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Original Research Article

Conscious Sedation by the Inhalation of Equimolar Mixture of Oxygen and Nitrous Oxide in a Paediatric Dentistry Department

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Abstract

Aims: To evaluate the management of patients initially refusing care and their treatment under conscious sedation by the inhalation of Equimolar Mixture of Oxygen-Nitrous Oxide in the Department of Paediatric Dentistry at the Faculty of dental medicine in Monastir. ***Settings and Design:*** A 5 years retrospective study. ***Methods and Material:*** Dental session's treatment under conscious sedation were done once a week. Data for only one operator was collected. Data entry was performed using SPSS statistical software. Quantitative variables were expressed by their mean and standard deviation and categorical variables by their number and frequency. Differences with P-value < 0.05 were recorded as statistically significant. ***Results:*** The sample represents 161 patients (226 care sessions), the majority of patients treated under conscious sedation are aged between 3 and 30 years. The mean age is 8.02 years with a standard deviation of 4.591 years. The most represented age group is that of 5-14 years with 74% of the total number. The category of the most treated patients in our study were disabled patients with 49%, then young children with 36% and anxious patients with 13%. The category of occasional indications related to the act represents only 3%. Recruitment was mostly performed within the Department of Paediatric Dentistry. Extractions represent 40%, no serious side-effects were observed. The success rate was 93.2%. ***Conclusions:*** Since it is carried out in a Paediatric Dentistry department, this study provides a vision of conscious sedation benefits with young patients requiring this specific treatment.

Keywords: Conscious sedation, Inhalation of equimolar mixture of oxygen and nitrous oxide, Paediatric Dentistry.

Key Messages: Nitrous oxide inhalation sedation (N2O/O2) can improve cooperation for pediatric dental procedures, and the clinical efficacy of this technique is sufficient and predictable in most cases. Nitrous oxide inhalation sedation (N2O/O2) can be considered safe, practical and effective both for pediatric very young and fearful patients with low pain tolerance and for patients with intellectual disability.

INTRODUCTION

Dental fear and anxiety related to dental procedures have been recognized to be an obstacle to the successful treatment in children, impeding, or even precluding, quality dental care [1-3]. Anxiety and pain can be modified by psychological techniques, in many instances pharmacological approaches are required [4-6]. The outcome of pharmacological approaches is variable and depends upon each patient's response to various drugs. The clinical effect of nitrous oxide/oxygen inhalation, however, is more predictable among the majority of the population. When used for analgesia/anxiolysis, nitrous oxide/oxygen inhalation allows for diminution or elimination of pain and anxiety in a conscious patient, while entailing minimum risk [3, 6].

The patient responds normally to verbal commands [5, 7]. All vital signs are stable, there is no significant risk of losing protective reflexes, and the patient is able to return to preprocedural mobility. In children, analgesia/ anxiolysis may expedite the delivery of procedures that are not particularly uncomfortable, but require that the patient not move [3, 8]. It also may allow the patient to tolerate unpleasant procedures by reducing or relieving anxiety, discomfort, or pain. Furthermore, it increases reaction time and reduces pressure-induced pain. Furthermore, it increases reaction time and reduces pressure-induced pain, but does not affect pulpal sensitivity [4, 8].

Nitrous oxide in an effective analgesic/anxiolytic agent with multiple mechanisms of action, causing central nervous system depression and euphoria with little effect on the respiratory system, it can be absorbed rapidly allowing rapid onset and recovery with rare and minimal impairment or side-effects [4, 9, 10].

Nitrous oxide inhalation sedation (N2O/O2) was commonly employed to improve cooperation for pediatric dental procedures, and the clinical efficacy of this technique was sufficient and predictable in most cases [11].

It can be considered safe, practical and effective both for pediatric very young and fearful patients with low pain tolerance and for patients with intellectual disability, and was considered as the standard technique who has been widely used for several decades for managing pediatric patients with dental anxiety [1].

This technique was introduced at the pediatric dentistry department of the faculty of dental medicine of Monastir (Tunisia) in 2003. The aim of this study was to evaluate the management of patients initially refusing care and their treatment under conscious sedation.

SUBJECTS AND METHODS

The study was designed as a 5 years retrospective, observational survey undertaken in the department of Pediatric Dentistry at the Faculty of Dental Medicine of Monastir. Data for only one operator were collected, and dental treatment sessions under conscious sedation were done once a week after having obtained parental consent.

The administration of the equimolar mixture of oxygen and nitrous oxide was carried out according to the usual procedure.

Patients and Treatment Sessions

226 sessions and 161 patients aged between 3 and 30 years were selected to undergo dental procedures under conscious sedation with equimolar mixture of oxygen and nitrous oxide.

Inclusion Criteria

- Patients over three years, male or female.
- Patients belonging to health ASA class I and II according to The American Society of Anesthesiologists classification [12].
- Patients who did not cooperate with conventional dental treatment.

Exclusion Criteria

- Patients belonging to health ASA class III and IV and, or showing one or more of the following conditions were excluded: severe obstructive pulmonary disease, severe emotional disturbances or drug [12].
- The procedure was first discussed with the patients and their parents regarding the application of the gas and the expected effects, possible complications and alternatives for analgesia.
- Patients were asked not to eat for at least 2 hours before conscious sedation.
- Parents were invited to be present with their children during the caring sessions, the application of the gas occurred in a fully equipped ambulant operating room.
- The nitrous oxide was applied over a suitable face mask or nasal mask chosen in relation to the morphology of the patient in a previous session. The mask was held by the patients themselves or their parents.
- The flow rate was chosen according to the patient's age (4-5 L/min for most children and 6-7 L/min for an average-size adult). Before the actual dental care, the mixture of 50% nitrous oxide and 50% oxygen was applied for at least 3 minutes. Dental treatment was undertaken according to a predetermined treatment plan while verbal contact with the patient and monitoring of O_2 saturation were maintained.
- The application of nitrous oxide was stopped with the ending of the procedure, there was no need for further application of oxygen. The patients could be discharged shortly after the procedure.

Questionnaire design: Following treatment, the dentist completed a questionnaire which sought the following information:

Patient details: Sex, age of the patient; Recruitment process for consultation. Patient medical history details.

Details of sedation\treatment: The duration of inhalation. The dental treatment undertaken (restorative acts or dental extractions...). Which and how many teeth were treated at each visit.

Sessions appraisal: The session was considered successful if the planned dental treatment could be carried out under conscious sedation. Failure was recorded either if the sedation could not be induced or maintained, or if the dental treatment could not be completed.

Potential side effects: Incidence of adverse events during the sedation and recuperation periods was reported. Adverse events were collected according to 5 categories: respiratory problems (hyper or hypo-ventilation, desaturation...), digestive problems (nausea, vomiting...), neurological problems (convulsions, epileptic...), behavioral events (euphoria, hyper-

excitability...), and vaso-vagal effects (sweating, pallor, faint...).

Data Analysis

Data entry was performed using SPSS statistical software, release 18. Quantitative variables were expressed by their mean and standard deviation and categorical variables by their number and frequency. The comparison of the mean level of a quantitative variable between two groups was performed by the Student test, the relationship between two variables was investigated by the Chi-square test. Differences with P-value < 0.05 were recorded as statistically significant.

RESULTS

The sample represented 161 patients (226 care sessions), aged between 3 and 30 years. The mean age was 8.02 years with a standard deviation of 4.591 years. Patients aged between 3 and 6 years represented 52.1% of the sample and patients younger than 15 years old represented 8.6%. The age distribution was summarized in Figure-1.

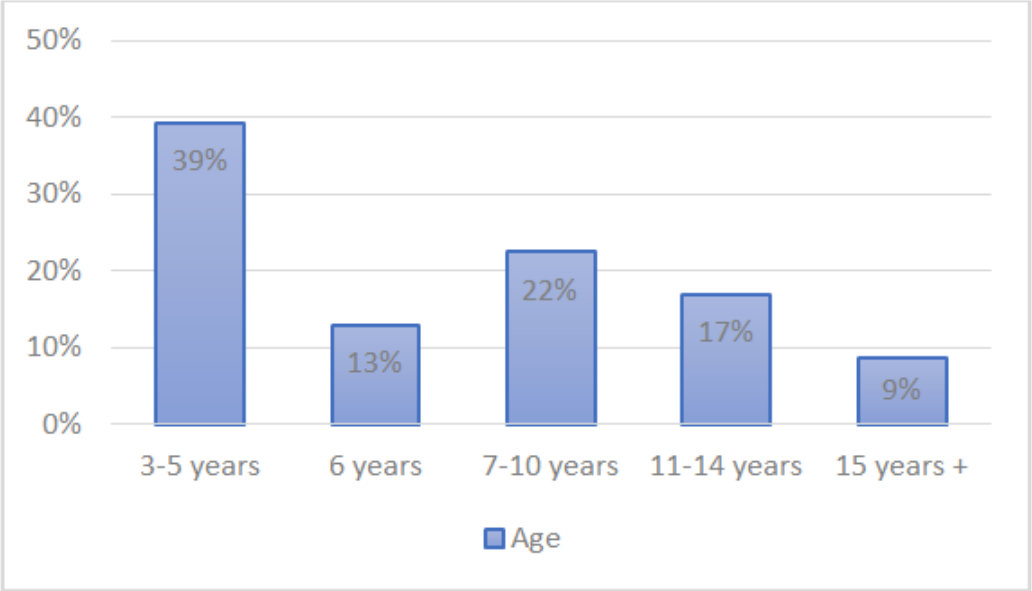

Fig-1: Age distribution

Planned dental treatment was successfully performed in 93.2% of sessions. In eleven cases, with a median age of 10 years sedation was interrupted.

Chi-square analysis showed that, in relation to the success-failure, there was a statistically significant difference between age classes (p = 0.043) (Figure-2).

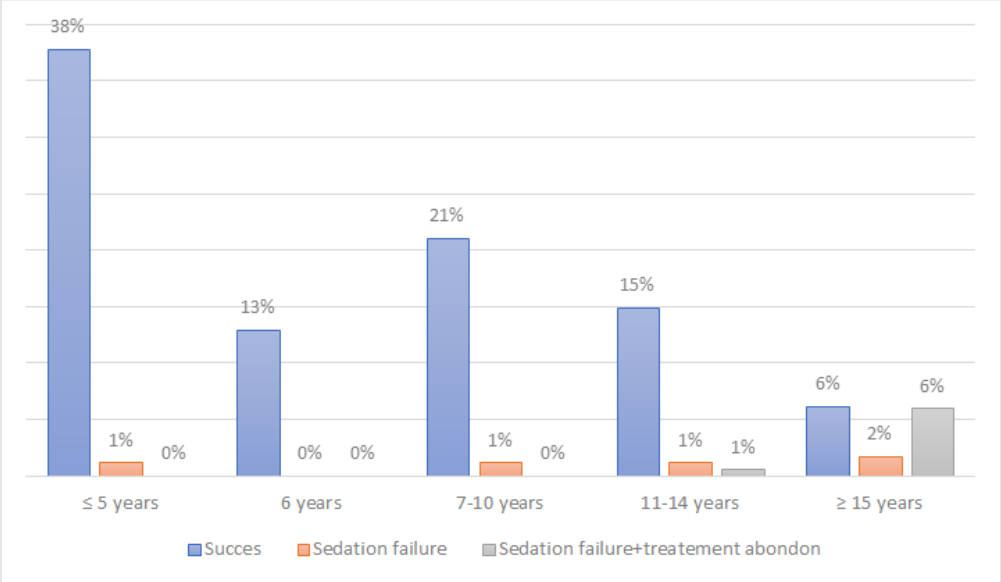

Fig-2: Success-failure distribution according to age classes

In relation to gender, 41.6% (67) of patients treated under conscious sedation were females and 58.4% (94) were males.

A success rate of 56.6% was recorded on male's patients and a success rate of 36.7% was recorded on female's patients.

Chi-square analysis showed that, in relation to the success/failure there was no statically significant difference between males and females.

In relation to the disability, patients with intellectual disability represented 49.1% of the sample. Data from the patient's medical histories are shown in Figure-3.

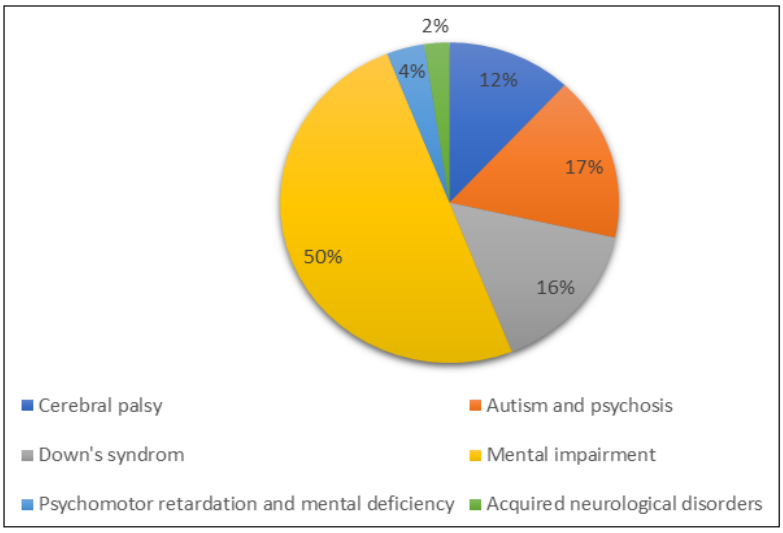

Fig-3: Patients medical history

Working sessions were successfully completed with disabled patients in 47.8% of cases while with 2 patients a total failure and abandon of treatment was recorded (Figure-4).

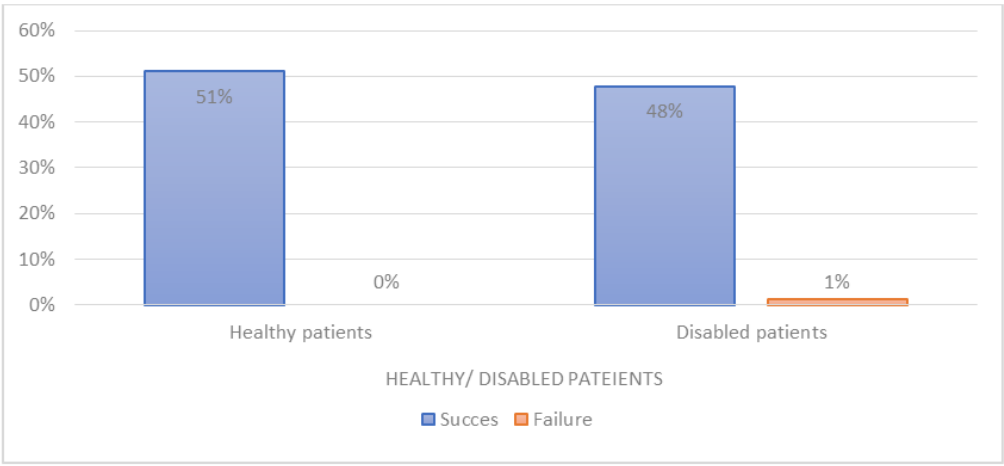

Fig-4: Success/failure in relation to healthy and disabled children

Chi-square analysis showed that, in relation to the success/failure there was a statically significant difference between healthy and disabled patients (p = 0.030). Inhalation was interrupted in 6.8% of cases.

A total failure, or abandon of treatment, was recorded in only 2 cases. Seven cases of inhalation interruption were observed in children older than 11 years.

Chi-square analysis showed that, in relation to the inhalation interruption, there was a statistically significant difference between age classes (p = 0.007).

Inhalation interruption occurred with 4.5% on females and Chi-square analysis showed that, in relation to the inhalation interruption, there was a statistically significant difference between genders (p= 0.030).

Inhalation interruption occurred with 5% on disabled patients, there was no statically significant differences between healthy and disabled patients.

During this study, 274 dental procedures were performed: 121 were treatment on deciduous teeth, 25 were treatment on permanent teeth, 3 were dental visit, 7 were professional oral hygiene treatments and 7 were oral surgery.

Dental extractions were performed in 111 working sessions: 81 were deciduous teeth extractions and 30 were permanent teeth extractions (Figure-5).

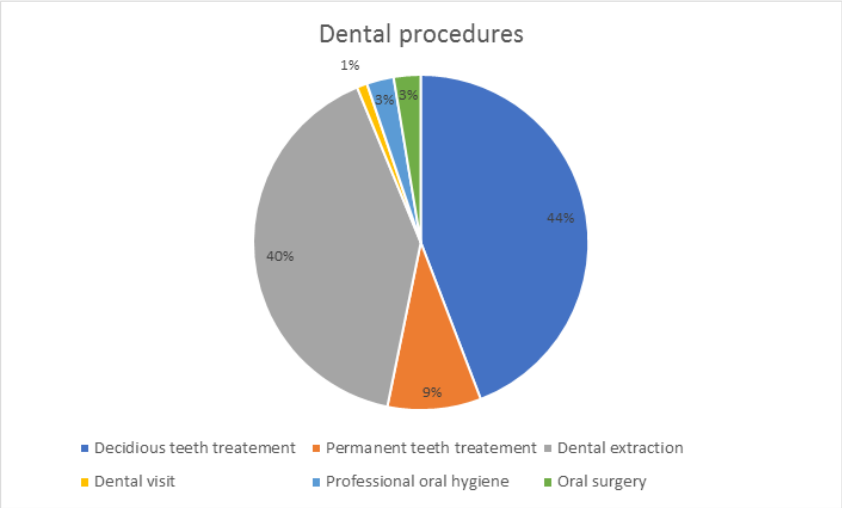

Fig-5: Dental treatments undertaken under conscious sedation

The nitrous oxide-oxygen average rate used in this study was 5.49 L / min (a standard deviation of 3.661). The difference was statistically significant between nitrous oxide-oxygen flow rate and age groups (p = 0.000) (Figure-6).

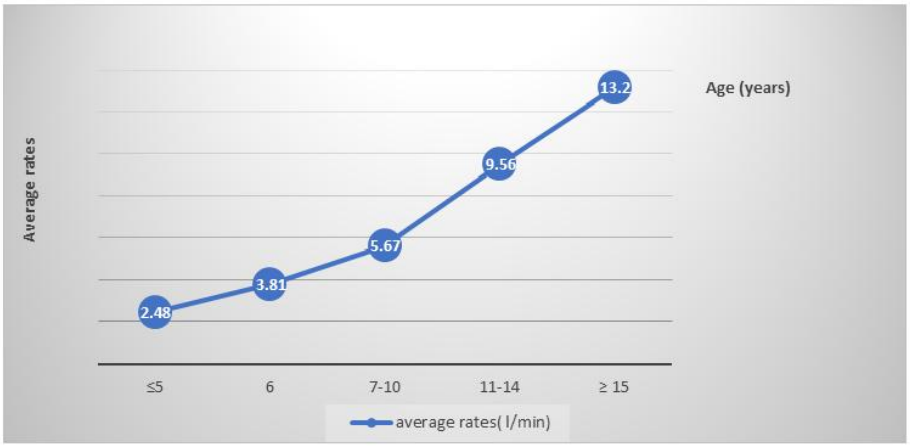

Fig-6: Nitrous oxide average rates distribution according to age classes

Adverse effects occurred in 4% of all case, the most frequent symptoms were nausea and vomiting (3.7%).

DISCUSSION

Results of the present study showed that conscious sedation with 50% nitrous oxide and 50% oxygen can be effectively used for providing high quality dental care in a large pediatric sample constituting precooperative, fearful and disabled patients, who fail to accept dental treatment, in alternative to general anesthesia.

In the present study, the overall percentage of successful sessions was 93.2%. These results were similar to other studies, reporting success rate of 93% and 93.6% respectively [13, 14].

Analysis showed that in the present study the mean age was 8.02 years with a standard deviation of 4.591 years. Patients subjected to dental procedures in conscious sedation were older than patients recruited in other studies [1, 14].

Indeed, in this survey 9% of patients were older than 15 years of age and these patients were with special needs for whom dental treatment under conscious sedation was the only alternative to general anesthesia cause the lack of special department.

Furthermore, in relation to the age, in this study, there was a statically significant difference between success and failure (p=0.043). A failure rate of 4.2% was recorded in patients older than 10 years. Other authors have also observed higher failure rates amongst older patients, particularly those more than 15 years of age [13-17] this explain the accessibility necessities to general anesthesia for older patients.

Regarding the disability, in relation to the success/failure, there was a statically significant difference between healthy and disabled patients (p = 0.030). these results agreed with Galeotti [1] who reported that, disability, impairing communications, intellectual functioning and linguistic development made it difficult to provide quality dental care, and disabled patient cannot be able to breathe adequately through a nasal mask or to tolerate unpleasant and long dental procedures.

As regards inhalation interruption, there was a statistically significant difference between age classes (p = 0.007). Seven cases of inhalation interruption were observed in children older than 11 years, in fact older patients were more difficult to control and more agitated.

In relation to the inhalation interruption, there was also a statistically significant difference between genders (p= 0.030), indeed inhalation interruption occurred with 4.5% on females this could be explained by the fact that females were more anxious than males [16].

Inhalation interruption occurred with 5% on disabled patients, but there were no statically significant differences between healthy and disabled patients, these results were in contrast with Collado *et al*., who reported that, patients with cognitive difficulties have exaggerated gag-reflexes related to neuro-motor disability and gastroesophageal reflux [18, 19].

Regarding dental treatment, 111 extractions were performed in this survey reflecting the late referral of patients to a specialist pediatric service by practitioners working within primary care [14, 17, 20].

During the working sessions, the percentage of nitrous oxide delivered was 50% that represented the maximum concentration recommended by the American Academy of Pediatric Dentistry in order to avoid nitrous oxide adverse effects [5].

The nitrous oxide-oxygen average rate used in this study was 5.49 L / min (a standard deviation of 3.661). The difference was statistically significant between nitrous oxide-oxygen flow rate and age groups (p = 0.000). Indeed, the average flow rate gradually increased with age classes, and this was related to increased ventilator capacity with age.

Finally, in relation to adverse effect occurring, the percentage was found to be very low (3.7 %). The most frequent symptoms were nausea and vomiting, in accordance with other authors [6, 7, 17, 19, 21-24].

CONCLUSION

Inhalation sedation for dental treatment in children resulted in successful completion of treatment in 93.2% of cases.

The fear of invasive procedures, such as injections and extractions, was the cause of dental anxiety amongst children and this explain why the most frequently undertaken treatment was dental extraction, and treatment under local anesthesia.

The final aim of the use of conscious sedation is not only to have a relaxed patient, but also to be able to provide efficient, quality dental care in the most comfortable way possible for the patient and practitioners.

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