Obesity
Considerations for the Surgeon

Smriti Nayan, Jesse Pasternak, Julie Strychowsky
Staff Supervisor: Dr. Hubert (Anesthesiologist SJH, Obesity Resource Person)

Resident Lead Session, Surgical Foundations
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Presentation Outline

- CanMEDS
- Definitions and epidemiology
- Meet our “Biggest Loser”
- Pre-operative considerations
- Intra-operative considerations
- Post-operative considerations
- Special populations
- The Obesity Paradox
- Summary
- Questions
CanMEDS

- **Medical expert**
  - Understand the impact of obesity and important surgical considerations

- **Communicator**
  - Communicate the importance of maintaining a healthy weight with patients in a respectful manner

- **Collaborator**
  - Understand the importance of collaboration between the Surgeon, Anesthesiologists, and other health care professionals

- **Scholar**
  - Review the evidence for morbidity related to obesity in surgery

- **Manager**
  - Adequately manage resources to ensure appropriate care for all patients

- **Professional**
  - Be aware and respectful of patient factors, specifically surrounding obesity

- **Health advocate**
  - Advocate for patients that would benefit from appropriate weight-loss management and exercise strategies and facilitate their access
Obesity

- **Metabolic disease** in which adipose tissue represents a proportion of body mass tissue greater than normal

- Up to 35% of North Americans and 15-20% of Europeans are considered obese

- In the absence of further pathological conditions, adipose tissue represents 15-18% of body weight in males and ~25% in females

Canadians

According to the 2004 CCHS, 23.1% of Canadians aged 18 or older, an estimated 5.5 million adults, had a body mass index (BMI) of 30 or more, indicating that they were obese.

Canadian statistics

Data sources: 2004 Canadian Community Health Survey: Nutrition; 1978/79 Canada Health Survey
Obesity

• **Higher risk of morbidity from:**
  - Hypertension
  - Dyslipidemia
  - DM-2
  - Coronary heart disease
  - Stroke
  - Gallbladder disease
  - Osteoarthritis
  - OSA and respiratory problems
  - Endometrial, breast, prostate, and colon cancers
  - Social stigmatization and discrimination

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.
Prevalence of high BP, by BMI category and sex, household population aged 18 or older, Canada excluding territories, 2004

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly higher than estimate for normal (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
Prevalence of diabetes, by BMI category and sex, household population aged 18 or older, Canada excluding territories, 2004

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly higher than estimate for normal (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
Prevalence of heart disease, by BMI category and sex, household population aged 18 or older, Canada excluding territories, 2004

Data source: 2004 Canadian Community Health Survey: Nutrition
* Significantly higher than estimate for normal (p < 0.05)
E Coefficient of variation 16.6% to 33.3% (interpret with caution)
Etiology of obesity

• Overweight and obesity are the result of an energy imbalance over a long period of time

• Believed to involve the interaction of social, behavioural, cultural, physiological, metabolic, and genetic factors

• Behaviour and environment appear to play a large role in the development of obesity and are often the focus for prevention and treatment actions

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.
Energy imbalance

Weight Gain
Calories consumed > Calories used

Weight Loss
Calories consumed < Calories used

No Weight Change
Calories consumed = Calories used

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.
Assessment of obesity

- Body mass index
- Waist circumference

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.
**Body mass index (BMI)**

- Mathematical ratio taking into account an individual’s weight and height

<table>
<thead>
<tr>
<th>Obesity Class</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 – 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0 – 29.9</td>
</tr>
<tr>
<td>Obesity I</td>
<td>30.0 – 34.9</td>
</tr>
<tr>
<td>Obesity II</td>
<td>35.0 – 39.9</td>
</tr>
<tr>
<td>Extreme Obesity</td>
<td>≥40</td>
</tr>
</tbody>
</table>

• BMI may overestimate or underestimate body fat as it does not distinguish between body fat and muscle mass.

• Consider athletes and the elderly.
Waist circumference

- Predictor of mortality and chronic disease
- Presence of excess body fat in the abdomen is considered an independent predictor of risk factors and ailments associated with obesity

**HIGH RISK**

- Men > 102 cm ( > 40 in)
- Women > 88 cm ( > 35 in)

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. 
# Disease risk

| Classification of Overweight and Obesity by BMI, Waist Circumference and Associated Disease Risks |
|---|---|---|---|---|
| **BMI (kg/m²)** | **Obesity Class** | **Men ≤ 102 cm (≤ 40 in)** | **Women ≤ 88 cm (≤ 35 in)** | **> 102 cm (> 40 in)** | **> 88 cm (> 35 in)** |
| Underweight | <18.5 | — | — | — | — |
| Normal | 18.5 – 24.9 | — | — | — | — |
| Overweight | 25.0 – 29.9 | Increased | — | High | — |
| Obesity | 30.0 – 34.9 | I | High | — | Very High |
| | 35.0 – 39.9 | II | Very High | — | Very High |
| Extreme Obesity | ≥40 | III | Extremely High | — | Extremely High |

* Disease risk for type 2 diabetes, hypertension, and CVD.
+ Increased waist circumference can also be a marker for increased risk even in persons of normal weight.

Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.

Obesity: Weight Related Changes

- Degenerative joint disease
- Dermal pressure changes
- Restrictive pulmonary physiology
- Increased intra-abdominal pressure effects
- Mobility limitations

Obesity: Physiologic Changes

- Hyperkinetic systemic circulation
- Myocardial hypertrophy
- Elevated systemic pressure
- Diastolic dysfunction
- Increased circulating blood volume
- Metabolic syndrome

Physiological Impact of Obesity

- Pulmonary disease
  - abnormal function
  - obstructive sleep apnea
  - hypoventilation syndrome
- Idiopathic intracranial hypertension
- Stroke
- Cataracts
- Coronary heart disease
  - Diabetes
  - Dyslipidemia
  - Hypertension
- Severe pancreatitis
- Cancer
  - breast, uterus, cervix
  - colon, esophagus, pancreas
  - kidney, prostate
- Gall bladder disease
- Gynecologic abnormalities
  - abnormal menses
  - Infertility
  - polycystic ovarian syndrome
- Nonalcoholic fatty liver disease
  - steatosis
  - steatohepatitis
  - cirrhosis
- Osteoarthritis
- Skin
- Gout
- Phlebitis
  - venous stasis

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Pre-operative considerations

Ergonomics

Diagnostic investigations

Pharmacologic considerations

Airway and respiratory system

Cardiovascular system

Other
Ergonomics

- Patients may be too big or too wide for the surgical table or chair
- Increased risk of injury to the patient and personnel during patient transportation
- Increase in technical challenges or problems

Investigations

• IV access more difficult in obese patients.

• Obesity affects each imaging modality differently
  – CT, MRI, fluoroscopy limited by patient size
  – Ultrasound, plain X-ray, nuclear medicine limited by attenuation through excessive fat

Table 1: Maximal available weight limit and aperture diameter per imaging modality

<table>
<thead>
<tr>
<th>Imaging modality</th>
<th>Weight limit (lb)</th>
<th>Maximum aperture diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoroscopy</td>
<td>700</td>
<td>63</td>
</tr>
<tr>
<td>Multidetector CT</td>
<td>680</td>
<td>90</td>
</tr>
<tr>
<td>Cylindrical-bore CT</td>
<td>550</td>
<td>70</td>
</tr>
<tr>
<td>MR imaging 1.5 T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical-field MR imaging 0.3–1.0 T</td>
<td>550</td>
<td>55</td>
</tr>
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Pharmacology

• Obese body characterized by a higher proportion of adipose tissue and lower proportions of tissue water and lean body mass ⇒ differing patterns of drug absorption and distribution can lead to subtherapeutic or toxic drug responses

• Most anesthetic agents are lipid soluble to rapidly cross the blood-brain barrier
  – Induction dosing should follow the ideal body weight
  – Adipose tissue has low blood flow with minimal early transfer to the fat compartment
  – Steady state volume of distribution will be larger in the obese patient, serum concentration for a given dose lower, and terminal elimination half-life of the drug greater
  – Absence of delayed awakening from anesthesia

Pharmacology II

• **Opioids should be avoided when possible**
  – Can produce rapid and sustained dose-dependent depression of ventilation ⇒ especially problematic in patients with OSA

• **Remifentanyl** seems to be the ideal narcotic because of a short half-life and lack of appreciable accumulation

• **Midazolam and diazepam** have an increased absolute dose and prolonged duration of action because of larger initial dose to achieve serum concentration and distribution to fatty tissues

Pharmacology III

- Prophylactic antibiotic dosing may be adjusted by weight for morbidly obese (cefazolin 1g vs. 2g)

- May consider administration of an antacid, promotility agent, and H2 receptor antagonists due to the theoretical elevated risk of GERD

Airway

• Difficulty in mask ventilation and intubation due to features such as a fat face and cheeks, short neck, large breasts, large tongue, excessive palatal and pharyngeal soft tissue, restricted mouth opening, limitation of motion of cervical spine

• May consider use of glidescope or awake fibreoptic bronchoscopic intubation

• For patients requiring tracheotomy, standard tracheotomy tubes may be too short and too curved for proper positioning
  – Higher risk of dislodging or occlusion
  – Obscured landmarks especially worrisome in an emergent situation

Tracheostomy tubes
OSA and OHS

- OSA and obesity hypoventilation syndrome related to both the anatomic and functional characteristics of the pharyngeal muscular structures and to the state of central nervous system activity.

- Narrowing of upper airway due to an extrinsic soft tissue enlargement caused by fat deposits in the posterolateral oropharyngeal area.

- Decrease of CNS activity during REM phase of sleep results in a decrease in the diaphragmatic and oropharyngeal muscle activity that facilitates airway collapse.

- May consider pre-operative polysomnography and adequate post-operative monitoring.

Respiratory system

• **Increased minute ventilation requirement at rest** to meet the metabolic needs of increased tissue mass, increased work and energy cost of breathing and changes in lung volumes.

• **Hypoxemia may be mild or absent** (if not affected by OHS); morbidly obese patients are often hypoxemic with at-rest consumption of oxygen ~25% higher than in non-obese patients.

• **Carbon dioxide almost normal** (if not affected by OHS) due to an unchanged physiological dead space and ratio of dead space to tidal volume.


Respiratory system

• Typical restrictive pattern with a reduction of FVC (from 25% to 50% predicted), FRC, and TLC in morbidly obese patients

• Compliance of respiratory system is low (~35% lower than predicted) mainly due to the effect of obesity on the chest wall

• Patient positioning aggravates these lung volumes and contributes to poor respiratory reserve (reverse Trendelenberg position optimal)

• May consider pre-operative pulmonary function testing


Cardiovascular system

- Increase in blood volume and cardiac output

- Increased cardiac output largely the result of ventricular dilation that causes increased wall stress and hypertrophy and manifest as reduced compliance, pulmonary edema, and systolic dysfunction, ultimately resulting in right- and left-sided heart failure

- Pre-operative investigations including ECG, echocardiogram, stress test, or other when warranted

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Intra-operative considerations

- Regional Anesthesia
- General Anesthesia/Opioids
- DVT Prophylaxis

- Intra-operative Fluids
- Surgeon considerations
- Bariatrics
Regional Anesthesia

• Beneficial in obese patients when possible
  – Minimal intraoperative airway interventions
  – Less cardio-pulmonary depression
  – Improved pain control
  – Potentially shorter recovery and LOS

• Warnings
  – Obese patients are technically more difficult
  – Less anesthetic might be required to achieve adequate analgesia
  – Not much literature (most from OBS)
General Anesthesia

• **Sevoflurane**
  – Increases inorganic fluoride levels
  – Metabolized 100% faster in obese patients
  – Fluorides can build up and cause nephrotoxicity

• **Desflurane**
  – Most resistant to hepatic degradation
  – Low solubility profile
  – Less deleterious effects on BP
  – Rapid washout
Opioids

Nociceptor Stimulation

Tissue Injury

Activation of Central Pathways

PAIN
Opioids

• Remi/Fentanyl/Morphine/Dilaudid etc
• Fat Soluble
DVT Prophylaxis

• Anticoagulation

• SCD compression system

• TED stockings
  – deterrent
DVT Prophylaxis

Intra-operative Fluids

• Nisanevich et al – non-obese study

• More bariatric procedures tend to restrict
  – Ideal vs actual body weight
Surgeon Considerations

• **Laparoscopic surgery**
  – Pneumoperitoneum
    • ↑vascular resistance, ↓ cardiac index, ↑MAP transiently
  • Rare reflex bradycardia

• **Peripheral nerve injury**
  – Brachial plexus, ulnar nerve palsy
    • Positioning + VIT B def
Surgeon Considerations

- Surgeon Expertise
- Hospital Facility Expertise
Bariatrics

More Common Today

Gastric Band
Gastric Sleeve Resection
Gastric Bypass
Bariatrics

• Anastomotic leak
  – 2% overall
  – Usually occult

• Wound complications
  – Infection - 3% vs 7% (open)
  – Incisional hernia – 0.45% vs 9% (open)

• Internal hernia
  – 2-3% lap

• Thromboembolism
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Post-operative considerations

- Post-surgical Monitoring
- Thromboembolic Events
- Analgesia
- Wound Complications
- Respiratory Complications
General Considerations

• **Postsurgical Monitoring:**
  – ICU vs. step-down unit should be considered for patients with class 3 obesity (BMI > 40) or class 2 obesity (BMI > 35) with medical risk factors.
  
  • **Advantages:** gentler weaning from ventilator, easily perform chest physiotherapy and non-invasive ventilation, optimize fluid balance and pain control.
  
  • **Disadvantages:** increased cost and more difficulty in organizing the surgery.

• Obese patients are more likely to have **obstructive sleep apnea**.

• **Arterial Blood Gases**

Respiratory Complications

• Patient's weight, BMI or preoperative lung function tests are not accurate predictors of postoperative complications.

• Obese patients have reduced FRC due to reduced lung and chest compliance.

• More predisposed to post-operative sputum retention, atelectasis, hypoxia, hypercapnia and bronchopulmonary infection.

• Adequate ventilator settings aimed to keep the lung open during surgery and post-operatively may help to reduce pulmonary complications.
Respiratory Complications

2. Pathophysiological mechanisms leading to postoperative pulmonary complications in obese patients.

Respiratory Recommendations

• To avoid respiratory complications, the following treatments are recommended (although limited clinical studies):
  – Semi-recumbent position (30-45°)
  – Chest physiotherapy
  – Incentive spirometry
  – Intermittent positive pressure breathing
    • Non-invasive CPAP
  – Early ambulation
Respiratory Recommendations

- **Non-invasive CPAP**: simplest method of respiratory assistance and should be administered as early as possible when the PaO2/FiO2 ratio falls below 300, and maintained for a prolonged period of time during the day.

- **Non-invasive positive pressure ventilation (PSV + PEEP)** may have a role in the treatment of selective patients with severe restrictive disorders or when they develop acute lung injury.

Proinflammatory Phenotypic Changes in Obesity

- Vascular intimal atherosclerotic changes

- Prothrombotic state with:
  - Increased fibrinogen
  - Decreased fibrinolysis
  - Increased antithrombin-III levels
  - Increased plasmin activator inhibitor levels
  - Increased blood viscosity

Thromboembolic Events

• In addition to the obesity related changes, the post-operative course is further complicated by:
  • Prolonged immobilization
  • Increased intraabdominal pressure which increases the pressure in the inferior vena cava and causes venous blood stasis, heart failure.

• Thus, greater incidence of DVT postoperatively occurs in obese patients, compared with the non-obese.

• Pulmonary embolism occurs in obese patients twice as often as in non-obese patients
  • Prophylactic anticoagulant therapy and pneumatic compression devices should be considered in all obese patients.

Wound Complications

• Obesity is an independent risk factor:
  – longer incisions
  – protracted operation times
  – tissue trauma
  – excessive traction
  – difficulty in tissue dead space
  – obliteration and inability of adipose tissue to resist infection

Wound Infection

- **Surgical wound infections** occur in 2% to 5% of clean extraabdominal surgeries and up to 20% of abdominal surgeries.

- **Wound complications** (dehiscence or incisional hernia) complicate roughly 10% to 20% of surgeries in morbidly obese patients.

- **Pre-operative antibiotics** tailored to procedure and location of procedure, dosed to weight and administered 30 mins before the skin incision is made.

- **Laparoscopic procedures** have reduced incidence of postoperative wound complications.
  - Nguyen et al. found that the rate of wound infection after open gastric bypass surgery was 10.5% compared with only 1.3% after laparoscopic gastric bypass.

Analgesia

• **I.M. route:**
  – not recommended due to the unpredictable effects and it’s inferiority as a route of administration compared to the other routes.

• **I.V. route:**
  – possible therapeutic method in obese patients, however, changed pharmacokinetics of these drugs must be considered.

• **I.V. patient-controlled analgesia:**
  – effective in relieving pain in obese patients.
  – Opioid doses administered this way are not weight- or body surface area-dependent.
  – Dosing rate should be based on ideal, rather than absolute body weight.

Analgesia

- **Extradural route**: Preferred route, using either local anesthetics or opioids.

- It permits:
  - More vigorous cough
  - More chest physiotherapy
  - More vigorous leg exercise
  - Earlier ambulation
  - Earlier PO intake
  - Lower incidence of pulmonary alveolar collapse and thromboembolic events.
  - Earlier discharge from hospital

- Reduced incidence of opioid ASE such as drowsiness, respiratory depression and nausea.

- Moreover, when morphine analgesia was administered extradurally to obese patients, supplementary requirements were 7 to 8 times less compared with I.M. morphine.

- Postoperative extradural bupivacaine analgesia was more efficient than i.v. morphine with regard to cardiac protection.

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Surgery in the Obese Pregnant Patient

• Maternal obesity increases surgical risks for both the fetus and mother.

• Nearly half of U.S. women of childbearing age are either overweight or obese.

Maternal Risks

- Increased risk for
  - preeclampsia
  - cesarean section
  - wound infection
  - deep venous thrombosis

Fetal Risks

- Increased risk for
  - Macrosomia
  - Shoulder dystocia
  - Stillbirth
  - Congenital anomalies: neural tube defects, omphalocele, and congenital heart defects.
  - Fetal exposure to hyperglycemia and hyperinsulinemia in utero results in altered metabolic programming and increased risks for the development of childhood diabetes, hypertension, and premature coronary artery disease.
Special Considerations for the Obese Pregnant Patient

- Pre-operative investigations, thromboembolic prophylaxis and antibiotic prophylaxis the same.

- Maternal positioning to avoid compression of the inferior vena cava.

- Operating table should be able to accommodate weight

- Need for Fetal Heart Rate monitoring?
  - No publications have specifically addressed the efficacy of fetal heart rate monitoring in obese patients undergoing nonobstetric surgery.

Surgery in the Obese Pediatric Patient

• In Canada over 26% of children and youth (1.6 million children) are considered overweight or obese.

• 50% of obese children will grow up to be obese adults while 75% of obese adolescents will be obese adults.

http://www.childhoodobesityfoundation.ca/
Surgery in the Obese Pediatric Patient

- Hypertension ($P = 0.001$), type II diabetes ($P = 0.001$) and bronchial asthma ($P = 0.006$), obstructive sleep apnea, hypercholesterolemia are more common in children with BMI over the normal range

- Difficult airway more common

- Overweight and Obese children were more likely to have prolonged stay (>3 h) in the PACU probably a reflection of the increased incidence of upper airway obstruction ($P = 0.001$) and need for more than two antiemetics


Let’s revisit Frado...
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The Obesity Paradox

- American College of Surgeons, National Surgical Quality Improvement Program study reviewed more than 118,707 nonbariatric surgical procedures (including laparoscopic) during the period of 2005 to 2006. BMI classes were compared and regression analysis was performed.*
  - Underweight patients had a significantly higher 30-day mortality (5%) than the other classes.
  - In the overweight class, postoperative mortality (1.2%) was less than in the normal-weight class (1.8%); however, it increased by overweight category (1.0%–1.3%). (OR and 95% CI: 2.80, 2.30 to 3.38) respectively.
  - Analysis of vascular procedures in 7500 patients showed that the risk factors of DM and HTN were higher in the obese categories, the mortality curve showed a J-shape over normal-weight individuals.

* One significant issue was that underweight patients seemed to undergo longer and more complex procedures than any other class.

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Summary

• The management of the clinically severe obese patient requires meticulous preoperative, intraoperative, and postoperative care.

• Careful preoperative planning is essential before taking the patient to the operating room.

• Multidisciplinary approach is necessary: primary care physician, anesthesiologist, surgeon, nursing staff, and social work, is necessary.

• Role for peri-operative weight counseling.
Questions?

Thank you for listening.
References


