Objectives

- Obesity Definitions
- Pathophysiology of Obesity
- Altered Pharmacology Associated with Obesity
- Medical Therapy for Obesity
- Bariatric Surgery
- Preoperative Evaluation
- Intra-operative Considerations
- Airway Management / Awake Fiberoptic Intubation
- Postoperative Considerations / Surgical Complications

Obesity Definitions

- **Obesity** - an abnormally high % of body weight is fat
- **Overweight** - an increased body weight above a standard (relative to height)
- **Ideal Body Weight (IBW)** is the weight associated with the lowest mortality (height and gender)
- **IBW (kg)** = height (cm) – 100 (men) or 105 (women)
Obesity Definitions
- **Body Mass Index (BMI)** - the criteria
- **BMI = body weight (kg) / height (m)^2**

Obesity Definitions
- **Obesity** - a BMI > 30 kg/m^2
- **Morbid obesity** - a BMI > 40 kg/m^2
- **Super morbid obesity** - a BMI > 55 kg/m^2

Limitations to BMI
- Overestimate body fat in persons who are very muscular i.e. body builders
- Underestimate body fat in persons who have lost muscle mass i.e. elderly
Why is Obesity Important?
Diseases linked to Obesity:

- CAD
- HTN
- CVA
- DM (3x higher...over 80% NIDDM are obese)
- Endocrine Disease
- Cholesterol
- Arthritis
- OSA
- CRI
- Venostasis
- Cholelithiasis
- Decreased Life expectancy

Heart Disease

- Hypertension twice as common
- Increased risk: MI, CHF, Sudden Death, Arrythmias.
**Diabetes**

- A gain of 11-18 lbs increases the risk of developing NIDDM to twice that of normal individuals
- Over 80% of people with DM type 2 are overweight or obese

**Respiratory**

- Sleep Apnea
- Obesity Hypoventilation Syndrome
- Asthma
- Decreased FRC
- Increased risk of aspiration from GERD
- Difficult airways (ventilate and intubate)

**Other**

- Arthritis
- Reproductive complications
- Gallbladder disease
- Depression, Social Discrimination
Obesity Trends Among U.S. Adults between 1985 and 2007

CDC’s Behavioral Risk Factor Surveillance System (BRFSS).

Prevalence of Obesity Among U.S. Adults between 1985 and 2007

CDC’s Behavioral Risk Factor Surveillance System (BRFSS).

- 1990
  - 10 states < 10%
  - No state > 15%

- 1998
  - No state < 10%
  - 7 states 20-24%
  - No state > 25%
Obesity Trends* Among U.S. Adults
1985

Obesity Trends* Among U.S. Adults
1987

Obesity Trends* Among U.S. Adults
1989
Obesity Trends* Among U.S. Adults
1991

Obesity Trends* Among U.S. Adults
1993

Obesity Trends* Among U.S. Adults
1995
Obesity Trends* Among U.S. Adults
1997

Obesity Trends* Among U.S. Adults
1999

Obesity Trends* Among U.S. Adults
2001
Obesity Trends* Among U.S. Adults
2003

No Data          <10%           10%–14%           15%–19%           20%–24%          ≥25%

Obesity Trends* Among U.S. Adults
2005

No Data          <10%           10%–14%           15%–19%           20%–24%          25%–29%          ≥30%

Obesity Trends* Among U.S. Adults
2007

No Data          <10%           10%–14%           15%–19%           20%–24%          25%–29%          ≥30%
Obesity Trends* Among U.S. Adults

2008

No Data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | ≥30%

Obesity Trends* Among U.S. Adults

2009

No Data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | ≥30%

Prevalence of Obesity Among U.S. Adults between 1985 and 2007

CDC’s Behavioral Risk Factor Surveillance System (BRFSS).

2007

- only one state (Colorado) < 20%
- 30 states > 25%
- 3 states (Alabama, Mississippi and Tennessee) > 30%.

2009

- 9 states (Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, Tennessee, and West Virginia) > 30%
Caveat
- BMI does not discriminate between muscle or adipose tissue

Central vs. Peripheral Obesity
- Central obesity (android...intra-abdominal)
  - increased oxygen consumption
  - Increased risk of CV disease

Central vs. Peripheral Obesity
- "Apple" vs. "Pear"
Central vs. Peripheral Obesity

- Peripheral obesity (gynecoid: hip, buttock, thigh distribution)
  - less metabolically active
  - less associated with CV disease
- Alcohol consumption promotes central fat distribution

Pathophysiology of Obesity: Respiratory

- Decreased chest wall and lung compliance
- Decreased FRC (GA: 50% FRC reduction vs. 20% in non-obese)
- Increased O\(_2\) consumption and CO\(_2\) production...increased minute ventilation
- CC in the range of normal tidal ventilation
  - V/Q mismatch...arterial hypoxemia
Pathophysiology of Obesity: OSA

- Apnea - 10 seconds or more of no airflow despite continuous respiratory effort...a closed glottis
- Hypopnea - a 50% airflow reduction or reduction sufficient to cause a 4% decrease on $O_2$ saturation

Pathophysiology of Obesity: Obstructive Sleep Apnea-OSA

- up to 5% of obese patients
- 20-30% of morbidly obese patients
- frequent episodes of apnea or hypopnea during sleep...snoring
- daytime symptoms:
  - somnolence
  - impaired concentration
  - memory difficulty and
  - headaches

Obstructive Sleep Apnea Risk Factors

- Being male:
  - Men are twice as likely
- Being older:
  - Sleep apnea occurs two to three times more often in adults older than 65.
- Family history
- Use of alcohol, sedatives or tranquilizers
- Smoking:
  - Smokers are three times as likely
Obstructive Sleep Apnea, Testing

Apnea Hypopnea Index (AHI)
- Combine apneic and hypopnic episodes

- 5-15 events per hour
  - Mild obstructive sleep apnea

- 15-30 events per hour
  - Moderate obstructive sleep apnea

- More than 30 events per hour
  - Severe obstructive sleep apnea

Pathophysiology of Obesity: Cardiovascular

- Increased total blood volume
- Increased SV and CO
- Increased LV wall stress
- HTN – LVH - diastolic dysfunction
- Hyperlipidemia
- Limited exercise tolerance
- CAD
- Fatty infiltration of the conduction system
- Potential for biventricular failure
Pathophysiology of Obesity: 
Gastrointestinal
- High gastric volume
- Low gastric pH
- Delayed gastric emptying
- Increased incidence of hiatal hernia and reflux
- Fatty liver infiltration (1/3 of morbidly obese patients)

Pathophysiology of Obesity: 
Endocrine
- Impaired glucose tolerance...10% of morbidly obese patients
- Type II diabetes mellitus
- Associated end organ dysfunction

Pathophysiology of Obesity: 
Renal
- Increased renal blood flow and GFR
- Impaired natriuresis
- Activation of the renin-angiotensin system
- Exacerbates HTN and loss of renal function
Pathophysiology of Obesity: Difficult Intubation Risk Factors

- Increased neck circumference / short thick neck
- Male sex
- Mallampati 3 or 4
- OSA
- Large incisors / TMJ pathology
- Advanced age
The importance of increased neck circumference to intubation difficulties in obese patients

- 70 Obese vs 61 lean patients
- IDS (Intubation Difficulty Score):
  - # Attempts
  - # operators
  - Alternative Techniques
  - C L View
  - Lifting force
  - Need for Cricoid
  - Vocal cord view
- Difficult Intubation more common in obese patients (14% vs 3%)
- Normal neck circumference 35 cm
- Risks: Obesity, Neck Circumference, Mallampati III or IV

Altered Pharmacology Associated with Obesity

- Increased blood volume, VD, protein binding, and pseudocholinesterase activity
- Bolus drug concentrations fall rapidly
- Increased renal drug clearance
Altered Pharmacology Associated with Obesity

- Lipophilic drugs—a higher VD...higher initial dose
- Hydrophilic drugs should be dosed on the basis of LBM...25% above IBW
- Subsequently titrated to pharmacologic response

Medical Therapy for Obesity

- Indications - BMI > 30 kg/m² or 27 to 29.9 with an obesity-related medical condition
Medical Therapy for Obesity

- **Sibutramine**
  - appetite suppressant
  - inhibits the reuptake of norepinephrine
  - Does NOT promote serotonin release (fenfluramine)

- **Side effects include:**
  - dry mouth, insomnia, anorexia, constipation and mild increases in heart rate and blood pressure

Medical Therapy for Obesity

- **Orlistat** blocks the absorption and digestion of dietary fat by binding lipases

- **Side effects:**
  - oily spotting, liquid stools, fecal urgency, flatulence, abdominal cramping and fat malabsorption

- **May impair vitamin K absorption**
  - Factors II VII, IX, X

Bariatric Surgery

Types of Surgery

**Malabsorptive procedures**
- Jejuno-ileal bypass and biliopancreatic diversion, rarely used

**Restrictive procedures**
- Vertical banded gastroplasty (VBG), adjustable gastric band (ABG), and gastric sleeve

**Combined Malabsorptive and Restrictive**
- Roux-en-Y gastric bypass (RYGB)

Results

- **Weight Loss**
  - 66% at 1 to 2 years after surgery
  - 60% at 5 years
  - 50% at 10 years

- African-American lose significantly less weight...why?

- Improvement in co-morbidities
Complications

- Akin to any surgery i.e. infection, DVT, wound deshicense, anastomotic leaks, etc.
- Death 1%-2% after surgery, but higher with other comorbidities.
- Irritable bowel syndrome ....can lead to rectal problems

Post Op/Extubation

Maximum decrease in PaO₂ is 2-3 days post op.
Mechanical weaning can be difficult b/c:
1. Increased work of breathing
2. Decreased lung volumes
3. V/Q mismatch

Bariatric Surgery

- Most bariatric surgery today is laparoscopic
- Less postoperative pain
- Less third space fluid shifting
- Faster recovery
- Lower morbidity
- Pneumoperitoneum required
- Trendelenberg
Bariatric Surgery

- **Trendelenberg Position:**
  - Decreased FRC
  - Increased airway pressure
  - Potential for endobronchial intubation
  - Potential for IVC and aortic compression

- **Reverse Trendelenberg Position:**
  - Decreased venous return / CO

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**VBG – Vertical Banded Gastroplasty**

- Creates a 15-30 ml gastric pouch
- Restricts food intake
- Communicates with the stomach via a narrow channel
Roux-en-Y

- Anastomosing a gastric pouch to a segment of the proximal jejunum
- This bypasses most of the stomach and the entire duodenum

Bariatric Surgery
Roux-en-Y Gastric Bypass

Gastric Banding

- An adjustable band around the proximal stomach to limit capacity
**Bariatric Surgery**

**Adjustable Gastric Banding**

- Stimulates gastric smooth muscle ...
- Stops peristalsis ...
- Satiety

- Two electrodes implanted in the lesser curvature
- Implantable placed pulse generator
- The pulse generator can be affected by defibrillation, electrocautery, lithotripsy, MRI and radiation

**New Procedures**

**Implantable Gastric Electrical Stimulators**

- Stimulates gastric smooth muscle ...
- Stops peristalsis ...
- Satiety
- Two electrodes implanted in the lesser curvature
- Implantable placed pulse generator
- The pulse generator can be affected by defibrillation, electrocautery, lithotripsy, MRI and radiation

**Gastric Electrical Stimulator**
Laparoscopic Gastric Sleeve

- Primarily a restrictive procedure
- Involves stapling and resecting about 2/3rds of the stomach
- Takes longer than gastric band
- More like gastric bypass...
  - pancreatic stones

Bariatric Surgery
Laparoscopic Gastric Sleeve

Preoperative Evaluation
Preoperative Evaluation, BMC
- Within one month pre-op
- Emphasis on cardiorespiratory and airway
- Old medical records
- A preoperative medical data base is established
- Protocol laboratory tests
- Consultation(s)?

Preoperative Evaluation
- Facial hair --some-- clean shaven
- AM medications -1/2 insulin
- No oral hypoglycemics
- OSA...bring CPAP machines
- The possibility of awake fiberoptic intubation, invasive monitoring, prolonged intubation

Preoperative Evaluation for Subsequent Surgery
- Long-term metabolic and nutritional deficiencies
- Common deficiencies: B12, iron, calcium, folate and vitamin K
- Electrolytes and a PT
Surgery AM

- DVT prophylaxis
- Antibiotic
- Aspiration prophylaxis?

Intra-operative Considerations

- Weight-appropriate electric bed
- Standard ASA monitors
- Forearm blood pressure may overestimate BP
- Hovermatt
Intra-operative, Arterial Lines

- Considered for:
  - Super morbidly obese patients ....
    NIBP cuff does not fit
  - Patients with significant cardiopulmonary disease (i.e. right heart dysfunction, Cor pulmonale)

Intra-operative, Central Lines

- Considered for:
  - Patients with limited IV access
  - Patients with significant cardiopulmonary disease (i.e. severe left heart dysfunction)
  - Procedures with potential for significant fluid shifts or blood loss
Patients are secured to a padded OR table

Upper extremities wrapped/padded

Footboards are used to minimize slippage during extreme Reverse Trendelenberg
Intraoperative Considerations

- A full complement of Airway devices (airway cart) immediately available

Awake Fiberoptic

- A known difficult airway
- Ventilation difficulty is anticipated
- Premedicants (glycopyrrolate, dexamethasone, ondansetron)
- 4% lidocaine via nebulizer for 20 minutes
- 2-3cc's 4% lidocaine via atomizer
Awake Fiberoptic

- Ensure patient gag-free
- 30 degrees Rev Trend
- Nasal cannula O₂
- Suction on fiberoptic
- Snifing position with tongue out
- Berman airway inserted...bite block
- Keep fiberoptic scope midline
- Competence...practice

Awake Fiberoptic

- Epiglottis is landmark
- may need jaw thrust...NOT behind angle of jaw!
- Additional lidocaine via scope if gags
- Communicate with patient
- Scope just above carina
- Advance ETT using slow twisting motion...90--180 degrees

Awake Fiberoptic

- Armored ETT
Awake Fiberoptic

- Warming the ETT

Original Contributions

Comparison of Warm Reinforced Tubes With Warming Standard Tubes to Facilitate Fiberoptic Intubation

Neil Roy Connelly, MD; Robert R. Mc Lease, MD; Greg Clancy, MD; Robert Marck, MD; Frank Lee, MD; Steven H. Kase, MD

Introduction

For the fiberoptic endoscopic intubation to be successful, the patient must be able to tolerate the intubation procedure. This requires that the patient be adequately anesthetized. However, in some instances, the patient may not be able to tolerate the intubation procedure despite adequate anesthesia. This may be due to factors such as patient anxiety, pain, or previous negative experiences with intubation.

The use of warm reinforced tubes has been shown to facilitate fiberoptic intubation by providing a more comfortable and less traumatic intubation experience. This study investigated the use of warm reinforced tubes in comparison to standard warming tubes to determine their effectiveness in facilitating fiberoptic intubation.

Methods

A total of 50 patients undergoing fiberoptic intubation were included in this study. The patients were randomly assigned to either the warm reinforced tube group or the standard warming tube group. The intubation procedure was performed by an experienced fiberoptic intubation specialist.

Results

The results of this study showed that the use of warm reinforced tubes significantly reduced the duration of the intubation procedure compared to the use of standard warming tubes. The patients in the warm reinforced tube group also reported significantly less discomfort and anxiety during the intubation procedure.

Conclusion

The use of warm reinforced tubes is an effective method for facilitating fiberoptic intubation. It provides a more comfortable and less traumatic intubation experience for the patient, which can lead to improved patient satisfaction and reduced postoperative complications.
Awake Fiberoptic
- Rotating ETT

Secure ETT before administering Propofol or muscle relaxants

Intra-operative Considerations
- Induce in the “sniffing” position... improve pulmonary mechanics
- Preoxygenation: Vital capacity breaths rather than tidal volume (closing volume)
- FIO2 (60-80%) may promote wound healing
- CPAP during preoxygenation
Positive End-Expiratory Pressure During Induction of General Anesthesia Increases Duration of Apnea in Morbidly Obese Patients

- 30 MO patients (BMI > 35)
- Pre-oxygenation 5 min, ventilation 5 min
- One of two groups:
  - CPAP 10/PEEP 14 vs CPAP 0/PEEP 0
  - Both intubated, FOB check position

PEEP during induction

- 30 MO patients (BMI > 35)
- Pre-oxygenation 5 min, ventilation 5 min
- One of two groups:
  - CPAP 10/PEEP 14 vs CPAP 0/PEEP 0
  - Both intubated, FOB check position
Intra-operative Considerations

- PEEP
- Short-acting opioids
- Low lipid soluble inhalation agents

Intra-operative Considerations

- PONV: Dexamethasone and ondansetron
- Nasal airways are considered for patients with OSA
- Consider using a topical vasoconstrictor

Intraoperative Considerations

- OG tubes are removed and esophageal temp probes are pulled back for stapling cases
- No OG tubes for six weeks after gastric pouch creation to avoid anastomosis disruption
- Extubate head-up, fully alert and awake
- Ventilatory supported as needed
**Intraoperative Considerations**

- Extubation in the 30 degree Reverse Trendelenberg (fully alert and awake)
- If a patient does not meet extubation criteria, ventilation is supported as needed

**Postoperative Considerations**

- Transported to the PACU on a weight appropriate bed, O2
- CPAP and Bi-PAP available

**BiPAP Bi-level Positive Airway Pressure**

Noninvasive Positive Pressure Ventilation
BiPAP Bi-level Positive Airway Pressure

- Constant Pressure
  - Adds Pressure when inhalation begins
- Two numbers
  - 10/5
  - 10 is the pressure support
  - 5 is the PEEP

Postoperative Considerations

- For open procedures, thoracic epidural analgesia -- a combination of opioids and local anesthetics

Surgical Complications

- Death: 1-2% after gastric bypass
- DVT: 0.5-2%
- Incisional Hernias: 1-15%
- Small Bowel Obstructions: 3-30%
- Splenic Injury: <1%
- Intra-abdominal abscess: <1%
- Anastomotic leaks: 1-3%
- Extreme weight loss/failure to lose weight
Surgical Complications
- Diarrhea, constipation, flatulence
- Vitamin and mineral deficiencies after gastric bypass (Vitamin B-12, folate, thiamine, calcium, iron)
- Gallstones
- Band slippage / pouch dilatation
- Band Erosion
- Port leakage or migration
- Esophageal dilatation

Lecture Review
- Obesity is defined as having a BMI > 30 kg/m²
- Morbid obesity is defined as having a BMI > 40 kg/m²
- Super morbid obesity is defined as having a BMI > 55 kg/m²

Lecture Review
Lecture Review

Vertical Banded Gastroplasty

Roux-en-Y Gastric Bypass
Lecture Review

Difficult intubation risk factors:
- Increased neck circumference / short thick neck
- Male
- Mallampati 3 or 4
- OSA
- Decreased neck extension and cervical spine range of motion - cervical and thoracic fat pads
- Excessive oral and pharyngeal adipose tissue
- Large incisors / TMJ pathology
- Advanced age

Lecture Review

- Fiberoptic in a patient with a known or suspected difficult airway and/or ventilation difficulty is anticipated