Dr. Aseel H. AL-Haidar

Enteral Route

Enteral sedation is achieved by drugs that are swallowed and absorbed through the digestive or enteric system. The practice of having parents administer oral medications to children prior to arrival at the office should be avoided onset approximately 30 minutes after administration, with peak effect noted by 60 minutes. The taste may be quite objectionable, especially to very young children. This can usually be overcome when the drug is mixed with a palatable liquid.

Advantages	Disadvantages
● Universally accepted ● Ease of administration ● Low cost ● Decreased incidence and severity of adverse reactions ● No pricks (needles, syringes), No equipment is required. ● No special training	● Reliance ● Prolonged latent period ● Erratic & incomplete absorption of drugs from GIT ● Inability to titrate ● Prolonged duration of action ● Inability to radially lightened or deepened the level of sedation

Rectal route

Rectal administration of sedative drugs with suppositories has a limited history in pediatric dentistry. Drugs administered through this route are absorbed through two different vascular systems, one of which delivers agents to the liver while the second bypasses the liver. As a result, wide variations of bioavailability are seen after rectal administration.

Absorption is often irregular and incomplete. For this reason, and because of the tendency toward mucosal irritation from drugs delivered via this route, rectal administration is not recommended for pediatric sedation.

Complication

- Rectal mucosal irritation
- Initiation of bowel movement
- Risk of over sedation

Indications

- Unwilling to take orally
- Nausea & vomiting
- Patient objecting injection
- Post-op control of pain

Advantages	Disadvantages
● Low cost ● Ease of administration ● No pricks ● Absorb directly into systemic circulation (rapid onset of action) ● Bypassing entero hepatic circulation	● Inconvenience to the administer ● Variable absorption ● Inability to reverse ● Inability to titrate ● Possible intestinal irritation ● Prolonged recovery

Intra muscular route

Intramuscular administration relies upon the high vascularity of muscle tissue to achieve a moderately rapid onset of action, usually within 5 to 10 minutes. When properly administered, intramuscular injection provides a more rapid onset and offset as compared with enteral techniques.

Indications

- Other controllable routes are unavailable or have proved ineffective.
- Prior to IV sedation or general anesthesia.

Complications

- Nerve injury
- Intra-vascular injection
- Air embolism
- Periostitis
- Hematoma
- Abscess
- Cyst
- Necrosis

Advantages	Disadvantages

● Rapid onset of action ● Maximum clinical effect within 30min ● More reliable absorption than oral or rectal sedation ● Pt cooperation is not required	● Inability to titrate ● Inability to reverse the drug action ● Prolonged duration of drug effect ● Injection needed and its possible injury

Intravenous Route

The IV route of drug administration represents the most effective method of ensuring predictable and adequate sedation in virtually all patients. Effective blood levels of drugs are achieved quite rapidly.

The use of intravenous conscious sedation in pediatric dentistry is somewhat restricted to certain types and ages of patients. Venipuncture is difficult to accomplish in the very young or the combatant child. Such difficulty is attributable to smaller vein size and availability together with the need to restrain the patient. Because of this, the technique is often more suitable for the apprehensive preteen and adolescent patient.

Advantages	Disadvantages
● Rapid onset of action ● Easily titrated ● Rapid recovery ● Minimal side effects ● Emergency IV access available	● Venipuncture is required ● More monitoring necessary ● Hematoma at the site of injection ● Most agents cannot be reversed by antagonistic agents

Inhalation

The inhalational route is a highly effective route of administration, allowing nonirritating gases and volatile drugs to be inhaled and absorbed directly through the pulmonary epithelium and mucous membranes of the respiratory tract into the circulation. The almost instantaneous absorption of agents delivered through this route is due to the large surface area of the lung. Equilibrium is quickly established among the partial pressure of the drug in the alveolar gas space, serum, and target tissues in the brain. As a result, inhaled anesthetic gases are easily titrated by adjustment of the amount of inhaled gas, provided the rate and depth of ventilation are adequately controlled.

Indications

- Anxiety

- Medically compromised patients
- Gagging

Contraindications

- Severe behavioral problems
- Acute respiratory conditions
- Inability to communicate and Learning difficulties
- Very young children
- Fear of the mask

Advantages	Disadvantages
• Rapid onset • Peak clinical actions • Titration possible • Depth of sedation can be altered • Rapid and complete recovery • Duration at discretion of administration • No injection • Safe and no systemic effects • Can be used instead of topical anesthesia	• High cost equipment • Space in dental office • Potency • Training of staff • Occupational hazard • Cooperation is required • Raise pain reaction threshold • Potential problems with chronic exposure

DRUGS AND AGENTS USED FOR SEDATION

Hydroxyzine (Atarax, Vistaril)

Antihistamine with weak sedative, anticholinergic, and antiemetic properties. It produces sedation by inhibiting the hypothalamic H-1 histamine receptors involved in governing the sleep-wake cycle in humans.

In normal doses, it has no cardiovascular or respiratory depressant effects. Absorption through the gastrointestinal tract is relatively rapid, with the onset of action occurring in 15 to 30 minutes. Peak levels occur at 2 hours.

Recovery is slow by modern standards, reflected by the mean half-life of 3 hours. It is available in two forms, hydroxyzine hydrochloride (Atarax) and hydroxyzine pamoate (Vistaril).

Administration is preferably by the oral route, intramuscular injection must be deep in a large muscle mass. **The drug should not be injected subcutaneously or intravenously because of potential tissue necrosis and hemolysis.**

Preparation: tablets, elixir

Dosage: 0.5 to 1.0 mg/kg

Also available as IM inj. 1mg/kg

Side effects: prolonged drowsiness, ataxia, dry mouth. In children, paradoxical reactions may occur at sedative doses.

BENZODIAZEPINE AGONISTS AND ANTAGONISTS:

Midazolam (Versed)

It is a water soluble type of benzodiazepine. The clinical potency of midazolam is estimated to be 2 to 5 times the potency of diazepam. Onset of action 3-5 minutes after IV administration and recovery take place in 2-6 hrs.

The elimination half-time of midazolam is 1 to 4 hours, which is significantly shorter than that of diazepam. Cognitive testing in adults shows return of normal mental function within 4 hours.

Adverse drug reaction

Respiratory depression dose, defendant risk of apnea, more often when used with narcotics, Hypertension has also been reported when used in combination.

Preparation: syrup, parenteral injection solution.

Pediatric dose: 0.05 - 0.1 mg/kg (IV. IM.)
0.03 – 0.75 mg/kg orally
0.4 - 1 mg/kg rectally
0.2 -0.3 mg/kg nasally

Note: Flumazenil should be available in the emergency drug kit as it is a direct, specific reversal agent used in clinical practice to treat benzodiazepine overdose (reverse sedation).

SEDATIVE-HYPNOTICS

Barbiturate

Can produce all levels of CNS depression, ranging from mild sedation to general anesthesia and deep coma. Their use are of very limited value for pediatric patients.

Chloral Hydrate

Chloral hydrate is an aldehyde compound that is metabolized in the liver. It is a chemical irritant to the skin and mucous membranes and is associated with a high rate of nausea and vomiting, particularly when administered on an empty stomach, so it should

be diluted in a flavored vehicle. After oral administration, the drug was characterized by a slow onset time (30 to 60 minutes) and had a duration of action of 4 to 8 hours, with an elimination half-life of 8 to 11 hours.

Children given chloral hydrate would often enter a period of disinhibition resulting in excitement and irritability before reaching a level of clinically useful sedation.

The drug causes prolonged drowsiness or sleep and respiratory depression. In large dose it produces general anesthesia. Large doses sensitize the myocardium to the effects that resulting in arrhythmias, and thus should be avoided in patients with cardiac disease.

The lethal dose of chloral hydrate is stated to be 10 g in adults, yet ingestion of 4 g has been associated with a fatal outcome.

Because the drug dose not reliably produce sedation of a degree to permit operative procedures at lower doses, there is tendency to push the dosage higher to achieve the necessary sedation. With such a wide range of reported toxicity, this drug may be an unwise choice for many pediatric patients. It is recommended that young children receive not more than 1 g as a total dose.

Chloral hydrate is no longer available commercially in the United States.

Risks are increased when it is accompanied with nitrous oxide, narcotics or local anesthetic agents.

Dosage: 25-50 mg/kg to a maximum of 1 g

Supplied: oral capsules 500 mg

Oral solution: 250 and 500 mg/5ml

Rectal suppositories: 324 and 648 mg.

Narcotics

Demerol (Meperidine)

Meperidine is a synthetic opiate agonist, closely related to fentanyl in chemical structure. It is water-soluble but is incompatible with many other drugs in solution. Meperidine may be administered through either enteral or parenteral administration; however, oral administration is only about half as effective as intramuscular injection. It is rapidly and well absorbed from the GI tract, reaching peak effect in about 60 minutes. Approximately 90% of an oral dose undergoes biotransformation via first-pass metabolism to normeperidine and meperidinic acid. Normeperidine is an active metabolite with approximately 50% of the analgesic activity as the parent compound, and manifests an elimination half-life of 15 to 40 hours. **Normeperidine also possesses CNS stimulation and can become proconvulsant with prolonged accumulation of the metabolite. Its use is contraindicated in patients with a history of hepatic disease, renal disease or dysfunction, or seizure disorders.**

Supplied: oral tablets—50 and 100 mg; oral syrup—50 mg /5 mL; parenteral solution—25, 50, 75, and 100 mg/mL

Dosage: oral, subcutaneous, or intramuscular—1.0 to 2.2 mg/kg, not to exceed 100 mg when given alone or 50 mg when in combination with other CNS depressants.

Note: Overdose or rapid administration can lead to respiratory depression, apnea, rigidity and bradycardia; if these remain untreated, respiratory arrest, circulatory depression or cardiac arrest may occur.

Nitrous oxide N_2O

It is the most frequently inhalation agent used in pediatric sedation .Nitrous oxide is a slightly sweet-smelling, colorless, heavier than air, and inert gas. It is compressed in metal cylinders as a liquid that vaporizes on release. The gas is nonflammable but will support combustion. Very potent analgesic but weak anesthetic. It is absorbed quickly from the alveoli of the lungs and is physically dissolved in the blood with no chemical combination anywhere in the body. It is carried in the serum portion of the blood and excreted through the lungs without any biotransformation, small amount may be found in the body fluids and intestinal gas.

OBJECTIVES

The objectives of nitrous oxide sedation, as stated by the American Academy of Pediatric Dentistry, include the following:

- Reducing or eliminating anxiety
- Reducing untoward movement and reaction to dental treatment
- Enhancing communication and patient cooperation
- Raising the pain threshold
- Increasing tolerance for longer appointments
- Aiding in the treatment of a patient with mental and/or physical disabilities or a medically compromised patient
- Reducing gagging
- Potentiating the effects of sedatives.

Disadvantages of nitrous oxide–oxygen inhalation may include:

- Lack of potency
- Dependence on psychological reassurance
- Interference of the nasal hood with injection to the anterior maxillary region
- Need for the patient to be able to breathe through the nose

• Nitrous oxide pollution and potential occupational exposure health hazards.

Action (Pharmacodynamics) of N_2O

- Create an altered state of awareness without impairment to the motor function and it is a CNS depressant.
- Increase the respiratory rate and decrease the tidal volume.
- Cardiac output is decreased and peripheral vascular resistance is increased (important in the cardiac patients).
- Rapid induction and reversal may induce vomiting.

Absorption, metabolism and excretion

Onset: Anywhere from a few seconds up to 3-5 minutes
Crosses the blood-brain barrier rapidly

Enter the blood by crossing the pulmonary epithelium and depends upon the concentration gradient. During early phases of administration, the brain, heart, liver and kidney absorbs the major portion of N_2O from blood.

Elimination

- Rapid elimination
- Unchanged with exhalation from the lungs so (Do not hold a child close to your face while they are "waking up")
- No significant metabolism by the liver or kidneys
- Not stored in the tissues

Requirements of the equipment used for the induction of N_2O:

1. Should have a continuous flow design with flow meters capable of accurate regulation.
2. Automatic shut down if the O_2 level falls < 20 %.
3. Flush level for easy and immediate flushing of the system with 100% O_2.
4. Can be either mobile units or operating from a central supply to a wall mounted with mobile head.
5. Good and efficient scavenger system.
6. Nasal hood should be of adequate size for adults and children.

Types of Inhalation Sedation units

1- Intermittent (demand flow) gases delivered according to the patient, respiratory demand and requirements.

2- Continuous flow: continuous flow of gases (more safe and accurate).

Components of the continuous flow unit

1- Compressed gas cylinders and pressure gauge.
2- Reducing valve (regulator)
3- Flow meter
4- Reservoir bag
5- Conducting tubing
6- Nasal hood, full face mask or nasal cannula

Preparation of Patient

- Patient in reclined position
- Use TSD
- Describe sensations in advance

Four Plateaus of Analgesia with N_2O (Stages of Sedation):

1. Tingling sensation (Paresthesia - tingling of hands, feet).
2. Followed by a warm feeling (Vasomotor - warm sensations).
3. Feeling of well-being, hearing may dissolve into electronic throbbing. (Drift - euphoria, pupils centrally fixed sensation of floating).
4. Sleepiness, Nausea sets in, dream can occur (Dream - eyes closed but will open in response to questions, difficulty in speaking, jaw sags open).

Techniques

The acceptance of the nosepiece by the patient is very important in the procedure for effective conscious sedation. If the patient exhibits resistance then this method is not advisable for such a child.

1- Slow induction technique

The bag is filled with 100% oxygen and delivered to the patient for 1 or 2 minutes at an appropriate flow rate, typically between 4 and 6 L/min. With an appropriate flow rate, movement covering one quarter to one half of the breathing bag should be observed with each inhalation and exhalation. With too high a flow rate, the bag will be overinflated, movement will not be seen with each breath, and leakage will occur from around the mask. In this instance, the flow rate should be adjusted downward. Too low a flow rate will deplete the bag of mixed gases. Once the proper flow rate is achieved, the nitrous oxide can be introduced by slowly increasing the concentration in increments of 10% to 20% until the desired level is achieved.

After stabilization of the nose piece, 100% O_2 is delivered for 3-5 min , then N_2O level is increased slowly to 30-35% for 3-5 min (induction period) during this period the dentist should continuously communicates with the child to promote relaxation and reinforce cooperative behavior. If the child is older, he can be asked for the physical changes like tingling sensation in the fingers and toes.

The eyes will take a distance gaze with sagging of eyelids, most of the dentists prefer to increase the level of N2O to 50% for 3-5 min to provide the maximum effect for the administration of L.A. **Concentration more than 50% is contraindicated** in dental practice, after administration of L.A. the concentration can be brought down to 30-35 %.

After the treatment:

- Inhalation of 100% O_2 for not less than 5 min should be continued to allow diffusion of nitrogen from the venous blood into the alveoli, which will be then exhaled as N_2O through the respiratory tract and also allow the patient to return to the pretreatment activities, with any incident inadequate oxygenation may produce: nausea, headedness or dizziness.
- The child should be kept in supine position or in his side to maintain air way patency. Upon arriving home, the child should be placed on his side and observed carefully for the first hour and if he wishes to sleep, he can be allowed to do so.

2- Rapid induction technique

Initiation is done by administration of equal parts of N_2O and O_2 for 10-15 min , this is followed by maintenance phase where N_2O is reduced by half for 40 min, the withdrawal is done by administration of O_2 only which is used to prevent anoxia that may result when N_2O is used alone.

Common problems associated with N_2O

1- Sleep

Patient may go into sleep during the procedure and frequent arousal or communication is required.

2- Air way obstruction

Frequent repositioning of the head is needed to hyper extend the mandible so that the tongue is brought forward.

3- Vomiting

It could be due to: Over dose of N_2O

Prolonged administration of N_2O

Pre-existing GIT infection or influenza
History of motion sickness or vomiting (use antiemetic drugs)
Impurities during delivery (rare)

This (vomiting) can be prevented by:

(1) Using min. effective concentration.
(2) Avoid prolong procedure.
(3) Empty stomach inhalation.
(4) Slow return to upright position.
(5) Aspiration is unlikely.

So just ask the patient, to vomit in a chair side emesis basin if there is vomiting.

4- Diffusion Hypoxia

Since c has a lower blood solubility, it rapidly diffuse into the alveoli and dilutes the alveoli air causing fall in the partial pressure of the oxygen in the alveoli, to avoid this 100% O_2 for 10 min.

5- Increased N_2O concentration

This should be avoided otherwise pressure will be created in the air filled body cavities especially in the middle ear.

6- Hallucinations

This can occur when we give high concentration of N_2O (> 60 %) so reduce the dosage of N_2O.

Chronic Exposure to N2O

"Long-term (chronic) exposure to nitrous oxide in sufficient concentrations can produce irreversible, toxic changes, and should be a concern for dental personnel working in environments in which nitrous oxide is administered to patients."

Chronic exposure may cause disorders in the:

- Respiratory system
- Hematological
- Immunological
- Liver
- Kidney
- Neurological such as loss of concentration, numbness and paresthesia, ataxia, loss of bladder control, loss of bowel sphincter control.

Controlling N2O in the operatory:

To minimize the risk of chronic exposure:

- ✓ Good scavenging system
- ✓ Adequate circulation of the room air
- ✓ Limiting of speech and mouth breathing by the patient
- ✓ Chose the proper size of the nasal hood

Note:

Nitrous oxide is not a substitute for the traditional behavior management technique and it should be considered an adjunct to aid in the management of mild to moderate anxious child who is capable to cooperate in the dental chair.