Anesthesia for Bariatric Surgery

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Obesity

- An abnormally high percentage of body weight as fat
- Android vs. Gynecoid
  - Apple shaped vs. Pear shaped
  - Android has more truncal component and consequently more oxygen consumption and higher incidence of CV disease
- Generally classified based on body mass index (BMI)
  - BMI = weight (kg)/height^2 (cm)
  - <18.5 – underweight
  - 25-29.9 – overweight
  - 30-39.9 – obese (class I/II)
  - 40 and above – extreme/morbid obesity

Disclosure Statement

- I do not have relevant financial relationships with commercial interests related to the content of this presentation.

Ideal and Lean Body Weight

- Lean body weight = total body weight – adipose tissue
  - Approximately 80% TBW in males and 75% in females
  - VERY difficult to measure – poss. calipers, impedance measurement, DEXA, ultrasound
- "Ideal" body weight – determined by life insurance companies
  - Men: Height (cm) – 100
  - Women: Height (cm) – 105
  - In nonobese patients, IBW~TBW~LBW
  - In extremely obese patients, increasing IBW by 20-30%~LBW

Learning Objectives

- **1) List the problems and additional risk factors encountered when morbidly obese patients are surgical/anesthesia candidates**
- **2) List indications and contraindications to Bariatric surgery**
- **3) List the available surgical options for morbidly obese patients**
- **4) Plan anesthetic management highlighting prevention of aspiration, eye injuries, compression injuries, hemodynamic and respiratory compromise, etc**
- **5) Plan appropriately for post-anesthetic care of obese patients.**

Physiologic Consequences of Obesity

- Respiratory
- Cardiovascular
- Gastrointestinal
- Endocrine/Metabolic
- Renal
- Neurologic
- Hematologic
- Musculoskeletal
- Psychiatric

Respiratory Changes with Obesity

- Reduced chest wall and lung compliance
  - Main component is chest wall due to increased tissue
  - Lung compliance may actually remain normal
- Decreased functional residual capacity
  - Directly related to a change in ERV
  - Can cause resting tidal breathing to create lung volumes below the lung's closing capacity and small airway closure
  - This leads to V/Q mismatch or shunt, and hypoxemia
  - Exaggerated further decrease with induction of GA
- Increased minute ventilation
  - Results from increased oxygen consumption and CO2 production

Obesity Hypoventilation Syndrome

- Occurs in 5-10% obese patients and separate from/possibly concurrent with OSAS
- Obesity and chronic hypoventilation result in pulmonary hypertension/cor pulmonale
- Altered control of breathing from chronic hypercapnia → CNS mediated apnea
- Eventual progression to right heart failure
- Must rule out other causes of hypercapnia

Obstructive Sleep Apnea Syndrome

- Upper airway obstruction that occurs in ~5% of obese patients
- Presents with symptoms of apnea and snoring, daytime sleepiness, memory problems, morning headaches
- Apnea-hypopnea index quantifies the severity of OSAS (>30 events/hr is severe)
- Oxygen saturation and drop dramatically during events – at least 4% decline in SpO2 and up to 50%
- Ventilatory parameters are normal except in period of apnea
- Can result in systemic disease: hypoxemia, hypercapnia, pulmonary and systemic vasoconstriction, polycythemia

Cardiovascular Consequences of Obesity

- Increased total blood volume, but decreased based on weight
- Increased cardiac output – results from LVEDV/SV increase (can get ventricular dilation)
  - Increased LV work and stress → LVH and diastolic dysfunction
- Systemic hypertension – increased RAA axis activity
- Accelerated atherosclerosis → CAD, PVD, cerebrovascular disease
  - May not get typical anginal symptoms as obesity leads to limited mobility and exercise ability
- Conduction abnormality – fatty infiltration

STOP BANG

- Snoring (loudly)
- Tired (during daytime)
- Observed – stopped breathing during sleep
- Pressure – treatment for hypertension
- BMI - >35 kg/m2
- Age - >50
- Neck circumference - >40cm
- Gender – Male

- *High risk of OSAS* – 3 or more positive responses

Gastrointestinal System Changes

- Increased gastric volume, Decreased gastric pH
  - Antral distenstion and hormone release play a role, increased parietal cell secretion reduced pH
  - Fasted obese patients may still have >25mL fluid at pH <2.5
- Increased incidence of hiatal hernia and GERD – aspiration risk
- Nonalcoholic fatty liver disease
  - Can lead to inflammation, focal necrosis, cirrhosis
  - Elevated LFT are not necessarily indicative of functional decline (most often ALT increased)

Endocrine Changes

- Impaired glucose tolerance – 10%
  - Fat infiltration in tissues causes inability to respond to insulin
  - Eventually lead to type 2 diabetes mellitus
  - Predisposes to infection and MI
- Hypothyroidism – up to 25%
  - Possibly due to thyroid hormone resistance in fat infiltrated tissues
  - Associated with hypoglycemia, hyponatremia, and impaired hepatic drug metabolism

Other Organ System Effects

- Neurologic
  - Increased incidence of carpal tunnel syndrome, pseudotumor cerebri
  - Increased incidence of CVA from vascular disease
- Musculoskeletal
  - Gout, Osteoarthritis, and rheumatoid arthritis are more commonly seen
- Psychiatric
  - Depression, reduced self esteem, social concerns

Metabolic Syndrome

- Constellation of abdominal obesity, glucose intolerance, hypertension, and dyslipidemia
- Watch for vascular events
- 5x risk of developing type 2 DM
- 2x risk of death from MI or stroke

Pharmacologic Considerations

- Drug dosing should take into account the volume of distribution and clearance of a drug
  - Vd is most important in determining the appropriate loading dose, clearance is most important in determining the maintenance dose
- If a drug is mainly distributed to lean tissues, LBW should determine dose, if equally to fat and lean tissue, then TBW is used for weight based dosing
- Maintenance doses should use LBW when clearance is the same in obese vs nonobese people, but should be increased in drugs that are cleared more rapidly in obese patients

Other Organ System Effects

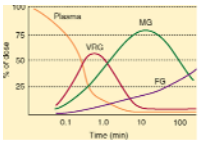
- Renal
  - Glomerular hyperfiltration – due to inc. RBF and GFR
  - Increased tubular reabsorption – inc. RAA activity
  - Possible progression to nephron loss of function
- Hematologic
  - Hypercoagulability and DVT risk – release of bioactive substances from adipose tissue
  - Increased levels of fibrinogen, FVII, FVIII, PAI-1
  - Reduced ability for fibrinolysis
  - Polycythemia possible in cases of prolonged hypoxemia/OHS

Pharmacologic Considerations

- First distribution of IV drugs is usually unchanged in obese patients
- Vd changed by reduced total body water, increased body fat, increased blood volume, and altered protein binding (possibly more binding)
- Increased Vd will lead to prolonged elimination time despite unchanged ability of the body to clear a drug
- Increased splanchnic blood flow should decrease bioavailability of oral drugs, but mainly only seen with drugs cleared by phase II reactions (conjugation)
- Renal elimination generally increased in obesity

ACCESS Medicine

From: Chapter 9. Intravenous Anesthetics
Morgan & Mikhail's Clinical Anesthesiology, 5e, 2013



Legend:

Distribution of thiopental from plasma to the vessel-rich group (VRG; brain, heart, liver, kidney, endocrine glands), to the muscle group (MG), and finally to the fat group (FG). (Modified and reproduced, with permission, from Price HL et al: The uptake of thiopental by body tissues and its relation to the duration of narcosis. Clin Pharmacol Ther 1960;1:16.)

Pharmacologic Considerations

- Opioids
  - LBW correlates better with required plasma concentrations and total body clearance than TBW dosing for fentanyl
  - Sufentanil has increased Vd and prolonged clearance – initial dose based on LBW but infusion should account for TBW; plasma concentration will be overestimated in extremely obese
  - Remifentanil dosed by LBW as clearance should be same in both and duration of action very short
- Take home point is that initial doses may be diluted by extra plasma volume, but TBW dosing will be excessive due to poor blood flow in fat

Pharmacologic Considerations

- Induction Agents:
  - Thiopental – larger Vd and fat stores leads to possibility of prolonged somnolence, dose based on LBW with slight increase to account for inc blood volume and cardiac output
  - Propofol – No difference in initial Vd between obese and nonobese, maintenance infusion will show larger Vd, but clearance is increased so accumulation effect is small, dose based on LBW for induction and TBW for infusion
- Benzodiazepines
  - Highly lipophilic, long persistence in body of obese patients
  - Possibly prolonged sedation

Candidates for Bariatric Surgery

- 1991 NIH Guidelines still widely followed with some alterations by CMS:
  - BMI >35 with at least one obesity related comorbidity (usually type 2 diabetes, also HTN, OSAS, severe dyslipidemia)
  - BMI >40 irrespective of comorbidities
- Usually have to demonstrate that medically directed weight loss has failed with a reasonable effort over time
- Considerations being made for Adjustable Gastric Band with BMI 30-35 and at least one comorbidity – studies ongoing on outcomes for these patients
- Largest predictors of risk (10 year mortality): diabetes, age, current smoking, male sex
- Very high BMI patients have increased mortality, but only at extreme levels

Pharmacologic Considerations

- Neuromuscular blockers and reversal agents
  - Increased pseudocholinesterase activity with weight increase → higher dose of succinylcholine (TBW based)
  - Rocuronium and vecuronium show prolonged activity when dosed by TBW – so dose LBW
  - Atracurium and cisatracurium also show delayed recovery with TBW dosing
  - TBW dosing of reversal shows rapid early reversal with TBW dosing, but still with prolonged full recovery

Contraindications to Bariatric Surgery?

- Case by case basis
- SAGES: "There are no absolute contraindications to bariatric surgery. Relative contraindications to surgery may include ***severe heart failure, unstable coronary artery disease, end-stage lung disease, active cancer diagnosis/treatment, cirrhosis with portal hypertension, uncontrolled drug or alcohol dependency, and severely impaired intellectual capacity. Crohn's disease*** may be a relative contraindication to RGB [58] and BPD [59], and is listed by the manufacturer as a contraindication to the LAP-BAND® system." and "Laparoscopic surgery may be difficult or impossible in patients with ***giant ventral hernias, severe intra-abdominal adhesions, large liver, high BMI with central obesity or physiological intolerance of pneumoperitoneum***."

Anesthesia for Bariatric Surgery

- Malabsorptive vs restrictive procedures
- Usually performed laparoscopically or with robotic assistance – robot is positioned squarely in the anesthesia area
- Laparoscopic associated with less postop pain and fluid shifts
- Pneumoperitoneum makes ventilation very difficult
- Positioning makes venous return and cardiac output greatly reduced
- Our assistance is often needed in passing esophageal bougie, leak tests with air/saline/methylene blue
- Rhabdomyolysis is a serious problem in prolonged procedures – postop buttock/hip/shoulder pain can be indicative – check CPK and myoglobin, watch urine for color changes

Roux-en-Y Gastric Bypass

- Malabsorptive procedure – concern for nutritional deficiencies postoperatively
- Data suggests greater and more easily maintained weight loss compared to other procedures
- Worry about dumping syndrome postoperatively with poor diet compliance, anastomotic leak, internal hernia
- Demonstrates remission of type 2 DM, hypertension, dyslipidemia, and OSAS
- Longer and more complex operation

Types of Bariatric Procedures

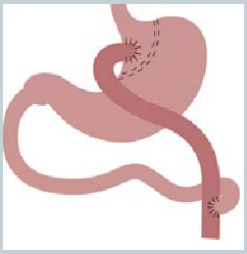
- Roux-en-Y gastric bypass
- Vertical sleeve gastrectomy
- Adjustable gastric banding
- Biliopancreatic diversion +/- duodenal switch

- First three account for 93% of worldwide bariatric procedures

Vertical Sleeve Gastrectomy

Arterburn DE, Courcoulas AP. Bariatric Surgery for Obesity and Metabolic Conditions in Adults. BMJ 2014; 349: g3961.

Roux-en-Y Small Pouch Gastric Bypass



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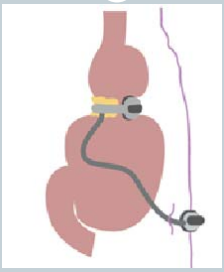
Vertical Sleeve Gastrectomy

- Restrictive procedure
- Successful weight loss and remission of DM – somewhere in the middle of RYGB and band in terms of success rates and maintenance
- Faster operation – becoming more common in high risk patient population
- Worry about leak, postoperative vomiting, possible reexpansion of the stomach and loss of restriction

Adjustable Gastric Band



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Anesthetic Considerations in Obese Patients

- Consider the specific physiologic changes associated with obesity
- Preoperative Assessment
  - Look at old anesthetic records
  - Cardiac eval – systemic/pulmonary HTN, right/left heart failure, ischemic heart disease, EKG
  - Respiratory eval – OSA/OHS, hypoxemia/hypercapnia, CPAP?, plan for postop ventilation/invasive monitoring
  - Metabolic/nutritional eval – previous bariatric surgery?, diabetes, electrolyte abnormalities, liver dysfunction
  - AIRWAY – plan for awake?

Adjustable Gastric Band

- Restrictive procedure
- Very short operation, least invasive
- Still with successful weight loss – falling out of favor due to emergence of sleeve gastrectomy
- Very high reoperation rate for complication/failure (up to 50%)

Anesthetic Considerations

- Premedication
  - Continue most home meds – except hypoglycemics in most patients
  - DVT prophyaxis – may need SQ heparin preop and at least TED/SCD
  - Aspiration risk – preop H2 blocker, oral antacid, PPI, +/- promotility agent
  - Anxiolysis – midazolam usually ok, consider drugs with minimal respiratory effects (clonidine, dexmedtomidine)

Future Avenues

- Single incision bariatric procedures
- Natural orifice operations
- Endoscopic weight loss surgery

Anesthetic Considerations

- Intraoperative
  - Monitoring – 5 lead ECG, consider invasive monitoring, forearm NIBP measurements overestimate SBP/DBP
  - Access – possible need for central line
  - Airway – large neck circumference (>40 cm) is the single biggest predictor of difficult laryngoscopy
    - POSITIONING – head-elevated laryngoscopy position (aka sniffing), tragus should be at level of or above sternal notch
    - plan for difficult mask ventilation
    - Many are actually easy laryngoscopy – WITH POSITIONING
    - Consider awake intubation in predicted or proven difficult airway
    - Consider possibility of aspiration of gastric contents and plan accordingly – rapid sequence?

Anesthetic Considerations

- Intraoperative (continued)
  - Positioning – Big table or double tables (max ~ 200kg), consider bean bag
    - CHECK PRESSURE POINTS meticulously – increased risk for nerve injury and rhabomyolysis in longer procedures
    - Consider effects of surgical positioning on ventilation and cardiovascular system
  - Induction – PREOXYGENATE (3 min or 4 VC breaths), may need larger doses of induction agents as discussed (LBW vs IBW)
  - Maintenance – any volatiles are ok, infusions of short acting medications are most useful, same with opioids, for more rapid emergence, dexmedetomidine can be useful due to less respiratory depression and analgesic properties

References

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Anesthetic Considerations

- Intraoperative (continued)
  - Ventilation – plan TV based on IBW, >13 ml/kg does not improve recruitment and oxygenation, PEEP is the most useful measure, but watch for decreased venous return
  - Fluids/Blood loss – avoid overdoing fluids – prone to CHF
    - Obese have higher blood loss due to possible venous congestion and more difficult surgical exposure
    - Less tolerant of small volume losses – consider early blood products or colloids
  - Regional anesthesia – great alternative to GA due less ventilatory and cardiovascular changes – may be more technically difficult and thus, unsuccessful
    - Neuraxial – epidural doses should be lowered due to reduced volume in epidural space, engorged epidural veins can cause IV catheters, technical diffuclties
    - Consider spinal block – technically easier, catheter less likely to migrate, easy to titrate
    - CSE is probably best – benefits of both modalities and early ambulation

Anesthetic Considerations

- Postoperative
  - Emergence – extubate in head up position, consider immediate/early transition to CPAP or BIPAP, adequate analgesia is key to preventing pulmonary complications, do not extubate unless you are confident that the pt will maintain adequate airway and ventilation (deep and pre-stage 2 extubations are a BAD idea)
  - Should use incentive spirometry immediately, pulmonary complications are the most devastating in the obese population
  - If no regional technique, transition to IV PCA ASAP
  - Problems in PACU are most commonly related to sedation, hypoxemia, hypoventilation, and possibly DVT/PE