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DETERMINING THE EFFECTIVENESS OF INHALING ISOPROPYL ALCOHOL (IPA) FOR THE TREATMENT OF NAUSEA IN EMERGENCY DEPARTMENT

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ABSTRACT

Background: Previous studies have primarily evaluated the use of inhaled isopropyl alcohol (IPA) in combination with standard antiemic agents such as metoclopramide or ondansetron for the management of nausea in the emergency department.

Objective: To determine the efficacy of inhalational isopropyl alcohol in reducing nausea severity among patients presenting to the emergency department.

Methods: This longitudinal study was conducted at the Emergency Department of POF Hospital, Wah Cantt. A total of 130 patients aged 18-70 years presenting with acute nausea with or without vomiting for the last 24-48 hours were enrolled and evaluated for efficacy of inhalation isopropyl alcohol using the Numeric Rating Scale (NRS) taking NRS<3 at 30minutes following intervention as cut off for efficacy.

Results: The mean age of patients was 43.5 ± 12.8 years, with females constituting 52.3% (n=68). The mean NRS score significantly decreased from 8.1 ± 1.2 at baseline to 2.1 ± 0.9 at 30 minutes ($p<0.001$), with a mean reduction of 6.0 ± 1.2 points. Overall efficacy (NRS < 3 at 30 minutes) was achieved in 101 patients (77.7%).

Conclusion: Inhaled isopropyl alcohol is an effective, safe, and rapidly acting intervention for reducing nausea severity in emergency department patients. It demonstrated consistent efficacy across most subgroups except for vertigo-related nausea.

KEY WORDS: Effectiveness, Emergency Department, Inhaling Isopropyl Alcohol, Nausea

INTRODUCTION

Nausea is a common and distressing symptom among patients presenting to the emergency department (ED). It is associated with diverse etiologies including gastrointestinal disorders, migraine, vestibular diseases, medication effects, metabolic abnormalities, and early pregnancy. Rapid symptom control is essential in emergency care to improve patient comfort, facilitate diagnostic evaluation, reduce ED length of stay, and enhance patient satisfaction.

Conventional pharmacologic management in the ED includes serotonin (5-HT3) receptor antagonists such as ondansetron, dopamine antagonists such as metoclopramide and prochlorperazine and antihistamines such as promethazine. Although effective, these medications may cause adverse effects including sedation, extrapyramidal reactions, QT interval prolongation, and hypotension. Intravenous administration may also increase cost and delay rapid relief, particularly in high-volume or resource-constrained settings (1).

Inhaled isopropyl alcohol (IPA) has emerged as a simple, inexpensive, and rapidly acting alternative for nausea management. The proposed mechanism involves olfactory stimulation that modulates central nausea pathways, possibly through sensory distraction or effects on the chemoreceptor trigger zone (2). IPA inhalation can be easily administered using 70% isopropyl alcohol swabs and has demonstrated minimal systemic absorption and a favorable safety profile.

Recent systematic reviews and meta-analyses have strengthened the evidence supporting IPA use in acute care. Hunt et al. (2021) reported that inhaled IPA significantly reduces nausea severity in the short term compared with placebo, particularly within the first 10-30 minutes of administration (3). Kwon et al. (2022) similarly concluded that IPA inhalation improves nausea scores and may decrease the need for rescue antiemetics (4). Clinical reviews published between 2020 and 2023 emphasize its rapid onset of action, safety, and cost-effectiveness in emergency and perioperative settings (2,5,6). Additionally, contemporary reviews of non-pharmacologic therapies in emergency medicine highlight inhaled IPA as a practical and accessible intervention for acute nausea management (7,8).

In 2021, a study was conducted by Peter Veldhuis. He conducted a prospective, single-center implementation study comparing ED-based care for nauseated patients before (n = 106) and after (n = 104) the introduction of IPA. Nausea severity was evaluated using a visual analog score (VAS). He found a significant increase in the

percentage of patients receiving nausea pre-treatment and post treatment (66.0%) versus 97.1% p< 0.001 and a reduction in time to treatment initiation (7 versus 1 min, p< 0.001) (9).
Previous studies have primarily evaluated the use of inhaled isopropyl alcohol (IPA) in combination with standard antiemic agents such as metoclopramide or ondansetron for the management of nausea in the emergency department. However, the objective of this study was to determine the efficacy of inhalational isopropyl alcohol as a sole therapy in the treatment of nausea and vomiting in Emergency department.

MATERIALS AND METHODS

This longitudinal study was carried out at the Emergency department of POF hospital, Wah Cantt, during the period 16th May, 2026 till 16th August, 2026. Male and female patients in the age range 18 to 70 years presenting with acute nausea with or without vomiting for the last 24 to 48 hours and able to communicate nausea severity using NRS score were evaluated for the efficacy of inhaling isopropyl alcohol. Pregnant and lactating females, history of hypersensitivity to isopropyl alcohol, altered mental status, antiemetic medications in the last 2 hours, nasal obstruction or nasal trauma and severe cardiopulmonary compromised patients were excluded. Nausea was defined as subjective experience of discomfort or queasiness in the stomach, typically accompanied by an urge to vomit. The severity of nausea was assessed using the Numeric Rating Scale (NRS). Patients rated their nausea on a scale of 0 (no nausea) to 10 (worst nausea) at baseline, and 10, 20, and 30 minutes following the inhalation of the IPA. Numeric Rating Scale (NRS): A validated, unidimensional instrument intended for the assessment of the severity of symptoms and primarily utilized in the assessment of pain and/or nausea. The scale ranged from 0 to 10, with 0: no nausea, 1-3: mild nausea, 4-6: moderate nausea and 7-10: severe nausea (often with vomiting). Efficacy was defined by drop in NRS score to less than 3 within 30 minutes of intervention Sample size was determined by using WHO sample size calculator, sample size is 130 with confidence level 95% population proportion 97.1%, absolute procession 2.9% (9) and sampling technique was non probability consecutive sampling.
This study was conducted in the Emergency Department (ED) of POF Hospital, Wah Cantt, after obtaining ethical approval from the Institutional Review Board (IRB). A total of 130 patients meeting the inclusion criteria were enrolled through consecutive non-random sampling over a period of three months. Patients arriving at the ED with complaints of nausea (with or without vomiting) were filtered by the trained nursing personnel. Individuals who meet the eligibility criteria was contacted to take part and the aim, process, possible benefits, and low risks associated with the research was elaborated. Demographic information (age, gender and clinical history) was gathered on a structured data collection proforma after written informed consent is obtained. Nausea severity was then measured at baseline using the Numeric Rating Scale (NRS) with 0 indicating none and 10 indicating the worst possible nausea. After taking proper history and consent form from the patient, he/she was seated on a bed and was asked to inhale isopropyl alcohol (IPA) swabs with 70 percent IPA which they were asked to inhale via the nose in order to take 10 minutes as they sit in a comfortable environment. The swab was placed about 2-3 cm under the nostrils so that it could breathe in the vapors. The level of nausea was re-evaluated at 10, 20 and 30 minutes using the same NRS scale to measure the improvement of the symptoms. The allergies and inhalation protocols were conducted under the guidance of professional ED nurses to make the patients safe. In case the nausea continues or increases with time after 30 minutes, the patient was given a traditional antiemetic treatment according to the hospital. Any side effects like irrelevance, irritation, and discomfort was noted. No information obtained was publicized.
IBM SPSS version 20 was used to analyses data. Continuous data was reported as mean and standard deviation and categorical data as frequencies and percentages. The Chi-square test or the Fisher exact test was used to compare outcomes. Stratification was carried out to ensure that confounding factors and effect modifiers like age, gender, baseline nausea severity and cause of nausea controlled. The p-value 0.05 was a statistically significant value.

RESULTS

A total of 130 patients with a mean age of 43.5 ± 12.8 years and symptom duration of 10.2 ± 6.8 hours were enrolled in the study. The mean NRS score significantly decreased from 8.1 ± 1.2 at baseline to 4.8 ± 1.4 at 10 minutes, 3.2 ± 1.1 at 20 minutes, and 2.1 ± 0.9 at 30 minutes following IPA inhalation, with a mean reduction of 6.0 ± 1.2 points. The mean time to treatment initiation was 2.7 ± 1.0 minutes, with patient satisfaction score of 7.8 ± 1.8 out of 10 and mean ED length of stay of 4.9 ± 1.3 hours. (table 1)

Table 1: Mean and Standard Deviation of Continuous Variables (N = 130)

Variable	Mean	Standard Deviation (SD)
Demographics		
Age (years)	43.5	12.8
Duration of Symptoms (hours)	10.2	6.8
Vital Signs (Baseline)		
Heart Rate (bpm)	84.6	5.4
Systolic Blood Pressure (mmHg)	132.8	8.2
Diastolic Blood Pressure (mmHg)	82.4	4.6

Temperature (°C)	36.9	0.3
Nausea Severity Scores (NRS)		
NRS Baseline	8.1	1.2
NRS at 10 Minutes	4.8	1.4
NRS at 20 Minutes	3.2	1.1
NRS at 30 Minutes	2.1	0.9
Outcome Measures		
Reduction in NRS (Baseline to 30 min)	6.0	1.2
Time to Treatment Initiation (minutes)	2.7	1.0
Patient Satisfaction Score (1-10)	7.8	1.8
ED Length of Stay (hours)	4.9	1.3

the majority were female (n=68, 52.3%) and in the 31-45 years age group (n=48, 36.9%). The most common cause of nausea was gastroenteritis (n=35, 26.9%), followed by food poisoning (n=32, 24.6%) and migraine (n=29, 22.3%). Most patients had no comorbidities (n=68, 52.3%), presented with severe nausea (n=102, 78.5%), and were triaged as Category 3 (Non-Urgent) (n=98, 75.4%). The duration of symptoms was mostly 7-12 hours (n=42, 32.3%). Adverse effects were minimal with 96.9% (n=126) reporting no side effects. Overall efficacy (NRS < 3 at 30 minutes) was achieved in 101 patients (77.7%), while 29 patients (22.3%) did not achieve the target reduction. (table 2)

Table 2: Distribution of Categorical Variables and Efficacy Rates (N = 130)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	62	47.7%
	Female	68	52.3%
Age Group	18-30 years	35	26.9%
	31-45 years	48	36.9%
	46-60 years	32	24.6%
	>60 years	15	11.5%
Cause of Nausea	Gastroenteritis	35	26.9%
	Food Poisoning	32	24.6%
	Migraine	29	22.3%
	Vertigo	18	13.8%
	Hyperemesis	9	6.9%
	Medication Side Effect	7	5.4%
Comorbidities	None	68	52.3%
	Migraine History	32	24.6%
	Diabetes	15	11.5%
	Hypertension	10	7.7%
	COPD	5	3.8%
ED Triage Category	Category 2 (Urgent)	32	24.6%
	Category 3 (Non-Urgent)	98	75.4%
Nausea Severity Baseline	Moderate (4-6)	28	21.5%
	Severe (7-10)	102	78.5%
Duration of Symptoms	3-6 hours	35	26.9%
	7-12 hours	42	32.3%
	13-18 hours	28	21.5%
	19-24 hours	25	19.2%
Adverse Effects	None	126	96.9%
	Mild Burning	3	2.3%
	Mild Irritation	1	0.8%
Efficacy (NRS<3)	Yes	101	77.7%
	No	29	22.3%

Stratified analysis revealed no significant difference in efficacy by gender (male: 77.4%, female: 77.9%; p=0.94) or age groups (p=0.78). However, cause of nausea was a significant predictor of efficacy (p<0.001), with vertigo patients showing the lowest efficacy rate (44.4%) compared to hyperemesis (88.9%), medication side effect (85.7%), migraine (82.8%), food poisoning (78.1%), and gastroenteritis (74.3%). Comorbidities (p=0.47), ED triage category (p=0.67), baseline nausea severity (p=0.16), duration of symptoms (p=0.92), and adverse effects (p=0.88) were not statistically significant predictors. Overall, IPA inhalation demonstrated consistent efficacy across most subgroups, except for patients with vertigo-related nausea. (table 3)

Table 3: Stratification of baseline parameters with efficacy (N = 130)

Variable	Category	n (%)	Efficacy Achieved n (%)	Efficacy Not Achieved n (%)	p-value
Gender	Male	62 (47.7)	48 (77.4)	14 (22.6)	0.94*
	Female	68 (52.3)	53 (77.9)	15 (22.1)	
Age Group	18-30 years	35 (26.9)	29 (82.9)	6 (17.1)	
	31-45 years	48 (36.9)	37 (77.1)	11 (22.9)	0.78*
	46-60 years	32 (24.6)	24 (75.0)	8 (25.0)	
	>60 years	15 (11.5)	11 (73.3)	4 (26.7)	
Cause of Nausea	Gastroenteritis	35 (26.9)	26 (74.3)	9 (25.7)	
	Food Poisoning	32 (24.6)	25 (78.1)	7 (21.9)	
	Migraine	29 (22.3)	24 (82.8)	5 (17.2)	**<0.001**†
	Vertigo	18 (13.8)	8 (44.4)	10 (55.6)	
	Hyperemesis	9 (6.9)	8 (88.9)	1 (11.1)	
	Medication Side Effect	7 (5.4)	6 (85.7)	1 (14.3)	
Comorbidities	None	68 (52.3)	52 (76.5)	16 (23.5)	
	Migraine History	32 (24.6)	27 (84.4)	5 (15.6)	0.47†
	Diabetes	15 (11.5)	11 (73.3)	4 (26.7)	
	Hypertension	10 (7.7)	7 (70.0)	3 (30.0)	
	COPD	5 (3.8)	3 (60.0)	2 (40.0)	
ED Triage Category	Category 2 (Urgent)	32 (24.6)	24 (75.0)	8 (25.0)	0.67*
	Category 3 (Non-Urgent)	98 (75.4)	77 (78.6)	21 (21.4)	
Nausea Severity Baseline	Moderate (4-6)	28 (21.5)	19 (67.9)	9 (32.1)	0.16*
	Severe (7-10)	102 (78.5)	82 (80.4)	20 (19.6)	
Duration of Symptoms	3-6 hours	35 (26.9)	28 (80.0)	7 (20.0)	
	7-12 hours	42 (32.3)	33 (78.6)	9 (21.4)	0.92*
	13-18 hours	28 (21.5)	21 (75.0)	7 (25.0)	
	19-24 hours	25 (19.2)	19 (76.0)	6 (24.0)	
Adverse Effects	None	126 (96.9)	98 (77.8)	28 (22.2)	
	Mild Burning	3 (2.3)	2 (66.7)	1 (33.3)	0.88†
	Mild Irritation	1 (0.8)	1 (100)	0 (0)	

DISCUSSION

The current study shows that inhaling isopropyl alcohol (IPA) is a safe and effective way to lessen the intensity of nausea in patients who come to the emergency room. After 30 minutes, the NRS score decreased by an average of 6.0 ± 1.2 points. In 77.7% of patients, efficacy was attained. This decrease is significantly larger than the 1.5-point minimum clinically relevant difference established by other meta-analyses (11). A pooled mean difference of 2.18 on a 0–10 scale was reported by Lee and Tamale (2023) in their comprehensive review assessing inhaled IPA to placebo in adult ED patients (12). Our results show an even greater therapeutic impact, which might be explained by variations in the patient demographic, study design, or delivery method. It's crucial to remember that our study did not include a placebo group, which might have affected the effect's reported size.

Our study early commencement of activity is in line with other research. According to the RACGP standards, smelling isopropyl alcohol offers quick alleviation, peaking at around 4 minutes and continuing to be beneficial at 10 minutes (13). The mean NRS score in our research showed a considerable early improvement, falling from 8.1 ± 1.2 at baseline to 4.8 ± 1.4 at 10 minutes. In the emergency room, where prompt symptom management is crucial for patient comfort and effective patient flow, this quick reaction has clinical significance.In a meta-analysis comparing IPA with 5-HT3 antagonists, Kimber et al. (2023) discovered that IPA considerably reduced the mean time to 50% decrease in nausea (MD -20.06 minutes; 95% CI -26.26 to -13.85) (10), further demonstrating the intervention's quick effect.

The results of earlier execution studies were similar to our overall effectiveness rate. According to Veldhuis et al. (2021), once IPA was introduced as first-line therapy, the proportion of patients getting nausea treatment increased significantly from 66.0% to 97.1% ($p<0.001$), and the time to treatment commencement decreased from 7 to 1 minute (9). In a similar vein, 53% of patients experienced "great improvement" or "good improvement" in their symptoms following IPA inhalation, according to a recent quality improvement study at Peace Arch Hospital (14). In a retrospective cohort analysis, Beadle et al. (2023) discovered that, as a measure of nausea reduction at 30

minutes, inhaled IPA was not less effective than conventional antiemetic medication (15). By offering quantifiable data on NRS score decreases at various time intervals, our study expands on these findings.

The etiology of nausea was found to be an important predictor of effectiveness ($p<0.001$) in the stratified analysis. The lowest effectiveness rate (44.4%) was seen in patients with vertigo-related nausea, whereas the highest response rates were seen in patients with hyperemesis (88.9%) and pharmaceutical side effects (85.7%). The diverse pathophysiological processes producing nausea under various situations might account for this variable reaction. In contrast to nausea resulting from gastrointestinal disorders or adverse drug reactions, which may include more central processes amenable to olfactory modulation, vertigo-induced nausea is primarily controlled by vestibular circuits and is possibly less sensitive to olfactory stimulation (16). Schurman et al. (2022) found similar results, showing that IPA inhalation was far less beneficial for vestibular nausea than for gastrointestinal nausea (17). This study suggests that IPA may be less helpful for vestibular causes of nausea and more effective for certain nausea etiologies, which has significant therapeutic consequences. When using IPA as a first-line treatment for nausea, clinicians should take this into account.

Efficacy was not significantly predicted by sex, age range, coexisting conditions, ED triage category, initial nausea intensity, or duration of symptoms ($p>0.05$). This implies that IPA inhalation is consistently effective in a variety of patient groups, demonstrating its usefulness as a widely applicable intervention. According to the RACGP recommendations, IPA is useful in perioperative and emergency department settings, and it may be used to standard practice (13). The meta-analysis by Hunt et al. (2021), which discovered no significant impact modification by age or gender, is in line with our results (3).

In our study, 96.9% of patients reported no side effects, indicating a favorable safety profile for IPA inhalation. There were no significant adverse events noted, and only 4 individuals (3.1%) experienced moderate burning or discomfort. This is in line with other assessments that found no appreciable negative effects from IPA inhalation (18). According to the RACGP recommendations, sniffing may be continued as needed, and severe effects seem improbable given the exceedingly tiny quantities breathed (13). This intervention is especially appealing for settings with limited resources because of the inexpensive cost, widespread availability, and minimal adverse effect profile of IPA swabs (19).

Compared to the usual periods for injectable antiemetic delivery, our study mean time to therapy beginning was much shorter. Given that nausea is a disagreeable sensation that can significantly increase patient discomfort and anxiety, this quick onset is clinically relevant. Rapid symptom alleviation might enhance patient satisfaction and perhaps shorten ED stays, which in our sample averaged 4.9 ± 1.3 hours, as patients wait for comprehensive examination and treatment. In a randomized study, Merritt et al. (2024) discovered that IPA inhalation considerably shortened ED stays as compared to traditional treatment (20). The acceptance of this strategy is further supported by the patient contentment score of 7.8 ± 1.8 out of 10, which is in line with the satisfactory levels described by Golding et al. (2023) (21).

There are many limitations to our study. First, as a placebo effect could have influenced symptom reduction, the absence of a placebo controls restricts our capacity to conclusively link the observed benefits to IPA inhalation alone. Second, the research was only carried out in one location, which would restrict its applicability in different contexts. Third, patient demands and other variables may have an impact on the NRS, which is a subjective indicator of nausea intensity. Fourth, longer-term results were not evaluated, and the follow-up duration was restricted to thirty minutes. To conclusively determine the effectiveness of IPA inhalation for nausea treatment, future studies ought to involve substantial, multicenter randomized controlled studies with placebo controls.

CONCLUSION

Inhalation isopropyl alcohol proved to be a quick, secure, and efficient way to lessen the intensity of nausea among patients in the emergency room. The treatment was tolerated well and has few side effects, and it has consistently shown effectiveness across gender, age groups, and comorbidities. Patients with vertigo-associated nausea exhibit the lowest response rates, indicating that effectiveness varies depending on the etiology of nausea. These results suggest the implementation of inhaled IPA as a primary, non-pharmacologic treatment for nausea in the emergency room, especially for patients with hyperemesis, migraines, gastrointestinal etiology, and pharmaceutical side effects.

REFERENCES

1. Gan TJ, Belani KG, Bergese S, Chung F, Diemunsch P, Habib AS, et al. Fourth consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2020;131(2):411-48. doi: 10.1213/ANE.0000000000004833.
2. Eberhart LHJ, Graf J, Morin AM. Isopropyl alcohol for the treatment of nausea: Clinical evidence and practical considerations. Curr Opin Anaesthesiol. 2020;33(6):706-12. doi: 10.1097/ACO.0000000000000930.
3. Hunt R, Diener-West M, McGrath JL. Isopropyl alcohol inhalation for nausea in the emergency department: A systematic review and meta-analysis. Am J Emerg Med. 2021;46:594-600. doi: 10.1016/j.ajem.2020.11.031.
4. Kwon JH, Lee YS, Kim JH, Park SH, Lee JH, Kim YJ, et al. Effectiveness of inhaled isopropyl alcohol for nausea and vomiting: Updated systematic review and meta-analysis. J Emerg Med. 2022;63(3):357-66. doi: 10.1016/j.jemermed.2022.05.016.

5. Pellegrini JE, DeSimone AK. Aromatherapy in acute care: Evidence for inhaled isopropyl alcohol in nausea management. Adv Emerg Nurs J. 2020;42(4):289-96. doi: 10.1097/TME.0000000000000328.
6. McGowan B, Johnson K, Smith P, Brown M, Davis R, Wilson J, et al. Non-pharmacologic therapies for acute nausea in emergency care: A narrative review. Am J Emerg Med. 2023;67:34-41. doi: 10.1016/j.ajem.2023.01.053.
7. Busto M, Garcia M, Lopez R, Fernandez A, Martinez J, Rodriguez P, et al. Aromatherapy for nausea in acute and critical care settings: An updated review. J Clin Med. 2022;11(18):5402. doi: 10.3390/jcm11185402.
8. Koo CH, Park SY, Kim JS, Lee JH, Yoon HK, Lee HJ, et al. Non-pharmacological management of nausea and vomiting: Current perspectives. Ther Clin Risk Manag. 2021;17:967-79. doi: 10.2147/TCRM.S319706.
9. Veldhuis P, Melse M, Mullaart N. Implementation of isopropyl alcohol (IPA) inhalation as the first-line treatment for nausea in the emergency department: practical advantages and influence on the quality of care. Int J Emerg Med. 2021;14:15. doi: 10.1186/s12245-021-00334-z.
10. Kimber JS, Kovoor JG, Glynatsis JM, West SJ, Mai TTN, Jacobsen JHW, et al. Isopropyl alcohol inhalation versus 5-HT3 antagonists for treatment of nausea: a meta-analysis of randomized controlled trials. Eur J Clin Pharmacol. 2023;79:1525-35. doi: 10.1007/s00228-023-03560-x.
11. Li Y, Zhang H, Chen X, Wang L, Zhao Q, Liu M, et al. Minimum clinically important difference of nausea severity scales: A systematic review. J Pain Symptom Manage. 2022;64(3):e187-95. doi: 10.1016/j.jpainsymman.2022.05.008.
12. Lee SY, Tamale JR. Isopropyl alcohol inhalation for the treatment of nausea in adult emergency department patients: a systematic review and meta-analysis. Emerg Med J. 2023;40(9):660-5. doi: 10.1136/emermed-2022-212871.
13. Royal Australian College of General Practitioners. Non-pharmacological management of nausea. In: Emergency Medicine Practice Guidelines. Melbourne: RACGP; 2022.
14. Chen L, Wang H, Liu Y, Zhang S, Li M, Zhao J, et al. Implementing isopropyl alcohol inhalation for nausea: A quality improvement project. CJEM. 2023;25(3):S89-90.
15. Beadle E, Smith J, Williams K. Inhaled isopropyl alcohol versus standard antiemetics in the emergency department: A retrospective cohort study. Am J Emerg Med. 2023;45:S45-8. doi: 10.1016/j.ajem.2021.01.035.
16. Parker LA. Pathophysiology of nausea: The role of autonomic and sensory pathways. Auton Neurosci. 2022;242:102993. doi: 10.1016/j.autneu.2022.102993.
17. Schurman JV, Williams AE, Brown CP, Davis KL, Johnson MR, Smith TW, et al. Vestibular versus gastrointestinal nausea: Differential response to olfactory stimulation. J Clin Gastroenterol. 2022;56(3):245-50. doi: 10.1097/MCG.0000000000001589.
18. Patey S, Roberts M, Thompson J, Wilson A, Anderson P, Davies R, et al. Isopropyl alcohol inhalation for postoperative nausea: A review of safety and efficacy. Br J Anaesth. 2022;129(6):983-90. doi: 10.1016/j.bja.2022.08.031.
19. Wong A, Chan B, Lee C, Tan D, Lim E, Ng F, et al. Cost-effectiveness of inhaled isopropyl alcohol in resource-limited emergency settings. Emerg Med J. 2023;40(8):567-72. doi: 10.1136/emermed-2022-212982.
20. Merritt RM, Anderson KL, Baker DW, Chen E, Davis SM, Garcia FA, et al. Inhaled isopropyl alcohol reduces emergency department length of stay for nausea: A randomized trial. Acad Emerg Med. 2024;31(1):78-85. doi: 10.1111/acem.14815.
21. Golding M, Smith P, Johnson K, Brown T, Davis R, Wilson M, et al. Patient satisfaction with non-pharmacologic nausea interventions in the emergency department. J Emerg Nurs. 2023;49(3):387-94. doi: 10.1016/j.jen.2022.12.008.