BRIEF REPORT

Isopropyl Alcohol Inhalation

Alternative Treatment of Postoperative Nausea and Vomiting

Bret A. Merritt ▼ Charles P. Okyere ▼ Donna M. Jasinski

- ***Background:*** The mechanisms for postoperative nausea and vomiting are numerous and pathways not well elucidated. Although many medications have been developed to help prevent postoperative nausea and vomiting, the search for better approaches to recovery treatment continues.
- ***Objective:*** The purpose of this study was to evaluate the effectiveness of isopropyl alcohol (IPA) inhalation for treatment of postoperative nausea and vomiting for patients who have general anesthesia for a surgical procedure.
- ***Method:*** Participants were recruited from an urban hospital on the East Coast of the United States. Participants were assigned to an experimental or control group and IPA inhalation was compared to the standard anti-emetic treatment for rescue treatment in the immediate postoperative period. Postoperative nausea and vomiting was rated using a descriptive ordinal scale.
- ***Results:*** The results of this study show IPA to be effective and that there was no significant difference between the standard treatment protocol and treatment with IPA. Treatment with IPA was significantly more cost effective than standard drug treatment.
- ***Discussion:*** Further research is recommended to evaluate the length of effectiveness, standard dose needed, most effective mode of inhalation, and factors blocking IPA effectiveness.

- ***Key Words:*** alternative treatment • IPA • nausea • postoperative • vomiting

Today's healthcare concerns center on decreasing costs, shortening hospital stays, and facilitating a quick return to normal activity for patients. Post-operative nausea and vomiting (PONV) is a major concern for patients having same-day surgery under general anesthesia as it causes increased complications and delays in discharge from the hospital (Hirsch, 1994).

Approximately one-third of the 11 million patients undergoing outpatient surgery under general anesthesia will experience significant nausea or emesis in the postoperative period (Claybon, 1994). The mechanisms for PONV are numerous and the causative pathways not well elucidated. Many factors may play a role in an episode of nausea and vomiting, and despite advances in new drug therapies in minimizing the incidence, no ideal drug has been found to prevent all the causes of PONV.

Aromatherapy is a relatively new and under-researched alternative treatment that might hold promise in treating PONV. Isopropyl alcohol (IPA) is among several aromas displaying possible anti-emetic properties. Isopropyl alcohol inhalation is a new treatment with only limited investigations to date (Langevin & Brown, 1997).

Literature Review

Current PONV treatment strategies are based on the understanding of the vomiting reflex; however, the lack of well-elucidated pathways in the control of PONV has contributed to the problems with these treatment strategies and medications. It has been well documented that some patients are more susceptible to PONV indicating variations in sensitivity of the vomiting reflex to stimuli. This complicates discovering how anesthesia and surgical procedures might cause PONV (Naylor & Inall, 1994).

The vomiting reflex has two main detectors of the need to vomit: the gastrointestinal tract and the chemo receptor trigger zone (CTZ) in the nucleus tractus solitarius of the area postrema located in the brain stem. The vomiting reflex is triggered in the gastrointestinal tract by 5-HT chemoreceptors in the mucosa of the upper digestive tract, which leads to the activation of visceral vagal afferents and propagating of information to the CTZ. Stimulation of either the gastrointestinal tract or the CTZ pathway results

Donna M. Jasinski, CRNA, DNSc, is Assistant Professor, Georgetown University, Washington, DC.

Bret A. Merritt, CRNA, MS, is a graduate of Georgetown University, Washington, DC.

Charles P. Okyere, MS, is a graduate of Georgetown University, Washington, DC.

in activation of the vomiting episode (Naylor & Inall, 1994). It has been postulated that the motor component of the vomiting reflex is mediated by both the autonomic and somatic nervous system with the emetic center in the brain acting as the coordinating zone. However, at present there are no known anti-emetic drugs that act directly on the emetic zone (Andrews et al., 1990).

There is little doubt that the mechanisms underlying PONV are numerous. Factors which are likely to contribute or associate with increased incidence include (a) type of surgical procedure, (b) anesthetics used, (c) inadequate postoperative pain control, and (d) certain participant characteristics (e.g., sex, age, anxiety, previous history of PONV) (Kenny, 1994).

Many drug therapies have been developed over the last 50 years in response to PONV either for prophylactic or rescue usage. All of these therapies have possible adverse reaction such as sedation, antihistamine actions, extrapyramidal reactions, and limited dosing abilities (Sung, 1996). The cost of prophylactic treatment can be relatively inexpensive as seen with the use of promethazine (Rodola et al., 1995) or relatively expensive as seen with the new HT-3 receptor antagonist like granisetron (Cieslak, Watcha, Phillips, & Pennant, 1996). Fujii, Tanaka, & Toyooka (1997) concluded that a combination of dexamethazone and granisetron helped significantly reduce PONV in women after gynecologic surgery at a cost over $107 per dose. While the results are promising, the high cost may prevent its use in the cost conscience world of healthcare. Further, 20% of the participants treated with the combination treatment had some adverse effect including headache, drowsiness, and dizziness.

There have been no reports of human toxicity due to inhalation

Alternative medicine treatments are now being used to help control PONV. These treatments include oral ginger as a prophylactic medicine and acupuncture as prophylactic and rescue treatment. Mixed results are reported for both (Sung, 1996). Aromatherapy is another alternative medical treatment that could be used to treat PONV. There are limited studies on aromatherapy or olfactory remediation that consist mainly of qualitative data research with mixed anecdotal results (Martin, 1996). Despite the uncertain mechanism of action, aromatherapy has been used effectively in many types of treatments. The treatment of PONV could be considered. Recently, nasal inhalation of IPA has been considered as treatment for PONV (Langevin & Brown, 1997).

Isopropyl alcohol has been in use for many years as an antiseptic in hospitals and at home. The safety of IPA has been demonstrated and there are no warnings on the alcohol pad other than that it is intended for external use only. Toxicity is seen in human adults only with oral ingestion. Studies in rats and mice in which the animals were exposed to inhalation of IPA vapor at 100, 500, 1500, or 5000 parts per million (ppm) for six hours a day, five days a week for 13 weeks, demonstrated organ and neurobehavioral effects only at 5000 ppm (Burleigh-Flayer et al., 1995). There have been no reports of human toxicity due to inhalation.

Recently, nasal inhalation of IPA has been considered as treatment for PONV. A pilot study of IPA inhalation (N = 15) showed an 80% success rate in treating PONV (Langevin & Brown, 1997). Wang, Hofstadter and Kain (1999) evaluated IPA inhalation in 91 children ages 6–16. After three treatments, 65% of the children had a significant reduction in the severity of either nausea or vomiting. The effect was transient however, and 54% had recurrent symptoms. The mechanism of action related to prevention of nausea and vomiting with inhalation of IPA is unknown, but may be due to its depressant qualities on the central nervous system.

The purpose of the current study was to evaluate the effect of IPA inhalation for rescue treatment of PONV in adult same-day surgery patients who had general anesthesia for any type of surgical procedure. It was hypothesized that (a) patients treated with IPA inhalation would have decreased nausea and vomiting in the immediate postoperative period; (b) IPA inhalation treatment would be more effective in decreasing nausea and vomiting in the immediate postoperative period than standard rescue treatment; and (c) IPA inhalation treatment would decrease postanesthesia care costs.

Methodology

This quasi-experimental study was conducted at a medium-sized urban teaching hospital on the East Coast of the United States. Following Institutional Review Board approval, a convenience sample was drawn from patients admitted for same-day surgery. Inclusion criteria were (a) requirements for general anesthesia, (b) ability to breathe through nose before and after procedure, (c) minimum of 18 years of age, (d) American Society of Anesthesiologists (ASA) physical status of I, II, or III, and (e) ability to read and write English. Exclusion criteria were (a) allergy to IPA, (b) alcohol abuse, (c) no recent history of nausea or vomiting within the last 8 hours, (d) no recent intake of cefoperazone, Antabuse, or metronidazole, (e) ability to communicate in recovery room, (f) regional anesthesia, and (g) monitored anesthesia care. When patients agreed to participate, written informed consent was obtained.

Sample size determined by power analysis was 64 to achieve an alpha of .05, critical effect of .30 and a beta/power of 80%. The actual number of participants enrolled in the study was 111. Of these 111 participants, 71 had no nausea or vomiting, thus a total of 40 were evaluated.

Participants were recruited in the preoperative waiting area on the day of the surgical procedure. Participants were blinded to which treatment they were to receive. Group assignment was alternated by day: experimental one day and control the next. This method was used instead of ran-

dom assignment because the intervention took place in the post anesthesia care unit where control patients could potentially overhear the researchers explaining the intervention to the experimental group participants.

Many tools have been used to measure nausea and vomiting such as visual analog scales (VAS) and descriptive ordinal scales (DOS). For this study DOS scores were chosen over VAS because many patients cannot read without glasses in the recovery room due to the use of eye lubricant, which can blur vision. Each participant was given instructions on how nausea and vomiting were to be measured via the DOS on a scale from 0 to 10, with 0 being no nausea or vomiting and 10 being the worst nausea and vomiting they could imagine.

If nausea or vomiting was present in control participants, an appropriate anti-emetic was given. Experimental participants were given IPA via nasal inhalation using standard hospital alcohol pads. The participant was instructed to take three deep sniffs with the pad one inch from the nose. This was repeated every five minutes for three doses or until nausea and vomiting was relieved. If nausea and vomiting continued after three doses of IPA, then an intravenous drug was given.

Data analysis. Descriptive statistics were obtained on: (a) demographic data (age, weight, sex, smoking history, alcohol use); (b) class of surgical procedure; (c) type of anesthesia used for both induction and maintenance; and (d) prophylactic medications given intra-operatively. Hypotheses were tested with *t* tests and a one-way analysis of variance (ANOVA).

Results

Participants ($N = 111$) were enrolled in the study: (age: $X = 43$; range 19–80 years) 40 (36%) had PONV, 71 (64%) had no complaints of PONV, and 94 (84.6%) received prophylactic anti-emetics. Types of surgery included (a) intra-abdominal (29.7%), (b) orthopedic/extremity (23.4%), (c) perineal (19.8%), (d) neuro-skeletal (10.8%), (e) extra-thoracic (6.3%), (f) eyes, ear, nose, or throat (6.3%), and (g) neck (3.6%). The average length of surgical procedure was 90 minutes (range 30–180 minutes).

Of the 40 participants who had some form of PONV, one participant had spontaneous recovery before any treatment was given. Of the 39 participants remaining, 21 were in the experimental group and 18 were in the control group (Table 1). Anesthetic types and the surgical procedures of these 39 participants are presented in Table 2.

The first hypothesis of the study was that participants would have decreased PONV with the use of IPA. In the experimental group, 11 (52.4%) had relief of PONV after the first dose and 10 needed at least one medication from the standard regimen. Thirteen (72.2%) of the 18 control group participants had relief of nausea and vomiting after the first dose of anti-emetic, and five had no relief. The second hypothesis was that IPA treatment would be superior to standard anti-emetic treatment for relief of symptoms. A two-tailed *t* test was used to analyze the nausea change scores. The results were not significant ($p = .21$) (Table 3). The third hypothesis was that the cost of IPA treatment would be less than the cost of the standard treatment regimen (see Table 3). The IPA group had a PONV average medication cost (IPA and other anti-emetics when necessary)

TABLE 1. Demographics: Control and Experimental Groups

	IPA *n* = 21	Control *n* = 18
Sex		
Male	10 (47.6%)	5 (27.7%)
Female	11 (52.4%)	13 (72.3%)
Age (yrs)		
M	40	37
SD	12	14
Weight (Kg)		
M	72	77
SD	18	17
Smoking history		
Never	13 (61.9%)	16 (88.8%)
Quit	3 (14.3%)	1 (5.6%)
Current	5 (23.8%)	1 (5.6%)
Alcohol use		
Never	5 (23.8%)	5 (27.7%)
Occasional	15 (71.4%)	13 (72.3%)
Moderate	1 (4.8%)	0
Heavy	0	0

Note. IPA, isopropyl alcohol.

TABLE 2. Frequency of Surgical Procedures and Inhalation Agents Used

Inhalation agents	IPA *n* = 21	Control *n* = 18
Isoflurane/nitous oxide	14	10
Desflurane/nitrous oxide	6	7
Sevoflurane/nitrous oxide	1	1
Surgical procedures		
Intra-abdominal	6	6
Orthopedic	4	4
Perineal	5	5
Neuroskeletal	1	2
Extrathoracic	2	2
Neck	1	0
Eye/ear/nose/throat	2	1

Note. IPA, isopropyl alcohol.

TABLE 3. Results of Descriptive Ordinal Scores and Costs for Isopropyl Alcohol and Control Groups

	IPA (*n* = 21) Mean (*SD*)	Control (*n* = 18) Mean (*SD*)
Pretreatment DOS	5.71 (2.10)	6.11 (2.32)
Post-test DOS	2.7 (3.02)	1.94 (2.48)
Cost (U.S. $)	9.75 (11.89)	17.08 (8.61)*

*One-way ANOVA $f = 16.55$; $df = 38$; $p = .003$.
Note. IPA, isopropyl alcohol; DOS, descriptive ordinal scores.

of $9.75. The PONV average medication cost for the control group was $17.08. A one-way ANOVA demonstrated a significant difference ($F = 16.5$, $df = 38$, $p = .003$)

Discussion

The groups are similar with respect to demographics, type of surgical procedures, anesthetics administered and postoperative analgesics given. Only 40 of the 111 participants recruited had PONV. This is explained by aggressive prophylactic treatment at the study facility where only 7 (6.3%) of 111 participants did not receive prophylactic medication and none of these 7 participants had PONV. Additionally, the researchers speculate that pain may have been a confounding factor in accurate assessment on the DOS. A landmark study by Anderson and Krogh (1976) identified pain as a major cause of postoperative nausea.

The findings of the present study parallel results obtained in a previous study (Langevin & Brown, 1997) and suggest that IPA is a clinically important treatment for PONV. The current results indicate no statistically significant difference in the recovery from PONV after standard treatment and IPA treatment. Numerous factors play a role in PONV. A meta-analysis (Apfel & Roewer, 2000) revealed that female sex, a history of prior PONV, nitrous oxide, opioids, and inhalation agents are correlated with PONV. Isopropyl alcohol treatment is relatively inexpensive at $0.01 per alcohol pad and on hand anywhere in the hospital. The average cost of rescue treatment for the control group was significantly higher than with the IPA group. These results demonstrate the clinical effectiveness of IPA in a little over half the participants and its low cost.

Isopropyl alcohol can be administered quickly and easily without going to the "drug cabinet." Participants remarked favorably about such a simple method to control their nausea, and asked if IPA can be used for other types of nausea. More research is needed to evaluate the length of effectiveness, standard dose needed, most effective mode of inhalation, and factors blocking IPA effectiveness.

Accepted for publication July 12, 2001.

Corresponding author: Donna M. Jasinski, CRNA, DNSc, Georgetown University SNHS, Box 571107, 3700 Reservoir Road, NW, Washington, DC 20057 (e-mail: jasinskd@georgetown.edu).

References

Anderson, R. & Krohg, K. (1976). Pain as a major cause of postoperative nausea. *Canadian Anaesthetists Society Journal, 23*, 366-379.

Andrews, P. L., Davis, C. J., Bingham, S., Davidson, H. I., Hawthorne, J., & Maskell, L. (1990). The abdominal visceral innervation and the emetic reflex: Pathways, pharmacology, and plasticity. *Canadian Journal of Physiology and Pharmacology, 68*, 325-345.

Apfel, C. C. & Roewer, N. (2000). Risk factors for nausea and vomiting after general anesthesia: Fictions and facts. *Anaesthetist, 49*, 629-642.

Burleigh-Flayer, H. D., Gill, M. W., Strother, D. E., Masten, L. W., McKee, R. H., Tyler, T. R., et al. (1994). Isopropanol 13 week vapor inhalation study in rats and mice with neurotoxicity evaluation in rats. *Fundamental and Applied Toxicology, 23*, 421-428.

Cieslak, G. D., Watcha, M., Phillips, M. B., & Pennant, J. H. (1996). The dose-response relation and cost-effectiveness of granisetron for the prophylaxis of pediatric postoperative emesis. *Anesthesiology, 85*, 1076-1085.

Claybon, L. (1994). Single dose intravenous ondansetron for the 24-hour treatment of postoperative nausea and vomiting. *Anaesthesia, 49*(Suppl.), 24-29.

Fujii, Y., Tanaka, H., & Toyooka, H. (1997). The effects of dexamethasone on antiemetics in female patients undergoing gynecologic surgery. *Anesthesia and Analgesia, 85*, 913-917.

Hirsch, J. (1994). Impact of postoperative nausea and vomiting in the surgical setting. *Anaesthesia, 49*(Suppl.), 30-33.

Kenny, G. N. (1994). Risk factors for postoperative nausea and vomiting. *Anaesthesia, 49*(suppl.), 6-10.

Langevin, P. B., & Brown, M. M. (1997). A simple, innocuous, and inexpensive treatment for postoperative nausea and vomiting. *Anesthesia and Analgesia, 84*(Suppl.), 16.

Martin, G. N. (1996). Olfactory remediation: Current evidence and possible applications. *Social and Scientific Medicine, 43*, 63-70.

Naylor, R. J., & Inall, F. C. (1994). The physiology and pharmacology of postoperative nausea and vomiting. *Anaesthesia, 49*(Suppl.), 2-5.

Rodola, F., Cannelli, G., Barbi, S., Forte, E., Anastasio, S., & Vagnoni, S. (1995). Cost effective prophylaxys of postoperative nausea and vomiting by anesthetic premedication. *European Review for Medical and Pharmacological Sciences, 17*, 243-246.

Sung, Y. (1996). Risks and benefits of drugs used in the management of postoperative nausea and vomiting. *Drug Safety, 14*, 182-193.

Wang, S. M., Hofstadter, M. B., & Kain, Z. N. (1999). An alternative method to alleviate postoperative nausea and vomiting in children. *Journal of Clinical Anesthesiology, 11*, 231-234.