Recent advances in obstetrical anesthesia and analgesia

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RECENT ADVANCES

IN

OBSTETRICAL ANESTHESIA AND ANALGESIA

A SENIOR THESIS

BY

BERNARD E. MC CONVILLE
PREFACE

It may be well at the outset to make it clear that this thesis does not aim at being a textbook, in the art of anesthesia, and most of the elementary teachings, and description of well known methods have purposely been omitted. Its more modest object is to provide a concise collection of some of the important advances made during the last few years, in the field of Obstetrical Anesthesia and Analgesia.

Researches, which are of academic interest only have not been included in this thesis, as it is intended, that practical considerations should have preference.

The modern apparatus for anesthesia will not be considered as this is a subject in itself.

Bernard E. McConville.
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HISTORICAL CONSIDERATIONS

The use of anesthetics to alleviate the pain of surgical operations and of childbirth was unknown before the middle of the nineteenth century. The discovery of anesthesia for surgical operations was first demonstrated with the use of ether in 1846.

It depended not so much upon the employment of a new drug as upon a new method of administering drugs. The anesthetics are inhaled and therein lies their especial feature. The action of a drug which is swallowed cannot be controlled once the drug has passed into the body; its effects diminish only as the drug is slowly eliminated during hours or even days. On the other hand, the action of the vapors of gases which are used as anesthetics continue fully only as long as these substances are inhaled. When the inhalation ceases they are rapidly exhaled and their action can thus be accurately controlled. The narcotic action of such drugs as opium, hemp, and mandrake has been known from antiquity, as will be seen later, but these drugs cannot be used satisfactorily as anesthetics. They deaden pain, but they also exert a depressing influence upon the action of the heart and upon respiration, which, if the dose of the drug is large, may result fatally. Moreover, pain partially counteracts the action of the narcotic drugs. Thus when they are given in the large amounts necessary to relieve the pain of an operation, they may prove poisonous when the operation is over and their effects are no longer neutralized by the pain.
In the past such drugs were sometimes administered for surgical operations, but in the amounts that could be given safely they served merely to allay the sharpest agonies of the operation. The narcotic drugs did not furnish true anesthesia, and they were used in the past as they are used today—to relieve in part the suffering from wounds or painful diseases and thus to allow the sufferer to rest.

This deadening of pain by soporific potions was known even to some primitive peoples as well as those of the earliest civilizations. Helen cast "nepenthe" into the wine of Ulysses, and the Talmud of the Jews speaks of a narcotic called "samme de shinta"; there is the "bhang" of the Arabian Nights and the "drowsy syrups" of Shakespeare's time. Opium and Indian hemp, "hashish", were probably known to the Egyptians and Greeks, and the mandrake to the Babylonians and Hebrews. This mandrake is the European plant, not the May apple, or mandrake, of America. Besides having narcotic properties, mandrake was said to have the power of arousing the sexual passions; Rachel sought mandrakes of Leah (Gen. XXX: 14-16), but it is uncertain for which purpose she used them.

Mandrake was the most popular substitute for an anesthetic during the Middle Ages. It held its vogue up to the sixteenth century and is referred to by Elizabethan poets. It was an inefficient anesthetic and ceased to be employed. Its inefficiency is evident from the fact that Paré did not use it, and he was a compassionate surgeon who did not believe
in torturing "poor wounded men." Pare used no anesthesia; he simply tied his patients so that their struggles would not interfere with his work.

The surgeons of the eighteenth and nineteenth centuries sometimes intoxicated their patients with alcohol or occasionally drugged them with opium when the procedures of the operation necessitated freedom from struggling. But the surgeons of these pre-anesthetic days depended largely upon speed; an operation verged on being a sleight-of-hand affair designed to shorten to the minimum the suffering of the surgeon's victim. Thus one reads of Langenbeck, surgeon-general of the Hanoverian army in the time of Napoleon, amputating a shoulder while one might take a pinch of snuff.

In all of this nothing is said of the child-bearing woman. Soporific potions may have been used in ancient times, but no one then troubled about the pains of women. Indeed, the efforts to avoid the pangs of child-bearing sometimes called forth punishment. The Greek goddess Acremia, terrified by her mother's suffering at her own birth, besought Zeus the favor of eternal virginity. Subsequently she seduced Endymion and was punished for her early prudery by a truly god-like superfecundation; she became the mother of fifty daughters all at one time. One of the reasons that soporific potions were not used to relieve the pain of childbirth was because the nature of the substances available--opium, for instance--precluded their employment in effective doses. They arrest the progress
of the birth or are injurious to the child. There are, however, some recorded instances of painless child-birth during profound intoxication which was not induced for this purpose. One such case occurred in a woman brought into the Hotel Dieu of Paris in 1813. There is also the celebrated case of the Countess de St.-Ceran, who was rendered insensible by a draught given to her by the midwife; she was delivered, and her child was abducted before she regained consciousness.

There is a prescription for relieving painful child-birth set forth in a manuscript of Zerobabel Endecott of Salem. Zerobabel was a son of Governor Endecott by his second wife, but the records provided little information as to his career other than that he was a physician, that he served on an occasional jury, and was fined, in 1659, by the Quarterly Court for excessive drinking. Endecott's prescription is given here in full: "For Sharpe & Difficult Travel in Women with child, Take a Lock of Vergins Haire on any Part of ye Head, of half the Age of ye Woman in travill. Cut it very smale to fine Powder then take 12 Ants Eggs dried in an oven after ye bread is drawne or other wise make them dry & make them to powder with the haire, give this with a quarter of a pint of Red Cows milk or for want of it give it in strong ale wort."

The alternative of ale for milk, as the vehicle for the ant eggs and human hair, was a wise provision; milk was exceedingly scarce in America in those days, but ale was both plentiful and cheap. While this concoction has no effect ex-
cept on the imagination, it was at least less disgusting than were many of the medicaments used at that time.

The events leading up to the controversy over anesthesia started in 1800, when Sir Humphry Davy in England experimented upon himself with nitrous oxide. He states that, "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage in surgical operations in which no great effusion of blood takes place." Forty-four years later Horace Wells of Hartford, Connecticut, began to use nitrous oxide in dentistry and thus was the first man to make a practical application of anesthesia. Wells was led to use the gas as the result of an observation made while attending a lecture given on nitrous oxide in New Haven, Connecticut. The lecturer allowed members of his audience to inhale the gas, and Wells noticed that those under its influence did not appear to be sensible to slight injuries caused by falling or by staggering against the furniture on the stage. Some years later a death resulted from an anesthesia which he gave, and this caused Wells to withdraw from practice. He eventually became depressed over what he regarded as his failure and put an end to his own life.

Wells reported the progress of his work to William Morton of Charlton, Massachusetts, a friend and former partner. After the failure of Wells with nitrous oxide, Morton was on the lookout for some substance which would be safe and reliable.
Morton practiced dentistry in Boston and undertook at the same time the study of medicine at the Harvard Medical School. His work there brought him into contact with Dr. Charles Jackson, and from him Morton learned of the anesthetic properties of ether. Jackson had obtained this knowledge through an observation similar to that made by Wells at the lecture on nitrous oxide. Ether was sometimes inhaled by medical students at so-called "ether frolics," indulged in for amusement and for the mild intoxication or "ether jag" which the vapor produced. Jackson had noticed that when the students were thus under the influence of ether they appeared to be insensible to pain caused by falling over furniture. Jackson had never taken advantage of his knowledge to use ether for the purpose of obtaining relief from pain; but Morton, searching for an anesthetic to be used in his dental practice, at once saw the possibilities presented by ether. He accordingly experimented with ether at his home, first using the family dog as a subject, and finally anesthetizing himself. His next step was to use it in his dental practice and an opportunity to do so was soon presented in the person of one Eben Frost, 1846. To the joy of the operator and the astonishment of the patient the attempt was perfectly successful. This event occurred in the last part of September, 1846.

Morton, as stated above, was a medical student as well as a dentist, and, after his success with his patient, Eben Frost, his mind quite naturally turned to the possibility of using ether to lessen the frightful suffering from surgical
operations which were then performed with nothing to relieve it. After two weeks of preparation he called on Dr. Warren, who was senior surgeon of the Massachusetts General Hospital at Boston. Morton told him of his use of ether and of his success in relieving pain, and asked for an opportunity to give a demonstration of his method on a patient undergoing a surgical operation. Dr. Warren consented and the date of the demonstration was set for October 16, 1846. The operation was highly satisfactory and thus ether was introduced to Surgery. However, four years prior to Morton's demonstration at the Massachusetts General Hospital, ether was used for an operation in a small town in Georgia by a Dr. Long who did not, however, make public its use until after Morton's declaration.

To Dr. James Y. Simpson of Edinburgh, professor of obstetrics at the University of Glasgow, belongs the honor of having first induced unconsciousness by ether for the purpose of facilitating delivery.

On the tenth of February, Professor Simpson laid the subject before the Obstetrical Society of Edinburgh at some length, and presented the lessons derived from his experience in the following terms:

1. That the inhalation of ether procured for the patient a more or less perfect immunity from the conscious pain and suffering attendant upon labor.

2. That it did not, however, diminish the strength or regularity of the contraction of the uterus.
3. That, on the other hand, it apparently (more especially when combined with ergot), sometimes increased them in severity and number.

4. That the contraction of the uterus after delivery seemed perfect and healthy when it was delivered.

5. That the reflex assistant contractions of the abdominal muscles, etc., were apparently more easily called into action by artificial irritation and pressure on the vagina etc., when the patient was in an etherized state.

6. That its employment might not only save the mother mere pain in the last stage of labor, but might probably save her also, in some degree, from the occurrence and consequences of the nervous shock attendant upon delivery and thereby reduce the danger and fatality of childbirth; and

7. Its exhibition did not seem to be injurious to the child.

In a short time Dr. Murphy of London, Mr. Lloyd, Dr. Protheroe Smith and Mr. Lansdowne of Bristol had used it successfully. Also it was very early tried in France. Fourrier Deschamps and Paul Dubois being of the first to introduce it in that country, closely followed by Villeneuve of Marseilles and Staltz of Strasburg. In Germany, Martin of Jena and later Siebold published papers on the subject.

In our country ether was not resorted to as early as might have been expected considering that it was the birthplace of artificial anesthesia.
The first administration took place April 7, 1847 by Dr. M.C. Keep of Boston, and a little later ether was used by Dr. Walter Channing who wrote a book on the subject "A Treatise on Etherization in Childbirth", 1848.

Soon the introduction of a new anesthesia, with Simpson again the pathbreaker, chloroform was tried in November, 1847, and a few months later, following the reports of Simpson, it was tried in this country by Dr. A. K. Gardner of New York.

However, in spite of the almost miraculous properties of anesthesia to alleviate pain, its use in childbirth was very strongly antagonized by not only the clergy of that period, but also by the members of the medical profession. "In sorrow thou shalt bring forth thy children" was quoted from the bible and interpreted to mean that the woman was to suffer thus for her sins.

In no better person than Simpson could obstetrical anesthesia found a better champion. He alone was more than equal to the forces of opposition.

Scotland has a legend regarding anesthesia: Thenu, the mother of St. Kentigern, or St. Mungo, of Glasgow was impregnated without her knowledge under the influence of some soporific potion. In consequence, as a punishment, she was cast down from the top of a high hill, but, wonderful to say, she was not hurt. Not satisfied with this evidence of divine intervention, her judges then sentenced her to be set adrift in a small boat on the Firth of Forth, whereupon she floated across to Fife, and was received by St. Servanus. In due time
she was safely delivered of a son, who became afterward the famous St. Kentigern. Having a saint whose history recorded an anesthesia so closely connected with childbirth may have given the clergy some sensitiveness on the subject. At any rate, it is a historical fact that in 1591 a lady of rank, Eufane Macalyane, sought the assistance of Agnes Sampson for the relief of pain at the time of the birth of her two sons. Agnes Sampson was tried before King James, for her heresy, was condemned as a witch, and was burned alive on the Castle Hill of Edinburgh. Again in the nineteenth century the Scottish clergy rose, if not to burn Simpson with fire, at least to consume his practices with their fiery condemnations. Simpson, less submissive than the lady of the sixteenth century, turned, and with their own weapon of religious interpretation silenced the clergy and cleared the way for the more serious controversy with the men of his own profession with the following biblical quotation: "And the Lord God caused a deep sleep to fall upon Adam, and he slept: and he took one of his ribs, and closed up the flesh instead thereof." (Gen. II: 21)

At the same time that Simpson was fighting for the use of chloroform to alleviate the pains of childbirth, Dr. Channing of Boston was waging a less picturesque but none the less effective struggle to introduce ether for a similar purpose. An objection brought in America against Dr. Channing's work was one that would seem ridiculous today if it were not for the fact that as late as 1921, in the revival of "twilight
sleep", the same objection was raised. It can be phrased best in the words of one of Channing's correspondents, who claimed that "the very suffering which a woman undergoes in labour is one of the strongest elements in the love she bears for her offspring."

In the middle of April, 1853, an event occurred which exerted a greater influence on popular acceptance of anesthesia at childbirth, not only in Great Britain, but in America as well, than all the efforts of Simpson. Queen Victoria accepted chloroform for the delivery of her seventh child, Prince Leopold. Nothing could exceed the astonishment with which the announcement was received. The tone of the leading medical journals showed only too plainly what would have been the sentence passed upon Her Majesty's medical attendants had anything untoward occurred. There was not one word of approval for the medical men, for the royal patient, or for humanity.

The LANCET, May, 1853, said: "In no case could it be justifiable to administer chloroform in a perfectly ordinary labour."

Again in 1857, the Queen accepted chloroform for her confinement. Formal opposition ceased in Great Britain thereafter, and chloroform was often referred to as 'anesthesia à la reine.'

Although ether and chloroform are still the anesthetics most extensively used in child-bearing, nitrous oxide and the other gaseous anesthetics have replaced them to some extent. Nitrous oxide in particular has the advantage that it can be
given for a long time with much less danger to the mother and
the child than is the case with chloroform or even ether.
Nitrous oxide, which was suggested as an anesthetic by Sir
Humphry Davy in 1800, and used in dentistry by Wells in 1844,
was recommended for childbirth by Klikowitch of St. Peters-
burg in 1880. The increasing use of nitrous oxide, either alone
or combined with ether, for surgical operations has led to the
more general use of this anesthetic in childbirth. While it
is unquestionably safer than chloroform and much more rapid
in action and less irritating than ether, it has the practical
disadvantage of requiring special and cumbersome apparatus for
its administration. It is used to some extent in lying-in
hospitals and to a much less extent for deliveries in homes,
and there only among the comparatively few patients who can
afford such service.

The anesthetics which are inhaled have been an in-
estimable boon to the child-bearing woman; they have been also
a step in the search for means to make child-bearing painless.

In 1899 the use of morphine combined with scopolamine, (5)
a drug closely related to belladonna, was advocated to relieve
the pain of surgical operations. The patient was drugged into
a semiconscious dreamy state called "twilight sleep", in which
pain was felt but not appreciated, and was soon forgotten.
In 1902 the method was used in childbirth, and from the first
reports it seemed, indeed, as if the painless childbirth so
eagerly sought for had at last been attained. The medical
profession naturally grasped this opportunity to relieve the
pain of the child-bearing woman, and the drugs were soon ex-
tensively employed, and soon abandoned in most places. Labor
was in many instances prolonged and it was necessary to use
forceps in greater numbers of cases. The method was not adapt-
ed for use in homes, but only in such hospitals as had an un-
usually large staff, for it was necessary to guard against
danger to the child, since the drugs used were harmful to the
child. The woman accepting "twilight sleep" as a relief from
some of her suffering, did so at the price of possible injury
or even occasionally the loss of her child. In 1921 there
was a revival of interest in "twilight sleep", but at that
time it was shown that the increased mortality for the child
from the drugs used had not been eliminated.

A mixture of chloroform and ether or a combination
of the two with alcohol was tried by Drs. Ellis, Sansom Ellis,
Isaac Brown, Playfair and others with presumably great success.
An article of this nature appeared in the American Journal
of Obstetrics in April, 1885.

Chloral was introduced to therapeutics in 1869. In
the same year it was first used in obstetrics by Simpson, who
found that while the patient was so deeply hypnotized by it
as to be only partially aware that labor was going on, the
uterus still continued to contract strongly and regularly.
In 1874, Dr. Playfair urged its especial use in women of a
"highly organized nervous type, primiparae, and in those whom
dilation of the os took place slowly and painfully."
Bromide of ethyl was first used in obstetrics by Dr. Turnbull and Dr. H. Augustus Wilson of Philadelphia in 1880.

Cocaine has also been used in obstetrics. Doleris of Paris published a paper on it in January, 1885. This was a solution or ointment applied to the cervix and vulva.
OBSTETRICAL ANESTHESIA

General anesthetics are administered in labor in two distinct classes of cases:

1. In obstetrical operation and painful maneuvers.
2. In normal labor to mitigate or annul pain.

In the first class of cases the administration differs in no essential point from that of surgery. More important in obstetrics because two lives are at stake, deep anesthesia is the same in the one as in the other and but a few points require special consideration.

In the second class, however, the process is a special one and demands careful study. The object here is to alleviate or annul suffering without abolition of consciousness; the sensations of the patient are to be in abeyance, while the relations with the external world remain but little disturbed. This condition because of no better word for it is termed in this country obstetrical anesthesia.

The physiological basis of obstetric anesthesia is the fact that the action of anesthetics is regularly progressive, affecting first the lower portions of the nervous system and ascending gradually to the high. Experimental proof of this was furnished by Flourens and Longet as early as 1847 and repeated in 1875 by Bernard. First, the lower part of the spinal cord is affected then the dorsal and cervical portions, finally the medulla oblongata. The intellectual processes are early disturbed, then comes loss of perception of external impressions, as of touch and the special senses, then entire
loss of consciousness, while sensibility to internal impression remains, and reflex actions arising from them are only abolished later. In labor the contractions of the uterus continue after consciousness is lost; they will be excited to increased energy upon passing the hand into the organ even in a condition of deep narcosis. At a more advanced period this internal or unconscious sensibility, if the term may be used, is also abolished, the reflex action dependent upon the medulla oblongata (respiration and circulation) cease and life is extinguished.

The peoples of the world today, more than at any time are concerned over their birth rate and maternal mortality, and it is our duty, in so far as lies in our power, to contribute to the safety of mother and child. (7)

It is probable that every known type of anesthesia, analgesic and amnesic has been used to mitigate or eliminate the pain of natural and operative childbirth. Opinion is by no means unanimous regarding the use of various anesthesia and analgesia, so much so that, not only are new kinds appearing almost daily in the literature, but combinations of old types and also of new and old methods are being constantly tried.

From the foregoing it can be seen that the perfect obstetrical anesthesia and analgesia has as yet not been found, however, the requirements of obstetrical anesthesia and analgesia have recently been more fully recognized and there is a great increase in scientific interest in the subject of obstetric analgesia on the part of the profession. Numerous
drugs in various combinations are being used in an attempt to meet requirements under various conditions. No routine method can be used in all cases and no method is without danger for Mother and Child unless they are handled with great care and intelligence. The best results are obtained by being familiar with more than one method and individualizing the patient, using the best method applicable to the particular case. Only large experience with various drugs will prepare the obstetrician to administer them skilfully.

The ideal obstetrical anesthesia should meet the following demands:

(9)

1. It must induce surgical anesthesia swiftly and without excitement.
2. It must permit the birth of an unaffected infant.
3. It must not relax uterine musculature to the point of causing hemorrhage.
4. It must not induce vomiting.
5. It must permit of rapid clear awakening.
6. It must not depress circulatory or respiratory function

On the other hand the ideal obstetrical analgesia must fulfill the following qualifications:

1. It must induce prolonged partial or complete relief from pain.
2. It must in no way retard the progress of labor.
3. It must cause no excitation.
4. It must not affect the baby.
5. It must maintain the patient in a mental state in which she is amenable to suggestion and capable of cooperation.
ETHER

Ether is still an old standby not only in obstetrics but also surgery, and is still used extensively in this country. Although the old open drop method is still used, the technique of administering ether is altering, as the modern tendency is to avoid using it alone, but rather as an adjuvant to nitrous oxide-oxygen or ethylene-oxygen either by a facepiece or through an endo-tracheal tube. The smallest possible amount of ether to secure adequate relaxation is added to the gases and this reduced quantity results in lessened toxicity to the patient. According to Kane and Roth, ether mixtures tend to cause asphyxia of the baby. (10)

CHLOROFORM

Chloroform, like ether, is now rarely given alone but in conjunction with nitrous oxide and oxygen where the less toxic drug is contra indicated.

It may be well to point out that any use of adrena-line where anesthesia by chloroform, or a mixture containing it has been induced, is definitely contra indicated because of ventricular fibrillation and heart failure. Chloroform can exert toxic effects in at least four different ways:

1. Vagal stimulation in high concentration causing primary cardiac failure—(It is possible that full doses of atropine may give some protection from vagal stimulation.)

2. Ventricular fibrillation due to an intermittent ad-
ministration or to stimulation before the patient is fully anesthetized, or to administration of adrenaline.

3. Gradual paralysis of the respiratory center from overdose.

4. Delayed chloroform poisoning.

Nitrous Oxide

Nitrous Oxide with Oxygen still ranks as one of the anesthesias of choice in obstetrics, so much so, in fact that small portable units are manufactured for use in general practice.

(12) Nitrous Oxide may be given earlier than ether or chloroform, near the end of the first stage, and throughout the second. For surgical or deep narcosis the method of giving Nitrous Oxide and oxygen does not differ from that employed by surgeons, and the reader is referred to appropriate text books. Obstetrical analgesia requires skill and attention to detail.

(13) At the beginning of the second stage, and in rare cases, toward the end of the first, the gas is started. The large inhaler is used, and at the very beginning of the pain, perceived by the hand laid on the belly, or felt by the patient, two deep breaths of pure Nitrous Oxide are allowed, the next two inhalations are of a mixture of 90 per-cent nitrous oxide and 10 per-cent oxygen, the next two of 50 and 50, then pure oxygen for three breaths—inhaler removed. At the proper time the parturient may be allowed to bear down and labor is conducted in the usual manner.
The patient must not become cyanotic, must not lose consciousness, must not complain of headache, which means that too much Nitrous Oxide has been given. The amount of the gas needed varies with every patient, and this must be determined with care. The gas is given only during the pains, but more must be given as the second stage nears the end, and during the actual birth of the deep anesthesia is produced for a few minutes.

Contrary to the effect of ether and chloroform the uterine contractions are not weakened by Nitrous Oxide, indeed, labored is shortened and the pains seem more effectual.

ETHYLENE

Ethylene, or Olefiant Gas, is an unsaturated hydrocarbon having the formula C2H4. Ethylene can be used in the same apparatus as nitrous oxide, the main differences being (A) The induction time is slightly shorter; (B) Slightly more oxygen can be used (about 20% as a rule); (C) There is increased vascularity of tissue and secretion of saliva and mucus; (D) There is better muscular relaxation; (E) There is sometimes distressing nausea after anesthesia and occasional vomiting; (F) Ethylene is inflammable in the pure state and explosive when mixed in certain proportions with air or oxygen, the force of the explosion sometimes being terrific. The upper and lower limits of explosive mixtures are 3.05% to 28.5% with air; and with oxygen 3.1% to 79.9%. It is thus unsafe to use the gas with any form of cautery.
DeLee uses ethylene in preference to nitrous oxide and starts the inhalations toward the end of the first stage, rarely when the cervix is 7 cm. in diameter, and then only if the pains are severe. At the very beginning of the pain, diagnosed by the hand feeling the uterus harden, or from the parturient squirming a little, a few deep breaths of 50% ethylene and 50% oxygen are given, and the mask is removed as the height of the pain passes. The patient does not go to sleep and does not change color. As the second stage pains grow stronger the percentages of the two gases are changed--60-40, 80--20, 90--10, but never pure ethylene. As soon as the head is born the administration is stopped, to be resumed when sutures are inserted. The baby is not asphyxiated unless the anesthesia has been continued several hours.

ACETYLENE

It was observed that acetylene produced anesthesia in animals as long ago as 1895, but the pharmacological action of the gas was only worked out recently by Wieland, since then it has been extensively used in anesthesia in combination with oxygen under the name of Narcyclon, in Germany, and to a lesser extent in America. Acetylene resembles ethylene in most respects, but must be stored in cylinders containing acetone to avoid spontaneous explosion. Commercial Acetylene must not be used for anesthesia owing to such impurities as phosphine and sulphur. Absolutely pure acetylene has, like
ethylene, a faint ethereal odor, but as it is impossible to produce it at reasonable cost, the smell is disguised by pine essence. Most characteristics of ethylene are possessed by acetylene, the main differences lying in the oxygen percentage possible. This lies in the region of 50%, so that cyanosis should never occur in any circumstances. The induction of anesthesia and recovery are alike rapid with acetylene, as has been explained by the findings of blood analyses in rabbits. In five minutes after the induction of anesthesia 88% saturation is reached, and in seventeen minutes saturation is complete. In one minute after discontinuing the administration 85% of the gas has been eliminated, and in twenty minutes none is demonstrable in the blood. Similar precautions against fire and explosion must be taken as with ethylene.

No opinion can be given at this time as regards its place in obstetrics.

PROPYLENE

Propylene, the second member of the simple olefine series, with the formula, C₃H₆, is an inflammable gas and acts in a way similar to ethylene and acetylene, although only 30% with oxygen produces unconsciousness. It appears to be a satisfactory anesthetic in animals, but has as yet not been given an extensive trial in man owing to a doubt as to its action on the heart rhythm. There is, however, no change in the character of an electrocardiogram. The high percentage of oxygen possi-
ible with propylene render feasible the addition of nitrogen in such proportions that the three gas mixture is non-explosive.

CYCLOPROPANE

Cyclopropane (Trimethylene) is another hydrocarbon gas having the formula C₃H₆. It is an isomer of propylene but with a cyclic structure and no unsaturated bonds, two hydrogen atoms being attached to each of the three carbon atoms. Although it is a saturated hydrocarbon, it acts in some ways as an unsaturated compound because of its unstable ring structure. It is soluble in sulphuric acid and combines with bromine, but will not react with alkaline potassium permanganate.

The first preparation of cyclopropane and proof of its cyclic structure was made by Freund in 1882.

Cyclopropane is capable of producing narcosis in concentrations as low as 4% administered along with oxygen. The average concentration of cyclopropane for first plane, third stage anesthesia (roving eyeball) was 7.4%; second plane (fixed eyeball) 13.0% and third plane (with intercostal paralysis) 23.3%. Respiratory arrest was produced with an average concentration of 42.9%. Induction was by the closed carbon-dioxide absorption technique.

The physical signs are the same as for ether anesthesia except that induction and recovery are very rapid. Surgical anesthesia may be produced in three to five minutes and recovery takes place in less than five minutes, and the
after-effects of this anesthesia are very slight.

Clinical laboratory studies show that cyclopropane has a minimum deleterious effect upon the metabolic processes of the body. The electrocardiographic changes are no more evident than with other commonly used agents. Post operative complication compare extremely favorable with ethylene and ether. The blood pressure, pulse, and respiratory rates are lowered somewhat. There is no liver damage demonstrable after the use of cyclopropane.

After a year study Waters and his collaborators, (14) of the university of Wisconsin have found that cyclopropane in much lower concentrations is equal in efficiency to other gaseous anesthetics and that an excess of oxygen may be administered with this patent anesthetic; that it causes relaxation comparable with ether and that laryngeal reflexes are abolished more quickly than with ether; that it replaces ethylene to the satisfaction of all concerned; that it is to be chosen in preference to ether in well over 75% of the work formerly done under that agent. It is also to be preferred to nitrous oxide as a means of inducing ether anesthesia.

Because of the high percentage of oxygen, used with cyclopropane no cyanosis occurs, the patient retains a pink healthy color.

Used with oxygen within ordinary anesthesia limits it is not explosive or just mildly so. A chart on the explosibility of cyclopropane in oxygen mixtures is enclosed
at the end of this writing.

Bournes used cyclopropane in his obstetrical cases as an intermittent analgesia as indicated for the more severe labor pains, and as anesthesia for delivery. He states that satisfactory analgesia was easily produced, with very small quantities of cyclopropane inhaled with oxygen. Although none of the times of analgesia were continued long in his cases he believes it would be quite safe to relieve the pains with cyclopropane much earlier in labor than has been done, for the reason that the uterine contractions have not been inhibited, and that so much oxygen is used with it. We all know that it is good to administer oxygen intermittently;—good for the mother and good for the fetus, especially should the heart of the latter be weak. The use of oxygen in obstetrics is very important. With Cyclopropane anesthesia any required degree of muscular relaxation can be obtained without evident harm and recovery is devoid of any untoward effect to mother and child.

Bournes concludes by saying that cyclopropane seems to be very suitable for the relief of pain in obstetrics for the following reasons.

1. An abundances of O2 is given with cyclopropane.
2. Circulation and respirations are not depressed.
3. Anesthesia is produced without appreeciable metabolic disturbance.
4. Liver function is not impaired.
5. Anesthesia is quickly and agreeably induced, satisfactorily maintained at any desired dept with ready flexibility and with minimum danger to the mother and child and recovered
from easily and uneventfully.

At first it was thought that the cost of this anesthesia would be prohibitive but with the closed-carbon dioxide absorption apparatus, and the small amount needed for anesthesia it compares very favorably with any of the gases.

**ETHYL CHLORIDE**

Ethyl chloride continues to be used extensively for the induction of anesthesia and for short operations in children. Its portability, safety, and rapidity of action are its main advantages. From time to time attempts are made to adapt Ethyl Chloride for anesthesia in prolonged operations, and it has been used in some extent in obstetrics. Perhaps more shall be heard of it in the next decade. Its advantages, certainly are a step in the right direction.

**VINYL ETHER**

Investigations made with the other ethers appear to show that there is little likelihood of their use in human anesthesia with the exception of vinyl ether (Vinethene).

The inchoative studies of Leake and Chen were done with impure material. Later Ruigh and Major prepared a pure vinyl ether which Leake and his collaborators used on mice and dogs. They found that anesthesia could be more easily produced with vinyl ether than with ethyl ether., that there is less struggling and excitement, less mucus secretion; that recovery takes place more quickly, that nausea and vomiting
are less marked and that there is no significant pathological effects on the various organs. They found vinyl ether to be preferable to chloroform and ethyl ether.

Gelfan and Bell were the first to use vinyl ether on man. They anesthetized each other, and felt it to be worthy of clinical use.

Extensive physiological, pathological, and clinical studies have been made by Goldschmidt Rawin, Lucke, Muller, Johnston, and Ruigh on the dog, the monkey, and man. They have shown that the anesthetic potency of vinyl ether is four times that of ethyl ether and one and three-tenths greater than that of chloroform; at the same time there is a wider "margin of safety" between the anesthetic and lethal concentrations of vinyl ether and chloroform. They report having given vinyl ether to nearly five hundred patients of all ages and conditions, and for operations of a very varied nature. In these they encountered no untoward effects on respiration, the circulation, the liver, or kidneys, Muscular relaxation was good.

With early prescience this anesthetic agent was applied to obstetrics. The success obtained in this field is due to the rapidity with which an anesthetic state can be reached when vinyl ether is inhaled, the promptness of recovery and the relative safety. Bourne is entirely satisfied with its suitability for employment in obstetrics. It permits of rapid application, equally rapid recovery, and a satisfactory maintenance of any desired degree of narcosis with minimal danger to the
mother and child.

Vinyl ether is very volatile and for that reason a closed apparatus is preferred to avoid waste.

TRICHLORETHYLENE

This is also a general anesthetic, and the specific type of anesthesia which it produces is midway between that of ethyl chloride and diethyl ether. Experiments so far have failed to show any deleterious effect on the liver or other internal organs, or the respiratory tract. The drug is not very volatile and a little goes a long way. Herein lies the danger of overdosage.

Respirations are increased in number and depth. There is no change in the blood pressure. It is non-flammable, and non-explosive. The pure drug has a somewhat sweetish and rather faintly odor which is not unpleasant.

EVIPAN

Intravenous Sodium Evipan was discovered by Krapp, and Taub, and pharmacologically tested by Weese. It is the sodium salt of N-Methyl-cyclohexenyl-methyl and barbituric acid. It is a white crystalline tasteless powder which is easily soluble in water and gives a clear solution.

Evipan is used in a 10% solution in experimental animals, and in human beings. The time of injection requires an average from two to three minutes. The experimental animal goes to sleep after one minute without any evidence of
excitation; the respirations remain regular, become slightly slower, and deeper. After two minutes the animal is already in a deep narcotic sleep. With a lethal dose the death of the animal is first evidenced by respiratory failure, not by cardiac failure. In animal experiments the retained function of the heart can often be verified after complete cessation of respiration. The rapid action above corresponds to the short duration of the anesthesia and the rapid awakening. Just these characteristics, the unusually rapid awakening, the quick induction, and the sufficiently deep, but short anesthesia are the advantages of this new pharmaceutical. Its excretion from the body is not brought about by an aeration from the lungs as in the case of ether, but by a chemical breakdown. The liver plays an important part in this detoxification as borne out by experiments and the kidneys do not cause any destruction of evipan. In animals, the blood pressure falls 15-20 mm. The heart action is not affected. The depressed resperation can immediately be accelerated by carbon-dioxide inhalations. As a rule no deleterious effects are observed in the body metabolism, or its alkali reserve. A Stage of excitement is rare and when it occurs is slight.

The average anesthesia lasts 15, 20, at times, 25 minutes. It is best to begin the operation immediately after the injection. A quick awakening follows this period. The patient has a complete retrograde amnesia, he is able to get up and walk without help. Vomiting is rare.

COURSE: The maximum of the anesthetic action is reached with
the completion of the injection, and then lasts for 15-20 minutes. The respirations are usually unchanged, deep, and quiet. The blood pressure falls on an average of 15-20 mm.; the pulse as a rule shows no change from the normal; the patient appears fresh and in good color. Definite conclusions regarding the depth of the anesthesia cannot be made from watching the reflexes. The corneal and lid reflexes have already diminished with the onset of the anesthesia and with the deep anesthesia are no longer obtainable. The patellar reflexes disappear first, the abdominals last; the pupils are first small and become large with a deepening anesthesia, but still reacting. It is only with the deep anesthesia that pupillary reflex disappears entirely.

(24)

Indications and contra indication:

The short anesthesia with evipan is well adapted, for all short operations in which one desires to avoid the unfavorable aftereffects of an inhalation anesthesia. It can be used successfully in obstetrics for the end of the second stage of labor, for perineal tears etc. Something similar to a twilight sleep can be achieved with it and is used with good results by many authors. Generally there is no diminution of the uterine contractions. In this way the most severe labor pains can be avoided for women, already greatly weakened. The elimination of all shock is the great advantage of evipan.

CONTRA INDICATIONS:

Evipan should not be used in severely ill cachectic patients with respiratory, or circulatory pathology. It should
not be used in patients with poor liver function, the liver being the organ to break down the evisper and excrete it. It is also not to be used in peritonitis, ileus, gallbladder disease, and generalized pyogenic infections.

There is one danger which has to be avoided; Overdosage; If the anesthetist has injected too high a dose for the individual case serious respiratory irregularity or even cessation of breathing can occur. For these cases, the most valuable often life saving effect of coramine in 5-10cc. doses are than to be injected intravenously at once. If this injection is supported by artificial respiration this danger of overdosage can be successfully overcome.

ETHYL ALCOHOL

From time to time efforts have been made to utilize ethyl alcohol for the production of anesthesia apart from the time-honored technique of taking an overdose by mouth.

Manin of Mexico has successfully used alcohol intravenously, Donconstantin has tried out the method, and finds it useful in patients suffering severely from shock, or loss of blood, or other debilitating conditions. A light anesthesia is secured, but muscular relaxation may not be complete.

It is not surprising therefore that Cooke suggests (25) the injection of alcohol into the median basilic vein at the onset of labor as a method of shortening and rendering painless the second stage. He uses 20 parts of absolute alcohol and 80 parts sterile normal saline.
HEDONAL

Hedonal is the carbamic ester of tertiary amyl alcohol with the formula, C₆H₁₀O₂ (OC₅H₁₁).

The intravenous injection of this drug to produce anesthesia was introduced in 1909, but largely abandoned owing to its prolonged effect, and marked fall of blood pressure. Farkin, however, has obtained good results with minimal doses used in conjunction with ether, while a solution containing hedonal, sodium chloride, and gum acacia has been used successfully in animals, as also has a mixture of hedonal and isopral (Trichlorisopropyl alcohol).

CHLORALOSE

Chloralose, or glucosochloral, has the formual C₆H₁₂O₆CCL₃CHO, and is a somewhat unstable compound of chloral and glucose which tends to polymerize into parachloralose. Chloralose when given intravenously possesses the unusual properties of raising the blood pressure and producing anesthesia; It is even possible by repeated injections to raise the pressure to twice its normal figure. It is conceivable that the drug may eventually be of some use in man.

(26)

SPINAL ANESTHESIA

Anesthesia of the spinal cord invented by Corning, and elaborated by Bier, and Tuffier, has recently been gaining vogue. Its dangers—respiratory paralysis, headache, vomiting, hyperpyrexia, lachycardia, muscular spasms, drug intoxication, meningitis, and peripheral necroses— are being gradually
eliminated by improvement in the technique. Kronig said spinal anesthesia is dangerous in pregnancy and labor, and present experience with all the drugs—stovain, sponocain, tatocain, procain, -sadly confirms him. Dodek however uses spinocain with good results.

According to DeLee, and Greenhill (29), Spinal Anesthesia in obstetrics is dangerous because:

1. During labor the changes in blood pressure are marked.
2. The changes in the intraspinal pressure are rapid and profound. A German investigator, in a child with meningitis, injected antimeningococcus serum stained with methylene blue into the spinal canal low down. The child cried and strained, and he recovered the blue serum from a cisterna puncture. Straining occurs during the pains, and even the pain itself can raise spinal fluid pressure and cause waves up toward the artal nerve centers.
3. The curves of the spinal column make it hard to inject the anesthetic solution.
4. Emptying the abdomen changes the pressure and currents in the spinal fluid.
5. The drop of blood pressure when the uterus is emptied may coincide with the drop resulting from the mode of anesthesia, and this is particularly dangerous if there is hemorrhage.

However the new spinal perchaine introduced by Carl Heischer, and employing the technique of Howard Jones may change the present opinion of spinals in obstetrics.

Stoeckel advised the injection of novacain into the sacral canal, and Sellheim, blocked the pubic nerves,
reaching them through vaginal puncture. Banar, and Hecker, in 1923, recommended sacral nerve block and it seems practical for cases where general anesthesia is dangerous.

LOCAL ANESTHESIA

Procain is a very valuable local anesthetic and DeLee uses it for obstetric, and gynecologic operations wherever possible. Vernon uses a 1% solution for episiotomies.

(30)

However local anesthetics are not widely used in obstetrics.
ANALGESIA

The subject of Analgesia in obstetrics is not only large, but extremely varied. New analgesics and amnesics appear constantly in the literature, some holding their place as valuable hypnotics, others being changed, or their places taken by a newer addition.

Morphine, and scopolamine have early been used, and still remain as old standbys. Their chief use has been to mitigate preoperative fear, and relieve pain; but the first attempt to render a patient actually unconscious in bed without inhalation anesthesia was made by Gwathmey in 1913, with his rectal oil-ether solution. Some years afterwards he developed his synergistic method of using multiple drugs, which is based on Barger's hypothesis. This states that "drugs having the same pharmacological action summarize their therapeutic effect when given together, but drugs of different pharmacological actions increase their activity markedly more than the sum of their action when given separately." Thus preliminary narcotic drugs mutually reinforce each other, and also the general anesthetic following, so that it may be possible to secure adequate relaxation with a combination of drugs, and nitrous oxide-oxygen alone, or with an amount of ether quite inadequate by itself. Gwathmey has worked out many formulae of drug combinations, one of his rectal instillations containing no less than ten ingredients, including morphine,
hyoscine hydrobromide, magnesium sulphate, ether, paraldehyde, and alcohol; these complicated techniques have tended to fall out of use since it has been found that single drugs can be given safely in sufficient dosage, to produce unconsciousness, without surgical anesthesia. These drugs have been given the name of basal narcotics, and they thus lie midway between preliminary hypnotics such as morphine and scopolamine, on the one hand, and anesthetics such as chloroform, and ether on the other.

The advantages of basal narcotics are; (A) The absence of any apprehension by the patient; (B) Less general anesthesia is necessary; (C) There is less after pain; (D) There is less vomiting;

The disadvantages are; (A) Most methods of administration take some time, and involve some calculation of dosage, that is, no routine dosage is possible; (B) More nursing care is necessary afterward; (C) The diminished or absent reflexes after operation may be disadvantageous in certain cases; (D) Great care is necessary to avoid cumulative effects, with other sedative drugs. Several fatalities have occurred from this cause.

Administration may be by mouth, intravenously, rectally, and intramuscularly, most basal narcotics can be given in this way if necessary.

ETHER OIL COLOMIC ANALGESIA

This is one of the better analgesics for use in
general obstetrical practice, having no effect on the contractions of the uterus, but with a relief from pain. This analgesia was first introduced by Gwathmey as mentioned above, but probably the most popular method in use now is a modification of the Gwathmey technique, with an absence of the quinine and magnesium sulphate, and a decrease or absence of the morphine using a barbiturate instead. For the original Gwathmey technique the reader is referred to DeLee’s Text book of Obstetrics.

(13)

One of the modifications of Gwathmey’s method is Barb-eth-oil. Its formula is as follows;

Ethyl (methyl-butyl) barbituric acid — 8 gr.
N-butyl ethyl barbituric acid (neon) — 5 gr.
Quinine alkaloid -------------------------- 20 grs.
Ether -------------------------------------- 2½ oz.

Mineral oil-------------------------------1½ oz.

Another popular mixture is sodium amytal by mouth simultaneously with injection by rectum of the ether oil mixture consisting of

Ether -------------------------------------- 2½ oz.

Olive Oil------------------------------- 1½ oz.

Quinine Sulphate------------------------ 20 gr.

AVERTIN

Avertin is the trade name for tribromethyl alcohol. It was first used in anesthesia by Eicholz in 1926. It is a white, crystalline substance, soluble with difficulty in water up to 3%. For the sake of convenience "Avertin Fluid" is now
chiefly used; this is a solution of avertin in amylene hydrate. It is a clear liquid, 1 cc. of which contains 1 gm. of avertin.

The advantages of avertin are, that it is odorless, and after effects are rare, induction is almost invariably quiet, without any excitement.

Its disadvantages are that it tends to depress the respiratory center, lower the blood pressure, and there is a prolonged period after operation with depressed reflexes, and shallow breathing, and that it may have some toxic effect upon the liver and kidneys.

The dose varies from 0.09 to 0.12 gm. per kilogram body weight. As a rule the higher the patients basal metabolic rate the greater the dose necessary. The solution is made up to 2\% in distilled water, and a few drops of congo red are added to 5 cc. of the solution. The color must remain red, as blue indicates the presence of hydrobromic acid, which is an irritant to the rectal mucosa. The drug only remains in solution at about 90\% F., so that it should be freshly prepared, and administered before the liquid has time to cool down. The patient gradually lapses in unconsciousness without realizing that anything unusual is happening.

Avertin is contra indicated in patients with very low basal metabolic rate; they do not readily eliminate the drug; in patients in whom brisk reflexes are required after operation; in patients with abnormally low blood pressures; when other methods or drugs, that lower blood pressure will be used, or when other methods, or drugs that depress respiration
will be used, as chloroform, large doses of morphine, etc.; in operations in the region of the rectum, or anus; in nephritis, and diseases of the liver.

Antidotes are ephedrine, coramine, and high rectal irrigation with warm hypertonic sodium thiosulphate solution, for combating collapse from an overdose of Avertin.

According to Dodek, Avertin has nothing to recommend its use as an analgesic in place of colonic instillation of ether oil mixture; not only does the latter interfere less, with the uterine contractions, but the degree of relief, and relaxation, which it affords lasts more than twice as long. It is necessary also to have ample trained assistance in case some untoward reaction occurs.

Walter, however, believes that the best anesthesia is that produced by a combination of a hypnotic and an anesthetic, preferably Avertin, and Nitrous Oxide.

PARALDEHYDE

Paraldehyde is a polymer of ethylaldehyde with the formula C₆H₁₂O₃. It is a colorless liquid with an unpleasant smell. It resembles alcohol in its effects though it is a much more powerful narcotic and rarely induces any symptoms of excitement.

Even in large doses, it does not affect the heart directly, an important consideration in heart disease, and it produces no such effects on the protein metabolism, as...
accompany the prolonged use of chloral. It is observed that the pulse is somewhat slower, and the carbonic acid exhaled is less than normal, but these changes are relatively greater in degree, than those that occur in the course of natural sleep, and must thereby be ascribed to the lessening of muscular movements. In fact substantial quantities of paraldehyde have been taken without fatal results, or with any more serious consequences, than prolonged unconsciousness. It is secreted, partly by the lungs, and for the most part in the urine.

Its advantages are; that is probably the safest basal narcotic known, that in normal doses it has practically no effect on the respiratory center or on the blood pressure, and that reflexes are only slightly diminished after operation.

Its chief disadvantage is the smell as paraldehyde is partly excreted through the lungs.

Paraldehyde is used in a 10% solution in normal saline, and is run into the rectum slowly at blood heat. It might be added that all retention enemata should be given with the patients lying on their left sides. This allows a larger area of absorptive gut to be exposed.

Paraldehyde is used in combination with other drugs. On the opinion of Calvin, and Bartholomew, Para-

(32) ldehyde, as a basic amnesic agent in combination with Sodium Amytal, or Pentobarbital approaches the ideal in satisfying the fundamental requirements pertaining to labor. Complete amnesia may be obtained with a minimum of restlessness, in from 90-95% 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. These are no contra indications to its use in home confinements.

Also DeLee and Greenhill, suggest Pentobarbital \textsuperscript{(29)} supplemented by rectal administration of paraldehyde in olive oil, with the following advantages;

1. Production of prolonged amnesia, and analgesia.
2. Freedom of danger of mother, and fetus.
3. Reduction of excitation to a minimum.
4. Avoidance of delay in labor.
5. Simplicity of administration.

Investigation by Kame and Roth, showed that a \textsuperscript{(33)} combination of paraldehyde and benzyl alcohol produces satisfactory analgesia, and complete amnesia in practically all cases in which labor is of more than four hours duration. This solution is retained, having been expelled only in cases in which the presenting part was pressing on the rectum. It does not cause vomiting, and no ill effects have been noted in either mother, or child. Having been spared the psychic shock of pain, the memory of suffering, and fatigue from bearing down and straining during the second stage, the patient awakens from her long post partum sleep actually refreshed.

Benzyl alcohol, in the above, anesthetizes the rectal \textsuperscript{(10)} mucosa, as benzyl preparations have the power to relax unstriped muscle, it was believed that it would allow more rapid dilation of the cervix. This is borne out by laboratory, and clinical observations;
An analysis of 300 cases using paraaldehyde, bears (35) out the above statements.

MORPHINE AND SCOPOLAMINE:

Since Steinbuchel recommended its use in labor in 1902, Morphine and Scopolamine have been analgesics of choice, falling for a short period of disrepute, because of alleged asphyxiation of the fetus. However today they are the second most common type of analgesia, being second only to the barbiturated.

(29) For the technique of "twilight sleep" the reader is referred to DeLee's Testbook. (13)

A Chart is appended of the physiological, and Synergistic action of these drugs.

Morphine Sulphate, in moderate doses has no effect upon the uterus in established true labor, but occasionally shortens labor by relaxing the cervix. This reaction may be said to be due to a combination of a relaxation of the cervix, an increased tonicity of the uterine muscle, and a general refreshment of the whole organism resulting from induced psychic tranquility.

The combination of morphine scopolamine is an ideal analgesia for primiparous patients, when given with proper regard for the expected time of termination of the 2nd stage of labor. Based on the opinion that if given too close to the time of delivery it may cause depression of respiration in the baby, this treatment is never started when the birth of the fetus is expected vaginally or abdominally, within 4 hours.
The injection of scopolamine are stopped when the cervix is dilated about 8.5 cm., since delivery usually occurs with 2-2½ hours after the beginning of the 2nd stage. Analgesia is continued by inhalations of ether, nitrous oxid-oxygen, or ethylene, or a colonic instillation of ether.

Scopolamine combined with morphin has no characteristic effect upon contractions of the uterus other than those which one sees with morphine alone; and just as morphine does not interfere in general with the normal progress of labor to any appreciable degree, one way , or another, so is it when scopolamine is added.

Morphine, and Scopolamine are not used within 4-6 hours of expected delivery, because of the belief that it causes fetal asphyxia, however Kane, and Roth are convinced (10) that the incidence of asphyxia is grossly exaggerated, and that spontaneous respiration take place no matter how late the administration of the drug.

(37)

Different combinations these drugs, with the barbiturates have been tried with seemingly satisfactory results,

Using Sodium Pentobarbital, Callaway, and Smith (38), concludes that;

1; Nembutal and Scopolamine were used to allay the pain of labor in 500 cases with successful results in 93.6 percent.
2. Maternal mortality, and morbidity are not increased.
3. Infant mortality and morbidity are not increased.
4. Operative incidence is increased but the increase is
almost wholly confined to outlet forceps, and is due to failure of cooperation by the patient, because of the drug. This appears inseparable from any effective method of pain relief.

5. The method was used in 63.8% of the women admitted while this study was in progress. This method in common with all methods of pain relief is not universally applicable. Whether it should be given, or withheld should be decided by the Obstetrician.

6. Constant and intelligent observation of patient during and for some time after labor is essential. It is therefore hospital procedure only.

7. Our results with this method have been sufficient satisfactory to warrant its further use.

McNeal, Bauer, and Sanford, investigating various combinations state that best results were obtained by a combination of Scopolamin, and Sodium Pentobarbital, in doses of gr. 1/150, and gr 6 respectively.

Using a combination of Sodium Amytal, and Morphine, Daichman, and Shir have compared its effects with other commonly used drugs, and were favorably impressed, with its advantages.

A chart of their work is appended.

Axelrod, investigating the combination of barbiturates concluded:

1. Potentiating the barbiturates with opiates definitely reduces the volume of the supplemental anesthetic.

2. Potentiating the barbiturates with opiates permits of an increased concentration of O with gas anesthesia.

3. Potentiating the barbiturates with opiates permits
of a reduced dosage of each with better clinical results.

4. Pantopon is found to have a marked advantage over morphine, when used to potentiate the barbiturates.

5. Blood pressure, as a rule, is not materially affected when the barbiturates are potentiated with an opiate.

6. Codeine gives only a mild degree of tranquilization when used to potentiate the barbiturates;

7. Morphine is found to materially depress respiration, when used to potent the barbiturates.

8. Scopolamine does not induce tranquilization, when use to potentiate the Barbiturates.

9. The balanced used of sedatives, analgesics and anesthetic help to control apprehension and fear of operation.

BARBITURATES

The barbiturates, as mentioned before, are the most commonly used analgesics today.

Mention has been made of their use with rectal ether, morphine, and scopolamine.

The more popular barbiturates used in obstetrics are Sodium amytal, Pentobarbital (Nembutal), and Sodium Alurate, Intravenous Dial, Pernocton, and Somnifene are used somewhat.

SODIUM AMYtal

Sodium Amytal, the correct name for which is sodium-iso-amylethyl-barbiturate; was first described by Shoule, and Moment in 1923, and its pharmacology worked out in the same year by Page.
Sodium Amytal is initiated by a dosage of 9 gr. by mouth. If the patient is not comfortable on sleeping between pains within twenty minutes, a second dose of 3 gr. are repeated at 1 to 1½ hour interval until the cervix is 8 cm. when an anesthetic is given.

Sodium Amytal may be given at any stage of labor. no ill effects upon the fetus have been demonstrated, and its analgesic and amnesic qualities have absolutely no depressing effect upon the contractions of the uterus. Quite to the contrary, it is not uncommon to observe rather sudden cervical dilation after a dose of this drug, with consequent relaxation of the lower uterine segment. The contractions of the uterus may become more intense for this reason, but not more painful.

Occasionally it may stimulate rather than quell, but a colonic instillation of ether oil overcomes this effect.

Constant nursing care is necessary.

PENTOBARBITAL (NEMBUTAL)

Pentobarbital is sodium ethyl-methyl-butyl-barbiturate. It has to a large extent displaced sodium amytal as its action is shorter, and there is less restlessness, and delirium. It's pharmacological action is the same as that of sodium amytal, while intravenous drugs are frowned upon in America.

Somnifene is used quite extensively in France, and Pernocton in Germany. Dial, however, has its advocates in America.

Rund claims that it alleviates pain, relaxes the cervix, and perineum, does not retard labor, and does not
depress the respirations of the newborn.

Erlisch, and Brown in their investigations have made
such a concise report of barbiturate that the writer has taken
the liberty of reproducing them.

Criteria for their use was:

1. Dilatation of cervix to 2 fingerbreadths.
2. Pains recurring every 5 min. and 30 seconds or longer
duration

DRUGS USED

DIAL: Intravenous in doses of 2 cc. (equivalent to 3 gr.)

It is most important that all of the medication enter
the veins as this substance is extremely irritating to the sub-
cutaneous tissue, and may lead to more or less sloughing. Rep-
etition if patient begins to recover from effects of medication.

COMMENT: Apparently this is a perfectly safe drug, in the dosages,
used, for both mother and infant. It proved so lacking in
beneficial results, however, that we felt that barbiturates alone
apparently had too little value to warrant their being used
without other drugs.

The duration of labor was the longest of any and
while the drug afforded some rest for the mother both intra-
and post partum, it did so in only a minor degree as compared
with other drugs in the series. It ranks 2nd highest in pro-
duction of excitement. The technical difficulties of administra-
tion add to the undesirability of this drug intravenously in
labor.
SODIUM AMYTAL AND MORPHINE:

Sodium Amytal 6 to 9 gr. by mouth followed by 1/8 to 1/6 morphine sulphate by hypodermic.

COMMENT: This combination of drugs was apparently safe for considering the use of morphine. Analgesia was fairly good, and amnesia was relatively poor. The duration of labor not significantly influenced. Excitement was present to such a slight degree that it was not an annoyance.

SODIUM AMYTAL AND RECTAL ETHER:

Sodium Amytal by mouth simultaneously with injection by rectum of the ether oil mixture, consisting of ether 2\(\frac{1}{2}\) oz., Olive oil 1\(\frac{1}{2}\) oz. and quinine sulphate 20 gr.

COMMENT: This combination was safe for both mother and infant. The analgesia produced was slightly better than when morphine was used in place of rectal ether, and the degree of amnesia was definitely increased by the latter. The duration of labor was not favorably influenced, and the restlessness occurred to about the same degree as in our other rectal ether series. Labor appeared somewhat delayed.

The difficulties of administration as well as only average efficiency detract from satisfaction with this method.

SODIUM ALURATE WITH PANTOPON

Sodium Alurate by mouth of 9 gr. followed by 1/6 gr. of pantopon hypodermic. Repetition if necessary.

COMMENT: The percentage of apneic babies in the series constitutes the greatest objection to the use of this combination.
of drugs provided the obstetrician is capable of, and has facilities for, the resuscitation of infants.

SODIUM ALURATE WITH SCOPOLAMINE

Routine same as above except that Scopolamine stable ampoules, or hyoscine was substitute for pantopon.

COMMENT: This combination of drugs is decidedly satisfactory with the exception of restlessness, which was the most marked of that in any series, and in some cases very troublesome. It is perfectly safe for both mother and child, easy to administer, and seems to shorten the duration of labor. The restlessness renders this combination of drugs unsatisfactory for general use, but where sufficient nursing care is available it gives gratifying results. Owing to the amnesia none of these patients have any recollection of their excitement.

BARB-ETH-Oil

This preparation is for rectal installation, and its formula is as follows;

Ethyl (1 methyl butyl) Barbituric acid—8 gr.
N-butylethyl barbituric acid (meonal) —5 gr.
Quinine Alkoid--------------------------20 gr.
Ether-------------------------------------2½ oz.
Mineral Oil-----------------------------1¼ oz.

COMMENT: The effect of this drug is so profound that it produces prostration of the mother at times. There were 2 cases of postpartum hemorrhage in this group, and the lack of response to remedial measures was alarming.

Patients were almost uniformly drowsy for at least
48 hours following medication. From the standpoint of analgesia, and amnesia this was the best group.

Labor seemed to be slightly shortened. There are definite technical difficulties in the administration, and it requires complete cooperation of the patient. Were it possible to exclude the toxicity of this combination of drugs the results would be very satisfactory.

CONCLUSIONS:

1. Barbiturates used alone apparently are of less value for relief of pain during labor, and for the production of amnesia than they are when combined with certain other drugs.

2. Barbiturates combined with sedative or amnesia-producing drugs appear to accentuate and prolong their action.

3. The drugs used in these series produced no serious permanent effects on either mother or child.

4. The labors were shortest in the patients in whom the greatest degree of analgesia and amnesia were observed.

5. Ether per rectum used in conjunction with the barbiturates appears to delay labor to a degree.

6. Barbiturates are excitants in about 25% of all cases, and its condition is aggravated by the use of another excitant such as scopolamine, and lessened by sedative such as pantopon and morphine.

7. Apnea in the infants is more common when barbiturates are used during labor, and is aggravated when pantopon is used in addition.

8. Barbeth-oil gave the last statistical results but
general atony of patients after recommended doses has the possibility of serious consequences.

9: Considering safety of mother and infant, efficiency in producing analgesia, and amnesia, and simplicity of administration, we feel that the combination of sodium Alurate and scopopamine. Excitation produced by this combination is a deterring factor and requires special nursing care.
CHART I

Table I

Postoperative complications—Respiratory in 4400 Clinical Inhalation Anesthetics.

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<thead>
<tr>
<th>Cases</th>
<th>Cyclopropane</th>
<th>Other Agents</th>
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<tbody>
<tr>
<td>Complications</td>
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</tr>
<tr>
<td>Cough, Slight</td>
<td>4.0</td>
<td>3.60</td>
</tr>
<tr>
<td>Cough, Severe</td>
<td>0.72</td>
<td>1.90</td>
</tr>
<tr>
<td>Hi-cough</td>
<td>0.31</td>
<td>0.45</td>
</tr>
<tr>
<td>Others</td>
<td>0.31</td>
<td>0.62</td>
</tr>
</tbody>
</table>

(Expressed in percentages of total cases for each group)

Table II

Postoperative complications—Circulatory in 4400 Clinical Inhalation Anesthetics.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Cyclopropane</th>
<th>Other Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachycardia</td>
<td>4.60</td>
<td>4.10</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>0.45</td>
<td>0.27</td>
</tr>
<tr>
<td>Sev. Drop B.P.</td>
<td>5.20</td>
<td>3.20</td>
</tr>
<tr>
<td>Shock</td>
<td>0.34</td>
<td>0.13</td>
</tr>
<tr>
<td>Fibrillation</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Heart Block</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Others</td>
<td>0.48</td>
<td>0.39</td>
</tr>
</tbody>
</table>

(Expressed as above)

Table III

Postoperative complications—Nausea and Emesis in 4400 Clinical Inhalation Anesthetics.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Cyclopropane</th>
<th>Other Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea only</td>
<td>5.80%</td>
<td>4.90%</td>
</tr>
<tr>
<td>N. &amp; E. O. D. Only</td>
<td>19.50</td>
<td>21.80</td>
</tr>
<tr>
<td>1-3 days P.O.</td>
<td>5.65</td>
<td>6.90</td>
</tr>
<tr>
<td>After 3rd Day</td>
<td>0.63</td>
<td>0.72</td>
</tr>
<tr>
<td>1st day severe</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>More than 1 day severe</td>
<td>0.22</td>
<td>0.41</td>
</tr>
<tr>
<td>None</td>
<td>68.08</td>
<td>64.90</td>
</tr>
</tbody>
</table>

(Expressed as above)
Table IV
Postoperative Deaths in 4400 Clinical Inhalation Anesthetics.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cyclopropane</th>
<th>Other Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>2200</td>
<td>2200</td>
</tr>
<tr>
<td>Total Deaths</td>
<td>94</td>
<td>87</td>
</tr>
<tr>
<td>Mortality Per Cent</td>
<td>4.19%</td>
<td>3.99%</td>
</tr>
<tr>
<td>Time of Death:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day of Operation</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1st Day P.O.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2nd-3rd Day P.O.</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>4th-7th &quot;</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>2nd Week</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Later</td>
<td>39</td>
<td>31</td>
</tr>
<tr>
<td>Causes of Death:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Other Respiratory</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Other Circulatory</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Toxemia</td>
<td>32</td>
<td>22</td>
</tr>
<tr>
<td>Carcinoma</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Shock</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>
### CHART II (15)

Explosibility of Cyclopropane in Oxygen Mixtures

<table>
<thead>
<tr>
<th>Percentage Mixtures</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Explosive</td>
</tr>
<tr>
<td>Cyclo</td>
<td>Non explosive</td>
</tr>
<tr>
<td>0</td>
<td>Moderate</td>
</tr>
<tr>
<td>2</td>
<td>Explosive</td>
</tr>
<tr>
<td>C</td>
<td>Very</td>
</tr>
<tr>
<td>0</td>
<td>Explosive</td>
</tr>
<tr>
<td>2</td>
<td>Very</td>
</tr>
<tr>
<td>C</td>
<td>Explosive</td>
</tr>
<tr>
<td>0</td>
<td>Moderately</td>
</tr>
<tr>
<td>2</td>
<td>Explosive</td>
</tr>
<tr>
<td>C</td>
<td>Very Mildly</td>
</tr>
<tr>
<td>0</td>
<td>Explosive</td>
</tr>
<tr>
<td>2</td>
<td>No Explosive</td>
</tr>
<tr>
<td>Scopolamine</td>
<td>Morphine</td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Antagonistic Action</strong></td>
<td><strong>Synecistic action</strong></td>
</tr>
<tr>
<td>Elevates Temperature</td>
<td>Loweres Temperature</td>
</tr>
<tr>
<td>Quickens Respiration</td>
<td>Slows Respiration</td>
</tr>
<tr>
<td>Increases Urinary secretion</td>
<td>Sl. diminishes Urinary Secretions</td>
</tr>
<tr>
<td>Increases Peristalsis</td>
<td>Diminishes Peristalsis.</td>
</tr>
<tr>
<td>Arrest skin and saliv. gl. secretion</td>
<td>Sudorific</td>
</tr>
<tr>
<td>Dilates Pupils</td>
<td>Contracts pupils</td>
</tr>
<tr>
<td>Raises blood pressure</td>
<td>No effect on bl. press.</td>
</tr>
<tr>
<td>Stimulates vaso, motor center</td>
<td>No effect on Vaso. motor center</td>
</tr>
<tr>
<td>Incr,rapidity and force of circulation.</td>
<td>No effect on circulation</td>
</tr>
<tr>
<td>Excites motor areas of spinal cord.</td>
<td>Depresses motor areas of Spinal cord.</td>
</tr>
<tr>
<td>Relieves pain</td>
<td></td>
</tr>
<tr>
<td>Induces Sleep</td>
<td></td>
</tr>
</tbody>
</table>
CHART IV

(40)

<table>
<thead>
<tr>
<th>DRUGS</th>
<th>No. of cases</th>
<th>Drug action (hrs)</th>
<th>Analgesia good %</th>
<th>Analgesia fair %</th>
<th>Asphyxia babies</th>
<th>Duration of labor %</th>
<th>Good &amp; fair lab %</th>
<th>Fair lab %</th>
<th>Good &amp; fair %</th>
<th>P.P %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sod. Amytal</td>
<td>60</td>
<td>2-3</td>
<td>58.3</td>
<td>33.3</td>
<td>8.3</td>
<td>14.6</td>
<td>28.0</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Sod. Amytal &amp; Scopolamin</td>
<td>53</td>
<td>3-4</td>
<td>32.4</td>
<td>39.6</td>
<td>1.8</td>
<td>16.4</td>
<td>67.9</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sod. Amytal &amp; Morphine</td>
<td>91</td>
<td>4-5</td>
<td>98.7</td>
<td>2.2</td>
<td>8.7</td>
<td>15.5</td>
<td>50.5</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Gwathmey</td>
<td>50</td>
<td>2-4</td>
<td>74.0</td>
<td>8.0</td>
<td>20.4</td>
<td>20.4</td>
<td>8.0</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Avertin</td>
<td>40</td>
<td>1-3</td>
<td>79.7</td>
<td>2.5</td>
<td>14.8</td>
<td>14.8</td>
<td>17.5</td>
<td>32.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHART V
Analgesia (43)

0 10 20 30 40 50 60 70 80 90 100

Dial

Sod, amytyl
& morphine

Sod, amytyl
& rectal ether

Sod, alurate
&Pantopon

Sod, Alurate
& Scoop.

Barb. eth
oil.

-----
Good

Fair

AMNESIA

0 10 20 30 40 50 60 70 80 90 100

Dial

Sod, Amyt.
&Morphine

Sod. Amytyl
& Rectal ether

Sod, Alurate
&Pantopon

Sod, Alurate
&Scoop.

Barb. eth

-----
complete

partial
<table>
<thead>
<tr>
<th>Medication</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sod. Alurate &amp; Scopolamine</td>
<td>5.18</td>
</tr>
<tr>
<td>Dial</td>
<td>6.09</td>
</tr>
<tr>
<td>Sod. Alurate &amp; Pantothen</td>
<td>6.28</td>
</tr>
<tr>
<td>Barb, eth oil</td>
<td>6.72</td>
</tr>
<tr>
<td>Sod. Amytal &amp; Morphine</td>
<td>7.37</td>
</tr>
<tr>
<td>Sod. Amytal &amp; Rectal ether</td>
<td>8.39</td>
</tr>
<tr>
<td>Agent</td>
<td>Boiling Point</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Below 33°</td>
</tr>
<tr>
<td>Ethylene</td>
<td></td>
</tr>
<tr>
<td>Acetylene</td>
<td></td>
</tr>
<tr>
<td>Propylene -48°</td>
<td>Possibly some cardiac action</td>
</tr>
<tr>
<td>Ethyl Chloride</td>
<td>12.5°</td>
</tr>
<tr>
<td>Ether</td>
<td>34.6 0.72°</td>
</tr>
<tr>
<td>Chloroform +0.1°</td>
<td>1.487</td>
</tr>
</tbody>
</table>
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