Incidence, Timing, and Factors Associated with Postoperative Nausea and Vomiting in the Ambulatory Surgery Setting

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Purpose: *To examine incidence, timing, and factors associated with postoperative nausea and vomiting (PONV) in patients recovering in the ambulatory postanesthesia care unit (PACU).*
Design: *Descriptive correlational, cross-sectional.*
Methods: *Data were collected prospectively, including patient, surgery, anesthesia, and postoperative factors associated with PONV. Independent predictors of nausea were determined using logistic regression.*
Findings: *In 139 randomly selected patients, 10.8% had nausea and 2.9% vomited. On arrival to the PACU, 3 patients had nausea, which increased incrementally to 10 during the next 90 minutes, declining to 3 by 150 minutes. These patients had significantly more hydration and longer PACU stays. Fifty-three percent had nausea at discharge. Younger age and gastroesophageal reflux disease were significantly and independently associated with nausea.*
Conclusions: *PONV is relatively infrequent, but remains a distressing problem resulting in negative surgical experiences and increased cost. Future research is warranted to examine gastroesophageal reflux disease as a novel risk factor.*

Keywords: *postoperative nausea, postoperative vomiting, postanesthesia care unit, ambulatory surgery.*

TWO OF THE MOST distressing problems experienced by inpatients during the first 24 hours postsurgery are nausea and vomiting. Approximately, 50% of patients during this period report having nausea, whereas 30% have one or more episodes of vomiting.[1-3] The rate of postoperative nausea and vomiting (PONV) approaches 80% in patients with multiple risk factors.[1-3] Considering the fact that nearly 60% of surgeries are performed in the ambulatory setting,[4] PONV is an important problem for patients and health care professionals in this specialty practice.[3,5-11] The incidence of PONV in ambulatory care is similar to that of hospitalized patients.[6,11-13]

Postoperative nausea and vomiting rarely leads to serious morbidity, such as aspiration pneumonia, dehydration, electrolyte imbalances, wound dehiscence, or bleeding. However, it is associated with prolonged length of stay in the postanesthesia

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care unit (PACU); increased cost because of additional hydration, medications, and staff time; and most importantly, patient discomfort ranging from mild to severe and dissatisfaction with the surgical experience.[3,7,8,11,14-16] In fact, patients rated PONV as a major concern[10,17] and are willing to pay more for their surgical procedure to avoid PONV.[17]

Postoperative nausea and vomiting has been under investigation since the early 1990s. Most researchers focused on the identification of independent predictors of PONV and its prevention, rather than its timing, severity, and duration.[18] The research designs used by these investigators were retrospective medical record reviews or prospective assessment of patients throughout the postoperative recovery period.[18] It is interesting to note that the operational definition of the outcome variable also varied across these studies. Many investigators combined nausea and vomiting as one variable,[2,6,19] whereas others examined each of these clinical concerns separately,[1,5,20] which is more desirable.[21] Combining nausea and vomiting as a single outcome variable is problematic, as not all patients experience both nausea and vomiting.

Despite the variation in research methods, there is consensus among noted researchers that risk factors associated with these two distressing clinical problems can be categorized into patient, surgical, anesthesia, and postoperative factors. Approximately, 20 contemporary researchers using similar methods, including prospective data collection and multiple regression models, namely logistic regression, reported a number of independent risk factors associated with PONV. The authors of the 2014 Consensus Guideline on the Management of PONV[3] identify these risk factors as younger age, female gender, nonsmoker, and history of PONV or motion sickness, type of surgery (cholecystectomy, gynecologic, laparoscopic), general versus regional anesthesia, volatile anesthetics and nitrous oxide, duration of anesthesia, and postoperative opioid use. However, studies examining PONV in the ambulatory setting are limited, thus findings from studies with inpatients may not be generalizable to the ambulatory surgery patient population.

Nurses in our ambulatory PACU observed that PONV is a common problem in this practice setting, yet the incidence, timing, and duration of PONV were not well defined. They also noted that the timing of the patient's first oral intake, opioid administration, change in body position from stretcher to chair, and surgery later in the day, all appeared to be associated with PONV. Results from previous studies support the notion that these interventions, which are within the scope of nursing practice, warrant further study.[6,9,20]

Purpose

The aims of this study were to:

1. Determine the incidence and timing of PONV in the ambulatory PACU;
2. Examine the effect that common nursing interventions (initiating oral intake, moving patient from stretcher to chair, and administering opioids) and surgery performed later in the day (duration of preoperative nil per os [NPO]) have on PONV; and
3. Identify patient (demographic characteristics and medical history), surgical, anesthesia, and postoperative factors independently associated with PONV in adult patients recovering in the ambulatory PACU.

Methods

Design, Sample, and Setting

A descriptive correlational, cross-sectional design was used with a random sample of 139 patients who were admitted to a 10-bed ambulatory PACU located in a 1,541-bed Magnet designated university affiliated medical center. Most patients admitted to this unit require Phase II care, but on rare occasions patients have oral airways in place and need Phase I care. Patients aged 18 years or older, able to speak and read English, and scheduled to undergo an ambulatory surgical procedure were eligible to participate in this study. Patients were excluded if they had a history of chronic pain, and scheduled to have a surgical procedure with local anesthetics, such as ophthalmologic procedures, or experienced intra- or postoperative complications (eg, vasovagal response, laryngospasm or bronchospasm, aspiration, allergic reactions, bleeding requiring return to the operating room, or hypovolemia requiring

fluid boluses). The study was approved by the hospital's institutional review board.

Measures

A 35-item data collection tool was designed specifically for use in this study.[21] Item selection was based on the commonly cited predictors of PONV in the research literature[3,21] and those of specific interest to the investigators, namely history of gastroesophageal reflex disease (GERD), surgery performed later in the day, and nursing interventions commonly provided in the ambulatory surgery setting. These data elements were categorized as 14 patient, 2 surgical, 6 anesthesia, and 13 postoperative factors. Nausea and vomiting were measured as two distinct outcome variables. Patients were asked to rate the level of nausea using a 0 (no nausea) to 10 (worst nausea) severity scale[22] at the time of PACU arrival, then at 15-, 30-, 60-, 90-, 120-, and 150-minute intervals, as well as before discharge. If nausea was present, the PACU nurses documented the duration in minutes of each patient's nausea episode and indicated if it occurred within 15 minutes of common nursing interventions (eg, drinking or eating, opioid administration, or assisting the patient from the stretcher to the chair). Vomiting was measured as a dichotomous (yes/no) variable. Similarly, with each episode of vomiting, the nurse indicated if it occurred within 15 minutes of these nursing interventions.

Procedures

Each afternoon, we reviewed the operative schedule for the following day to create a list of patients meeting study criteria. A random table of numbers was then used for patient selection. On the day of surgery and after the patient completed the preoperative assessment, we invited the patient to participate, obtained written informed consent, and completed the patient-related category on the data collection tool. After surgery, the patient's PACU nurse completed the tool by collecting data about the surgical, anesthesia, and postoperative PACU factors.

Statistical Analysis

The sample size of 139 participants was based on an a priori power analysis (effect size 0.15; $\alpha = 0.05$; 80% power; 15 predictor variables) for binomial logistic regression. Data were analyzed using SPSS, version 22, statistical software. Descriptive statistics were used to describe the sample that included frequencies and percentages for categorical variables and measures of central tendency and dispersion for continuous variables. Unadjusted associations were determined by independent *t* tests or χ^2 tests between predictor variables (patient, surgical, anesthesia, and postoperative factors) and the two dependent variables, nausea and vomiting, which were each measured as dichotomous variables. Variables with a *P* value of $\leq .05$ in the bivariate analyses were entered into a multivariate analysis using binomial logistic regression to examine factors associated with nausea.

Findings

The mean age of the 139 patients was 49.7 ($\pm$15.3) years, 70.5% were women, 15.1% used tobacco products within the last 14 days, and approximately one-third had a history of PONV (33.8%), vertigo (32.4%), and GERD (30.2%). Using a 0 (no pain) to 10 (worst) pain scale, the mean preoperative pain score was 1.3 ($\pm$2.5). Of those reporting pain (29.5%), only 8.6% indicated that they took an analgesic (acetaminophen/codeine) before coming to the ambulatory surgical center. Similarly, when rating the level of anxiety on a 0 (none) to 10 (worst) scale, 35.3% of the sample had a mean anxiety level of 3.1 ($\pm$3). Of these, 9.4% self-medicated with lorazepam before arrival. A few cases of preoperative nausea (9.4%), with a mean score of 0.3 ($\pm$1) were present. Only one patient reported taking ondansetron before arrival at the ambulatory care center. These patients fasted for a mean of 15.9 ($\pm$3) hours before surgery and very few (2.9%) required preoperative hydration (Table 1).

The most common surgical procedures were orthopaedic (34.5%), plastic (23%), general surgery (22.3%), and gynecologic (19.4%). General anesthesia was used in 85.6% of the cases with a

Table 1. Patient, Surgical, Anesthesia, and Postoperative Factors

Patient Factors	
Demographic characteristics (N = 139)	
Age, mean (SD), y	49.7 (15.3)
Female gender, *n* (%)	98 (70.5)
Medical history	
Nonsmoker, *n* (%)	118 (84.9)
History of PONV, *n* (%)	47 (33.8)
History of vertigo or motion sickness, *n* (%)	45 (32.4)
History of GERD, *n* (%)	42 (30.2)
Preoperative nausea level, mean (SD)	0.3 (1)
Preoperative pain level, mean (SD)	1.3 (2.5)
Preoperative anxiety level, mean (SD)	3.1 (3)
Duration of preoperative NPO, mean (SD), h	15.9 (3)
Surgical Factors (Type of Surgical Procedure), *n* (%)	
Orthopaedic	48 (34.5)
Plastic	32 (23.0)
General	31 (22.3)
Gynecological	27 (19.4)
Other	2 (1.4)
Anesthesia Factors	
Type of anesthesia, *n* (%)	
General	119 (85.6)
Monitored anesthesia	18 (12.9)
Block	9 (6.5)
Type of anesthetic agent used, *n* (%)	
Propofol	129 (92.8)
Midazolam	94 (67.6)
Desflurane/Sevoflurane	92 (66.2)
Nitrous oxide	72 (51.8)
Other	20 (14.4)
Analgesics, *n* (%)	
Fentanyl	119 (85.6)
Ketorolac	53 (38.1)
Hydromorphone	34 (24.5)
Meperidine	10 (7.2)
Alfentanil	8 (5.8)
Morphine	1 (0.7)
Other	8 (5.8)
Antiemetic, *n* (%)	
Ondansetron	97 (69.8)
Dexamethasone	92 (66.2)
Metoclopramide	90 (64.7)
Scopolamine patch	5 (3.6)
Other	13 (9.4)
Intravenous fluids, mean (SD)	769.1 (429.7)
Duration of anesthesia, mean (SD)	93.6 (49.1)
Postoperative Factors	
Pain level, mean (SD)	2.63 (3)
Analgesics, *n* (%)	
Fentanyl	37 (26.6)
Acetaminophen/oxycodone	21 (15.1)
Acetaminophen/hydrocodone	14 (10.1)
Hydromorphone	11 (7.9)
Meperidine	8 (5.8)
Ketorolac	4 (2.9)
Diazepam	5 (3.6)
Acetaminophen/codeine	2 (1.4)
Morphine	1 (0.7)
Ibuprofen	1 (0.7)
Antiemetic, *n* (%)	
Ondansetron	13 (9.4)
Hydroxyzine	2 (1.4)
Metoclopramide	1 (0.7)
Scopolamine	1 (0.7)
Other	3 (2.2)
Intravenous fluids, mean (SD), mL	334.8 (213.3)
Duration of time in PACU, mean (SD), min	85.1 (30.4)

n, number; PONV, postoperative nausea and vomiting; GERD, gastroesophageal reflex disease; NPO, nil per os; mL, milliliters; PACU, postanesthesia care unit.

mean duration of 93.6 (±49.1) minutes. The agents used were propofol (92.8%), midazolam (67.6%), desflurane or sevoflurane (66.2%), or nitrous oxide (51.8%). Only a small proportion of patients had monitored anesthesia (anesthesiologist present during intravenous sedation and local anesthetics; 12.9%) or peripheral nerve block (6.5%). All patients received intraoperative hydration (mean 769.1 ± 429.7 mL) and most received an opioid (93%) and an antiemetic (87.8%) (Table 1).

During the PACU stay, the mean pain score was 2.6 (±3). Pain was reported by 53.2% of patients during this postoperative recovery period. Opioid analgesia was used to treat pain in 47.5% of the patients, whereas four patients received ketorolac (2.9%) and one (0.7%) received ibuprofen. All patients received postoperative hydration. On average, patients PACU length of stay was 85.1 (±30.4) minutes with a range of 38 to 210 minutes.

Table 2. Nausea Severity Experienced by Patients in the Postanesthesia Care Unit

	Time Intervals, min						
	Arrival	**15**	**30**	**60**	**90**	**120**	**150**
Overall severity level (n = 15), Mean (SD)	1.4 (3.1)	1.9 (2.9)	1.5 (2.4)	2.7 (3.4)	3.1 (3.05)	1.9 (3.1)	0.8 (1.9)
Nausea present, n (range)*	3 (4-10)	6 (2-10)	7 (1-8)	9 (1-10)	10 (1-9)	7 (1-10)	3 (2-7)

n, number.
*Nausea was measured using a 0 (none) to 10 (worst) Nausea Severity Scale.

At the time of discharge, most patients were able to go home, whereas 3.6% of the patients were transferred to a health care facility (Table 1).

Incidence and Timing of PONV

Only four patients (2.9%) vomited after complaining of nausea while recovering in the PACU. Nausea was reported by an additional 11 patients who did not vomit. Therefore, the incidence of nausea was 10.8%. The mean duration of these nausea episodes was 63 (±42.6) minutes, ranging from 12 to 135 minutes. Table 2 provides more details about these nausea episodes across each of the seven time points (PACU arrival, 15, 30, 60, 90, 120, and 150 minutes). On PACU arrival, the mean level of nausea for the 15 patients was 1.4 (±3.1). However, the three patients with nausea at this time point reported levels ranging from 4 to 10, indicating mild to severe nausea. The number of patients with nausea increased incrementally to 10 during the next 90 minutes. At this time, the mean level of nausea severity was the highest (3.1 ± 3.05) compared with all other time points. By 150 minutes, the number of patients with nausea decreased to just three, as did the nausea severity (mean 0.8 ± 1.9). In addition, we found a statistically significant positive correlation between mean level of nausea and duration of nausea (P = .021).

We also examined relationships between nausea and hydration as well as PACU length of stay. Patients with nausea received almost double the amount of intravenous fluids compared with those who did not have nausea (575 ± 236.3 mL vs 297.4 ± 168.4 mL, respectively, P < .001) and had a longer mean length of PACU stay (2.2 ± 0.7 hours vs 1.3 ±0.4 hours, respectively, P < .001) (Table 3). More than half of these patients (53.3%, n = 8) reported having nausea at the time of discharge. Patients having a longer mean duration of nausea (84.8 ± 28.3 minutes) compared with those with a shorter duration (38.1 ± 44 minutes) were more likely to be discharged from the PACU with nausea (P = .028).

Effects of Nursing Interventions and NPO Duration on PONV

None of the vomiting episodes occurred within 15 minutes of drinking, eating, or receiving opioids for pain. Only one of the four episodes of vomiting occurred within 15 minutes of moving the patient from stretcher to chair. The mean duration of NPO was 15.21 (±4.2) hours in patients who experienced vomiting compared with 15.96 (±2.94) hours in those who did not, and this difference was not statistically significant (P = .62).

In the cohort of patients with nausea, 47% occurred when moving from stretcher to chair, 33% after drinking or receipt of opioids, and 7% after taking solid food. The mean duration of NPO before surgery was 16 hours in patients with and without nausea.

Factors Independently Associated with PONV

In the unadjusted analysis, the two patient factors significantly associated with nausea were age (mean 37.7 ± 12.5 years with nausea vs 51.1 ± 15 years without nausea) (P = .001) and

Table 3. Unadjusted Associations Among Patient, Surgical, Anesthesia, and Postoperative Factors and Nausea (n = 139)

Variables	Nausea (n = 15)	No Nausea (n = 124)	P Value
Patient Factors			
Demographic characteristics			
Age, mean (SD), y	37.7 (12.5)	51.1 (15)	.001
Female gender, n (%)	13 (13.3)	85 (86.7)	.146
Medical history			
Nonsmokers, n (%)	14 (11.9)	104 (88.1)	.334
History of PONV, n (%)	5 (10.6)	42 (89.4)	.967
History of vertigo or motion sickness, n (%)	8 (17.8)	37 (82.2)	.066
History of GERD, n (%)	8 (19)	34 (81)	.039
Preoperative nausea level, mean (SD)	.13 (.52)	1.4 (2.5)	.525
Preoperative pain level, mean (SD)	.67 (2.1)	1.4 (2.5)	.291
Preoperative anxiety level, mean (SD)	2.5 (2.5)	3.3 (3.1)	.396
Preoperative NPO, mean (SD), h	16.01 (2.92)	15.94 (2.98)	.931
Surgical Factors (Surgical Procedure), n (%)			
Orthopedic surgery	3 (6.3)	45 (93.8)	.210
Plastic surgery	5 (15.6)	27 (84.4)	.315
General surgery	2 (6.5)	29 (93.5)	.377
Gynecological surgery	5 (18.5)	22 (81.5)	.149
Anesthesia Factors			
Type of anesthesia, n (%)			
General	15 (12.6)	104 (87.4)	.093
Monitored anesthesia	0 (0)	18 (100)	.114
Block	1 (11.1)	8 (88.9)	.974
Type of anesthetic agent used, n (%)			
Propofol	15 (11.6)	114 (88.4)	.254
Midazolam	10 (10.6)	84 (89.4)	.933
Desflurane/Sevoflurane	14 (15.2)	78 (84.8)	.019
Nitrous oxide	10 (13.9)	62 (86.1)	.222
Other	4 (20)	16 (80)	.151
Analgesics, n (%)			
Fentanyl	12 (10.1)	107 (89.9)	.512
Ketorolac	4 (7.5)	49 (92.5)	.333
Hydromorphone	7 (2.6)	27 (79.4)	.034
Meperidine	2 (20)	8 (80)	.330
Alfentanil	0 (0)	8 (100)	.311
Morphine	0 (0)	1 (100)	.727
Other	1 (12.5)	7 (87.5)	.873
Antiemetic, n (%)			
Ondansetron	15 (15.5)	82 (84.5)	.007
Dexamethasone	14 (15.2)	78 (84.8)	.019
Metoclopramide	10 (11.1)	80 (88.9)	.869
Scopolamine patch	1 (20)	4 (80)	.499
Other	3 (23.1)	10 (76.9)	.134
Intravenous fluids, mean (SD), mL	990 (724.1)	742.4 (375.2)	.212
Duration of anesthesia, mean (SD), min	113.5 (66.6)	91.1 (46.3)	.096
Postoperative Factors			
Pain level, mean (SD)	4.1 (2.9)	2.5 (1)	.041
Analgesics, n (%)			
Fentanyl	7 (18.9)	30 (81.1)	.063
Acetaminophen/oxycodone	2 (9.5)	19 (90.5)	.839

(Continued)

Table 3. Continued

Variables	Nausea (n = 15)	No Nausea (n = 124)	P Value
Acetaminophen/hydrocodone	1 (7.1)	13 (92.9)	.643
Hydromorphone	2 (18.2)	9 (81.8)	.410
Meperidine	1 (12.5)	7 (87.5)	.873
Ketorolac	0 (0)	4 (100)	.480
Diazepam	1 (20)	4 (80)	.499
Acetaminophen/codeine	0 (0)	2 (100)	.620
Morphine	0 (0)	1 (100)	.727
Intravenous fluids, mean (SD), mL	575 (236.3)	297.4 (168.4)	< .001
Duration of PACU stay minutes, mean (SD)	132.27 (43)	79.3 (22.8)	< .001

n, number; PONV, postoperative nausea and vomiting; GERD, gastroesophageal reflex disease; NPO, nil per os; PACU, postanesthesia care unit.

P value indicates result of independent t test for continuous variables or χ^2 test for categorical variables.

having a history of GERD (P = .039) (Table 3). Significant anesthesia factors were administration of desflurane/sevoflurane (P = .019), hydromorphone (P = .034), ondansetron (P = .007), and dexamethasone (P = .019). Having a higher mean level of pain (4.1 ± 2.9), compared with a lower pain level (2.5 ± 1), was the only postoperative factor associated with nausea (P = .041). There were no surgical factors associated with nausea.

In the analysis adjusted for these seven factors, younger age was independently associated with nausea (β = −0.125; odds ratio = 0.883; 95% confidence intervals = 0.812, 0.960; P = .003). History of GERD was also an independent predictor increasing the odds of having nausea by 9.62 (β = 2.264; 95% confidence intervals = 1.686, 54.887; P = .011). We did not examine factors associated with vomiting as the incidence was so low.

Limitations

This study was conducted in a small ambulatory PACU, limiting the generalizability of our findings to other settings. We relied on nursing staff to document the occurrence and timing of PONV throughout patients' PACU stay. Although a coinvestigator was present in the PACU each day to supervise data collection, it is possible that some data elements were not collected accurately. Future studies will benefit from a larger sample size, across multiple ambulatory sites given the low incidence of PONV.[3]

Conclusions

To date, very few studies examined the problem of PONV in the ambulatory setting. The incidence of nausea and vomiting in our study was 10.8% and 2.9%, respectively, lower than results reported by Teunkens et al[14] (13.9% vs 3.3%, respectively), Apfel et al[5] (19.9% vs 3.9%, respectively) and Odom-Forren et al[12] (56% vs 19.4%, respectively). Sarin et al[13] indicated that 25% of patients experienced PONV after ambulatory surgery in a large academic medical center and this rate was as high 35% in a small community hospital.[6] Despite the lower PONV rates in our ambulatory surgical center, we concur with authors who are now coining ambulatory PONV as the "big little problem"[11,13,23] for several reasons. First and foremost, for the patients who do develop PONV, it becomes a significant and distressing problem that contributes to a negative surgical experience.[10,14]

To our knowledge, this was the first study that examined the association between severity of nausea and duration of nausea, which we found to have a significant positive correlation. We also discovered that there was an unstable pattern associated with nausea as the number of patients with nausea increased incrementally from 3 patients at the time of PACU admission and peaked to10 patients at 90 minutes, and in some cases the nausea was severe. The patients with nausea unsurprisingly required significantly more intravenous hydration and a longer PACU length of stay. These findings are similar to the results of others, as PONV is known to contribute

to greater use of resources and cost of care.[7,8,11,15,16,18]

About one-half of the patients in our study who experienced nausea during the PACU stay reported having this symptom at the time of discharge. In fact, patients with a longer duration of nausea during the PACU stay were significantly more likely to go home with nausea. Postdischarge nausea and vomiting (PDNV) is an underappreciated problem after ambulatory surgery that can greatly affect the patient's recovery[7] and quality of life.[12] Results of recent studies report a 37% incidence of PDNV 48 hours after discharge[5] and a higher prevalence rate of 56.9% over 7 days postdischarge.[12] Apfel et al[5] determined that nausea in the PACU was one of the five independent predictors of PDNV, which increased patients' risk threefold. Other PDNV risk factors were female gender, age less than 50 years, history of nausea or vomiting after previous anesthesia, and opioid administration in the PACU. Clinicians should find this information useful, because it highlights the importance of optimizing PONV management in the PACU and implementing antiemetic prophylaxis as part of the discharge plan for patients at high risk for PDNV.

Offering patients oral fluids and light snacks, providing pain medications, and initiating mobility activities are common nursing interventions provided in the PACU that we hypothesized would influence PONV. Vomiting was precipitated in only one of the four patients during activity, but not with the other three nursing interventions. Contrary to this finding, nausea was more commonly precipitated when moving patients from the stretcher to the chair, having something to drink, or after opioid administration. The least common was after eating. There was no association between duration of NPO status and PONV, which has been substantiated by others.[3] These results have implications for nursing practice, as prophylactic antiemetic medications and nonpharmacologic therapies should be provided before engaging in nursing interventions that may precipitate PONV in patients at high risk.

Finally, we found only two independent predictors of PONV in the ambulatory setting, namely, younger age and history of GERD. The first predictor, younger age, was consistent with what is repeatedly reported as a significant risk factor for PONV,[3] including a study with patients recovering from ambulatory surgery.[13] We were surprised that GERD emerged as a novel risk factor. We found very few studies that examined history of GERD as a potential risk factor for PONV. Sawatzky et al[24] used a retrospective medical record review to examine history of GERD as one of the several risk factors in patients who received a single dose of granisetron after cardiac surgery. In the unadjusted analysis, history of GERD was not significantly different between patients with and without any nausea event. Palazzo and Evans[25] had similar results when prospectively examining heartburn as one of the several potential PONV risk factors in patients undergoing minor orthopaedic surgery. However, it is difficult to draw conclusions when comparing the results of these two studies with ours because of the variations in study design, sample, and measurement of the outcome variables. Consideration should be made to include history of GERD as a potential PONV predictor variable in future studies to substantiate our finding, as it has been so infrequently studied in both inpatient and ambulatory settings.

Implications for PACU Nursing Practice

The culture of PACU nursing practice needs to include a low threshold for patients experiencing PONV. A key to minimizing episodes of PONV is having a heightened awareness of patients' risk factors, including age and history of GERD. Clear communication about each patient's risk factors and the prevention and management plan is necessary among nurses, surgeons, and anesthesia providers across the pre-, intra-, and postoperative phases of ambulatory surgery. Armed with this knowledge, PACU nurses will be better positioned to individualize their patients' care, which should include ensuring that the patient is adequately hydrated with intravenous fluids, as needed.[3]

Nurses must remain vigilant to prevent and manage PONV, including use of rescue therapies and ongoing assessment of patients' responses to pharmacologic and nonpharmacologic interventions. There are several nonpharmacologic interventions that can be used by nurses in the ambulatory PACU to reduce the incidence of PONV. Aromatherapy is an effective, nurse-driven, complementary therapy

that involves the use of essential oils (peppermint, ginger, or a combination of lavender, peppermint, ginger, or spearmint oils). Aromatherapy is used as an adjunct to antiemetic medications.[26] There is a high level of supportive literature indicating that Nei-Guan (P6) acupuncture point stimulation (located 2 to 3 cm proximal to the distal wrist crease)[27] significantly reduces the risk of PONV and the use of rescue antiemetics.[3,28] These concerted efforts to reduce the incidence of PONV will have a positive effect on the ambulatory surgical experience of patients as well as reducing morbidity and health care costs.[3,8]

Our hope is that the results of this study will inspire PACU nurses to engage in similar scholarly work to understand further the problem of PONV in the ambulatory setting. PACU nurses can be integral members of research teams examining ambulatory PONV/PDNV risk factors or testing novel interventions to prevent or manage these complications. As recommended by the 2014 Consensus Guidelines for the Management of Postoperative Nausea and Vomiting,[3] hospitals should charge quality improvement teams to ensure that evidence-based guidelines are systematically applied to practice. Nurses are well positioned to lead these improvement efforts to minimize PONV/PDNV in patients undergoing ambulatory surgery.

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