Chapter 27: Nausea and Vomiting

INTRODUCTION

- *Nausea* is usually defined as the inclination to vomit or as a feeling in the throat or epigastric region alerting an individual that vomiting is imminent. Vomiting is defined as the ejection or expulsion of gastric contents through the mouth, often requiring a forceful event.

ETIOLOGY AND PATHOPHYSIOLOGY

- Specific etiologies associated with nausea and vomiting are presented in **Table 27-1**.
- **Table 27-2** presents cytotoxic agents categorized by their emetogenic potential. Although some agents may have greater emetogenic potential than others, combinations of agents, high doses, clinical settings, psychological conditions, prior treatment experiences, and unusual stimuli to sight, smell, or taste may alter a patient's response to a drug treatment.
- The three consecutive phases of emesis are nausea, retching, and vomiting. Nausea, the imminent need to vomit, is associated with gastric stasis. Retching is the labored movement of abdominal and thoracic muscles before vomiting. The final phase of emesis is vomiting, the forceful expulsion of gastric contents due to GI retroperistalsis.
- Vomiting is triggered by afferent impulses to the vomiting center, a nucleus of cells in the medulla. Impulses are received from sensory centers, such as the chemoreceptor trigger zone, cerebral cortex, and visceral afferents from the pharynx and GI tract. The vomiting center integrates the afferent impulses, resulting in efferent impulses to the salivation center, respiratory center, and the pharyngeal, GI, and abdominal muscles, leading to vomiting.

TABLE 27-1

Etiologies of Nausea and Vomiting

Intraperitoneal
Mechanical obstruction
Gastric outlet obstruction
Small-bowel obstruction
Altered sensorimotor function
Gastroparesis
Gastroesophageal reflux
Intestinal pseudo-obstruction
Irritable bowel syndrome
Chronic idiopathic nausea
Functional vomiting
Cyclic vomiting syndrome
Cannabinoid hyperemesis syndrome
Rumination syndrome
Inflammatory diseases
Pancreatitis
Pyelonephritis
Cholecystitis

- Appendicitis
- Hepatitis
- Acute gastroenteritis
- Viral
- Bacterial
- Biliary colic
- Liver failure

Cardiovascular diseases

- Myocardial infarction
- Cardiomyopathy

Neurologic processes

- Increased intracranial pressure
- Migraine headache
- Vestibular disorders
- Intracerebral hemorrhage
- Intracerebral malignancy

Metabolic disorders

- Diabetes mellitus (diabetic ketoacidosis)
- Addison's disease
- Renal disease (uremia)

Psychiatric causes

- Depression
- Anxiety disorders
- Anorexia and bulimia nervosa

Therapy-induced causes

- Antineoplastic agents
- Radiation therapy
- Anticonvulsant preparations
- Digoxin, cardiac antiarrhythmics
- Opioids
- Oral hypoglycemics
- Oral contraceptives
- Antibiotics
- Volatile general anesthetics

Drug withdrawal

- Opioids
- Benzodiazepines

Miscellaneous causes

- Pregnancy

Noxious odors

Postoperative vomiting

TABLE 27-2

Emetic Risk of Agents Used in Oncology and Treatment Options

Antiemetic Agent	Antiemetic Dose on Day 1 of Chemotherapy	Antiemetic Dose on Subsequent Days
High Risk (>90%): Anthracycline/Cyclophosphamide combination, carboplatin AUC >4, carmustine, cisplatin, cyclophosphamide >1500 mg/m^2, dacarbazine, mechlorethamine, streptozocin		
NK-1 Antagonist		
Aprepitant	125 mg oral	80 mg oral on days 2–3
Fosaprepitant	150 mg IV	
Netupitant/Palonosetron	300 mg/0.5 mg oral	
Rolapitant		
	180 mg oral	
5-HT3 Antagonist[a]		
Dolasetron	100 mg oral	
Granisetron	2 mg oral or 1 mg IV or 10 mcg/kg IV or 1 patch or 10 mg SQ	
Ondansetron	8 mg oral twice daily or 24 mg oral or 8 mg IV or 0.15 mg/kg IV	
	0.5 mg oral or 0.25 mg IV	
Palonosetron	0.3 mg IV	
Ramosetron	5 mg oral or 5 mg IV	
Tropisetron		
Dexamethasone[b]	12 mg or 20 mg oral/IV	8 mg oral/IV daily or twice daily on days 2–4
Olanzapine	10 mg oral	10 mg oral on days 2–4
Moderate Risk (30%–90%): Aldesleukin, alemtuzumab, arsenic trioxide, azacitidine, bendamustine, busulfan, carboplatin AUC <4, clofarabine, cyclophosphamide <1500 mg/m^2, cytarabine >1000 mg/m^2, dactinomycin, daunorubicin, daunorubicin/cytarabine liposomal, doxorubicin, epirubicin, idarubicin, ifosfamide, irinotecan (conventional and liposomal), melphalan, oxaliplatin, romidepsin, temozolomide, thiotepa, trabectedin		
5-HT3 Antagonist		

Dolasetron	100 mg oral	
Granisetron	2 mg oral or 1 mg IV or 10 mcg/kg IV or 1 patch or 10 mg SQ	
Ondansetron	8 mg oral twice daily or 8 mg IV or 0.15 mg/kg IV	
Palonosetron	0.5 mg oral or 0.25 mg IV	
Ramosetron	0.3 mg IV	
Tropisetron	5 mg oral or 5 mg IV	
Dexamethasone	8 mg oral/IV	8 mg oral/IV on days 2–3[c]
Low Risk (10%–30%): Aflibercept, atezolizumab, belinostat, blinatumomab, bortezomib, brentuximab, cabazitaxel, carfilzomib, cetuximab, cytarabine <1000 mg/m^2, docetaxel, doxorubicin, liposomal (Doxil®), elotuzumab, eribulin, etoposide, fluorouracil, gemcitabine, ipilimumab, ixabepilone, methotrexate, mitomycin, mitoxantrone, paclitaxel (conventional and albumin-bound), necitumumab, olaratumab, omacetaxine, panitumumab, pemetrexed, pentostatin, pertuzumab, talimogene-iaherparepvec, temsirolimus, topotecan, trastuzumab emtansine		
Choose One		
5-HT3 Antagonist		
Dolasetron	100 mg oral	
Granisetron	2 mg oral or 1 mg IV or 10 mcg/kg IV or 1 patch or 10 mg SQ	
Ondansetron	8 mg oral twice daily or 8 mg IV or 0.15 mg/kg IV	
Palonosetron	0.5 mg oral or 0.25 mg IV	
Ramosetron	0.3 mg IV	
Tropisetron	5 mg oral or 5 mg IV	
OR		
Dexamethasone	8 mg oral/IV	
Minimal Risk (<10%): Avelumab, asparaginase (Erwinia and Pegaspargase), bevacizumab, bleomycin, cladribine, daratumumab, decitabine, durvalumab, fludarabine, nelerabine, nivolumab, obinutuzumab, ofatumumab, peginterferon, pembrolizumab, pralatrexate, ramucirumab, rituximab (IV and SQ), siltuximab, trastuzumab, valrubicin, vinblastine, vincristine (conventional and liposomal), vinorelbine		
No routine prophylactic antiemetics are needed		

[a]No additional 5-HT3-RA is needed if netupitant/palonosetron is used.

[b]Dexamethasone dose on day 1 should be reduced to 12 mg when given with aprepitant, fosaprepitant, and netupitant/palonosetron due to drug interactions. Dexamethasone dose on days 2–4 should be omitted when used as antiemetic with anthracycline/cyclophosphamide combination regimen or carboplatin AUC ≥4.

[c]Only if regimen is known to cause delayed nausea/vomiting (eg, cyclophosphamide, doxorubicin, oxaliplatin).

CLINICAL PRESENTATION

- The clinical presentation of nausea and vomiting is given in **Table 27-3**. Nausea and vomiting may be classified as either simple or complex.

TABLE 27-3

Clinical Presentation of Nausea and Vomiting

General Depending on severity of symptoms, patients may present in mild-to-severe distress
Symptoms *Simple:* Self-limiting, resolves spontaneously, and requires only symptomatic therapy *Complex:* Not relieved after administration of antiemetics; progressive deterioration of patient secondary to fluid-electrolyte imbalances; usually associated with noxious agents or pyschogenic events
Signs *Simple:* Patient complaint of queasiness or discomfort *Complex:* Weight loss; fever; abdominal pain
Laboratory tests *Simple:* None *Complex:* Serum electrolyte concentrations; upper/lower GI evaluation
Other information Fluid input and output Medication history Recent history of behavioral or visual changes, headache, pain, or stress Family history positive for psychogenic vomiting

TREATMENT

- Goal of treatment: Prevent or eliminate nausea and vomiting; ideally accomplished without adverse effects or with clinically acceptable adverse effects.

General Approach to Treatment

- Treatment options for nausea and vomiting include drug and nondrug modalities such as biofeedback and hypnosis. For patients who are suffering due to excessive or disagreeable food or beverage consumption, avoidance or moderation in dietary intake may lead to symptom resolution.
- Patients with symptoms of systemic illness may quickly improve as their underlying condition resolves. Patients in whom these symptoms result from labyrinthine changes produced by motion may benefit quickly by assuming a stable physical position.
- Changes in diet such as restricting oral intake, eating smaller meals, avoiding spicy or fried foods and instead eating bland foods such as with the

BRAT diet (Bananas, Rice, Applesauce, and Toast) can help alleviate symptoms.

Pharmacologic Management

- Information concerning commonly available antiemetic preparations is compiled in **Table 27-4**. The treatment of simple nausea and vomiting often involves self-care from a list of nonprescription products. Nonprescription and prescription drugs are useful in the treatment of simple nausea and vomiting in small, infrequently administered doses and are associated with minimal side effects. As the symptoms persist or become worse, prescription medications may be chosen, either as single-agent therapy or in combination.
- For most conditions, a single-agent antiemetic is preferred; however, for patients not responding to such therapy and those receiving highly emetogenic chemotherapy, multiple-agent regimens are usually required.
- The management of complex nausea and vomiting, such as in patients who are receiving antineoplastic agents, may require initial combination therapy. In combination regimens, the goal is to achieve symptomatic control through administration of agents with different pharmacologic mechanisms of action.

TABLE 27-4

Common Antiemetic Preparations and Adult Dosage Regimens[a]

Drug	Adult Dosage Regimen	Dosage Form/Route	Availability
Antacids: Useful with simple nausea/vomiting *Adverse drug reactions: Magnesium products—diarrhea; Aluminum or calcium products—constipation*			
Antacids (various)	15–30 mL every 2–4 hours prn	Liquid/Oral	Nonprescription
Antihistaminic–Anticholinergic Agents: Especially problematic in the elderly; increased risk of complications in patients with BPH, narrow angle glaucoma, or asthma *Adverse drug reactions: Drowsiness, confusion, blurred vision, dry mouth, urinary retention*			
Dimenhydrinate (Dramamine)	50–100 mg every 4–6 hours prn	Tab, chew tab, cap	Nonprescription
Diphenhydramine (Benadryl)	25–50 mg every 4–6 hours prn 10–50 mg every 2–4 hours prn	Tab, cap, liquid IM, IV	Prescription/nonprescription
Hydroxyzine (Vistaril, Atarax)	25–100 mg every 4–6 hours prn	Tab (unlabeled use)	Prescription
Meclizine (Bonine, Antivert)	12.5–25 mg 1 hour before travel; repeat every 12–24 hours prn	Tab, chew tab	Prescription/nonprescription
Scopolamine (Transderm Scop)	1.5 mg every 72 hours	Transdermal patch	Prescription
Trimethobenzamide	300 mg three to four times daily	Cap	Prescription

(Tigan)	200 mg three to four times daily	IM	
Benzodiazepine: Used for ANV but is contraindicated with olanzapine *Adverse drug reactions: Dizziness, sedation, appetite changes, memory impairment; observe for additive sedation especially if used with narcotic analgesics*			
Lorazepam (Ativan)	0.5–2 mg on night before and morning of chemotherapy	Tab, IV	Prescription (C-IV)
Butyrophenones: Used for breakthrough CINV; droperidol has limited use *Adverse drug reactions: Haloperidol—sedation, constipation, hypotension, EPS; droperidol—QTc prolongation and/or torsade de pointes, 12-lead electrocardiogram prior to administration, followed by cardiac monitoring for 2–3 hours after administration*			
Haloperidol (Haldol)	0.5–2 mg every 4–6 hours prn	Tab, liquid, IM, IV	Prescription
Droperidol (Inapsine)[b]	2.5 mg; additional 1.25 mg may be given	IM, IV	Prescription
Cannabinoids: Used for breakthrough CINV *Adverse drug reactions: Eurphoria, somnolence, xerostomia*			
Dronabinol (Marinol)	5–15 mg/m^2 every 2–4 hours prn 4.2–12.6 mg/m^2 every 2–4 hours prn	Cap Oral solution	Prescription (C-III)
Nabilone (Cesamet)	1–2 mg twice daily	Cap	Prescription (C-II)
Corticosteroids: Useful as a single agent or in combination therapy for prophylaxis of CINV or PONV *Adverse drug reactions: Insomnia, GI symptoms, agitation, appetite stimulation, hypertension, and hyperglycemia*			
Dexamethasone	See **Table 27-2** for CINV dosing and **Table 27-6** for PONV dosing	Tab, IV	Prescription
Histamine (H2) Antagonists: Useful with nausea secondary to heartburn or GERD *Adverse drug reactions: Headache, constipation, or diarrhea*			
Cimetidine (Tagamet HB)	200 mg twice daily prn	Tab	Nonprescription
Famotidine (Pepcid AC)	10 mg twice daily prn	Tab	Nonprescription
Nizatidine (Axid AR)	75 mg twice daily prn	Tab	Nonprescription
5-Hydroxytryptamine-3 Receptor Antagonists: Useful as a single-agent or combination therapy for prophylaxis of CINV or PONV *Adverse drug reactions: Asthenia, constipation, headache*			

	See **Table 27-2** for CINV dosing and **Table 27-6** for PONV dosing	Tab, IV	Prescription
Miscellaneous Agents **Metoclopramide:** Prokinetic activity useful in diabetic gastroparesis. *Adverse drug reactions: Asthenia, headache, somnolence, EPS* **Olanzapine:** Use with caution in elderly; contraindicated with benzodiazepines. *Adverse drug reactions: Sedation, prolonged QTc interval, EPS* **Pyridoxine:** Used in NVP. May be used alone or in combination with doxylamine 12.5 mg. Combination product available as prescription. *Adverse drug reactions: Drowsiness, headache*			
Metoclopramide (Reglan)	10–20 mg (0.5–2 mg/kg) four times daily	Tab, IV	Prescription
Olanzapine (Zyprexa)	5–10 mg daily	Tab	Prescription
Pyridoxine (vitamin B_6)	10–25 mg orally three to four times daily	Tab, cap	Nonprescription
Phenothiazines: Useful in simple nausea/vomiting or breakthrough CINV *Adverse drug reactions: Prolonged QTc interval, constipation, dizziness, tachycardia, tardive dyskinesia, drowsiness*			
Chlorpromazine (Thorazine)	10–25 mg every 4–6 hours prn	Tab, liquid	Prescription
	25–50 mg every 4–6 hours prn	IM, IV	
Prochlorperazine (Compazine)	5–10 mg every 4–6 hours prn	Tab, liquid	Prescription
	5–10 mg every 3–4 hours prn	IM IV	
	2.5–10 mg every 3–4 hours prn		Prescription
	25 mg twice daily prn	Supp	Prescription
Promethazine (Phenergan)	12.5–25 mg every 4–6 hours prn	Tab, liquid, IM, IV, supp	Prescription
Substance P/Neurokinin-1 Receptor Antagonist: Useful in combination therapy for prophylaxis of CINV and PONV *Adverse drug reactions: Constipation, diarrhea, headache, hiccups, dyspepsia, and fatigue*			
Aprepitant	See Table 27-2 for CINV dosing and Table 27-6 for PONV dosing	Cap, IV	Prescription

Fosaprepitant		IV	Prescription
Netupitant/Palonosetron		Cap	Prescription
Rolapitant		Cap	Prescription

[a]All regimens should be monitored for resolution or occurrence of nausea and vomiting as well as maintaining an adequate hydration status.

[b]See text for warnings.

ANV, anticipatory nausea and vomiting; C-II, C-III, and C-IV, controlled substance schedule 2, 3, and 4, respectively; cap, capsule; chew tab, chewable tablet; CINV, chemotherapy-induced nausea and vomiting; GERD, gastroesophageal reflux disease; liquid, oral syrup, concentrate, or suspension; PONV, postoperative nausea and vomiting; prn, as needed; supp, rectal suppository; tab, tablet.

Chemotherapy-Induced Nausea and Vomiting (CINV)

- There are five categories of CINV: acute, delayed, anticipatory, breakthrough, and refractory. Nausea or vomiting that occurs within 24 hours of chemotherapy administration is defined as acute CINV, whereas when it starts more than 24 hours after chemotherapy administration, it is defined as delayed CINV.
- Nausea or vomiting that occurs prior to receiving chemotherapy is termed anticipatory nausea and vomiting (ANV). Breakthrough nausea and vomiting is defined as emesis occurring despite prophylactic administration of antiemetics and requiring the use of rescue antiemetics. Breakthrough emesis occurs in 10%–40% treated with antiemetics.
- The emetogenic potential of the chemotherapeutic agent or regimen (see **Table 27-2**) is the primary factor to consider when selecting an antiemetic for prophylaxis of CINV. Recommendations for antiemetics in patients receiving chemotherapy are presented in **Table 27-2**.

Prophylaxis of CINV

- The primary goal of emesis prevention is no nausea and/or vomiting throughout the period of emetic risk.
- The duration of emetic risk is 2 days for patients receiving moderately emetogenic chemotherapy and 3 days for highly emetogenic chemotherapy. Emetic prophylaxis should be provided through the entire period of risk.
- The selection of the antiemetic regimen should be based on the chemotherapy drug with highest emetogenicity (see **Table 27-2**). Prior emetic experience and patient-specific factors should also be considered.
- When given in equipotent doses, oral and IV 5-HT3-RAs are equivalent in efficacy.
- The toxicities of antiemetics should be considered and managed appropriately.
- Patients receiving highly emetogenic chemotherapy should receive a four-drug antiemetic regimen that is initiated prior to the administration of chemotherapy on day 1, which includes an NK1 receptor antagonist, a 5-HT3-RA, dexamethasone, and olanzapine. Antiemetics administered on the subsequent days following completion of chemotherapy may include aprepitant (if aprepitant was used on day 1), dexamethasone, and olanzapine on days 2–4 as outlined in Table 27-2.
- Patients receiving moderately emetogenic chemotherapy should receive a two-drug regimen with a 5-HT3-RA and dexamethasone on day 1. Dexamethasone should be continued on days 2–3 only if the chemotherapy agent is known to cause delayed nausea and vomiting (eg, cyclophosphamide, doxorubicin, oxaliplatin). Depending on the dose given, patients receiving carboplatin may receive the three-drug combination of an NK1 receptor antagonist, a 5-HT3-RA, plus dexamethasone on day 1 of therapy. If aprepitant was used on day 1, it should be

continued on days 2–3; otherwise, no additional antiemetics are required in the delayed emetic risk period.

- For chemotherapy regimens that are of low emetic risk, either dexamethasone or a 5-HT3-RA as a single agent may be used on day 1 only. For minimal emetic risk, no routine antiemetic prophylaxis is recommended.
- Nonpharmacologic interventions, such as behavioral therapy with systematic desensitization, hypnosis, acupuncture/acupressure or music therapy, may be of benefit for ANV. If ANV occurs, oral lorazepam 0.5–2 mg starting the evening prior to chemotherapy and then an additional dose 1–2 hours prior to chemotherapy administration may be used.

Radiation-Induced Nausea and Vomiting

- Radiotherapy-induced emesis risk groups include total-body irradiation (highest risk), upper body or abdomen and craniospinal radiotherapy (moderate risk), brain, head, and neck, thorax, and pelvic radiotherapy (low risk), and extremity or breast radiotherapy (minimal risk).
- Those at highest risk should receive preventive therapy with a 5-HT3-RA plus dexamethasone in patients who are receiving total-body irradiation (high emetic risk).
- Patients undergoing RT procedures with moderate emetic risk should receive a 5-HT3-RA prior to each fraction and optional dexamethasone prior to fractions 1 through 5.
- Those receiving low and minimal emetic risk radiotherapy may be offered rescue therapy with a 5-HT3-RA, dexamethasone, or dopamine receptor antagonist.

Postoperative Nausea and Vomiting (PONV)

- Risk factors for PONV are listed in **Table 27-5**. Those with 3–5 risk factors are at highest risk, 2–3 risk factors at moderate risk, and 0–1 at low risk.
- A variety of pharmacologic approaches are available and may be prescribed as single or combination therapy for prophylaxis of PONV. See **Table 27-6** for doses of specific agents.
- Patients at highest risk of vomiting should receive two or more prophylactic antiemetics from different pharmacologic classes, while those at moderate risk should receive one or two drugs. For prophylaxis of PONV scopolamine patches must be initiated the evening before the surgery or at least 2 hours prior, whereas NK1 antagonists should be given during the induction of anesthesia; all other agents are recommended to be given at the end of the surgery.
- Ondansetron is considered the “gold standard” 5-HT3-RA. Granisetron has similar results as ondansetron and is less effective than palonosetron.
- Patients who experience PONV after receiving prophylactic treatment with a combination of 5-HT3-RA plus dexamethasone should be given rescue therapy from a different drug class such as a phenothiazine, metoclopramide, or droperidol. If no prophylaxis was given initially, the recommended treatment is low-dose 5-HT3-RA such as ondansetron 1 mg.

TABLE 27-5

Risk Factors for Postoperative Nausea and Vomiting (PONV)

Patient-related factors
Age less than 50 years old
Female gender (two to three times greater incidence of PONV vs males)
Nonsmoker
History of PONV or motion sickness (threefold increase in incidence of PONV)
Hydration status
Factors related to anesthesia
Use of general anesthesia
Use of volatile anesthetics
Nitrous oxide
Use of opioids (intraoperative or postoperative)
Factors related to surgery
Type of surgical procedure (laparoscopic, gynecological, cholecystectomy)
Duration of surgery

TABLE 27-6

Recommended Prophylactic Doses of Selected Antiemetics for Postoperative Nausea and Vomiting in Adults and Postoperative Vomiting in Children

Drug	Adult Dose	Pediatric Dose (IV)	Timing of Dose[a]
Aprepitant[b]	40 mg orally	Not labeled for use in pediatrics	Within 3 hours prior to induction
Dexamethasone	4–5 mg IV	150 mcg/kg up to 5 mg	At induction
Dimenhydrinate	1 mg/kg IV	0.5 mg/kg up to 25 mg	Not specified
Dolasetron	12.5 mg IV	350 mcg/kg up to 12.5 mg	At end of surgery
Droperidol[c]	0.625–1.25 mg IV	10–15 mcg/kg up to 1.25 mg	At end of surgery
Granisetron	0.35–3 mg IV	40 mcg/kg up to 0.6 mg	At end of surgery
Haloperidol	0.5–2 mg (IM or IV)	*N/A*[d]	Not specified
Methylprednisolone	40 mg IV	*N/A*[d]	At induction
Ondansetron	4 mg IV, 8 mg orally disintegrating tablet	50–100 mcg/kg up to 4 mg	At end of surgery
Palonosetron[b]	0.075 mg IV	N/A[d]	At induction
Promethazine[c]	6.25–12.5 mg IV	N/A[d]	At induction
Scopolamine	Transdermal patch	N/A[d]	Prior evening or 4 hours before surgery

[a]Based on recommendations from consensus guidelines.

[b]Labeled for use in PONV but not included in consensus guidelines.

[c]See FDA "black box" warning.

[d]Pediatric dosing not included in consensus guidelines.

Disorders of Balance

- Beneficial therapy for patients with nausea and vomiting associated with disorders of balance can reliably be found among the antihistaminic–anticholinergic agents. Oral regimens of antihistaminic–anticholinergic agents given one to several times each day may be effective, especially when the first dose is administered prior to motion.
- Scopolamine (usually administered as a patch) is effective for the prevention of motion sickness and is considered first line for this indication.

Antiemetic Use During Pregnancy

- A prenatal vitamin started 1 month prior to becoming pregnant may help reduce the incidence and severity of nausea and vomiting of pregnancy

(NVP). Eating smaller, more frequent meals every 1–2 hours, and avoiding foods or odors that trigger symptoms is recommended.

- Pyridoxine (10–25 mg one to four times daily) is recommended as first-line therapy with or without doxylamine (12.5–20 mg one to four times daily). Dimenhydrinate, diphenhydramine, prochlorperazine, or promethazine may also be considered in the treatment of NVP.
- Patients with persistent NVP or who show signs of dehydration should receive IV fluid replacement with thiamine then dextrose.
- Ondansetron, promethazine, and metoclopramide have similar effectiveness for hyperemesis gravidarum, although ondansetron may be better tolerated due to less adverse effects.

Antiemetic Use in Children

- For children receiving highly emetogenic chemotherapy the three-drug combination of an NK-1 antagonist, a 5-HT3-RA, and dexamethasone is recommended. If an NK-1 antagonist cannot be used, a 5-HT3-RA and dexamethasone are recommended. If dexamethasone cannot be used, an NK-1 antagonist with a 5-HT3-RA should be used.
- Children treated with low emetic risk chemotherapy should receive single-agent 5-HT3-RA prior to chemotherapy, while minimal emetic risk chemotherapy regimens do not require routine antiemetics.
- For nausea and vomiting associated with pediatric gastroenteritis, there is greater emphasis on rehydration measures than on pharmacologic intervention.

See Chapter 52, Nausea and Vomiting, authored by Leigh Anne Hylton Gravatt, Krista L. Donohoe, and Mandy L. Gatesman, for a more detailed discussion of this topic.