Evaluation of Need to Pulse Oximetry Monitoring During Inhalation Sedation for Periodontal Treatments

N. Kaviani MD*, R. Birang DDS, MSc**

ABSTRACT

Introduction: Inhalation sedation is used for pain and anxiety control in dentistry. Hypoxia is the most important side effect which can be detected using pulse oximetry, however, there are different opinions about the use of this instrument. This study has been designed to investigate this subject.

Methods and Materials: In this study, 32 adult patients from periodontal surgical department were selected for their surgical treatment to be performed under inhalation sedation with 50% oxygen and 50% nitrous oxide. Chances of hypoxia occurrence in these patients during and after surgery were evaluated, using pulse oximetry.

Results: Average arterial blood oxygen saturation before surgery was measured to be 98.8±0.61% while it was 99.4±0.17% during the surgery. Hypoxemia was seen in one case during the surgery. Average arterial blood oxygen saturation in the first and the fifth minute after disconnection from nitrous oxide were above 97%.

Discussion: Hypoxia occurred in one case which can be due to patient's malaise and movement. Inhalation sedation may be administered without the use of pulse oximetry. However, if the observed hypoxia is a sign of real hypoxemia, we conclude that pulse oximetry is necessary during relative analgesia. Due to our lack of adequate experience with inhalation sedation, it is advisable to employ pulse oximetry for this type of sedation in dentistry.

Key words: Inhalation Sedation, Pulse Oximetry, N2O

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Introduction

Inhalation sedation by a mixture of Oxygen (O_2) and nitrous oxide (N_2O), called Relative Analgesia (RA), has been used in dentistry over than 150 years as a method for decreasing pain and anxiety in dental patients [1-8]. Nitrous oxide was discovered in 1772 and identified as an analgesic material in 1844, but because of its many side effects, a mixture of N_2O with O_2 began to be used in the 1860_s and the use of this gas increased ever since [1, 9].

After the discovery and employment of lidocaine hydrochloride in 1940 for decreasing the pain, the use of RA declined in dentistry until 1976, when Langa showed that the use of local analgesia with RA can decrease pain, anxiety and fear to a minimum level. [2]. By 1977, the use of RA had already gained an increasing trend in dentistry, so that 35% of American dentists were using RA as a useful method to decrease pain, anxiety, and gag reflexes [3, 10]. With the development of general anesthesia, it replaced RA both in hospitals and in private offices by 1994 [11]. As the general anesthesia was more dangerous than RA, General Dental Council (GDC) in 1998 and Royal English College in 1999 banned the use of general anesthesia in private offices [11, 12].

*Assistant Professor, Oral and Maxillofacial Department, Faculty of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran.
**Assistant Professor, Periodontology Department, Faculty of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran.

In response to this decision, the use of RA in dentistry immediately increased so that 250,000 RA cases were reported in 2000 only in England and Wales [6, 11, 13, 14].

The important characteristics of an ideal sedation are rapid change in dose, low risks of side effects, and no necessity for special environment [15, 16]. These characteristics have made this pain-relief method so important and useful in dentistry and about 90% of patients accept it easily [1, 13, 17, 18, 19].

Side effects of RA like nausea, vomiting, dizziness, and headache have a chance of occurring, as 4% to 10%, while this chance is only 0.7% for its dangerous side effects like hypoxemia. Vomiting and nausea are more common with high concentrations of N_2O (more than 50%) or with prolonged exposure to N_2O (for more than 2 hours) [13].

Hypoxemia is one of dangerous side effects of RA and is usually found when N_2O concentration is higher than 70% or when it falls to zero at the end of operation when 100% O_2 is inhaled. The maximum concentration of N_2O recommended for dental operations is 55% in which there no chance for hypoxemia [13, 20, 21].

Roberts (1997) reported that no dangerous side effect has been observed over the previous 45 years. Other studies have also revealed the safety of RA in patients of ASA (American Society of Anesthesiology) classes I and II [1, 13, 17, 18, 19].

The importance of RA in dentistry and its increased daily employment require some important and accurate monitoring to be used in order to control the patient's conditions without interfering with the operation. The monitoring should include: sedation level evaluation, mucous color evaluation, breathing rate, and heart rate during the operation. These features can be easily evaluated without any need for special examination [13, 20, 22].

One of the most useful monitoring tools used in dentistry is the pulse oximetry. It is a noninvasive instrument whose probe is attached to the patient's finger or ear to show the arterial blood oxygen saturation level (SaO2) and the cardiac rhythm during operation [1, 20, 22, 23]. However, it also has its associated limitations including patient's movement or intense light in the surrounding environment [24, 25].

The low frequency of hypoxemia in dental operations and the limitations associated with pulse oximetry have given rise to contraversy about whether this instrument should be used in dental operations at all. Some dentists maintain the pulse oximetry as a necessary instrument for RA [1, 21], some others do not find it necessary but only prefer to use it [26], while some dentists still refuse to use it altogether, because of its capability to evoke anxiety in patients by means of its probe on the patient's ear or finger [27].

RA is being used in Isfahan School of Dentistry for the first time in Iran. As the induction and fixation of sedation is the dentist's duty and also as patients have never had any prior experience with inhalant sedation, it is necessary, therefore, to monitor the side effects, especially hypoxemia, during the operation.

This study investigates hypoxemia as a dangerous side effect of RA and the requirement of pulse oximetry during a dental operation.

Methods and Materials

Considering ethical approval protocol, 32 patients aging 20 to 40, waiting for periodontal surgery were selected. The patients had been screened to show no cardiovascular, respiratory, or psychological diseases, no smoking habits or drug abuse, and no eye or brain surgery (ASA classes I and II) in their history. The selection procedure was based on simple sampling.

Each patient got an appointment for surgery for the following one or two days and received instructions to have no breakfast and not to use nail polish. The surgery was performed in the morning. After the patient was placed in the dental chair, the pulseoximetry probe was connected to the patient's finger from the cardiovascular monitoring machine (made by Saa' Iran Company, figure 1) with a silent option and then a nasal mask was used. The mask was connected to a special machine (Cyprane Quantiflex Dental MDM Ireland, figure 2) with an oxygen rate of 6 lit/min [23]. The N_2O concentration was raised in the mixture by 10% each minute until nitrous oxide level reached to 50% of the total gas volume. After 5 minutes, the surgeon injected 2 local anesthetic cartridges (2% lidocaine and 1:80000 epinephrine). After that local anesthesia effects appeared, the surgery was started on one quadrant. During the surgery, more local anesthesia was injected (maximum dose as 4 cartridges) when necessary. An anesthesiologist was responsible for use of the gas mixture, vital signs monitoring, and for

the diagnosis and handling of possible complications. After surgery was completed, the patients would get 100% oxygen for 2 minutes before the nasal mask was removed.

Blood pressure, heart rate, and arterial blood oxygen saturation were monitored prior to inhalation sedation, at intervals of 5 minutes during the surgery, and at the first and fifth minutes after surgery. An arterial blood oxygen saturation of less than 91% was defined as a decrease in oxygen blood saturation (desaturation) and considered important to be investigated [28]. Changes in blood pressure of about 20% (increase or decrease), vomiting, nausea, and other probable changes were considered abnormal and recorded [29]. Finally the obtained data were analyzed using SPSS and the Median and the Standard Deviation (SD) were calculated.

Results

In this study, 32 patients 28 females (87.5%) and 4 males (12.5%) with an average age of 33.18 ± 6.94 years old were studied for their responses to inhalation sedation. The mean time of surgery was 28 ± 12 minutes. No side effects including nausea, vomiting, cyanosis, blood hypotension or hypertension, or other complications were observed during and after surgery, except only in one case in which surgery was finished without nitrous oxide so as to prevent hypoxia.

Blood pressure and heart rate were observed during and after surgery to be normal and no arrhythmia was reported. All of the patients accepted nasal mask without fail and nobody refused surgery.

The mean arterial blood oxygen saturation before surgery was $98.8 \pm 0.61\%$, while it was $99.4 \pm 0.17\%$ during surgery, $97.1 \pm 0.31\%$ one minute after surgery, and $99.1 \pm 0.13\%$ five minutes after surgery.

One patient showed anxiety and body movements during surgery. The patient's arterial blood oxygen saturation reached 89%, resulted in the use of pure oxygen to reach the saturation to 95% and the surgery to be completed without RA.

Discussion

In spite of the fact that earlier studies had shown hypoxemia to be one of the dangerous side effects of RA, no decrease was observed in arterial blood oxygen saturation in 96.88% of the patients in the present study. There was just one case with a saturation decrease which might have been due to the patient's malaise and movement. It is, therefore, possible to recommend inhalation sedation as a safe method. In agreement with Trond, Roberts, Jackson, and Takarada, inhalation sedation may even be administered without the use of pulseoximetry monitoring [13, 17, 18, 19].

Ascribing the only case of arterial blood oxygen saturation decrease to the patient's movement and its subsequent effects on the pulse oximetry, we may agree with Raymond and coworkers to regard the pulse oximetry as an unnecessary equipment [20]. However, if the observed decrease in arterial blood oxygen saturation is a sign of real hypoxemia, we may conclude in agreement with Trimble and Stanley that pulse oximetry during surgery is necessary when using RA [1, 22].

Finally, with regard to the fact that RA has been used for the first time in dentistry in Iran and, thus, the experiences are not yet adequate, the surgeon should be responsive to the side effects, their diagnosis, and timely handling. Moreover, pulse oximetry may be recommended to be used as a noninvasive and easy method accompanying RA during surgery.

Since the pulseoximetry is a safe and noninvasive method and sufficient experiences must yet be gained with RA, it is advisable to use pulseoximetry as a monitoring instrument with RA in dentistry.

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