

The Dental Learning Network



Nitrous Oxide Sedation Review

2 Homestudy Credit Hours

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Nitrous Oxide Sedation Review

(2 Credit Hours - \$30.00)

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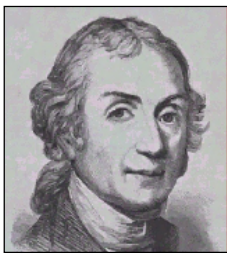
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Course Objectives

Upon completion of this course, the student should:

- Understand the history of nitrous oxide sedation.
- Know the benefits and risks associated with nitrous oxide sedation.
- Identify the risks associated with nitrous oxide abuse.
- Understand how to administer nitrous oxide sedation.
- Know the contraindications of nitrous oxide use.
- Know how to properly document a sedation case.
- Understand the protocol for disinfection of sedation apparatus between patients.



Nitrous Oxide is a colorless gas that is used commonly in the medical and dental professions as a sedative inhalant. Its chemical formula is N_2O . English scientist Joseph Priestley, who is best known for being the first to isolate oxygen, discovered nitrous oxide in 1793. Priestley initially thought it could be used as a preserving agent, but his attempt to perfect it as such failed. Humphrey Davy of Bristol, England was the first to experiment with the physiological properties of the gas. He observed its effects on respiration and behavior as well as its anesthetic properties. After observing the amusing effects on people who inhaled nitrous oxide, he coined the term “laughing gas.” Despite its potential medical uses, for the next few decades the gas was primarily used as a recreational drug.⁶

About the Author

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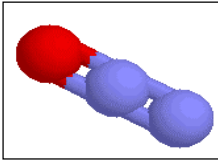
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History of Nitrous Sedation

It was not until 1844 that the gas was first used as an anesthetic. At that time, a medical school dropout named Gardner Colton put on a traveling show involving nitrous oxide. He put on a show in Hartford, Connecticut and during the show, a young man under the effects of the gas, gashed his leg while stumbling around the stage. The young man, though badly injured, was unaware of the injury until the effects of the gas wore off. A dentist in the audience, Horace Wells observed this and realized that N₂O may produce a painkilling effect. The following day he arranged an experiment in which he had his own molar extracted by his partner while under the effect of 100% nitrous oxide. Dr. Wells experienced no pain during the procedure and the birth of nitrous oxide as an anesthetic had arrived.^{6,7}

After this, Wells set out to unveil his discovery to the medical community. Unfortunately, while demonstrating the effects of nitrous oxide on a patient at Harvard Medical School, Wells' patient complained of feeling "slight discomfort" during the extraction. Wells was booed off of the stage and in the aftermath of the incident, he lost his professional reputation and eventually committed suicide. However, to this day, Wells is considered the "Discoverer of Anesthesia."

Gardner Colton continued to experiment with the gas and eventually opened a dental business through which he and his partners extracted around 75,000 teeth in a five-year span around 1868 using 100% N₂O anesthesia. Today, nitrous is widely used in both medicine and dentistry. Nitrous oxide has proven a very safe and popular sedative agent and a mild anesthetic agent at higher concentrations. Administered properly, the nitrous oxide-oxygen technique has a very high success rate with a very small number of adverse effects and complications.⁷



Nitrous Oxide Molecule. Nitrous oxide produces analgesic and anxiolytic effects. The exact mechanism of action through which these effects are perpetuated is unknown. However, the most widely accepted theory is that the analgesic effect is mediated through interaction with the opioid receptors. These are the same receptors activated by morphine and heroin. This stimulation occurs in the midbrain leading to activation of the descending inhibitory pathways, which alters pain processing in the spinal cord. The anxiolytic effect is mediated through interaction with the GABA-A receptors. The mechanism of action closely resembles that of ethanol. GABA is an inhibitory neurotransmitter that inhibits the pre-synaptic cells from transmitting thus decreasing nervous system activity.

Medical and Dental Uses

Nitrous oxide gas is used in both the medical and dental professions to ensure patient comfort during procedures. In medicine, a 40%-70% N₂O mixture (the remainder consisting of oxygen) is used as an adjunct to inhalation and IV general anesthesia. The gaseous mixture is administered using either a mask or an endotracheal tube. Nitrous is useful in medicine due to its relative fast rate of induction. The onset of action for N₂O is between 2-5 minutes. However, since the mean alveolar concentration (MAC) of N₂O considered the ED50 for general anesthesia (the dose at which 50% of patients will experience anesthesia) is 105%, nitrous cannot be used alone as a general anesthetic. Typically, it is only used to help start the process.

In dentistry, nitrous oxide is typically used as an anxiolytic. It is given in a 25%-50% mixture with oxygen. Most often it is administered through a nasal mask. The patient should be started out breathing 100% oxygen and then slowly allowed to breath increasing amounts of N₂O until the desired effect is achieved. It is important that the patient be reminded to breathe through the nose in order for the gas to work. The patient should be questioned as to how they are feeling to ensure an optimal level of nitrous is being administered. Therapeutic levels will vary from patient to patient. If the nitrous level being administered is too low, the patient will not be receiving an effective anxiolytic dose. If the nitrous level is too high, unwanted side effects may occur. After the procedure is finished, allow the patient to breathe 100% oxygen again for 2-5 minutes in order to clear the nitrous from the lungs and return the patient to a normal feeling.



Introduction

Patient anxiety has always been a major issue in dental offices. Practitioners have jumped at any potential tool that could be used to help alleviate this anxiety. Less patient anxiety leads to greater treatment acceptance and, in the long term, more business. With the plethora of pharmaceutical options available these days, dentists have more choices than ever. Many of these choices require specialized training of the dentist and staff as well as specialized safety equipment (pulse oxymeter). Due to its relative safety and efficacy, nitrous oxide remains the leading anxiolytic used in dental offices today.

As previously stated, nitrous oxide is used in the dental office for its calming effects. It enables patients to better tolerate lengthy dental procedures and makes the overall experience more of a positive one. Many practitioners will tell you that it can be a tremendous practice builder. Nitrous is generally administered in a 25-50% mixture with oxygen. It is administered through a small mask that covers the patient's nose. Some patients may feel uncomfortable having their nose covered so the dentist should closely monitor the patient for the first few minutes of use. Likewise, patients who have trouble breathing through their nose may be better off abstaining from nitrous use. Some patients only require nitrous to overcome their anxiety and fear of receiving an intraoral injection. Good communication with the patient should bring any problems to light early in the procedure.

The Benefits of Nitrous Oxide Sedation

1. Increase patient comfort and enjoyment
2. Safe and effective
3. Potential practice building tool
4. Short recovery time
5. Short duration of onset
6. Easy to administer



***Nitrous Oxide
Propellant Canisters***

When a patient is receiving nitrous oxide for the first time, the dentist or assistant should explain to the patient what the experience would feel like. This discussion should include what to look for in the instance that the patient is receiving too high a dose of the gas. At a proper therapeutic dose, the patient will experience tingling in the hands and feet. They will feel a slight “floating” sensation and a general disconnectedness to what is occurring around them.

At a correct therapeutic level, the experience will be very positive for most patients. If the level of nitrous administered is too high, the patient will begin to experience slight to severe nausea, uncontrollable giggling (hence the nickname “laughing gas”) and may even experience a greater sense of anxiety than they would have had without the nitrous. Communication with the patient is instrumental in ensuring the patient is receiving the correct dose. It is generally recommended that the patient be started on 25% nitrous with the percentage being increased if the desired effect is not being achieved.



Modern nitrous oxide delivery systems employ “fail-safe” mechanisms that allow a minimum of 30% oxygen to be delivered at any given time. When you consider that the atmosphere we breathe everyday is made up of around 21% oxygen, this fail-safe mechanism ensures that the body is never oxygen starved during the administration of nitrous oxide. Modern nitrous machines also ensure that if at any point during sedation the office supply of bottled oxygen runs out, the nitrous oxide will be automatically shut off. This guarantees that the patient will not at any point be breathing 100% N₂O. Both the flow meter delivery system and the tanks from which the gasses are dispensed uses the universal color-coding for both nitrous oxide (blue) and oxygen (green). The flow meter balls are calibrated so that when the ratio of nitrous to oxygen is 50/50, the balls are floating at the same level. If a practitioner were to adjust only the oxygen level, the nitrous level would adjust to keep this ratio the same. In order to increase or decrease the percentage of nitrous oxide being administered, the nitrous oxide lever must be adjusted. Next to this lever is typically a listing of percentages for ease of adjustment. The tanks that these gasses are dispensed from follow also follow the same color code. The pressure of gas inside the tanks is an indication of the amount left. This can be monitored using the nitrous oxide manifold that is typically located near the tanks.

It is important that administration of nitrous oxide in a dental setting be closely monitored. Long term, chronic exposure to nitrous can cause serious health problems. With this in mind, a very important part of the nitrous oxide armamentarium is the scavenger system. This system employs a vacuum to remove any gas exhaled through the patient's nostrils or escaping from the nosepiece. The nosepiece is also provided with a plurality of holes in the underside to scavenge gas exhaled through the patient's mouth. This helps minimize gas leakage into the environment and potential exposure to health care workers.



Nitrous Oxide Delivery Masks

The dangers associated with nitrous use in the dental office are few but potentially very serious. Women who are known to be pregnant or think they may be pregnant should not use nitrous. N_2O has shown teratogenic properties in rodents. While the few studies involving humans have been inconclusive, it is prudent to refrain from administering N_2O to pregnant women. Nitrous oxide itself is not a flammable gas. However, since it is administered with oxygen (which is flammable), the mixture is flammable and can pose a problem in select situations. The use of a diamond bur on titanium or other metals can cause sparking and may lead to ignition of the oxygen being administered. This may sound far-fetched but cases of this have occurred and it is a legitimate concern. Always use carbide burs to cut titanium in the presence of flammable gas.

Patient Understanding

There are some frequently asked questions associated with nitrous oxide sedation and it is important that the patient be fully informed before determining whether or not to be sedated. Patients are often concerned about whether or not they will be able to drive home after their procedure. One of the characteristics of nitrous that makes it so ideal for use in a dental setting is its short recovery time. After the procedure is finished, the nitrous should be turned off leaving the patient breathing 100% oxygen. This should continue for 3-5 minutes to help avoid the onset of diffusion hypoxia and to clear the nitrous oxide from the lungs. After this time period, the patient should be returned to an upright position and allowed to sit in this manner for an additional couple of minutes. By this time the patient should be feeling "normal" again and should be fine to drive home. Naturally, the recovery time differs from patient to patient so communication will help determine when a patient is fit to leave the operatory. Another common patient concern is the level of sedation. Many patients are under the impression that they are being put to sleep. It is important that patients understand that they will be aware of all that is going on and will remain in total control during the procedure. Patients also must understand that nitrous oxide, though able to make a procedure more comfortable, is not a replacement for administration of local anesthetic. Nitrous oxide sedation may or may not be covered by insurance and the additional cost to the patient, if any, should be discussed prior to treatment.

Contraindications of Nitrous Oxide Use

One of the great advantages to using nitrous oxide in a dental setting is the relative safety if used correctly. There are relatively few contraindications for nitrous oxide use. These contraindications for nitrous use include women who are in the first trimester of pregnancy,

any person who has chronic obstructive pulmonary disease (COPD), and patients undergoing bleomycin sulfate treatment. So why is nitrous oxide contraindicated for these patients? Lets examine these individually.

For pregnant patients, the ADA recommends that elective dental treatment only be given in the 2nd trimester of pregnancy. If a pregnant patient requires dental treatment, it should be postponed until either the second trimester, or, if possible, until after the baby is born. If an emergency procedure is necessary, then the most important thing is to get the patient out of pain. However, any treatment should be discussed with the patient's obstetrician prior to the procedure.



In most cases, nitrous oxide should not be used on pregnant patients. This is due to some evidence linking its use to a higher risk of miscarriage in dental assistants operating in offices without scavenging equipment. It should be noted that dental assistants undergo prolonged exposure whereas patients would undergo far less exposure. It is up to the patient and the dental practitioner to ultimately weigh the risk versus the benefit of any dental procedure. Regardless informed consent is a must in these types of situations.

Bleomycin sulfate is an antineoplastic pharmaceutical agent used for patients who have certain types of cancers. This medication works by binding to the DNA molecule and cleaving it, thus inhibiting DNA synthesis and further cell propagation.¹¹ Patients undergoing bleomycin treatment are predisposed to respiratory failure following exposure to high concentrations of oxygen. The FDA recommends that in any circumstance, these patients receive no more than 25% oxygen.¹² Since high concentrations of oxygen are generally used in nitrous oxide sedation, there is no way to avoid possible problems in these patients other than to abstain from using N₂O sedation. It is also important to be aware that the susceptibility to respiratory failure can be an issue for these patients up to one year after succession of bleomycin therapy.¹¹



Chronic obstructive pulmonary disease (COPD) is a group of chronic lung diseases caused by the long-term inhalation of chemical irritants. The main culprit is cigarette smoking (80-90% of cases). These patients suffer from two diseases, emphysema and bronchitis, both of which make breathing very laborious. Damage to the alveoli in the lungs is a characteristic of emphysema. They do not perform gas exchange as easily or efficiently as someone with healthy lungs would. COPD patients depend on low O₂ concentrations in the blood as their primary stimulant for respiration. Use of high dose oxygen in these patients effectively cancels out this system and can cause respiration to cease.¹³

Some textbooks and practitioners list “a history of psychiatric problems” as a contraindication to nitrous oxide sedation. However, in this day and age, a good many people are taking “mood altering” drugs of some sort, whether they be SSRIs or antidepressants. These have become a relatively normal course of therapy. However, patients taking these medications have a history of psychological problems, though many of them are minor. In some cases, these are the patients who benefit the most from sedation. In my opinion, this is no longer a contraindication for nitrous oxide use. However,

practitioners should be aware of the potential for problems and consider each patient individually. Many times just talking to a patient for a few minutes can give you a pretty good idea of their mental state and allow you to better predict how they will react to sedation.

The Dangers of Nitrous Oxide Use and Abuse

1. Oxygen deprivation of the brain.
2. Diffusion hypoxia
3. Bone marrow suppression
4. Decreased fertility
5. Liver and kidney disease
6. Peripheral neuropathy
7. Mixture of N₂O / O₂ is flammable

Documentation

In this day and age of frivolous malpractice lawsuits, it is important to document all aspects of any given procedure. The details concerning the administration of nitrous oxide sedation must be added to your post procedural write-up. The details that must be included are the percentage of nitrous given, the percentage of oxygen given, the length of time the patient was sedated and the flow of gas administered. Also, if the patient had any negative or atypical reactions to the sedation, these should be included also. For the doctor's convenience, the percentage of nitrous oxide given could be included for easy reference during future appointments. This would avoid any tinkering during the procedure to reach an ideal therapeutic level, as this level has already been determined. For instance:

"Patient given 25% N₂O/75% O₂ for 45 minutes @ 7 L/min. Patient initially given 35% N₂O/65% O₂ and reported "slight uneasy feeling" in stomach – N₂O level was subsequently adjusted and comfortable level of sedation achieved."

This is a very detailed description that can be tailored to fit each practitioner's style. For instance, if the patient experiences no ill effects, there is no need to document the patient's reaction to the sedation. If the patient has a serious negative reaction, they should be advised against having sedation performed in the future and the reaction should be noted in the chart.

Disinfection

Disposable nose masks are available and widely used due to their convenience. However, if a reusable nosepiece is used, it is important to disinfect it between each patient. Nosocomial infections have occasionally been linked with the use of unsterile inhalation devices due to cross contamination. The recommended technique for disinfection of these masks is the use of an alkaline glutaraldehyde solution.⁴

Abuse and Adverse Effects



Due to the ability of nitrous oxide to produce a disconnected, dream-like high, it is a commonly abused substance. Outside of the medical and dental professions, it is typically administered in 100% concentrations. This practice has been going on since N_2O was invented in 1793. Common street names for nitrous are “laughing gas” and “whippets.” Believe it or not, cans of whip cream are a source for the gas due to their use of N_2O as a propellant. When allowed to settle, the gas separates from the cream allowing only the gas to escape when the lever is pressed.⁵

Nitrous oxide given in 100% doses can be dangerous for several reasons. In the short term, when pure N_2O is inhaled, the brain is oxygen starved for a very short time. During this time, the individual may experience a brief black out period. During this black out period, the individual loses psychomotor function resulting in physical injuries due to accidents (most often falling and hitting their head). Often this will lead to serious head trauma and broken bones and teeth. Other dangers from acute nitrous use include nausea and diffusion hypoxia.³ Diffusion hypoxia occurs when the nitrous is discontinued at the end of the procedure and produces a “hangover” type effect in the patient. Rapid diffusion of nitrous oxide from the blood back into the alveoli of the lungs results in a displacement of oxygen from the lungs and a subsequent drop in pO_2 . However, some literature indicates that this leads to a drop of around 2% in oxygen saturation and is only an issue in patients with an airway obstruction or cardiopulmonary disease.^{1,2} Any problems can be avoided by allowing the patient to breathe 100% O_2 for 3-5 minutes after discontinuation of nitrous oxide.

Prolonged use can lead to severe systemic problems. Bone marrow suppression is the most severe of these problems. Inactivation of methionine synthase (a vitamin B_{12} dependant enzyme) by long term N_2O use causes interference in the production of leukocytes and red blood cells. This can lead to anemia as well as a decrease immune response. Other dangers include hepatic and renal disease, peripheral neuropathy and decreased fertility in females. These conditions are similar to those seen in Vitamin B_{12} deficient individuals.³

Conclusion

Nitrous Oxide sedation has become a staple in the dental and medical industry. More and more patients are asking for it and many will not get any work done without it. The widespread use of nitrous over the years has only strengthened the confidence that practitioners have in both its effectiveness and its safety. Likewise, nitrous oxide sedation has provided a means through which those people who are extremely anxious dental patients can be comfortable and get the dental work they need done. The value of a comfortable patient cannot be underestimated in both patient acceptance of treatment and practice building due to word of mouth. Nitrous oxide is a great tool to add to help grow your practice and keep your patients happy.

Please mark only one **best** answer to the following questions on the one page answer sheet. Return the answers by mailing or faxing the answer sheet or entering your answers on the form available on our website at <http://www.fice.com/>.

This test contains 10 questions. Please mark your answers in spaces numbered 1 through 10 on your answer sheet.

1. Nitrous oxide was first considered for use in a dental setting by...
 - a. Joseph Priestley
 - b. Horace Wells
 - c. Humphrey Davy
 - d. Garner Colton
2. Nitrous oxide is used in dentistry as a general anesthetic.
 - a. True
 - b. False
3. In order to avoid the onset of diffusion hypoxia after nitrous oxide use, you should...
 - a. Place the patient in a supine position.
 - b. Shut the nitrous machine off and immediately dismiss the patient
 - c. Allow the patient to breath 100% N₂O for 3-5 minutes.
 - d. Allow the patient to breath 100% O₂ for 3-5 minutes.
4. It is normal for a patient to experience _____ during administration of nitrous oxide sedation.
 - a. Tingling in the hands and feet
 - b. Nausea
 - c. Tremors
 - d. Uncontrollable giggling
5. When documenting the administration of nitrous oxide sedation, which fact need not be included?
 - a. percentage of nitrous oxide administered
 - b. percentage of oxygen administered
 - c. duration of nitrous sedation
 - d. patients reaction to sedation
6. Nitrous oxide is contraindicated for pregnant women due to an increased risk of fetal hypoxia.
 - a. True
 - b. False

7. Nitrous oxide is contraindicated in patients undergoing bleomycin sulfate treatment due to...
 - a. a pharmaceutical reaction between the two drugs
 - b. the greater potential for respiratory failure
 - c. nitrous canceling out the effect of the bleomycin sulfate
 - d. nitrous oxide is not contraindicated in these patients

8. Nitrous oxide is contraindicated in patients who have chronic obstructive pulmonary disease (COPD) because...
 - a. these patients take medications that interfere with the anxiolytic effect of N₂O
 - b. they require upwards of 70% nitrous oxide for any anxiolytic effect
 - c. high dose oxygen can cause cessation of respiration
 - d. nitrous oxide is not contraindicated in these patients

9. A history of psychiatric problems is an absolute contraindication for nitrous oxide use.
 - a. True
 - b. False

10. The most serious problem arising from prolonged nitrous oxide abuse is...
 - a. bone marrow suppression
 - b. chemical dependency
 - c. chronic bronchitis
 - d. decreased cerebral function

(end of test)

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