URGANCH DAVLAT TIBBIYOT INSTITUTI
JANUBIY OROLBO‘YI TIBBIYOT JURNALI
2 - TOM, 5/2- SON. 2026
14.00.00 - TIBBIYOT FANLARI ISSN: 3093-8740

УДК 616.314-053.2:615.831:615.384

INHALATION SEDATION WITH CONSCIOUSNESS USING NITROUS OXIDE AND OXYGEN IN PEDIATRIC DENTISTRY



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Abstract: Conscious sedation is a method in which one or more pharmacological drugs are used to create a mild depression of the central nervous system without loss of consciousness, in order to always maintain verbal contact with the patient, this allows for certain dental procedures. The use of nitrous oxide/oxygen (N2O) is becoming increasingly common for general and pediatric dentistry procedures and has become common practice in many countries.(6,7,8,9) It is also commonly used in general pediatric dentistry(10,11) for procedures ranging from minor surgeries to more invasive diagnostic procedures.

Keywords: sedation, pediatric dentistry, nitrous oxide, safe dentistry.

Nitrogen oxide (N2O) is a colorless gas with a sweetish taste. It has an anxiolytic and sedative effect, and also promotes muscle relaxation and analgesia.7 N2O does not irritate the respiratory tract, has a minimal alveolar concentration, and low solubility in tissues. It acts with a quick start and rapid recovery, the entire procedure lasts only a few minutes.4 When N2O is introduced in concentrations from 20% to 50% (along with 80-50% O2), the patient almost always remains awake, calm, and capable of following oral instructions. However, some patients may suffer from episodes of loss of consciousness when N2O concentrations exceed 50%.4.6 Sedatives, such as N2O, are classified by the way they are administered or by their effect on patients' consciousness.

Accordingly, N2O-O2 represents an inhaled conscious sedation. Nevertheless, in the 2007 Guide for Dentists on the Use of General Anesthesia published by the American Dental Association (ADA), a more specific classification is recommended, qualifying conscious sedation as minimal, moderate, or deep7, and for this purpose, H2O-O2 is classified as moderate. The recommendations of the American Academy of Pediatric Dentistry consider this a safe and effective basic control method that reduces child anxiety and contributes to improved communication between the pediatric dentist and the child (10,12). It is described as a "standard methodology" for pediatric dentistry and as a successful procedure in 90% of adequately selected patients.

Unlike sedation in adults, in children, the procedure aims to control behavior and achieve complete treatment in a safer and more effective way. The child's cooperation and the pediatric

dentist's ability to monitor the child vary depending on the child's age (10.13.14). In many situations, a moderate level of sedation is required to control the behavior of children under 6 years old and patients with developmental delays. However, this need should be assessed prior to the procedure. Inhalation conscious sedation using N2O-O2 is used to achieve the following goals: maintaining the safety and well-being of patients; minimizing discomfort and physical pain; controlling anxiety, minimizing psychological trauma, and maximizing amnesia; increasing behavior and movement control, allowing for the completion of dental treatment; and providing patients with a safe state without the need for medical intervention.

Compared to intravenous sedation, which can also be titrated, ZACS is considered more beneficial, as it eliminates the need to administer a cannula to a pediatric patient. ZACS has a sedative effect and also promotes muscle relaxation and analgesia (18). Especially in children, this function helps to speed up procedures that are long-term, facilitates procedures that may be unpleasant but require immobility from patients. Reduced awareness of pain caused by pressure is an additional advantage for dental procedures (19). Along with using good behavioral management methods, the administration of local anesthetics can be practically painless and stress-free for the child, achieving high parental satisfaction at lower costs compared to OA (14, 20).

Regarding N2O-O2 sedation, the pediatric dentist's training program must include theoretical and practical elements (2, 4). The Council of European Dentists (2) recently recommended a two-day theoretical course (10-14 hours), which covers knowledge on anxiety control, technical aspects of various forms of sedation, psychological and biological features of H2O use, and basic life support.

Research materials and methods. Patient selection is carried out based on a thorough clinical examination and a well-documented medical and dental examination. A history developed by a pediatric dentist. Determining risk factors and better understanding the patient's profile is mandatory. If one risk factor is detected, it is necessary to consult with an anesthesiologist to decide whether the patient can undergo a sedative procedure. (4) Patients should be classified according to the American Society of Anesthesiologists (ASA) classification system, as shown in Table 1. (17). Sedation using N2O-O2 can be performed in patients with ASA III and ASA IV, provided that its use is limited by hospitals and under the supervision of a responsible anesthesiologist.

Table 1 - Assessment of the American Society of Anesthesiologists (ASA) Physical Condition Classification

Patient class	Patient health records
Class I	No organic, physiological, biochemical, or psychiatric changes.
Class II	Moderate systemic changes (diabetes, asthma)
Class III	Severe systemic changes (acute diabetes, psychomotor disorders)
Class IV	Serious changes that may pose a threat to life (heart failure)
Class V	A dying patient with no chance of surviving surgery

Both the specialist and the team responsible for the patient's treatment must be trained as described above and be familiar with appropriate methods that can be used in any emergency situation. (10,17,18,19)

Sedation in children can be associated with serious risks, such as hypoventilation, apnea, airway obstruction, laryngospasm, and cardiopulmonary changes. These side effects may occur during and after the sedation procedure; the risk can be minimized, but not completely eliminated, by a preliminary analysis of the patient's health status. But it is important to remember that the effectiveness of its influence cannot be guaranteed at 100%. (10)

Diffusion hypoxia is a theoretical risk, but it can be avoided by administering 100% oxygen for 3-5 minutes at the end of the procedure. However, it has been suggested that reoxygenation is not clinically necessary when nitrogen dioxide is used as the sole agent in healthy patients at a concentration of less than 70% (38, 39).

Other rare side effects include euphoria, hyperexcitability, seizures, diarrhea, pallor, and dizziness (40). Even less frequently, gentle regurgitation and subsequent aspiration may occur. However, this can be avoided by preventing the patient from falling into a clinically unconscious state, thereby maintaining an untroubled pharyngeal-lacrimal reflex (8.23). The effects of prolonged exposure to nitrogen oxide are not final, as the conducted studies were of low methodological quality (41).

Occupational exposure was associated with bone marrow suppression, reproductive system disorders, premature births, miscarriages, and congenital defects in infants (42-44). Methods for reducing occupational health hazards include using effective cleaning systems, ensuring the proper functioning of all equipment, and good clinical methods, such as using rubber pads, minimizing patients' talking, crying, and mouth breathing (45-47).

Discussion. Pediatric dentists who are members of the IAPD (International Association of Pediatric Dentistry) and EAPD (European Academy of Pediatric Dentistry) use a number of methodological behavioral corrections, including pharmacological ones.

Nevertheless, interest in continuous training in the field of sedation is growing.2 Pediatric dentists can receive special training in sedation in this technique at advanced training courses, but data accumulated in recent years still show that this varies greatly depending on the programs of each country. There are various reasons for such variability.

The rules and regulations of dental practice differ in different countries, and the most important differences arise in the rights of dentists regarding the use of sedation methods in different countries. Within the framework of EAPD, the United Kingdom (UK) and Norway have developed guidelines for the treatment of teeth in children.

In the United Kingdom, 99% of students specializing in odontology state that they are familiar with the N2O-O2 sedation technique and believe its use should be mandatory during the specialization.22 Inhalation conscious sedation using N2OO2 is mentioned as the first choice method in 90% of cases among other conscious sedation methods.23

In Portugal, the Association of Dentists (Ordem dos Médicos Dentistas - OMD) considers the practice of conscious sedation (using a nitrogen substitute) to be an important component of the curriculum that contributes to the quality of specific dental procedures, the safety and well-being of patients, and professional working conditions. In 2009, the Council of European Dentists unanimously adopted a resolution titled "Necessary Competencies for Dental Medicine Practice in the European Union." This suggests that sedation should be practiced by professionals who have special training and who should never neglect the importance of covering activity risk through insurance adequate to the given situation.

The Association of Dentists (Ordem dos Médicos Dentistas - OMD) unites a working group engaged in the study and regulation of conscious sedation in relation to the professional profile of a dentist.

To perform the most unpleasant and painful procedures, such as tooth extraction, with a diagnosis of "periodontitis," it is possible to temporarily increase the nitrogen oxide concentration to 50%. Nitrous oxide has an analgesic effect and potentiates the effects of local anesthetics. Even if the child was frightened or experienced unpleasant sensations, after the manipulation ends, they quickly calm down and are able to continue the treatment calmly.

The use of ZACS allows for complex and sufficiently long-term treatment. For example, treating pulpitis with subsequent restoration using composite materials or standard crowns in a single

visit. The completion of the work must be carried out using traces of nitrogen deposits. The exit from the sedation state should be smooth and conclude with inhalation of 100% oxygen for 5-10 minutes. During this time, the doctor can communicate with the child, recording the positive impressions of the clinic visit. The ZACS effect is due to non-specific CNS suppression.

Although ZAKS is considered a safe sedation method, it is not without risks. Thorough preparation is necessary to manage any predictable emergency situations. The use of nitrogen poisoning for minimal sedation is defined as the administration of nitrogen poisoning <50% without the use of other sedative, opioid, or other depressant drugs prior to or simultaneously with the administration of nitrogen poisoning to a healthy patient ASA I or II (51). In this mentioned situation, the sedation team must perform preparation and requirements for managing minimal sedation. If changes occur in administration, i.e., when the percentage of administered nitrogen sedation exceeds 50%, the probability of moderate or deep sedation increases. Thus, the principles of governance are changed (10, 52).

A comfortable, relaxed state; a pleasant mood; soft, relaxed, inhibited body movements; absence of resistance; deep breathing; decreased motor activity of the eyes, an easily fixed gaze; reduced sound perception — all these are symptoms of sedation. The patient may be disoriented and easily succumb to suggestion.

The use of ZAKS significantly facilitates the treatment process for both the child and the dentist. Children develop a positive attitude toward dental appointments, which instills a culture of dental health in them. Children's dentists are opening up new prospects for conducting more high-quality, large-scale, and calm treatment!

Output. A patient with a non-cooperative profile in a children's dental clinic requires a special approach for effective treatment and child safety. If psychological methods are unproductive, inhalation conscious sedation should be considered as a possible option. Sedation using N2O-O2 is recommended in special cases when it is supported by behavior control methods that can provide greater safety and comfort for children during dental treatment. The advantages of providing good sedation for children are numerous; psychologically, it reduces patient anxiety and trauma, reduces parental emotional discomfort, improves communication, and ensures dental treatment in a less intimidating manner. Special training in this field is of fundamental importance for a professional medical team, as well as deep knowledge of the methodology itself, so that the country's laws and regulations are applied without harming the patient's health.

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