Managing Postoperative Complications Related to Anesthesia
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Managing Postoperative Complications Related to Anesthesia

A G E N D A

6:15 a.m. – 6:45 a.m.  Registration and Breakfast

6:45 a.m. – 6:50 a.m.  Welcome – Introductory Remarks
  Tricia Meyer, Pharm.D., M.S., FASHP

6:50 a.m. – 7:40 a.m.  Managing Postoperative Complications Related to Anesthesia

7:40 a.m. – 7:45 a.m.  Questions & Answers

F A C U L T Y

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Managing Postoperative Complications Related to Anesthesia

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Dr. Meyer declares that Scott and White is the recipient of a multisite grant from Merck.

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Dr. Bickham declares that she has no relationships pertinent to this activity.

**Erika Thomas, M.B.A., B.S.Pharm.**

Ms. Thomas declares that she has no relationships pertinent to this activity.

**Kristi N. Hofer, Pharm.D.**

Dr. Hofer declares that she has no relationships pertinent to this activity.

**Susan R. Dombrowski, M.S., B.S.Pharm.**

Ms. Dombrowski declares that she has no relationships pertinent to this activity.

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ACTIVITY OVERVIEW

The Centers for Disease Control and Prevention estimates that there are 48 million inpatient surgical procedures each year in the U.S. Over the last 25 years, anesthesia has become significantly safer resulting in a dramatic decrease in anesthesia-related mortality rates. The American Society of Anesthesiologists estimates that an individual is approximately 40 times more likely to be struck by lightning than he or she is to die from anesthesia-related complications. However, anesthesia and anesthetic drugs can cause adverse events in some surgical patients. This symposium will focus on selected postoperative complications related to anesthesia drugs.

Whether anesthetic drugs are administered in the hospital setting or in an ambulatory surgery center, pharmacists should be aware of the risks in order to assist in managing anesthesia drug-related complications. This symposium will highlight recommendations for the management of common complications of anesthesia, such as postoperative nausea and vomiting, neuromuscular residual paralysis, and other adverse events, emphasizing the important role of pharmacists in perioperative patient care.

ACTIVITY OBJECTIVES

At the conclusion of this application-based educational activity, participants should be able to

- Describe common anesthesia-related complications that occur in the early postoperative phase.
- Discuss pharmacologic strategies for managing postoperative complications related to anesthesia drugs.
- Apply clinical evidence and emerging therapy for the management of a postoperative patient with complications related to anesthesia drugs.
Managing Postoperative Complications Related to Anesthesia

CONTINUING EDUCATION ACCREDITATION

The American Society of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. This activity provides 1.0 hour (0.1 CEU) of continuing pharmacy education credit (ACPE activity #0204-0000-12-439-L01-P).

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Your educational opportunities extend beyond today’s symposium…

A live webinar to be conducted February 28, 2013, where Tricia Meyer, Pharm.D., M.S., FASHP will explore issues raised by participant questions in today’s symposium (1 hour of CPE).

E-Newsletters featuring tips for incorporating information from this symposium into practice, as well as updates on emerging information.

Web-based activity based on today’s live symposium (1 hour of CPE, but please note that individuals who claim CPE credit for the live symposium are ineligible to claim credit for the web-based activity).

For more information and to sign up to receive e-mail updates, visit www.cemornings.com
Managing Postoperative Complications
Related to Anesthesia

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Tricia A. Meyer, M.S., Pharm.D., FASHP, is Senior Director – Department of Pharmacy at Scott and White Healthcare in Temple, Texas. Dr. Meyer is also Associate Professor of Anesthesiology for the Department of Anesthesiology at the Texas A&M University College of Medicine at the Temple campus and Adjunct Associate Professor of Pharmacy Practice at the Texas A&M Irma Lerma Rangel College of Pharmacy.

Dr. Meyer earned her Bachelor of Science degree in pharmacy with honors at the University of Texas in Austin, Texas, Master of Science degree from Texas State University in San Marcos, Texas, and Doctor of Pharmacy degree from Shenandoah University in Winchester, Virginia.

Dr. Meyer has published and presented extensively on the topics of perioperative pharmacy, anesthesia, and post-operative nausea, and vomiting. She is a member of the American Society of Health-System Pharmacists (ASHP) and was recognized as a fellow of ASHP in 2001. She is also a member of the Texas Society of Health-System Pharmacists and the Anesthesia Patient Safety Foundation.
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Learning Objectives

• Describe common anesthesia-related complications that occur in the early postoperative phase.
• Discuss pharmacologic strategies for managing postoperative complications related to anesthesia drugs.
• Apply clinical evidence and emerging therapy for the management of a postoperative patient with complications related to anesthesia drugs.

Surgical Stats

• 46 million inpatient procedures in 2006
• 53 million outpatient surgical and non-surgical procedures for ambulatory surgery visits in U.S.
• 24 million surgeries in U.S. involve general anesthesia
• 6% postoperative complication for non-cardiac surgeries in U.S.
• >30% postoperative complications for high risk surgeries in U.S.

Types of Postoperative Complications

• Complications common to any procedure
  – Major and minor complications
• Complications common to specific procedure
  – Major and minor complications
• Anesthesia related complications
  – Major and minor complications

Complications can be immediate, early in postoperative period or delayed

Postoperative Surgical Complications

• Wound complications
  – dehiscence, infection, hematoma, bleeding
• Cardiovascular
  – hypertension, arrhythmias, hemorrhage, shock, MI, DVT
• Renal
  – urinary retention, acute renal failure
• Hepatic
• Gastrointestinal
  – ileus
• Cerebral
  – Seizure, stroke
• Nerve injury
• Pulmonary

Postoperative Anesthesia Complications

• Bronchospasm
• Laryngospasm
• Airway obstruction
• Delayed emergence
• Aspiration of gastric contents
• Residual paralysis
• Cognitive dysfunction
• Vision loss or blindness
• Drug-induced respiratory depression
Other Postoperative Complications

- Pain
- Shivering
- Delirium/Agitation
- Nausea, vomiting and retching
- Sore throat
- Fever
- General-headache, dizziness, drowsiness

Agents Used in General Anesthesia

- Induction agents (e.g., propofol)
- Analgesics (e.g., fentanyl, sufentanil)
- Neuromuscular Blocking Agents (e.g., rocuronium, vecuronium, cisatracurium, pancuronium)
- Inhalational Agents (e.g., desflurane, sevoflurane, isoflurane)
- Antagonism of non-depolarizing NMBA* (e.g., neostigmine, edrophonium, pyridostigmine)
- Antiemetics (e.g., ondansetron, dexamethasone, droperidol, promethazine, aprepitant)

*SMB is neuromuscular blocking agent

Surgical Case for the Day

- M.S. is a 81 year-old female
- Scheduled for inpatient surgery colon resection (open abdominal), scheduled for 4 hrs. OR time
- Wt. = 98 Kg, Ht. = 5'4"
- ASA Physical Class = 2/5
- Allergies: penicillin, cephalosporin
- PMH: PONV, motion sickness on last cruise, asthma, non-smoker
- PSH: Mastectomy; pt. stated “difficult to wake up”
- General anesthesia: propofol, desflurane; pancuronium, fentanyl, antiemetics-TBD
Neuromuscular Blocking Agents and Residual Paralysis

Use of Neuromuscular Blocking Agents During Surgery

- Total muscle relaxation is needed to help achieve best operating conditions/visual field
- Adds to safety of the patient during delicate or critical surgeries
- Additional use of NMBA for muscle relaxation for endotracheal intubation
- 100,000 annually patients suffer respiratory complications after surgery due to residual paralysis
- Lack of standard for monitoring post-surgery weakness

Residual Neuromuscular Blockade/Paralysis

- Incomplete recovery from non-depolarizing neuromuscular blocking agents; prolonged neuromuscular blockade in recovery
- Frequency of residual paralysis ranges from 2-64%
- Most clinical trials examining postoperative residual paralysis now use a train-of-four (TOF) ratio <0.9 to define incomplete neuromuscular recovery
- TOF-ratio >0.9 indicates sufficient recovery of neuromuscular transmission for awakening the patient and ensuring safe tracheal extubation
Current Reversal Agents
(edrophonium, neostigmine, pyridostigmine)

Recovery rate is dependent on: depth of blockade; which reversal agent and dose used; rate of spontaneous recovery; concentration of inhaled anesthetic

Rapidity of reversal: edrophonium > neostigmine > pyridostigmine however edrophonium is not as effective in profound block

Use of glycopyrrolate and atropine to block muscarinic effect/cardiovascular effects

Neostigmine may take 10-15 min. to achieve complete neuromuscular recovery

Adverse effects of residual neuromuscular blockade in awake volunteers and surgical patients

- Impaired airway protective reflexes
- Upper airway obstruction
- Impaired hypoxic ventilatory response
- Postoperative hypoxemia
- Symptoms and signs of profound muscle weakness
- Swallowing disrupted; increased risk aspiration
- Delay in discharge

Relationship of the Train-of-four to Clinical Signs and Symptoms of Residual Paralysis in Awake Volunteers

<table>
<thead>
<tr>
<th>Clinical Signs/ Symptoms</th>
<th>TOF 0.7</th>
<th>TOF 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td>Diplopia</td>
<td>Significant visual disturbances</td>
</tr>
<tr>
<td>Clench teeth tightly</td>
<td>Weak opposition to tongue depressor</td>
<td>Opposition to tongue depressor</td>
</tr>
<tr>
<td>Head/ Leg lift</td>
<td>Sustained</td>
<td>Sustained</td>
</tr>
<tr>
<td>Grip strength</td>
<td>69% of control</td>
<td>83% of control</td>
</tr>
</tbody>
</table>
Incidence of Postoperative Residual Bock in Recovery after Intermediate-acting Neuromuscular Blocking Drugs

<table>
<thead>
<tr>
<th>Residual block</th>
<th>Total</th>
<th>Vecuronium n=50</th>
<th>Atracurium n=50</th>
<th>Rocuronium n=48</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOFR &lt; 0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall postoperative paralysis</td>
<td>52%</td>
<td>64%</td>
<td>52%</td>
<td>39%</td>
</tr>
<tr>
<td>Unable to open eyes</td>
<td>29 (20%)</td>
<td>10 (20%)</td>
<td>12 (24%)</td>
<td>7 (15%)</td>
</tr>
<tr>
<td>Unable to protrude tongue</td>
<td>41 (28%)</td>
<td>13 (26%)</td>
<td>17 (34%)</td>
<td>11 (23%)</td>
</tr>
<tr>
<td>Unable to lift head for 5 sec</td>
<td>90 (61%)</td>
<td>35 (70%)</td>
<td>29 (58%)</td>
<td>26 (54%)</td>
</tr>
<tr>
<td>Unable to lift leg for 5 sec</td>
<td>91 (62%)</td>
<td>33 (66%)</td>
<td>32 (64%)</td>
<td>26 (54%)</td>
</tr>
<tr>
<td>Unable to grip hand</td>
<td>101 (68%)</td>
<td>41 (82%)</td>
<td>34 (68%)</td>
<td>26 (54%)</td>
</tr>
<tr>
<td>Unable to swallow</td>
<td>37 (23%)</td>
<td>12 (24%)</td>
<td>13 (26%)</td>
<td>7 (15%)</td>
</tr>
</tbody>
</table>

Residual Paralysis in PACU after a Single Intubating Dose of Nondepolarizing Muscle Relaxant of Intermediate Duration

Residual paralysis rate (%) between administration of muscle relaxant and arrival to PACU

Residual Paralysis at the Time of Tracheal Extubation

- "Complete recovery of neuromuscular function should be present at the time of tracheal extubation to reduce the risk of adverse respiratory event."
- "Respiratory and pharyngeal function do not normalize until TOF ratios of 0.8-1.0. These findings suggest that removal of endotracheal tube in the presence of minimal levels of residual block can potentially contribute to adverse outcomes."
- "Period of vulnerability" between tracheal extubation and complete recovery of neuromuscular function, leading to airway obstruction, aspiration, and ventilatory depression.
Recovery from Neuromuscular Blockade: A Survey of Practice
Perceptions of TOF ratio required for safe extubation

<table>
<thead>
<tr>
<th>TOF ratio (%)</th>
<th>Respondents (n)</th>
<th>Respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>44</td>
<td>8.2%</td>
</tr>
<tr>
<td>&gt;90%</td>
<td>110</td>
<td>20.6%</td>
</tr>
<tr>
<td>80-85%</td>
<td>68</td>
<td>12.7%</td>
</tr>
<tr>
<td>75%</td>
<td>122</td>
<td>22.8%</td>
</tr>
<tr>
<td>70%</td>
<td>55</td>
<td>10.3%</td>
</tr>
<tr>
<td>50-69%</td>
<td>23</td>
<td>4.3%</td>
</tr>
<tr>
<td>&lt;50%</td>
<td>10</td>
<td>1.8%</td>
</tr>
<tr>
<td>0%</td>
<td>89</td>
<td>16.6%</td>
</tr>
<tr>
<td>Other response</td>
<td>13</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

Muscle Relaxants

- “The most important problem in current clinical use of muscle relaxants is failure to achieve adequate recovery” from their effect

- “Omitting pharmacologic reversal is a common practice, and the clear consequence is inadequate recovery of neuromuscular function...”

- “…probably underestimates the true incidence of inadequate recovery of neuromuscular function.”

- “Given that postoperative residual curarization is a potentially preventable patient safety problem, it is important to find ways to reduce its incidence.”

Polling Question...
M.S. may have a greater chance of having residual paralysis due to

- Female sex
- Use of long acting NMBA
- Cephalosporin allergy
Antiemetics and Postoperative Nausea and Vomiting

PONV: An Undesirable Consequence of Surgery

<table>
<thead>
<tr>
<th>Rank</th>
<th>Postoperative Anesthesia Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vomiting</td>
</tr>
<tr>
<td>2</td>
<td>Gagging on endotracheal tube</td>
</tr>
<tr>
<td>3</td>
<td>Incisional pain</td>
</tr>
<tr>
<td>4</td>
<td>Nausea</td>
</tr>
<tr>
<td>5</td>
<td>Recall without pain</td>
</tr>
<tr>
<td>6</td>
<td>Residual weakness</td>
</tr>
<tr>
<td>7</td>
<td>Shivering</td>
</tr>
<tr>
<td>8</td>
<td>Sore throat</td>
</tr>
<tr>
<td>9</td>
<td>Somnolence</td>
</tr>
</tbody>
</table>

Adapted from Macario A et al. Which clinical anesthesia outcomes are important to avoid? The perspective of patients. Anesth Analg. 1999;89:852–858.

Post-discharge PONV (PDNV)

Incidence of PONV

- Recovery room: 16.1%
- <48 h post discharge: 29.5%
- >48 h to 5 d post discharge: 31.2%

Complications of Postoperative Nausea and Vomiting

- Aspirations
- Suture dehiscence
- Esophageal Rupture
- Bilateral pneumothoraces
- Delays
- Unexpected admission
- Annual cost estimated several $100 Million

Risk Factors For PONV In Adults

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive overall</td>
<td>Female sex</td>
</tr>
<tr>
<td>History of PONV or Motion Sickness</td>
<td>Age ≥ 50 years</td>
</tr>
<tr>
<td>Non-smoking</td>
<td>Younger age</td>
</tr>
<tr>
<td>General vs. regional anesthetics (A1)</td>
<td>Presence or regional anesthetics (A1)</td>
</tr>
<tr>
<td>Use of volatile anesthetics and nitrous oxide (A1)</td>
<td>Postoperative opioids (A1)</td>
</tr>
<tr>
<td>Duration of anesthesia (A2)</td>
<td>History of motion sickness</td>
</tr>
<tr>
<td>Conflicting</td>
<td>ASA physical status</td>
</tr>
<tr>
<td>BMI (A1)</td>
<td>Type of surgery (cholecystectomy, laparoscopic, gynecological)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Level of anesthetist's experience</td>
</tr>
<tr>
<td>Muscle relaxant antagonists (A2)</td>
<td>Malignant or familial clinical relevance</td>
</tr>
<tr>
<td>Disproven or of limited clinical relevance</td>
<td>Nausea</td>
</tr>
<tr>
<td>Use of volatile anesthetics and nitrous oxide (A1)</td>
<td>Supplemental oxygen (A1)</td>
</tr>
<tr>
<td>Postoperative opioids (A1)</td>
<td>Perioperative fasting (A1)</td>
</tr>
<tr>
<td>History of motion sickness</td>
<td>Migraine</td>
</tr>
</tbody>
</table>

See page 28 for enlarged view
Risk Score in Children

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery ≥ 30 min.</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥ 3 years</td>
<td>1</td>
</tr>
<tr>
<td>Strabismus surgery</td>
<td>1</td>
</tr>
<tr>
<td>History of POV or PONV in relatives</td>
<td>1</td>
</tr>
</tbody>
</table>

Sum = 0...4


Postdischarge Nausea and Vomiting (PDNV) Adult Risk Score

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>1</td>
</tr>
<tr>
<td>History of PONV</td>
<td>1</td>
</tr>
<tr>
<td>Age &lt;50 years</td>
<td>1</td>
</tr>
<tr>
<td>Use of opioids in the PACU</td>
<td>1</td>
</tr>
<tr>
<td>Nausea in the PACU</td>
<td>1</td>
</tr>
</tbody>
</table>

Sum = 0...5


Reduce baseline risk

1. Avoidance of general anesthesia by the use of regional anesthesia
2. Use of propofol for induction and maintenance of anesthesia
3. Avoidance of nitrous oxide
4. Avoidance of volatile anesthetics
5. Minimization of intraoperative and postoperative opioids
6. Adequate hydration

Families of Antiemetic Drugs

- **Phenothiazines (Dopamine D_2 receptor)**
  - Chlorpromazine
  - Prochlorperazine
  - Promethazine

- **Butyrophenones (Dopamine D_2 receptor)**
  - Droperidol
  - Haloperidol

- **Benzamides (Dopamine D_2 receptor)**
  - Metoclopramide

- **Antihistamines (Histamine)**
  - Dimenhydrinate
  - Hydroxyzine
  - Diphenhydramine

- **5-HT_3 antagonists (Serotonin)**
  - Dolasetron
  - Granisetron
  - Ondansetron
  - Palonosetron
  - Steroids (Receptor is unclear)
  - Dexamethasone
  - NK_1 receptor antagonists
  - Aprepitant

Pathophysiology of PONV

5HT-3 Receptor Antagonists IV

- **Ondansetron** 4mg, give at end of surgery; cost=$
- **Granisetron** 0.3mg-1 mg, give at end of surgery; cost=<$
- **Dolasetron** 12.5mg, give at end of surgery; cost=$$$
- **Palonosetron** 0.075mg (not marketed for PONV); cost=$$$$$$$$
- More effective for vomiting rather than nausea
- Used for prevention and treatment
- Side effects: HA, constipation
- Recent FDA warning for ondansetron: Avoid use in patients with congenital long QT syndrome; ECG monitoring - electrolyte abnormalities, congestive heart failure, bradyarrhythmias, or patients taking medications that can lead to QT prolongation. Dolasetron and granisetron carry similar concerns
  - Palonosetron has not shown QT prolongation concerns
Anticholinergic Agents

- **Scopolamine transdermal patch** - 1.5 mg; one patch 4 hrs prior to surgery; duration 24 hrs; cost = $$
- Do not use in children; caution in elderly
- Do not cut patch
- Wash hands after handling
- Contraindicated in closed angle glaucoma
- Common side effects: sedation, dry mouth, visual disturbances

Butyrophenones IV

**Droperidol** - 0.625 mg - 1.25 mg; given at end of surgery; cost = ¢
- Efficacy with nausea
- Potential for serious proarhythmic effects and death:
  - Reserve for treatment of patients who failed other treatments
  - 12-lead ECG prior to administration
  - Continue ECG monitoring for 2-3 hours after administering droperidol

**Haloperidol** - 0.5 mg - 2 mg; cost = ¢
- Used more in treatment
- Similar concerns of CV effects to droperidol (no FDA boxed warning)

Phenothiazines IV

**Prochlorperazine** - 5 - 10 mg; unavailable supply since 7 - 2011

**Promethazine** - 6.25 mg - 25 mg; start with 6.25 mg dose, 25 mg associated with significant side effects; cost = ¢

**FDA boxed warning-risk of serious tissue damage:**
- Dilute drug
- Slow administration
- Use large patent veins
- Educate patient about signs of extravasation
- Contraindicated in children < 2 yrs
- Use lowest dose possible with elderly
Dexamethasone IV

- **Dexamethasone** - 4mg given at induction; cost=¢
- **Mechanism of action is unclear**
- **Duration of action** – up to 24hrs.
- **Most common side effect** - vaginal or anal irritation or itching
  - Administer drug slowly over 5-10 min.
  - Administer after induction

Recent reports in literature

- Increase in blood glucose levels
- Concerns of post op infection
- Tumor lysis syndrome
- Bleeding post tonsillectomy

Substance P/NK₁ receptor antagonist

- **Aprepitant** 40mg oral and given 3 hrs prior to induction
- **Indicated for prevention of postoperative nausea and vomiting.**
- **Drug interactions:**
  - warfarin- patient to have INR post surgery;
  - oral contraceptives- patient to use other forms of birth control for 1 month
- $$$$$$$$$

Results of Factorial Trial of 6 Interventions

<table>
<thead>
<tr>
<th>Number of Antiemetics</th>
<th>Incidence of PONV</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>52%</td>
</tr>
<tr>
<td>One</td>
<td>37%</td>
</tr>
<tr>
<td>Two</td>
<td>28%</td>
</tr>
<tr>
<td>Three</td>
<td>22%</td>
</tr>
</tbody>
</table>

There were no significant differences between the antiemetics or pairs of antiemetics. 26% reduction in relative risk for each additional antiemetic used.

Algorithm for Management of PONV


<table>
<thead>
<tr>
<th>Drug</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aprepitant</td>
<td>(HA, Elevated liver enzymes)</td>
</tr>
<tr>
<td>Ondansetron</td>
<td>(HA, Lightheadedness, Elevated liver enzymes, Constipation, QT prolongation)</td>
</tr>
<tr>
<td>Dolasetron</td>
<td>(HA, Lightheadedness, Elevated liver enzymes, QT prolongation, Diarrhea)</td>
</tr>
<tr>
<td>Droperidol</td>
<td>(Sedation, Dizziness, Anxiety, Hypotension, EPS, QT prolongation, Torsade de pointes)</td>
</tr>
<tr>
<td>Granisetron</td>
<td>(HA, Lightheadedness, Elevated liver enzymes, Constipation)</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>(<em>Hyperglycemia (gluconeogenesis in liver)</em>)</td>
</tr>
<tr>
<td>Metoclopramide</td>
<td>(Sedation, Hypotension, EPS)</td>
</tr>
<tr>
<td>Promethazine</td>
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Antiemetic Man
Common side effects with traditional antiemetic medications

Polling Question...
What are the risk factors for PONV for the surgery patient (M.S.)?

- Female sex
- History of PONV/Motion Sickness
- Non-smoker
Postoperative Opioid-Induced Respiratory Depression (POIRD)

Opioid Use
- Opioid analgesia is primary intervention for pain in hospitalized patients
- Opioid side effects: nausea/vomiting, urinary retention, pruritus, prolonged postop ileus
- Main hazards of opioids is respiratory depression
- 50% of postoperative respiratory depression involved opioids
- Severe respiratory depression-breathing rates of 8-10 breaths/min
- Risk of opioid-induced respiratory depression in postop patients is greatest in first 24 hrs after surgery
- Respiratory depression occurs most frequently between hours of 2300-0700 when patients are sleeping

Opioid Induced Respiratory Depression Risk Factors
- Age >55yrs
- Obesity
- Untreated sleep apnea & history snoring
- Neck circumference >17.5"
- Preexisting pulmonary/cardiac disease
- Smoker > 20pack-years
- Prolonged surgery
- Thoracic or other large incisions that interfere with ventilation
- Concomitant administration of other sedating drugs
- Patients with prior naloxone administration for respiratory depression are at risk for repeated respiratory depression
- ↑ opioid requirement
- Major organ failure
- Dependent functional status

Naloxone

- Introduced in late 1960's
- Onset of action is rapid (1-2 min.)
- Duration 30-60 min.
- Recurrence of respiratory depression due to short half life
- Efficacy depends on pharmacokinetics and pharmacodynamics of individual opioid analgesic

Consider:

**Nonsteroidal anti-inflammatory drugs**
Several meta-analyses support conclusion that nonselective NSAIDs added to opioid regimens for post op pain resulted in reduced incidence of opioid-induced sedations

Screening preoperatively for pts at increased risk
Monitoring postoperatively in higher levels of care or more frequent vital signs or use of end-tidal CO2 monitoring
Be aware of renarcotization after naloxone and recurrence of respiratory depression
In patients on supplemental oxygen, consider which should have lower oxygen saturation targets

Polling Question...

M.S. risk factor(s) for postoperative opioid induced respiratory depression include

- Female sex
- Obesity
- Previous surgery
Conclusion

• Neuromuscular blockade is important to achieve the best surgical conditions and added patient safety during delicate or critical surgeries. Residual paralysis is a patient safety concern. Studies show frequency of residual block ranges from 2-64%.

• Depending upon the risk, prophylaxis should be initiated with monotherapy or combination therapy using interventions that reduce baseline risk, nonpharmacologic approaches, and antiemetics. Antiemetic combinations are recommended for patients at moderate to high risk for PONV.

• Opioid analgesia is often required for pain control in the postoperative setting. This is associated with a small but significant risk for respiratory depression. Consider screening patients, monitoring at increased levels, addition of non-opioid to opioid regimen.
Residual Paralysis in PACU after a Single Intubating Dose of Nondepolarizing Muscle Relaxant of Intermediate Duration

Residual paralysis rate (%) between administration of muscle relaxant and arrival to PACU

## Risk Factors For PONV In Adults

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive overall</td>
<td>Female sex</td>
</tr>
<tr>
<td></td>
<td>History of PONV or Motion Sickness</td>
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<td></td>
<td>Non-smoking</td>
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<td>Younger age</td>
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<td>General vs. regional anesthesia (A1)</td>
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<td></td>
<td>Use of volatile anesthetics and nitrous oxide (A1)</td>
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<tr>
<td></td>
<td>Postoperative opioids (A1)</td>
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<tr>
<td></td>
<td>Duration of anesthesia</td>
</tr>
<tr>
<td>Conflicting</td>
<td>ASA physical status</td>
</tr>
<tr>
<td></td>
<td>Type of surgery (cholecystectomy, laparoscopic, gynecological)</td>
</tr>
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<td></td>
<td>Menstrual cycle</td>
</tr>
<tr>
<td></td>
<td>Level of anesthetist’s experience</td>
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<tr>
<td></td>
<td>Muscle relaxant antagonists (A2)</td>
</tr>
<tr>
<td>Disproven or of limited clinical relevance</td>
<td>BMI</td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
</tr>
<tr>
<td></td>
<td>Nasogastric tube (A1)</td>
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<tr>
<td></td>
<td>Supplemental oxygen (A1)</td>
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<tr>
<td></td>
<td>Perioperative fasting (A2)</td>
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<tr>
<td></td>
<td>Migraine</td>
</tr>
</tbody>
</table>

Algorithm for Management of PONV

**KEY**

Aprepitant= **A**  
(HA, Elevated liver enzymes)

Ondansetron= **O**  
(HA, Lightheadedness, Elevated liver enzymes, Constipation, QT prolongation)

Dolasetron= **D**  
(HA, Lightheadedness, Elevated liver enzymes, QT prolongation, Diarrhea)

Droperidol= **Dr**  
(Sedation, dizziness, anxiety, hypotension, EPS, QT prolongation, and Torsade de pointes)

Granisetron= **G**  
(HA, Lightheadedness, Elevated liver enzymes, Constipation)

Dexamethasone= **Dx**  
(Vaginal itching or anal irritation with IV bolus, Hyperglycemia (gluconeogenesis in liver))

Metoclopramide= **M**  
(Sedation, Hypotension, EPS)

Promethazine= **P**  
(Sedation, Hypotension, EPS, Possible severe tissue irritation)

Scopolamine Patch= **S**  
(Sedation, Dry mouth, Visual disturbances; CNS effects in elderly patients, Renal or hepatic impairment)

Palonosetron= **Pa**  
(HA, Constipation, QT prolongation, Bradycardia)

Prochlorperazine= **Pc**  
(Sedation, Hypotension, EPS)

Dimenhydrinate= **Dm**  
(Sedation, dry mouth, blurred vision, dizziness, urinary retention)

Diphenhydramine= **Dp**  
(Sedation, dry mouth, blurred vision, dizziness, urinary retention)

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**Antiemetic Man**

Common side effects with traditional antiemetic medications
SELECTED REFERENCES AND RESOURCES


Managing Postoperative Complications Related to Anesthesia


Tsai Chih-Chung; Chung Ham-See; Chen Po-Liang; YU Chong-Ming; Chen MMing-Shan; Hong Chian-Lang. Postoperative residual curarization: Clinical observation in the post-anesthesia care unit. *Chang Gung Med J*; 2008;31:4


SELF-ASSESSMENT QUESTIONS

1. Neuromuscular blocking agents are used for which of the following?
   a. Muscle relaxation during endotracheal intubation.
   b. Muscle relaxation during the surgical procedure to prevent movement.
   c. Both a and b are correct.
   d. Neither a or b is correct.

2. Which of the following reversal agents is most frequently used in surgery?
   a. Edrophonium.
   b. Neostigmine.
   c. Pyridostigmine.
   d. Vecuronium.

3. Which of the following anesthetic drugs is most likely to increase the risk for postoperative nausea and vomiting?
   a. Muscle relaxant antagonists.
   b. Volatile anesthetics.
   c. Propofol.
   d. Regional dexamethasone.

4. Which of the following is an antiemetic agent with evidence of efficacy for decreasing the risk of postoperative nausea and vomiting in surgical patients?
   a. Metoclopramide.
   b. Ondansetron.
   c. Cannabinoids.
   d. Bromocriptine.

5. Which of the following is a risk factor for opioid-induced respiratory depression?
   a. Nonsmoking.
   b. Insomnia.
   c. Obesity.
   d. Female sex.

6. Which of the following choices applies to patients at risk for postoperative opioid-induced respiratory depression?
   a. Monitored in higher levels of care.
   b. Not be given opioids.
   c. Not be given local anesthetics.
   d. Not be given general anesthesia.

Answers
1. c
2. b
3. b
4. b
5. c
6. a
Managing Postoperative Complications
Related to Anesthesia