Medical and Research Publications
International Open Access

Review Article **Journal of MAR Dental Sciences (Volume 3 Issue 2)**

Nitrous Oxide Sedation: A Review

Gurman Pal Mallhi*

Corresponding Author: Gurman Pal Mallhi BDS, Adesh Institute of Dental Sciences and Research, Bathinda, Punjab, India

Received Date: July 25, 2021

Published date: August 01, 2021

Abstract

The American Academy of Pediatric Dentistry (AAPD) recognizes nitrous oxide/oxygen inhalation as a safe and effective technique to reduce anxiety, produce analgesia, and enhance effective communication between a patient and health care provider. Sedation should be considered as part of the management of pain and dental anxiety, to make the treatment a pleasant learning experience. Conscious sedation is a safe method with a wide safety margin that can be used effectively in managing dental fear and anxiety and can reduce the need for general anesthesia. Inhalation sedation using nitrous oxide is the recommended choice for conscious sedation in children. This article reviews article provides various aspects of nitrous oxide sedation in pediatric dentistry.

Keywords: *Pediatric dentistry, Pediatric patient, Conscious sedation, N2O/O2, Nitrous oxide.*

Introduction

The reduction of pain and anxiety in child dental patients has been an issue for a long time. Although the majority of pediatric dental patients could be managed by conventional behavior management methods, a fair number of them require pharmacological intervention. For these children, conscious sedation or general anesthesia are the primary treatment options that allow comprehensive restorative dental care. Because of the risks and costs involved with general anesthesia, conscious sedation is often the option of the first choice. Although most pediatric dentists prefer using oral sedation, parenteral sedation techniques are also popular.

Conscious sedation is defined as a technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal contact with the patient is maintained throughout sedation. The various drugs and techniques used in providing conscious sedation for dental treatment should carry a margin of safety wide enough to render loss of consciousness unlikely.**[**3**]**

The American Academy of Pediatric Dentistry (**AAPD**) recognizes nitrous oxide/oxygen inhalation as a safe and effective technique to reduce anxiety, produce analgesia, and enhance effective communication between a patient and health care provider. Nitrous oxide is a colorless and virtually odorless gas with a faint, sweet smell. It is an effective analgesic/anxiolytic agent causing central nervous system (**CNS**) depression and euphoria with little effect on the respiratory system. **[**4**]**

This review of the literature article aims to discuss various aspects of nitrous oxide sedation in pediatric dentistry.

Goals of Nitrous oxide sedation: [5]

1. Promoting patient welfare and safety.
2. Facilitating provision of quality care.
3. Minimizing the extremes of disruptive behavior.
4. Promoting a positive psychological response to treatment.
5. Returning the child to a physiological state in which safe discharge is possible.

The objectives of nitrous oxide/oxygen inhalation: [4]

Conscious sedation techniques possess several characteristics that differentiate them from unconscious modalities. In general, conscious techniques:

1.It should alter the patient's mood, thus making him psychologically receptive to dental treatment.

2.It must allow the maintenance of consciousness throughout the procedure.

3.It must result in patient cooperation. Numerous studies carried out at the University of Pittsburgh have shown that chairside productivity is increased by a minimum of 30% when conscious sedation is utilized for dental procedures (Bennett, in preparation).

4.It should raise the pain threshold that is usually beneficial particularly when long appointments are contemplated.

Nitrous Oxide:

The first clinical application of nitrous oxide (N2O) was in 1844, by an American dentist named Horace Wells who used it to control pain during tooth extraction. Since then, N2O has shared a 170-year history with modern dental anesthesia. N2O, an odorless and colorless gas, is very appealing as a sedative owing to its anxiolytic, analgesic, and amnestic properties, rapid onset and recovery, and, in particular, needle-free application. **[**6**]**

Machines intentionally designed for the administration of inhalation sedation in dentistry should be used and be capable of administrating N2O to a maximum limit of 70% with not less than 30% of oxygen in volume, even though in the majority of cases, adequate analgesia is achieved with concentrations of N2O that do not exceed 50% in volume. These machines must be in conformity with the European (or otherwise applicable) legislation and be maintained and serviced according to the producers' orientations. It is also important that regular maintenance be documented, where all safety rules must be respected, such as, the presence of a device that cannot fail in an emergency (if the oxygen pressure drops, N2O supply must automatically stop). **[**7**]**

Preparation for Conscious Sedation: Special consideration should be given because of pediatric patients, the problem of the dental chair and dental set up and because of oral surgery as there are more chances of aspiration in sedated patients. **[**8**]**

The patient, parent, escort, guardian, or caregiver must be advised regarding the procedure associated with the delivery of any sedative agents, and informed consent for the proposed sedation must be obtained. Pre-operative dietary restrictions must be considered based on the sedative technique prescribed. Pre-operative verbal and written instructions must be given to the patient, parent, escort, guardian, or caregiver. Baseline vital signs must be obtained unless the patient's behavior prohibits such determination. A focused physical evaluation must be performed with a particular focus on the airway. **[**9**]**

Pre sedation check-up: Pediatric patients are classified according to the American Society of Anesthesiologists class and then considered for sedation. The patient is checked for adenotonsillar hypertrophy and anatomic airway abnormalities. A child with a special need may require individual consideration. Practitioners are encouraged to consult with appropriate specialties for underlying medical and surgical conditions. The pediatric patient should be accompanied by a parent, legal guardian, or another responsible person. **[**10**]**

Consent: Preoperative instructions are given to the child and parent/guardian in writing. Informed consent is taken. An adult well known to the child should accompany to and fro to the hospital. Only in context to school dental clinics and use of nitrous oxide/oxygen sedation do schoolchildren with parents' consent get treatment without the presence of an adult. **[**10**]**

Fasting guidelines: Before conscious sedation, it is recommended that the patient has fasted accordingly:

- No clear liquids 2–3 h before sedation
- No Breast milk or nonclear fluids 4 h before sedation
- No formula milk 6 h before sedation
- No solids 8 h before sedation

For emergency, where proper fasting is not assured, increased risk weighed against benefits of treatment and the lightest effective sedation is used. If the possible patient may benefit by delaying the procedure. The risk of aspiration during procedural sedation likely differs from that during GA. **[**11**]**

Back up emergency facilities and emergency services: The institution using sedation should have facilities, equipment and personnel to manage emergency and rescue situation. **[**12**]**

Preparation and setting up sedation procedures: Part of the safety net of sedation is to use a systemic approach and the most commonly used acronym useful for planning and preparation for the procedure is **SOAP-ME:**

S: Size appropriate suction catheter and apparatus

O: Adequate oxygen supply and functioning flow meters/other devices to allow its delivery

A: Size appropriate airway equipment (nasopharyngeal and oropharyngeal airway, laryngoscopes blades, endotracheal tubes, face mask, bag-valve-mask)

P: Pharmacy; all the basic drugs to support life during an emergency

M: Monitors; functioning pulse oximeter with size appropriate oximeter probes and other monitors (e.g.: Non-invasive blood pressure, end-tidal carbon dioxide, ECG, and stethoscope)

E: Special equipment or drugs for a particular case (e.g.: Defibrillator). **[**4,10**]**

Patient selection: The indications for use of nitrous oxide/ oxygen analgesia/ anxiolysis include:

- A child mature enough to understand the procedure, usually older than 7-8 years;
- A fearful or anxious patient;
- Children with special health care needs;
- A child whose gag reflex interferes with dental care;
- A patient for whom profound local anesthesia cannot be obtained;
- Lengthy dental procedures. **[**12**]**

Review of patient's medical history should be assessed and should include: History of previous allergic or adverse drug reactions;

- Medications including dose, time, route, and site of administration;
- Systemic disorders;
- Previous hospitalization to include the date and purpose. **[**12**]**

Contraindications of Nitrous Oxide Sedation [12**]**

Nitrous oxide is considered safe for its use in medicine and dentistry, but similar to any drug may not be suitable for all patients. It is very important to carefully review the medical history of a patient and to consider the small number of situations in which nitrous oxide sedation may be contraindicated or may at least pose a relative contraindication.

Use of Nitrous oxide sedation should be avoided in the following conditions: Chronic obstructive pulmonary diseases, Severe emotional disturbances or drug-related dependencies, first trimester of pregnancy, treatment with bleomycin sulfate, methylenetetrahydrofolate reductase deficiency, Cobalamin deficiency

The technique of nitrous oxide/oxygen administration

Nitrous oxide/ oxygen should be administered by appropriately trained individuals, or under the direct supervision thereof. **[**12**]**

Selection of an appropriately sized nasal hood should be made. A flow rate of five to six liters per minute (**L/min**) generally is acceptable to most patients. The flow rate can be adjusted after observation of the reservoir bag. The bag should pulsate gently with each breath and should not be either over or underinflated. The introduction of 100% oxygen for one to two minutes followed by titration of nitrous oxide in 10% intervals is recommended. During nitrous oxide/oxygen analgesia/anxiolysis, the concentration of nitrous oxide should not routinely exceed 50%. To achieve sedation, clinicians should keep the patient's talking and mouth breathing to a minimum, and the scavenging vacuum should not be so strong as to prevent adequate ventilation of the lungs with nitrous oxide. **[**4**]** According to Malamed et al. patients undergoing nitrous oxide-oxygen inhalation sedation demonstrated that the typical patient requires from 30 to 40% nitrous oxide to achieve ideal sedation. Nitrous oxide concentration may be decreased during easier procedures (e.g., restorations) and increased during more stimulating ones (e.g., extraction, injection of a local anesthetic). During treatment, it is important to continue the visual monitoring of the patient's respiratory rate and level of consciousness. The effects of nitrous oxide largely are dependent on psychological reassurance. Therefore, it is important to continue traditional behavior guidance techniques during treatment. Once the nitrous oxide flow is terminated, 100% oxygen should be administered until the patient has returned to pre-treatment status. The patient must return to pre-treatment responsiveness before discharge. **[**4**]**

Review of literature

Author	**Observation**
Stach DJ et al. (1995)	Author found that the Nitrous oxide inhalational sedation has been reported as an effective sedation and very safe technique to reduce dental treatment–induced fear and anxiety.[14]
Stewart RD et al. (1985)	He found that the use and acceptance of the nasal mask was considered critical, especially in children and in patients with anatomic abnormalities in the nasal region.[15]
Ilasrinivasan JVS et al. (2018)	Study conducted to evaluate the efficacy of nitrous oxide-oxygen inhalation and low dose oral midazolam-ketamine combination for anxiolysis in the management of children aged between 3 to 10 years for dental treatment. It was observed from the study that both oral ketamine-midazolam combination, nitrous oxide-

	oxygen inhalation are equally effective for anxiolysis in children during dental treatment.
Takkar D et al. (2015)[17]	Study was conducted to evaluate efficacy of N_2O-O_2 during inferior alveolar nerve block administration in children. It was found that the Pain experienced by children receiving N_2O-O_2 sedation was significantly lower. N_2O-O_2 inhalation sedation produces adequate sedation with vital signs within normal limits and treatments successfully completed.
Pedersen RS et al. (2015)[18]	Pedersen *et al.* reviewed the safety and efficacy of N_2O and found it to be effective during brief, but mild to moderately painful pediatric procedures.

Conclusion

Non-pharmacological behavior management techniques are routinely used and suffice to create an environment that facilitates the development of a child's confidence and allows the dentist to carry out procedures with minimal disruption. However, in the case of very fearful or anxious children, these techniques may not be sufficient and conscious sedation may prove to be a helpful tool. Use of pharmacological behavior management techniques such as nitrous oxide (N 2 O) conscious sedation coupled with local anesthesia when required forms the foundation of the delivery of pain-free dentistry to children.

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