Gastric Bypass

- Morbid obesity increasing in US and Europe
- 50% US. Overweight
  - 30% morbidly obese
- Bariatric surgery most effective Tx for morbid obesity
  - On rise >110,000/yr in US
    - Most procedures now performed laparoscopically

Types of Bariatric Surgery

- Restrictive - Small fundal pouch “satiety”
  - limits food intake
- Malabsorptive - Bypasses portion of intestine
  - Limits digestion and absorption
- Combination of above

BARIATRIC SURGERY PROCEDURES

- Roux-en Y Gastric Bypass (GBP) -
  - most successful and most widely performed
- Laparoscopic Adjustable Gastric Banding
- Biliopancreatic Diversion/Duodenal Switch
- Long-Limb Gastric Bypass

Roux-en-Y Gastric Bypass

- American Society for Bariatric Surgery
- National Institutes of Health
  - Roux-en-Y Gastric Bypass current gold standard procedure for weight loss surgery
- Combination
  - Restrictive: Create 15ml to 20ml stomach pouch
  - Malabsorption: Pouch empties directly into the lower portion of the jejunum, thus bypassing calorie absorption.
Surgical Technique

Creation of gastric pouch

Creation of Roux limb and mesenteric division


Surgical Technique

Passage of Roux limb through retrocolic retrogastric tunnel

Creation of jejunoojejunostomy and closure of mesenteric defect.


Final Outcome

Retrocolic

Transmesenteric

Retrogastric

Side to Side


Roux en-Y Gastric Bypass


Roux en-Y Gastric Bypass


BARIATRIC SURGERY - Implications for Imaging-

- Routine evaluation with UGI or CT
  - Identify range of early and late complications
- Findings of bariatric surgery often noted on UGI or CT exams for non-specific abdominal pain and unrelated conditions
Preoperative Evaluation
- RUQ U/S to R/O Cholelithiasis
  - Some Surgeons will electively perform cholecystectomy if Gallstones are present
- UGI for anatomy on patients with previous surgeries

UGI EVALUATION—Early Post-Op—
- POST-OP DAY 1-2
- Wash Univ 5-7 days
- Supine LPO Position
  - Want to bathe the anastamosis with contrast supine
- Water-Soluble Contrast Followed by thin Barium
- Fluoro: Focus on Pouch, G-J Anastamosis
  - Limited in extremely obese patients → C arm; serial KUBs
- Follow-up Overhead Images until Contrast material passes Distal Anastamosis

Normal Appearance
Normal narrowing at transverse mesocolon

Normal Appearance
Follow to the level through the JJ site by overheads

Normal Appearance
Mild narrowing—Normal (through mesenteric defect)
Post-Op GI appearance

Normal (through mesenteric defect)  Gastrojejunal stricture

Gastrojejunal Anastomotic Stricture
- Stomal stenosis
  - Occurs in up to 10%
  - Usually >1mo post op
  - Due to fibrosis
  - GJ more common than JJ
  - Treat with endoscopic dilatation

CT TECHNIQUE
- Oral contrast: water soluble contrast
  - 1-2 hours before study & on table
- IV contrast: 150cc
- Multidetector: 5mm slice thickness
  - Thinner cuts allow for scatter in obese patients
- May need to increase mAs, increase scan time, KVP

Normal Post Gastric Bypass CT

Gastric Bypass Complications (6-8%)

Early
- Leak
- Obstruction - Stoma - J/J Anastomosis
- Distended Excluded Stomach

Late
- Stomal Stenosis
- Staple Line Leak
- Marginal Ulcer
- SBO
- Internal Hernias
- Abdominal Wall Hernia
- Intussusception
### Post-Gastric Bypass-Leak

- Most Serious Complication - (1-6%)
- Most Dx within 7-10 Days - (80%)
- Reoperation 80%
  - High Morbidity
  - Increased Mortality

Dx relies on presence of contrast leak on UGI/CT
  - Often fills extraluminal collection or communicates w/drain

### Extraluminal Leaks

- Extraluminal leak occurs at rate of approx 5-6%
  - Mortality in those patients estimated at about 6%
- Average hospital stay after routine RYGBP 2 days
  - Average length of the hospital stay in the setting of extraluminal leak 42.4 days

### Leak Locations

- Gastrojejunal Anastomosis (77%)
- Distal Esophagus (10%)
- Gastric Pouch (10%)
- Blind Jejunal End (4%)
- Jejunojejunal Anastomosis (2%)

- Look at drain

### Leak Locations

- Gastrojejunal Anastomosis (77%)
Gastrojejunal Anastomosis Leak

Important to administer - water soluble contrast

Leak Locations

- MOST IN LUQ - 63%
- Left - 77%
- Anterior - 19%
- Right - 17%
- Posterior - 8%
- Inferior - 6%

Carucci, L. R. et al. Radiology 2006;238:119-127

Gastrojejunal Anastomosis Leak

Most in LUQ

Important to administer - water soluble contrast

Carucci, L. R. et al. Radiology 2006;238:119-127

STAPLE LINE LEAK - Dehiscence
Gastro-Gastric Fistula

- Leak into Excluded Stomach - 4%
- Early or Late
- Non-Emergent
- Results in Failure to Lose Weight
  - Weight Gain

Contrast seen in the excluded stomach

STAPLE LINE LEAK - Dehiscence
Gastro-Gastric Fistula

- Early or Late
- Non-Emergent

Results in Failure to Lose Weight
  - Weight Gain

Contrast seen in the excluded stomach
Abscess

Can occur in up to 2% of patients...usually associated with leak

Small Bowel Obstruction

- Usually caused by internal hernias or adhesions
- Laparoscopic approach
  - Reduced the prevalence of adhesions
  - Common during first post op month
  - Increase in the prevalence of internal hernias
  - Usually present later

Post-Gastric Bypass Obstruction

- Early: SBO
- G-J Anastomosis
- Transverse Mesocolon
- J-J Anastomosis

- Late: SBO (5%):
  - Adhesions
  - Internal Hernia
  - Ventral Hernia

Patterns of SBO Related to J-J Anastomosis

A. Obstructed dilated roux Limb
B. Obstructed dilated roux Limb & dilated excluded Limb
C. Obstructed dilated excluded limb

A. Obstruction J-J Anastomasis:
Roux Limb Dilated
**C. Obstruction J-J Anastomosis: Excluded Limb/Stomach Dilated**

- True closed loop circuit

**Abdominal Wall Hernia**

- Common after Gastric Bypass
- (3-24%)
- Incisional, Ventral, Port Site
- Less Common after Lap Gastric Band

**Internal hernias after Gastric Bypass**

- N = 2000 pts with laparoscopic gastric bypass
- 3.1% (63/2000) with internal hernias
  - 20% nl imaging (SBFT and/or CT)
  - Majority symptomatic

**Internal Hernia Post-Gastric Bypass**

- Potentially fatal complication
  - Approx 3%
  - Late – mo-yr postop (4yr)
- Herniation of SB through mesenteric defects
- **MESENTERIC DEFECTS**
  - Transverse Mesocolon (A)
  - Petersen’s Defect (B)
  - SB Mesentery (C)

**Internal Hernia Post-Gastric Bypass on CT**

- Atypical Bowel Configuration
- Change in Position of Staple Line or Bowel
- Distal anastamosis to the right of midline
- Clustered SB Loops- (Lat to L colon, LUQ)
- Stretching/Displacement Mesenteric Vessels-CT
- “Mushroom sign”
- Distal tubular mesenteric fat surrounded by bowel loops
- Small bowel loop behind SMA

---

Carucci, L. R. et al. Radiology 2006;238:119-127


Lockhart et al. AJR 2007; 188:745-750
Transmesocolic hernia
• Atypical Bowel Configuration
• Clustered SB Loops- (LUQ)

Normal Post Gastric Bypass CT

Transmesocolic hernia
• Atypical Bowel Configuration
• Clustered SB Loops- (LUQ)

Transmesocolic Internal Hernia
• Clustered SB Loops- (Lat to L colon, LUQ)
• Small bowel adhered to the anterior abdominal wall

Transmesocolic Internal Hernia
• Atypical Bowel Configuration
• Clustered SB Loops- (Lat to L colon, LUQ)
• Stretching/Displacement Mesenteric Vessels-CT
• Change in Position of Staple Line or Bowel
Transmesocolic Internal Hernia
- Small-bowel clustered in LUQ
- Engorged mesenteric vessels

Internal Hernia at J-J Site
Distal tubular mesentry with surrounding loops of small bowel
Lockhart et al. AJR 2007; 188:745-750

- Change in Position of Staple Line or Bowel
- Round appearance of distal mesenteric fat with SB completely surrounding this region.

Internal Hernia at J-J Site
Round appearance of distal mesenteric fat with SB completely surrounding this region.

Internal Hernia at J-J Site
- Small-bowel loop behind SMA
- No SB bowel loop should lie behind SMA
- Dilated small bowel loop clustered in Left mid abdomen

Internal Hernia at J-J Site
- Round appearance of distal mesenteric fat with SB completely surrounding this region.
Mushroom sign: narrowed mesenteric root with bowel passing between SMA.

Engorged mesenteric root with lymph nodes.

"WEEPY MESENTERY"
"Weepy Mesentery" Engorged mesentric root with lymphnodes

"Mushroom sign" narrowed mesentric root with fat vessels passing between SMA

Internal Hernia; Peterson

Other Complications

Intussusception

Intussusception usually involve JJ anastamosis

Intussusception

Intussusception
Other Complications

- Marginal ulcers
  - Occurs in 3%
  - Near GJ anastamosis
  - Decreased incidence with smaller pouch
  - Medical treatment, unless perforation

Ulcer Post Gastric Bypass

Near GJ anastamosis

Laparoscopic Adjustable Gastric Banding

- First LAGB performed in 1993
- Devices
  - LAP-BAND: FDA approved 2001
    - Inflates to 4cc
    - Radiopaque, saline-filled
  - SWEDISH BAND: Not FDA approved
    - Wider, inflates to 9cc
    - Not radiopaque
    - Requires injection of contrast material

Laparoscopic Adjustable Gastric Banding

- Small neostomach (pouch)
  - Restrictive
  - Not larger than 20 ml (4cm pouch)
- Full pouch leads to early satiation
  - Stomal width adjusted to 3-5 mm
- If stoma too wide
  - Ingested food passes quickly through the stoma
  - Stomach will not feel any satiation
  - Results in insufficient weight loss
- Stomal width is adjusted at 6 wk F/U

ADVANTAGE-LAGB

- Less Invasive-Laparoscopic
- Less Risk
  - No Cutting/Stapling of Stomach/SB
- Adjustable Stoma Size
- Band easily Reversible
  - Restores normal stomach anatomy after removal

DISADVANTAGE-LAGB

- Less rapid, less consistent wt loss
- Re-operation Rate - 11%
- Band Adjustments - x3

**Laparoscopic Adjustable Gastric Banding**

- Plain Film / UGI
  - Position of Device
  - Pouch Size and Morphology
  - Stoma Size - 3-5 mm
  - Esophageal/Pouch Emptying
  - Complications

**IMAGING ASSESSMENT**

- Gastric band is inclined up 45° to the left of patient
- Phi angle = angle between spinal column and gastric band
  - range should be between 45-55°
  - lies about 5 cm below the diaphragm

- Small neostomach (pouch)
  - Not larger than 20 ml (4 cm pouch)
- Stomal width 3-5 mm

**Gastric Band in Normal Position**

- Phi angle = angle between vertical axis and gastric band 45-55°

**Gastric Band in Normal Position on CT**
Laparoscopic Adjustable Gastric Banding

COMPLICATIONS

• Early: Rare-Perforation; Band Malposition
• Pouch Dilatation-stoma tight
• Obstruction-Stoma Tight
• Reflux/Eosophageal Dysmotility
• Band Slippage-Fundic Herniation
• Band Erosion

**COMPLICATIONS**

- Gastric Band malposition
  - Phi angle = angle between vertical axis and gastric band 45°-55°

**Slipped Gastric Band**

- Posterior slippage

**Slipped Gastric Band**

- Normal: Gastric band is inclined up 45° to the left of pt
  - Slippage: Usually associated with pouch dilatation

**Slipped Gastric Band**: Hint: "Never see band on end" "D" sign

**Slipped Gastric Band**: Hint: "Never see band on end" "D" sign

**Slipped Gastric Band**: Normal: Gastric band is inclined up 45° to the left of pt
  - Slippage: Usually associated with pouch dilatation
Laparoscopic Adjustable Gastric Banding

Slipped Gastric Band - Posterior slippage

Normal: Gastric band is inclined up 45° to the left of pt. Slippage: Usually associated with pouch dilatation

Laparoscopic Adjustable Gastric Banding

Slipped Gastric Band - Pouch dilatation; GE Reflux

Normal: Gastric band is inclined up 45° to the left of pt. Slippage: Usually associated with pouch dilatation

Laparoscopic Adjustable Gastric Banding

Infection: Hepatic Abscess

Laparoscopic Adjustable Gastric Banding

Perforation

Laparoscopic Adjustable Gastric Banding

Perforation
Laparoscopic Adjustable Gastric Banding

Perforation

Small Bowel Obstruction

Tubing may cause an inflammatory reaction and lead to scar

Gastric Reduction Procedures

- Widely and routinely performed for weight reduction
  - With increasing trend
- Importance of use of proper technique for imaging
- Importance of familiarizing potential complications
  - Leaks
  - Adhesions (with common locations)
  - Internal Hemias
  - Marginal Ulcers
  - Intussusception
- Laparoscopic Adjustable Gastric Banding
  - Understanding normal positioning of band
  - Recognize the potential complications