

“Medicated oxygen” – the wonder drug for anxious children

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Pain and anxiety management is of paramount importance in dentistry especially for child patients. The term “Medicated Oxygen” or “Magic Air” refers to a mixture of nitrous oxide and oxygen gases that is commonly used for partial sedation in pediatric dental populations. The gas is colorless and virtually odorless with a faint, sweet smell. Nitrous oxide sedation is administered by inhalation, absorbed by diffusion through the lungs, and eliminated via respiration. In children, sedation may accelerate the delivery of dental treatment that requires patient serenity and may allow the patient to tolerate unpleasant procedures by reducing anxiety, discomfort, or pain.

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Introduction

Uncooperative behavior and fear in child patients are common encounters in the daily clinical situation. The dentist may need to use pharmacologic means to obtain acquiescence and cooperation from his/her patient. Techniques that use drugs to induce a cooperative yet conscious state in anxious or uncooperative children are referred to as techniques of sedation.^{1,2}

The major goal of sedative use in children’s dentistry is to provide a light conscious sedation, which decreases the child’s anxiety and enhances his/her cooperation during treatment.^{2,3} Nitrous oxide/oxygen (“medicated oxygen” or “magic air”) inhalation is a safe and effective technique to reduce anxiety and enhance effective communication. Nitrous oxide is a colorless gas and relatively insoluble and excreted quickly from the lungs. It is always administered with oxygen to safeguard the patient’s supply of oxygen. It causes minimal impairment of any reflexes, thus protecting the cough reflex. Its onset of action is rapid, the effects are easily titrated and reversible, recovery is rapid and complete. It is

generally acceptable by children and its high success rate is well documented.^{3,4}

Case report

A 9-year-old boy was brought by his mother to the Oral Health Center of the International Medical University in Kuala Lumpur, Malaysia in August 2011. The patient’s chief concern was a small deformed tooth that had erupted between the upper central incisors. The patient’s mother was concerned of her son’s unpleasant appearance. They requested treatment to improve the condition. Initial examination and review of medical history of the patient showed the patient to be healthy with no underlying medical condition.

Clinical oral examination revealed 18 permanent teeth and 6 primary teeth, all free of caries and restorations. Plaque was present on the lingual surfaces of his lower anterior teeth. A supernumerary tooth between the upper left and right central incisors was found (Figure 1). During the examination the patient’s mother shared that in the past visit to the dentist the patient exhibited fear of specific stimuli which in this case focused on the injection. His anxiety reactions towards injection included withdrawal, screaming, crying and refusal of treatment.

After initial and clinical oral examination, dental treatment options were explained to them. The option of extraction of the supernumerary tooth under nitrous oxide sedation was accepted. Cleaning and polishing were then carried out. Extraction of the supernumerary tooth under nitrous oxide sedation was scheduled on a second session, and the mother was advised not to give her son a heavy meal on the appointment day to prevent possible reactions of nausea and vomiting.

At the second session nitrous oxide/oxygen were introduced to the mother and the patient by using a ‘Tell-Show-Do’ approach. The mother signed informed consent after her son agreed to undergo the procedure. Before the patient sat on the dental chair, an appropriate nasal hood (Figure 2) was selected and the patient was

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asked to hold and put it on his nose by himself. After a few minutes of familiarisation with the nasal hood and the patient proceeded to sit on the dental chair, the nasal hood was then connected to the machine (Figure 3), adjusted to prevent leakage and the gas flow was regulated.

Pulse oximetry probe (Figure 4) was positioned properly with clip-on device on the patient's index finger to monitor the amount of oxygen present in the blood as well as the pulse rate were within normal range. Oxygen administration of 100% was successfully tolerated followed by nitrous oxide titrated at 40:60 percent ratio of $N_2O:O_2$. This was achieved by starting at a concentration of 10% N_2O with increase of 5% of N_2O concentration every 5 minutes to assess the patient's tolerance. When the nitrous oxide titrated reached 40:60 percent ratio of $N_2O:O_2$, the patient felt 'good' and became relaxed. 'Sleepy eyes' was the most common objective symptom seen on the patient with tingling feeling sensation on the hand as reported by the patient himself; however the patient was still able to follow instructions.

The extraction procedure was initiated with a buccal infiltration and palatal mucosal injection. Injection and extraction of supernumerary tooth was successfully carried out. The concentration of nitrous oxide administered throughout treatment fluctuated between 35-40% of N_2O depending on the patient's subjective assessment of need. After treatment was completed, 100% of oxygen was administered for 5 minutes. The patient did not exhibit any side effect such as nausea or vomiting.

Discussion

Dental fear represents a major barrier to dental care especially in children and it may result uncooperative behavior during dental treatment. The foremost objective of nitrous oxide/oxygen inhalation procedure in the dental management of a child patient is to provide conscious sedation, which makes the child more easily

influenced by behavioral techniques, and be able to keep the mouth and eyes open as well as to communicate and cooperate.^{3,4}

The patient in this case was willing to cooperate during oral examination and cleaning and polishing procedure only. He was extremely anxious of the extraction procedure and exhibited fear of anesthetic injection. His fear was insurmountable by behaviour management alone and caused him to refuse the extraction procedure. In general the patient did not have any significant medical history or underlying medical problem, he was a suitable candidate for nitrous oxide/oxygen sedation.⁵

According to the American Academy of Pediatric Dentistry guidelines in patient selection for nitrous oxide/oxygen sedation, the indications are⁴:

1. A fearful, anxious, or obstreperous patient
2. Certain patients with special health care needs
3. A patient for whose gag reflex interferes with dental care
4. A patient for whom profound local anesthesia cannot be obtained
5. A cooperative child undergoing a lengthy dental procedure.

Review of the patient's medical history should be performed prior to the decision to use nitrous oxide/oxygen sedation.² If an underlying medical condition is detected, consultation with a relevant medical specialist should be carried out.^{4,5}

The term "medicated oxygen" was used to help lay persons' comprehension, it refers to the fact that oxygen is the main composition and nitrous oxide is always administered with oxygen. It starts with administering 100% oxygen for 1 to 2 minutes, to be followed by titration of nitrous oxide in 5-10% intervals and slow increases to achieve sufficient concentration of nitrous oxide/oxygen ratio. Slow induction is recommended to regulate the number of litres of gas that the patient

breathes in per minute with sufficient concentration of nitrous oxide/oxygen. The most common concentration of nitrous oxide for child patients is 30-35%. For this patient a concentration of 40% nitrous oxide was required because he had an adult size body with 69 kg of body weight and the objective signs of nitrous oxide/oxygen sedation clearly appeared and stabilised only when a concentration of 40% nitrous oxide was reached. The procedures started as soon as objective signs were exhibited and the patient felt relaxed. He was able to keep his mouth and eyes open as well as follow the instructions properly.⁴

Documentation before nitrous oxide/oxygen sedation shall include instruction and information provided to the responsible person by the operator and informed consent signed by the responsible person and witness. Dietary precaution needs to be given prior to the procedure to prevent nausea and vomiting during or after administration of nitrous oxide/oxygen. The technique of nitrous oxide/oxygen sedation administration has to start with selection of an appropriately sized nasal hood. A flow rate of 5 to 6 L/minute generally is acceptable to most patients and it can be adjusted after observation of the reservoir bag. The bag should pulse gently with each breath and should not be either over- or under-inflated.^{4,5}

Pulse oximetry is useful to monitor oxygen saturation and patient's pulse throughout the treatment. The response of patients to commands during procedures serves as a guide as to their level of consciousness.⁵

After completion of the dental treatment, 100% oxygen is given for 5 minutes to ensure the patient returns to pretreatment responsiveness. Although the patient is able to leave the chair after the first 5 minutes, it is necessary to observe the patient for another 10-20 minutes to confirm the patient's condition.^{2,5}

Conclusion

In conclusion, nitrous oxide/oxygen inhalation which provides conscious sedation can help child patients with dental fears. The use of nitrous oxide/oxygen sedation in dental clinics and hospitals in Malaysia is common nowadays because it makes the child more easily influenced by behavioral techniques; the child is still able to keep his mouth and eyes open as well as communicate and cooperate. The Malaysian Dental Association has provided the regulations and guidelines for the management of dental child patients with nitrous oxide/oxygen sedation.

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Figure 1: Supernumerary tooth (as indicated by the arrow)



Figure 2: Nasal Hood



Figure 3: Nasal Hood with Connector



Figure 4: Pulse Oximetry



Figure 5: Nitrous-Oxide/Oxygen sedation machine

