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COMPLIMENTS OF THE AUTHOR.

LAUGHING GAS

AS AN ANÆSTHETIC IN GENERAL SURGERY.

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Reprint from SOUTHERN JOURNAL OF HOMŒOPATHY, November, 1893.

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When a student and hospital interne I was impressed with the profound importance attached to anæsthetics. For this impression, the consequent study and the continuance of an extreme interest in the subject, I have to thank that whilom prince of surgery, Charles M. Thomas of Philadelphia, (now making as great a success of ophthalmology as he did formerly in general surgery). No surgeon who has ever studied anæsthesia with the degree of interest that the subject merits, can ignore the dangers, the disagreeableness and tardiness of action attending our anæsthetics as ordinarily employed, and he is therefore the more ready to adopt some form of anæsthesia that is free from these features. I believe the enthusiast is a dangerous man, and in the present matter have endeavored to avoid undue enthusiasm and intend to give my friends the results of my experience with nitrous oxide in general surgery. If it possesses any advantages over other anæsthetics, they will be glad to recognize them.

It has been an almost universal impression, among physicians, that nitrous oxide was useful only for brief periods of anæsthesia. That this is fallacious will be shown by the cases appended. The idea of the transientness of the gas anæsthesia is probably due to the fact that its use is confined almost solely to the extraction of teeth, a procedure which *necessitates the removal of the inhaler* and sensibility *of course rapidly ensues*, and I have endeavored to find out some objections to the renewal of inhalations, but without success. It is simply the *custom not to do so.* Now under the same circumstances ether and chloroform would likewise be transient in their effects, so that the wonder is that gas has not long ago been applied in general surgery. Before going further I wish to admit that Priestley, Davy, or Horace Wells are the men who discovered and experimented with nitrous oxide and finally demonstrated its practical application. I say this in order to save any one the trouble of writing at length to prove that I am not the discoverer of laughing gas, nor of its practical value. I am simply giving

my clinical experience with this anæsthetic. I am not claiming any thing original, although I have seen no records of a successful and painless thigh amputation (in a patient seventy years of age) with gas as the anæsthetic. In this matter I wish to acknowledge my deep indebtedness to Dr. F. A. Gardener of this city for the aid and encouragement he has afforded me in these studies.

The following cases are taken, in the main, from my surgical records in the National Homœopathic Hospital and are mentioned in the order of occurrence.

Case I.—Dr. T. L. M. Anæsthetized by Dr. F. A. Gardener. This was our first experiment and the only points noted were the completeness of the anæsthetic state and the duration of the same, the latter being determined by freely palpating the conjunctiva and cornea. This was continued for seven minutes when the inhaler was removed, and in a few seconds consciousness returned with a sense of pleasure and well-being. The position was that of recumbancy, and there was no asphyxia, none of the ghastly lividity (so frequently seen in the sitting posture) and no perceptible change in the pulse. With the return of consciousness the whole skin surface was covered with a gentle perspiration.

Case II.—Dr. Gardener. In less than a minute he was profoundly anæsthetized. The face was slightly flushed, the conjunctiva somewhat injected, but neither that nor the cornea were in the least sensitive to the palpating finger. After five minutes I allowed him to recover, which he did in about a quarter of a minute after the removal of the inhaler. In the meantime his pulse had remained full and strong and but slightly accelerated. He, too, experienced the same general perspiration, and also complained of some nausea and distress at the stomach. He had just eaten a hearty dinner which probably accounted for these symptoms. They rapidly subsided.

Case III.—Miss L., aged 22. A neurasthenic. Prepared as for ether. In one minute after beginning the gas inhalation, she had reached the stage of surgical anæsthesia. The treatment consisted of examination of the bladder, cervical dilatation, trimming off shreds of the hymen, and stretching the anal sphincters. This latter was done most thoroughly, and it is well known what a severe test this is for anæsthesia, because "the ano-genital region is the last to give up its sensitiveness." But she flinched no more than she did on a former occasion when etherized. This work occupied half an hour, and as a last test of sensibility I forcibly tore away the hood which was firmly adherent to the clitoris—a procedure which I believe I have never yet performed either with the aid of chloroform or ether, without provok-

ing sound or motion (or both) from the patient. These manifestations occurred with the use of the gas also, but diminished and disappeared when the anæsthetic was pushed. During the thirty minutes there were no bad symptoms. Once or twice a slight tinge of blueness occurred but disappeared as soon as the gas was shut off. From time to time the face piece was removed for a few seconds, and then re-applied and the gas inhalation continued. Recovery was unaccompanied by the slightest nausea or other discomfort.

Case IV.—Mrs.——, æt. thirty-five. Same treatment as case III, except the removal of an urethral caruncle. Time, thirty minutes. The interne had never before administered gas, and it was therefore not surprising when, after ten minutes, the patient displayed a considerable degree of asphyxia. This was promptly relieved by pushing the forefinger through the buccal cavity and between the jaws back of the teeth, and hooking the finger over the base of the tongue and drawing it forward. (If one is the proud possessor of a base-ball finger crooked at the first joint like a Mercier catheter, it is just the thing for the above procedure). After being anæsthetized for half an hour the patient was placed in bed. There was no nausea, and the pulse was the same as before the administration of the anæsthetic.

Case V.—Boy, æt. 10. Extensive suppurative mastoiditis, caries and burrowing of pus along the sterno-cleido-mastoid muscle. Thorough opening up and curettement. He was wild with terror and howling lustily till the face-piece was applied, and in less than a half minute he was asleep. The gas controlled him perfectly. It required about twenty minutes for the work. In about a minute and a half after stopping the inhalation he was conscious and comfortable. No nausea.

Case VI.—Child, six months old. Circumcision. The anæsthetic did not hold the child steady, and when about half through ether was substituted, with no better result. The latter producing vomiting. Chloroform was not much of an improvement, as the child was either too deeply under or else wriggling. Even in this case the gas can scarcely be pronounced a failure, for it was administered by a novice (his first experience) and the inhaler was the adult size and could not be made to fit the child's face.

Case VII.—Female, over seventy years of age, suffering from a sarcoma of the leg. The growth had recurred three times. The patient had not used the leg for nearly three months. She was rather feeble generally, having distinct mitral and aortic murmers. The treatment was amputation near the middle of the femoral shaft. Time under gas anæsthesia, forty minutes. This included the time occupied in wheeling the patient from the anæsthetizing room, scrubbing the

limb and final dressing. During the operative manipulations there was not a sign of flinching. I never saw ether or chloroform keep a patient more steadily or profoundly anæsthetized. The pulse remained good throughout, and in a minute and a half after removal of the inhaler she was conscious and answering questions intelligently. She was placed in bed, with scarcely a sign of shock, and perfectly free from nausea.

Case VIII was the preceding in which secondary suture of the stump was resorted to. She was controlled perfectly for twenty-two minutes and was conscious in one-half minute after shutting off the gas.

Case IX.—Male, æt. sixty. Subungual suppuration, with ulceration extending well up the thumb. The dead portion of the nail was exsected, the suppurative tract thoroughly scraped and packed. The gas controlled him satisfactorily. Time, fifteen minutes.

Case X.—Mrs. L——, æt. twenty-seven, pregnant (three months) and suffering with a large labial abscess. She was anæsthetized in one minute; the abscess opened, excavated, scraped and packed. Time, ten minutes. In half a minute from the time the inhalations were stopped, she was conscious and talking intelligently. No nausea and no discomfort or interference with gestation.

Case XI.—Male, æt. thirty, with stricture of the rectum, perirectal abscess and caries of the coccyx. The patient was strong and muscular, just the kind that would be expected to give trouble under ether. The heart's action was very slow and arythmical. Stretching the anal sphincters, which I began a little too soon, caused a momentary muscular action, but after that the gas controlled him perfectly for forty minutes. There was no nausea, and the pulse was the same when the patient was placed in bed as when he was laid on the table. Consciousness returned in one-half minute after the anæsthetic was stopped.

Case XII.—Mrs. H., æt. thirty-five, referred to me by my friend, Dr. Van Lennep. From time to time for the last eight years the patient had been prostrated from suffering due to hæmorrhoids, fissures, etc. Dr. Van Lennep had advised operation, so had several other physicians, and so had I, but her fear of ether and chloroform could not be overcome. She was trying to persuade herself to be operated when Col. Shepard died. That almost paralyzed her with terror and drove operation from her mind, and she continued to be wretched. A short time since she heard that I was using gas as an anæsthetic, and to my surprise she called on me, of her own accord, and asked to be operated. The cervix was dilated, uterus curetted, anal sphincters

thoroughly dilated and the pile bearing inch removed. Time, forty minutes. This included time of washing, scrubbing, shaving, dressing, etc. She moved a little at first, but after that anæsthesia was satisfactory. She was conscious in thirty seconds after suspending the flow of gas. No shock, but some flatulence which was an old complaint, and not due to the nitrous oxide.

Since recording the above cases, many others have presented themselves; but I see no advantage in citing further.

THE PROPERTIES OF NITROUS OXIDE, N_2O.

It is colorless, slightly sweetish in taste and almost odorless. (In fact patients sometimes scarcely recognize that they are breathing other than atmospheric air). Although its chemical symbol betokens its composition to be of the same gases as the air we breathe, it is not a simple mixture of these two gases, but is a definite chemical compound in which the properties of the original gases are lost, and new ones peculiar to itself are developed (Guilford). Under heavy pressure it is condensed into a transparent liquid and in this form is quite portable (in iron cylinders) for surgical purposes. The precise manner in which anæsthesia is produced by this gas has never been clearly understood. The same is true of ether and chloroform. The process of anæsthesia has been divided into three stages, namely, exhilaration, excitement and relaxation. From having experimented with it upon myself several times, and from watching its effects on others, I should be inclined to regard the stages as follows: First, stimulation, then anæsthesia and later cyanosis. And I believe it is possible to avoid the latter and confine the action of the gas to what I term the second stage, *i. e.*, complete anæsthesia without cyanosis or asphyxia. It is not always possible to differentiate these stages; as in ether or chloroform anæsthesia the stages may be confluent. The ability to exhibit the gas in full quantity at the beginning without producing distress, the rapidity of its action in overcoming sensibility and its equally rapid elimination as soon as administration is suspended, are features that are peculiarly characteristic of this anæsthetic, and absent in the others. Another fact is that nitrous oxide practically defies the law of stimulation and depression. That is to say that stimulation, whatever its degree, is followed by depression in proportion to the stimulation, (exhilaration or exaltation) preceding it. This is a regretful truth as regards ether or chloroform but cannot be said of gas, and hence is removed one of the strongest factors in the production of surgical shock. That the gas has not been understood is shown by the following quotation from Dr. Turnbull's Anæsthetic Manual.

"After numerous experiments on man and animals, I have arrived at the following conclusions :—

1. Nitrous oxide has a very limited range when given alone, owing to the rapidity of its action and its still more rapid elimination.

2. It acts directly upon the cerebrum and muscular apparatus almost simultaneously.

3. It produces regular and progressive modification in the action of the heart and capillaries of the skin, and, if carried to a greater extent, it affects the spinal axis, and lastly the cerebrum and medulla oblongata with suspension of respiration and circulation, and finally death.

4. Death in no case occurs without premonitory symptoms, and if respiration should cease for even a half to one minute resuscitation is yet possible."

For years Turnbull's work has been one of the authorities on anæsthesia, and has done much to fashion professional opinion on this subject. And his first conclusion (in reference to the limited range of nitrous oxide) agrees exactly with that of the medical mind generally, but the cases already cited show this to be an error. And curiously enough the very reasons that he gives for his conclusion, that the range of gas is limited, are the reasons that have led me to conclude that its range is almost limitless. The aphrodisiac effect of nitrous oxide is a certainty. I have observed it myself and so have many others. Zeigler says: "It has a special tendency to the genito-urinary organs and exerts a powerful influence over their functions." Dr. Johnston also says: "Anæsthetics do stimulate the sexual functions," but from my own experience I believe none of them so much so as nitrous oxide.

DANGER, COMPARATIVE.

Dr. Squibb has well said that "the line of greatest safety in practice is to regard the difference between anæsthesia and death as a difference in degree only." It is conceded by all that nitrous oxide is the safest of all anæsthetics. Back in 1870 the mortality with the different anæsthetics was estimated in round numbers as follows:

Ether, 1 death in 23,000.

Chloroform, 1 death in 2,000.

Nitrous oxide, no death in 75,000.

And since that time there have been, in one office alone, one hundred and forty-seven thousand administrations of gas without one death or any serious result. Deaths have been reported, but I have been unable to find that any have occurred since the liquified gas has been in use. It was formerly the custom for dentists to manufacture

their own gas, and it is not unlikely that much of it was impure. Then, too, some of the deaths attributed to gas were due to other causes, *e. g.*, foreign bodies in the larynx or trachea. Another thing of importance is the fact that in dentistry, anæsthetics are administered while the patient is in the sitting posture, which is contrary to the surgical rules of our profession and consequently should make nitrous oxide *a safer anæsthetic in general surgery than in dentistry.*

ITS ADMINISTRATION.

So far as my reading goes, I am unable to find any contra-indications to its use, nor in my experience have I found any, nor can I imagine any. Although I believe that lesions of the heart, lungs or kidneys offer no contra-indications, I do not go quite so far as Underwood who says: "Organic disease does not involve any additional risk whatever to the patient." A chain is weaker for having an imperfect link; anæsthesia is a departure from the normal, and any lesion of the vital organs (while it does not contra-indicate the anæsthetic) must necessarily augment the departure from the basis of safety. I have never tried gas in an alcoholic, but should expect the alcohol in the system to interfere, to some extent at least, with its action. At any rate I am painfully aware that the stronger anæsthetics (so called) are more or less interfered with by alcohol.

Before the administration of gas I observe all the rules generally laid down for other anæsthetics, except that it is not so essential that the stomach be empty. I make all the usual preparations for complications, although I have not seen any as yet. Cardiac and respiratory stimulants, tongue forceps, etc., should always be at hand. The patient should be watched constantly and the conjunctiva palpated, as a measure of insensibility. By watching the face we can prevent asphyxia, which is ushered in by a dull bluish or grayish pallor overspreading the countenance. This is apt to be accompanied by spasmodic or jerky respirations, and sometimes stertor. The first appearance of these changes demands that the amount of gas flowing into the inhaler be diminished, or it may be suspended for a few seconds.

I have noticed but little change in the pulse or the pupils; but should either heart or respiratory organs fail, the same rules would apply here that are so familiar in similar conditions arising so frequently from ether or chloroform. In the case of gas I should regard artificial respiration as very important. I have always been a stickler for caution in the use of any anæsthetic, and the pages of our surgical history will bear closer inspection when anæsthetists are all taught to

to attend strictly to their business instead of gaping and gossiping. Only constant watchfulness can give the patient that degree of safety that belongs to him by the right of employing a reputable surgeon and entrusting his life in his hands. As White has said : "Immunity from danger can best be assured only by an intelligent and watchful guard, and the anæsthetic should be suspended while yet the centres governing respiration and circulation are not too profoundly impressed."

The operator who uses gas for the first time will feel a little uneasy, because the arterial and venous blood are dark, but one soon becomes accustomed to this.

I am not a "stock-holder in a gas company," and when I state that my portable outfit was obtained from the S. S. White Dental Co., of Philadelphia, it is because I anticipate the first question that would be asked by those who wish to know more about this subject.