

Safety of Nitrous Oxide/Oxygen Inhalation: Are We Still in Doubt?

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Dear Editor,

Pediatric dentistry is a demanding and taxing branch of dentistry with the biggest challenge arising out of dental fear and anxiety in children. Although pediatric dentists are trained well to manage the behavior of children, the efficiency and quality of work often get compromised consequent to managing child's anxiety. Unfortunately, a promising and useful technique of using nitrous oxide to bring about anxiolysis has not found much space in most of the South Asian countries. This could be attributed to misinformation about the safety of this technique.

Majority of the apprehension related to the use of this gas stems from our education, where this gas is introduced to dental students in pharmacology as an "inhalational anesthetic agent." However, it is a very weak anesthetic agent with a minimum alveolar concentration being 104.¹ Related to this property, an intriguing fact is that this gas is never used alone by anesthetists to induce general anesthesia. It is used as a carrier gas in combination with other inhalational anesthetic agents during the induction of general anesthesia. In dentistry therefore, where it is used in combination only with oxygen, there is no chance that the gas could cause an anesthetic state.

Similarly another important property which makes nitrous oxide safe to be used by the dentists is its low blood gas partition coefficient compared to inhalational anesthetic agents.¹ This makes it possible to have a rapid onset and a rapid recovery implying that, during the course of treatment if the dentists feel that the depth of sedation is higher than desired (based on clinical signs), the concentration of nitrous oxide can be decreased to reduce the depth of sedation. Importantly, both these properties can be utilized to the fullest only when nitrous oxide/oxygen is used alone without combining it with any other sedative or hypnotic.

The main objective of using nitrous oxide in dentistry is for anxiolysis and analgesia. It is not meant to bring about "conscious sedation" which concurs with depression of consciousness or "moderate sedation" as per American Society of Anesthesiologists.² If a child patient is maintained in a state of minimal sedation, where all the protective reflexes remain intact, there should be no fear in the mind of pediatric dentists for an agent which is meant to reduce fear in the child patients being treated by them!

Unfortunately, being a pharmacological agent, many pediatric dentists keep nitrous oxide at the same pedestal as other forms of sedation which are meant to "sedate" the child and hence "reserve" its use for children for whom the basic (nonpharmacological) behavior management techniques fail. On the contrary, this technique works in conjunction with nonpharmacological behavior management techniques to build a positive dental attitude and hence, American Academy of Pediatric Dentistry has incorporated this as a basic behavior guidance technique, whereas various forms

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of sedation and general anesthesia have been kept under the umbrella of advanced behavior guidance.³

Nitrous oxide when used in dentistry is delivered using a dedicated delivery system which can deliver a maximum of 70% nitrous oxide. The oxygen concentration being delivered at this level is 30% which is still more than that present in the ambient air. Besides, this it has various other safety features such fail safe mechanism, minimum flow rate, color coding, etc.

At this juncture, it would also be prudent to comment on the contraindications of this technique. Nitrous oxide gas has expansive nature and therefore, may expand the air-filled cavities in body. This property prohibits its use after recent eye and ear surgeries which can alter the outcome of surgery.⁴ Another condition where nitrous oxide technique should not be used is in children undergoing bleomycin therapy, where it can cause pulmonary toxicity on exposure to high concentration of oxygen (nitrous oxide technique delivers oxygen at a minimum concentration of 30% at any given time).⁴ Besides these absolute contraindications, there are certain relative contraindications where it can be used with caution (Table 1). On the basis of this reasoning, pediatric dentists can confidently use this technique for children in category ASA I and II. Its use is not contraindicated in cardiovascular disorders such as heart murmurs, congenital heart disorders; central nervous system conditions such as epilepsy; asthma; etc. to name a few.

The adverse events related to use of nitrous oxide in dentistry are mostly minor and self-limiting. These could be nausea, vomiting, headache, dizziness, sleepiness with their incidence being 3–5%.^{5,6} None of the studies related to dental operatory have reported any major adverse events. On the contrary, in a routine dental practice, many other emergency situations have been reported such as allergic reaction to local anesthesia, aspiration, or ingestion of foreign objects,⁷ medical emergencies, etc. Hence, it is unfair and unjustified to not accept this technique and question its safety which was in fact invented by a dentist more than 150 years ago, and has had a spotless safety track record.

Table 1: Relative contraindications to use of nitrous oxide/oxygen

<i>Relative contraindication</i>	<i>Rationale for avoiding use of nitrous oxide</i>
Upper respiratory tract infection or congestion	It may be difficult for a child to inhale nitrous oxide/oxygen gas through a nasal hood, thereby reducing its efficacy
Ear infection	It may cause ear pain due to increase in intratympanic pressure
Stomach pain	It may aggravate stomach pain due to expansive nature of gas
Mental illness	The child may not understand or accept the clinical effects of nitrous oxide/oxygen gas and become uncooperative
Behavioral disorders	It may be difficult to introduce nasal hood to child patients
Claustrophobia	The children may not allow use of a nasal hood over their nose

The octagon of nitrous oxide safety comprises of eight important factors including proper knowledge and understanding of nitrous oxide delivery equipment, not combining use of nitrous oxide/oxygen with any sedative, achieving and maintaining minimal depth of sedation, establishing verbal communication at regular intervals, watching out for signs of over sedation, avoiding clinical depression of consciousness, use of rubber dam, and adequate training of auxiliaries. It is high time that the stigma attached to

nitrous oxide be removed and this technique of nitrous oxide begins to form the backbone of pediatric dentistry based on proper education, knowledge, and training which will help in building a positive dental attitude and give pediatric dentists a better life.

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