



THE EFFECT OF NITROUS OXIDE ON SUBSEQUENT DEVELOPMENT OF
POSTOPERATIVE VOMITING IN CHILDREN UNDERGOING
ADENOTONSILLECTOMY

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ABSTRACT

Objective: To determine the impact of nitrous oxide on postoperative vomiting in children undergoing adenotonsillectomy. **Patients and Methods:** Eighty participants, both male and female, ranging in age from 3 to 14 years, were included in this study. Two distinct groups were formed from the participants. Group I received anesthesia induced with halothane in oxygen, while Group II received anesthesia induced with a mixture of nitrous oxide and oxygen to which halothane was gradually added. The occurrence of postoperative vomiting was recorded within specific time periods. **Results:** All demographic and surgical variables, including age, gender, weight, type and duration of surgery, and duration of anesthesia, revealed no statistically significant variations between the two groups. The occurrence of vomiting within the first four hours (0-4 hours) did not differ significantly between the two groups. In group I, two patients (5%) experienced vomiting compared to three patients (7.5%) in group II ($P < 0.05$). Both groups had the same incidence of vomiting during the period from four to twenty four hours. Two patients (5%) in each group vomited during this time frame. Consequently, the rate of emesis-free individuals within the initial twenty-four hours was nearly identical in both groups. **Conclusion:** The administration of nitrous oxide did not have a significant effect on the occurrence of emesis in pediatric patients after tonsillectomy, regardless of whether adenoidectomy was also performed. Eliminating nitrous oxide from the inhalation mixture throughout anesthesia in those participants did not result in a reduction in the frequency or severity of subsequent vomiting following surgery.

KEYWORDS: Tonsillectomy, Adenoidectomy, Nitrous oxide, Postoperative vomiting.

INTRODUCTION

Tonsillectomy, a common outpatient surgical procedure for children, often leads to postoperative vomiting, with an incidence rate ranging from 40% to 73%.^[1-3] Pediatric patients are more prone to experience postoperative emesis than adults.^[4] This unpleasant side effect is often rated by patients as one of the most annoying side effects of anesthesia, and many find it just as painful as the actual surgery.^[5] Moreover, Nausea and vomiting after surgery may lead to the development of medical complications.^[6,7] leading to increased resource utilization and the need for additional healthcare professional attention.^[5]

Various factors contribute to postoperative nausea and vomiting, including patient-related factors, surgery related factors, and factors related to anesthesia. Among

the anesthetic factors, nitrous oxide has been extensively studied as a possible trigger for emesis.^[8,9]

Multiple receptor systems, such as the brain's opioid receptors, sympathetic nervous system, and medullary dopaminergic system, have been shown to be activated by nitrous oxide, resulting in vomiting.^[10,11] In addition, variations in pressure within the middle ear and distension of bowel caused by the Nausea and vomiting following surgery may also be attributed to the diffusion of nitrous oxide into closed cavities.^[12,13]

Numerous studies have explored the relationship between nitrous oxide and postoperative nausea and vomiting, with some demonstrating a positive correlation, while others have failed in setting up an association.^[14-20] In order to determine the impact of

nitrous oxide on postoperative vomiting in children undergoing adenotonsillectomy, we conducted a prospective randomized, double-blind study.

PATIENTS AND METHODS

Eighty participants, both male and female, ranging in age from 3 to 14 years, were included in this study. The purpose was to evaluate the effect of anesthesia on patients undergoing adenotonsillectomy. The study design was randomized and double-blinded. The criteria for tonsillectomy were chronic tonsillitis, frequent attacks of acute tonsillitis, and sleep apnea syndrome due to enlarged tonsils. Participants who had received certain medications within 24 hours before surgery were excluded from the study. The participants were divided into two distinct groups. Group I received anesthesia induced with halothane in oxygen, while Group II received anesthesia induced with a mixture of nitrous oxide and oxygen to which halothane was gradually added. After induction of anesthesia, each child received atropine and fentanyl intravenously. Tracheal intubation was facilitated with vecuronium. For maintenance of anesthesia, Group I received halothane and 30% oxygen in air, whereas Group II received halothane and 30% oxygen in nitrous oxide. Routine monitoring was performed for all participants, including electrocardiogram, blood pressure, and pulse oximetry. Intravenous fluids were given to replace fluid deficiencies, meet maintenance needs, and substitute for

blood loss that occurred. Before extubation, the stomach's contents were aspirated. At the end of surgery, the anesthetics were stopped, and neuromuscular blockade was reversed. Extubation was carried out when all prerequisites for extubation had been fulfilled. The surgeries were performed by two surgeons employing the conventional dissection approach.

Hemorrhage was managed by cautery or ligature. Postoperative pain control was achieved by administering rectal paracetamol every 6 hours. Following surgery, all participants were transferred to the recovery room and then to the floor. A soft diet was provided during their hospital stay, and intravenous fluids were maintained until oral intake was adequate. The occurrence of postoperative vomiting was recorded within specific time periods, and if there were two or more episodes, a rescue antiemetic was given. Metoclopramide was used to treat participants who had more than two bouts of vomiting while in the hospital.

RESULTS

A total of 80 patients, evenly divided into two groups (40 patients per group), participated in the study. All demographic and surgical variables, including age, gender, weight, type and duration of surgery, and duration of anesthesia, revealed no discernible variations between the two groups. (see Table 1).

Table 1: The demographic features of the patients within each group.

Characteristics	Group I (n =40)	Group II (n = 40)
Age (yr)	4.4 ± 2.1	4.5 ± 2.2
Weight (kg)	19.5 ± 5.7	20.4 ± 5.5
Sex (male/female)	28/12	29/11
Type of operation		
- Tonsillectomy	13	14
-Adenotonsillectomy	27	26
Duration of operation (min)	18.6 ± 3.7	17.8 ± 4.2
Duration of anesthesia (min)	37.1 ± 6.3	38.2 ± 5.3

The occurrence of vomiting within the first four hours (0-4 hours) did not differ significantly between the two groups. In group I, two patients (5%) experienced vomiting compared to three patients (7.5%) in group II ($P < 0.05$).

Both groups had the same incidence of vomiting during the period from four to twenty-four hours. Two patients (5%) in each group vomited during this time frame.

Consequently, the rate of emesis-free individuals within the initial twenty-four hours was nearly identical in both groups.

DISCUSSION

The frequency of vomiting after pediatric adenotonsillectomy operations is reported to range from 40% to 73%.^[1-3] Postoperative vomiting can significantly

impact hospital discharge, sometimes leading to unexpected overnight stays in this patient population.^[21,22] Other factors such as primary bleeding, airway blockage and inadequate oral intake that require intense nursing assistance can also contribute to delayed discharge following T&A procedures.^[21,22]

In our study, we examined the overall occurrence of postoperative vomiting, specifically in children induced with halothane in Oxygen and those induced with a 2:1 mixture of nitrous oxide and Oxygen to which halothane was slowly introduced. We observed a 10% incidence of postoperative emesis in the children induced with halothane in Oxygen, compared to 12.5% in those induced with the Nitrous oxide and oxygen mixture.

Research pertaining to the potential effects of the nitrous oxide on post operative nausea and vomiting in adults

has been widely conducted, but studies in pediatric age are limited. Similarly to adult studies, the few studies conducted in children also present conflicting conclusions regarding the impact of eliminating nitrous oxide during anesthesia on.^[14,23,24] These discrepancies might be related to other variables like the kind of surgery, intravenous vs inhalation induction, and the use of additional drugs such opioids. Wilson and Fell^[14] reported a five times drop in vomiting incidence by eliminating the nitrous oxide from the gas mixture upon inhalation. They used thiopental to induce anesthesia intravenously. Splinter et al,^[24] on the other hand, reported no difference in vomiting occurrence between patients who was given nitrous oxide and those not given, while having exactly the same surgeries.

We aimed to control as many factors as possible in our research, which investigated nitrous oxide's effects on postoperative vomiting in children having adenotonsillectomy. Our data show that eliminating nitrous oxide during anesthesia has no difference in the frequency or intensity of postoperative vomiting between induction and maintenance in this patient group.

The exact mechanism, through which nitrous oxide may contribute to postoperative nausea and vomiting, if present, remains speculative and requires further investigation. A possible hypothesis is that Nitrous oxide elicits vestibular stimulation during recovery by producing traction owing to negative pressure in the middle ear, resulting in nausea and vomiting.^[12] However, Montgomery et al.^[25] and Blackstock and Gettes^[26] found no link between negative middle ear pressure caused by nitrous oxide inhalation and postoperative vomiting.

In conclusion, our study revealed no discernible difference in vomiting incidence between children induced with halothane in Oxygen and those induced with the mixture of nitrous oxide and Oxygen to which halothane was gradually added.

CONCLUSION

The administration of nitrous oxide did not have a significant effect on the occurrence of emesis in pediatric patients after tonsillectomy, regardless of whether adenoidectomy was also performed. Eliminating nitrous oxide from the inhalation mixture throughout anesthesia in those participants did not result in a reduction in the frequency or severity of subsequent vomiting following surgery.

REFERENCES

1. Litman RS, Wu CL, Catanzaro FA. Ondansetron decreases emesis after tonsillectomy in children. *Anesth Analg*, 1994; 78: 478–81.
2. Furst SR, Rodarte A. Prophylactic antiemetic treatment with ondansetron in children undergoing tonsillectomy. *Anesthesiology*, 1994; 81: 799–803.
3. Ferrari LR, Donlon JV. Metoclopramide reduces the incidence of vomiting after tonsillectomy in children. *Anesth Analg*, 1992; 75: 351–4.
4. Rose JB, Watcha MF. Postoperative nausea and vomiting in pediatric patients. *Br J Anaesth*, 1999; 83: 104–17.
5. Ledesma MJS, Olaondo LL, Pueyo FJ, et al. A Comparison of Three Antiemetic Combinations for the Prevention of Postoperative Nausea and Vomiting. *Anesth Analg*, 2002; 95: 1590-1595.
6. Celiker V, Ornek N, Canbay O. Minimum effective dose of dexamethasone for preventing nausea and vomiting after adenotonsillectomy. *J ankra medical school*, 2003; 25(1): 21-25.
7. Schumann R, Polaner DM. Massive subcutaneous emphysema and sudden airway compromise after postoperative vomiting. *Anesth Analg*, 1999; 89: 796–797.
8. Hartung J: Nitrous oxide-It's enough to make you vomit [Letter]. *Anesthesiology*, 1993; 78: 403-5.
9. Erkola O: Nitrous oxide: Laparoscopic surgery, bowel function, and PONV [Editorial]. *Acta Anaesthesiol Scand*, 1994; 38: 767-8.
10. Murakawa M, Adachi T, Nakao S, Seo N, Shingu K, Mori K: Activation of the cortical and medullary dopaminergic systems by nitrous oxide in rats: A possible neurochemical basis for psychotropic effects and postanesthetic nausea and vomiting. *Anesth Analg*, 1994; 78: 376-81.
11. Gillman MA: Nitrous oxide at analgesic concentrations-An opiate agonist: Further evidence [Letter]. *Anesth Analg*, 1982; 61: 394-5.
12. Perreault L, Normandin N, Plamondon L, Blain R, Rousseau P, Girard M, Forget G: Middle ear pressure variations during nitrous oxide and oxygen anaesthesia. *Can Anaesth Soc J*, 1982; 29: 428-34.
13. Eger EI, Saidman LJ: Hazards of nitrous oxide anesthesia in bowel obstruction and pneumothorax. *Anesthesiology*, 1965; 26: 61-6.
14. Wilson IG, Fell D: Nitrous oxide and postoperative vomiting in children undergoing myringotomy as a day case. *Paediatr Anaesth*, 1993; 3: 283-5.
15. Ranta P, Nuutinen L, Laitinen J: The role of nitrous oxide in postoperative nausea and recovery in patients undergoing upper abdominal surgery. *Acta Anaesthesiol Scand*, 1991; 35: 339-41.
16. Felts JA, Poler SM, Spitznagel EL: Nitrous oxide, nausea, and vomiting after outpatient gynecologic surgery. *J Clin Anesth*, 1990; 2: 168-71.
17. Hovorka J, Korttila K, Erkola O: Nitrous oxide does not increase nausea and vomiting following gynaecological laparoscopy. *Can J Anaesth*, 1989; 36: 145-8.
18. Sengupta P, Plantevin OM: Nitrous oxide and day-case laparoscopy: Effects on nausea, vomiting and return to normal activity. *Br J Anaesth*, 1988; 60: 570-3.
19. Bloomfield E, Hilberman M, Brown P, Noe H, Gaydos J, Miller G, Sherrill D, Williams G: Postoperative nausea and vomiting: A comparison of

- sufentanil, nitrous oxide, and isoflurane. *Cleve Clin J Med*, 1988; 55: 549-52.
20. Korttila K, Hovorka J, Erkol O: Nitrous oxide does not increase the incidence of nausea and vomiting after isoflurane anesthesia. *Anesth Analg*, 1987; 66: 761-5.
 21. Carithers JS, Gebhart DE, Williams JA: Postoperative risks of pediatric tonsillectomy. *Laryngoscope*, 1987; 97: 422-9.
 22. Crysdale WS, Russel D: Complications of tonsillectomy and adenoidectomy in 9409 children observed overnight. *Can Med Assoc J*, 1986; 135: 1139-42.
 23. Pandit U, I'ryn S, Randel G, et al. Nitrous oxide does not increase postoperative nausea/vomiting in pediatric outpatients undergoing tonsillectomy-adenoidectomy. *Anesthesiology*, 1990; 73: A1245.
 24. Splinter WM, Roberts DJ, Rhine EJ, et al. Nitrous oxide does not increase vomiting in children. *Anesthesiology*, 1991; 75: A949.
 25. Montgomery CJ, Vaghadia H, Blackstock D. Negative middle ear pressure and vomiting in pediatric outpatients. *Anesthesiology*, 1988; 68: 288-91.
 26. Blackstock D, Gettes MA. Negative pressure in the middle ear in children after nitrous oxide anaesthesia. *Can Anaesth Soc J*, 1986; 33: 32-5.