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REVIEW ARTICLE

An update on the management of postoperative nausea and vomiting

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Abstract Postoperative nausea and vomiting (PONV) and postdischarge nausea and vomiting (PDNV) remain common and distressing complications following surgery. PONV and PDNV can delay discharge and recovery and increase medical costs. The high incidence of PONV has persisted in part because of the tremendous growth in ambulatory surgery and the increased emphasis on earlier mobilization and discharge after both minor and major operations. Pharmacological management of PONV should be tailored to the patients' risk level using the PONV and PDNV scoring systems to minimize the potential for these adverse side effects in the postoperative period. A combination of prophylactic antiemetic drugs should be administered to patients with moderate-to-high risk of developing PONV in order to facilitate the recovery process. Optimal management of perioperative pain using opioid-sparing multimodal analgesic techniques and preventing PONV using prophylactic antiemetics are key elements for achieving an enhanced recovery after surgery. Strategies that include reductions of the baseline risk (e.g., adequate hydration, use of opioid-sparing analgesic techniques) as well as a multimodal antiemetic regimen will improve the likelihood of preventing both PONV and PDNV.

Keywords Postoperative nausea and vomiting · Postdischarge nausea and vomiting · Multimodal antiemetic therapy · Antiemetic drugs · Non-pharmacologic antiemetic therapies

Introduction

Postoperative nausea and vomiting (PONV) is a common and distressing complication following surgery and anesthesia and may result in dehydration, electrolyte imbalance, wound dehiscence, pulmonary aspiration and delayed hospital discharge [1–4]. Despite widespread use of prophylactic antiemetic agents, short-acting anesthetics, and minimally invasive surgical techniques, PONV still affects about 20–40% of surgical patients, with certain high-risk patients experiencing rates of up to 80% [5, 6]. The high incidence of PONV has persisted in part because of the tremendous growth in ambulatory surgery and the increased emphasis on earlier mobilization and discharge after both minor and major operations [7]. Despite the extensive literature describing strategies for the prevention of PONV, the optimal prophylactic antiemetic regimen has not been established [5, 6]. This review article is focused on the prevention and treatment of PONV using multimodal antiemetic prophylaxis. Both pharmacological and non-pharmacological treatment strategies for preventing (and treating) PONV will be discussed.

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Physiology of PONV

PONV is a complex physiologic phenomenon involving multiple neurophysiologic pathways and both central and peripheral receptor mechanisms [8]. Primary control of nausea and vomiting arises from the vomiting center, located in the medulla. There are at least five major receptor systems involved in PONV: the chemoreceptor triggering zone, the vagal mucosal pathway in the gastrointestinal system, reflex afferent pathways from the cerebral cortex, neuronal pathways from the vestibular system, and midbrain afferents. Stimulation of one of these afferent pathways can activate the vomiting center via cholinergic (muscarinic), dopaminergic, histaminergic, or serotonergic receptors.

Antiemetic drug classes

A wide variety of antiemetic drugs are available for the treatment and prevention of PONV, including the 5-hydroxytryptamine (5-HT_3) receptor antagonists (e.g., ondansetron, dolasetron, granisetron, tropisetron, ramosetron, and palonosetron), neurokinin-1 (NK-1) receptor antagonists (e.g., aprepitant, fosaprepitant, casopitant, and rolapitant), corticosteroids (e.g., dexamethasone and methylprednisolone), butyrophenones (e.g., droperidol and haloperidol), metoclopramide, phenothiazine, prochlorperazine, antihistamines (e.g., dimenhydrinate and meclizine), and anticholinergics (transdermal scopolamine). Prophylactic doses and timing for the administration of antiemetics are summarized in Table 1. Apfel et al. reveal that droperidol, dexamethasone, and ondansetron, the most widely used drugs for the prevention and treatment of PONV, possess similar antiemetic efficacy when administered for antiemetic prophylaxis [9].

5-HT_3 receptor antagonists

5-HT_3 receptor antagonists are recommended as the first-line regimen for PONV prophylaxis. Ondansetron is effective for both the prevention and treatment of PONV without producing significant side effects [10]. Granisetron, a more selective 5-HT_3 antagonist, has been alleged to produce a sustained antiemetic effect when used for prophylaxis [10]. White et al. demonstrated that granisetron (1 mg orally) and ondansetron (4 mg IV) were equally effective for reducing the incidence of PONV in patients undergoing either minor or major laparoscopic procedures [10]. Ramosetron has higher affinity to the 5-HT_3 receptor and longer duration of action, and has a similar or greater prophylactic effect on PONV compared with older 5-HT_3 receptor antagonists (e.g., granisetron and ondansetron) [11, 12]. Palonosetron is a second-generation 5-HT_3 receptor antagonist with proposed higher efficacy and sustained action for prophylaxis of PONV [13]. For the timing of 5-HT_3 antagonist administration, the efficacy of preventive PONV is better when they are administered immediately prior to the end of surgery. Tang et al. found that ondansetron 4 mg IV administered before the end of surgery (vs after induction of anesthesia) was the most efficacious in preventing PONV, facilitating both early and late recovery, and improving patient satisfaction (90 vs 67%) after outpatient laparoscopy [14].

Table 1 Prophylactic doses and timing for the administration of antiemetic drugs

Drug group	Drugs	Dose	Timing	Adverse effect
Serotonin (5-HT_3 receptors) antagonists	Ondansetron	4–8 mg IV	End of surgery	Headaches, constipation, raised liver enzymes
	Granisetron	1 mg IV		
	Tropisetron	2 mg IV		
Corticosteroids	Dexamethasone	4–10 mg IV	After induction of anesthesia	Increased blood glucose level, hypo/hypertension, diabetes mellitus
Butyrophenone	Droperidol	0.625–1.25 mg IV	After induction of anesthesia	Psychomimetic, extrapyramidal disturbance, sedation, dizziness, Parkinson's disease, increased QT interval
Neurokinin antagonists (NK-1 receptors)	Aprepitant	40 mg orally	1–2 h prior to induction	Headaches, constipation, fatigue
Anticholinergics	Scopolamine	Transdermal patch	Evening prior to surgery or in preoperative period	Dizziness, dry mouth, visual disturbances
Dopamine antagonists	Metoclopramid	10–25 mg IV	15–30 min prior to end of surgery	Sedation, hypotension (fast injection)

Glucocorticoid steroids

Dexamethasone, a corticosteroid, has been shown to be effective when administered at a dose of 4–12 mg intravenous (IV) [15, 16]. A combination of dexamethasone and 5-HT_3 receptor antagonists was effective treatment of preventing both early and late nausea/emesis [16]. Combined therapy of 0.15 mg/kg dexamethasone before induction and intraoperative fluid 'superhydration' is more effective in reducing PONV than monotherapy with either dexamethasone, or superhydration alone for pediatric strabismus surgery [17]. Although dexamethasone has been found to be as effective as both ondansetron and droperidol for antiemetic prophylaxis, concerns remain regarding its 'potential' complications (e.g., delayed wound healing, hyperglycemia, risk of infections) in selected 'at risk' patient populations (e.g., diabetics) [9].

NK-1 receptor antagonists

NK-1 receptor antagonists with a long elimination half-life value were effective for the prophylaxis and treatment of PONV [18]. The NK-1 receptor antagonist aprepitant appears to be more effective in decreasing the incidence of PONV as compared with ondansetron [19, 20]. The combination of aprepitant and ondansetron prolonged the time to administration of rescue antiemetics compared with either drug alone and was associated with a low incidence of emesis (2%) [21, 22]. It is recommended that aprepitant is used to treat patients at risk for PONV and for whom PONV could lead to serious adverse outcomes, and where concerns exist regarding side effects with less costly antiemetic drugs.

Butyrophenone

Droperidol remains the most cost-effective antiemetic therapy despite concerns about extrapyramidal side effects and the potential for prolonging the electrocardiographic QT interval when excessively large doses of the drug are administered [23]. In several well-controlled, randomized, comparative clinical trials, droperidol has been demonstrated to be as safe and effective as the more costly 5-HT_3 and NK-1 antagonists [24, 25]. The degree of QT-interval prolongation associated with antiemetic doses of the drug appears to be of little, if any, clinical significance [26]. A combination of droperidol and a 5-HT_3 receptor antagonist actually decreased the risk of QT prolongation [27].

Dopamine antagonists/gastrokinetic drugs

Metoclopramide is probably the most commonly used antiemetic for 'treatment of PONV', in particular when the 5-HT_3 compounds and/or droperidol prophylaxis has failed. High doses of metoclopramide (e.g., 0.5–1 mg/kg) used for prophylaxis by oncologists are associated with extrapyramidal side effects, but the small doses (5–10 mg) used in the perioperative period rarely cause any adverse effects. A systematic review reveals that the administration of metoclopramide in a dose of 10 mg is effective and safe for prophylaxis against early PONV in patients undergoing cesarean delivery under neuraxial anesthesia [28].

Anticholinergics

Scopolamine, a centrally active anticholinergic drug, is as effective as droperidol (1.25 mg) or ondansetron (4 mg) in preventing nausea and vomiting in the early and late postoperative periods. However, concerns have been raised regarding its use for routine antiemetic prophylaxis because of its alleged slow onset of action and side effect profile (e.g., drowsiness, visual disturbances, dry mouth) [29]. Scopolamine is an acceptable and cost-effective alternative to ondansetron as part of a multidrug prophylaxis regimen in patients with motion-induced emesis as well as high-risk patients undergoing major surgery [29].

Miscellaneous drugs

Dexmedetomidine, with sedative, analgesic and sympatholytic properties, is a potent and highly selective α_2-adrenoceptor agonist. A meta-analysis demonstrated that intraoperative administration of dexmedetomidine reduced the incidence of PONV by decreasing consumption of intraoperative opioids [30]. The recent meta-analysis by Grant et al. concluded that preoperative pregabalin was associated with a significant reduction in PONV [31]. However, White et al. found that preoperative pregabalin failed to significantly decrease either PONV or postoperative pain [32]. The adminstration of dimenhydrinate is limited due to its significant adverse events (e.g., dizziness, sedation, and dry mouth, throat, and nose). The apparent antiemetic effect of these miscellaneous drugs is likely due to limiting the effects of other drugs that contribute to producing postoperative emesis (e.g., opioid analgesics).

Risk factors for PONV

The pathogenesis of PONV remains unclear. Identification of risk factors for PONV enables targeting antiemetic prophylaxis to those patients who will benefit the most from the use of these medications [33]. Patient, anesthetic and surgical factors all contribute to the incidence of emetic symptoms in the postoperative period (Table 2) [34, 35]. Patient-specific factors include female gender, nonsmoking, history of PONV or motion sickness, and age < 50 years [34]. Anesthesia-related risk factors include the use of opioids, volatile agents, nitrous oxide (which increases the risk for postoperative vomiting), and high doses of neostigmine for reversal of neuromuscular blockade [36–39]. Extensive use of opioids is associated with a variety of perioperative side effects including PONV, which can contribute to a delayed hospital discharge and resumption of normal activities of daily living for surgical patients [40, 41]. A study found that nonsmoking female patients who developed a fentanyl-induced cough during induction of anesthesia have a higher incidence of PONV [42]. A retrospective observational study revealed a dose-dependent association between dose of intraoperative remifentanil administration and increase in the risk of PONV [43]. Strategies to minimize the use of opioids should be considered for all moderate and high-risk patients. Surgical related factors include duration of surgery, with each 30-min increase in duration increasing the risk of PONV by 60% [44]. Type of surgery as an independent risk factor for PONV remains controversial. Certain types of surgery with a frequent incidence of PONV (e.g., abdominal surgeries), may be due to the long exposure to general anesthesia and higher doses of opioids [37].

Scoring systems for PONV and postdischarge nausea and vomiting (PDNV) assessment

Since adverse effects of antiemetics can range from mild headache to more serious QTc prolongation, it is important to determine the patient's risk for development of PONV and PDNV [45, 46]. To avoid putting patients at unnecessary risk for rare but well-described side effects of antiemetics, it is important to objectively assess a patient's baseline risk for PONV and PDNV using a validated risk analysis scoring system. Apfel et al. produced a simplified risk score based on 4 predictors: female gender, history of PONV and/or motion sickness, nonsmoking status, and use of postoperative opioids, which increased risk of PONV by 10, 21, 39, 69, and 79% with 0, 1, 2, 3, and 4 risk factors, respectively [47]. Compared to predicting a patient's risk for PONV based on a history of PONV or the type of surgery alone, the use of this simplified risk scoring system has been found to be more sensitive and specific [47–50]. White et al. investigated the relationship between patient risk factors and early versus late postoperative emetic symptoms and found that despite the frequent use of multiple antiemetic drugs for prophylaxis, the Apfel risk score of three or four (vs 2) was associated with a higher incidence of emetic sequelae in the first 24 h after surgery. However, the occurrence of late (24–72 h) emetic symptoms was low and appeared to be unrelated to the patient's Apfel risk score [34]. The management of PONV should be risk-tailored, prophylactic treatment based on risk estimates from a prediction model, to prevent unnecessary costs and possible side effects, in contrast to administering multiple drugs to all patients [51].

The issue of PDNV remains a concern for practitioners for the growing outpatient population undergoing

Table 2 Patient-, anesthesia-, and surgery-related risk factors for PONV

Category	Risk factors
Patient related	Female gender History of PONV Motion sickness Nonsmoking status Age <50 years
Anesthesia related	Prolonged duration of anesthesia Intraoperative and postoperative opioid analgesics Volatile agents Nitrous oxide (>50%) Increased doses of neostigmine (>3 mg)
Surgery related	Prolonged surgery procedures Type of surgery (e.g., neurosurgery, intra-abdominal surgery, cholecystectomy, laparoscopic surgery, gynecological surgery)

ambulatory and office-based surgical procedures [52, 53]. A multi-center study of 2170 adults undergoing ambulatory surgery with general anesthesia reported that 37% of patients experienced PDNV [18]. Such patients may not have ready access to 'rescue' antiemetic drug therapies after their discharge home and simple non-pharmacologic antiemetic devices may represent a cost-effective alternative [52, 53]. Apfel et al. determined that female gender, age < 50 years, history of PONV, opioids administered in the post-anesthesia care unit (PACU), and nausea in the PACU were strong predictors for PDNV [54]. Odom-Forren et al. found that pain seems to be a factor in late PDNV [55]. The main difference between risk factors for PONV and PDNV was that patients who experienced nausea in the PACU had a threefold increased risk for PDNV [55]. Interestingly, nonsmoking status was not an independent predictor for PDNV. When 0, 1, 2, 3, 4, and 5 risk factors are present, the corresponding risk for PDNV is approximately 10, 20, 30, 50, 60, and 80%, respectively [54]. This simplified risk score helps clinicians to identify patients who would benefit from long-acting prophylactic antiemetics and/or disposable non-pharmacological antiemetic devices before patients are discharged from the hospital.

Multimodal antiemetic prophylaxis for the prevention of PONV and PDNV

The multifactorial etiology of PONV necessitates increased interest in using a combination of therapies or a multimodal approach that includes 2 or more interventions [56]. There is no evidence to date that a specific antiemetic is especially effective for a particular patient profile or a particular operation. Therefore, combination antiemetic therapy using drugs that act at different neuroreceptor sites has been recommended for the at-risk patient [57]. Previous clinical studies have demonstrated that the use of a combination of prophylactic antiemetic drugs can reduce the incidence of PONV and PDNV while improving patient satisfaction with their quality of recovery, and may facilitate the recovery process compared with the use of a single antiemetic drug modality alone [1, 58]. Patients at moderate or high risk for PONV should receive combination therapy with antiemetics acting at different receptor sites [56]. By using a multimodal approach, it has been possible to achieve a dramatic reduction in the incidence of PONV (to less than 10%) and an improvement in patient satisfaction [59].

When a combination of antiemetics with different mechanisms of action is administered, the efficacy is optimized and the side effects are decreased [26]. A meta-analysis suggested that combining dexamethasone with a 5-HT_3 receptor antagonist provided greater antiemetic efficacy, and this combination therapy was recommended as the 'optimal' choice for prophylaxis against PONV [60]. However, in a study involving an outpatient surgery population at varying risks of PONV, the addition of ondansetron failed to improve upon the antiemetic efficacy of a combination of low-dose droperidol and dexamethasone [57]. The combination of dexamethasone with either granisetron, or haloperidol was also more effective than single drug therapy [61, 62]. When the various therapeutic combinations are compared, no differences are found between 5-HT_3 receptor antagonist plus dexamethasone, 5-HT_3 receptor antagonist plus droperidol, and droperidol plus dexamethasone [63]. However, combinations involving metoclopramide are not found to reduce PONV to a greater extent than monotherapy [64]. As most patients undergoing surgery have one or two risk factors and 20–40% of these patients are predicted to suffer from PONV, combination antiemetic therapies will likely assume an increasingly important role in the prevention of PONV.

The impact of PDNV requires that the prophylactic treatment of this complication would ideally extend well beyond the time of discharge from the hospital [52, 53]. New research centered on different antiemetics, administered at various time points, has been done to evaluate the effects on reducing PDNV. A study demonstrated that patients who received the combination of 4 mg IV ondansetron and ondansetron oral disintegrating tablet 8 mg immediately before discharge had less severe nausea and fewer vomiting episodes compared to 4 mg ondansetron IV alone (3 vs 23%) [65]. In a multicenter study, intraoperative dexamethasone did not appear to reduce PONV in the PACU, but significantly reduced PDNV [54]. Patients at moderate or high risk are best treated with a combination strategy. The increasing use of disposable non-pharmacologic antiemetic devices (e.g., Relief Band, Pressure Right) should be considered in patients at risk for PDNV. In addition, the patient should be given instructions for appropriate 'rescue' treatment before they are discharged home.

Optimal antiemetic dosing with combination 'multimodal' therapy remains controversial. For dexamethasone, droperidol and ondansetron, it has been suggested that when used as combination therapy, ondansetron doses in adults should not exceed 4 mg, dexamethasone doses should not exceed 8 mg IV, and droperidol doses should not exceed 1.25 mg IV [66]. Another study confirmed that low-dose granisetron, 0.1 mg plus dexamethasone 8 mg is as effective as the combination of dexamethasone 8 mg and ondansetron 4 mg [67]. Prophylactic use of antiemetics has been shown to minimize emetic symptoms, and improve patient satisfaction and speed of recovery compared with the treatment of symptoms when they occur in the postoperative period [34]. Therefore, antiemetic drugs are now commonly administered both at the start and end of surgery to patients considered to be at increased risk of developing

PONV [68]. However, the optimal combinations and doses of antiemetic drugs are yet to be determined.

Multimodal strategies for treating established PONV

When PONV occurs in patients who did not receive prophylaxis or failed prophylaxis, prompt antiemetic treatment is indicated. If PONV occurs despite prophylaxis, particularly in the immediate postoperative phase (within 6 h postoperatively), an antiemetic from a pharmacologic class that is different from the prophylactic drug initially given should be administered. However, if the PONV occurs more than 6 h postoperatively, repeat dosing of the initial prophylactic drug may be considered. If no prophylaxis was given, the recommended treatment is a low-dose 5-HT_3 antagonist (e.g., ondansetron 1–2 mg IV). Alternative treatments for active PONV include metoclopramide (10 mg), droperidol (0.625 mg), dexamethasone (2 mg), promethazine (6.25–12.5 mg), dolasetron (12.5 mg), granisetron (0.1 mg), or tropisetron (0.5 mg) [69, 70]. Yazbeck-Karam et al. investigated haloperidol versus ondansetron for treatment of established nausea and vomiting following general anesthesia and found that haloperidol (1 mg) is noninferior to ondansetron (4 mg) in the early treatment of established PONV, but is associated with sedation [71]. Dexamethasone and scopolamine should not be used as monotherapy for rescue, but only in combination with a faster-acting drug. Since there is no evidence of dose-responsiveness for these antiemetics when used for rescue, smaller doses have been recommended for the treatment PONV. Possible contributing factors, such as opioids, hypovolemia (inadequate intraoperative hydration), presence of blood in the pharynx, or bowel obstruction, should be excluded before rescue therapy is initiated.

For existing PONV treatment, a multimodal strategy should also be considered, since, despite treatment, the recurrence rate of PONV over the subsequent 24 h is 35–50% [72]. A combination of ondansetron plus dexamethasone, dolasetron or haloperidol have been found to be superior to monotherapy alone [73]. Those interventions that have proven to be effective for prophylaxis of PONV have also been shown to be effective for PONV treatment.

Recommendations for reducing the risk for PONV and PDNV

The management strategy for each individual patient should be based on level of risk for PONV, patient's preexisting condition, patient preference, and cost-efficiency. In addition to using a combination of antiemetics with different mechanisms of action, the multifactorial etiology of PONV might be better addressed by the adoption of a multimodal approach to reduce the baseline risk for PONV in high-risk patients (Table 3). Several effective strategies are recommended for reducing the baseline risk for PONV: (1) local and regional anesthesia (e.g., local infiltration and/or peripheral nerve blocks); (2) propofol induction and maintenance; (3) minimization of perioperative opioids; (4) minimize use of volatile anesthetics; (5) avoidance of nitrous oxide and reversal drugs; and (6) insure adequate intraoperative hydration [37, 74]. If general anesthesia was required, substituting propofol for volatile anesthetics reduced the risk of PONV. A study demonstrated a combination of propofol and air/oxygen had additive effects, reducing early PONV risk by approximately 25% [9]. The non-opioid analgesic drugs (e.g., nonsteroidal anti-inflammatory drugs [NSAIDs], cyclooxygenase-2 inhibitor [COX-2], acetaminophen) will likely assume an increasingly important role as preventative PONV for facilitating the recovery process and improving overall patient satisfaction [75–80]. For example, a multimodal regimen involving non-opioid analgesics and antiemetics was reported to be more effective than a one- or two-component regimen in reducing pain and PONV after breast cancer surgery [78]. Adequate IV fluid hydration is also an effective strategy for decreasing the baseline risk for PONV [37]. Nitrous oxide had little impact when used less than 1 h as part of the fresh gas [81, 82]. Thus, nitrous oxide may be an option for the shorter ambulatory procedures. Although previous studies suggest the clinical importance of neostigmine's effects on PONV, a study revealed that minimization of neostigmine dosage failed to reduce the baseline risk [83]. Sugammadex, a drug that rapidly reverses neuromuscular blockade produced by steroid-based muscle relaxant drugs, could be a useful alternative to neostigmine, edrophonium or pyridostigmine in combination with an anticholinergic for 'at risk' patients receiving non-depolarizing muscle relaxants during surgery [84].

Pharmacological management of PONV and PDNV should be tailored to the patients' risk level using the PONV and PDNV scoring systems to minimize the potential adverse side effects and drug–drug interactions in the postoperative period (Table 3). PONV prophylaxis is rarely warranted in low-risk patients. However, moderate-risk patients benefit from single or often multiple antiemetic interventions. 'Multimodal' therapy (e.g., triple antiemetic prophylaxis) should be routinely used for all high-risk patients [37].

Table 3 Recommendations in relation to various risk factors of postoperative nausea and vomiting (PONV) following surgical procedures

Mild risk (none or 1 risk factor)	Moderate risk (2 risk factors)	High risk (≥3 risk factors)
No prophylaxis required or monotherapy with a cost-effective antiemetic drug if there is a risk of medical sequelae from PONV	Consider antiemetic prophylaxis with a combination of antiemetic therapies If general anesthesia is required, reduce baseline risk factors by minimizing the use of volatile anesthetics, opioid analgesics, nitrous oxide, and high doses of reversal drugs Utilize local anesthetic infiltration and regional anesthesia with peripheral nerve blocks Non-pharmacologic alternatives (e.g., acupressure or electrical acupoint stimulation) may be used as an alternative or adjuvant therapy	Initiate combination therapy with 2 or 3 prophylactic agents acting at different receptor sites The baseline risks should be reduced by employing multimodal opioid-sparing analgesic techniques whenever possible—minimize the perioperative use of opioid analgesics. In addition, minimizing the use of volatile anesthetics, nitrous oxide, and high doses of reversal drugs (e.g., neostigmine, flumazenil, naloxone) Utilize local anesthetic infiltration and regional anesthesia with peripheral nerve blocks
Treatment options If prophylaxis fails or was not received: use antiemetic from different class than prophylactic agent. Re-administer only if > 6 h after post-anesthesia care unit; do not re-administer dexamethasone or scopolamine		

Non-pharmacological therapies for PONV and PDNV

A variety of non-pharmacologic techniques have been used to control emetic symptoms in the postoperative period, including acupressure [85, 86], acupuncture [87], and transcutaneous electrical stimulation [88, 89]. In an earlier study, White et al. demonstrated that the combination of ondansetron and transcutaneous electroacustimulation was more effective than ondansetron alone in preventing PONV [88]. These preliminary findings were subsequently confirmed by Gan et al. who further suggested that acustimulation could produce analgesic effects [89]. A sham-controlled study by White et al. demonstrated that the adjunctive use of the disposable, noninvasive Pressure Right acupressure device enhanced the emetic efficacy of the most frequently used prophylactic antiemetic drug combination (namely, droperidol, ondansetron and dexamethasone) for preventing emetic symptoms during the first 24 h after major laparoscopic surgery [90]. A systematic review of P6 acupoint stimulation (versus sham or non-acupoint treatments) for PONV demonstrated that acustimulation reduced nausea, vomiting, and the need for rescue antiemetic therapy after surgery [91]. In addition to pharmacologic therapy, non-pharmacologic alternatives are available and these modalities can produce additive effects without increasing side effects or the potential for adverse drug interactions.

Summary

PONV can delay discharge and recovery and increase medical costs. It is also important to recognize that PONV is one of the most undesirable postoperative complications from the patient's perspective. An understanding of the proposed mechanisms responsible for PONV and the sites of action of the available antiemetic drugs, as well as a careful assessment of risk factors for both PONV and PDNV, can provide a more rational approach to the clinical management of this common postoperative complication. Avoiding highly emetogenic anesthetic and analgesic drugs and insuring adequate hydration are essential in order to reduce the risk of PONV. Combining a multimodal opioid-sparing analgesic strategy for preventing postoperative pain with the effective use of antiemetic drugs with differing sites of action as part of a risk-based PONV prophylaxis regimen will reduce the incidence of PONV and PDNV for all surgical populations while also facilitating the recovery process.

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