Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 91.86

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Evaluation of the effect of nitrous oxide inhalation sedation during inferior alveolar block administration in children aged 5-10 years- A randomised control trial

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ABSTRACT:

Background: To evaluate the effect of nitrous oxide-oxygen inhalation sedation during inferior alveolar block administration in children. **Materials & methods:** A total of 40 children of age 5- 10 years, with a treatment plan of extraction of primary teeth were enrolled in this study. The subjects were randomly divided into two groups as "N_2O-O_2"and"Oxygen" group using randomiser software. Thoe ones who presented with clinical conditions which contraindicated the use of N_2O–O_2 or having known allergy to lignocaine were excluded from the study. Thephysiologic vital signs and behaviour of children were measured and assessed. The data was collected and analysed usingSPSS (Statistical Package for the Social Sciences 2016) software. The data revealed a high level of significance ($P \leq 0.05$) in nitrous oxide inhalation sedation group. **Results:** A total of 40 children were enrolled, 20 in each group. There was a significantly lower pain reaction to local anesthetic administration in the N_2O-O_2 group ($P < 0.01$). Scoring was done. In O_2 administrated patients. 85% were in deep sedation during and even after the procedure. In N_2O-O_2, 35% patients were in light sedation after the procedure. 60% of subjects after procedure were in moderate sedation with N_2O-O_2. **Conclusion:** N_2O- O_2 inhalation showed better results as vital signs were normal and treatment was completed successfully.

Keywords: sedation, inhalation sedation, conscious sedation, nitrous oxide, anxiety.

Received: 17 July, 2022 Accepted: 19 August, 2022

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This article may be cited as: Misgar BA, Goyal V, Goyal P, Shaveta, Rani N. Evaluation of the effect of nitrous oxide inhalation sedation during inferior alveolar block administration in children aged 5-10 years- A randomised control trial. J Adv Med Dent Scie Res 2022;10(9):70-73.

INTRODUCTION

Nitrous oxide–oxygen (N_2O–O_2) inhalation sedation has been recognized as a safe and effective technique to reduce anxiety, produce analgesia, and enhance effective communication between a patient and a health-care provider. [1] It has gained reputation as the most popular mode of sedation over other modalities. N_2O is a non-irritating, colorless, inert gas with a faint sweet smell and odor. It is an effective analgesic/anxiolytic agent which causes central nervous system depression and euphoria with little effect on the respiratory system[2,3]. Nitrous oxide is absorbed rapidly, allowing for both rapid onset and recovery (two to three minutes). It causes minimal impairment of any reflexes, thus protecting the cough reflex.6 It exhibits a superior safety profile with no recorded fatalities or cases of serious morbidity when used within recommended concentrations. Use of nitrous oxide in combination with other inhalational agents provides an additive anesthetic action since the minimum alveolar concentration of nitrous oxide is directly additive to theirs. Nitrous oxide in 60%-70% concentration equals a minimum alveolar concentration value of around 0.55-0.65.[4] It accelerates the time of anesthetic induction when used in conjunction with poorly soluble inhalational agents. Nitrous oxide as a component of anesthesia has shown to reduce the utilization of inhalational agents, propofol, and opioids.[5] During inhalational induction with mask in children, high concentration of nitrous oxide facilitates a faster loss of consciousness by concentration effect and second gas effect. The use of nitrous oxide during induction has proven to increase the mask acceptance in children and lower incidence of airway related complications. However, nitrous oxide favours the incidence of excitatory phenomena

with sevoflurane during inhalational induction. It has been seen that adding up nitrous oxide to other inhalational anesthetic agents decreases the occurrence of hemodynamic suppression as compared to use of equipotent doses of volatile agents alone. [6]
Subjective evaluations of efficacy of N_2O in dentistry have been widely researched, but the objective evaluations of psychomotor effects have been less commonly reported. Few investigators have used clinically adaptable objective and quantitative measures of modalities pertinent to patient recovery from dental anesthesia. For this reason, psychomotor functions were chosen as the measure of N_2O-induced effects; visual motor coordination was the particular modality of interest. [7] Hence, this study was conducted to evaluate the nitrous oxide- oxygen inhalation sedation during inferior alveolar block administration in children.

MATERIALS & METHODS

The research was carried outin the Department of pediatric and Preventive Dentistry, Guru Nanak Dev Dental College and Research Institute, Punjab, India after obtaining an approval from the ethical committee of Guru Nanak Dev Dental College and Research Institute, Sunam, Punjab, India.A total of 40 children, 5- 10 years of age, with a treatment plan of extraction of primary teeth, were enrolled in the study. The subjects were randomly divided into 2 groups as N_2O-O_2 (Figure 1)and Oxygen(Placebo) group using randomiser software. Those who presented with clinical conditions some chronic obstructive pulmonary diseases, recent middle ear disturbance/surgery, severe emotional disturbances or drug-related dependencies, treatment with bleomycinsulfate, methylenetetrahydrofolate reductase deficiency, Cobalamin (vitamin B-12) deficiency, or having known allergy to lignocaine contraindicating the use of N_2O–O_2 were excluded from the study. Consent was taken from parents/guardians of the children. The baseline physiological signs such as Pulse rate, O_2 saturation, Blood Pressure, respiratory rate, oral temperature, and anxiety were recorded(Figure2). Not more than 50% N_2O was administered to any patient.The physiological vital signs and behavioural pattern of anxiety(Frankls behaviour rating scale, Figure3) were assessed. Postoperative vital signs and anxiety were assessed with similar measures. Data was collected and result was analysed using SPSS software. The level of significance was at $P \leq 0.05$.

RESULTS

A total of 40 children were enrolled, 20 in each group. There was a significantly lower pain reaction to local anesthetic administration in the N_2O-O_2 group ($P < 0.01$). Scoring was done. In O_2 administrated patients. 85% were in deep sedation during and even after the procedure. In N_2O-O_2, 35% patients were in light sedation after the procedure. 60% of subjects after procedure were in moderate sedation with N_2O-O_2. Improvement in the behaviour of the children belonging to N_2O-O_2 group during and after the procedure as compared to the O_2 group ($P <0.01$) was observed. All the vital signs recorded were in the normal physiologic limits in both the groups.

Figure 1: portable Sedation unit with nasal hood

Figure 2: Monitoring of vital signs

Table 1: Sedation Scale

Score	Interpretation
1	Unconscious
2	Deep sedation

3	Moderate sedation
4	Light sedation
5	Alert

Figure 3: Frankls behaviour rating sacle

Rating	Attitude	Definition
1	DEFINITELY NEGATIVE	Refusal of treatment, crying forcefully, fearful or any other overt evidence of extreme negativism.
2	NEGATIVE	Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced, i.e. / sullen, withdrawn.
3	POSITIVE	Acceptance of treatment; at times cautious, willingness to comply with the dentist, at times with reservation but patient follows the dentist's directions cooperatively.
4	DEFINITELY POSITIVE	Good rapport with the dentist, interested in the dental procedures, laughing and enjoying the situation.

Table 2: behaviour recording during local anesthetic administration

Behaviour rating	N_2O-O_2 (n=20)		Oxygen (n= 20)	
	During procedure	After procedure	During procedure	After procedure
Rating 2	1 (5%)	1 (5%)	17 (85%)	17 (85%)
Rating 3	13 (65%)	12 (60%)	3 (15%)	3 (15%)
Rating 4	6 (30%)	7 (35%)	0 (0%)	0 (0%)

DISCUSSION

Dentists have expertise in providing anxiety and pain control for their patients. While anxiety and pain can be modified by psychological techniques, in many instances pharmacological approaches are required.1 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. Nitrous oxide has multiple mechanisms of action. The analgesic effect of nitrous oxide appears to be initiated by neuronal release of endoge-nous opioid peptides with subsequent activation of opioid receptors and descending gamma-aminobutyric acid type A (**GABAA**) receptors and noradrenergic pathways that modulate nociceptive processing at the spinal level. The anxiolytic effect involves activation of the GABAA receptor either directly or indirectly through the benzodiazepine binding site.Nitrous oxide has rapid uptake, being absorbed quickly from the alveoli and held in a simple solution in the serum. It 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 causes minor depression in cardiac output while peripheral resistance is slightly increased, thereby maintaining the blood pressure.This is of particular advantage in treating patients with cerebrovascular system disordersNitrous oxide has been a part of the routine anesthetic practice for over 15 decades. From being the fad of recreational use at parties, nitrous oxide has evolved to hold an important place in contemporary practice of anesthesia. [4] N_2O-O_2 inhalation sedation is one of the most common pharmacological means of behavioral modification

advocated in children and anxious adults owing to its unique properties such as high efficiency, potency, fast onset, rapid recovery, and least adverse effects. [8] Hence, this study was conducted to evaluate the nitrous oxide- oxygen inhalation sedation during inferior alveolar block administration in children.

In the present study, a total of 40 children were enrolled, 20 in each group. There was a significantly lower pain reaction to local anesthetic administration in the N_2O-O_2 group ($P < 0.01$). Scoring was done. In O_2 administrated patients. 85% were in deep sedation during and even after the procedure. In N_2O-O_2, 35% patients were in light sedation after the procedure. A study by Takkar D et al, studied to use N_2O-O_2 alone, to evaluate its effectiveness for pain control during inferior alveolar nerve block administration in children. There was a single-centered, simple randomized, double-blinded, placebo-controlled parallel-group study involving 40 children in the age group of 5-10 years divided into 2 groups: N_2O-O_2 sedation and oxygen. There was a significantly lower pain reaction to local anesthetic administration in the N_2O-O_2 group ($P < 0.01$). All the vital signs recorded were in the normal physiologic limits in both the groups. Pain experienced by children receiving N_2O-O_2 sedation was significantly lower. N_2O-O_2 inhalation sedation produces adequate sedation with vital signs within normal limits and treatments successfully completed.[9]

In the present study, 60% of subjects after procedure were in moderate sedation with N_2O-O_2. Improvement in the behaviour of the children belonging to N_2O-O_2 group during and after the procedure as compared to the O_2 group ($P < 0.01$) was observed. All the vital signs recorded were in the normal physiologic limits in both the groups. Another study by Shafi RI et al, studied Nitrous oxide (N_2O)–oxygen (O_2) inhalation sedation is one of the most widely used modalities for the management of fear and anxiety in children. A total of 300 healthy patients in the age range of 6–12 years (mean 8.9 years), who needed extraction of primary tooth, were included in the study. Pulse rate, SpO_2, blood pressure (BP), and temperature were recorded at baseline, 30% N_2O concentration, 50% N_2O concentration, and again postoperatively. In addition, anxiety levels and neuromuscular coordination were recorded at the respective intervals. The results revealed a mean decrease in pulse rate and BP from baseline and an increase in temperature and O_2 saturation during the sedation procedure. The findings were statistically significant. Significant impairment of coordination and psychomotor ability was seen at each step. Anxiety had significantly reduced after the onset of sedation due to the anxiolytic effect of N_2O. N_2O–O_2 inhalation sedation under different concentrations reduces the anxiety of the patient and produces adequate sedation with vital signs within normal limits along with temporary impairment of psychomotor ability and coordination.[10]

CONCLUSION

N_2O- O_2 inhalation showed better results as vital signs were normal and treatment wascompleted successfully. Nitrous oxide-oxygen inhalation sedation helped in completeion of dental extraction procedures in anxious children with all the vital signs within normal physiologic limits.

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