Clinical Trial

CONSCIOUS SEDATION AND PAIN CONTROL IN DENTAL SURGERY WITH NITROUS OXIDE: CLINICAL PROTOCOL

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ABSTRACT

Usually, dental implant and oral surgical procedures are performed outside of the operating room. Conscious sedation is a method in which the use of one or more drugs produces a state of depression of the central system (CNS) and euphoria with little effect on the respiratory system; verbal contact with the patient is maintained throughout sedation. Conscious sedation does not require intubation of the patient to maintain airway patency independently. It is a drug-induced depression of consciousness induced by drugs, during which the patient intentionally responds to light tactile stimulation and verbal commands. The level of sedation must be such that the patient remains conscious, maintains protective reflexes, and can understand and respond to tactile or verbal commands. Anxiolytics in dentistry are very important to achieve absolute patient cooperation. Nitrous oxide/oxygen (N_2O/O_2) inhalation is used for analgesia/anxiolysis as a safe and effective technique to manage pain and anxiety in dentistry. Nitrous oxide (N_2O) is a colorless, soluble gas with a sweet odor. So, anxiolytics with nitrous oxide can be used for the management of the patient undergoing oral surgery.

KEYWORDS: *conscious sedation, analgesics, nitrous oxide, oral surgery*

INTRODUCTION

More patients must undergo invasive dental treatments with new surgical techniques and increasing average age (1). The increased focus on dental care and the recent evolution towards particularly demanding elective and emergency techniques identifies the need to recognize aspects of the patient's anamnestic profile and any other helpful information related to executing the chosen conscious sedation technique. Conscious sedation is a method in which the use of one or more drugs produces a state of depression of the central system (CNS) and euphoria with little effect on the respiratory system (2); verbal contact with the patient is maintained throughout sedation. CNS depression defines a continuum from preservation to loss of consciousness, where the latter draw stages of varying depth that are called “moderate sedation,” “deep sedation,” and “general anesthesia” up to irreversible depression of CNS functions if the necessary measures are

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not taken to maintain the patient in a state of vitality (tracheal intubation, automatic ventilation, support of cardiovascular functions, etc.). Conscious sedation does not require intubation of the patient to maintain airway patency independently (3). These drugs can cause increasingly deep levels of sedation concerning the doses, to the point of disruption of vital functions and signs of life, and cardiovascular function is usually maintained (4). It also retains protective reflexes and can understand and respond to verbal commands. Conscious sedation is a drug-induced depression of consciousness induced by drugs, during which the patient intentionally responds to light tactile stimulation and verbal commands. The level of sedation must be such that the patient remains conscious, maintains protective reflexes, and can understand and respond to tactile or verbal commands (4); it may be considered the first level in the sedation process (5, 6). Conscious sedation can use oral, intramuscular, intravenous, and inhalation drugs. Different drugs commonly used for procedural sedation and analgesia include the following: midazolam, fentanyl, ketamine, propofol, etomidate, dexmedetomidine, methohexital, and nitrous oxide. Of these methods, midazolam and nitrous oxide are the drugs considered to be the gold standard, given their popularity in the literature. In clinical practice, healthcare prefers conscious sedation over general anesthesia because it has less risk and low mortality. The reason for this is the reduction of the mortality risk and delirium, along with the improved recovery time and reduced reliance on anesthetic staff, as it can be performed even without the presence of an anesthesiologist (3). Another advanced conscious sedation is that it is cheaper by about a third compared with general anesthesia (7). The advantage of conscious sedation is that it reduces anxiety, not just limited to children but extends to adults, too.

The techniques of conscious sedation in dentistry and used in Italy are as follows:

1. the inhalation technique with nitrous oxide and oxygen (N_2O/O_2);
2. the enteral technique with benzodiazepines with anxiolytic activity;
3. the enteral technique using benzodiazepines with anxiolytic activity;
4. the intravenous technique using benzodiazepines with anxiolytic activity in the patient undergoing pre-sedation per os.

Nitrous oxide/oxygen (N_2O/O_2) inhalation is used for analgesia/anxiolysis as a safe and effective technique to manage pain and anxiety in dentistry. Nitrous oxide (N_2O) is a colorless gas with a sweet odor and soluble. It causes central nervous system depression and euphoria and has a low effect on the respiratory system through different mechanisms of action. The analgesic effect appears to be initiated by neuronal release of endogenous opioids (e.g., enkephalins) with impact on the central excitatory (n-methyl-d-aspartate) NMDA receptor (8). N_2O exerts inhibitory properties on this receptor, thus preventing its excitatory effects. The receptors recognize glutamic acid as a neuromediator. This receptor is released into the synaptic space of the excitatory cortico pathways and contributes to sustaining, maintaining, and preserving anxiogenic effects. The anxiolytic effect involves activation of GABA; this receptor is released into the synaptic space of the excitatory cortico-liberal pathways and contributes to sustaining, maintaining, and preserving anxiogenic effects.

Recommended concentrations of N_2O vary from 30 to 50%. For these reasons, N_2O can be considered a practically perfect drug, with both anxiolytic and analgesic activity. It has a low water/oil solubility coefficient, and it is a drug for high-perfusion organs such as the CNS due to the high diffusibility at the level of the pulmonary alveoli and the equally rapid availability to the CNS. Due to its poor solubility in plasma, N_2O is rapidly eliminated upon discontinuing its administration as the patient's neurological functions and alertness recover.

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The technique requires machines that cannot deliver more than 70 percent N_2O and no less than 30 percent O_2.

Consequently, the inhalation mixture will, in any case, contain higher percentages of O_2 than atmospheric O_2, guaranteeing 'hyperoxygenated' breathing if one considers that the rate of atmospheric O_2 is 21%.

Machines releasing varying percentages of N_2O/O_2 can titrate N_2O until optimal subjective signs and symptoms of tranquillity and well-being are achieved. The effect can be traced back to action on the type A GABA receptor, where many other anxiolytic drugs, including benzodiazepines act.

The percentage that reaches these levels of effectiveness is called the Baseline and varies from individual to individual by the degree of anxiety; the empathy reached with the practitioner, the type of breathing, and previous experience.

The administration technique

The administration technique involves a series of steps, starting with the denitronisation process, which consists of decreasing the N_2 concentration in the blood by administering 100% O_2 through a face mask.

Breathing through a face mask with 100 percent O_2 should last no less than three minutes, at the end of which the N_2 content in the blood and alveoli is reduced from pressures of 570 mm Hg to values close to zero.

The primary purpose of denitronisation is to avoid a rapid drop in the alveolar O_2 concentration even if N_2O is initially used together with O_2 due to the greater diffusion of N_2O compared to O_2, which causes a balancing of the administered gas percentages in favor of N_2O. To correctly recognize the baseline value, the percentages of N_2O in O_2 must be increased, starting with minimum N_2O values of 5 or 10 percent and increasing the N_2O percentages by 5 or 10 percent every 5 minutes.

Baseline recognition must be achieved by maintaining verbal contact with the patient. At the same time, physical contact must be maintained (e.g., the operator's hand resting on the patient's shoulder).

At the end of each N_2O exposure time, the patient should be asked, using an analog numeric scale from 1 to 10, about the level of tranquillity the patient achieves. The N_2O rates will be increased until the patient indicates a maximum tranquillity score of 10. The dentist notes the percentage of Baseline that will 'almost always' be used in subsequent conscious inhalation sedation.

The technique of conscious sedation with N_2O causes an anesthetic effect on the mucous membranes of the oral cavity to such an extent that the tendency to vomit is inhibited or nullified, even in patients with a particularly lively gag reflex. This type of technique can be used in most patients, except those with severe chronic obstructive pulmonary disease (COPD), in which ventilatory function is sustained by the hypoxic stimulus exerted in the respiratory centers.

The American Society of Anesthesiology defines three levels of sedation based on the "responsiveness" of patients (9) (Fig. 1-3, Table I):

1. Minimal (or mild) sedation:
   the patient has a good level of anxiolysis but is perfectly responsive and cooperative and has perfect efficiency of respiratory activity and airway protection reflexes;
2. Moderate (conscious) sedation:
   the patient is more sedated and, therefore, has a reduced level of vigilance but responds adequately to tactile or verbal stimuli. Spontaneous ventilation is usually adequate, and protective airway reflexes are maintained; therefore, interventions are not required to preserve efficiency and patency;
3. Deep sedation:
   the patient is no longer alert, can respond adequately only to painful or repetitive stimuli, and may require some assistance to maintain adequate ventilation and/or airway patency.

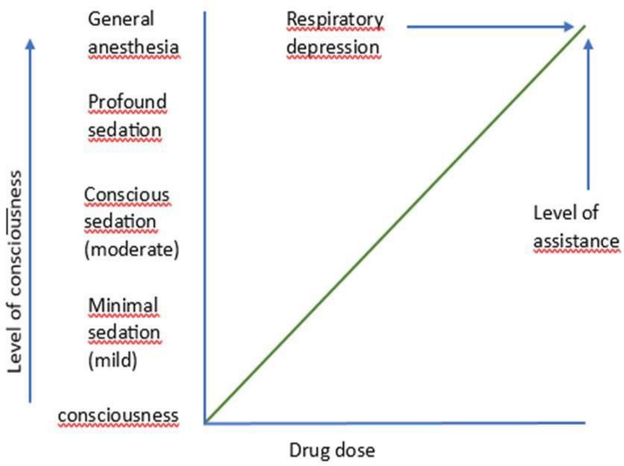

Fig. 1. *Effect of drug dosage and depth of sedation ansylosis.*

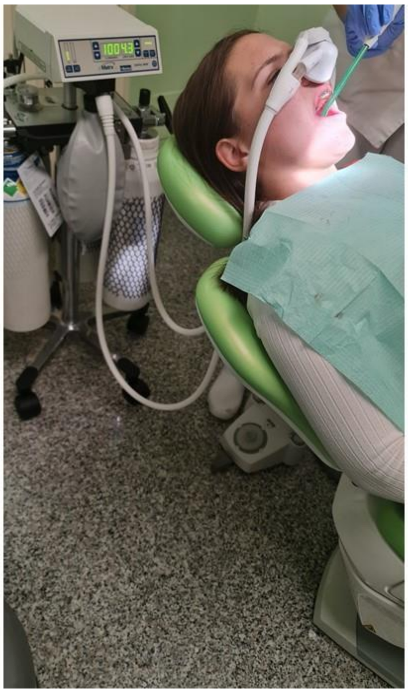

Fig. 2 *The patient with correct placement of nasal mask.*

Fig. 3 *Control panel that allows the flow rate of oxygen and nitrous oxide to be varied.*

Table I. *Continuum of depth of sedation: definition of general anesthesia and levels of sedation/analgesia.*

	Minimal Sedation Anxiolysis	**Moderate Sedation/ Analgesia (“Conscious Sedation”)**	**Deep Sedation/ Analgesia**	**General Anesthesia**
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response following repeated or painful stimulation	Unarousable even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous Ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular Function	Unaffected	Usually maintained	Usually maintained	May be impaired

Contraindications

This technique has some contraindications that are worth mentioning, including patients suffering from psychosis, those suffering from claustrophobic panic attacks, patients recently operated on the auditory tract, those suffering from obstruction of the first airways in the first three months of pregnancy, hyperthermic children, and patients suffering from chronic bronchopneumonia. The symptoms of sedation can be subjective and objective. Subjective symptoms consist of a generalized sensation

of warmth due to the peripheral vasodilator effect, a tingling sensation in the upper limbs, a feeling of heaviness in the lower limbs, a sense of chest weight due to the muscle relaxant effect on the intercostal muscles, and muffling of sounds. At the same time, verbal contact, although always preserved, is slowly slowed down.

During surgery, respiratory and heart rate and O_2 saturation in the blood must be monitored. Thirty minutes after the start of the procedure, N_2O percentages must be reduced by 5% due to the progressive saturation of tissues with low blood perfusion. Once the procedure is over, N_2O administration must be discontinued and replaced with 100% O_2 percentages, thus ensuring the complete elimination of N_2O from the body and the full restoration of the patient's brain functions.

After removing the nasal mask, the patient is asked if he/she complains of residual N_2O symptoms (dizziness), and if this symptom is still persistent, 100% O_2 is continued for a few minutes.

CONCLUSIONS

Anxiety control during oral surgery is essential to promote patient cooperation between patient and dentist; this also ensures the security of the procedure (10, 11). Nitrous oxide has proven to be the most effective drug for performing conscious sedation in individuals with dental phobia.

Dental treatment under general anesthesia is not repeatable at close intervals and is not aimed at increasing patient cooperation (12). Conversely, with conscious sedation, the patient may cooperate during the treatment. Repeated sessions of conscious sedation have indeed been shown to improve the level of cooperation significantly (13, 14).

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