncrasy toward avertin.

Avertin is very useful for nervous patients as it prevents psychic shock. The patient will go to sleep shortly after the administration and will have no recollection of any happening until he awakes several hours later; often he will return to a natural sleep after having reacted the first time. The incidence of post operative nausea and vomiting is low.

There is a temporary drop in the blood pressure. The respiration may become depressed and the air way may have to be kept clear. The anesthetic is beyond control after it is administered and can not be withdrawn.

The drug is detoxified by the kidneys and liver.Consequently it should not be used upon patients

with kidney or liver damage. It is contraindicated for operations upon the bowel, in cases where there are lesions of the rectum, if there is acidosis, dehydration, excessive obesity, general debility, or low blood pressure.

Avertin is very good for nervous people. Also for operations upon the nose and face, for brain work, and for patients with lung conditions. It has been used to quiet patients in psychiatry, in eclampsia, tetanus, fractured skulls, and coryza.

EVIPAL: INTRAVENOUS ANESTHETIC

The administration of an intravenous anesthetic is spectacular. Evipal is one of the newest drugs to be so administered. The drug comes as a powder and is disolved in sterile distilled water shortly before the administration. While a tourniquet is being applied, the patient is told to count as long as he is able. As soon as the injection is started the patient begins, "One, two, three, etc." Suddenly, perhaps in the middle of a word, the patient will stop. Complete anesthesia with a good degree of relaxation is obtained.

The patient awakens quickly and quietly. There is seldom any nausea or vomiting, even if the patient has had food recently. Amnesia is complete, the patient has no recollection of having heard or felt anything.

The anesthetic is supposed to have a wide therapeutic margin. There is a slight drop in the blood pressure as soon as the injection is made; however, the former pressure is regained before the patient awakens. The pulse remains full and regular. Respiratory failure is said to occur before heart failure.

No pre-operative medication is necessary. However, if one should be desired, it is best not to use

a barbital as evipal is a barbiturate, and it is inadvisable to administer different compounds of that group. The dose of evipal may be repeated without hesitation. Also a mild barbital may be given shortly after the patient has reacted, if so desired.

The dosage is detirmined by the body weight. The patient looses consciousness as soon as about one cc. of the solution has been administered; the remainder of the dose is given as necessary---more is given if the case is to be long that if the case is to be short. A supplimental anesthetic may be given if necessary; nitrous oxide is the one most frequently used.

The anesthetic is contra-indicated for old or seriously ill persons. Nor should it be used if there is evidence of pathology of the liver as it is detoxified by that organ. Because it causes a drop in the blood pressure, it is inadvisable to use on patients with a low blood pressure.

BARBITURATES

An example of hypnotics that are used as anesthetics is the barbital group. The various salts of barbituric acid have a hypnotic effect and are anti-spasmotic. They have little effect upon the heart but do have a marked depressing action upon the respirations if used in large doses. Some people show an idiosyncrasy to the grugs. Large quantities of the drug may cause a fall in the blood pressure. During the period when the effects of the drug are wearing off, it is not unusual for the patient to be extremely restless and to need restraint.

The main value of the barbitals is in pre-operative medication or as a basal anesthetic. It is especially good for cases in which novocaine is to be used; it has a detoxifing effect upon that agent. If fairly large doses of barbitals are given before surgery, the patient does not have any nervous fear nor does he retain any unpleasant memories. The patient usually does not have an excitement stage to the anesthetic.

The disadvantages include the untoward experiences of patients who have an idiosyncrasy to the

drug and the respiratory depression which may cause complications either in surgery or post-operatively.

For a specific example of a barbiturate, sodium amytal may be used as it is the most favored today. It may be given by mouth, by rectum, or intravenously. It allays nervousness and reduces the amount of anesthetic needed to produce surgical relaxation. There is a slight fall in the blood pressure at times. The respiratory depression is usually counteracted by carbon dioxide. The patients usually do not suffer from post-operative nausea nor vomiting.

Sodium amytal has also been used in cases of strychnine poisoning, tetanus, rabies, eclampsia, and epilepsy; although another barbital, luminal, has been used widely in treating the last condition mentioned. Some other widely used barbitals include dial, ipral, allonal, amytal, and nembutal.

LOCAL ANESTHESIA

Local anesthesia is making some particular area insensible to pain by treating the peripheral nerves. This may be accomplished by applying the drug to the mucous membranes, by pressure, by freezing, by infiltration of the tissue in the field of operation, by anesthetizing the nerves that supply the field of operation, and by spinal anesthetics.

For local application to the mucous membranes cocaine or novacaine, with adrenalin, is used. Butyn is prefered by some doctors who think that it is less toxic.

Pressure anesthetics are rarely used today. In the olden days the patient was forced into a semi-stuperous condition by pressure upon important nerves and blood vessels. For operations upon extremnities pressure has been used as an anesthetic, but the pain of the anesthetic would be almost as severe as the pain of the operation.

Anesthesia by freezing has been accomplished by the use of ethyl chloride or ether which is sprayed upon the surface. This is painful when the anesthetic is

wearing off and there is danger that too thorough freezing may cause sloughing.

Local infiltration is the injection of fluid along the line of the incision; an edema is caused which desensitizes the nerve endings. Novocaine is the agent that is usually employed; however, it has been reported that equally satisfactory results may be obtained by the use of sterile water. Not much relaxation for abdominal work is obtained in this way.

Spinal anesthesia is a form of nerve blocking that effects the lower half of the body. The agent is administered into the spinal canal, usually in a solution of spinal fluid. The degree of anesthesia depends upon the amount of the drug used, the position of the patient---whether the patient is in Trendelenberg or has his head slightly raised---, and upon the force with which the injection is made. There is usually a drop in the blood pressure which is treated by administrations of ephedrine sulphate. The respirations may become difficult or the patient may become nauseated and show signs of shock. However, the relaxation for abdominal work is excellent. Spinal anesthetics are contra-indicated

for patients with heart trouble, low blood pressure, severe jaundice, or shock.

Caudal and paravertebral block anesthetics are injected extradurally. A large amount of solution is needed. Anesthesia is complete in about twenty minutes and lasts from about two to three hours. This is used in operations upon the perineum and rectum mainly.

ANESTHESIA IN OBSTETRICS

Frequently analgesia, not anesthesia, is obtained today in obstetrics by the use of hypnotics of which the barbitals are the most popular. Rectal administrations of ether in oil afford much relief. However, for anesthesia the ideal agent is still nitrous oxide.

Nitrous oxide can be administered over a long period of time and still the baby will show no ill effects. Sufficient oxygen is administered with the gas to keep the patient free from cyanosis. The administration is started as soon as the contractions in the third stage necessitate it. The patient is instructed to tell the anesthetist as soon as she feels each pain beginning and the gas is administered until the pain subsides. This affords relief from pain but the patient is still able to cooperate and help with the expulsion. When the head begins to distend the perineum, ethylene is usually given to produce a greater degree of anesthesia. It is inadvisable to use ethylene at the beginning because of the depressing effects of the agent. If necessary, ether may be given to retard the progress of labor or to obtain more complete relaxation.

Immediately after the baby is delivered, before the cord is cut, pure oxygen is administered for stimulation. (This is beneficial to the baby and the mother is usually in a condition from which that small amount of stimulation will not awaken her.)

There are two points to remember especially in such an anesthetic, the first is the probability of the patient having had food and fluids recently which may cause nausea. Secondly, there is the possibility of the patient's having had some narcotic for rest which may cause respiratory depression.

Today drop ether is usually given because it is convenient and inexpensive. But nitrous oxide is still considered superior as an obstetrical anesthetic.

The advantages of the use of an anesthetic in obstetrics, aside from the relief of pain, are the prevention of shock and exhaustion and the increased ability to make better expulsive efforts.

THE PERFECT ANESTHETIC

Each of the previously discussed anesthetics has advantages, but it also has some disadvantages. The long expected perfect anesthetic which is yet to be discovered shall combine the good points of these and yet have none of the drawbacks. It will be administered easily to young, old, or seriously ill patients. The induction will be agreeable and the agent will have no delecterious effects upon the respiration nor upon the circulation. The blood pressure will be maintained at the normal level thru-out; there will be neither an increase nor a fall in the blood presure.The agent will be under control at all times. Elimination will be rapid and there will be no harmful effects to the hepatic, renal, or lung tissues. Sensory paralysis and muscular relaxation shall be rapidly and safely obtained. These are the attributes of a perfect anesthetic.

THE ROLE OF THE NURSE ANESTHETIST

In the last thirty to forty years there have been great changes in anesthesia. These changes were caused by the improvement of the methods of administration, by the introduction of new agents, and by the development of nurse anesthetists.

Dr. Arthur W. Elting said in a paper read to the Hospital Association of the State of New York in July 1934 that the nurse anesthetists originated to fill a need. He said that doctors, as a rule, do not give good anesthetics (there are exceptions to this he allowed.) In an emergency a doctor is not always available while a nurse is. The nurse began giving anesthetics as an emergency measure and the trend has developed from that.

Dr. Elting said that each hospital should have a staff of resident anesthetists to insure good anesthetic service twenty four hours a day. A doctor may be at the head of the staff, if so desired, but the actual anesthetics should be administered by nurses. The nurse has no other interest in the operation but the anesthetic; it is difficult for a doctor to confine his attention to the welfare of the patient. As to the competency of a nurse to give an anesthetic, she takes a

special course, as must the doctor, to learn that art; there is no training given in medical schools to the students, therefore the doctor must learn as much as the nurse.

The selection of the anesthetic to be used is the responsibility of the surgeon who may, if he so desires, confer with the anesthetist; it is not the privilege nor the duty of the anesthetist, either doctor or nurse, to select the agent to be used. The nurse is able to administer anesthetics cheaper than the doctor; this enables the poorest patients to receive good anesthetics.

The medical profession in some states looks with disapproval upon nurse anesthetists. In other states the opposite attitude is held. The trend is for the nurses to replace the doctor anesthetists. Each year an increasing number of anesthetics are given by nurse anesthetists. Eventually, in the future, nurses will be universally accepted as anesthetists.

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Holman, Albert W: Evipal

Margason, Merle: Avertin

Meyers, Daniel: Miscellaneous remarks

Pease, George Norman: Avertin

Some material used in this thesis was obtained from those discussions.

Grateful acknowledgement is made of the assistance from The Library of the University of Oregon Medical School and The Library of the American College of Surgeons, Chicago.