

MUSIC AS A SUPPLEMENT IN NITROUS OXIDE-OXYGEN ANESTHESIA *

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NITROUS oxide has been the most popular anesthetic agent in the medical and dental profession ever since it was popularized in 1868. Its popularity has increased steadily in the past seven or eight decades, with comparatively little reference made to the dangers inherent in this agent when the oxygen is reduced seemingly to increase the potency of the gas.

Although the gas was discovered by Priestley in 1775, and recommended by Davy (1800) (1) that it be used in surgery, it was Wells, Colton and Evans (2) who popularized its use. Not until the work of Hewitt, Andrews and Bert (3, 4, 5) was reported, however, did the necessity for combining oxygen with nitrous oxide become apparent. In 1915, Teter (6) introduced his machine for anesthesia but recommended only 5 to 10 per cent oxygen mixtures and advocated disregard of cyanosis. As late as 1911 McKesson (7), with the introduction of his machine and its improvements, still taught that subnormal amounts of oxygen should be administered with nitrous oxide. His hypoxial procedures spread rapidly, disseminated by popularization of the "saturation" and "secondary saturation" technics, since it was found that induction with 100 per cent nitrous oxide was very fast and pleasant to the patient, and diminished the time of the induction.

No reference was made in the early days to any morbidity or mortality associated with the administration of this gas, although it scarcely seems possible that none occurred. Although in 1896 Kemp (8) indicated that some anoxia existed with nitrous oxide anesthesia, and although this was later substantiated by Leake and Hertzman (9), Greene et al. (10), Brown, Lucas and Henderson (11), it required a series of independent investigations of morbidity and mortality during and following the use of this drug, accompanied by anoxia, to crystallize and make apparent the inherent dangers. Considerable work was published (12) to demonstrate that anoxia can and does produce temporary and permanent damage (13, 14, 15, 16) to the brain, particularly and primarily, and to the other organs with more reversibility (17). Courville's work (18, 19) left no doubt that a close relationship existed

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between anoxia and the various types of death occurring during or after the anesthesia.

As the effects of anoxia became clearer, more case reports and pathological findings (20, 21, 22, 23) in delayed deaths were found in the literature. In spite of this accumulated knowledge it was necessary for the thesis by Rovenstine and Barach (24, 25) to arouse the interest of the medical and dental professions and to resound in the newspapers (26, 27) and focus public attention on this problem. Publicity of the danger of anoxia caused some confusion but helped to popularize the use of nerve block or "conduction" anesthesia. Not much was done to correct the negative phase of this widespread reaction. Even the legislatures began to speak of laws to limit the use of anesthetics to specially trained anesthetists.

Rovenstine and Barach advocated that oxygen 20 per cent and nitrous oxide 80 per cent be combined in one cylinder under a pressure of 700 pounds so that at no time could less than 20 per cent oxygen be furnished to the patient. It is recognized that this is an expensive procedure, but the necessity to maintain a safety factor makes consideration of expense negligible. Such dispensation of the mixture, however, requires the cooperation of the manufacturers, which was not readily obtained. One admitted that it was being done, but only for experimental purposes, and the product was allocated to only one clinic.

The other manufacturers refused for various reasons. The most common and most applicable reasons are the following: "1,(28) Cylinders could only be filled to a third of their normal capacity and have such a mixture come out with any degree of uniformity; 2, that circumstances would mean that three times as many cylinders to handle such requirements would be necessary, as would be necessary if the gases were supplied individually; that, 3, therefore, transportation and delivery costs also would be trebled; and 4, that with the scarcity of cylinders that developed during the war . . . that the backlog, of unfilled orders, which represents about a two years requirement for this industry, would still further be increased." ". . . (29, 30, 31) these two gases in combination are not practical because depending on the patient and the particular situation, 20 per cent oxygen would not always be sufficient." We have encountered unpremedicated individuals who cannot be anesthetized with this mixture beyond Stage II with its attendant delirium and uncooperative motor hyperactivity.

In dentistry one must necessarily deal with ambulatory, fearful and emotionally distressed patients. These factors are probably the greatest contributors to raising "reflex irritability," (32) and thus rendering nitrous oxide a less potent gas. These factors, perhaps with the exception of the specific toxemias, raise reflex irritability more than all others combined. Not only is nitrous oxide rendered more innocuous, but the tissues and their cells become much more active, so that

the demand for oxygen becomes greater. It then follows that any diminished oxygen supply will necessarily create a greater demand, far out of proportion to an average state.

Premedication to lower the reflex irritability has been considered and attempted but discarded for several reasons. The use of opiates, barbiturates, or even scopolamine led to prolongation of the office visit time which interfered both with the dentist and with the patient. If these drugs were given in sufficient time it meant that either the patient had to be brought by someone else at the appointed hour, or that the patient would have to come to the office at least one hour before the appointed time. These drugs required a prolonged postoperative recovery period, which again required the assistance of an extra person, increased office space, and recovery rooms, and which, finally, added considerably to the loss of time for the patient and dentist. Another objection to the use of premedicants is that they are habit-forming. Since most dental work requires repeated visits it is easily understood how addiction to these drugs could become established.

The so-called basal anesthetic, avertin, as a premedicant again prolongs the "office visit time," is a big premedicant for a small job, and is not without its morbidity and mortality *per se* (33). The disagreeable side effects, such as soiling of the clothes, add to the contraindication of its use.

To avoid these disadvantages it was decided to investigate the use of more potent agents. Ethylene and cyclopropane, 30 per cent and 100 per cent anesthetic agents respectively, would be more practical but they cannot be safely used in an office because these anesthetic mixtures are in the explosive range. Some consider the garlic-like odor of ethylene too offensive, but in our experience this has not been objectionable to the patients. Divinyl ether meets the requirements by its ease of induction and rapidity of elimination, but in addition to its inflammability it is difficult to maintain in an open system, produces excessive mucous secretion, and contributes to post anesthetic vomiting, vertigo, and general malaise.

Ethyl chloride and chloroform are summarily dismissed as too dangerous. Trichlorethylene has not been used, but will be investigated. Observation of this drug in general surgery, however, has demonstrated prolonged recovery time compared with the gaseous inhalation agents, and the occurrence of arrhythmias.

Ethyl ether has received considerable mention and need not be discussed here. Briefly stated, it requires premedication for drying secretions, has a prolonged induction and recovery time, and produces uncomfortable postanesthetic sequelae, nausea, retching, vomiting, and so forth.

Sodium pentothal bears the same objections as enumerated, but also carries its own dangers of laryngospasm, bronchospasm, and other overactive parasympathetic manifestations. It is now generally con-

ceded that sodium pentothal should not be employed in an office procedure unless an airtight resuscitative machine with positive pressure oxygen is immediately available, as well as someone who is fully trained in the use of this equipment.

The endotracheal technic provides an ideal type of administration, but its use requires the employment of the more potent drugs with their concomitant disadvantages. This technic is advocated in all prolonged, difficult surgical manipulations of the mouth.

It is recognized that nerve block, or "conduction" anesthesia of the maxillary or mandibular branches of the trigeminal nerve solves practically all the difficulties mentioned, but this paper is meant to deal with those cases in which an unconscious state is preferable or necessary.

Hypnosis was attempted as a supplement to nitrous oxide, but its very name immediately brought up legal factors which required signed consent, a willingness by the patient to be hypnotized and the proper subject. Such difficulties again interfered with an active clinic or office practice. Diversionary tactics were then employed in the form of music, with considerable success.

The equipment used with the music technic included an ordinary electric record player with earphone transmission instead of the usual loudspeaker. The earphones had large cups in order to exclude environmental sound, movements of the personnel, jingle and clashing of instruments, conversation, opening and closing of the doors of cabinets, sterilizer, and so forth. The patient is given a remote volume control and instructed how to use it to his or her maximum enjoyment. A microphone is interconnected with the player so that the operator is able at any time to talk to the patient, who can then follow the necessary instructions without interruption of the assembled apparatus.

The type of music most efficacious was found by trial and error to be the following:

1. Clair De Lune, by Debussy
2. Moonlight Sonata, by Beethoven
3. Dream Pantomine, by Humperdinck
4. Evening Star, by Wagner
5. Forest Murmers, by Wagner
6. Poeme, by Fibich.

It is not our intention to offer these dogmatically, but one can safely say that the music the patient prefers is the most suitable. The music found to be most effective had a smooth, even tone and contained no conflicting, harsh or startling instrumentation. In a series of more than 1000 cases, it was found that the aforementioned records were more frequently chosen than any other, and gave the most profound type of unconsciousness. It was distinctly found that the modern jazz, rapid or excitable tempo music, or muscle twitching swing musical

gyrations were not suitable, and even tended at times to produce the undesirable, sensitive-to-pain, uncooperative attitude.

The anesthetic machine used was the usual type found in dentist's offices, either the Heidbrink, Foregger, or McKesson machines equipped with nitrous oxide and oxygen yokes, without carbon dioxide absorption, and with the gases led by way of a rubber tube to a nose mask with an expiratory valve controlled by a light spring. In this series the McKesson machine was used practically throughout the experimental phase.

TECHNIC

After considerable experimentation a routine was established which became more successful as the experience of the operators increased. This routine was made to begin from the time the patient entered the waiting room. The receptionist was trained to treat all patients warmly but their dental condition casually.

All apparatus is kept out of sight or covered so that there is a minimum of exciting objects in view. The attitude of the operator to the patient must be reassuring, cordial, firm and positive. The vocabulary must be positive, unconflicting, and reassuring. Such words as fear, afraid, pain, hurt, worry, should not be mentioned, but such words as fine, well, improved, better, good, fortunate, may be used to produce some euphoria. If this conversation does not produce the desired result, then simple mind abstraction may be employed with the basic discussion centered on music. Once the patient has become comfortable in the chair, the subject is then gradually directed to the use of the music and instructions for the patient's operation of the volume control.

The music is started and the volume is adjusted by the patient to his or her taste. The nasal inhaler mask previously described is carefully and lightly placed on the nose, and the head strap is made as loose as consistent with maintenance of the mask in position. At first the expiratory valve was permitted to open only with expiration, but it was soon discovered that the insertion of a cotton wad which kept it open with inspiration as well did not dilute the inhaled mixtures enough to interfere with the depth of anesthesia. The anesthesia machine was set to deliver 75 per cent nitrous oxide and 25 per cent oxygen, but this mixture was further diluted at the open expiratory valve by an estimated 20 per cent. Once the patient is asleep, the mixture may be further enriched with oxygen to as much as 35 per cent to 50 per cent.

The mouth props are inserted before the patient falls asleep. The rubber or cork type is considered preferable. Throat packs are considered unnecessary and detrimental. Small 2 inch by 2 inch exodontia sponges with attached string are inserted just in back of the region of the operative field to catch blood and debris. It is believed, however,

that there should be no aspiration since the laryngeal and gag reflexes are not obtunded. Further dilution of the gases by oral inhalation of air does not seem to interfere with the level of anesthesia.

DISCUSSION

In order to reduce the amount of nitrous oxide and its attendant oxygen deprivation as prevalently practiced in dentistry, a method of helping to reduce the reflex irritability was designed without the necessity of using depressing, hypnotic premedicants which interfered with dental office routine. This method employed psychologic assurance, simple abstraction and music. The psychophysiologic explanation is not attempted beyond the superficial presentation of suggestion, auto-suggestion, soothing rhythm, and perhaps finally some informal mesmerism.

Simple mind abstraction was found occasionally to be effective without the addition of nitrous oxide in mildly painful manipulations. A simple request of "hand me a soft drill" would sometimes be sufficient for a drilling procedure. "I am only examining you" or "I am only looking at your x-rays" while manipulating the tooth may prove sufficient. Statements deprecating the tension and fearful awareness of the environment are attempted by indicating that the situation is banal: "everyone is nervous which is normal," "such cases as yours are very common," and so forth.

The nitrous oxide-oxygen mixtures are maintained with a minimum of 25 per cent oxygen, or more when possible, and diluted further with air. Although no blood studies of inspiratory or alveolar air or oxygen were performed, clinically no hypoxia could be discovered. The mucous membranes, the conjunctivae, the nailbeds were all closely watched for cyanosis and none found. The blood pressure and pulse were frequently checked and little variation found. Although it was often found that the respiratory rhythm paralleled that of the music, the pulse was unaffected except as expected with the reduction of the reflex irritability.

Various aromatic oils were introduced through the cotton in the expiratory valve to disguise the odor of the gases and the rubber, but they were soon discarded because no favorable contribution to the anesthesia could be discerned.

Nausea, retching, excitement, jactitation, soft tissue obstruction, aspiration and swallowing have been notably absent. There was no immediate or delayed induction or emergent delirium. Most of the patients claimed that their dreams occupied their period of narcosis, and that these dreams were always pleasant. Even children were attracted by the music and submitted docilely to the application of the nasal mask. Only one child of a large series refused to submit to the anesthetic. Only two adults reported slight perception of pain.

The early hesitancy in applying this technic in the poorer risk patients was soon abandoned except in those cases requiring extensive oral operations. It was found, however, that such surgical procedures could be performed in multistage operations. The increased surgical latitude that this technic provides in the poorer risk patient compensates considerably by permitting extension of the operating time from a minute or two to ten to fifteen minutes. The longest recorded administration in this series was twenty-three minutes.

It is not claimed that the idea of combining music with an anesthetic agent is original, but no evidence could be found in the literature indicating that music had been used to reinforce a general anesthetic, particularly in dentistry. Nor were we able to discover any previous description of a method employed as herein described: a remote volume control adjusted by the patient and an interconnected microphone to transmit instructions to the patient, eliminating the necessity of removing the earphones.

Burdick (34) placed a phonograph just outside the office so that muffled music came to the patient during a local anesthetic or during the induction phase of general anesthesia. "We observed that the anesthesia was almost invariably taken more calmly and with less tendency to resist the earlier inhalations than formerly. Also, and this was of no small importance, if the action of the machine was resumed for a few minutes as the patients were recovering consciousness, they were thereafter blended into a dreamy idea that they had heard the strains of the music from start to finish, without a break in their connection, and consequently, had escaped all operative interference, the cure effected having been as it were extraneous to any operative procedure."

Kirschner (35), McGlenn (36), (37), Rusca (38) and Kane (39) have used music to supplement local or spinal anesthesia. Podolsky (40) has advocated the usefulness of music in medicine in general.

Gatewood (41) presented some logic in her explanation of this anesthesia phenomenon: "If the attention of the individual be sufficiently centered on one stimulus or group of stimuli it may keep out all others. It is a neurological fact that two stimuli passing centrally at the same time tend to neutralize each other, the stronger more persistent one coming into consciousness. According to Meyer's principle of induction (a similar theory is advanced by Sherrington) the nervous process already stimulated along one pathway, tends to draw into its channel the processes established in adjoining neural pathways, thus increasing the intensity of the original excitation. Accordingly if we succeed in getting pleasant stimulation started first, it is more apt to dominate and later stimulation loses its own appropriate meaning in the flow of the original neural process." Thus, if pleasure through music is elicited prior to the initiation of pain stimuli, the sensations following, such as sleep and dulled pain, produced by the nitrous oxide-

oxygen become interpreted as pleasurable. "It seems logical to make the last waking stimuli as pleasant and as quieting as possible. Music causes one to forget grief, frets, and worries; it takes one's mind off the fear and dread of what is to come."

CONCLUSION AND SUMMARY

A technic of music with nitrous oxide oxygen anesthesia devoid of oxygen deprivation is introduced. It was found to render anesthesia adequate for all types of dental office procedures. Further advantages of this technic may be summarized as: (1) a smooth induction as exemplified by the complete absence of excitement, struggling, or delirium; (2) absence of retching or vomiting even after a recent meal; (3) rapid and complete emergence from the anesthetic state so that the patient requires no assistance or support when leaving the dental chair; (4) minimum chair occupation time, and (5) no undesirable effects in the poor risk patient. The occasional patient in whom this regimen is not adequate is so rare as to preclude any discussion.

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