Anesthesia for Bariatric Surgery: What the occasional anesthesiologist should know

Prof Samar Jabbour-KHOURY, MD
Dayane DAOU, MD

American University of Beirut Medical Center
Beirut-Lebanon
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Who am I?
Unfortunately...

...he died at age 37 due to his obesity!
Introduction
• Bariatric ➔ GREEK word: *baros* = weight and *iatrics* = medical treatment

• Greatest health challenge in western countries

• UK: 23% men, 25 % women *

• USA: 200 million people are overweight**

Definition

• Excess of body fat

• Intake > Expenditure

• Genetic, behavioral, cultural and socioeconomic factors

• Reduces quality of life and life expectancy

• Increased healthcare services demands (> 100 billion dollars)
\[ \text{BMI} = \frac{\text{weight (lb)} \times 703}{\text{height}^2 \text{ (in}^2) } \]

OR

\[ \text{BMI} = \frac{\text{weight (kg)}}{\text{height}^2 \text{ (m}^2) } \text{ (metric)} \]

Categories of Weight:
- Normal: BMI 18.5 – 24.9
- Overweight: BMI 25 – 29.9
- Obese: BMI 30 – 34.9
- Severely Obese: BMI 35 – 39.9
- Morbidly Obese: BMI ≥ 40
### Body Mass Index vs. Definition

<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Definition</th>
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<tbody>
<tr>
<td>less than 18.5</td>
<td>underweight</td>
</tr>
<tr>
<td>18.5–24.9</td>
<td>normal</td>
</tr>
<tr>
<td>25.0–29.9</td>
<td>overweight</td>
</tr>
<tr>
<td>30.0–34.9</td>
<td>Class i Obesity</td>
</tr>
<tr>
<td>35.0–39.9</td>
<td>Class ii Obesity</td>
</tr>
<tr>
<td>more than 40.0</td>
<td>Class iii Obesity</td>
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The Class iii definition has been refined by the medical profession as follows.

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<tr>
<td>over 40</td>
<td>severe obesity</td>
</tr>
<tr>
<td>40.0–49.9</td>
<td>morbid obesity</td>
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<tr>
<td>over 50</td>
<td>super obesity</td>
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Limitations of BMI

- Not a direct measure of adiposity
- No account of fat distribution
- No account of duration of obesity
- Inaccurate at extremes of height
- Inaccurate with extremes of lean body mass (athletes, elderly)
Some definitions...

- **IBW = Ideal Body Weight (kg) =** height (cm) – X
  Where X = 100 in males and 105 in females

- **PBW = predictive body weight (kg):**
  Males $\rightarrow$ PBW = 50 + 0.91(height in cm -152.4)
  Females $\rightarrow$ PBW = 45.5 + 0.91(height – 152.4)

- **LBW = Lean Body Weight =** TBW (Total Body Weight) – adipose tissue
  Males = 80% of TBW
  Females = 75% of TBW
Associated co-morbidities
• Hypertension
• Coronary Artery Disease and Stroke
• Sudden death (cardiac)
• Restrictive lung disease
• Obstructive Sleep Apnea, Hypoventilation
• Diabetes Mellitus, Insulin Resistance
• Cancer (breast, gynecological, gastrointestinal)
• Osteoarthritis
• Socioeconomical and psychosocial impairment
Airway
Excess adipose tissue
Short neck
Limited neck extension

Cardiovascular
All major cardiovascular disorders are common
DVT/PE

Gastrointestinal
Steatohepatitis
Liver fibrosis
Gallbladder disease
Liver dysfunction

Neurological
Increased CVA risk
Depression

Pulmonary
Asthma
Obstructive sleep apnea
Inadequate pulmonary reserve

Endocrine
Type 2 diabetes

Musculoskeletal
Degenerative joint disease
Arthritis
Studies: weight loss of 5-10% can improve glucose intolerance, DM2, HTN and DLP!!

Obesity is second only to smoking as a preventable cause of death!!
Treatment

MEDICAL
- Sibutramine
- Orlistat
- Rimonabant

SURGICAL
- Restrictive Surgery
- Malabsorptive
- Combined
There are many types of bariatric surgeries...
Vertical Banded Gastroplasty

- Esophagus
- Small stomach pouch
- Band
- Stomach
- Staples
- Duodenum
Adjustable Gastric Band
Sleeve Gastrectomy
Roux-en-Y Gastric Bypass
Sleeve Gastrectomy with duodenal switch
Indications for Surgery

✓ BMI > 40 or between 35 – 40 + comorbidities
✓ Failed non-surgical treatment (6 months)
✓ METABOLIC SYNDROME!
✓ Needing intensive specialist management
✓ Fit for anesthesia and surgery
✓ Committed to the need of long term follow-up
Contraindications

• Unstable CAD
• Uncontrolled severe OSA
• Uncontrolled psychiatric disorder
• Mental retardation (IQ<60)
• Inability to understand the surgery
• Perceived inability to adhere to postoperative restrictions
• Continued drug abuse
• Malignancy with a poor 5-year prognosis
Health benefits of bariatric surgery

Improvement of Comorbidities
Anesthetic management for bariatric surgery
What the anesthesiologist should know preoperatively?
The pathophysiological changes associated with obesity
Respiratory system

- Decreased chest wall compliance
- Decreased lung compliance
- Decreased FRC $\rightarrow$ decreased ERV $\rightarrow$ decreased safe apnea time $\rightarrow$ rapid desaturation
  $\rightarrow$ CC $>$ FRC
- Decreased VC
Respiratory system (cont’d)

• Increased (A-a) O2 gradient
• Increased O2 consumption and CO2 production $\rightarrow$ high energy turnover
• Increased V/Q mismatch!!
• OSA $\rightarrow$ do polysomnography preoperatively $\rightarrow$ need for CPAP?
Cardiovascular system

- Increased blood volume $\rightarrow$ fat!
- Atherosclerosis and hypercoagulability!
- Increased Cardiac Output $\rightarrow$ 20-30 ml/kg
- LV wall stress $\rightarrow$ dilatation and hypertrophy $\rightarrow$ obesity cardiomyopathy
- Sympathetic activation $\rightarrow$ HTN
- Arrhythmias $\rightarrow$ fatty infiltration of conductive system
Lean normotensive

Preload  | Afterload

Obese normotensive  | Lean hypertensive

Dilatation  | Hypertrophy

Obese hypertensive

Dilatation and hypertrophy

Congestive heart failure
OBESITY

OSA/OHS
- Hypoxia
  - Increased pulmonary blood volume
    - Pulmonary hypertension
      - Increased RV workload
        - RV hypertrophy
          - RV failure
    - Increased RV workload
      - RV hypertrophy
  - Increased LV workload
    - LV hypertrophy
    - LV failure
      - Systemic hypertension
      - Coronary artery/ischemic heart disease
- Increased total blood volume
  - Increased cardiac output
    - Increased LV workload
      - LV hypertrophy

BIVENTRICULAR FAILURE
Gastrointestinal system

- Increased gastric volume (> 25 mL)
- Increased acidity (pH < 2.5)
- Increased risk of regurgitation and aspiration!!
- DM type 2
- Metabolic syndrome
- Fatty infiltration of liver
- Hiatal hernia and GERD!
Musculo-skeletal and other systems

- Oestheoarthritis
- Compression fractures
- Urinary incontinence
- Skin infections (candidiasis) → wound
- Varicose veins
- Lymphoedema
- Hypothyroidism
Airway Changes

• Limitation of movement of atlantoaxial joint and cervical spine → upper thoracic and low cervical fat pads

• Excessive tissue folds in the mouth and pharynx

• Suprasternal, presternal and posterior cervical fat pads

• Short thick neck

• Very thick submental fat pad

• OSA → excessive tissue in lateral pharyngeal walls
How does this affect drug dosing??
Effects on drug distribution

- Reduced total body water
- Increased total body fat
- Increased lean body mass
- Altered protein binding
- Increased blood volume
- Increased cardiac output
- Loading Dose ➔ Volume of Distribution
- Maintenance Dose ➔ Clearance

- Increased redistribution ➔ increased T1/2
- Increased alpha-1-glycoprotein ➔ decreased free drug concentration
Effects on drug elimination

• Hepatic clearance $\rightarrow$ only phase II affected

• Renal clearance increased $\rightarrow$ increased RBF $\rightarrow$ increased GFR (ex: increased dosing of cimetidine and aminoglycosides antibiotics)
• Highly lipophilic (BZD, BrB) → increased VD → dosed on TBW

• Less lipophilic (nondepolarizing muscle relaxants) → no change → dosed on LBW

• Increased blood volume → increased plasma concentrations of rapidly injected IV drugs

• Repeated injections → accumulation in fat → increased duration of action

➔ Exceptions: Digoxin, Procainamide and Remifentanil → highly lipophilic but dosed on LBW
Preoperative assessment

What should we focus on??
• Stabilizing comorbidities
• Identifying OSA symptoms
• Previous surgeries and previous anesthetics
• Difficult airway anticipation

NECK CIRCUMFERENCE!!:*  

- 40 cm → 5% risk  
- 60 cm → 35% risk

BMI per se is not a predictor of a difficult airway!

Routine and specific lab tests

- Glucose, lipid profile
- Vitamin deficiencies
- Liver function tests
- ABG
- Lung function tests
- Polysomnography \(\rightarrow\) initiate CPAP periop
- Echocardiography
Preoperative preparation

✓ Avoid Sedatives!

✓ Aspiration prophylaxis → PPIs, H2 antagonists

✓ Thromboembolism prophylaxis
Intraoperatively...
We need:

→ Special equipment

→ Trained personnel

→ Anesthetic expertise!!
Positioning
• Special table with a bean bag
• Cushion gel pads → pressure on gluteal muscles may lead to rhabdomyolysis!
• Proper positioning:
  ✓ Modified Lloyd – Davis position = steep trendelenburg with legs spread apart and both arms out on arm boards
Head Elevated Laryngoscopy Position (patient)

Reverse Trendelenburg Position (OR table)
ALWAYS CHECK FOR THE CRITERIA OF A DIFFICULT AIRWAY MANAGEMENT
Induction

• Head-up position (HELP)
• Stacking
• Good preoxygenation
• Tidal volumes < 13 ml/kg
• **PEEP** and recruitment maneuvers
Induction Issues

- Regurgitation*
- Aspiration
- Hypoxemia

Maintenance

• Sevoflurane and Desflurane $\rightarrow$ lower lipid solubility than Isoflurane

• AVOID N$_2$O

• Fluids well balanced $\rightarrow$ avoid ATN and volume overload

• Short-acting agents preferred

• Consider Dexmedetomidine*

• Profound muscle relaxation needed → Vecuronium, Rocuronium and Cisatracurium
• Pneumoperitoneum < 15 mmHg
• Cephalad displacement of diaphragm → displace ETT to mainstem bronchus!

• Help with intragastric balloon placement and leak tests!
Emergence

• Semirecumbent and FULLY awake

• Prompt but SAFE

• Observe in OR before transfer
Recovery Room

• SKILLED personnel
• Watch ventilation
• Initiate CPAP or BiPAP if needed
• Use multimodal analgesia
Postoperatively...

- Initiate thrombophylaxis
- Continue analgesics
- Continue CPAP if initiated
- Antibiotic prophylaxis
- PPIs and gastric protection
- Fluid management
Complications of bariatric surgery
Risk factors for complications

✓ Male
✓ Age > 65
✓ Open surgery
✓ Long operative time
✓ Cardiac and respiratory comorbidities
✓ Diabetes
✓ Low case load
General complications

- Infection
- Hemorrhage
- Incisional hernia
- Bowel obstruction
- Deep Venous Thrombosis
Specific complications

- Anastomotic leak
- Anastomotic stricture
- Dumping syndrome
- Nutritional deficiencies:
  - Vitamin B12
  - Thiamine
  - Protein
  - Vitamin A
<table>
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<tr>
<th></th>
<th>All Surgeries</th>
<th>Gastric Banding</th>
<th>Roux-en-Y</th>
</tr>
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<tbody>
<tr>
<td><strong>Early</strong></td>
<td>Bleeding, Infection, Dehydration, Peritonitis, Bowel obstruction, Perforation, Pneumonia, Pneumonia, DVT/PE, Death</td>
<td>Band slippage, Band malfunction, Infection at band site</td>
<td>Leak from anastomotic site</td>
</tr>
<tr>
<td><strong>Late</strong></td>
<td>Cholelithiasis, Cholecystitis, Pouch dilation, GERD/dysphagia, Herniation at the surgical site, Nutritional issues, Fat-soluble vitamin deficiencies (vit B12)</td>
<td>Anorexia, Band slippage, Band malfunction, Infection at band site</td>
<td>Small bowel obstruction, Marginal ulcers, Pancreatitis, Stricture</td>
</tr>
</tbody>
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In conclusion...
Health benefits

• Sustained loss of 65-80% of excess body weight
• Resolution of:
  ✓ Diabetes
  ✓ Hypertension
  ✓ Dyslipidemias
  ✓ OSA
  ✓ GERD
  ✓ Low back pain and joint pain
Obesity and Heart-Rate Variability

What’s HRV?

- Variation in intervals between heartbeats
- Reflects cardiac autonomic modulation
- Influenced in a favorable way by increased parasympathetic activity

• Obesity $\rightarrow$ autonomic imbalance $\rightarrow$ increased sympathetic and decreased parasympathetic activities $\rightarrow$ increased workload and stress on the heart $\rightarrow$ decreased HRV $\rightarrow$ risk factor for heart diseases (MI, sudden death...)

• Weight loss $\rightarrow$ restored autonomic balance $\rightarrow$ increase HRV $\rightarrow$ correlates with decreased heart diseases!!!

Increased self-esteem and participation in social activities!!
To Conclude...
Obesity...
✓ Is a major healthcare problem
✓ Increases co-morbidities and decreases the quality of life
✓ Is a daily challenge for the anesthesiologists
✓ Needs extra care during the perioperative period

➡️ Advancement in the anesthesia technology has made a dramatic improvement
Bariatric surgery is a beneficial and cost-effective healthcare intervention!
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Thank you!
Need HELP?