Ambulatory Anesthesia for the Obese Patient

Disclosures

- I have nothing to disclose

At the conclusion of this presentation, the attendee will be able to:

1. Identify the common anatomic and physiologic alterations present in obese patients
2. Utilize current, evidence-based practice to risk stratify obese patients for ambulatory surgery
3. Formulate safe, efficacious anesthetic plans for obese patients in the ambulatory surgical setting

What is obesity?

- According to the WHO and NIH:

<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 18.5</td>
<td>Underweight</td>
</tr>
<tr>
<td>18.5 – 25</td>
<td>Normal weight</td>
</tr>
<tr>
<td>25 - 30</td>
<td>Overweight</td>
</tr>
<tr>
<td>30 – 35</td>
<td>Class I Obesity</td>
</tr>
<tr>
<td>35 – 40</td>
<td>Class II Obesity (Severe)</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>Class III Obesity (Morbid)</td>
</tr>
</tbody>
</table>

- Health risk from any BMI increases if patient has gained more than 11 lbs. since the age of 25, or their waist circumference is ≥ 40 in

Obes Res. 1998;6 Suppl: S35

<table>
<thead>
<tr>
<th>BMI</th>
<th>Ideal weight</th>
<th>Overweight</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>13.5</td>
<td>19.0</td>
<td>25.0</td>
</tr>
<tr>
<td>0.1</td>
<td>15.2</td>
<td>20.2</td>
<td>25.2</td>
</tr>
<tr>
<td>0.2</td>
<td>16.4</td>
<td>20.5</td>
<td>25.5</td>
</tr>
<tr>
<td>0.3</td>
<td>17.0</td>
<td>20.7</td>
<td>25.7</td>
</tr>
<tr>
<td>0.4</td>
<td>17.6</td>
<td>21.0</td>
<td>26.0</td>
</tr>
<tr>
<td>0.5</td>
<td>18.2</td>
<td>21.2</td>
<td>26.2</td>
</tr>
<tr>
<td>0.6</td>
<td>18.8</td>
<td>21.5</td>
<td>26.5</td>
</tr>
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<td>19.4</td>
<td>21.7</td>
<td>26.7</td>
</tr>
<tr>
<td>0.8</td>
<td>20.0</td>
<td>22.0</td>
<td>27.0</td>
</tr>
<tr>
<td>0.9</td>
<td>20.6</td>
<td>22.2</td>
<td>27.2</td>
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Determination of body mass index from weight and height

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Keech, Brian, MD, FAAP
Ambulatory Anesthesia for the Obese Patient

Anatomic and Physiologic Alterations Present in Obese Patients

- Anatomic Implications of Obesity include:
  - Impact on choice of anesthetic
  - Relaxation
  - Anticipated difficult mask ventilation or intubation
  - Increased risk of hypoventilation/hypercapnia
  - Redundant tissue

- Physiologic Alterations are Primarily Respiratory and Cardiovascular and result from:
  1. Physical impingement of lung volumes
  2. Restriction of chest movement
  3. Increased metabolic requirements of excess tissue

- Consequences of these changes include:
  1. Faster desaturation during apnea
  2. Increased \( O_2 \) requirement
  3. Hypoventilation with supine spontaneous ventilation

\[ \text{\uparrow V/Q Mismatch} \]
\[ \text{\uparrow O_2 Consumption} \]
\[ \text{\uparrow WOB} \]
Ambulatory Anesthesia for the Obese Patient

Anatomic and Physiologic Alterations Present in Obese Patients

**Cardiovascular**
1. Increased circulating blood volume
2. Decreased SVR
3. Increased CO
4. Right and Left Ventricular Hypertrophy


**Respiratory**

↑↑ V/Q Mismatch

↑↑ WOB

↓↑ SVR

↑↑ Circulating Blood Volume

↑↑ O2 Consumption

RVH

LVH

Factors Influencing Ventricular Remodeling Include:
- Severity and duration of obesity
- Severity and duration of systemic hypertension
- Elevated SNS tone/Activation of the RAAS
- Insulin resistance with hyperinsulinemia
- Leptin resistance with hyperleptinemia
- Adiponectin Deficiency
- Lipotoxicity
- Lipoapoptosis

Prog Cardiovasc Dis 2014; 56:391

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

**The Obesity Paradox**
- Otherwise healthy overweight and class I obese patients had comparable or decreased morbidity and mortality compared with patients of normal BMI (except VTE)
- However, outcomes were worse for underweight and more severely obese patients, and for obese patients with other comorbidities


Common comorbidities include:
1. Obstructive Sleep Apnea (OSA)
2. Obesity Hypoventilation Syndrome (OHS)
3. Hypertension
4. Heart Disease
5. Diabetes
6. Metabolic Syndrome
7. Kidney Disease
Ambulatory Anesthesia for the Obese Patient

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

1. OSA
   - Repetitive episodes of apnea or reduced inspiratory airflow due to upper airway obstruction during sleep
   - Increased sensitivity to the respiratory depressant effects of sedatives and opioids and a greater tendency to obstruct the airway during sedation
   - Diabetes, HTN, pHTN, CAD and arrhythmias


Ambulatory Anesthesia for the Obese Patient

Screening

- Low risk: 0-2
- Intermediate risk: 3-4
- High risk: 5-8

UpToDate, 2017

Ambulatory Anesthesia for the Obese Patient

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

2. OHS
   - Awake alveolar hypoventilation not attributed to other conditions
   - Usually associated with OSA
   - Sensitive to respiratory-depressant effects of sedatives and opioids
   - Supplemental O2 may increase hypercapnia, leading to difficulty with weaning from mechanical ventilation

Chest. 2011;139(5):1018

Ambulatory Anesthesia for the Obese Patient

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

3. Hypertension
   - Associated with labile BP during anesthesia, cardiac, neurological and renal complications
   - Baseline blood pressure measurements should be recorded prior to the day of surgery
   - Non-urgent surgery should be postponed in instances of poorly managed HTN or if systolic ≥170; diastolic ≥110


Ambulatory Anesthesia for the Obese Patient

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

4. CAD, CHF and AF all more common in obesity

Cardiovascular Evaluation and Management of Severely Obese Patients Undergoing Surgery

A Science Advisory From the American Heart Association

Paul Nessar, MD, PhD, EBCC, FIBA; Chao, Martin K.; Al-Khun, MD; FIBA; Lee, A.; Flicker, MD, FIBA, Paul D. Thompson, MD, FIBA; Harvey J. Sugenman, MD, Lara E. Stone, PhD, MPH, RN, FIBA; Downer M., MD, PhD; Dr K. A. Spina, PhD, FIBA, on behalf of the American Heart Association Obesity Committee of the Council on Nutrition, Physical Activity and Metabolism; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing and Council on Clinical Cardiology

Circulation. 2009;120(1):108
Risk Stratification for Obese Patients undergoing Ambulatory Surgery

Cardiovascular Evaluation and Management of Severely Obese Patients Undergoing Surgery
A Science Advisory From the American Heart Association

- 2009 AHA scientific advisory on obesity:
  - Patients with at least 1 risk factor for CAD (DM, smoking, HTN, hyperlipidemia) or poor exercise tolerance should have 12-lead ECG prior to surgery
  - Chest radiograph (PA and lateral) should be obtained for severely obese patients (BMI ≥ 40)

Circulation. 2009;120(1):86

Common comorbidities include:

1. Obstructive Sleep Apnea (OSA)
2. Obesity Hypoventilation Syndrome (OHS)
3. Hypertension
4. Heart Disease
5. Diabetes
6. Metabolic Syndrome
7. Kidney Disease

Risk Stratification for Obese Patients undergoing Ambulatory Surgery

The Inappropriate Ambulatory Surgery Patient

- Unstable ASA Physical Status 3 and 4
- Malignant Hyperthermia
- Complex Morbid Obesity
- Complex OSA
- Acute Substance Abuse

Anesthesiology. 2014 Sep;121(3):667-8

Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

Implications of Obesity on Anesthetic Planning

- Anatomic and physiologic concerns
- Pharmacologic concerns
- Special equipment needs
- Induction, maintenance, emergence
- Positioning concerns
- Regional anesthesia
- Management of pain and anxiety
- Post-anesthetic care unit management

Clin Pharmacokinet. 2010;49(2):71

Obesity and Pharmacology

Obesity-related increases in lean body weight, CO, blood volume and regional blood flow can affect:

1. Peak plasma concentration
2. Renal clearance:
   - Changes in GFR, tubular secretion and tubular reabsorption are observed in obesity. Degree varies with specific drug
3. Hepatic elimination:
   - Hepatic metabolic pathways are generally enhanced in obesity. Degree varies with specific drug
**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

- The Volume of Distribution ($V_d$) is the principal determinant of a drug's loading dose
- The $V_d$ of lipophilic drugs is generally increased in obesity; less lipophilic drugs generally have little to no change in $V_d$

*Clin Pharmacokinet. 2010;49(2):71*

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**Obesity and Pharmacology**

- Pharmacodynamic changes also occur in obese individuals with certain drugs
- Therapeutic windows may be narrowed
- Side-effects may be exaggerated
- Difficult to predict

*J Pharm Sci. 1999;88(1):1*

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**Ambulatory Anesthesia for the Obese Patient**

**Ideal Body Weight (IBW):**

- Males = 50 kg + 2.3 kg per inch over 5 feet
- Females = 45.5 kg + 2.3 kg per inch over 5 feet

*Obesity. 2009;17(5):889*

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

- The Volume of Distribution ($V_d$) is the principal determinant of a drug's loading dose
- The $V_d$ of lipophilic drugs is generally increased in obesity; less lipophilic drugs generally have little to no change in $V_d$
- The Elimination half-life ($t_{1/2}$) impacts dosing interval and continuous infusion dosing
- The $t_{1/2}$ of a drug is directly proportional to its $V_d$ and inversely proportional to its clearance

*Clin Pharmacokinet. 2010;49(2):71*

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**Ambulatory Anesthesia for the Obese Patient**

**Weight for Dosing (DW)**

1. Total Body Weight (TBW)
2. Lean Body Weight (LBW):
   - Calculated by subtracting body fat weight from total body weight
   - Typically 60-90% of TBW
3. Ideal Body Weight (IBW):
   - Describes the average weight based on age, height and gender

*Obesity. 2009;17(5):889*

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology – Sedative/Hypnotics**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Weight for Dosing (DW)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol (bolus)</td>
<td>LBW</td>
<td>Titrare to clinical endpoint</td>
</tr>
<tr>
<td>Propofol (maintenance infusion)</td>
<td>LBW</td>
<td>Titrare to clinical endpoint</td>
</tr>
<tr>
<td>Midazolam</td>
<td>TBW</td>
<td>Dose incrementally until clinical endpoint is reached</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>Unknown</td>
<td>No specific dosing recommendations available. Titrare to clinical endpoint</td>
</tr>
</tbody>
</table>

*Obesity. 2009;17(5):889*
### Ambulatory Anesthesia for the Obese Patient

#### Obesity and Pharmacology - Opioids

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<tr>
<th>Drug</th>
<th>Weight for Dosing (DW)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthetic Opioids (e.g. fentanyl, sufentanil, remifentanil)</td>
<td>LBW</td>
<td>Supra-therapeutic plasma levels noted with TBW dosing</td>
</tr>
<tr>
<td>Morphine</td>
<td>IBW</td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>IBW</td>
<td></td>
</tr>
</tbody>
</table>

*Obesity. 2009;17(5):889*

#### Obesity and Pharmacology – NMBs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Weight for Dosing (DW)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-depolarizers</td>
<td>IBW</td>
<td></td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>TBW</td>
<td>Superior intubating conditions noted with 1 mg/kg TRW</td>
</tr>
</tbody>
</table>

*Obesity. 2009;17(5):889*

#### Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

**Preparation for Induction**

- Morbid obesity does not correlate with GERD
- Reverse Trendelenberg position with head elevated
- Preoxygenation performed with manually applied PEEP
- Nasal cannula at 10 LPM for passive apneic oxygenation during laryngoscopy

*Obes Surg. 2015 Nov;23(11):1939-41*

**Lung Protective Ventilation Strategy**

- Set tidal volume to 6 to 8 ml/kg IBW
- Adjust RR to normocapnia
- Keep $F_{\text{O}_2}$ below 0.5 to 0.8
- Use recruitment maneuvers every 30 minutes (10 – 20 seconds duration, plateau pressure 40 cm H$_2$O)
- Institute PEEP 6 to 8 cm H$_2$O

Ambulatory Anesthesia for the Obese Patient

Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

Reversal of NMB
- Sugammadex (2 mg/kg, dosed at IBW + 40%) shown to be superior to neostigmine in terms of recovery from NMB and TOF ratio in PACU


University of Colorado Anschutz Medical Campus

Ambulatory Anesthesia for the Obese Patient

Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

Post-Anesthesia Care Unit Management
- Use of Incentive Spirometry
- Use of Non-invasive Ventilation

Anesth Analg. 2010;110(5):1360

University of Colorado Anschutz Medical Campus

Ambulatory Anesthesia for the Obese Patient

Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

Pain Management
- Local anesthetic wound infiltration
- NSAIDs
- Acetaminophen
- Ketamine
- Gabapentin
- Clonidine/Dexmedetomidine

Obesity. 2009;17(5):889

University of Colorado Anschutz Medical Campus

Ambulatory Anesthesia for the Obese Patient

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