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An Experimental Study of the Control of the Gag Reflex with Nitrous Oxide

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Gagging represents a management problem during dental procedures. A controlled, double blind experiment on human volunteers evaluated the efficacy of nitrous oxide for suppressing experimentally-induced gagging. The ability of the subjects to tolerate palatal and oropharyngeal stimulation was evaluated by measuring the distance of the anatomic palatal and oropharyngeal structure which produce gagging. It was observed that under N_2O/O_2 inhalation subjects tolerated a significantly more intrusive (deeper) oropharyngeal stimulation than under control conditions.

There is very little dental literature on the subject of gagging and its control other than the recent review articles by Conny and Tedesco.[1,2] Though gagging associated with dental treatment may be a normal, healthy reflex,[3] problems have emerged with some patients. Gagging may compromise many aspects of dental treatment, particularly impression-making, the taking of x-rays, restorative treatment, and the use of a rubber dam. Even dentures may be difficult to tolerate. As a consequence, many gaggers avoid dental treatment.

The causes of gagging are varied. Systemic disorders, drug-induced, physiologic, psychologic, iatrogenic, extraoral, and intraoral factors have all been cited.[1,3,4] Kramer and Braham[5] noted that fear is the major etiologic factor influencing "the psychological gagger." Our experiences support this conclusion. Evidence that personality factors or general adjustment is related to gagging has been lacking.[6]

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Not all areas of the mouth are equally sensitive to stimuli that produce the gag reflex. Five regions of maximum sensitivity have been identified as "trigger areas."[1] They are the fauces, base of the tongue, palate, uvula, and posterior pharyngeal wall.

Although both pharmacologic and psychologic interventions have been described as useful in the literature, there have been few controlled studies.[2] The lack of clinical evaluation of drugs used to manage gagging, given the possible psychological and etiological factors at work, is disappointing. Only one drug, trimethobenzamide (Tigan), has been evaluated clinically.[7]

Nitrous oxide has been reported to have utility in the control of gagging. Langa[8] states that "although nitrous oxide sedation does not totally eliminate gagging in extreme cases, it depresses the gag reflex sufficiently that a good impression is obtained at first attempt in all cases." Rosen[9] reported a case where nitrous oxide sedation and suggestion were used to construct dentures for a patient with a sensitive gag reflex.

This study evaluated in a controlled laboratory setting the efficacy of nitrous oxide sedation in depressing the gag reflex.

METHODS

Twenty-six adult subjects aged 21–45 (sixteen men and ten women) agreed to participate as volunteers in this study. All participants completed a questionnaire based on the work of Wright[6] in an attempt to identify gaggers and their health, social, and family history. All subjects were nongaggers.

Subjects agreed to allow palatal and pharyngeal stimulation of their gagging reflex with the tip of a nine-inch long cotton swab, a method similar to that used by Klepac et al.[10] in assessment of psychologic management strategies. Swabs were placed at the incisive papilla and moved along the midline of the palate to the uvula. The distance between the incisors and the spot where gagging

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was noted was marked on the cotton swab itself and later recorded in millimeters. The same measurement was repeated two more times. If the patient did not gag when the swab reached the uvula, the distance between the deepest oropharyngeal area reached and the incisive papilla was recorded.

A nasal inhaler was placed over the nose during all three experimental conditions. In condition one, subjects were administered room air in an attempt to collect baseline data (Table 1). For this purpose, the nasal inhaler was first disconnected from the analgesia machine and was open to the room air.

In conditions two and three, the subjects were given either 50% nitrous oxide/50% oxygen or 80% nitrogen/20% oxygen via a specially designed analgesia machine that delivered the gases by a switch operation. The gases in conditions two and three were administered in a double blind manner by an anesthesiologist: neither the researcher nor the patient were told which mixture included nitrous oxide. There was an interval of two hours between conditions two and three in order to ensure that no residual effects of gases remained.

Two-way analysis of variance with repeated measures was calculated for the mean distances for each of the three conditions. Chi square analysis was used to compare the incidence of gagging and not gagging between nitrous oxide and air conditions.

Table 1. Summary of Experimental Design

Condition one:	A) Room air—15 minutes.
	B) Baseline data collection—three measurements of cotton swab depth along palate to cause gagging.
Condition two:	A) 50% N_2O/50% O_2 or 80% N_2/20% O_2—15 minutes.
	B) Three measurements of cotton swab depth along palate to cause gagging.
Two-hour interval	
Condition three:	A) If N_2O/O_2 were administered in condition two, then N_2/O_2 is given; if N_2/O_2 were administered in condition two, then N_2O/O_2 is given—15 minutes.
	B) Three measurements of cotton swab depth along plate to cause gagging.

RESULTS

Table 2 shows the results of depth of inserted cotton swab along palate and oropharynx in the three experimental conditions. Results indicated that when subjects were in the nitrous oxide condition, they were able to tolerate stimulation further along the palatal and oropharyngeal midline ($\bar{x}$ = 88.0 ± 6.6, F = 3.87 $p < .001$) than at baseline ($\bar{x}$ = 78.6 ± 8.6) or with the nitrogen-oxygen mixture ($\bar{x}$ = 80.8 ± 8.0). The effect of the order of the mixtures, where nitrous oxide was administered first or second, was not significant (F = 1.4, $p = .25$). Results indicate gagging to be much less likely in the nitrous oxide condition ($\chi^2 = 36.14$, $p < .005$).

Table 2. Depth of Cotton Swab Insertion Along Palate and Oropharynx in Three Experimental Conditions

Patient number	*Baseline (mm)*	*80% N_2/20%O_2 (mm)*	*50% N_2O/50%O_2 (mm)*
1	80.15	86.50	93.50
2	69.17	89.17	76.67
3	73.67	73.83	86.67
4	82.17	83.00	89.50
5	75.83	80.00	92.67
6	71.50	75.00	88.17
7	85.33	87.00	90.50
8	69.17	69.83	87.83
9	88.83	86.33	94.17
10	78.17	73.33	89.00
11	78.83	73.17	78.83
12	78.00	76.50	85.50
13	64.50	84.17	87.17
14	86.67	86.00	88.00
15	83.83	86.17	86.00
16	63.00	63.50	68.17
17	85.33	86.00	91.33
18	73.67	77.67	87.67
19	97.00	97.00	99.83
20	67.80	68.70	88.20
21	73.30	80.83	86.17
22	84.33	88.00	93.33
23	82.33	84.64	88.83
24	78.50	74.50	81.50
25	95.00	93.50	99.50
26	78.00	77.50	88.67
$\bar{x}$ ± SD	78.6 ± 8.6	80.8 ± 8.0	88.0 ± 6.6

$\chi^2 = 36.14$, $p < .005$.

DISCUSSION

Although it has been suggested that nitrous oxide may depress the gagging reflex, there is little experimental evidence to support this clinical effect. The results of the present study indicate that nitrous oxide has a definite effect on the incidence of experimentally-induced gagging. Subjects were nongaggers and control conditions were almost identical to baseline. It is possible that the sedative, anti-anxiety effect of the drug affected the psychologic component of gagging. On the other hand, this study has yet to be accomplished with gaggers.

In all, nitrous oxide appears to have utility in controlling the gag reflex during problematic aspects of dental treatment. The short duration of its effect may be seen as

an advantage; the gag reflex, a normal defense mechanism, should be inhibited no longer than needed.

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