

Consensus Guideline Adoption for Managing Postoperative Nausea and Vomiting

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ABSTRACT

Objective: Postoperative nausea and vomiting (PONV) is a major source of patient dissatisfaction and is the leading cause of discharge delays and unanticipated postsurgical hospital admissions. The objective of this study was to examine the efficacy of PONV management consensus guidelines at the institutional level.

Design: Retrospective, cross sectional study.

Setting: Post-anesthesia care unit (PACU) at a 504-bed multispecialty referral center.

Participants: 300 adult surgical patients who underwent general anesthesia prior to institutional adoption of PONV management guidelines and 301 adult surgical patients who underwent general anesthesia following adoption of guidelines.

Methods: The records of 601 adult surgical patients were examined for documented treatment for PONV while in the PACU, length of PACU stay, medications administered perioperatively, and patient characteristics including number and type of PONV risk factors.

Results: Institutional incidence of PONV decreased from 8.36% to 3.01% following adoption of management guidelines ($P=0.0047$). All patients who developed PONV had 3 or more risk factors, and the reduction in incidence is attributable to an overall increase in preoperative antiemetic prophylaxis ($P<0.0001$), with a concomitant increase in multimodal treatment ($P<0.0001$) and decrease in single modality treatment ($P=0.0004$). Length of stay in the PACU increased approximately 15 minutes in patients with PONV, but did not reach statistical significance. Development of PONV was associated with the presence of greater than 3 conventional risk factors ($P=0.009$), never smoker status ($P=0.0009$), and surgery type.

Conclusions: Implementation of consensus PONV prevention guidelines significantly reduced incidence at an institutional level. However, patients with 3 or more risk factors remain at risk for PONV. Risk stratification remains important and greater intervention is required in this

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subgroup at our institution. In response to publication of procedural consensus guidelines, individual institutions should consider modification of practices and assessment of outcomes following application.

INTRODUCTION

Both anesthesiologists and patients rate nausea and vomiting among the top clinical anesthesia outcomes to be avoided, and postoperative nausea and vomiting (PONV) is considered by many patients to be more distressing than postsurgical pain,^{1,2} with cost of recovery increasing significantly in patients that develop PONV.³ In the absence of pharmacological treatment, the rate of PONV is approximately 30% in the general population,⁴ and can be as high as 70% in patients at highest risk.^{5,6} Several risk factors have been delineated.⁷ Those most strongly associated with PONV and used in clinical risk assessment include type of surgery, female gender, nonsmoker status, history of postoperative nausea and vomiting or motion sickness, and postoperative opioid use. The consequences

surrounding PONV have prompted physicians, scientists, and drug companies to invest considerable effort into improving perioperative management, yet rates remain unacceptable.

Postoperative nausea and vomiting is a complex condition with a multifactorial etiology that encompasses both patient-specific and surgery-related risk factors and involves multiple physiological pathways in its origins. Historically, selection of pharmaceutical agents for its control and treatment varied across institutions based on personal preference, price, and availability. More recently, risk factors were defined to identify those at highest risk for developing PONV and for preoperative administration of prophylactic treatment.⁸ In 2003, the first consensus guidelines that incorporated administration of pro-

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CME available. See page 214 for more information.

Table 1. Comparison of Group Characteristics in Surgical Patients Before and After Guideline Implementation

	Group 1 (Before Guidelines) n=300	Group 2 (After Guidelines) n=301	P-value
Conventional Risk Factors			
Gender (female)	53.0%	54.5%	0.7150
Age (mean ±SD)	59.2 ± 17.6	60.4 ± 16.7	0.3827
History of PONV/motion sickness	9.0%	10.0%	0.6859
Length of surgery (mean±SD [minute])	109.4±74.2	105.4±65.1	0.4863
Length of surgery (> 2 hours)	34.0%	36.2%	0.5699
Nonsmoker status	45.5% (125/275)	45.6% (125/274)	0.9689
Obesity	37.2% (110/296)	46.5% (140/294)	0.0102
Use of postoperative opioids	68.7%	63.8%	0.2060
Use of intraoperative opioids	99.00%	98.67%	1.0000
Use of volatile anesthetics	100.0%	100.0%	1.0000
Greater or equal 3 risk factors	49.90%	50.10%	0.9871
Prophylaxis Treatment Comparisons			
Preoperative prophylaxis	32 (10.67%)	95 (31.56%)	<0.0001
Intraoperative prophylaxis	186 (62.00%)	197 (65.45%)	0.3793
Prophylaxis multimodal dose	46 (15.33%)	111 (36.88%)	<0.0001
Prophylaxis single dose	160 (53.33%)	117 (38.87%)	0.0004
No prophylaxis	94 (31.33%)	73 (24.25%)	0.0527
Rate of PONV	8.36% (25/299)	3.01% (9/299)	0.0047

Abbreviation: PONV, postoperative nausea and vomiting

phylactic antiemetic treatment based on risk score stratification were published.⁹ These guidelines incorporated risk assessment and minimization and customized, multimodal, pharmacological treatment approaches for PONV management based on level of risk. The guidelines were updated in 2007 under the auspices of the Society of Ambulatory Anesthesia (SAMBA),¹⁰ but their basic principles remain the same.^{9,10} Since publication of the SAMBA guidelines, several studies have examined their appropriate implementation and efficacy, particularly in high-risk patients and before and after intervention with automated reminder systems.¹¹⁻¹³ However, no study has examined retrospectively the effect of guideline implementation at the institutional level following adoption by the institution's own accord and application by medical staff without prompting.

In 2005 the standard approach to management of PONV at our institution was modified to comply with the 2003 consensus guidelines, including identification of patients at risk for developing PONV, reduction of baseline risk factors, preoperative administration of recommended prophylactic treatment, and antiemetic treatment for patients with PONV in the post-anesthesia care unit (PACU), without repeat administration of failed drugs.⁹ This revised approach was adopted to increase the likelihood of patient response to treatment, thereby increasing patient comfort and satisfaction, decreasing PONV-associated adverse events, and avoiding unnecessary exposure to ineffective medications.

The purpose of this study was to assess whether implemen-

tation of these guidelines had a significant impact on PONV incidence compared to historical incidence across our system. The rate of PONV improved, even though with the exception of guideline adoption, no other intervention for the promotion of guideline compliance was performed.

METHODS

Study Population

The historical PONV incidence rate at Marshfield Clinic in a 6-month period before publication of consensus guidelines was determined and compared to incidence in a 6-month period after guideline implementation. Following IRB approval, electronic medical record (EMR) interrogation identified 300 surgical patients with a documented PACU stay at St. Joseph's Hospital (SJH), a 504-bed multispecialty referral center in central Wisconsin, who underwent

surgery between January 1, 2002 and July 1, 2002. Although the guidelines were not adopted institution-wide until 2005, the reference period was before initial guideline publication in order to preempt any potential learning bias by individual physicians. For comparison, chart interrogation identified 301 surgical patients at the hospital between September 2007 and May 2008, following adoption of the consensus guidelines. Adults > 18 years of age who received general anesthesia during surgery and recovered in the PACU were included in the study. Patients who underwent surgical procedures for which preexisting nausea and vomiting were likely to exist independent of the surgical context (endoscopies, colonoscopies, laparotomies) had gastrointestinal obstruction; presented with preoperative complaints of overt nausea, vomiting, or emesis; received local or monitored anesthesia care in the absence of general anesthesia administration; or had surgery for which no preoperative data were available (eg, emergent conditions such as emergency or trauma-related surgery) were excluded from analysis.

Patient data were collected for the primary outcome measures of PONV incidence rate and length of PACU stay in the pre- and postguideline implementation period. Secondary outcomes included change in rate of PONV at time of PACU discharge, rate of multimodal therapy application during perisurgical management, and characteristics (number and nature of risk factors) of patients experiencing PONV following guideline implementation. Medications administered preoperatively, intraoperatively, and in the PACU were abstracted to evaluate

potential association between treatment and change in PONV rate. Additional data collected for each patient included gender, age, height, weight, prior history of PONV, smoking status, and type of surgery. Manual chart review performed for feasibility purposes verified that all retrospective data points were reliably available in both study periods to allow for analysis of patient characteristics and risk factors for PONV. Data were quality assured by a reabstraction process on 10% of charts.

Statistical Analysis

Differences in conventional risk factors for PONV, prophylaxis treatment, and rate of PONV between preguideline publication and postguideline implementation were compared. Continuous variables were compared using a 2-tailed *t* test or Wilcoxon rank sum test and categorical variables were evaluated using chi-square test or the Fisher exact test when appropriate. In addition, the number needed to treat to prevent PONV following guideline implementation and its 95% CI were calculated. The same statistical methods described above also were used to evaluate the differences between the PONV and non-PONV groups. The association between PONV and surgery type was evaluated using chi-square test.

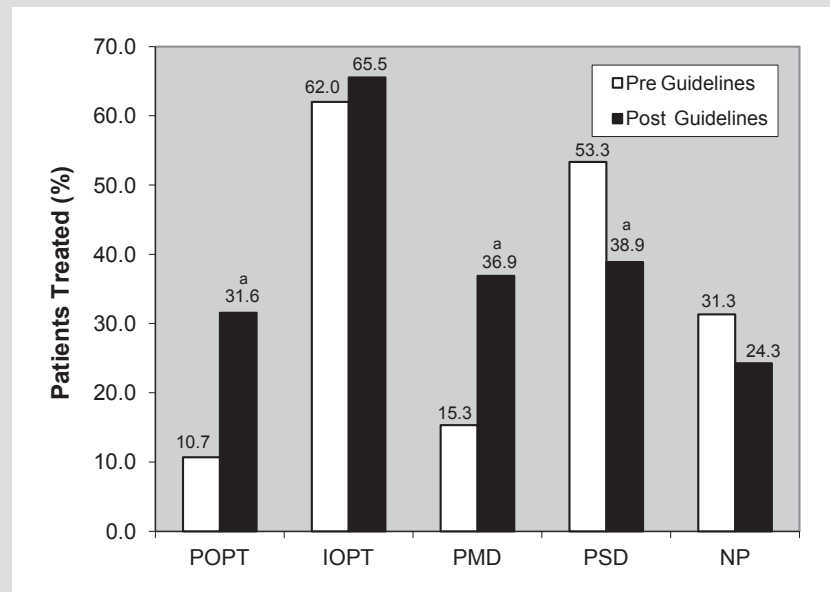
RESULTS

Comparison of Patients Before and After Guideline Implementation

Characteristics of surgical patients before and after guideline implementation are shown in Table 1. The rate of PONV was significantly reduced after guideline implementation (3.01%) compared to the pre-guideline group (8.36%) ($P=0.0047$). The number of patients who were given prophylactic treatment in the postguideline group in order to prevent 1 case of PONV (number needed to treat) was 19 (95% CI, 11-60).

Relative to conventional risk factors, only obesity was significantly different between the preguideline and postguideline groups, with more obese patients following guideline adoption ($P=0.0102$). The percentage of patients treated with preoperative prophylaxis was significantly greater following guideline implementation ($P<0.0001$). This increase can be attributed to a significant increase in multimodal prophylaxis adminis-

Figure 1. Prophylaxis Treatment Comparison



A statistically significant increase in overall preoperative prophylaxis treatment was noted ($P<0.0001$) with a significant increase in multimodal prophylaxis ($P<0.0001$) and a significant decrease in single modality prophylaxis ($P=0.0004$). The white bars represent the preguideline adoption time period and the black bars represent the postguideline adoption time period. The percent of patients treated with each type of prophylaxis is indicated above the bar.
^a $P<0.001$.

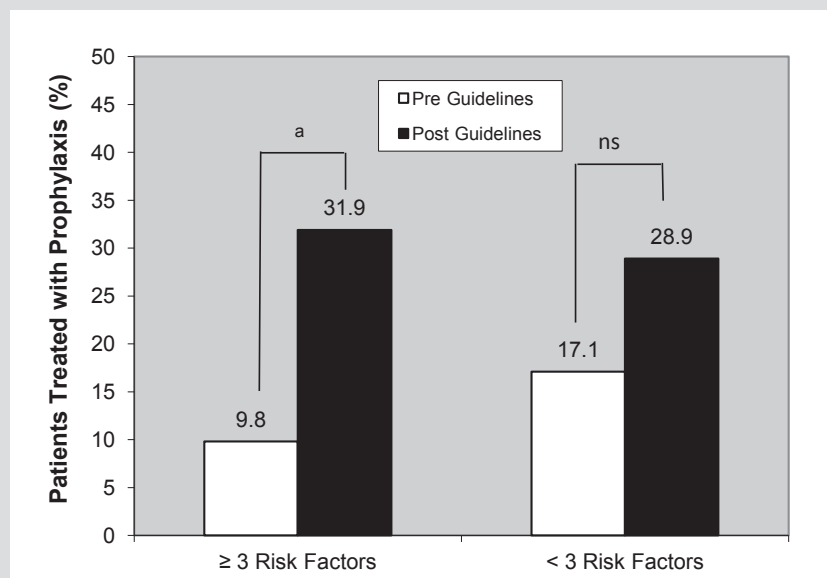
Abbreviations: POPT, Preoperative Prophylaxis Treatment; IOPT, Intraoperative Prophylaxis Treatment; PMD, Prophylaxis Multimodal Dose; PSD, Prophylaxis Single-modal Dose; NP, No Prophylaxis Treatment.

tration in the period after guideline adoption ($P<0.0001$), as single modality prophylaxis significantly decreased from pre- to postguideline adoption ($P=0.0004$) (Figure 1). A higher percentage of preoperative prophylaxis treatment was noted in the postguideline adoption period in patients with 3 or more conventional risk factors (31.9% vs 9.8%, $P<0.001$), but the difference in patients with fewer than 3 risk factors pre- and postguideline adoption (17.1% and 28.9%, respectively) was not significant (Figure 2).

Comparison of Patients With and Without PONV

This study included 34 patients who developed PONV. The characteristics of patients with and without PONV are shown in Table 2. All patients who developed PONV had 3 or more risk factors. In both study periods combined, 6.5% of patients with 3 or more risk factors developed PONV. Patients who were smokers had a lower PONV rate (2.68%) compared to patients who never smoked (9.24%) ($P<0.0009$). For patients with PONV, the median length of stay in the PACU was longer by 0.245 hours (15 minutes) than patients without PONV. However, Wilcoxon rank sum test failed to detect a significant difference ($P<0.1222$), likely due to the small number of patients that developed PONV.

Figure 2. Preoperative Prophylaxis Treatment for High- and Low-Risk Patients.



Prophylactic treatment increased in patients at both high- and low-risk for the development of PONV postguideline adoption (black bars) compared to the preguideline adoption time period (white bars). The difference was significant only for patients with 3 or more risk factors. The percent of patients treated with prophylaxis is indicated above each bar.

Table 2. Comparisons of PONV and Non-PONV groups

	PONV	Non-PONV	P-value
High and Low Risk	n=34	n=564	
Number of risks >3	34 (6.59%)	482 (93.41%)	0.0090
Number of risks <3	0 (0.00%)	82 (100.00%)	
Smoking Status	n=31	n=517	
Smoker	8 (2.68%)	291 (97.32%)	0.0009
Never Smoker	23 (9.24%)	226 (90.76%)	
LOS in PACU	n=34	n=540	
Hours (Median)	2.165 (1.080-4.330)	1.920 (0.330-5.830)	0.1222

Abbreviations: PONV, postoperative nausea and vomiting; LOS, length of stay; PACU=post-anesthesia care unit.

Whether dexamethasone as monotherapy prevents PONV is not entirely clear, but it appears to perform better in combination with other prophylactic agents.¹⁴ Of the 68 patients who received dexamethasone prophylactically, 5 received it as monotherapy. Postoperative nausea and vomiting occurred in 1/5 (20%) of patients who received dexamethasone as monotherapy and in 3/63 (4.76%) of patients who received dexamethasone as part of a multitherapy regimen. However, this difference was not significant ($P < 0.2686$), possibly due to the small sample size.

PONV Rate By Surgery Type

The highest rate of PONV was observed in patients undergo-

ing breast surgery (16.67%) and lowest in patients undergoing neurological surgery (2.44%). Rates of PONV by surgery type in each study period are shown in Figure 3. Guideline implementation resulted in a significant decrease in PONV rates in laparoscopic gynecological, orthopedic, and general surgery. In the literature, breast and laparoscopic surgery are reported to be associated with the highest rates of PONV.¹⁵⁻¹⁷ In this study, surgeries were categorized into high- and low-risk groups: Group A (breast and laparoscopic gynecological surgeries) and Group B (ear, nose, and throat [ENT], eye, neurological, orthopedic, general, two surgeries and others). The difference between the two groups in the pre- and postguideline adoption time periods is shown in Figure 4. Chi-square test revealed that the difference in PONV rate between Group A and Group B was statistically significant over both study periods combined (13.16% vs

4.60%, respectively, $P = 0.0026$), with more PONV occurring in patients in the high-risk group, as expected. The same was true during each study period assessed separately. Importantly, guideline adoption affected a decrease in the rate of PONV following both high- and low-risk surgeries, though the magnitude of the change was much larger in the high-risk group.

DISCUSSION

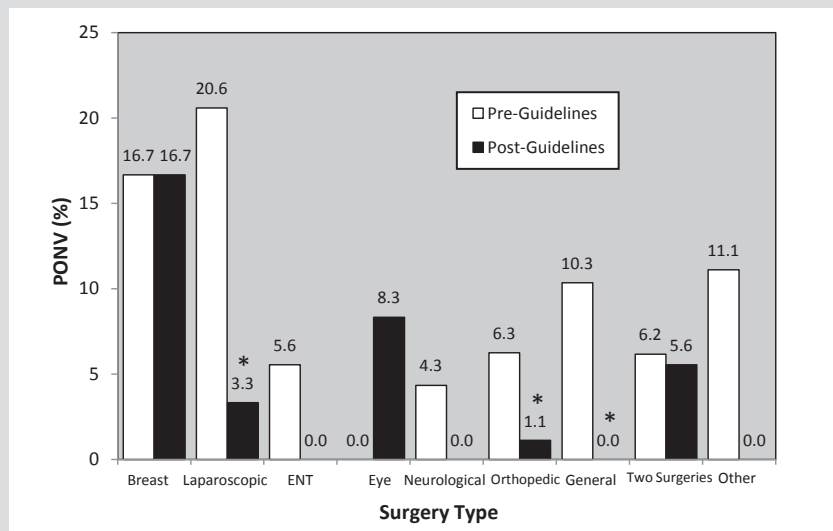
In addition to the obvious discomfort and distress experienced by patients with PONV and the additional burden placed on caregivers, PONV also is associated with considerable adverse impact on patient health. Complications may include airway obstruction, aspiration of vomitus with the potential for aspiration pneumonia, wound disruption, increased intracranial pressure (of particular concern in neurosurgical patients), dehydration and electrolyte imbalance, delay in administration of oral analgesia or other pharmaceuticals, exhaustion, interference with nutrition, and delay in mobilization and recovery.¹⁸ Because patients are so adversely affected by PONV onset, it is important to address this problem aggressively and effectively.^{1,2} In June 2005, the 2003 consensus guidelines published by Gan et al⁹ were adopted as standard of care at our institution. This study was performed following adoption of the guidelines to assess the relative reduction of PONV incidence compared to historical data.

The incidence of PONV was significantly reduced from 8.36% to 3.01% following guideline adoption. Our results demonstrate that adoption of the guidelines for the management of PONV reduced incidence at the institutional level. These findings are consistent with the results of other studies regarding the use of risk assessment in determining the need for prophylaxis,^{19,20} the utility of specific drug combinations in prevention,²¹ and the benefit of guideline compliance in subsets of patients at high risk,^{12,13} especially with the use of proactive intervention to promote physician compliance.¹¹ Until now, however, no retrospective, cross-sectional study of the efficacy of consensus guidelines for the prevention of PONV has been performed at an institution that adopted guidelines of their own accord and applied them without prompting of the medical staff to promote compliance. This is the first study to demonstrate in a broad sense the efficacy of guideline implementation at the institutional level in the absence of intervention.

Risk factors for PONV were evenly distributed in the pre- and postguideline groups, with the exception of obesity. While obesity is often cited as a risk factor for postoperative nausea and vomiting,⁷ a systematic review of the literature found no evidence of a correlation between body mass index and PONV,²² suggesting that the efficacy of guideline implementation was unlikely to be altered by the increased number of obese patients in the postguideline implementation group. We attribute the statistically significant decrease in the rate of PONV to recognition of high-risk patients, better drug selection, avoidance of repetition of the same drug, and utilization of a multidrug approach to target multiple pathways triggering PONV onset, as described in the guidelines.⁹ Patients more frequently received preoperative antiemetic treatment in the postguideline period and had better outcomes. Interestingly, following guideline adoption, single modality treatment decreased while multimodal prophylaxis and prophylaxis for patients with 3 or more risk factors for PONV increased.

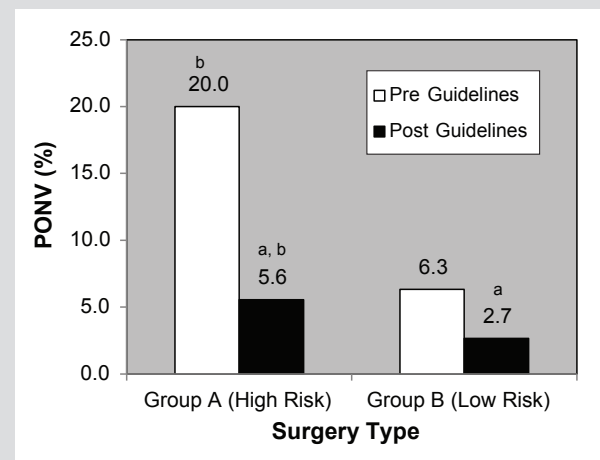
In the present study, all patients who developed postoperative nausea and vomiting had 3 or more risk factors, and the presence of 3 or more risk factors during presurgical screening was significantly associated with PONV incidence, as has been demonstrated in several other studies.²³ The risk factors

Figure 3. Postoperative Nausea and Vomiting (PONV) Rate by Surgery Type.



The white bars represent the pre-guideline adoption time period and the black bars represent the post-guideline adoption time period. With the exception of eye surgery (0/13 patients with PONV pre-guidelines, 1/12 post-guidelines), the PONV rate either decreased or stayed the same for all other types of surgery. Significant decreases were noted for laparoscopic gynecological, orthopedic, and general surgery following guideline implementation. PONV rates were highest overall for breast and laparoscopic surgery. The percent of patients that developed PONV undergoing each surgery type is indicated above each bar.
* $P < 0.05$.

Figure 4. Postoperative Nausea and Vomiting (PONV) Rate in Different Surgery Groups



Group A consisted of high-risk surgeries including breast and laparoscopic gynecological surgeries; and Group B consisted of low-risk surgeries including ear, nose and throat (ENT), eye, neurological, orthopedic, general, two surgeries, and others. The percent of patients in each group that developed PONV in the pre- (white bars) and post- (black bars) guideline implementation time periods is indicated above each bar. Patients undergoing high risk surgery were more likely to develop PONV and implementation of guidelines resulted in a decrease in PONV in both the high-risk and low-risk surgery groups.
^a $P < 0.05$ compared to preguideline implementation.
^b $P < 0.01$ compared to low risk surgery group.

for development of PONV that achieved statistical significance in this study were consistent with those defined previously in the literature. Never-smoker status was significantly associated with the development of PONV with a history of smoking decreasing incidence by 7% in our study. Thus, smoking seems to be a protective factor against development of PONV, confirming findings in previous studies.^{8,17} Additionally, when PONV incidence was evaluated by type of surgery, the highest rate was observed in conjunction with breast surgery, consistent with the literature.¹⁵⁻¹⁷ Since breast surgery by itself has a significantly high rate of PONV and guideline implementation had no effect on incidence, administration of multidrug therapy prophylaxis to patients undergoing breast surgery appears advisable.

Patients in the PACU presenting with postoperative nausea and vomiting had a 15 minute longer length of stay on average than patients who did not develop PONV. However, this difference did not achieve significance, which is likely attributable to the low number of patients that developed PONV. Since PACU stay is charged per 30 minute intervals at our institution, a higher cost for stay would be associated with the management of patients with PONV while in the PACU, consistent with the literature.³ Decreased incidence following guideline adoption may have helped to ameliorate some of this excess cost.

In recent years, a multimodal approach to PONV prophylaxis has been used as an alternative strategy to repetitive dosing with, or dose escalation of, a single medication in order to target more potential etiological pathways.²⁴ In the present study, when comparing patients who received single agent treatment to those treated with multidrug combinations, no significant differences in PONV rate were detected. However, from pre- to postguideline adoption, an overall increase in the percent of patients receiving antiemetic prophylaxis and a significant improvement in outcome were observed. The increased administration of preoperative prophylaxis corresponded with a significant increase in the rate of multimodal prophylactic treatment and a significant decrease in the rate of single modality treatment, suggesting that the increase in multimodal treatment may play an important role in the reduction of PONV incidence.

As demonstrated by this study and others, adoption of a risk-based PONV management program can reduce incidence institutionally.^{19,20} However, even with proactive intervention to promote guideline compliance, PONV incidence does not reach 0%.^{11,13} The inability of institutions to eradicate PONV in spite of the large body of scientific literature surrounding its management is a topic of current debate.²⁵ Some advocate for improved implementation of risk-based antiemetic administration,²³ while others have suggested that the idea of risk-based management should be discarded and that a liberal antiemetic prophylaxis approach should be taken with all surgical patients.²⁶

Importantly, in 2007 it was demonstrated via computer simulation that of 10 current algorithms for PONV management, none were universally applicable across different patient populations and institutions.²⁷ Therefore, others have suggested that there is a need for individual institutional policies based on local incidence as well as the demands of the patients and surgeons.²⁶ At our institution, we were able to detect a significant reduction in the incidence of PONV following institution-wide adoption of consensus management guidelines. We also observed a significant increase in prophylactic therapy, particularly multimodal antiemetic prophylaxis, following guideline adoption. We advocate similar individual institution-based studies to determine the best mode of PONV management for the local situation.

A limitation of this study is the lack of assessment of guideline compliance. While the guidelines were adopted institution-wide, no specific intervention program was undertaken to promote medical staff compliance. The exact percentage of high-risk patients treated in accordance with the institutional guidelines is unknown. Following application of an institution-wide, automatic decision support system, Kooij et al^{11,13} found a guideline adherence rate of only 70% to 80%, suggesting that compliance may not have reached 100% in our study. Regardless, a rate of PONV of 3.01% institution-wide is relatively low. Based on the data presented here, we are unable to determine whether the 3% of patients that developed PONV following guideline adoption was due to non-compliance with the guidelines, imperfections in the risk-assessment system,²⁶ lack of patient response to antiemetic prophylactic therapy, or the presence of other unknown risk factors. We also were unable to examine a complete list of all PONV risk factors that may have affected outcomes. For example, data regarding length of surgery were not collected, although it is known that longer surgery—and thus longer time under anesthesia—increases the risk of PONV, and we cannot rule out the possibility that it may have had an effect on PONV incidence. Additionally, as pharmaceutical antiemetics and pain management procedures continually improve, we cannot account for what portion of the reduction in PONV incidence following guideline implementation may have been the result of the availability of improved medications and procedures (ie, epidural catheters and nerve blocks for postoperative analgesia). It remains to be seen if a customized process to increase guideline compliance at our institution could further reduce the incidence of PONV.

CONCLUSION

At our institution, adoption of the 2003 consensus guidelines⁹ reduced the incidence of PONV from 8.36% to 3.01%. Despite the significant reduction, PONV management at our institution leaves room for institution-specific improvements in order to optimize the effect of guideline implementation on patient

clinical outcomes. Based on evidence to suggest that algorithms for PONV management are not universally applicable between different patient populations and institutions,²⁷ we advocate serious consideration of published consensus guidelines and the performance of similar institution-specific studies for the purpose of evaluating guideline efficacy at the institutional level and to determine areas for institution-specific improvement.

Acknowledgement: The authors thank the Marshfield Clinic Research Foundation's Office of Scientific Writing and Publication for assistance in the preparation of this manuscript.

Financial Disclosures: None declared.

Funding/Support: This study was conducted at Marshfield Clinic and St. Joseph's Hospital, Marshfield, Wis. Financial support was provided by Marshfield Clinic Physician Research Funds.

Planners/Reviewers: The planners and reviewers for this journal CME activity have no relevant financial relationships to disclose.

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Quiz: Consensus Guideline Adoption for Managing Postoperative Nausea and Vomiting

EDUCATIONAL OBJECTIVES

1. Understand the risk factors that aggravate postoperative nausea and vomiting.
2. Understand the impact of implementing consensus prevention guidelines for postoperative nausea and vomiting within an institution.
3. Understand the role of a customized, multimodal, pharmacological treatment approach for postoperative nausea and vomiting.

PUBLICATION DATE: October 15, 2012

EXPIRATION DATE: October 15, 2013

QUESTIONS

1. Which of the following risk factors are associated with an increased risk of postoperative nausea and vomiting (PONV):

- A. Obesity
- B. Non-smoker status
- C. Type of surgery
- D. History of PONV or motion sickness
- E. Postoperative opioid use

- All of the above
 B and D only
 C, D and E only
 All except A
 B, C, D only

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2. The authors of this study found the following changes after implementing guidelines for postoperative nausea and vomiting (PONV):
 - A. The incidence of PONV was reduced from about 15% to about 3%.
 - B. Nearly 3 times as many patients received preoperative prophylaxis.
 - C. Significantly more patients received intraoperative prophylaxis.
 - D. Significantly fewer patients received single-dose prophylaxis.

- All of the above
 A, B and D only
 B and C only
 A and D only
 B and D only

3. Which of the following statements are true?

- A. In the absence of pharmacological treatments, the rate of PONV is approximately 30% general population, and can be as high as 70% in patients at high risk.
- B. In this study, the only patients who developed PONV had 3 or more risk factors.
- C. In this study, the use of a multimodal treatment plan appeared to play important role in the reduction of PONV.
- D. The types of surgery that appear to have the lowest overall incidence of PONV include breast and laparoscopic surgeries.

- All of the above
 A and B only
 A, B, and C only
 A and D only
 B and C only

4. In this study, the overall incidence of PONV was reduced following the institution of management consensus guidelines for PONV, and this reduction was associated with an overall increase in preoperative antiemetic prophylaxis, with a concomitant increase in multimodal treatment and a decrease in single modality treatment.

- True
 False

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