

Postoperative Nausea and Vomiting with Plastic Surgery: A Practical Advisory to Etiology, Impact, and Treatment

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Summary: Ambulatory surgery is common in plastic surgery, where many aesthetic and reconstructive procedures can be performed in hospitals, ambulatory surgery centers, or office-based surgery facilities. Outpatient surgery offers advantages to both the patient and the surgeon by increasing accessibility, flexibility, and convenience; lowering cost; and maintaining high-quality care. To optimize a patient's experience and comfort, postoperative nausea and vomiting (PONV) should be prevented. However, in those patients who develop PONV, it must be appropriately managed and treated. The incidence of PONV is variable. It is often difficult to accurately predict those patients who will develop PONV or how they will manifest symptoms. There are a variety of recommended "cocktails" for PONV prophylaxis and treatments that are potentially effective. The decision regarding the type of treatment given is often more related to provider preference and determination of side-effect profile, rather than targeted to specific patient characteristics, because of the absence of large volumes of reliable data to support specific practices over others. Fortunately, there are several tenets for the successful prevention and treatment of PONV we have extracted from the literature and summarize here. The following is a summary for the practicing plastic surgeon of the current state of the literature regarding PONV cause, risk factors, prophylaxis, and treatment that may serve as a guide for further study and practice management. (*Plast. Reconstr. Surg.* 141: 214, 2018.)

According to government statistics, more than 60 percent of surgical procedures performed in the United States annually are performed on an outpatient basis.¹ For many plastic surgery procedures, general inhalational anesthesia and narcotic pain control are required and may predispose patients to postoperative nausea and vomiting (PONV). General anesthesia was introduced in the 1840s, and PONV was immediately found to be a common problem.² There are varying estimates on the incidence of PONV, likely resulting from diversity among patients, surgical procedures, and pharmaceuticals used. Reported

studies on the condition list incidences as high as 56 percent, whereas a meta-analysis found that the overall incidence was 28.3 percent.³

Although there is a tendency to discount the problem of PONV, it remains one of the most significant factors resulting in prolonged postanesthesia care unit stay and hospitalization following ambulatory surgery.⁴⁻⁷ The consequences of nausea and vomiting can be severe and may contribute to complications such as hematoma, incisional dehiscence, respiratory compromise, pain, longer hospital stay, slower recuperation, and patient dissatisfaction.^{2,8-10} The neurochemical mechanisms mediating the physiology of nausea and vomiting are presented in Figure 1.^{2,6,9,11}

Symptoms occurring in the surgery recovery area are commonly referred to as PONV, whereas

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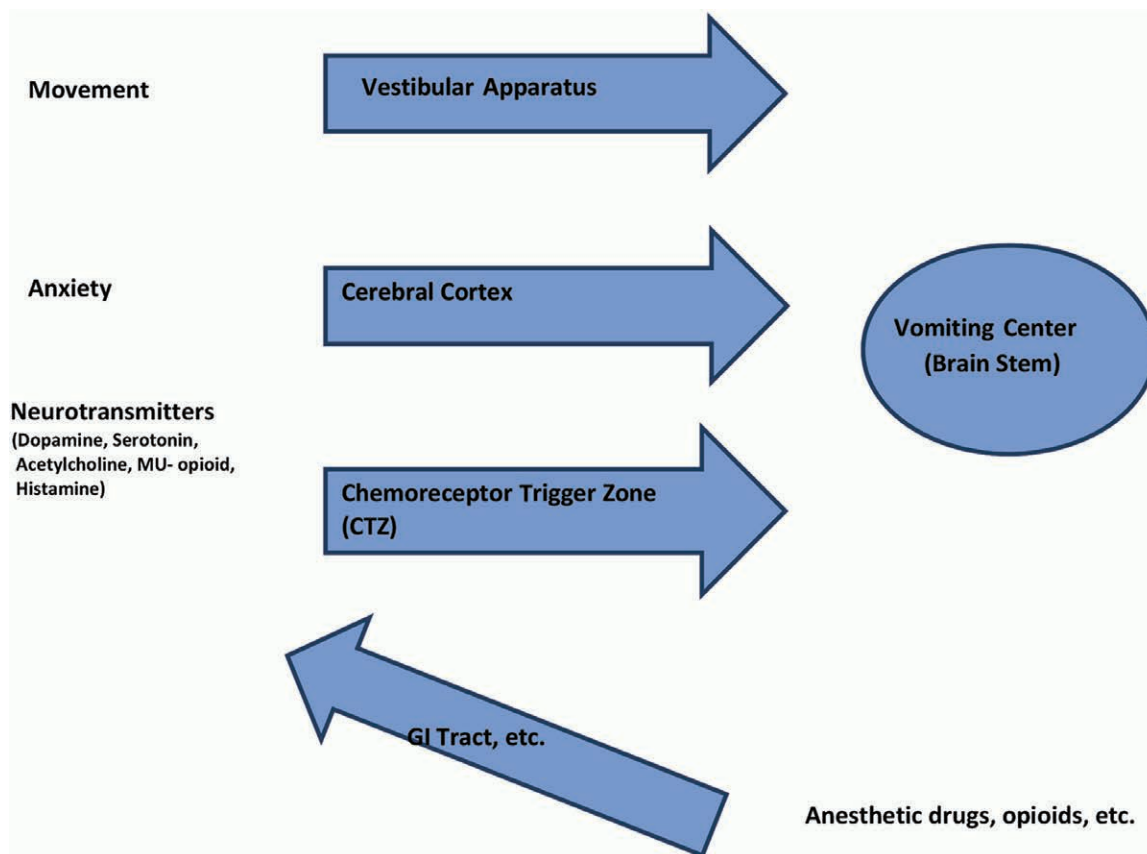


Fig. 1. Diagram indicating a response from the vomiting center. *GI*, gastrointestinal.

symptoms that develop following discharge from the recovery are increasingly referred to as post-discharge nausea and vomiting. The precise definition of these terms, however, has not been established. Postdischarge nausea and vomiting is often included in the definition of PONV. It is convenient to consider these as the same phenomenon defined by their time frame of occurrence, although there is some evidence that there may be differences in the causative mechanisms. Postdischarge nausea and vomiting has not been as well studied as PONV.^{4,11,12} Patients who experience postdischarge nausea and vomiting do not necessarily experience PONV in the recovery area, and the risk factors do not appear to be identical. There is clearly a need for further research into postdischarge nausea and vomiting, and with time, this may develop into a more distinct entity rather than existing under its current guise as refractory PONV.

RISK FACTORS FOR INCIDENCE

Risk factors for PONV fall into four categories: patient-related, anesthesia-related, surgery-related, and other factors.¹³⁻¹⁵ The four patient-related risk factors described by Apfel

Table 1. Risk Factor Predictors

Patient-related predictors
Female sex
Active smokers
History of PONV/motion sickness
Genetics
Age (50 yr or younger)
Obesity (BMI >30 kg/m ²)
Anesthesia-related predictors
Postoperative opioids
Inhalational anesthetics
Nitrous oxide
Surgery-related predictors
Surgery duration
Surgery type
Other factors
High patient anxiety
Postoperative pain

BMI, body mass index.

et al. are commonly used: female sex, history of motion sickness/PONV, nonsmoker, and use of postoperative opioids. Other risk factors are also included in Table 1.^{16,17}

None of the risk factors alone are able to predict PONV, yet they have a strong predictive accuracy. Plastic surgeons should identify those patients at higher risk and discuss the possibility of PONV before any surgical procedure.

Pharmacologic interventions to alleviate the symptoms associated with PONV are summarized in Table 2.^{11,18,19} There are a variety of recommended “cocktails” for prophylaxis and treatments that are potentially effective. The decision regarding the type of treatment given is often more related to provider preference, rather than targeted to specific patient profiles, because of the absence of large volumes of reliable data to support specific practices over others. As further emphasis is placed on this field, risk stratification systems and consensus guidelines are emerging. The reader is encouraged to pursue the rapidly changing literature in this area and use risk-stratification and/or treatment regimen tools as appropriate for individual practice.¹⁸

Surgeon’s Role in Prevention/Prophylaxis

In many practices, anesthesiologists will ultimately choose PONV pharmacologic regimens. Surgeons, however, must actively participate in decreasing PONV and associated complications. Surgeons are often asked to allay patient fears preoperatively and will bear the brunt of dissatisfaction when PONV occurs.

Discussion of PONV must be part of the preoperative consultation. Many plastic surgery patients harbor overly optimistic opinions regarding their postsurgical recovery. Providing specific counseling and education regarding risk factors for PONV and early education regarding modifiable risk factors may be beneficial. Patients with previous PONV successes or failures may benefit from a review of prior anesthetic records, because individuality of response is the rule rather than the exception.²⁰

On the day of surgery, patients should be actively encouraged to be forthcoming about PONV symptoms as they develop to allow early treatment. Communication between the anesthesia and surgical teams will facilitate comprehensive planning for perioperative prophylaxis. Maintaining adequate hydration and minimizing blood loss are important. Risk factors identified by the surgeon may determine special circumstances to be discussed with the anesthesiologist, which might alter routine planning for PONV prophylaxis.²⁰

Minimizing the duration of surgery and protecting the gastrointestinal tract from draining blood are important risk-reduction strategies.^{10,18,19} Performing procedures using only local anesthesia will obviously protect the patient from exposure to emetogenic volatile anesthetics.^{18,19} Even in those cases where general anesthesia or deep sedation is necessary, the use of local anesthetics

to minimize discomfort, either through local injection or the use of longer acting modalities [e.g., liposomal bupivacaine (e.g., Exparel; Pacira Pharmaceuticals, Inc., Parsippany, N.J.)], pain pumps) can result in decreased postoperative narcotic need for pain control and be beneficial in reducing opiate-induced PONV.^{21–25}

Emphasis deserves to be placed on avoidance of situations that may produce nausea and vomiting. Well-recognized trends over time within plastic surgery support movement toward procedures performed solely under local and/or regional anesthesia whenever possible. These situations, which may encompass significant operations not only on the extremities but also the trunk, head, and neck, require no sedation and can obviate the need for the strategies compiled to reduce and treat PONV.

Careful questioning of the patient regarding prior experience with postoperative pain medication can provide information regarding previous side effects. Patients with a history of nausea and vomiting with opioid medications may benefit from use of other classes of analgesic medications, such as nonsteroidal antiinflammatory drugs or acetaminophen. Patients requiring more vigorous pain control, but who are intolerant of oxycodone, may benefit from the use of tapentadol (Nucynta; Depomed, Inc., Newark, Calif.), a benzenoid class of opioid with improved gastrointestinal tolerability.²⁶

Anesthesiologist’s Role in Prevention/Prophylaxis

To control PONV, the surgeon and anesthesiologist must work in concert. Stratification of risk factors (as discussed above) allows for identification of those patients with a greater risk for development of PONV. Many of the interventions may be joint ventures between the anesthesia and surgery teams.

General anesthesia using volatile agents increases the risk of PONV. In patients who have previously experienced PONV or have other risk factors, agents such as nitrous oxide, inhalational agents, etomidate, and ketamine should be avoided.^{6,13} Regional and local anesthesia can offer a lower risk of PONV and might be used as an adjunctive measure to general anesthesia.^{6,19} Total intravenous anesthesia with propofol infusion allows for anesthesia without the emetogenic side effects of inhalational anesthetics. The anesthesia team must keep the patient adequately hydrated to avoid exacerbating the emetogenic effects of inhalational agents.⁶

Table 2. Prophylaxis and Treatment Options

Name	Dose	Timing	Half-Life (hr)	Risks	Notes
H1-R antagonist*					
Dimenhydrinate	1 mg/kg IV	Every 4–6 hr	1–4	Drowsiness, urinary retention, dry mouth, blurred vision, extrapyramidal, vascular necrosis (promethazine)	Generally less effective than 5-HT3 antagonists*
Cyclizine	25–50 mg IV	Every 4–6 hr	20		
Promethazine	6.25–25 mg IV	Anesthesia induction	3–4		
Diphenhydramine	25 mg IV	End of surgery	7–17		
Muscarinic receptor antagonist					
Scopolamine	Transdermal patch 1.5 mg	4 hr or more preoperatively	9	Visual disturbance, dry mouth, dizziness	Avoid touching eyes
Dopamine receptor antagonist					
Propranolol	0.625–1.25 mg IV	End of surgery	8–12	QT prolongation, ventricular arrhythmias (droperidol), sedation	FDA black box warning (droperidol)
Metoclopramide	10 mg IV	End of surgery	10		
Haloperidol	0.5–2 mg IM/IV	End of surgery	14–37		
Prochlorperazine	5–10 mg IM/IV	End of surgery	6–8		
Steroids					
Dexamethasone	4 mg IV	Anesthesia induction	3	Hyperglycemia (questionable)	
5-HT3 antagonist*					
Ondansetron	4 mg IV	End of surgery	3	Headache, prolonged QT (ondansetron)	Granisetron inferior, palonosetron superior for patient-controlled anesthesia use
Granisetron	0.35–1.5 mg IV	End of surgery	4–9		
Tropisetron	2 mg IV	End of surgery	6–7		
Ramosetron	2 mg IV	End of surgery	3–5		
Palonosetron	80 mg PO	1–2 hr preoperatively	40		
NKI-R antagonist*					
Aprepitant	80 mg PO	1–2 hr preoperatively	9–13		

IV, intravenously; FDA, U.S. Food and Drug Administration; IM, intramuscularly; PO, orally.

Personalized risk assessment will stratify patients into varying risk categories. Although there is debate on the ideal prevention algorithm, anesthesiologists generally follow either a “risk-adapted approach” or a “fixed combination” protocol for nausea prophylaxis. The risk-adapted approach evaluates a patient’s individual risk factors and is more selective when choosing multimodal antiemetic therapy, allowing for more appropriate use of resources. Many electronic medical record systems offer patient-specific support for risk stratification (known as “clinical decision support systems”), and provide therapeutic recommendations using the risk-adapted approach. A “fixed combination” approach limits risk stratification and simply allows the anesthesia provider to offer at least two preventative measures to any patient at risk for PONV.¹⁹

Most anesthesiologists treat patients with two or more general risk factors, or a specific history of postoperative nausea, with two different antiemetic therapies. Although treatments vary among institutions, prevention usually requires blockade of the cholinergic, histaminergic, dopaminergic, or serotonergic system. Higher risk patients are treated with two different medications, usually affecting two different systems. A scopolamine transdermal patch (Transderm Scop; Sandoz/Novartis, Princeton, N.J.) may be applied 4 or more hours before surgery and offers anticholinergic effects for up to 72 hours.⁶ Aprepitant (Emend; Merck, Kenilworth, N.J.), an oral neurokinin blocker taken approximately 2 hours before a procedure, has a prolonged effect and has been shown to have excellent antiemetic qualities. However, its price point (approximately \$100 per tablet) has limited its wider use.^{27,28} Ondansetron (Zofran; Novartis, Princeton, N.J.) is a serotonin antagonist that offers postoperative coverage when given just before extubation and is often used as a first-line agent because of widely held acceptance of its minimal complication profile. In addition, low-dose corticosteroids such as dexamethasone (4 to 8 mg) are often given after induction but with caution in patients with impaired glucose control.¹⁹ Although most antiemetics can be readministered after 6 hours, repeated doses of dexamethasone and scopolamine are generally not recommended. A detailed list of prophylaxis and treatment options is given in Table 2.

Intraoperative opioids are associated with an increased risk of PONV.^{6,16} Preoperative discussion with the anesthesia team regarding the likelihood and degree of opioid use is essential. As previously mentioned, nonnarcotic pain control

using nonsteroidal agents such as ketorolac (Toradol; Roche, Basel, Switzerland) and cyclooxygenase-2 inhibitors [e.g., celecoxib (Celebrex; Pfizer, New York, N.Y.)] should be considered. Recent studies with agents such as ketorolac demonstrate significant reductions in postoperative narcotic use, which translates into decreased rates of PONV. Although there has been concern that nonsteroidal use would increase the risk of postoperative bleeding, Stephens et al. revealed no increased risk of hematoma formation in patients who received ketorolac.²⁹ Acetaminophen has been shown to reduce postoperative narcotic use and thus theoretically decreases the risk of PONV. Patient-specific risk factors, such as liver disease, must be considered when choosing an agent and its specific dose.

Intraoperative placement of long-acting local anesthesia has been shown to decrease use of narcotics postoperatively. Injectable liposomal bupivacaine can be diluted with up to 280 cc of normal saline, allowing the surgeon significant volume for injection and nerve blockade in even the largest of operations. Although liposomal bupivacaine is currently only U.S. Food and Drug Administration–approved for hemorrhoidectomy and bunionectomy, several studies have supported its off-label use in breast reconstruction and body contouring procedures with pain control for 24 hours and beyond.^{21–24} Local anesthetic-containing “pain pumps” using small catheters to slowly diffuse the local anesthetic into a wound site offer another method of controlling pain for up to 2 days without narcotics. A less expensive alternative that offers a benefit in the early postoperative period is injectable bupivacaine hydrochloride. Although the onset of action is rapid, its half-life is only 2.7 hours in adults; thus, longer term pain control is still an issue.²⁵

Refractory PONV/Postdischarge Nausea and Vomiting and Treatment after Prophylaxis

When nausea or vomiting persists, further evaluation of the patient for causative agents is required. Morphine is notorious for exacerbating nausea. Furthermore, mechanical obstruction of the gastrointestinal tract, or the drainage of blood into the gastrointestinal tract after head and neck surgery, can result in discomfort and nausea.

If antiemetic prophylaxis was not previously used, a serotonin antagonist, such as ondansetron, can be the first treatment choice. If a serotonin antagonist is not effective, it should not be repeated, as studies have shown no additional benefit.⁹ Instead, drugs from other antiemetic classes

should be considered. Although droperidol (Inapsine; Taylor Pharmaceuticals, Decatur, Ill.) and promethazine (Phenergan; Aventis, Surrey, United Kingdom) are often chosen as second-line agents, side effects of QT prolongation and sedation must be closely monitored. If nausea and vomiting persist, repeated doses of serotonin antagonists every 6 hours should be considered, along with alternating doses of a second-line agent such as droperidol.⁶ Repeated dosages of corticosteroids have shown no benefit and offer no rescue relief.^{6,8,9}

The incidence of nausea and vomiting following discharge (postdischarge nausea and vomiting) is reported to be between 33 and 60 percent. Reported incidences of postdischarge nausea range from 0 to 60 percent, whereas postdischarge vomiting incidences range from 0 to 20 percent. Symptoms tend to decrease with each successive postoperative day but can last as long as 1 week after surgery.^{8,12,13,30,31} The true incidence is probably closer to the higher number because of underreporting.^{13,32}

In addition, postdischarge nausea and vomiting leads to significant impairment in quality of life, return to normal function, and return to work following ambulatory surgery. Postdischarge nausea is probably more significant than postdischarge vomiting in this effect. The economic impact can be significant but is not yet fully understood, as there are few data on the increased cost of care for this condition.^{8,11,12,30,32} Specific literature to support treatment recommendations for postdischarge nausea and vomiting (as compared to PONV or nausea caused by other conditions) does not exist.

Nonpharmacologic PONV Reduction/Treatment

Evidence suggests that nonpharmacologic interventions to treat and prevent PONV may be effective, economical, and feasible to implement in practice. These include acupuncture, acupressure, acupoint stimulation, and transcutaneous electrical nerve stimulation. These modalities may facilitate reduction in proemetic narcotic use for pain control and have a direct impact on PONV symptoms. Acupuncture, applying needles on specific skin points, potentially stimulates the release of endorphins to relieve pain. Acupressure applies therapeutic pressure to certain body points. Acupoint stimulation involves a combination of acupuncture, cupping therapy (application of external negative pressure to a body point to promote blood flow), and electrical stimulation to ease pain. Transcutaneous electrical nerve stimulation uses low-voltage electrical current for pain relief.^{21,33,34}

Shortcomings limiting the wider use of nonpharmacologic interventions include the variability in how different modalities are provided, and the lack of randomized controlled trials, compared with those involving drug administration.^{11,34} However, the evidence for use of some nonpharmacologic modalities cannot be ignored. One randomized controlled trial showed a statistically significant reduction in PONV when two acupuncture points were used instead of one point (70 percent versus 86 percent).²¹ Another double-blind, randomized, controlled trial demonstrated that acupoint stimulation offered added protection against PONV in an outpatient aesthetic surgery population compared with standard treatment.³³ A meta-analysis of 19 randomized controlled trials concluded that nonpharmacologic techniques were equivalent to commonly used antiemetic drugs in preventing PONV. Although these modalities were more effective than placebo in preventing PONV within 6 hours of surgery in adults, there was no observed benefit in children.³⁴ Therefore, surgeons should be aware of these nontraditional options and consider incorporating them into practice.

Some patients may ask about the use of marijuana for PONV. Cannabinoids such as tetrahydrocannabinol, the active ingredient in marijuana, and dronabinol have been shown to be moderately effective in the treatment of chemotherapy-induced nausea and vomiting.³⁵ Evidence-based studies have not demonstrated these drugs to be effective in the postoperative patient. Although many states have legalized medical marijuana, and a few states have legalized recreational marijuana, federal law still prohibits its use. A federal court ruled that it is not illegal for a physician to discuss the use of marijuana with a patient. However, plastic surgeons should verse themselves in their particular state's regulations before making any recommendations to a patient, as this may be a rapidly changing landscape.

CONCLUSIONS AND FUTURE DIRECTIONS

It is clear that postoperative/postdischarge nausea and vomiting presents an extensive problem. Although most of the literature is generalized, the field of plastic surgery demonstrates an increasing focus on scientific investigation in this area.^{20,36,37} It is to be emphasized that plastic surgery-specific studies demonstrate very high prevalence of this disease.^{36,37} Most plastic surgeons would agree that a complication estimated

Table 3. Tabular Summary of Summary Recommendations

Prevention
Education
Patients
Care team
Surgeon
Risk factor minimization
Preoperative
Intraoperative
Postoperative
Treatment
PONV
Pharmaceutical choice
Treatment timing
PDNV
Pharmaceutical choice
Treatment timing
Assess for other causes

PONV, postoperative nausea and vomiting; PDNV, postdischarge nausea and vomiting.

in some studies to affect one-third of patients and to have such severe consequences as decreased satisfaction, delay in discharge, and hematoma must be scrutinized for opportunities for further improvement.^{36–38}

There is great occasion for collaboration between specialties. Currently, it appears that plastic surgery patients benefit from the same recommendations as other surgical populations.^{36,37} This is advantageous, as the complexity of treatment options makes replication of similar interventions in a variety of different surgical populations cumbersome. Apfel et al. highlight this principle in their investigation into the relative benefits of six potential prophylactic regimens as applied to populations of varying risk profiles.³⁸ Further areas of multidisciplinary engagement that are bearing fruitful observations include enhanced recovery after surgery protocols, many of which focus some interventions on postoperative/postdischarge nausea and vomiting.^{39,40} It is expected that further evidence in this still somewhat nascent area will be shortly forthcoming.

SUMMARY RECOMMENDATIONS

1. Be aware of and actively educate patients on postoperative/postdischarge nausea and vomiting and potential consequences preoperatively (Table 3).
2. Decrease risk factors when possible¹⁸:
 - a. Anesthesia: Minimize the use of volatile anesthetic agents in higher risk patients and substitute propofol for induction and maintenance, avoid nitrous oxide and neostigmine, minimize intraoperative opioids, and provide adequate hydration.¹⁸
 - b. Surgery: Use local anesthetic modalities when possible (both short- and long-term), minimize surgical duration,^{10,18,19} protect gastrointestinal tract from blood (head and neck cases) with throat packs or suction.¹⁰
 - c. Postoperative: Use local anesthetics, nonsteroidal antiinflammatory drugs, acetaminophen (oral or intravenous), cyclooxygenase-2 inhibitors, or tapentadol as alternatives or adjuncts to narcotic medications for pain control.^{18,19}
 - d. Optimize hydration and minimize orthostatic hypotension.¹⁰
3. Use a risk-prediction tool to guide prophylactic interventions.^{18,19}
4. Use postoperative/postdischarge nausea and vomiting prophylaxis based on relative cost-to-benefit analyses.
 - a. Consider more liberal prophylaxis when there is increased risk (wired jaws, increased intracranial pressure, gastric/esophageal surgery) or a “strong preference to avoid PONV” exists.¹⁸
 - b. Consider one to two interventions for moderate-risk adults and two or more interventions for moderate-risk children. Use two or more interventions for all high-risk patients.^{18,19}
 - c. When choosing multimodal therapy, choose agents with different mechanisms of action.¹⁸ Consider time to onset of action when using multimodal therapy and choose agents with appropriate risk profiles.¹⁹
5. Treat occurrences of PONV aggressively.¹⁸
 - a. If prophylaxis was used, choose treatment from another pharmacologic class.
 - b. Without previous prophylaxis, first consider a serotonin antagonist.
 - c. Do not repeat drugs used until 6 hours has elapsed after completion of surgery.
 - d. Do not repeat use of dexamethasone or transdermal scopolamine.
 - e. If refractory symptoms persist: evaluate for other factors such as narcotic use, draining blood into gastrointestinal tract, or gastrointestinal obstruction/ileus.
6. Postoperative/postdischarge nausea and vomiting can occur despite optimal prophylaxis and treatment. Communication between patient, anesthesiology team, surgical team, and perioperative nursing staff is essential.²⁰

7. Consider individual in-depth study of any of the published reviews or guidelines that detail potential optimal specific drugs and drug combinations in particular clinical situations beyond the scope of this article. Periodic review will be necessary, as the body of evidence will likely increase and allow refinement of current techniques.

MORE INFORMATION

Most anesthesiologists and anesthesiologists are well acquainted with risk assessment and treatment of postoperative/postdischarge nausea and vomiting. Coordinating patient care requires team leadership skills and open communication with all members of the health care team. Encouraging feedback and open discussion will facilitate the flow of information and foster active engagement of other team members in care of the patient. More information can be found at the American Society of Anesthesiologists website:

<https://asahq.org>

<https://asahq.org/search.aspx?q=PONV>

<http://www.asahq.org/resources/publications/newsletter-articles/2002/april2002/therapy-of-ponv-an-overview>

Other sources include the following:

<http://www.ncbi.nlm.nih.gov/pubmed/24356162>

<http://www.medscape.com/viewarticle/782388>

http://ether.stanford.edu/policies/PONV_prophylaxis_guidelines.html

COMMITTEE STATEMENT

The American Society of Plastic Surgeons Patient Safety Subcommittee has developed a consensus-based patient safety advisory, entitled "Postoperative Nausea and Vomiting with Plastic Surgery: A Practical Advisory to Etiology, Impact, and Treatment." It is directed toward plastic surgeons that discharge their patients on the same day of surgery, regardless of the facility setting; it is also applicable to inpatient care.

DISCLAIMER

This advisory is based on the most relevant information available and reflects the collective opinion of the American Society of Plastic Surgeons Patient Safety Subcommittee. It is not an exhaustive list of postoperative nausea and vomiting prevention and treatment options. This document is meant as an overview, with additional resources included for more information.

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