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Present status of general and local anesthesia in obstetrics

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PRESENT STATUS OF

GENERAL AND LOCAL ANESTHESIA

IN

OBSTETRICS

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HISTORICAL CONSIDERATION

The use of some means of anesthetic to give
relief from the pain of childbirth was comparatively
unknown before the middle of the nineteenth century.
Although literature indicates that man has long
sought to assuage grief and pain by some means of
dulling consciousness, there are few incidents relat-
ing to attempts to relieve the pain of childbirth.
Simpson (1) quotes Plautus in his _Ophelion_ in which
a woman in childbirth received narcotic draughts and
was rendered insensible to pain, at which time a
lively boy was born. In the sixteenth century there
are many cases in which witches were persecuted for
attempting to abolish the pains of labor by charms
or other means. One method practiced was to hold a
sword before the patient, who was directed to look at
it steadily in the same way that Latina is said to
have held a palm branch and brought forth Apollo
without suffering; an attempt at mesmerism in reality.
Another way employed was to hang the husband up by
his feet in the next room until the labor was accom-
plished. Such a plan would not meet with much appro-
bation and encouragement now. The celebrated case of
the Countess de St. Geran is another instance of
narcotic draughts being administered to alleviate
the pains of labor. After she had been nine hours in

labor, the midwife gave her a mixture which kept her in an anesthetic state until the following morning, at which time she was safely delivered of a son.

Perhaps one of the reasons that soporifications were not used to relieve the pain of childbirth was due to the fact that the nature of the substances available--opium, for instance,--precluded their employment in effective doses. They arrest the progress of the birth and likewise are injurious to the child. Moreover, religious doctrines were opposed to the use of any means to alleviate pain of childbirth. This was the formidable barrier that faced the pioneers of modern anesthetics in the field of obstetrics.

Meanwhile, narcotic drugs had long been used, not producing true anesthesia, but to give relief in part from wounds or painful diseases and thus to allow the sufferer to rest. During the era of Grecian literature (2), Homer in his Odyssey caused Helen of Troy to put some drug in his wine to lull all pain and anger, and bring forgetfulness of every sorrow. Helen's "nepenthe" was believed to have been mandragora, while others maintain that it was opium. Five hundred years later Heradotes inhaled the fumes from a variety of hemp which produced an exalted mental state, followed by sleep.

By the beginning of the Christian Era mandragora
was well known to the writers of that period, among
them Dioscarides and Galen. At the same time the
Jews and Chinese were using Indian hemp (hashish) as
a means of producing intoxication, mental exaltation,
and sleep. A Chinese practitioner of the third
century, Hoa-tho, gave a patient a preparation of
hemp rendering him insensible as if he had been
deprived of life. After a certain number of days,
the patient found himself reestablished without having
experienced the slightest pain during the operation.
Later in the middle ages, an oil was used on occasion
of painful operations. Consisting of opium, the juice
of the unripe mulberry, hyoscyamus, the juice of
hemlock, the juice of the leaves of mandragora, the
juice of the leaves of wood ivy, of lettuce seeds,
of dock seeds and water hemlock; the oil was boiled
with a sponge. The solution was then applied to the
nostrils. To awaken the patient, another sponge,
soaked in vinegar, was applied to the nose.

The events leading up to the discovery and use
of modern inhalation anesthesia were the discovery of
hydrogen in 1766, nitrogen in 1772, and oxygen and
nitrous oxide in 1774. Thus was opened the field of
pneumatic chemistry. By 1800, Sir Humphry Davy (3)

in England had used nitrous oxide for the alleviation of headache and also for the extraction of one of his own wisdom teeth. This latter event led him to make the historic prediction, "Since nitrous oxide seems capable of destroying pain, it may be used in surgical operations." The value of this suggestion was not recognized for nearly a half a century. The first experiments on lower animals were made by Henry Hill Hickman between the years of 1820 and 1828. Having successfully operated upon anesthetized dogs, Hickman tried in vain to interest his colleagues in England and France, but was ridiculed and rebuffed at every turn. Disappointed and hopeless, Hickman died at the age of twenty-nine.

In 1844, Horace Wells of Hartford, Connecticut,
(4)
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 the influence of the gas did not appear to be sensible to slight injuries caused by falling or by staggering against the furniture of 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 life.

Wells reported the progress of his work to William
Morton of Charlton, Massachusetts, a friend and former
partner. After the failure of 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 the 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. 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 the pain.
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, 1847, 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 the fetus had been 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 more 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 childbed; and

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

In a short time Dr. Murphy of London, Dr. Lloyd, Dr. Protheroe Smith, and Mr. Landsowne of Bristol had used it successfully. Also it was very early tried in France. Fourrier Dechamps and Paul Dubois being of the first to introduce it in that country, closely followed by Villeneuve of Marseilles and Staltg 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. N. 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 came the introduction of a new anesthesia, with Simpson again the pathmaker, as 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 have found a 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 unhurt. 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 Froth, 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 sub-
missive than the lady of the sixteenth century, turned,
and with their own weapon of religious interpretations
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." (Gan. II-21).

At the same time that Simpson was fighting for
the use of chloroform to alleviate 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 "twi-
light 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 labor 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 on 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 labor."

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

Although ether and chloroform are still the anesthetics most extensively used in childbearing, 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 less danger to the mother and the child than is the case of 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. Petersburgh in 1880. The increasing use of nitrous oxide, either alone or combined with ether, for surgical purposes has led to the more general use of this anesthetic in childbirth.(5) 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 at homes, and there
only among the comparatively few patients who can
afford such service.

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

In 1899 the use of morphine combined with scopol-
amine, a drug closely related to belladonna, was
advocated to relieve the pain of surgical operations.(6)
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 extensively employed, and soon
abandoned in most places. Labor was in many instances
prolonged and it was necessary to use forceps in a
greater number of cases. The method was not adapted
for home use, but only in such hospitals as had an

unusually 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 "twi-
light sleep" as a relief from some of her suffering,
did so at the risk of possible injury or even, occass-
ionally, the loss of the 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 drugs used had not been eliminated.

A mixture of chloroform and ether or a combination
of the two with alchol was tried by Drs. Ellis, Sanson,
Edis, 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
dilitation of the os took place slowly and painfully."

Bromide of ethyl was first used in obstetrics
by Dr. Turnbull and Dr. H. Augustus Wilson in

Philadelphia in 1880.

Local anesthesia, meanwhile, had its historic beginning in the use of "ligatura fortis" by the Arabian physicians, which served to prevent loss of blood and at the same time reduced pain by compression of the nerve trunks. In 1676, Schuman described the use of such methods in which the surgeon had removed [7] a woman's foot before she realized the operation was completed.

There followed methods of local anesthesia by freezing tissue before surgery. This was first noticed on the battlefields in 1807 and was first described in literature by Annott in 1848. Then in 1853, Wood, of Edinburgh, discovered hypodermic injections by means of a hollow needle, which coupled with the advent of cocaine in 1855, gave local anesthesia a new impetus. However, it was thirty years later, in 1885, that Daleri$, of Paris, first used cocaine in obstetrics. This was a solution of ointment applied to the cervix and vulva. From this time to the present, local anesthesia has enjoyed a very slow rise in use and popularity in obstetrics, the present status of which will be discussed later.

OBSTETRICAL ANESTHESIA

General anesthesia is administered in labor in two distinct classes of cases: (8)

1. In operative obstetrics and painful maneuvers.

2. In normal labor to relieve pain.

In the first class of cases the use of anesthesia is similar to that in surgery. Deep anesthesia is the same in one as in the other and usually calls for considerable muscular relaxation. More important is the fact that two lives are at stake.

The second class calls for a special type of anesthesia, however, which for lack of a better term is called obstetrical anesthesia. The immediate goal of obstetrical anesthesia is to alleveate or annul suffering in labor without complete loss of consciousness, permitting the physician to remain in command of the patient's will, while the relations with the external world remain but little disturbed.

The urgency for relief of pain is in direct proportion to the severity of pain in the average individual. From the standpoint of the anesthetist, the duration of the period of labor, as well as the severity of the pain is an important factor in the choice of anesthetic agent or methods to be employed.

The physical condition of the patient is a most important factor in determining how the pain should be relieved, as certain conditions or diseases may contra-indicate the use of the agent or method that might otherwise be used; for example, in operative obstetrics the problem is easier than in normal labor because there is a wider choice of agents and methods, mainly for the reason that the duration of pain is shortened in the operative case whereas in normal labor the period of duration is uncertain.

The physiological basis of obstetrical 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 precesses 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 impressions 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 ad-
vanced period this internal or unconscious sensibility,
if the term may be used, is also abolished, the reflex
actionsddependent upon the medulla oblongata (respir-
ation and circulation) cease and life is extinguished.

The pharmacological properties of the several
available anestheticsaagents determine to a large extent
their usefulness in obstetrical procedures, during
which analgesia as well as anesthesia must be accom-
plished in controlling a variety of pains. The charac-
ter of respiration during anesthesia or analgesia in
obstetrical procedure does not interfere with the
progress of labor, as it may with operative procedures
in the upper part of the abdomen, so that the charac-
teristic quiet breathing, associated with the adminis-
tration of the agent,does not have the same significance
in the former as it does in the latter procedure. On
the other hand, relaxation comes in for considerable
consideration. In the first part of the labor, steady
relaxation, except of the cervix, produced by any
agent or method, is undesirable. Relaxation of the
uterus and patient between pains is desirable. However,
when the head is being delivered, it may be very

desirable to produce muscular relaxation and to inhibit labor for a few minutes to permit control of the presenting part on the perineum. The question of producing immediate or remote untoward results is twice as important as in general surgical practice because there are two types of patients to be considered. Each of them is quite different from the other in many respects as to ability to withstand the respiratory depression caused by anesthetic agents.

The obstetrician has divided labor into three main stages and the anesthetist can divide the pain of labor into three main phases.(9) However, just as the first stage of labor involves two mechanisms; namely, dilitation of the cervix and descent of the head, so is the first phase of pain of two distinct types, one of which is associated with dilitation of the cervix and the other with the descent of the head. The second stage of labor, consisting of the passage of the head through the perineum, is accompanied by the second phase of pain, and the third stage of labor, consisting of birth of the placenta, by the third phase of pain.

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.(10)
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 have, as yet not
(and probably will never be) the
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 obstetrical
analgesia on the part of the profession.(11) 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 to 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 skillfully.

The ideal obstetrical anesthesia should meet the following demands:(12)

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.

It must be remembered that the cardinal aim of an anesthetist is first, the preservation of life of his charges, and secondly, the relief of pain.

GENERAL ANESTHESIA

ETHER

Ether remains today the most commonly used anesthetic in both obstetrics and general surgery. The open drop method of administration is still used in hospitals for brief intervals of light anesthesia and is most popular outside the hospital in the hands of the general practitioner. In hospitals when surgical depth anesthesia is required, we find that the technique of administering ether is changing, the modern tendency being to avoid using ether alone. Rather, ether is used as an adjutant to nitrous oxide, oxygen, or ethylene-oxygen administered by means of rather complicated anesthesia machines.

Ether has considerable support because of its comparative safety in the average case and because ether can be administered in normal obstetrics by either trained or untrained assistants.(9) Moreover, ether produces a considerable degree of muscular relaxation which is a great aid in passage of the fetus through the birth canals(13), minimizing lacerations of the mother.

There are numerous factors which weigh against the use of ether, however, that should be carefully considered in each case, namely:

1. Ether has an unpleasant odor and taste and is

thus disagreeable to the patient.

2. Ether irritates the mother's respiratory
passages, as well as her kidneys, and may
lead to later complications. Two per cent
of all patients (14) have some form of pulmon-
ary complication after ether anesthesia, as
infections of the upper respiratory passages
find easy access to the lung in etherization.

3. Ether produces little analgesia, as the dose
to control pain produces an unconscious
patient. At the same time ether produces anes-
thesia slowly as compared with gas anesthesia.

4. Ether is second in toxicity only to chloroform.
This anesthesia depresses the child's respiratory
apparatus for one to two hours after admini-
stration to the mother, leading to difficult
resuscitation. (15)

5. If used in any quantity, as in a long labor,
ether tends to produce nausea and vomiting. (16)
This in turn leads to dehydration and intox-
ication of the patient. Thus it can be readily
seen that ether is not a desirable anesthesia
when used at length in obstetric procedures.

6. Ether is contraindicated in diabetes, renal
disorders, respiratory disorders, and pulmonary

conditions. (17) Here the anesthesia causes cumulative effects on the already pathological conditions.

Ether then, has its its disadvantages, but still may be widely used in obstetrics in the normal case which requires short anesthesia. Rayston (13) advocates the use of ether only in the second and third stages of labor. The anesthesia should be given only after the cervix is fully dilated, with the period of anesthesia falling in the last forty-five minutes of the delivery of the fetus and placenta. Here it seems the disadvantages of ether are minimized and a safe usage of this anesthetic is probable.

CHLOROFORM

Chloroform is still used throughout the world and entirely so in the tropics (18) in spite of the fact that it is our most toxic anesthetic.(19) America has slowly but surely condemned the use of chloroform in obstetrics, but this feeling is not universal. Danforth and Davis (20) came forth with the sincere statement that chloroform today has no place in obstetrical practice. Yet chloroform has its good points, in that the anesthetic produces swift anesthesia. That would be a boon to the obstetrician who is working alone and must himself administer the

anesthetic. Chloroform does not produce pharyngeal
or bronchial irritation (19), thus affording safety
to the patients with upper respiratory infections.
Again, chloroform has no unpleasant odor and is agree-
able to the patient. Usually, chloroform produces no
nausea and vomiting unless used over a long period of
anesthesia. Finally, chloroform produces a degree of
muscular relaxation that is favorable to all obstetrical
procedures and is certainly of some protection to the
mother in reducing the difficulties of delivery, as
well as possible lacerations. The use of chloroform
has been continued only due to the fact that the
actively practicing medical men have been content to
enjoy the advantages of chloroform and have evaded a
consideration of the points which stand against the
use of chloroform. Hewer (19), in a resume of critical
observations on chloroform, finds that the anesthetic
is six to eight times more potent than ether. Chloro-
form depresses the brain three times as much as ether
and likewise depresses the respiration three times as
much as ether. Furthermore, it acts as a depressant
twenty-five to thirty times as much as does ether.
Certainly these important factors indicate that chloro-
form is by far too dangerous an anesthetic to be used
in obstetrics where a trained anesthetist cannot always

be present. Even the accoucheur is, for the most part, too busy to give more than fleeting attention to his anesthetist, often leaving this duty to untrained hands. Parsons (21) feels that even the modern preparation of chloroform in capsules is not safe in the hands of an untrained anesthetist.

Chloroform is contraindicated (22) in diabetic patients, patients with liver or kidney damage, and patients suffering from toxemias of pregnancy. Autopsy has shown post-operative necrosis of the central portion of the liver lobule, plus parenchymatous changes in other organs. Such findings follow cases of chloroform poisoning (13), with symptoms of persistent vomiting, profound jaundice, and marked urinary findings. Death comes two or three days following the chloroform anesthesia. Striving first for the preservation of life, the physician should always remember the above paragraph and hesitate to use chloroform. There are other anesthetic agents to fill every demand for chloroform, and with two lives at stake no obstetrician should be willing to gamble these lives against a shorter, more pleasant, more relaxing anesthesia.

NITROUS OXIDE

Nitrous oxide anesthesia was introduced to obstetrical usage in 1915 (23) and as used in combination with oxygen has long ranked as the anesthetic of choice in obstetrics. Webster, Lynch, and Davis, who first used nitrous oxide-oxygen anesthesia felt that there were no contraindications to the use of this anesthetic as concerns toxemias, diabetes, or nephritis in the mother. In addition, these men found that the lowest fatal concentration of nitrous oxide was three times the concentration required for anesthesia, which was, to them, a greater margin of safety than any other anesthetic.

Certainly nitrous oxide-oxygen anesthesia has only slightly suffered through the findings of Brown, Lucas, and Henderson (24) that the anesthetic effect of nitrous oxide depends upon a depressing effect on medullary centers and thus the necessary presence of a certain degree of anoxemia in the patient. Macklin feels that this anoxemia is detrimental only in such conditions as toxic goitre, uncompensated heart lesions, pulmonary tuberculosis and pneumonia. (25)

Although nitrous oxide probably has some retarding effect on the pains of the first stage, (16) still this anesthesia can be used throughout the second stage

without causing any cessation of uterine contractions.
In fact, nitrous oxide has an oxytoxic action in the
second stage.(26) Keeping in mind the tendency to
produce anoximia in the patient which in turn would
by reflected in the child, nitrous oxide is usually
given first in the concentration of 90% nitrous oxide
and 10% oxygen. Given at the very beginning of the
pains, and then only for two or three breaths, the
concentration is rapidly cut down to a mixture of
50% nitrous oxide and 50% oxygen, and then to pure
oxygen for three breaths, after which the inhaler is
removed. This provides analgesia and at the same time
provides for sufficient oxygen for mother and baby.
Such anesthesia may be used over periods as long as
four to six hours at a time, without danger to the
mother or the fetus, danger signals being cyanosis,
loss of consciousness, and headache in the patient.
Naturally, as the second stage nears an end, the
anesthesia must be deepened for a few minutes.

Such anesthesia is highly praised as its use
through the second stage arrests the pain of the mother,
lessens chances for later complications, prevents
shock and exhaustion, and at the same time does not
slow down labor.(26) Doyle (27) feels that the arrest
of pain may even hasten the second stage as the

inhibition of voluntary effort caused by pain is
removed. His estimation is that labor in expulsion is
shortened 25%.

Nitrous oxide-oxygen anesthesia has added safety
in that this gas exerts no known deleterious effect
on the liver or kidneys.(16) Moreover, the elimination
of the gas is very rapid via the lungs and recovery
is swift and usually uncomplicated by nausea.

Unfortunately, nitrous oxide-oxygen anesthesia
at once intimates that perhaps some special apparatus
is needed for administration, and such is true. Today,
small portable machines are in use and tend to spread
the feasibility of use even wider than the previous
use only in hospitals. In the same trend, this
anesthesia in untrained hands becomes more dangerous
than either chloroform or ether.(16) (26)

Obstetricians also find fault with nitrous oxide-
oxygen anesthesia in that there is little muscular
relaxation obtained and thus its use is precluded in
many operations and manipulations.(28) The chance for
lacerations and tearing of the soft tissues of the
birth canal is enhanced and presents a serious problem
in numerous normal deliveries.

Advantage has been taken, however, of the good
qualities of this anesthesia in using it as an intro-

duction to ether anesthesia. Likewise, nitrous oxide-oxygen anesthesia used sparingly is valuable when combined with local or regional anesthesia. Certainly this anesthesia used transiently during labor in the hands of the skilled anesthetist is comparatively safe and pleasant to the patient.

ETHYLENE

Ethylene is used as an anesthetic similarly to nitrous oxide, and although used extensively only since 1923,(29) there are many who feel that this anesthesia is superior to all others for routine obstetrical demands.

The induction time with this anesthesia is slightly shorter than that of nitrous oxide-oxygen anesthesia, with the early production of a state of analgesia in which there is a satisfactory degree of supression of consciousness and of reflexes with scarcely any effects on the other functions. This condition is produced with a higher concentration of oxygen being used, (about 20%), so there is no anoxemia. In addition, the patient may be carried through the second stage of labor with a concentration of 50% ethylene-50% oxygen which definitely prevents anoxemia of mother or child.

As in nitrous oxide-oxygen, there is no irritation of lungs orkidneys, the induction is pleasant, and the

recovery swift and only occasionally accompanied by nausea. In addition, ethylene produces much more muscular relaxation than is afforded by nitrous oxide-oxygen and approaches that of ether anesthesia.

The chief disadvantage of ethylene comes in that the gas is highly explosive when mixed with gas or air, and is inflammable in the pure state.(30) The upper and lower limits of explosive mixtures are 3.5% to 28.5% in air and with oxygen, 3.1% to 79.9%. In America there have been ten explosions in 332,721 administrations of ethylene.(31) Thus it is unsafe to use this gas with any form of cautery and each case should have the anesthesia machine, table, and patient wired to prevent the production of a spark. Moreover, by keeping the humidity of the room above 56 degrees by means of a humidifier, inflammability is done away with. Nevertheless, Griffiths (15) feels that this anesthetic remains too dangerous for routine use in obstetrics, despite the evident advantages over ether and nitrous oxide. DeLee (32) uses ethylene in preference to nitrous oxide-oxygen and starts the inhalations towards the end of the first stage of labor, when the cervix is at least 7 cm. dilated and 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, does not change color
or show cyanosis, respirations are but slightly de-
pressed, and secretions are not increased.(33) As the
second stage pains grow stronger, the percentages of the
two gases are changed--60 and 40, 80 and 20, 90 and 10,
but never pure ethylene. As soon as the head is born,
the administration is stopped, to be resumed only if
repairs are to be made. The mother shows no ill effects
and the baby shows no asphyxia unless the analgesia
has been continued for several hours. Moreover, the
uterus contracts well after labor, and there is only
slightly more bleeding than in nitrous oxide-oxygen
anesthesia.(13)

Again a very good but dangerous anesthesia for
obstetrics has been presented with only a limited
following in this country. Perhaps use of this anes-
thetic routinely with a staff carefully trained to-
wards safety, such as DeLee has advocated, would see
greater use of this anesthetic. Unfortunately, the
average pratictioner could not hope to maintain proper
conditions for the use of this anesthetic.

CYCLOPROPANE

Cyclopropane is the latest inhalation anesthetic to be introduced to the practice of obstetrics, although its use has not been general.

Cyclopropane is capable of producing narcosis in concentrations as low as 4% administered along with oxygen.(19) 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.(34) 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 anesthetic 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.(35) Post-operative complications compare very favorably with ethylene and ether. The blood

pressure, pulse, and respiratory rates are lowered
somewhat,(36) and there is no liver damage demonstrable
after the use of cyclopropane.

After a years study Walters and his collaborators
of the University of Wisconsin have found that cyclo-
propane in much lower concentrations is equal in (34)
efficiency to other gaseous anesthetics and that an
excess of oxygen may be administered with this potent
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, and the patient
retains a pink, healthy color. Used with oxygen within
ordinary anesthetic limits it is not explosive or just
mildly so.

Bournes (37) 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
in 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 its.
We all know that it is good to administer oxygen
intermittently, --good for the mother and good for the
baby, especially should the heart of the latter be
weak. The use of oxygen in obstetrics is very impor-
tant. 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 abundance of oxygen is given with cyclopropane.

2. Circulation and respiration are not depressed.

3. Anesthesia is produced without appreciable
    metabolic disturbance.

4. Liver and kidney function are not impaired.

5. Anesthesia is quickly and agreeably induced,
    satisfactorily maintained at any desired depth,

with ready flexibility and with minimum
danger to the mother and child, and recovered
from easily and uneventfully.

Thus the only objection to the use of cyclopropane
in obstetrics would be its explosive tendencies, and
the required presence of a machine for administration.
Undoubtedly this means of analgesia and anesthesia
will find more extensive use in our country and abroad
as time goes by. Certainly, according to all indications,
here is a very favorable anesthesia for obstetrics.

VINYL ETHER

Vinyl ether is another anesthetic that has been
recently brought into use, although it is comparatively
in its experimental stage.

Riugh and Major (38) feel that vinyl ether pro-
duces anesthesia much more easily than ether; that there
is a lessened excitement stage with less mucous secre-
tions;(39) that recovery takes place more quickly
than with ether; that nausea and vomiting are at a
minimum, and that there are no significant pathological
effects on the various organs.

The success in the obstetrical field is due to the
rapidity with which an anesthetic state can be reached
when vinyl ether is inhaled,(37) the promptness of
recovery, the negative effect on uterine contractions,

and the comparative safety. Due to its volatility, a closed apparatus is preferred to avoid waste, yet this anesthetic may be very readily used via the open drop method, thus lending itself to the use of the physician who must practice obstetrics outside of the hospital.

Unfortunately, vinyl ether produces anesthesia in only a few inhalations,(40) and thus provides no analgesia which might be used during the second stage before actual delivery. Experiments have shown this anesthetic to be four times as strong as ether which accounts for this swift induction, and a discouraging note arises from England where Shipway (41) reports two deaths from liver necrosis following use of this agent, suggested by the fact that tests have shown a very slight impairment of the liver function (bromsulphalein dye test) following the administration of this anesthetic.(42)

With this warning of impending liver damage, vinyl ether should be reserved for reinforcing nitrous oxide-oxygen anesthesia when chloroform and ether are not suitable. Its continued use in obstetrics would undoubtedly show evidence of maternal mortality which violates our rule of preservation of life.

In addition to the six means of inhalation

anesthesia just discussed, ethyl chloride, acetylene,
and propylene have been used as general anesthetics,
but their use in obstetrics is so limited that a worth-
while discussion regarding them should not be attempted.
EVIPAL

The anesthesia by means of intravenous evipal
or evipan sodium has recently come into considerable
use with its advocates being highly enthusiastic,
holding as the goal of perfect anesthesia the follow-
ing qualifications:

1. Safe.

2. Acts quickly.

3. Terminates quickly and pleasantly in thirty-
   five to fifty-five minutes.

4. Produces complete amnesia.

5. Allows adequate relaxation immediately.

6. Easily administered.

7. No dangerous sequelae.

Findlay and Findlay (43) feel that evipal meets
these requirements in every respect and is the perfect
anesthetic thus far known. Careful investigation has
shown the above support of evipal to be largely true;
but, as usual, this anesthetic is not fool proof and
not without its dangers.

Although the ratio of the minimum lethal dose to

the anesthetic dose has been found to be between three
and four to one,(44) there have been reported four deaths
in a large series of cases.(45) Study has thus shown
that this anesthetic is dangerous in cases of debil-
itated patients, patients with liver or kidney damage,
and patients with marked sepsis, such as empyema,
cellulitis, peritonitis, or septicemia. In such cases,
the drug must be administered very slowly, taking care
to keep the dosage low.

The study of the use of this anesthetic in
obstetrics is made difficult by the scarcity of liter-
ature regarding this subject. Although foreign oper-
ators have reported its use in several instances, the
American profession has been slow to use evipal in
obstetrics.

Kassebohm and Schreiber (46) did report a series
of cases in which the anesthesia was used in operative
deliveries and also in spontaneous deliveries. In
each instance the anesthetic was satisfactory, with
forceps deliveries, packing of uterus and vagina, and
manual removal of placenta carried out successfully.
The anesthetic was not satisfactory in cases of
attempted version, for continued uterine contractions
and unaltered irritability of the uterine musculature
made version impossible. In spontaneous diliveries

this was of value only at the end of the second stage
and produced no effects on the fetus. The intravenous
anesthetic was most satisfactory if combined with gas-
oxygen analgesia during the second stage. Needless to
say, episiotomy and repair are very successfully done
under this anesthetic.

With the use of the drug limited to shorter pro-
cedures, due to its inability to produce a long safe
period of analgesia, there is no reason for a general
use of this anesthetic in obstetrics. Certainly, the
cases should be carefully picked, and continued use of
the anesthetic may develop further contraindications
to its use. With two lives at stake, the obstetrician
does not dare to experiment with relatively unknown
and uncertain types of anesthesia.

LOCAL ANESTHESIA

When the subject of infiltration or nerve block local anesthesia is considered, there seems to be both apathy on the part of obstetricians in their daily practice and a paucity of articles in the literature. J. W. Williams (47) in his text in the sixth edition states that he has had no experience with the use of such anesthesia in obstetrics. J. L. Baer (48) says in speaking of the conduct of normal labor,"Infiltration anesthesia of the cervix and perineal body has not won general approbation and is not to be recommended." R. M. Tovell (49) says,"Sacral block is to be generally preferred over less precise and less satisfactory methods such as infiltration of the perineum or nerve block of the inferior pudendal and inferior hemorrhoidal nerve." J. B. DeLee (32) is more enthusiastic about the use of local anesthesia. In the sixth edition of his textbook he says, "Whenever in obstetrics, as in surgery, it is possible to operate under local novocaine infiltration or nerve blocking, this should be done, since unquestionably the dangers are more than halved by the avoidance of general anesthesia." In the Chicago Lying-In Hospital, in the home service of the Chicago Maternity Center, central episiotomy and repairs are usually done under 'local.'

In 1916, R. W. King (50) in an excellent paper,
to which little attention seems to have been paid,
said, "While marked advancement has been made in the
realm of anesthesia, as applied to the local and general
blocking of the sensory nerves of the various parts of
the body, it is strange that so little attention has
been paid to applying these methods in the sensory
innervation of the female perineum. The literature of
this subject is remarkable because of its scarcity;
the subject apparently has not engaged the attention
of American investigators, and practically the only
work of importance that has come to my notice has been
carried on in Germany."

Such statements accurately reflect the present
attitude of the American medical profession as a whole.
The past twenty years have found only a few men who
had used this form of obstetrical anesthesia and had
entered their findings in the literature. The results
have been uniformly successful, yet no impression has
been made upon the obstetricians and there has been
little tendency for them to attempt this mode of
anesthesia. Why this restraint? The American profession
has long followed the innovations of the foreign author-
ities, and the new procedures which have been tried
and successfully tested in Europe are brought to America

and put into use more or less generally in a short
time. American operators pride themselves on their
technical ability and yet here is a procedure simple
enough, which has not been practiced to any extent.
All in all, there can be found no plausible and con-
crete evidences why the American obstetricians have
not more generally used local anesthesia in obstetrics.
This section is dedicated to a simple consideration
of the problem from every standpoint, with a final
attempt to determine the practicality and plausibility
of such anesthesia.

A brief consideration of the drugs employed in
local anesthesia is of importance here. While much
energy has been expended in the search for a drug
that is both efficient and safe for the production of
local anesthesia, none yet discovered meets all
requirements. Novocaine has thus far most nearly suited
the demands of the general surgeon, and is safe and
efficient within the limits required for local anes-
thesia. Cocaine, pontocaine, nupercaine, and metycaine
are the other leading drugs in use in local anesthesia
which will be considered representative in this
discussion.

Cocaine,(51) although the first local anesthetic
of any import, is now limited to surface anesthesia,

and is never injected into the body by modern surgeons. Recognized because of its powerful action, cocaine is now used as a standard on which is based the comparative classification of the strength of other local anesthetics.

Novocaine (procaine) is as efficient as cocaine when injected and much safer. It has a toxicity seven times less than cocaine and few persons possess a susceptibility to this drug. Injected locally this drug produces immediate local anesthesia with practically no irritation and produces a comparatively bloodless operative field. Injected in to a nerve, the anesthesia is instantaneous, while injections in the region of a nerve require fifteen to twenty minutes for anesthesia. If novocaine is used alone, the effects begin to disappear in about fifteen minutes. If used with a vaso-constrictor drug, the anesthesia is prolonged for one to three hours. The strength of the solution to be used may be either ½ or 1%, with a total dosage of 1 to 1,25 gms. considered the maximum safe dosage.

Nupercaine (percaine) differs from the cocaine-novocaine group in that it is a quinoline derivative. First used in 1929,(19) it was found that nupercaine was twenty-five times as toxic as novocaine, but this

was more than counterbalanced by the fact that its
minimal effective concentration is about one-fortieth
that of novocaine. The minimal reported lethal dose
is about 90 mg.(52), although individuals have survived
the administration of 750 mg. and 1500 mg. The result-
ant anesthesia always lasts ninety minutes and lasts
as long as six to eight hours if used with a vaso-
constrictor, thus definitely reducing the after-pain
of surgery. The usual dosage of nupercaine is 60 cc.
of 1:1000 solution.

Pontocaine is similar in effect to novocaine and
nupercaine, and it is just about midway between the
two as regards toxicity and length of anesthesia.(53)
The dosage is 150 mg. to 200 mg.

Metycaine, or neothesin compares closely with
novocaine, being about the same in toxicity when
injected subcutaneously, but from two to four times
as toxic when injected intravenously.(54) The anes-
thesia lasts about one-fourth to one-half longer than
novocaine. The maximum safe dosage is 200 mg. or
slightly above.

It has already been noted that all the local
anesthetics except cocaine cause vaso-dilitation.(55)
It is customary, therefore, to incorporate a vaso-con-

strictor in all solutions used for infiltration and field blocking. The advantages then secured are:(56)

1. A relatively ischaemic field.

2. A more prolonged effect of the analgesic drug due to its delayed escape from the injected area.

3. Diminished toxic effects from the drug owing to its slower absorption.

The vaso-constrictor drugs used commonly are adrenaline, epinine, and cobefrin.(19) Adrenaline is most commonly used in a final dilution of 1:200,000 for infiltration. This solution is unstable and cannot be resterilized by boiling. Moreover, the drug may cause severe tachycardia in patients suffering from toxic goitre, and also causes sudden collapse with fall of blood pressure in patients who are adrenaline sensative.

Epinine is a synthetic product with an action similar to that of adrenaline. It is rather more stable than the latter substance and is used in about ten times the strength.

Cobefrin is also chemically related to adrenaline, is used in about ten times its strength, and does not produce collapse in adrenaline sensative patients.

The extended use of local anesthetics has forced

the question of toxicity to the front and it is now
realized that these drugs and methods have their dangers
just as in general anesthesia. It must be remembered
that local anesthetics are protoplasmic poisons possess-
ing special affinity for nerve tissue (55), the sensory
fibers being affected before the motor fibers, with
the unmyelinated nerve fibers and then the smallest to
larger myelinated nerve fibers being anesthetized.
Thus the anesthetized area loses first vaso-constriction,
then temperature, pain, touch, and lastly, joint and
pressure sense.

In the usual process where a vaso-constrictor is
used, the drug remains in the tissues locally long
enough to be partially destroyed, with the liver and
kidneys completing this breakdown,(56) thus preventing
the drug from acting generally on the nerve fibers of
the central nervous system.

Cases of toxic reaction to local anesthetics can
be divided into three main groups. First is overdose.
This is rare as the universal adoption of novocaine
and nupercaine has provided a fairly wide margin of
safety, and overdosage in adults is rare although by
no means unknown. The toxic symptoms produced by over-
dosage of local anesthetics are excitement, restlessness,
rapid and feeble pulse, and later followed by uncon-

sciousness, convulsions, and death.(57)

Secondly, normal dosage in a susceptible patient as an allergic factor is a real problem, although cases are rare. One must guard against such a possibility by a careful investigation of the patient's history of reaction to drugs, and further safety is provided by locally testing the first injection.(58) A small wheal in these cases will almost immediately turn bright red. People sensitive to local anesthetics may have: 1. General ill health; 2. Low blood pressure; 3. Anemia; 4. Defective liver and kidney function; and 5.Allergy.(59)

Thirdly, inadvertent intravenous injection is the most reasonable explanation of the tragic cases of sudden collapse and death.(60) It has been estimated that the intravenous lethal dose of a local anesthetic is about one-tenth of its subcutaneous lethal dose.(56) The direct injection of the drug into the blood stream does not allow for local changes and there are immediate depressing effects on the respiratory and circulatory systems, with the action on the cerebrospinal centers producing convulsions. The adrenaline present undoubtedly increases the liability to cardiac failure and it has been suggested in such cases that the actual cause of death is ventricular fibrillation.(61)

Local toxic reaction may result from the use of an excessive amount of adrenaline with resulting vaso-motor or trophic disturbances. Extensive sloughing may follow local anesthesia in debilitated patients (62) and may even produce fatal results.(63)

The toxic effects as affecting the fetus have not received attention, for the simple reason that no cases have been reported in which the fetus has been harmed through use of local anesthesia during labor.

The treatment of any toxic reaction to local anesthetics is initiated by the use of barbiturates in the preliminary medication during the first stage of labor. Barbiturates are specific drugs to prevent such reactions, and their use raises the minimum lethal dose of local anesthetics considerably. (55) Sodium amytal is especially effective in this role. In the active treatment of such toxic reactions it is also well to remember that the more toxic barbiturates have swifter actions in treatment of the condition brought on by the local anesthetics. Thus dial and nembutal are advised in heavy dosage in toxic reactions.(64)

Novocaine, nupercaine, pontocaine, and metycaine are easily prepared, as their respective crystals are readily soluble in water and, if sterilized by boiling, remain stable. Clark has found that if the anesthetic (65)

solutions are alkaline, the induction period of the
anesthetic is reduced 600%, while the toxicity is
reduced 50%. Resolution is also more rapid in the
field of operation. Novocaine as ordinarily prepared
has a pH value of 5.5, while that of novocaine borate
is 8.4. Experiments show that values of 7.4 to 8.4
have the above advantages, with the only possible
disadvantage being a twenty-five per cent reduction of
duration of surgical anesthesia. Tennent stresses the
fact that solutions of local anesthetics should
always be freshly prepared, thus guarding against
deterioration , and at the same time providing a good
check on the contents and strength of the anesthetic.(66)

With the use of local anesthesia during the late
second stage, it is advisable to use analgesic prepar-
ations to lessen the pain of the first stage. The
natural question of resulting depression affecting the
fetus is quite in order, but it is felt that the small
doses of analgesic required here are never sufficient to
affect either the child or the mother. The purpose here
is to quiet the mother somewhat and allay her fears.
The pains of the first stage are in most cases not severe
enough to cause any great distress.

Analgesics are used according to each authors fancy,
with nembutal, morphine and scopolamine, and pentobarbital

being the most popular. Greenhill (67) feels that
morphine,gr.$\frac{1}{4}$, and scopolamine, gr.1/200, have no
effect on the child whatsoever if the delivery is made
within two hours after the injection of these drugs.
In his experience, deliveries three and four hours
after use of these drugs are apt to find fetal respir-
atory depression. Rose (68) uses intradermal infil-
tration during the first stage to relieve pain. With
the abdomen cleansed with soap and water and then
painted with 2 to 4% mercurochrome, he infiltrated
three areas. The first is a longitudinal area, or
more truly, a line which extends almost from the height
of the fundus down to just above the umbilicus. The
second, on the right side, starts about an inch medial
to the anterior superior spine and, conforming to the
contour of the uterine corpus and overlying the
inguinal ligament, curves medially and downward, ter-
minating in the midline over the symphysis. The third
area is a similar line on the other side meeting the
end of the second line. These latter lines as they
approach the symphysis should run along its superior
margin. His success in this procedure has been remark-
able, analgesia lasting over three hours.

The time to begin the infiltration during the
second stage is naturally variable, with different

authors using different methods of choosing the moment
when injection should begin. Rose begins infiltration
in the primipara when the os is fully dilated and the
cervix is completely taken up; in the multipara, the
same or when there is still a slight rim of cervix left.
Ditter (69) waits until the head or buttock advancing
on the perineum begins to open the anal orifice.
Torland (70) feels that the obstetrician can differen-
tiate between first stage pains and real bearing-down
pains when the head begins forcing its way through the
pelvic floor. Thus he begins his local infiltration
when the patient begins having her more severe second
stage pains.

Local anesthesia may be used to relieve the pain
of labor according to several techniques, with the most
popular being perineal infiltration. This technique,
as advocated by Torland and King and described by
Walker (71) is a combination of nerve block and infil-
tration. The instruments necessary consist of a Luer
Lok syringe of 10 cc. capacity, two local anesthetic
needles of about 19 guage, and novocaine,1%solution, 40cc.
With the patient in the lithotomy position, the skin of
the perineum and vulva is prepared by scrubbing with
neutral soap and water, and douched off with either a
weak iodine solution or merthiolate solutions. No

other antiseptic solution or application is used as
reliance is placed in thorough use of soap and water.
Before the patient is draped, the surgeon puts on a
pair of sterile gloves which are used for the admini-
stration of the local anesthetic, and then changes to
a fresh pair for the delivery. At a point 2 cm. above
the posterior border of the vaginal outlet and 2 cm.
medial the pubic ramus, the needle, attached to a syringe
containing 1% novocaine solution is inserted until it
pierces the fascia at a depth of about 3 or 4 cm. The
percing of Colles fascia transmits about the same
sensation to the operator as does the piercing of the
arachnoid in performing spinal block. In this situation
5 cc. of anesthetic solution are injected. The same
procedure is carried out on the opposite side. This
injection serves to block the fibers of the pubic nerve
which supply the skin over that area and also the labia
and clitoris. There is also some blocking of the fibers
of the genito-crural which supplies this same area and
are to be found at the same level under Colles fascia.
At a point midway between the ischial tuberosities and
the anus, the needle is again inserted at an angle so
that the point of the needle impinges on the tuber-
osity. It is then withdrawn a short distance and
reintroduced about 1 cm. medial and about 2 cm. deep

to the tuberosity. At this point 10 cc. of 1% novocaine
are introduced, the last 3 or 4 cc. being introduced
after the needle has been withdrawn 1 or 2 cm. A
like injection is carried out on the opposite side,
this injection serving to block the larger branches of
the inferior pudic nerve as it emerges from behind the
gluteus muscle. These nerve branches are superior
perineal, inferior hemorrhoidal, and dorsal nerve to
the clitoris, all of which branch from the inferior
pudic in this region and lie in a plane just deep to
the ischial tuberosity and between it and the anus.
Inasmuch as the operative activity is concentrated in
the perineum and due to the fact that, unless contra-
indicated, there is done routinely a medial episiotomy,
about 10 cc. of novocaine are infiltrated into the
perineum in the median line and well into the vaginal
mucosa. In a short time, usually about five minutes,
anesthesia is effective so that the patients usually
state that they feel numb and have lost the severe
pain which accompanies the attempts at expulsion with
fetal head on or near the pelvic floor. In the great
majority of cases, good anesthesia is evidenced by
relaxation of the pelvic floor and loss of pain,
although tactile sensation is not altogether abolished.
With the onset of good anesthesia any necessary procedure

for the delivery of the baby may be carried out.
Episiotomy and repair, manual rotation of the persistent
occipito-posterior head, Scanzoni maneuver, and all of
the low and midforceps deliveries have been satisfactorily
performed under this anesthesia.

Ditter enlarges upon this technique for the second
set of injections by inserting his index finger into
the vagina and directing it to the ischial tuberosity
which will act as his landmark. Keep the tip of the
finger at this point as it marks the approximate
position of the pudendal nerve.

Ditter also warns of the precaution to retract the
plunger of the syringe before injecting to make sure
that none of the solution is injected directly into
the blood stream. Due to the abundance of the blood
vessels in this region it will be an easy mistake to
make. While an effort should be made to block the
pudendal nerve, one cannot always be certain of success,
so it is suggested that an effort be made to block off
all the branches by fanning out the novocaine solution
in a horizontal direction. Usually 30 to 40 cc. of
solution is sufficient on each side in this procedure.

Greenhill (72) also advocated the injection of
anesthetic solution along the edges of the labii majora
and across the fourchette, as well as in the layer

between the vaginal wall and the rectum, not only in
the midline, but also well out to the sides in the
shape of a fan. This author tends to use more of a
general infiltration with no attempt at specific nerve
block to accomplish his purpose, using from 60 to 70 cc.
of anesthetic solution on each side.

Indications (73) for the use of local anesthesia
in obstetrics, as in major surgery, have long been
thought to include cases in which there is some contra-
indication to general anesthetics. Therefore, individ-
uals with cardiac or renal disease, pulmonary compli-
cations, severe diabetes, toxic goitre, marked anemia,
and toxemia of pregnancy are those especially chosen
for this type of anesthesia. Greenhill (74), however,
assails this view in that he feels this practice is
limiting the use of local anesthesia to too great an
extent. His belief is that it is not a wild prophecy
to believe that the time will come when, instead of
saying, "Local anesthesia should be used when general
anesthesia is contraindicated", one will say,"Inhalation
or spinal anesthesia should be employed only when infil-
tration anesthesia cannot be used." The increased use
of local anesthesia in normal obstetrics indicates there
is the growing realization in obstetricians that here
is perhaps the ideal obstetrical anesthesia for the

routine practice.

Results in the use of this means of obstetrical anesthesia have been almost uniformly successful. O'Connor (75) bests describes the results obtained when he says that after the method has been used twenty-five or thirty times by an individual, the nerve block is perfect in nearly every case in thin or normal women. In stout patients, it has been his observation that occasional partial failures result. Even in these, the amount of general anesthesia required is less than ordinarily used and this is advantageous.

The length of anesthesia obtained naturally varies with the drug used.(75) Novocaine will dependably give anesthesia for a period of forty-five minutes to an hour, with a longer duration very often the case. Abdurel and Reist state that they obtain an anesthesia lasting four or five hours with 1:1000 or 1:2000 nupercaine solution. Realizing the extreme vascularity of the tissues involved, a vaso-constrictor drug is used as previously described.

Infection is always a possibility in such cases where injections are made. Episiotomy further makes possible the chance of infection. However, the greater vascularity of the tissues reduces this factor it a mimimum and in cases reported there is no record of

an infection due to the infiltration. King, in 1916, one of the pioneers of this method, did get slight superficial necrosis at the sites of injection due to the use of too strong an adrenaline solution. Since his first efforts, this point has been corrected and he no longer has this trouble.

One may briefly record the advantages of local infiltration anesthesia as being: (76)

1. There is no mortality due to this method as has been reported in obstetrical cases.

2. There are no pulmonary complications directly attributable to this procedure. One of the chief reasons for the absence of these complications is the fact that the lungs are well aerated not only during delivery but afterward. Frey reports a series of 281 cesarian sections performed under direct infiltration anesthesia without the occurrence of pneumonia in a single instance, whereas in the 72 cases in his series in which general anesthesia was used, five patients developed pneumonia. Greenhill has performed 111cervical cesarian sections under direct infiltration anesthesia without the occurrence of post-operative pneumonia or a fatality.

Two women in his series did develop pneumonia
after ether anesthesia, both recovering.

3. There are no local or general complications.
    An old needle might break, the injection might
    be made into a vein, or the patient might have
    an idiosyncrasy to the drug used, but each of
    these factors is guarded against by the pre-
    liminary investigation and preparation for
    delivery.

4. The technique is simple and may be employed in
    the home as well as in the hospital.

5. There is no harmful effect on such vital organs
    as the liver, lungs, heart, circulatory appa-
    ratus, and central nervous system.

6. No special knowledge is required and the phy-
    sician is not dependent upon a second individual
    as anesthetist.

7. No special after care is required, as is
    necessary after general or spinal anesthesia.

8. There is a striking reduction of bleeding in
    episiotomy so that the amount of blood lost
    is negligible.

9. There is no interference with the action of the
    uterus, of the abdominal walls, or of respiration.

10. Gastro-intestinal symptoms after operation are

uncommon

11. Patients may take liquids and carbohydrates before, during, and after the procedure.

12. There is no need to hurry through a procedure; hence more time can be paid to proper suturing of episiotomy wounds.

13. The tissues must be handled gently; this is advantageous to the patient in recovery.

14. There is less wound infection, owing to diminished local trauma and to the fact that the patients general resistance has not been lowered.

15. The fear of having general anesthesia is eliminated.

16. Routinely perfect relaxation is obtained at the outlet.

The disadvantages of infiltration anesthesia in obstetrics are: (77)

1. Infiltration anesthesia cannot be used if the site at which the solution must be injected is infected or inflammed; a condition rarely seen in obstetrics.

2. This form of anesthesia should not be attempted in a woman who is exceedingly high strung and has an almost morbid fear when she is told

that her delivery will be performed under
local anesthesia. Fortunately, there are
only few women of this type.

The number of women, as just described, can still
further be reduced by properly preparing patients for this
form of anesthesia. After all, local anesthesia is a
relatively new procedure and patients believe that
they will see their delivery performed; that they will
hear all that goes on in the operating room, and that
they will experience much pain. A proper preparatory
talk on the part of the operator is essential. The
patient should be promised that her eyes will be covered
so that she will not see anything around her; that the
conversation she will hear will not be gruesome and
disagreeable; that the rattle of instruments and pans
will be reduced to a minimum; and, above all, that, if
she feels too much pain and desires it, a general anes-
thetic will be administered to her. The operator should
live up to his promises all the way through the delivery
or the patient may lose confidence, become excited, and
demand a general anesthetic.

Local anesthesia has been used in abdominal cesarian
sections for years. Webster's (78) first operation of
this kind took place as early as 1909 and Traugott
published a series of twelve cases in 1914. The

abdominal incision is rendered painless either by
infiltrating the abdominal walls in successive layers
along the line of the proposed incision, or by injecting
into the tissues around the incision in the form of an
ellipse.(79) The uterus itself possesses no sensibility
and may be incised and emptied of its contents without
causing discomfort; but any pull or pressure on the
parietal peritoneum produces more or less pain. It
follows then, that any method in which the uterus is
left in situ is better suited for local anesthesia than
the classical cesarian section with evantration of the
organ. Since cervical cesarian section is constantly
gaining in favor among progressive obstetricians, this
field is very promising for local anesthesia. Irving (80),
Trout (81), Roes (82), and DeLee (83) have obtained
very satisfactory results with this method and leave
no doubt as to its feasibility.

SPINAL ANESTHESIA

Spinal anesthesia, or lumbar anesthesia, produced
by injecting a local anesthetic into the sub-arachnoid
space of the spinal canal, has been used more or less
constantly since the discovery of novocaine in 1904
gave this method of anesthesia naewimpetus.

When a local anesthetic agent is injected into
the cavity of the spinal arachnoid, it affects the

nerve roots with which it comes in contact by narco-
tizing them. The most marked effect is upon the sensory
roots in the immediate region of the injection.(84)
However, the anterior motor roots and sympathetic fibers
are also affected. The posterior roots are affected by
the loss of pain, tactile, temperature, and muscle
sense in the involved segments, while the anterior roots
are affected by the loss of voluntary movement, paralysis,
muscular relaxation, and absence of superficial and
deep reflexes. The sympathetic fibers are affected by
causing a vaso-motor palsy, varying with the number of
rami affected. When all the white rami from the second
dorsal to the second lumbar are blocked there is com-
plete vasomotor relaxation of the entire body. If the
head and shoulders are raised with complete vasomotor
palsy, the patient becomes pulseless and unconscious
from cerebral anemia. (85)

Under spinal anesthesia the contractions of the
heart become slower and weaker from the interruption of
cardio-augmentor nerves, diminished vis a tergo, and
unopposed action of the inhibiting vagus. The correspon-
ding drop in blood pressure may vary from 0 to 70 mm. of
mercury, depending on the heighth of the anesthesia.(86)
Transient nausea and vomiting are produced in from five
to fifteen minutes following the injection of the

anesthetic, and corresponds to the maximal drop in
blood pressure.(85)

Respiration under spinal anesthesia is quiet, slow,
of small amplitude, and largely diaphragmatic, from
paralysis of the abdominal and thoracic muscles. (87)
Respiratory failure occurs if the level of anesthesia
rises too high and affects the phrenic nerves or if the
respiratory center is directly affected by the drug in
the blood stream.

There is an increase in peristalsis with strong
gastric and intestinal contractions occurring, accom-
panied by incontinence of the anal sphincters. At
the same time, the uterus in labor continues active,
forcible contractions, thus reducing hemorrhage during
labor and acting for swifter delivery. (88)

The intensity and duration of anesthesia varies
directly with the dose and concentration in the spinal
fluid. (89) The nerve roots first reached by the anes-
thetic are affected most intensely and for the longest
time. Therefore, the injection is made in the lower
lumbar segments for normal or operative deliveries.
The drug used will also vary the length of anesthesia,
as novocaine has been surpassed by the three hour anes-
thesia produced by pontocaine and nupercaine.(87)
Although more toxic, these drugs may still be used in

smaller doses which offset their toxicity.

The heighth of anesthesia from a given dose of local anesthetic varies according to the position in which the patient is injected and the specific gravity of the solution used, the anesthetic having been injected in a given interspace. (90) The level also varies with the force of the injection, the amount of fluid withdrawn, and the decompression of the dura. (91) The lateral recumbent position is preferred to the sitting position because in the former the dural sac has no obstruction which may arise from the varying lumbosacral curves seen in the latter position. (92) Moreover, the spread of the fluid injected is diminished by the lateral recumbent position. By regulation of the specific gravity of the anesthetic, spread to upper or lower levels of the cord may be gained at will. The patient should lie still for ten to fifteen minutes following injection with the body level so as to permit the fixation of the anesthetic at the level desired. Naturally, forcible injection produces a wider spread of the anesthesia, as does the injection of large amounts of anesthetic.

There has been much discussion and disagreement concerning the diffusibility of spinal anesthetic agents upward in the spinal canal and causing death through affecting the vital centers. Labat (93) says, "The

assumption that the anesthetic agent diffuses to the
brain and is the cause of respiratory failure is based
neither on chemical or laboratory findings but is due
to vasomotor paralysis causing cerebral anemia."
Circulation of the spinal fluid from cranial cavity to
the spine and out to the venous system at nearly all
levels is also a factor against upward diffusion.
Pitkin (90) has proven that solutions remain at the
site of injection by tapping the spinal canal with
needles at various intervals afterwards. Pitkin has
also found that unless an excessive dose has been used,
the drug becomes fixed in the first ten minutes follow-
ing injection and thus prevents further diffusion.

The evident advantages of spinal anesthesia in
obstetrics are: (94)

1. This anesthesia may be used in patients with
   pulmonary tuberculosis and upper respiratory
   infections.

2. It removes the dread so many patients have of
   going to sleep during delivery.

3. There is comparative freedom from post-
   operative vomiting.

4. Relaxation of the perineum is quite adequate.

5. There is a minimal general reaction to the
   anesthesia with absence of any effect on the

kidneys, liver, or respiratory passages.

6. The fall in blood pressure aids in reducing hemorrhage post-partum.

7. There is no excitement stage of anesthesia.

8. The anesthesia is economical.

A careful consideration of the disadvantages of spinal anesthesia in obstetrics is warranted with the above advantages. The disadvantages are:

1. There is a definite mortality. Generally, the death occurs shortly after the injection and is attributed to respiratory paralysis or fall in blood pressure. Cooke (95) says that spinal anesthesia "is apparently, as judged by mortality rates, more dangerous than general anesthesia." Bower, Clarke, and Burns say: (96)"Spinal anesthesia is responsible for more deaths than any other anesthetic in proportion to the number administered---Undoubtedly many deaths have occurred from spinal anesthesia which have been attributed to other causes." Pregnant women are especially susceptible to complications after spinal anesthesia. DeLee knows of seventeen deaths in obstetrics (97) from spinal anesthesia, while other authors (98) likewise report deaths during delivery under

under spinal anesthesia, with the anesthesia
the contributing factor in the death.

2. The incidence of pulmonary complications is
at least just as high as after inhalation
anesthesia. In fact, Brown and Debenham (99)
found that pulmonary complications, especially
atelectasis, occurred 4.29 times more commonly
after spinal than after inhalation anesthesia.
This is attributed to inhibition of respiratory
movements over a long period of time; secretions
of the tracheo-bronchial tree are more viscous,
and the patient remains quiet longer after a
spinal anesthesia.

3. There is a definite toxic effect on the spinal
cord and spinal nerve roots which is manifested
both clinically and pathologically. (100)
Observations show varying degrees of inflam-
mation in the leptomeninges; changes in the
ganglion cells of the gray matter of the cord;
swelling and fragmentation of the axis cylin-
ders, and signs of degeneration in the fiber
tracts of the cord. Koster and Kosman (101)
disagree with this statement and maintain the
spinal cord is normal in twenty-four hours
after spinal anesthesia is used. Certainly

there is a definite possibility of the intro-
duction of infection into the spinal canal
that must be considered.

4. There is frequently a pronounced fall in blood
   pressure, which may be accompanied by vomiting,
   restlessness, pallor, cold sweat, weak pulse,
   shallow respiration, and sometimes unconscious-
   ness. In 5% of all cases the blood pressure does
   not return to its normal level for at least
   twenty hours after the patient has had her
   delivery completed. (102)

5. Headaches, both temporary and persistent, fre-
   quently occur after delivery. Kosman, Kosman,
   and Shapiro (103) investigated the possible
   causes of such headaches after the use of spinal
   anesthesia and concluded the possible causes
   were; seepage of cerebrospinal fluid after
   puncture; an irritative meningitis; contamin-
   ation of material injected, causing irritation
   of nerve tissue.

6. After the drug has been injected into the
   spinal canal it is beyond control, and, if
   alarming symptoms appear, the cause cannot be
   removed.

7. This method of anesthesia fails in at least

5 to 10% of all cases. In Arnheim and Mage's
series (104), supplementary inhalation anes-
thesia had to be employed in 32.7% of the cases.
Deaver and Eckels (105) report that in their
series of 2,302 cases, additional anesthesia
was required in as high as 32.3%. In nearly
all cases in which supplementary anesthesia
is necessary, a general anesthetic is chosen.
As McKittrick, McClure, and Sweet (102) empha-
size, serious harm may result to both mother
and child if proper care is not exercised in
the administration of a general anesthetic
when the field of operation is already partially
anesthetized.

8. Spinal anesthesia cannot be used in cases of
    intra-abdominal hemorrhage, or abruptio pla-
    centa, and is hazardous in women with anemia
    or cardiac decompensation.

CAUDAL ANESTHESIA

The procedure known as caudal(intrasacral, sacral,
epidural, and extradural) anesthesia is made possible
by the anatomy of the central nervous system and the
coverings in the region of the sacral nerves. (106)
The lower termination of the dural sac containing
spinal fluid is found quite constantly at the level of

the second sacral vertebra, while the bony spinal canal
continues to the sacral hiatus, a gap left by the
failure of the fifth spinous process of the sacrum to
form. This hiatus is bounded laterally by the sacral
cornu, and above by the fourth sacral spine, being thus
a triangular area covered by a fairly resistant tissue,
the sacro-coccygeal membrane, and giving direct access
to the spinal canal. Introduction of local anesthetic
into this space makes possible blocking of the sacral
nerves without introducing the drug into the cerebro-
spinal fluid.

Such a procedure produces an anesthesia lasting
from one to three hours, and extends from the sacral
region and perineum down to the medial surface of the
thighs. Some patients complain of numbness, paresis,
and paralysis of the lower extremities (107), while in
a few cases the numbness continued up over the abdomen
as high as the costal margins. Anesthesia with relief
from labor pains is usually produced in five minutes with
marked relaxation of the perineum, thus allowing an
easy delivery. (108) Further advantages are:

1. Episiotomy and repair are easily and pain-
   lessly accomplished.

2. There are none of the after effects of inhal-
   ation anesthesia.

The disadvantages of such a procedure are: (109)

1. The technique is difficult and the results are not uniform. The procedure should not be used in the average home delivery.

2. There is difficulty in timing the administration of the drug, since it is often too early in the primiparae and too late in the multiparae.

3. Caudal anesthesia produces a certain amount of uterine inertia in practically every case, from a very slight reduction to a complete abolishment of the uterine contractions, necessitating operative deliveries for the completion of labor. (110)

4. It produces definite toxic manifestations in the mother and, without doubt, is the cause of fetal distress.

5. It does not relieve the pain of uterine contractions when an inertia does not develop. Since these pains are apparently almost as distressing as the pain from delivery of the head over the perineum, adequate relief is not obtained for the patient. (111)

First used as early as 1903, varying reports of success have been obtained. Oldham, in 1923, reported a series of 200 deliveries with marked effectiveness in

85 to 90% of these cases. (112) Meeker and Bonar (113) reported on 90 cases with like success, while Rucker (114), and recently, Oldham (115), have reported considerable success with this method of obstetrical anesthesia.

On the other hand, Perrill (116) found that caudal anesthesia lessened uterine contractions and was not sufficient for repairs. Schlimpert (117) reported the method as being worse than worthless. Kelso (109) reported 50% failure of anesthesia in a series of 34 cases. It is apparent that the above mentioned disadvantages of this anesthesia are truly formidable in this procedure and excellent results difficult to obtain.

CONCLUSIONS

1. The ideal obstetrical anesthesia is not possible with the present anesthetics.

2. Ether, despite its apparent disadvantages, is yet the most popular anesthetic used in obstetrics and is probably the safest anesthetic considering the use of general anesthetic agents today.

3. Chloroform has no place in obstetrics.

4. Nitrous oxide-oxygen anesthesia as administered by competent anesthetists is the best and safest obstetrical anesthesia obtainable, but is not practical for use outside the hospital.

5. Ethylene-oxygen anesthesia surpasses nitrous

oxide-oxygen anesthesia as an obstetrical anesthetic,
yet the inflammability of this gas makes its use
hazardous.

6. Cyclopropane gives very satisfactory obstet-
rical analgesia and anesthesia, but is too swift in
action to be used by anyone other then a trained
anesthetist. This anesthetic is not practical for
routine use in the home in that a machine is required
for administration.

7. Divinyl ether is not a suitable anesthetic for
obstetrics because it provides no period of analgesia
and is harmful to the liver of the patient.

8. Evipan sodium is not suitable for routine
use in obstetrics.

9. Novocaine is the least toxic of all local
anesthetic agents, while nupercaine produces a longer
anesthesia with a relatively less toxic dosage.

10. Local infiltration anesthesia in obstetrics
offers a comparatively new means of alleviating the
pains of childbirth that has not been generally regarded
as practical by the American medical profession.

11. Local infiltration anesthesia compares very
favorably with ether, cyclopropane, and nitrous oxide-
oxygen anesthesia in obstetrics, with novocaine, nuper-
caine, and pontocaine the drugs of choice.

12.   The use of local infiltration anesthesia in skilled hands offers the best obstetrical anesthesia for routine use outside the hospital.

13.   Spinal anesthesia is not satisfactory as an obstetrical anesthesia.

14.   Caudal anesthesia in skilled hands produces a satisfactory obstetrical anesthesia in operative deliveries.

15.   Obstetrical anesthesia does not receive sufficient attention in the medical education of young physicians.

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