QUESTION 3

When is it appropriate to use nitrous oxide and oxygen inhalation for children?

Background

The family dentist must often provide dental treatment to anxious, frightened or even uncooperative children. Even among children who are cooperative at the initial appointment, behaviour may deteriorate if a series of dental appointments is required to treat a specific condition.[1] Hence, the need to manage children's anxiety and thus to foster the development of healthy attitudes toward dentistry is paramount.

The use of inhalational sedation with nitrous oxide and oxygen is both effective and generally safe. Such sedation may reduce anxiety, provide some analgesia and help the child to sit still for treatment.[2] It may also help the child accept procedures perceived as unpleasant, such as injection of local anesthetic. Ideally, the patient is in a state of analgesia and anxiolysis: conscious and able to respond normally to verbal commands, with stable vital signs and no significant risk of losing protective reflexes, and able to return to pretreatment mobility.[3–7]

Nitrous oxide is a colourless gas with a weak sweet smell. It causes central nervous system (CNS) depression and euphoria with little effect on the respiratory system or the protective reflexes of the airway.[2–7] Uptake is rapid, and it is absorbed quickly from the alveoli and is held in solution in the serum. Nitrous oxide is relatively insoluble, passing down a gradient into other tissues and cells in the body, such as the CNS. It is excreted quickly from the lungs. Nitrous oxide has minimal effect on blood pressure, causing a slight increase in peripheral resistance and a slight decrease in cardiac output.[2–7]

Nitrous oxide sedation has a quick onset and recovery (within 2 to 3 minutes), and the drug can be titrated easily. Most children will accept nitrous oxide and oxygen inhalation therapy and are enthusiastic about the experience; they sometimes report dreaming or being on a "space ride."[7] However, other children will not accept this type of sedation, becoming distressed by feelings of loss of control or claustrophobia. Some children find the nasal mask confining and unpleasant.[8] Before deciding to use nitrous oxide and oxygen inhalation therapy, the dentist should consider the following factors: alternative behavioural management options, the extent of the planned dental treatment, the effect on quality of dental care, and the patient's emotional development as well as physical condition.

Although nitrous oxide and oxygen inhalation therapy has many uses for certain groups of children (**Box 1**), it has several limitations. The drug is not very potent, and the dentist must also use traditional (nonpharmacologic) behaviour management techniques, including "tell, show, do" and positive reinforcement. The patient must have no nasal obstructions, be willing to wear the nasal mask and be willing to breathe through the nose. The nasal mask may interfere with local anesthesia by infiltration for the maxillary anterior teeth.

Box 1 Uses of nitrous oxide and oxygen inhalation therapy[2]

• To reduce or eliminate anxiety
• To reduce physical reactions to dental treatment
• To enhance communication and patient cooperation
• To raise the patient's pain reaction threshold
• To increase the patient's tolerance for longer appointments
• To aid in the treatment of mentally or physically disabled or medically compromised patients
• To reduce gagging
• To potentiate the effect of other concomitant sedatives

Assessment of Patients

Children who may benefit from nitrous oxide and oxygen inhalation therapy[2] include those who are potentially cooperative but fearful or anxious; patients with mental, physical or medical special health care needs; patients whose gag reflex interferes with dental treatment; patients for whom profound local anesthesia cannot be achieved; and cooperative children undergoing lengthy procedures.

It is important to review the patient's medical history and perform a physical assessment (**Box 2**) before administration of nitrous oxide and oxygen inhalation therapy. In addition, the presence of any contraindications should be verified (**Box 3**).

Whenever possible, appropriate medical specialists should be consulted before administering analgesic or anxiolytic agents to patients with

Box 2 Assessment of patient before administration of nitrous oxide and oxygen sedation

Medical history
• Allergies and previous allergic or adverse drug reactions
• Current medications, including dose, time, route and site of administration
• Diseases, disorders or physical abnormalities; pregnancy status
• Details of previous hospital admission, including date and reason
Physical assessment
• Respiratory system
· Airway patency (nasal and oral)
· Brodsky tonsil and adenoid classification[9]
· Breath sounds on inspiration and expiration
• NPO (nothing by mouth) status

Box 3 Contraindications to use of nitrous oxide and oxygen sedation

• Young age (< 2 years)
• Moderate or extreme uncooperativeness
• Inability to breathe through the nose with the mouth open
• Chronic obstructive pulmonary disease
• Severe emotional or psychiatric disturbance
• Substance abuse
• First trimester of pregnancy[10]
• Treatment with bleomycin sulfate[11]

significant underlying medical conditions (e.g., severe obstructive pulmonary disease, congestive heart failure, sickle cell disease,[12] acute otitis media or recent tympanic membrane graft[13]).

Informed consent must be obtained from the parent and must be documented in the patient's chart. Pretreatment dietary precautions must be taken before the appointment. The patient's record must include the indication for use of nitrous oxide and oxygen, the dose administered, the duration of the procedure and the post-treatment oxygenation procedure.

Administration of Nitrous Oxide and Oxygen

Nitrous oxide and oxygen should be administered only by appropriately licensed individuals (or under their direct supervision), according to provincial law or the guidelines of the provincial licensing body. The responsible dentist must be trained in the use of such agents and appropriate emergency response should a problem occur.

Selection of an appropriately sized nasal mask will help to ensure that the child actually receives the delivered gas and will prevent leakage into room air. An oxygen flow rate of 5 to 6 L/min is acceptable to most patients. Nitrous oxide is added to the oxygen by titration until the desired effect is achieved. The total 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 under-inflated. Initiation with 100% oxygen for 1 to 2 minutes followed by titration of nitrous oxide in 10% intervals is recommended. During analgesia/anxiolysis induced by nitrous oxide and oxygen, the concentration of nitrous oxide should not routinely exceed 50%. The nitrous oxide concentration may be lower during easier procedures (e.g., restorations) and higher during more stimulating ones (e.g., extraction, injection of local anesthetic). During treatment, the patient's respiratory rate and level of consciousness should be monitored visually. Once the flow of nitrous oxide is terminated, 100% oxygen should be delivered for 3 to 5 minutes.[3] Nitrous oxide is 34 times more soluble than nitrogen in the blood, and diffusion hypoxia may occur. The patient must regain pretreatment responsiveness before discharge.

The patient's response to commands serves as a guide to the level of consciousness. Continual clinical observation of responsiveness, colour, and respiratory rate and rhythm are required. Pulse oximetery may be used. If any other pharmacologic agent is used, or if the patient is taken to a deeper level of sedation, monitoring guidelines appropriate for the level of sedation must be followed.[14]

An appropriate scavenging system is needed to avoid nitrous oxide pollution and health hazards related to occupational exposure. Both delivery and scavenging equipment must be periodically evaluated and maintained.

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