

## Morbidity and Mortality in Obstetrics as Influenced by Anesthesia\*

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THIS IS NOT our intention to dwell on the history of anesthesia. Only, it is worthy of mention that not long after the discovery of nitrous oxid, Humphrey Davy, the first superintendent of the Pneumatic Institute of Clifton, England, while working on the then known gases, noticed that the inhalation of nitrous oxid relieved pain. His friend Southey, the poet, used to visit the laboratory frequently and inhaled some. So impressed was he that the following eulogy came from his pen to his brother, "*Oh Tom! Such a gas has Davy discovered! Oh Tom! I have had some, it makes me strong, and so happy! So gloriously happy! Oh excellent gas bag! Tom, I am sure the air of heaven must be this wonderful working gas of delight.*" The anesthetist of today often hears this paraphrased, especially by the parturient women. This was written in 1798 and yet it was not until forty-six years later that this elastic fluid was used as an anesthetic, and then chiefly in dentistry for another twenty-four years, until Joseph Clover, surgeon and anesthetist, adopted nitrous oxid for general use in 1868.

Following the suggestion of Paul Bert, Klihowitsch of Petrograd, in 1880, used laughing gas in twenty-five cases of labor and reported satisfactory results. Then, rapidly followed the reports of a host of others with results not nearly so satisfactory, so that its use was entirely dropped, not to be revived until 1910 by Guedel, Webster and Davis. This revival was made possible by three factors. *First*, the purification of nitrous oxid by what is known as the acid wash system.

*Secondly*, by its admixture with oxygen (Marshall), and *thirdly*, by the perfection of apparatus for the control of pressure. So perfected are these factors now that there has been an unfortunate tendency for many to think that an automatic apparatus solves all problems of technic. This, of course, is a mistake and recently there has been begun a movement to create scientific interest in anesthesia by improving the courses and clinical instruction, not only for the undergraduate medical student but also for the post-graduate, to enable those who so desire to fit themselves as competent anesthetists, (McMechan).

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### Physiological Considerations

OF THE known anesthetics, nitrous oxid is the least harmful in its immediate and remote effects on metabolism, recovery after its use being almost instantaneous and usually without post-operative complications. The research work of Buxton, Chadbourne, Casto and others on human and animal subjects, tends to prove that the percentage of hemoglobin is always lowered in the anesthetics of chloroform, ether and nitrous oxid oxygen. This reduction of hemoglobin is *most marked* with chloroform and the anemia is severe, recovery not taking place until after the seventh day; with ether, the maximum reduction is at the end of twenty-four hours, after which there is a gradual return to normal in about one hundred hours. With nitrous oxid-oxygen, the reduction is not *only slight* but in about two hours there is a return to normal. The practical application of this is that any case with a color index of hemoglobin below sixty percent is a hazardous risk with ether or chloroform. Nitrous oxid-oxygen anesthesia is strongly indicated in anemias when operations must be done.

With all anesthetic agents there is a reduction in the number of red blood cells. This reduction is slightly less with nitrous oxid, averaging about sixteen per cent. However, with nitrous oxid, *the coagulation time is considerably shortened*, which is never the case with chloroform, and it is only slightly shortened with ether. Again, there is a leukocytosis in anesthetics of all agents, more marked in nitrous oxid-oxygen, under which the average gain is

sixteen per cent, affecting chiefly the small lymphocytes and the transitional forms. All these blood changes seem to be due to an increase in the H-ion and we must remember that this is directly influenced by oxygenation, as increased carbon dioxide tension means increased H-ion content, and this is the real constant in interpreting acidosis. The watchword, therefore, is to avoid cyanosis and practically, this means the maintaining of a good color in the capillary blood, so easily seen at the patient's ears. In shock or acidosis, whether obstetrical or otherwise, where analgesia or anesthesia is advisable, nitrous oxid-oxygen is the agent of choice by common consent. This was particularly emphasized by Geoffrey Marshall, of London, England and by W. B. Cannon, of Boston, in the surgery of the late war.

A few words about circulatory disturbances would seem apropos and these are somewhat intimately connected with blood pressures. We find that none of the agents used for anesthesia are accompanied by normal readings. Chloroform always causing a very early and very abrupt fall in all readings with a marked reduction in pulse pressure. There may be a fall of blood pressure with ether, but it is not nearly so marked if the administration is properly carried out, whereas with nitrous oxid-oxygen, the change is an initial slight rise in blood pressure readings, returning to almost normal as soon as the first stratum of third stage anesthesia (Guedel) is established, and so remaining for several hours, unless some extraneous factor intervenes. On some occasions, when

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too large percentages of nitrous oxid are given at the expense of good oxygenation, there will be a fall in blood pressures but they return to normal as soon as the anesthetic is discontinued or oxygen is added in proper percentage.

In interpreting our blood pressure findings in terms of circulatory depression, we classify, with Moots and McKesson, as follows:—

*First degree circulatory depression* is that in which there is a fifteen per cent increase in pulse rate without change in blood pressure or a ten per cent decrease in blood pressure without a decrease in pulse rate.

*Second degree* is that in which there is an increase of twenty-five per cent in the pulse rate, along with a ten to twenty-five per cent decrease in blood pressure.

*Third degree*, which may be known as *shock*, definitely is that in which the pulse rate is a hundred or more and ascending, accompanied by progressively falling blood pressures reaching eighty millimetres of mercury systolic and twenty pulse pressure or less.

### Dangers of Chloroform

**A** GAIN, Goodman Levy, of London, England, has clearly shown that death from ventricular fibrillations in chloroform anesthesia may occur during induction, during operation and after operation: (1) During induction in the struggling and excitement stage, in the removal of the chloroform and in the abrupt administration after removal or a sudden increase during a period of light anesthesia. Also, by a combination of these three. (2) During operation by a strong sensory

stimuli under light anesthesia and (3) after operation on removal of this drug, especially in short cases. I may here mention that Fleming's Coroners' statistics, presented to the Anesthetic Section of the Royal Society of Medicine, show rather conclusively that in the hands of the general practitioner, chloroform involves prohibitive immediate and remote mortality, more particularly in the presence of co-existing pathological states, systemic diseases and obstetrical complications. In the year 1911, in England and Wales alone from the Registrar General's reports, we find that there were two deaths from chloroform every three days. There is a growing tendency to believe, and we think correctly so, that injurious effects of any anesthetic persists for longer periods than was thought possible in the past, so that the anesthetic may be an important factor in some of the more remote post-operative complications. This makes one realize that the vulgar term *anesthetic death* means nothing.

### Effects of Anesthetics on the Liver

**I** T HAS been found, experimentally and clinically, that there never have been any changes in the mother or child in this organ with nitrous oxid-oxygen anesthesia. Nitrous oxid *alone*, when pushed too far, produces a liver picture exactly like that of ordinary asphyxiation: whereas chloroform is found, both experimentally and clinically, to cause swelling of the liver cells with fatty infiltration and necrosis in both mother and child, but more particularly in the child. Ether

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does not cause necrosis but there is a mild form of parenchymatous degeneration and tissue swelling. The work of C. H. Davis, of Milwaukee, in this connection is very recent and thorough and his experiments disprove Gwathmey's belief that chloroform vapor is made entirely safe when administered with pure oxygen.

### Mortality and Hospital Days

AT THIS point a few remarks on mortality seem advisable. That of nitrous oxid-oxygen anesthesia is about one in one million for short operations, and one in five hundred thousand for long ones (Zemp). Whereas for ether it is one in sixteen thousand; for ethyl chlorid one in six thousand and for chloroform one in four thousand. Even this is not a fair comparison because nitrous oxid-oxygen is now selected as the anesthetic of choice when all others are contra-indicated, often when the patient is practically moribund. If this anaesthetic is selected in the very worst cases it is surprising that more deaths have not been reported recently through its use.

### Meeting Certain Objections

YOU WILL hear some outstanding objections to the use of nitrous oxid-oxygen made by many, even of our best men. One is that it requires an *experienced anesthetist*—but should this not be the case for any anesthetic. That anyone can give an anesthetic is an idea evidently unscientific. Undoubtedly, many deaths have been caused by ignorance. Another is that its cost is considerable. This is true at first sight but on second thought

you will realize that the after-effects being so much less than with any other agent, your patient is saved so many days in the hospital at so much per day. Personally, we prefer to take one chance in one million as against one in four thousand in spite of increased cost.

To combat the so frequently expressed argument that the gases are inimical to the mother and foetus in the toxemic type, in which cyanosis is always present, let us emphasize the fact that cyanosis produced in a normal case is a sign of poor administration. If it is possible to maintain good color in normal cases it is equally possible to maintain the same relative balance of color in the toxic cases. Indeed our experience has been that, at least during the period of administration, we have been able, temporarily, to dispel the toxic cyanosis. This argument against the gases in this class of cases is pernicious and unjustifiable.

Persistent headache has often been quoted as a sequel to a prolonged nitrous oxid-oxygen administration. In our relatively large number of cases this complaint has not been brought to our attention and to those who have had to combat it, we would strongly advise the avoidance of cyanosis.

### Technique of Administration

IN OUR application of this method, the technic for normal labor has been as follows:—

The work is divided between the obstetrician and the anesthetist. When the former believes labor to be definitely established he administers  $\frac{1}{12}$  to  $\frac{1}{8}$  grain of heroin,

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or  $\frac{1}{4}$  grain of morphin. This allays the pain of the first stage to the point of almost complete dilatation of the cervix, the nitrous oxid-oxygen being more particularly reserved for the second or expulsive stage. It has been our experience that the too early use of nitrous oxid-oxygen is an unnecessarily prolonged and expensive procedure.

At or near the completion of the first stage, the anesthetist is called, who, after becoming acquainted with the outstanding details of the case, applies a blood pressure apparatus to the left arm along with a bracelet stethoscope, all tube connections being of sufficient length to avoid any inconvenience in the taking of readings. These are recorded on a chart for this purpose, together with pulse and respiratory rate. The recording of these is repeated at least every five minutes, in order that curves may be made. As explained before, from these curves, the slightest depression of circulation can be detected. Recently, we have decided to chart the foetal heart rate. The charts used are those of the National Anesthesia Research Society.

The uterine contraction is allowed to start before the gases are administered because no pain is ordinarily felt until contraction is fully established, and because of the rapidity of the action of nitrous oxid, *analgesia*, in our experience, is quickly produced, particularly in the presence of heroin or morphin. The patient is conscious of her environment so that she may carry out our instructions and yet be free from pain. She is, therefore, told to take four or five deep inhalations. It is impossible to de-

termine the percentage of gases for every case. It is safe to begin with nitrous oxid 80 per cent and oxygen 20 per cent, the main object being to produce analgesia and obtain good oxygenation. The varying of these figures must suit each individual case, always however, maintaining a good color. Let us remember that cyanosis is never a sign of analgesia or anesthesia. It is rather a sign of poorly conducted narcosis. This analgesic condition is produced intermittently for each pain until the head is about to be delivered over the perineum, at which point, *anesthesia* takes the place of analgesia. Here again, we deliberately avoid cyanosis. With the delivery of the child, 100 per cent pure oxygen is given under slight pressure until infantile respiration is fully established. We find it unnecessary to slap our babies and it is interesting to see the lobster pink color without effort. Throughout the entire procedure, constant maternal and foetal supervision is rigidly carried out in the observing of maternal blood pressures, pulse, respiratory rate, and color; and also of the foetal heart.

### Operative Obstetrics

**I**N THE toxemias of pregnancy, the modern obstetrician and anesthetist are, we believe, fully convinced that continuous and even moderately prolonged anesthesia under either chloroform or ether, is detrimental to the safety of both mother and child. In many of the toxemias, in which the minor operations of obstetrics, such as bougie and bag induction, are indicated, the technic may be carried out with little or no anesthetic.

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Nitrous oxid-oxygen, in this particular group of cases, is the recognized method. On the other hand, when major surgery is to be performed, the choice must be between the three agents, *namely* chloroform, ether and nitrous oxid-oxygen or a combination. There is no question, from the experiments so far made, but that chloroform has a detrimental effect on both liver and kidneys in anesthetics of over five minutes duration. For the sake of its ready application and powers of relaxation, the usefulness of chloroform anesthesia must be admitted. To the case or surgeon demanding its administration for five, but certainly not ten minutes, chloroform must be considered permissible but not without, in our opinion, jeopardizing the patient and her child unnecessarily, simply for the sake of convenience and personal equation.

Locally, nitrous oxid-oxygen has not, as yet, made a way for itself deeply enough into the confidence of all obstetricians, so that we have not a very large number of cases of this class to detail. From the results which we have obtained, we feel that nitrous oxid-oxygen is worthy of sincere consideration, not only as a primary and complete anesthetic but as one secondary to the delivery of the child following primary chloroform administration in operative work.

### Results and Statistical Data

**I**N OUR series of cases, the majority at the Montreal Maternity Hospital, we have had to deal with vaginal hysterotomy, abdominal hysterotomy, bougie and bag insertion with forceps or version as secondary to ether. The

conditions being those of toxic vomiting, eclampsia, chronic nephritis and diabetes. In our series of cases, we have consistently relied upon nitrous oxid-oxygen as the anesthetic of choice. In a few isolated cases of abdominal Cesarean section, we have had to add a small amount of ether to obtain the necessary relaxation.

Our total number of cases has been 202; 132 were primiparas, the remaining 70 multiparas.

Of the total, 145 were spontaneous and 57 artificial labors. Of the artificial labors the conditions were:

Pyelitis .....	4
Renal Stone .....	1
Hypo-thyroidism .....	1
Concealed Hemorrhage ....	1
Cardiac Disease .....	4
Breech Presentations .....	10
Premature .....	5
Toxemias of Pregnancy....	26
Placenta Previa .....	1
Multiple Pregnancy .....	3
Post-operative (App.) .....	1
	—
	57

The interferences for these were as follows:

Low Forceps .....	20
Mid-Forceps .....	9
Version .....	2
Accouchment Force .....	2
Vaginal Hysterotomy .....	2
Bougie Induction .....	1
Bag Induction .....	4
Abdominal Cesarean Section	14

The average length of time for nitrous oxid-oxygen analgesia and anesthesia was two and one-half hours per case in normal labor or in labor leading to forceps; the longest being ten hours and the shortest, one-half hour. There were no maternal deaths. In the

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uncomplicated cases, there were no deaths of children of the period of viability. In the lot, there were two foetal deaths, one in a case of threatened eclampsia, ten hours after birth, seven months terms, and one from hemophilia, twelve hours after birth with a direct history of this condition on the father's side. Here gas was given for two and one-half hours. The mother was an albuminuric.

In contra-distinction we may offer Hospital Statistics for the years 1908 to 1912 inclusive, in which chloroform was practically the sole anesthetic, and it should be stated that these supply a far greater number than we have at our disposal, and in which, no doubt, many of the patients were in a very bad condition. However, a comparison is interesting.

1. Albuminuria of Pregnancy	
Maternal Mor-	
tality .....	Nil
Foetal Mortal-	
ity .....	13 per cent
2. Nephritis	
Maternal Mor-	
tality .....	8 per cent
Foetal Mortal-	
ity .....	38 per cent
3. Eclampsia	
Maternal Mor-	
tality .....	11 per cent
Foetal Mortal-	
ity .....	29 per cent
4. Vomiting of Pregnancy Post-	
Operative	
Maternal Mor-	
tality .....	5 per cent

### Summary

We make the following conclusions:

1. That nitrous oxid-oxygen is

the most acceptable anesthetic to the patient.

2. That it is the most difficult to administer properly.

3. That it is the least harmful of all known anesthetic agents to the blood, liver and kidneys of the mother and child.

4. That with it the uterine contractions are decidedly stimulated.

5. That under it the freedom from pain permits the parturient woman to use her contractions to best advantage.

6. Instrumentation is reduced from high-, and mid-, to more frequent low-forceps.

7. We have in this method at our disposal, a remarkable means of indirectly oxygenating the child after birth.

8. As against the frequent distressing collapse of the mother in post-partum administration of chloroform, we fail to find such experiences under nitrous oxid-oxygen.

9. It has been established that the uterus in its systole absolutely blanches itself, and as these gases are administered only during the rise and acme of the systole, no nitrous oxid can be conveyed to the foetus during that period. In a well conducted case, the oxygen is commenced at the moment of declination of the systole and continued throughout the diastole until the uterus is at rest. We would emphasize particularly the necessity of this type of administration because by it alone the foetus escapes all possibility of nitrous oxid influence or asphyxia.

10. In no case in our series of normal labors or labors leading up

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