Objectives

- Review the current surgical treatment options and their effectiveness, possible side effects and complications
- Identify appropriate surgical candidates and be able to counsel patients about the importance of compliance with the post-operative regimen
- Discuss follow-up care and long-term management of the post-bariatric surgical patient
The Obesity Epidemic

- 69.2% of adults are overweight or obese (2010)
- $200 billion spent in 2005 to treat the medical consequences of overweight and obesity
- Obese individuals are more than twice as likely to take sick leave and three times as likely to become disabled
- Up to 365,000 deaths/year attributed to obesity

Flegal KM, Graubard BI, Williamson DF, Gail MH. Excess deaths associated with underweight, overweight, and obesity. JAMA. 2005;293(15):1861

Health Burden

Health Burden

- Type 2 diabetes
- Hypertension
- Cardiovascular disease
- Stroke
- Dyslipidemias
- Osteoarthritis
- Cancers
- Sleep apnea
- Gall bladder disease
- Female infertility
- Psychological issues
Therapeutic Options

- More than two-thirds of adults in the US are either trying to lose weight or to maintain their weight; however, only 20% are both eating fewer calories and engaging in 150 min of physical activity/week
  - Popular diets: reduce caloric intake by restricting certain foods and limiting portions, i.e. by counting calories, fat or carbs
  - Medically supervised diets
    - Very Low Calorie Diets (VLCD)
    - Liquid Fasts
  - Referral to a nutritionist or dietician
  - Exercise regimens
  - Medications (sibutramine, orlistat, locaserin, phentermine/topiramate)
  - Cognitive Behavioral Training
  - Bariatric Surgery


Bariatric Surgery

- Number of procedures performed has increased 25-fold
  - 14,000 in 1993
  - 140,000 in 2004
  - > 200,000 in 2005
  - > 300,000 in 2007
  - > 340,000 in 2011
Bariatric Surgery

Evidenced Based Recommendations

- Cochrane Review (2009):
  - Surgery results in greater weight loss than conventional treatment in people with BMI greater than 30 as well as those with more severe obesity.
  - Surgery leads to some improvements in quality of life and obesity related diseases such as hypertension and diabetes.
  - Certain procedures produce greater weight loss, but data are limited. The evidence on safety is even less clear. Due to limited evidence and poor quality of the trials, caution is required when interpreting comparative safety and effectiveness.

- IDF (2011):
  - Bariatric surgery is an appropriate treatment for people with T2D and obesity not achieving treatment targets with medical therapy.
  - Surgery should be an accepted option in people with T2D and BMI >35.
  - Surgery should be considered as an alternative treatment option in patients with BMI 30-35 whose diabetes is uncontrolled.
  - Available evidence indicates that bariatric surgery for obese patients with T2DM is cost effective and safe.


Indications

- Body Mass Index of ≥ 40 kg per m² or
- Body Mass Index of 35 to 39.9 kg per m² with one or more significant comorbidities:
  - Type 2 diabetes, Obstructive sleep apnea, Coronary artery disease, Debilitating arthritis, NASH, GERD
  - Online BMI calculator available @ http://familydoctor.org
- Body Mass Index 30 to 34.9 kg per m² with:
  - Uncontrollable T2DM
  - Metabolic Syndrome

Indications (continued)

- Previous failed weight loss attempts using an integrated weight loss program including:
  - Dietary modification
  - Behavioral support
  - Appropriate exercise
- Appropriate motivation and psychological stability to understand risks and benefits of the procedure
- The commitment to lifelong postoperative lifestyle changes and medical surveillance


Contraindications

- Poor surgical candidates – inadequate cardiopulmonary reserve, drug or alcohol dependency, impaired intellectual capacity
- Unable or unwilling to comply with post-op lifestyle changes, diet, supplementation, f/u
- Unstable psychiatric illness or eating disorders
- Uncontrolled coagulation problems or cannot be removed from coagulation therapy
- For Lap Band – Intra-abdominal adhesions or potential for inadequate pneumoperitoneum
What are the procedures available for weight loss?

- **The Malabsorptive Procedures**
  - Bypass a large amount of intestine and weight loss is achieved by:
    - Decreasing small bowel absorptive surface area, and/or
    - Diversion of biliopancreatic secretions that assist absorption

- **The Restrictive Procedures**
  - Restrict the size of the stomach which achieves weight loss by limiting caloric intake.

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**Surgical Options**

- **Gastric restriction:**
  - Vertical Banded Gastroplasty (VBG)
  - **Sleeve Gastrectomy (SG)**
  - Adjustable gastric banding (AGB)

- **Malabsorption:**
  - Jejunoileal bypass (JIB)
  - Duodenal Switch (DS)

- **Combined Gastric restriction and Intestinal malabsorption:**
  - Roux-en-Y gastric bypass (RYGB)
  - Biliopancreatic Diversion with Duodenal Switch (BPD-DS)
The Restrictive Procedures
Lap-Band

- Pure Restrictive Mechanism
- Requires Frequent Surgical Followup
  - Monthly to Every 6 weeks
- Requires Significant Dietary Changes
- No Malabsorption Risk
- Reversible
- Low Risk and Lowest mortality (0 - 0.5%)
- Outpatient Surgery
The Restrictive Procedures

Sleeve Gastrectomy

Permanent Partial Gastrectomy
- Resection of body of stomach
- Resection of fundus of stomach
- Resection of Antrum of stomach

Weight loss mechanisms:
- Decreased caloric intake
- Increased levels of GLP-1 and PYY which stimulate satiety
- Concerns over long-term recurrence of T2D, weight regain

Combined Procedures

Gastric Bypass

Creates a small Gastric pouch (<30 mL)

Creates a short Roux Limb (75 – 150 cm in length). Increasing Roux limb length can increase malabsorption.

Combined Procedure: Primarily restrictive
- Small Malabsorptive limb
- Restrictive gastric pouch

Difficult to Reverse

Weight loss mechanisms:
- Reduce caloric intake
- Increased levels of GLP-1, PYY, and CCK which creates an anorectic state and induces satiety
- Reduced ghrelin levels
Combined Procedure
BPD with Duodenal Switch

Fat Malabsorption Primary Mechanism
Malnutrition an issue
- Fat Soluble Vitamins
- Protein malnutrition

Frequent foul smelling stools
- Up to seven per day

Hepatotoxicity
- Elevated liver enzymes
- Potential for Liver Failure

Hypoalbuminemia
Hypoproteinemia

Investigational Procedures

Mini-gastric bypass
- Division of stomach and Pouch anastomosed to jejunum
- Excess weight loss ~50% at 18 months
- Limited long-term data and higher rates of bile reflux

Intragasric balloon
- Soft, saline-filled balloon that restricts for 6 months
- ~33% excess weight loss
- Not available in US

Endoscopic gastrointestinal bypass devices
- Barrier device deployed to prevent luminal contacts from absorption in SI (EndoBarrier, ValenTx)
- Placement failure in 13%
- High rates of removal due to patient complaints, sleeve migration, and obstruction
- Mean weight loss 10-20%
There is no evidence based medical approach for procedure selection

Available prospective data are often of short duration

Potential genetic or biomarkers are limited by clinical utility, sensitivity and specificity


Short Term Outcomes

- Rate of excess body weight loss
  - RYGB or SG: Occurs rapidly in the first few months (10-15 lb/mo), slows down after (5-7 lb/mo), and reaches a plateau at ~1 ½ years (100-120 lb total)
  - AGB: Occurs more slowly (4 lb/mo) with plateau at 2 years

<table>
<thead>
<tr>
<th>Operative procedure</th>
<th>Excess weight loss (percent)</th>
<th>Time until weight stabilization (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric bypass</td>
<td>60 to 85</td>
<td>1 to 1.5</td>
</tr>
<tr>
<td>Adjustable gastric band</td>
<td>45 to 55</td>
<td>2</td>
</tr>
<tr>
<td>Sleeve gastrectomy</td>
<td>55 to 80</td>
<td>1 to 1.5</td>
</tr>
</tbody>
</table>

Short Term Outcomes

- Hypertension*
  - ACS-BSCN: Remission of HTN at 1 year in 79% of RYGB, 68% SG, 44% AGB

- Dyslipidemia*
  - Total Cholesterol ↓ by 16%, TG by 63%, LDL by 31%
  - 60-100% of patients no longer require lipid lowering medications after RYGB
  - May be less improvement with AGB and SG

- OSA
  - 79% remission with RYGB, 77% with AGB and 86% with SG
  - Other studies have shown weight loss associated improvements

- GERD
  - 70% improvement at 1 year after RYGB and reduced adenocarcinoma of the esophagus – Should be procedure of choice
  - SG and AGB may be less efficacious and may have worsening

- Infertility
  - 70% of women who were infertile prior to procedure, irregardless of procedure, achieve successful pregnancy
  - No controlled prospective data on male fertility

Short Term Outcomes – T2D

- Dixon (JAMA 2008)
  - 73% of patients undergoing LAGB and 13% in medical and lifestyle group achieved T2DM remission.

- Schauer (NEJM 2012)
  - 42% after RYGB and 37% after LSG compared to 12% in intensive medical therapy and lifestyle group achieved T2DM remission (A1c<6% without diabetes medications)

- Mingrone (NEJM 2012)
  - 95% after BPD and 75% after RYGB compared to 0% with conventional medical therapy achieved T2DM remission (FPG <100, A1c <6.5% without diabetes medications).
Short Term Outcomes – T2D

Table 1. Efficacy of different bariatric operations

<table>
<thead>
<tr>
<th></th>
<th>LAGB</th>
<th>RYGB</th>
<th>BPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution of T2DM</td>
<td>48%</td>
<td>84%</td>
<td>98%</td>
</tr>
<tr>
<td>Resolution of hypertension</td>
<td>43%</td>
<td>68%</td>
<td>83%</td>
</tr>
<tr>
<td>Improvement of hyperlipidemia</td>
<td>59%</td>
<td>97%</td>
<td>99%</td>
</tr>
<tr>
<td>Percent excess weight loss</td>
<td>47%</td>
<td>62%</td>
<td>70%</td>
</tr>
</tbody>
</table>

LAGB, laparoscopic adjustable gastric banding; RYGB, Roux-en-Y gastric bypass; BPD, biliopancreatic diversion; T2DM, type 2 diabetes mellitus.


Effect of LAGB and RYGB Surgery on Insulin Sensitivity

Predictors of Diabetes Remission

- Jurowich, et al.
  - Younger age at time of surgery, lower preoperative insulin dose, lower number of oral antidiabetic medications, shorter duration of diabetes predicted a higher rate of remission.
  - Surgery that bypasses the upper GI tract (RYGB) had higher rate of remission than LAGB.
  - Remission was independent of BMI or degree of weight loss.

- Hall, et al.
  - A1c <10% and T2DM <10 years predicted higher rate of remission.

- Huang, et al.
  - Higher BMI, younger age, shorter duration of DM predicted higher rate.

- Hamza, et al.
  - Younger age, %EBWL predictive higher rate.

- Nannipieri, et al.
  - Beta cell function improved greater in remitters.

- Lee, et al.
  - Higher C-peptide levels predict greater remission.

Long Term Outcomes

- Brethauer et al. (2013)
  - 217 patients with at least 5 year F/U (median 6 yrs): 162 RYGB; 32 AGB; 23 SG patients.
  - T2D recurrence rates:
    - RYGB 17%
    - SG 38%
    - AGB 33%
  - Shorter duration of T2DM and higher long-term % EBWL predicted long-term remission.
  - Weight regain was associated with recurrence.

Long Term Outcomes

- Swedish Obese Subjects (SOS) Trial

Complications

- 30 day mortality
  - CABG 3.5%
  - AAA repair 3.9%
  - Pancreatic resection 8.3%
  - Bariatric Surgery <1%

- Higher mortality with older age (4.8% over age 65), male gender, super obesity, chronic disease, low-volume surgeons, and open surgery

- Readmission rate 5% and reoperation rate 2%

---

### Morbidity and mortality associated with LRYGB, LSG, and LAGB from the ACS-BSCN dataset

<table>
<thead>
<tr>
<th></th>
<th>LRYGB</th>
<th>LSG</th>
<th>LAGB</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-d mortality (%)</td>
<td>0.14</td>
<td>0.11</td>
<td>0.05</td>
</tr>
<tr>
<td>1-y mortality (%)</td>
<td>0.34</td>
<td>0.21</td>
<td>0.08</td>
</tr>
<tr>
<td>30-d morbidity (%)</td>
<td>5.91</td>
<td>5.61</td>
<td>1.44</td>
</tr>
<tr>
<td>30-d readmission (%)</td>
<td>6.47</td>
<td>5.4</td>
<td>1.71</td>
</tr>
<tr>
<td>30-d reoperation/intervention (%)</td>
<td>5.02</td>
<td>2.97</td>
<td>0.92</td>
</tr>
</tbody>
</table>

- More than one serious complication
  - AGB 0.9%, SG 2.3%, RYGB 3.3%

- One or more complication
  - AGB 4.62%, SG10.84%, RYGB 14.87%

- Operating Time:
  - SG 106.5 (range 66-127) min
  - RYGB 132.2 (range 94-186) min

---


Life-Threatening Complications
80% of deaths in the first 30 days are due to:

- Pulmonary embolism (0.4%) and Venous Thromboembolism
  - Risk factors
    - BMI $\geq 60$ kg/m$^2$
    - Chronic lower extremity edema
    - Obstructive sleep apnea
    - Truncal obesity
    - H/O pulmonary embolism
    - BPD surgery
- Anastomotic leaks
- Respiratory failure


Life-Threatening Complications

- Anastomotic leaks (0.8-6%) – Signs and Symptoms
  - Can occur in RYGB, SG, or BPD w or w/o DS
  - Sustained tachycardia, severe abdominal pain, fever, rigors, hypotension
  - Respiratory failure and sepsis
- Work-up: UGI or CT scan with contrast –
  - May be negative
- **Urgent** surgical consultation
- Exploratory surgery if equivocal signs
  - “Leak Until Proven Otherwise” post op day 1-14

Identify complications early and educate patients about reporting symptoms
RYGB Complications

- Bleeding (Significant in 0.4-4%)
- Wound infections (3-4%) - Decreased by preoperative antibiotics
- Stomal stenosis/Anastomatic strictures (6-20%)
  - Nausea, Vomiting, Inability to advance diet
  - Usually requires EGD and dilation
- Marginal ulceration (0.6-16%) near gastrojejunostomy
  - Usually ischemic but can be secondary to excess acid production
  - PPI (Prevacid Solutab), Carafate suspension
- Cholelithiasis (upwards of 38%)
- Nausea, Vomiting, Inability to advance diet
  - Usually requires EGD and dilation
- Marginal ulceration (0.6-16%) near gastrojejunostomy
  - Usually ischemic but can be secondary to excess acid production
  - PPI (Prevacid Solutab), Carafate suspension
- Cholelithiasis (upwards of 38%)
- Short Bowel Syndrome (~5%)
- Internal Hernias (0.4-5.5%) – 38% in BPD-DS
- Dumping Syndrome (50%) after high glycemic meals
  - Early (within 15 minutes) - abd pain, diarrhea, nausea from rapid emptying of food into si
  - Late (2-3 hours later) Insulin response leading to hypoglycemia – dizziness, diaphoresis, tremor
- Noninsulinoma pancreaticogenerative hypoglycemia syndrome from beta cell hypertrophy and possibly GLP-1

AGB Complications

- Pouch Dilation (11%)
- Band Erosion (7%)
- Port Infection (0.3-9%)
- Band slippage or prolapse (1.4-14%)
- Stomal Obstruction (up to 14%)
- Port malfunction (0.4-7%)
- Esophageal Dilatation (10%)
SG Complications

- Bleeding
- Stenosis – requires endoscopic dilatation
- Gastric leaks (5.3%)
- Worsening of GERD
- Lack of long-term data

Long-Term Complications

- Loose stools and diarrhea
  - More common after BPD and RYGB (50-60%)
- Constipation
  - More common after AGB (39%)
- Think Biliary Dyskinesia or Symptomatic Cholelithiasis
  - Up to 50% due to rapid weight loss
  - Consider prophylactic cholecystectomy at the time of surgery
  - Consider bile salt therapy – Daily for 6 months post op
Long-Term Complications

- Metabolic and Nutritional Derangements
  - Mechanisms
    - Insufficient intake due to dietary restrictions and food intolerance (meat, milk, fiber)
    - The exclusion of the stomach's inferior part results in a decreased secretion of gastric acid, sometimes required to absorb vitamins and minerals (B12 and iron).
    - Duodeno-jejunal malabsorption related to the short-circuit. The duodenum is the main absorption site for calcium, iron and vitamin B1 (thiamin).
    - Dysbiosis occurs between the bolus and the bilo-pancreatic secretions in the common portion of the intestine.

Micronutrient and mineral deficiencies mainly in BPD and RYGB; Macronutrient deficiency with BPD.

- Prevention
  - Adherence to high protein diet
  - Lifelong supplementation for RYGB, SG or BPD
    - MVI with iron (Centrum or Equate Complete)
    - Vitamin B12, 1000 mcg IM q mo or 1000 mcg po qd
    - Calcium 1200-1500 mg qd
    - Vitamin D 800 IU daily
    - Iron 40-65 mg elemental daily
    - Menstruating women may require parenteral iron infusions


Post-Op Monitoring

Follow-up

At 3 and 6 months postoperatively and then yearly

Lab Tests

CBC, Electrolytes, Glucose, Creatinine
Iron Studies, Ferritin
Aminotransferases, AlkPhos, Bilirubin, Albumin
Lipid profile
Thiamine, Folate, Zinc, Copper
25 OH vitamin D, PTH

Long-Term Complications

Compliance Issues

- Persistent vomiting due to pouch distention
  - More common with purely restrictive procedures VBG and ABG
  - Most due to non-adherence to dietary recommendations
    - Small portions
    - Chewing thoroughly
    - Eating slowly
    - Waiting one hour after eating before drinking
- Other causes of vomiting – pain meds, vitamins, dehydration, gastroenteritis, stricture, stomal stenosis


The End