The Critically Ill Bariatric Patient

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UCSF Dept of Anesthesia
Public Health Epidemic

Map showing the percentage of obesity by state in 1994 and 2008.
OBESITY: The percentage of the population older than 15 with a body-mass index greater than 30.

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>31%</td>
</tr>
<tr>
<td>Mexico</td>
<td>24%</td>
</tr>
<tr>
<td>UK</td>
<td>23%</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>22%</td>
</tr>
<tr>
<td>Greece</td>
<td>22%</td>
</tr>
<tr>
<td>Australia</td>
<td>22%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>21%</td>
</tr>
<tr>
<td>Hungary</td>
<td>19%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>15%</td>
</tr>
<tr>
<td>Canada</td>
<td>14%</td>
</tr>
<tr>
<td>Spain</td>
<td>13%</td>
</tr>
<tr>
<td>Ireland</td>
<td>13%</td>
</tr>
<tr>
<td>Germany</td>
<td>13%</td>
</tr>
<tr>
<td>Portugal</td>
<td>13%</td>
</tr>
<tr>
<td>Finland</td>
<td>13%</td>
</tr>
<tr>
<td>Turkey</td>
<td>12%</td>
</tr>
<tr>
<td>Belgium</td>
<td>12%</td>
</tr>
<tr>
<td>Poland</td>
<td>11%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>10%</td>
</tr>
<tr>
<td>Sweden</td>
<td>10%</td>
</tr>
<tr>
<td>Denmark</td>
<td>10%</td>
</tr>
<tr>
<td>France</td>
<td>9%</td>
</tr>
<tr>
<td>Austria</td>
<td>9%</td>
</tr>
<tr>
<td>Italy</td>
<td>9%</td>
</tr>
<tr>
<td>Norway</td>
<td>8%</td>
</tr>
<tr>
<td>Japan</td>
<td>3%</td>
</tr>
<tr>
<td>Korea</td>
<td>3%</td>
</tr>
</tbody>
</table>

Drawing by: http://www.WellingtonGrey.net
Crisis

- 75% of adults in US will be overweight or obese in **2015**!

Wang et al, Epidemiol Rev, 2007
Definitions

• Overweight: BMI > 25 kg/m²
• Obese: BMI > 30 kg/m²
• Morbidly obese: BMI > 40 kg/m²
Prevalence

- Obesity: 9-26% in med/surg ICU
- Morbid obesity: 1.4-7%

Ray et al, Chest, 2005

- Bariatric surgical patients: 6-24% will require ICU care

Cendan et al, Obes Surg, 2005
Obese patients

- Increased mortality
- Increased perioperative mortality
- Increased mortality after trauma
Mortality and severe obesity

Oliveros et al, Obesity, 2008
Procedures

• Gastric bypass (91.7%)
• Gastric banding (8.2%)
• Biliopancreatic diversion (0.1%)
• Duodenal switch

2004 Univeristy HealthSystem Consortium Benchmarking Project
Roux-en-Y Gastric Bypass

Divided stomach
Attached to intestine

Absorbs less calories
Food bypasses stomach
And upper small intestine

Decreased appetite
Altered metabolism
By changing release of various hormones

Up to Date
Gastric Band

Pt feels full after eating,
But absorption is the same

Passage of food to rest of stomach is delayed
Differences

• Restrictive procedures - banding
  – Gastric distention
  – Early satiety

• Bypass procedures - RYGB
  – Malabsorptive component
  – Quick shunting to large intestine
  – Change in GI hormones
Success

Christous et al, Can J Surg, 2009
## Success

<table>
<thead>
<tr>
<th></th>
<th>Banding</th>
<th>Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>47.9%</td>
<td>83.7%</td>
</tr>
<tr>
<td>HTN</td>
<td>43.2%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Lipids</td>
<td>58.9%</td>
<td>96.9%</td>
</tr>
</tbody>
</table>

Buchwald, JAMA, 2004
<table>
<thead>
<tr>
<th></th>
<th>Banding</th>
<th>Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 day mortality</td>
<td>&lt;0.1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Composite*</td>
<td>1.0%</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

*Death, DVT, PE, reinterventions, failure to d/c from hospital within 30 days

Flum et al, NEJM, 2009
Risk factors for ICU admission

- Male sex
- Age > 50 yrs
- BMI > 60 kg/m²
- Diabetes
- Cardiovascular disease
- OSA
- Venous stasis
- Intraoperative complications
Issues of Concern in the ICU

- Pulmonary system
- Cardiovascular system
- Nutrition
- Pharmacology
- Hypercoagulability
Pulmonary System

- Restrictive lung mechanics
  - Increased pulmonary blood volume
  - Increased chest wall mass
Compliance

![Graph showing the relationship between Cst rs (mL/cmH2O) and BMI (kg/m²). The graph includes a fitted line with the correlation coefficient r = 0.86 and p < 0.01.](image)
Pulmonary system

• Increased work of breathing
  – Abnormal diaphragm position
  – Upper airway resistance
  – Increased CO$_2$ production
  – Mechanical work is 2-4x greater

Sharp, J Clin Invest, 1964
FRC vs BMI

Jones et al, Chest, 2006
$\Delta (A-a) O_2$

Pelosi, Anesth Analg, 1998
OSA vs BMI

↓ = Patients with OSA

Nowbar, Am J Med, 2004
Critical respiratory event

- Hypoxia: Low FRC, large A-a grad
- Hypercarbia: hypoventilation
- Upper airway obstruction:
  - Relatively short neck with redundant oropharyngeal tissue
Laryngoscopy

Collins et al, Obesity Surg, 2004
## Results

**Table 2. Comparison of views during laryngoscopy**

<table>
<thead>
<tr>
<th>GRADED VIEW*</th>
<th>GROUP 1 (n)</th>
<th>GROUP 2 (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
General Articles

Morbid Obesity and Tracheal Intubation

Jay B. Brodsky, MD*, Harry J. M. Lemmens, MD, PhD*, John G. Brock-Utne, MD, PhD*, Mark Vierra, MD†, and Lawrence J. Saidman, MD*

Departments of *Anesthesia and †Surgery, Stanford University School of Medicine, Stanford, California
Results

[Graph showing the relationship between neck circumference and the probability of problematic intubation]
ICU respiratory management

- TV based on IBW
- Limit plateau pressures
- Higher PEEP
- Reverse trendelenburg position
- Unclear about early trach, but prepare longer trach tube
- Consider early CPAP after extubation
## Pulmonary outcomes

<table>
<thead>
<tr>
<th></th>
<th>Morbidly Obese</th>
<th>Nonobese</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on vent</td>
<td>10.6 d</td>
<td>4.6 d</td>
<td>0.004</td>
</tr>
<tr>
<td>Time to extubate</td>
<td>3.2 d</td>
<td>1.8 d</td>
<td>0.009</td>
</tr>
<tr>
<td>FiO₂</td>
<td>0.38</td>
<td>0.31</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Pieracci, Crit Care Med, 2006
Cardiovascular system

- Increased blood volume
  - 3 ml blood/100gm fat
- Increased afterload
- Chronic hyperdynamic state
  - LV hypertrophy
  - Decreased LV contractility
  - Diastolic dysfunction
PAP in OHS

Sugerman et al, Ann Surg, 1988
Cardiovascular issues

• Co-morbidities increase risk for CAD
  – Studies on B blockade did not include obese patients
  – May need tight BP/ HR control

• NIBP often inaccurate due to size discrepancy
## Cardiovascular Monitoring

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pneumothorax, No.</th>
<th>Catheter-Related Bacteremia, No.</th>
<th>Duration of Catheterization, days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidly obese (n = 117)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swan-Ganz</td>
<td>21</td>
<td>2 (9)</td>
<td>8.3 ± 6.5</td>
</tr>
<tr>
<td>Central line</td>
<td>82</td>
<td>9 (11)</td>
<td>13.6 ± 14.8</td>
</tr>
<tr>
<td>Arterial line</td>
<td>13</td>
<td>0</td>
<td>7.4 ± 5.4</td>
</tr>
<tr>
<td>Nonobese (n = 132)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swan-Ganz</td>
<td>11</td>
<td>0</td>
<td>5.1 ± 2.5</td>
</tr>
<tr>
<td>Central line</td>
<td>49</td>
<td>2 (4)</td>
<td>6.3 ± 8.4</td>
</tr>
<tr>
<td>Arterial line</td>
<td>4</td>
<td>0</td>
<td>3.6 ± 1.8</td>
</tr>
</tbody>
</table>

*Data are presented as No. (%) or mean ± SD unless otherwise indicated.

El-Solh, Chest, 2001
Nutrition

• “Starving” the obese patient is not beneficial
• Actually have increased REE
• Accelerated proteolysis
• 1 small study: < 20 kcal/kg/d
• Results have not been replicated

Dickerson et al, Nutrition, 2002
Nutrition

- Caloric needs generally based on ideal body weight using Harris Benedict equation
- Provide 25-30 kcal/d and 1.5-2.0 gm/kg of protein/day based on IBW
- Consider use of indirect calorimetry
Pharmacology

- Larger volume of distribution for lipophilic drugs
- Decreased lean body mass and tissue water for hydrophilic drugs
## Pharmacology

<table>
<thead>
<tr>
<th>Weight</th>
<th>Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBW (Ideal body weight)</td>
<td>Sedative infusions</td>
</tr>
<tr>
<td>TBW (total body weight)</td>
<td>Propofol, activated protein C, vancomycin</td>
</tr>
<tr>
<td>Dosing weight</td>
<td>Aminoglycosides, quinolones</td>
</tr>
</tbody>
</table>
Hypercoagulable

- VTE 0-2.4% after bariatric surgery
- PE 0-1.2%
- Although rare, most common cause of postoperative mortality
- In 3464 bariatric patients, PE was 50% of deaths

Podnos et al, Arch Surg, 2003
Prevention

- Early mobilization
- Pneumatic compression stockings
- No specific regimen
  - UFH, LMWH, fondaparinux
  - Start 1-2 hours preoperatively
Prophylactic IVC Filter

• New retrievable filters
• No data
• Consider in high-risk patients
  – Super obese (BMI > 50 kg/m²)
  – Truncal obesity
  – Venous stasis disease
  – Prior history of thromboembolism
Specific Complications

• Anastomotic leak
• Hemorrhage
• Pressure-Induced Rhabdomyolysis
Anastomotic leak

• 2nd leading cause of death (PE is #1)
• Prevalence of 0.5 - 2%
• Signs
  – Tachycardia
  – Fever, leukocytosis
  – Respiratory distress
  – Shoulder or abdominal pain
  – Change in drain output
  – NOTHING
Patient Risk Factors

- Super obese (BMI > 50 kg/m²)
- Male
- Age > 55 years old
- Prior bariatric surgery
- Multiple co-morbidities
Technical Factors

• Excessive tension
• Inadequate blood supply
• Treatment:
  – OR washout
  – Drains/ abx
GI hemorrhage

• Incidence 0.5-5%
• Early: staple lines
• Late:
  – Ulcer - peptic or marginal
  – AVM
  – Malignancies
  – Fistulas
Treatment

• Resuscitation and time  
  – Stop spontaneously

• Endoscopy  
  – Experienced endoscopist  
  – Secure airway  
  – Anesthesia
Pressure-Induced Rhabdomyolysis

- Prolonged, unrelieved pressure
- Associated with increased BMI, DM, ASA > II
- Incidence 6-75%
- Patients may c/o numbness or muscle pain
- Look for bruising or eruptions/blisters
Pressure-Induced Rhabdomyolysis

- Most often associated with prolonged OR time (>4-5 hours), but can occur in ICU
- Careful padding and Air/ pneumatic mattresses
- Serial CPKs
- Prevent AKI and electrolyte disturbances
Summary

- Understand the surgery and what the surgeon thinks
- Meticulous attention to detail
  - Difficulty with ventilator
  - Predisposing cardiovascular disease
  - Drug dosing is difficult
  - Physical exam challenging
  - Imaging often impossible
Summary

• Prevention
  – Hypercoagulable
  – Nutritional status
    • Obesity ≠ adequate nutrition
  – Nursing care
  – CRBSI and VAP
QUESTIONS