Practice Points: Postoperative Nausea and Vomiting

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Postoperative nausea and vomiting (PONV) is defined as nausea and/or vomiting occurring within 24 hours after surgery. Despite advances in surgical techniques, shorter orthopaedic surgical times and improved anesthetic agents, one out of three untreated patients still experience PONV.[4] Children are twice as likely to be affected as adults.[15] Up to 70-80% of high risk patients can be affected.[7] Early PONV occurs within the first 2-6 hours after surgery, often in the Post Anesthesia Care Unit (PACU), or exacerbated by movement upon transfer to the floor or Day Surgery Unit.[12] Late PONV occurs in the 6-24 hours after surgery, often related to narcotics. Delayed PONV occurs after 24 hours and can be related to narcotics and/or movement such as with the first physical therapy session.[3]

The etiology of PONV is multifactoral, related to individual risk factors, anesthetic and analgesic agents and surgical risk factors. The duration of surgery, with each 30 minute increase in duration, increases the risk of PONV by 60%.[18] Primary control of nausea and vomiting arises from the vomiting center in the medulla. There are five pathways involved in stimulating the vomiting center: 1) the chemoreceptor triggering zone (CTZ) in the postrema of the medulla, 2) the vagal mucosal pathway in the gastrointestinal system, 3) neuronal pathways from the vestibular system, 4) reflex afferent pathways from the cerebral cortex C2,3, and 5) midbrain afferents.[19]

Stimulation of one of these afferent pathways can activate the vomiting center in the brain stem via cholinergic (muscarinic), dopaminergic, histaminergic or serotonergic receptors that act as mediators. The vomiting reflex has two main detectors of the need to vomit: the gastrointestinal tract and the CRZ in the postrema. Antiemetic agents prevent or treat PONV by acting as antagonists to the receptors.[16]

PONV are complications that can occur after orthopaedic surgery. The development of PONV may impact the recovery process, resulting in a delay of discharge, increase in discomfort, decrease in mobility and overall patient satisfaction. PONV is the most commonly reported fear before elective surgery and viewed as more debilitating than postoperative pain.[3, 4] Vomiting has been associated with complications, such as aspiration and pneumonitis. Evidence-based practice guidelines have been developed for the prevention and management of PONV, such as the American Society of PeriAnesthesia Nurses,[3] and the Society of Obstetricians and Gynaecologists of Canada.[19]

What interventions are effective in identifying and reducing the risk of PONV?

Recommended for Practice

The management of PONV begins with risk factor assessment followed by pharmacologic intervention for prophylaxis and rescue treatment if needed.

Risk Factors for PONV

Risk factors for PONV can be divided into three main groups: 1) patient specific (female, non-smoker, and history of PONV or motion sickness), 2) type of anesthesia (volatile anesthetics, nitrous oxide, intra-operative and postoperative opioids and high doses of neostigmine), and 3) duration of surgery (longer duration increases risk of PONV).[19] Risk factors specific to children include surgery lasting longer than 30 minutes, age older than three years, and history of PONV in family members.[17] Orthopaedic nurses can intervene according to identified risk factors.

Apfel and colleagues have developed a simplified risk scoring system that can be used to predict PONV (Figure 1).[4, 5, 6] The incidence of PONV increases in conjunction with the number of risk factors.

Figure 1: Simplified Risk Factor Identification Tool [4, 5, 6]

Risk Factors	Points
Female gender	1
Non-smoker	1
History of PONV/Motion Sickness	1
Post-operative opioids	1
	Sum = 0-4

Routine antiemetic prophylaxis of all high-risk patients using either single or combination drug therapy should be administered at the smallest effective dose.[23] Prophylactic use of antiemetics to minimize PONV is best practice and is important for patient satisfaction. Prophylaxis with antiemetics is rarely warranted in low-risk patients. Moderate-risk patients may benefit from a single intervention. Multiple interventions should be reserved for high-risk patients.[4] Patients who did not receive prophylaxis or those in whom prophylaxis failed should be treated as soon as symptomatic.

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Recommended for Practice *(continued)*

Multi-modal prophylaxis and rescue treatment is recommended because they act at different receptor sites.[13] A drug from a different class of antiemetics should be given when a drug from one class fails, rather than repeating the same drug class. Patients in Day Surgery areas should be given instructions for management of PONV before being discharged. Rescue treatment should be provided to them if they are at high-risk.

Use of a Risk Assessment Tool

Preoperative nurses complete the patient's history with an emphasis on anesthesia-related items such as nausea and a history of motion sickness. Nurses should notify the anesthesiologist if the patient has any risk factors. A labeling system can be used, such as a sticker on the front of a patient record. Prophylaxis is based on risk factors. Refer to Figure 2 for an example of a research-based protocol.

Information on risk factors and prophylaxis should be communicated from the anesthesiologist to the nurse during hand-off in the PACU. The PACU nurse recognizes the at-risk patient, screens for additional risk factors (i.e., intra-operative narcotics), reviews the chart for appropriate antiemetics and intervenes appropriately. The PACU nurse should report the at-risk patient to the nurse during hand-off in the postoperative care areas, along with any medications given.

Nurses in the postoperative areas should review individual patient risk factors and interventions previously used. The patient is assessed for PONV at regular intervals as part of the routine postoperative assessment, especially for the first 24 hours. Movement, including transport out of PACU and out of bed can cause PONV. Women and patients whose surgical procedure was more than two hours in length should be assessed more frequently.[12]

Pharmacologic Intervention

Antiemetics with different mechanisms of action have additive (rather than synergistic) effects on the incidence of PONV; they act independently. Combinations do not cause interactions.[22] Combinations should be used initially as they are more effective than later rescue interventions. An example is droperidol and dexamethasone which are low cost and safe.[21] Timing of the antiemetic can have a significant effect. Ondansetron is more effective near the end of surgery rather than before surgery.[20] Administration of ondansetron at the end of surgery and before patients develop symptoms will likely be more satisfying to patients.

Although ondansetron and droperidol are equally effective in adults, ondansetron is more effective in preventing vomiting in children. Another benefit that ondansetron offers over other antiemetics commonly used, such as promethazine, is the lack of sedation. This is very appealing in the pediatric population when sedation-causing narcotics are being used in addition to antiemetics. The overall risk of side effects is not different among drug combinations. Both ondansetron and droperidol are more effective than metoclopromide in reducing PONV.[8] Aprepitant was the first neurokinin-1 (NK-1) receptor antagonist approved for treatment of PONV. It acts by blocking NK-1 receptors in the central and peripheral nervous system and prevents emesis for up to 24 hours. It is relatively expensive making it less appealing.[19] However, patients may be willing to pay out of pocket to avoid PONV.

Figure 2 Sample PONV Prophylaxis Protocol for Adults [3, 4]

Pre-operative Prophylaxis:	Metoclopramide 10 mg PO x1 or Ranitidine 150 mg PO x1 or Dimenhydrinate 50 mg PO x1	
Intra-operative Medication:	**1-2 Risk Factors:**	Dexamethasone 4 mg IV before induction and Ondansetron 2 mg IV at end of surgery.
	3-4 Risk Factors:	Dexamethasone 4 mg IV before induction plus Ondansetron 2 mg IV or Ondansetron 2 mg plus Droperidol 0.625 mg IV at the end of surgery.
	> 4 Risk Factors:	Dexamethasone 4 mg IV before induction plus Ondansetron 4 mg plus Droperidol 0.625 mg IV at the end of surgery.

Table 1 Antiemetic Agents [2, 5, 6, 19]

Drug	Adult Dosing	Pediatric Dosing	Adverse Effects
Phenothiazines-effective for opioid-induced PONV, contraindicated in Parkinson's Disease			
Prochlorperazine (Compazine)	5-10 mg PO before induction 5-10 mg IV at the end of surgery 25 mg rectally every 12 hours PRN for treatment of PONV	>2 yo: 0.4 mg/kg/day divided 3-4 doses PO/PR 0.1-0.15 mg/kg/dose IM IV not recommended	Sedation, lethargy, skin sensitization Less common: cardiovascular effects, extrapyramidal symptoms (EPS), cholestatic jaundice, hyperprolactinemia Rare: Neuroleptic Malignant Syndrome (NMS), hematologic abnormalities Sedation in combination with narcotics
Promethazine (Phenergan)	12.5-25 mg PO before induction 12.5-25 mg IV at the end of surgery 6.25-25 mg IV every 4-6 hours PRN for treatment of PONV Maximum dose 25 mg	>2 yo: 0.25-1 mg/kg/dose every 4-6 hours PRN Max Dose: 25 mg/dose	Sedation in combination with narcotics

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Drug	Adult Dosing	Pediatric Dosing	Adverse Effects
Anticholinergics			
Scopolamine (Transderm Scop patch)	Transdermal patch applied prior evening or 4 hours before end of surgery	Not Recommended	Dry mouth, drowsiness, impaired eye accommodation Rare: disorientation, memory disturbances, dizziness, hallucinations
Antihistamines			
Dimenhydrinate (Dramamine)	1-2 mg/kg IV every 4 hours	Not Recommended	Sedation, dry mouth, constipation Less common: confusion, blurred vision, urinary retention
Meclizine (Antivert)	25-50 mg PO 1 hour prior to procedure 25 mg PO every 8 hours for treatment of PONV	Not Recommended	Drowsiness, dry mouth Rare: blurred vision
Butyrophenones			
Droperidol (Inapsine)	0.625-1.25 mg IV at the end of surgery 0.625 mg IV for treatment of PONV Administer additional doses with caution Maximum dose of 2.5 mg	Not Recommended	Sedation, hypotension, tachycardia, prolonged QT interval Less common: dizziness, increased blood pressure, chills, hallucinations Do not administer to patients on other QT prolongers.
Haloperidol (Haldol)	1-2 mg IV at the end of surgery 1 mg IV q 6 hours for treatment of PONV	Not Recommended	Contraindicated in Parkinson's
Prokinetic			
Metoclopramide (Reglan)	10-20 mg IV or PO, every 6 hours for prophylaxis and treatment of PONV	Not Recommended	Sedation, restlessness, diarrhea, agitation, CNS depression Less common: EPS (more frequent with higher doses), hypotension, NMS, supraventricular tachycardia (with IV administration) Contraindicated in Parkinson's
Corticosteroids			
Dexamethasone (Decadron)	4-8 mg IV or 0.1 mg/per kg IV before induction 2-4 mg IV every 6 hours for treatment of PONV	Not Recommended	GI upset, anxiety, insomnia Less common: hyperglycemia, facial flushing, euphoria, perineal itching or burning
Serotonin antagonists			
Dolasetron (Anzemet)	12.5 mg IV at the end of surgery 12.5 mg IV (single dose) rescue antiemetic	2-16 yo: 0.35 mg/kg IV as single dose 15 min. before anesthesia ends or as soon as PONV begins Max Dose: 12.5 mg	Headache, diarrhea, asymptomatic prolongation of QT interval Less common: constipation, asthenia, somnolence, diarrhea, fever, tremor or twitching, ataxia, lightheadedness, dizziness, nervousness, thirst, muscle pain, warm or flushing sensation on iv administration
Granisetron (Kytril)	0.35-1 mg IV at the end of surgery 0.1 mg IV (single dose) rescue antiemetic	Not Recommended	Rare: transient elevations in hepatic enzymes
Ondansetron (Zofran)	2-4 mg IV at the end of surgery 1-2 mg IV for treatment of PONV (repeat once only in 24 hours)	1 mo-12 yo: 0.1 mg/kg IV over 2-5 min. x1 dose if ≤ 40 kg ≥ 40 kg: 4 mg IV over 2-5 min	Most effective when used in combination with other antiemetics
Neurokinin-1 Receptor Antagonist			
Aprepitant (Emend)	40 mg PO 1-3 hours prior to induction	Not Recommended	Headache, fatigue, dizziness and elevated liver enzymes

Likely to be Effective

Hydration is considered a therapeutic intervention.[3] Hypovolemia due to overnight fasting can cause PONV. Preoperative intravenous fluid administration has been shown to be effective.[1] In addition, healthy patients undergoing elective procedures should drink clear fluids up to 2 hours before surgery.[2] Use of regional anesthesia instead of inhaled agents and use of nonsteroidal anti-inflammatory agents to lessen the need for narcotics can decrease the incidence of PONV.[19] Narcotics can alter vestibular sensitivity, causing PONV in ambulatory patients in day surgery centers.[14] Shorter-acting agents and various peripheral nerve block techniques may prove to be effective alternatives to post operative narcotics. Maintaining adequate oxygenation and avoiding hypotension, prevents decrease in blood flow to the brain, which causes syncopal episodes leading to PONV. The use of supplemental oxygen may also decrease PONV by reducing gastrointestinal hypoxia.[11]

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Benefits Balanced with Harm

The debate over prophylaxis versus treatment of PONV has taken on significance, in part due to economic concerns. The prophylactic treatment of PONV is more expensive than treatment of established symptoms. However, PONV can delay recovery and impact patient satisfaction. Patients with PONV may not be able to participate in their post-operative therapy sessions. Hospital protocols may require use of less expensive agents first. Use of more expensive or non-formulary agents may be limited to outpatients at risk of inpatient admission due to PONV. Older, less expensive agents, such as prochlorperazine can cause sedation and negatively impact recovery. Patients who are not high risk should not be exposed to the side effects of antiemetic agents unless they become symptomatic.

Effectiveness Not Established

Although the mainstay of therapy for PONV is pharmacologic, non-pharmcologic therapies may play a role either as alternatives or in combination with rescue treatment. Complementary modalities include aromatherapy, herbal supplements and acupressure. These interventions may provide comfort and can be used in high risk patients or those expressing concern over PONV.[3]

Not Recommended for Practice

There is little evidence to support the routine prophylactic administration of antiemetics in patients with no risk factors. [9, 10] Propofol should be used instead of emetogenic agents such as nitrous oxide.[19]

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