PACU Management of the Obese Patient

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Goals and Objectives: Following the lecture, the audience should:

PACU Management of the Obese Patient

• Use goal directed fluid management to minimize postoperative complications.
• Improve oxygenation after surgery
  • including the safe use CPAP and BiPAP following gastric bypass procedures.
• Diagnose gastric leak syndrome.
• Recognize and treat rhabdomyolysis.

Vertical Banded Gastroplasty

Adjustable Gastric Banding

BilioPancreatic Diversion/Duodenal Switch

Roux-en-Y Gastric Bypass


**Out-patient Gastric Bypass (2005)**

<table>
<thead>
<tr>
<th>Length of Hospital Stay</th>
<th>N = 2000 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 hours</td>
<td>90%</td>
</tr>
<tr>
<td>2 days</td>
<td>75%</td>
</tr>
<tr>
<td>&gt; 7-Days</td>
<td>25%</td>
</tr>
</tbody>
</table>

**PACU: Anastomotic Leak – Gastric Bypass**
- 1-2% after RYGBP
- Diagnosis often difficult – subtle clinical signs
- 10-20% mortality
- Mortality related to delayed diagnosis and treatment

**“Bariatric Leak Syndrome”**
- Sinus tachycardia (>120 bpm)
- Tachypnea (>30 rpm)
- Fever (may be absent)
- Absence of typical findings of peritonitis
- Feeling of anxiety-impending doom

**Anastomotic Leak**
- Failure to improve
- Abdominal pain
- Increased iv fluid requirements
- Hiccups
- Progresses rapidly to overwhelming sepsis, necrotizing soft tissue infection, multi-system organ failure, and death
- Pulmonary dysfunction (symptoms may be confused with PE)

**Thromboembolism - DVT/PE in Obesity**
- Postoperative immobilization
- Large blood volume
- Relative polycythemia
- High serum lipid and fatty acid levels
- Diabetes
- Pneumoperitoneum

**Thromboembolism - DVT/PE Risk in Obesity**
- PE (1-2%)
- Most common cause of perioperative death (1/3 fatal)
- Symptomatic DVT < 1%
- DVT prophylaxis with compression boots and SQ Heparin
- Early ambulation
- Prophylactic IVC filter (???)
- Differential diagnosis in PACU is anastomotic leak
Management of Leaks Following Gastric Bypass Surgery


Sleeve Gastrectomy


Bariatric Procedures – United States

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>188,000</td>
<td>173,000</td>
<td>179,000</td>
<td>193,000</td>
<td>196,000</td>
</tr>
<tr>
<td>RNY</td>
<td>36.7%</td>
<td>37.5%</td>
<td>34.2%</td>
<td>26.8%</td>
<td>23.1%</td>
</tr>
<tr>
<td>Band</td>
<td>35.4%</td>
<td>20.2%</td>
<td>14%</td>
<td>9.5%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Sleeve</td>
<td>17.8%</td>
<td>33%</td>
<td>42.1%</td>
<td>51.7%</td>
<td>53.8%</td>
</tr>
<tr>
<td>BPD/SVS</td>
<td>0.9%</td>
<td>7%</td>
<td>1%</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Reverses</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
<td>11.4%</td>
<td>13.6%</td>
</tr>
<tr>
<td>Other</td>
<td>3.2%</td>
<td>2.3%</td>
<td>2.7%</td>
<td>0.1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>balloons</td>
<td>~700</td>
<td></td>
<td></td>
<td></td>
<td>18 cases</td>
</tr>
<tr>
<td>V-Bloc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimally and Non-Invasive Bariatric Procedures

Intra-Gastric Balloon

Type 1: Single Balloon
Type 2: Dual-Balloon

Intra-abdominal Vagal Nerve Blockade (VBLOC)

Natural Orifice Trans-Endoluminal Surgery (NOTES)

Endoluminal Transoral Gastroplasty
**EndoBarrier “gastric condom” - an impermeable sleeve that lines the first 60 cms of the small intestine**

**AspireAssist**

**Risk Score for Postoperative Nausea and Vomiting (PONV)**

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Points</th>
<th>No. of risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female gender</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>History of PONV</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Postoperative opiate</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

**PACU: Obesity and PONV - calculated risk**

<table>
<thead>
<tr>
<th>Mean BMI, no. of PONV, n = 50</th>
<th>Underweight</th>
<th>Normal weight</th>
<th>Overweight</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1, 22</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
</tr>
<tr>
<td>18.5, 24</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
<td>18.0 (17.9)</td>
</tr>
</tbody>
</table>

**PACU: Obesity is NOT a risk factor for PONV - incidence**

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Underweight</th>
<th>Normal weight</th>
<th>Overweight</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
</tr>
<tr>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
</tr>
</tbody>
</table>


**PACU Management of the Obese Patient**

Jay B. Brodsky, MD

Jay B. Brodsky, MD
Postdischarge nausea and vomiting: Risk assessment and treatment strategies

**Table 3** Number of patients who received postoperative naso-antemetics in various time periods after surgery

<table>
<thead>
<tr>
<th>Timing of administration and type of agent</th>
<th>Aprepitant (n = 175)</th>
<th>No aprepitant (n = 146)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In PACU</td>
<td>10 (11)</td>
<td>20 (17)</td>
</tr>
<tr>
<td>Desflurane</td>
<td>19 (19)</td>
<td>26 (26)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>0 (0)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Sevoflurane</td>
<td>0 (0)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>First hour after PACU</td>
<td>1 (0)</td>
<td>13 (12)</td>
</tr>
<tr>
<td>Desflurane</td>
<td>3 (5)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>5 (5)</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Sevoflurane</td>
<td>25 (26)</td>
<td>20 (20)</td>
</tr>
<tr>
<td>1-24h after PACU</td>
<td>72 (82)</td>
<td>49 (47)</td>
</tr>
<tr>
<td>Desflurane</td>
<td>20 (20)</td>
<td>25 (25)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>73 (74)</td>
<td>34 (34)</td>
</tr>
<tr>
<td>Sevoflurane</td>
<td>1 (1)</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Peptidase</td>
<td>8 (8)</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>4 (4)</td>
<td>3 (3)</td>
</tr>
</tbody>
</table>

Conclusion: Addition of aprepitant to a multimodal antiemetic prophylactic regimen may be associated with significant reduction of PONV during early recovery and potentially with reduced incidence of vomiting during the first 48 postoperative hours.

**Aprepitant** blocks the neurokinin 1 receptor

**Aprepitant (Emend®)** and antiemetic prophylaxis for postoperative nausea and vomiting in morbidly obese patients undergoing bariatric surgery.

- 318 pts received triple antiemetics (dexamethasone, droperidol, ondansetron *)
- 172 (55%) received aprepitant (40 mg p.o.) vs 146 (45%) control
- Rates of PONV in the PACU were 11% (aprepitant) vs 17% (control) [P = .02]
- 1 h after PACU discharge, fewer patients in the aprepitant group (21%) had PONV vs control (31%)
- During the first 48 postoperative hours, PONV rates were similar between the groups (68 and 66%)
- All reversed with neostigmine

* some patients had TIVA propofol, some had scopolamine patch, no N2O

**Strategies To Reduce PON(V)**

- Multimodal intraoperative prophylaxis
- Use regional anesthetic techniques
- Propofol for induction and maintenance of anesthesia
  - avoid nitrous oxide and volatile anesthetics (ie T.I.V.A.)
- Minimize perioperative opioids
- Avoid neostigmine (use sugammadex)
- Adequate hydration

**Average cost of Aprepitant**: $102/pill
**PONV PACU - N (%)**

<table>
<thead>
<tr>
<th></th>
<th>Group R</th>
<th>Group A</th>
<th>Group F</th>
</tr>
</thead>
<tbody>
<tr>
<td>No nausea</td>
<td>14/70.0</td>
<td>12/80.0</td>
<td>19/86.36</td>
</tr>
<tr>
<td>or vomiting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>5/25.0</td>
<td>3/20.0</td>
<td>3/13.64</td>
</tr>
<tr>
<td>Vomiting</td>
<td>1/5.0*</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

Values are mean ± SD; *P<0.05 compared with Group F.

Gazynski et al. Post-anesthesia recovery after infusion of propofol with remifentanil or alfentanil or fentanyl in morbidly obese patients. Obes Surg 2004; 14: 498-504

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**Sugammadex (S) vs Neostigmine (N)**

Conclusion: Neostigmine (N) associated with increased PONV in PACU and required more anxiolytic rescue medication during the postoperative 24 hours.

<table>
<thead>
<tr>
<th>Group R</th>
<th>Group S</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>31 (77%)</td>
<td>46 (92%)</td>
</tr>
<tr>
<td>Yes</td>
<td>1 (23%)</td>
<td>4 (85%)</td>
</tr>
</tbody>
</table>


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**Fluid Management in Morbid Obesity**

![Fluid Management Graph](image)

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**Intraoperative administration of 40 mL/kg vs 15 mL/kg LR**

Improved postoperative organ functions and recovery and shortened hospital stay after laparoscopic cholecystectomy


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**Improved exercise capacity**

- Improved exercise capacity
- Less orthostatic hypotension
- Earlier ambulation
- Less PONV


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**Deviation from Ideal Body Weight (%)**

![Deviation from Ideal Body Weight Graph](image)

TABLE 5. Effects of Pneumoperitoneum on Intraoperative Urine Output and Postoperative Renal Function in the Morbidly Obese

<table>
<thead>
<tr>
<th>Function</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative urine output</td>
<td>Decreased</td>
</tr>
<tr>
<td>Intraoperative hormonal</td>
<td></td>
</tr>
<tr>
<td>changes</td>
<td></td>
</tr>
<tr>
<td>Antidiuretic hormone</td>
<td>Increased</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>Increased</td>
</tr>
<tr>
<td>Plasma renin activity</td>
<td>Increased</td>
</tr>
<tr>
<td>Postoperative renal function</td>
<td></td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>Decreased</td>
</tr>
<tr>
<td>Creatinine</td>
<td>Decreased</td>
</tr>
<tr>
<td>Creatinine clearance</td>
<td>Unchanged</td>
</tr>
</tbody>
</table>


Fluid Replacement in Obese Patients

- No “evidence based” studies on obese patients - practice recommendations based on studies of non-obese patients
- Use “liberal” amounts of crystalloid in laparoscopic procedures
- Use goal directed amounts of colloid in open (laparotomy) procedures
- Aggressive crystalloid administration for long duration surgery (avoid rhabdomyolysis)

Postoperative Pulmonary Complications


Postoperative Pulmonary Atelectasis


Supine Position

Increased intra-abdominal pressure (IAP) decreased chest wall compliance and lung volume

Obstructive Sleep Apnea
Does CPAP cause gas distension in bypassed stomach pouch leading to staple disruption and gastric leak syndrome?

CPAP after RYGB does not result in increased the morbidity

• CPAP did not increase transmural gastric pouch pressure in laparoscopic bariatric patients
• CPAP following RYGB did not pose a risk for pouch distension

Pain after Laparoscopy

Morphine requirements 24 hrs after laparoscopic vs laparotomy gastric bypass

• CO₂ in the abdomen - carbonic acid (air, helium, xenon)
• Higher intra-peritoneal pressure is associated with more intense pain than lower pressure
• Cold gas
• Dry gas
• Blood left in the abdomen after surgery
• Diaphragmatic irritation (retained gas)
• Intraoperative pressure on capillary beds in the abdominal and possibly retroperitoneal viscera, causing nociception
• Peritoneal stretching

Heated CO₂ Insufflation - PAIN

• PACU pain following Laparoscopy: somatic + visceral
• Peritoneal irritation:
  - CO₂ in the abdomen - carbonic acid (air, helium, xenon)
  - Higher intra-peritoneal pressure is associated with more intense pain than lower pressure
  - Cold gas
  - Dry gas
  - Blood left in the abdomen after surgery
  - Diaphragmatic irritation (retained gas)
  - Intraoperative pressure on capillary beds in the abdominal and possibly retroperitoneal viscera, causing nociception
  - Peritoneal stretching

Laparoscopy is more painful in PACU (0-4 hrs); after 24 hrs laparoscopy is relatively “painless”

PACU pain following Laparoscopy: somatic + visceral
Peritoneal irritation:


Intraoperative intranasal nicotine as an analgesic

<table>
<thead>
<tr>
<th>yasunori matsuda, MD</th>
<th>Y</th>
<th>Yasu</th>
<th>2015</th>
<th>63</th>
<th>70</th>
<th>0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery score yasunori matsuda, MD</td>
<td>V</td>
<td>Yasu</td>
<td>2015</td>
<td>63</td>
<td>70</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Conclusion: Intraoperative intranasal nicotine did not exhibit opioid-sparing effect in nonsmoking bariatric female patients. Despite anterine prophylaxis, nicotine was associated with the higher frequency of the use of rescue antinemics in PACU.


110 Bariatric Patients

EXP Group: 300 mg ropivacaine in 200 ml NS instilled intraabdominally before closure

CONT Group: 200 ml NS

Sugammadex vs Neostigmine - laparoscopic bariatric surgery

<table>
<thead>
<tr>
<th>Sugammadex</th>
<th>Neostigmine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less PONV</td>
<td></td>
</tr>
<tr>
<td>Less postoperative pain</td>
<td></td>
</tr>
<tr>
<td>Reduced rescue opioids</td>
<td></td>
</tr>
<tr>
<td>Shorter PACU stay</td>
<td></td>
</tr>
</tbody>
</table>

Sugammadex

<table>
<thead>
<tr>
<th>Evaluation Variable</th>
<th>Sugammadex (n=48)</th>
<th>Neostigmine (n=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS Score</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>PONV</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Pain</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>50</td>
</tr>
</tbody>
</table>


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PAIN in PACU – TIVA ANESTHESIA

<table>
<thead>
<tr>
<th>VAS</th>
<th>Pain</th>
<th>Group R</th>
<th>Group A</th>
<th>Group F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No pain</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>1</td>
<td>Slight</td>
<td>6/10*</td>
<td>6/10</td>
<td>11/10</td>
</tr>
<tr>
<td>2</td>
<td>Mild</td>
<td>9/15</td>
<td>7/10</td>
<td>10/15</td>
</tr>
<tr>
<td>3</td>
<td>Disturbing</td>
<td>5/15</td>
<td>2/10</td>
<td>1/4</td>
</tr>
<tr>
<td>4</td>
<td>Strong</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>≥5</td>
<td>Severe</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

Values are mean ± SD; *P<0.05 compared with Group F.

Multi-Modal Analgesia

Reduce or eliminate opioids
Avoid long-acting opioids

Rhabdomyolysis (RML)
- Skeletal muscle (*rhabdomyo*) + rapid breakdown (*lysis*) due to injury
- Muscle damage may be caused by physical, chemical, or biological factors
- Destruction of the muscle leads to the release of breakdown products into the bloodstream

Rhabdomyolysis (RML) in Obesity

High muscle pressure
Diabetes, hypertension
Peripheral vascular disease
Muscle ischemia
Long operative time
Rhabdomyolysis


Case Reports RML and Bariatric Surgery


Case Series RML and Bariatric Surgery


Rhabdomyolysis
Dependent areas affected in morbidly obese patients

Shoulders
Lumbar area
Buttocks and Thighs
RML - CLINICAL FEATURES

**Dark Urine** (brown, tea color)
- Anuria
- Fever, Malaise
- Nausea/Vomiting
- Agitation/Confusion/Delirium

Myoglobinuria

RML Diagnosis

Creatine kinase (CK)-M chain
- elevated in the blood in RML

**CK = 1,000 IU = RML**
(sodium level 5x normal)

RML – Clinical Features

- Muscle pain and tenderness
- Swelling
- Bruising
- Weakness

Electrolyte Disturbances (early)

Potassium leaves muscle → hyperkalemia
- dysrhythmias
- cardiac arrest
Chloride and Calcium enter injured muscle
- serum hypocalcemia
- calcium retention in muscles and renal tissue
Phosphate leaves cells
- hyperphosphatemia
Metabolic acidosis
- lactic acid into the circulation

RML: Late complications

- Acute renal failure from myoglobinuria (CK > 6,000 IU)
- Disseminated intravascular coagulation
- Compartment syndrome

Prevention

- Discontinue statin therapy
- Reduce weight before bariatric surgery
- Use pneumatic bed
- Change patient position intra- and postoperatively
- Limit operative time
- Perform long duration procedures in 2 stages
- Early postoperative ambulation
- Pad all pressure areas
- Optimal position of patient on OR table
- Aggressive perioperative fluid replacement ***

RML – Intraoperative prevention

- Short operative time < 2-3 hrs
- Hydration > 13 ml/kg/hr
- Encourage postop diuresis > 2.3 ml/kg/hr

8% developed RML (CK > 1,000 IU)
1 clinically significant RML (CK > 5,000 IU)


Compartment Syndrome
Large volumes of intravascular fluid (up to 12 liters) leaves circulation and enters injured muscle
→ Hypovolemia
→ Hemodynamic instability
→ Shock (further compromise of renal function)

Compartment Syndrome Requiring Fasciotomy

Morbid Obese Patient
During surgery and postoperatively - iv fluid to maintain diuresis

Rhabdomyolysis