Nitrous oxide does not increase vomiting in children after myringotomy

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The aim of this study was to establish whether nitrous oxide has a clinically important effect on postoperative vomiting in children after myringotomy. We studied 320 healthy children of ages 0.5–13 yr undergoing elective myringotomy and tube insertion. Induction and maintenance of anaesthesia were randomized to inhalation with either 70% N₂O/30% O₂/halothane or 100% O₂/halothane. Surgical technique and postoperative management were not influenced by this study. Vomiting in the recovery room (PAR) and Day Care Surgical Unit (DCSU) was recorded by nurses unaware of the anaesthetic technique. Parents were contacted 24–48 hr after surgery to ascertain the incidence of vomiting after discharge. The groups were similar with respect to demographic data, except that the anaesthesia time was greater among the 158 patients in the N₂O-treated group (11 ± 4 vs 12 ± 4 min, mean ± SD). The incidence of vomiting was 13% in both groups. Most of the 42 patients that had emesis only vomited once or twice. The incidence of vomiting was not altered by sex (13% vs 13%) or duration of anaesthesia. The incidence of vomiting increased with increasing age. The children aged less than 3 yr vomited 4% of the time, those aged 3–5 vomited 11% of the time, those aged 6–8 yr vomited 17% of the time, while the incidence of vomiting among those aged 9–13 yr was 31%. Vomiting prolonged the postoperative hospital stay from 75 to 92 min, $P < 0.001$, ANOVA. In summary, we have been unable to demonstrate that N₂O induces vomiting by children after a brief general anaesthetic for myringotomy.

Key words

ANAESTHESIA: paediatric;
ANAESTHETICS, GASES: nitrous oxide;
VOMITING: nitrous oxide, postoperative.

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Cette étude a pour but d'établir si le protoxyde d'azote des vomissements chez les enfants après une myringotomie. L'étude porte sur 320 enfants bien portants âgés de 0,5 à 13 ans soumis à une myringotomie programmée avec insertion de tube. L'induction et l'entretien de l'anesthésie sont randomisés pour l'inhalation soit de N₂O 70%/O₂ 30% avec halothane, soit d'O₂ 100% avec halothane. Cette étude n'influence ni la technique chirurgicale ni la gestion postopératoire. Les vomissements à la salle de réveil et à l'unité chirurgicale de jour sont enregistrés par des infirmières ignorant la technique utilisée. Les parents sont contactés 24–48 après la chirurgie pour évaluer l'incidence des vomissements. Les groupes sont comparables au regard des données démographiques, à l'exception du fait que la durée de l'anesthésie est plus grande dans le groupe N₂O (moyenne ± SD: 11 ± 4 vs 12 ± 4). L'incidence des vomissements n'est modifiée ni par le sexe (13% vs 13%) ni la durée de l'anesthésie. L'incidence des vomissements augmente avec l'âge. Les enfants de moins de trois ans vomissent 4% du temps, ceux de 3–5 ans vomissent 11% du temps, alors que l'incidence des vomissements est de 31% chez les enfants de 9–13 ans. Les vomissements prolongent la durée du séjour hospitalier de 75 à 92 min, $P < 0,001$ (ANOVA). En résumé, nous n'avons pu démontrer que le N₂O provoque des vomissements après la courte anesthésie générale administrée pour la myringotomie.

Vomiting after general anaesthesia in children is common and may result in considerable postoperative morbidity. This vomiting is of multifactorial aetiology of which nitrous oxide is a possible contributing factor. Nitrous oxide may induce vomiting by causing bowel distension, decreasing gastric motility, increasing middle ear pressure or interacting with endogenous opioid receptors.^{1–3}

Among adults undergoing minor gynaecological surgery, as little as a 10–14 min exposure to N₂O₂ has been associated with increased vomiting.³ Overall, the results of adult investigations have been controversial. Both an emetic^{2–5} and lack of effect^{6–9} have been reported. There have been two paediatric studies. Pandit *et al.* failed to demonstrate a difference in vomiting after tonsillectomy (62% vs 76%).⁶ In another study of 104 children, nitrous oxide increased vomiting after myringotomy from 4% to

TABLE I Demographic data and recovery times

	<i>n</i>	Age (yr)	Weight (kg)	Anaesthesia time (min)	PAR + DCSU Stay (min)
Non N ₂ O	162	4.9 ± 2.9	20 ± 9	11 ± 4*	78 ± 19
N ₂ O	158	4.8 ± 2.5	20 ± 8	12 ± 4	77 ± 16

Mean ± SD, * $P < 0.05$, ANOVA.

TABLE II Effect of age on emesis

Age (yr)	<i>n</i>	Group	% Vomit
0.5–2.9	92	I	4
3.0–5.9	124	II	11
6.0–8.9	75	III	17*
9.0–12.9	29	IV	31†

* $P < 0.05$, III vs I; † $P < 0.05$, IV vs I or II, Chi-square analysis with Bonferroni correction factor.

21%, $P < 0.05$.⁴ The aim of the current study was to establish whether nitrous oxide has a clinically important effect on postoperative vomiting in children.

Methods

With Hospital Ethics Committee approval and parental consent we studied 320 healthy (ASA physical status I–II) children aged 0.5–13 yr undergoing elective myringotomy and tube insertion. Children were excluded if they had gastrointestinal disease or an allergy to one of the study drugs. Subjects did not receive premedication. After establishing routine monitoring, induction and maintenance of anaesthesia was randomized to inhalation of either 70%N₂O/30%O₂/halothane or 100%O₂/halothane. Surgical technique and postoperative management were not affected by this study, which included acetaminophen 10 mg · kg⁻¹ *po* for pain relief. The frequency of vomiting in the recovery room (PAR) and Day Care Surgical Unit (DCSU) was recorded by nurses unaware of the anaesthetic technique. Parents were contacted 24–48 hr after surgery to determine the incidence of vomiting after discharge and to confirm the incidence of DCSU vomiting.

Data were compared with ANOVA and Chi-square analysis, where appropriate. The acceptable alpha error was 0.05 with a Bonferroni correction factor when multiple comparisons were performed. For the purpose of sample size determination, the N₂O group was predicted to have greater or similar incidence of vomiting when compared to the non-N₂O group. The predicted incidences of vomiting were 16% and 7% and the power of the study was 80%.

Results

The groups were similar with respect to demographic data, except that the anaesthesia time was one minute longer among the N₂O-treated subjects (Table I). Stay in the PAR and DCSU was not influenced by N₂O exposure (Table I). The incidence of vomiting was 13% in both the N₂O and non-N₂O group. Most of the 42 patients that had emesis only vomited once or twice, but seven patients vomited on three occasions, one patient vomited four times and another ten times. The incidence of vomiting was 13% for both boys and girls. The duration of anaesthesia was 12 ± 4 and 11 ± 4 min among the subjects that did and did not vomit, respectively. Age had an effect on vomiting (Table II). Patients who vomited had an increased postoperative hospital stay, 75 ± 15 vs 92 ± 25 min, mean ± SD, $P < 0.001$, ANOVA.

Discussion

A brief 10–15-minute exposure to nitrous oxide did not affect vomiting after myringotomy in children. The observed overall rate of vomiting was similar to the 12% incidence observed by Wilson and Fell.⁴ Unlike Wilson *et al.*, the current study, which has greater power, did not demonstrate that N₂O induces vomiting after myringotomy in children. The results of Rowley and Brown's¹⁰ study, wherein the observed incidence of vomiting was 27%, are not comparable with the current study because they did not control anaesthetic technique and premedication.

The present study's results differ from most adult studies in which N₂O increased postoperative vomiting.¹¹ There have been controversial opinions of the relevance and analysis of these adult investigations.^{11,12} Conflicting results exist for a variety of reasons. Many investigations lack the power to conclude that N₂O has no effect on vomiting. One theoretical reason is that N₂O may have a relatively specific emetic effect. For example, the increased vomiting in adults is typically observed among female subjects exposed to opioids or procedures involving bowel motility. Investigations not specifically involving these subpopulations have been unable to establish a clinically relevant increased incidence of vomiting due to N₂O. Finally, the peripheral effects of N₂O include distension of the gastrointestinal tract and increased mid-

dle ear pressure. Both may have an emetic effect, but require a prolonged exposure to N₂O in order to occur. Both of these peripheral effects should not have influenced our subjects because myringotomy would eliminate any alteration of the middle ear pressure and a brief exposure to N₂O would have a minimal effect on bowel distension.

Vomiting may have added to the cost-of-care. Valuable nursing time was expended during the treatment of vomiting and during the extended in-hospital care of the patients that vomited.¹³

The observed effect of age on postoperative emesis has been previously reported,^{14,15} but its aetiology is unknown. Similar to Felts *et al.*² we were unable to demonstrate that duration of anaesthesia had an effect on post-anaesthesia emesis.

In conclusion, we were unable to demonstrate that N₂O altered the incidence of vomiting after general anaesthesia for myringotomy in children.

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