

Inhalational Sedation in Dentistry

Inhalation Sedation presents a perfect means of assuaging dental fear. The utilization of Sedation in dentistry is for the reduction of dental anxiety, irritability and to allow the dentist to work more effectively and efficiently in a relaxed and comfortable environment as possible.



Dental fear is one of the most intense and difficult fears to overcome. Inhalation Sedation presents a perfect means of assuaging this apprehension. It is reported that most of the dental patients will be agreeable to go to the dentist more frequently if general anaesthesia and conscious sedation were more readily available. The utilization of Sedation in dentistry is for the reduction of dental anxiety, irritability and to allow the dentist

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The American Society of Anaesthesiologists defines the continuum of sedation as follows:

1. Minimal sedation: Normal response to verbal stimuli.
2. Moderate sedation: Purposeful response to verbal/tactile stimulation (this is usually referred to as conscious sedation).

3. Deep sedation: Purposeful response to repeated or painful stimulation.
4. General anaesthesia: Unarousable even with painful stimulus.

Sedation by N_2O-O_2 is minimal sedation, a minimally depressed level of consciousness that retains the patient's ability to independently and continually maintain an airway and respond normally to tactile stimulation and verbal command. Mostly, the cognitive functions are moderately impaired and

the ventilator, cardiovascular functions remain unaltered.

Properties of Nitrous-Oxide

Physical

- It is an inorganic gaseous agent.
- Colourless.
- Odourless to sweet smelling.
- Non-irritating to the tissues.
- Non-inflammable but will support combustion.
- Molecular weight 44.
- Specific gravity 1.53, heavier than air.

Chemical

- Liquid under pressure in cylinder.
- Gaseous state when released from the cylinder.

Pharmacological

- Blood-gas solubility: It is the amount of gas distribution in blood through the body. N_2O-O_2 is dissolved and transported in blood without any biotransformation i.e. complete elimination from body through expiration devoid of any traces remaining behind in the body. The rapid removal of Nitrous Oxide from the body is due to its low blood-gas solubility coefficient (0.47).
- Minimum Alveolar Concentration (MAC): This represents the concentration of the N_2O-O_2 gas that renders 50% of the patients unresponsive to a surgical stimulus. Nitrous Oxide has low potency, (MAC 104) making it ideal in allaying apprehension and anxiety during any treatment in general. Ventilatory and Cardiovascular functions are minimally influenced, particularly when evaluated with more potent agents. However, caution is advised when Nitrous Oxide is combined with other anaesthetics, sedatives, or opioids. These agents can lower the MAC for Nitrous Oxide but also work synergistically in depressing Respiratory and Cardiovascular function.
- Diffusion Hypoxia: When a patient is recovering from N_2O anaesthesia,

large quantities of N_2O crosses from the blood into the alveolus causing O_2 and CO_2 in the alveolus diluted. This could cause the partial pressure of Oxygen to decrease and could temporarily lead to Hypoxia. The decrease in CO_2 would suppress ventilation, leading to potential Hypoxaemia. Nonetheless, this effect would only last a couple of minutes and it can be avoided by increasing inspired Oxygen concentration to 100% when recovering from N_2O anaesthesia.

Advantages & Disadvantages of Nitrous-Oxide

Advantages

- Mild Sedation Agent: In 1844, N_2O was used for the first time as an anaesthetic drug in dentistry by Dr. Horace Wells as a method of pain control in his office at Hartford, Connecticut. Today, N_2O-O_2 is used extensively as an anxiolytic drug which is considered as the safest sedative in dentistry. N_2O has only minor anaesthetic properties and must be used as an adjuvant to a local anaesthetic to suppress the pain caused by dental work.
- Analgesic and Anaesthetic Effect: Nitrous Oxide produces a mild analgesic effect. The most common estimate of analgesic efficacy suggests that 30% N_2O delivered through the full mask is equivalent to 10 - 15 mg morphine.
- Cardiovascular Effect: N_2O mildly depresses Myocardial Contractility. Usually, in Coronary Artery Disease patients, sub-anaesthetic concentrations of N_2O (0.1 to 0.5 MAC) have minimal influence on cardiac output, stroke volume, and heart rate. Sub-anaesthetic concentration of nitrous oxide does not show any variations in the Arterial blood pressure. It increases venous return to the heart and this likely contributes to the steady



Cardiovascular Function experienced with Nitrous Oxide.

Disadvantages

- Lack of potency (Can't be used alone).
- Dependency on psychological reassurance suggesting good patient cooperation.
- The patient must be able to breathe through the nose (Respiratory tract should be devoid of any obstruction).
- The nasal hood interferes with injection to the anterior maxillary region.
- High risk of N_2O pollution and potential occupational exposure health hazards if scavenging system not used in operatory.

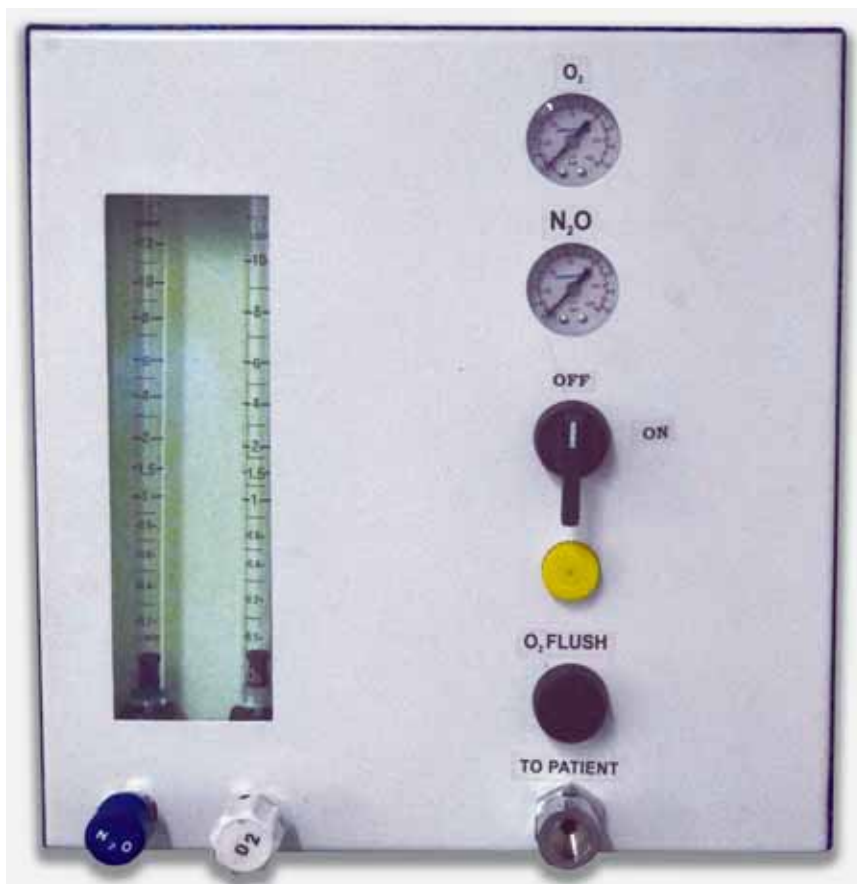
Indications, Contraindications & Caution for using Nitrous-Oxide

Indications

Patients with ASA I, II, III would be acceptable candidates for N_2O analgesia. The purpose of N_2O -Oxygen inhalation includes:

- Anxiolysis.
- Lessening of the untoward reaction to dental treatment.
- Raising the pain threshold reaction.

Sedation



- Increasing the acceptance for longer appointment.

Contraindications

- Chronic Obstructive Pulmonary disease patients.
- Children in pre-cooperative state (below 3 years) who are unable to respond appropriately during the procedure.
- Severely emotionally disturbed or drug-related dependencies.
- First trimester of pregnancy.

Caution

Caution should be used with patients suffering from:

- Congestive Heart Failure.
- Sickle Cell disease.
- Acute Otitis Media, recent Tympanic Membrane Graft.

Preoperative Evaluation

Dental procedures are often uncomplicated. Thus extensive patient evaluation is unnecessary. N_2O-O_2

sedation needs basic evaluation of patients to check the possibility of congestion in the respiratory tract. A verbal evaluation of the patient to check the maturity to respond during the sedated state (Young children below 3 years may not respond appropriately).

Armamentarium

Nitrous Oxide-Oxygen Delivery Systems

Two types of Nitrous Oxide-Oxygen delivery systems are available commercially.

- **Portable System:** It has a transportable yoke stand (Wheels attached) with attachment facility for 4 size E (15-pound) Nitrous Oxide and Oxygen tanks. The advantage of this N_2O-O_2 equipment is its portability between multiple dental operatories.
- **Fixed System:** It is a plumbed in central system. The immovable yoke

is directly fixed on the wall or dental chair. This option is more economical as N_2O and O_2 cylinder size G or H can be used which will require less frequent refills.

Monitoring Equipment

- Pre-tracheal stethoscope.
- Pulse oximeter (SpO_2 and Pulse rate).
- Monitoring of inflation and deflation of reservoir bag.

Technique

- Fasting is not required. A light meal can be consumed in 2 hours before the time of administration of N_2O-O_2 .
- Informed written consent to administer N_2O-O_2 should be taken separately apart from consent to dental treatment.
- Selection of an appropriately sized nasal hood (Different sizes available).
- Start the gas with 100% oxygen flow before the nasal hood placement. A flow rate of 5 to 6 L/min (Adult) generally is acceptable to most patients but sometimes higher flow rates may be required. Patient will feel suffocated with very slow flow rate. Continuous monitoring of reservoir bag can help in adjustment of the flow rate.
- Allow the patient to breathe the 100% oxygen for 2 to 4 minutes before turning on the N_2O . Increase N_2O in 10% intervals to desired level (30% or 50% Nitrous Oxide). N_2O provides pain control upto 25%. Subsequent to 25% it begins to produce light anaesthesia.
- Preferably do not exceed a 50:50 N_2O/O_2 mixture.
- When the patient begins to feel tingling in extremities or is sedated, administer local anaesthesia (LA). Titration of the nitrous oxide level should be kept at a higher level during the administration of local anaesthesia. Once the LA works, the N_2O concentration can be titrated to lower level.
- During treatment, the patient's



N₂O are given blue colour universally. While parts (tubes, knobs, cylinder) carrying Oxygen have colour white (With exception colour green in the USA).

- Diameter-Index Safety System (DISS): Non-interchangeable indexing of removable connections for use with medical gases (attachment of gas tubing components) has been added in the equipment.

- Emergency air inlet: There is an emergency air inlet for ambient air to be allowed to enter the system so that the patient can continue to breathe through the nasal hood or face mask.

- Minimum Oxygen litre flow: A minimum litre flow of 2.5 to 3.0 litres of oxygen per minute is mandatory for Nitrous Oxide to be

transported through the machine. If the Oxygen flow rate reduces below this level, the machine turns off N₂O supply automatically. The backup safety features for the minimum Oxygen litre flow are the low-oxygen pressure alarm, the Oxygen fail-safe valve and the emergency air inlet.

- Minimum Oxygen percentage: Concentration of Oxygen never decreases below 30% during gas delivery.

- Oxygen Fail-Safe System: The Oxygen Fail-Safe System is intended to cut off N₂O supply automatically when O₂ delivery is compromised or depleted.

- Oxygen flush button: The Oxygen flush button allows 100% Oxygen to be administered through a reservoir bag in the event of an emergency.

- Pin-Index Safety System (PISS): The pins projected from the yoke have a distinctive configuration that fits into corresponding holes in the tank

valves. Six targets for each of the two pins to be inserted are possible. These targets are measured in millimetres from the edge of the yoke (1-6 mm). For Oxygen tanks, the pins are inserted at the 2 and 5 mm positions, and for N₂O tanks, the pins are inserted at the 3 and 5 mm positions

- Quick connect for positive-pressure Oxygen: In an emergency situation in which positive-pressure Oxygen is required, (supplement Cardio-pulmonary Resuscitation) quick-connect compatibility ensures immediate access to positive-pressure Oxygen anywhere in the operatory.

- Reservoir bag: The reservoir bag (breathing bag) signifies the breathing of the patient. The bag should be kept partly full. It should not be overfilled as it is difficult for the patient to breathe against positive pressure. Empty bag denotes the gas flow is inadequate or there is a leakage in the system.

Conclusion

Nitrous Oxide-Oxygen is one of the best minimal sedatives available presently. When administered appropriately by accurate technique with properly maintained equipment, N₂O-O₂ sedation is one of the safest and most effective means to use to alleviate patients' anxiety and fear in the dental office. **+**

respiration and the level of consciousness should be constantly monitored.

- Once the procedure is terminated, turn off the N₂O flow and allow the patient to breathe 100% Oxygen for 3 to 5 minutes to reduce the chances of Diffusion Hypoxia.
- The patient must return to pre-treatment responsiveness before discharge.

Safety Features

With large margin of safety of Nitrous Oxide-Oxygen administration itself, certain important safety features have been advocated by American Dental Association (ADA) Council on Scientific Affairs.

- Alarms: Nitrous Oxide-Oxygen delivery systems have a number of audio and visual alarms. These low-oxygen-pressure alarms will sound or flash immediately if the oxygen gets depleted below a specific level.
- Color-coding: All parts (tubes, knobs, cylinder) of the equipment that carry



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