Surgical Management of Obesity

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Disclosures

• Gore Consultant
Objectives

- Obesity Trends and Risks
- Surgical Indications and Evaluation
  - Pre-operative evaluation
- Current Procedures
- Bariatric Surgery
  - Outcomes and Adverse Events
## Obesity Classification

Body Mass Index (BMI) = Wt(kg) / Ht(m\(^2\))

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 20</td>
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<tr>
<td>Normal</td>
<td>20 - 25</td>
</tr>
<tr>
<td>Overweight</td>
<td>25 - 30</td>
</tr>
<tr>
<td>Obese Class I</td>
<td>30 - 35</td>
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<tr>
<td><strong>Obese Class II</strong></td>
<td><strong>35 - 40</strong></td>
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<tr>
<td>Morbid Obesity</td>
<td>&gt; 40</td>
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<tr>
<td>Super Obesity</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Super-super Obesity</td>
<td>&gt; 60</td>
</tr>
</tbody>
</table>

BMI 40 = approximately 100 lbs above ideal weight
OBESITY

Psychologic
Genetics
Physiologic
Metabolic
Horomones
Sociocultural
Behavioral
Environment

Department of Surgery
Division of Metabolic & Bariatric Surgery

Washington University Physicians' Hospital

Sociocultural
20 Years Ago vs. Today

**Bagels**
- 140 calories
- 350 calories

**Pasta**
- 500 calories
- 1,025 calories

**Sandwiches**
- 320 calories
- 820 calories
Obesity Trends Among U.S. Adults

1997

2003

2008

2015

Washington University Physicians • Barnes-Jewish Hospital
Department of Surgery
Division of Metabolic & Bariatric Surgery
Mortality Risk in Obesity

Risk of Obesity
Which of the following are required for a patient to undergo bariatric surgery?

- BMI over 40
- BMI 35-40 with a high risk comorbid condition
- Pre-operative dietary evaluation
- Previous failure of a weight reduction program
- All of the above
1991 NIH Consensus Conference: Indications for Surgery

• Previous failure in an established weight reduction program
• Body Mass Index (BMI) > 40
• BMI 35-40 with high risk comorbid conditions
• Children and Adolescents initially excluded
  • Accreditation obtained 08/2018
• Pregnancy avoided until weight has stabilized
• Minimize peri- and post-operative risks using multidisciplinary team
  • Offer non-surgical alternatives
  • Psychology evaluation
  • Physical Therapy evaluation
  • Dietician evaluation
  • Labs including vitamin levels
Nutritional Deficiencies Preoperatively

- Consumption of excess calories does not equate to consumption of nutrient-dense, vitamins and mineral rich food, such as fruits, vegetables and whole grains.

- Morbidly obese patients can have micronutrient deficiencies despite excess in intake of macronutrients.
Nutritional Deficiencies Preoperatively

• Pre-operatively, the most common micronutrient deficiencies include vitamin D and iron.

• **Vitamin D deficiency:** related to inadequate exposure to sunlight, sunscreen use, geographic location, dark skin, age, or decreased intake of dairy and vitamin D rich food.

• **Iron deficiency:** associated with blood loss, inability to absorb enough iron (ex. Crohn’s disease or PPI use), or poor diet.
WUWLS Bariatric Surgery Options

Revisions
Adjustable Gastric Band

• Restrictive procedure
  • The pouch above the band is ~15 mL

• Approved for BMI of 30-35 kg/m² with a comorbid condition

• Adjustment of the band adjust the stoma diameter

• Excess weight loss 30-40%
Adjustable Gastric Band

• Can be performed in patients with a BMI of 30-35

• Vitamin Supplementation—
  • Multivitamin containing:
    • 400 micrograms folic acid
    • 15mg zinc
    • 18mg iron
  • Calcium Citrate 1200-1500 mg/day
Sleeve Gastrectomy

- Better option for patients with
  - NSAID use
  - Nicotine history
  - Need for prednisone
  - Inflammatory Bowel Disease
  - Abdominal wall hernias
  - Transplant candidates
    - Cardiac
    - Liver
    - Kidney
  - History of multiple abdominal surgeries or adhesive disease
Sleeve Gastrectomy

- Restrictive procedure
  - Resect the greater curvature
  - Leave the antrum and pylorus intact

- Excess weight loss 50-70%

- Most common surgery performed in the United States
Sleeve Gastrectomy

• Vitamin Supplementation—
  • Multivitamin containing:
    • 400 micrograms folic acid
    • 15mg zinc
    • 18mg iron (45-60mg iron if menstruating female or history of anemia)
    • 1-2mg copper
    • 12mg thiamine

• Calcium Citrate with Vitamin D3: 1500-2000 mg/day

• Vitamin B12: 300-500 micrograms/day OR 1000 micrograms/month
Roux-en-Y Gastric Bypass

- Better option for patients with:
  - Candidate for lung transplantation
  - Diabetes Mellitus
  - Hiatal hernias
  - Gastroesophageal reflux disease
  - Esophageal motility disorders

- Second choice for kidney transplant patients or post-op liver transplant patients
Roux-en-Y Gastric Bypass

- **Restriction**
  - Stomach pouch based on the lesser curvature and the left gastric artery
  - 25-30 mL pouch

- **Malabsorption**
  - 75-150cm in length

- **Excess weight loss of 60-80%**
Roux-en-Y Gastric Bypass

- Vitamin Supplementation—
  - Multivitamin containing:
    - 400 micrograms folic acid
    - 15mg zinc
    - 18mg iron (45-60mg iron if menstruating female or history of anemia)
    - 1-2mg copper
    - 12mg Thiamine
  - Calcium Citrate 1500-2000 mg/day with 3,000 IU Vitamin D

- Vitamin B12:
  - 300-500 micrograms/day
  - 1000 micrograms/month
Duodenal Switch

- Not indicated in patients undergoing transplant evaluation at this time
- Not indicated for noncompliant patients
- Consider in the following patients:
  - BMI > 50
  - BMI > 45 with diabetes mellitus
  - Revision for inadequate weight loss after a sleeve gastrectomy
Duodenal Switch

- Restriction = Sleeve gastrectomy
- Malabsorption
  - Bypass all the small bowel except 250cm (150cm Roux limb and 100 cm common channel)
- Excess weight loss of over 80%
- Fewer health insurance providers will cover it
Duodenal Switch

• Vitamin Supplementation—
  • Multivitamin x2 containing:
    • 400 micrograms folic acid
    • 15mg zinc
    • 18mg iron (45-60mg iron if menstruating female or history of anemia)
    • 2mg Copper
  • Calcium Citrate with Vitamin D3: 1800-2400 mg/day
  • Vitamin B12:
    • 300-500 micrograms/day
    • 1000 micrograms/month

• Fat Soluble Vitamins:
  • 10,000 IU Vitamin A
  • 3,000 IU Vitamin D
  • 300 micrograms Vitamin K
Expected Outcomes

• Dietary Changes
  • Alterations in food choices and eating patterns
  • Taste changes

• Weight Loss
  • Most patients fail to achieve ideal body weight
  • Most patients have unrealistic expectations regarding weight loss

• Comorbidity Reduction
  • Varies between procedures
# Reduction in Body Weight

## Table 4  Reported weight loss as percentage of excess body weight after bariatric surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Follow-up period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1–2</td>
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<tr>
<td>Vertical banded gastroplasty(^a)</td>
<td>50–72</td>
</tr>
<tr>
<td>Gastric banding(^b)</td>
<td>29–87</td>
</tr>
<tr>
<td>Sleeve gastrectomy(^c)</td>
<td>33–58</td>
</tr>
<tr>
<td>Roux-en-Y gastric bypass(^d)</td>
<td>48–85</td>
</tr>
<tr>
<td>Banded Roux-en-Y gastric bypass(^e)</td>
<td>73–80</td>
</tr>
<tr>
<td>Long-limb Roux-en-Y gastric bypass(^f)</td>
<td>53–74</td>
</tr>
<tr>
<td>Biliopancreatic diversion ± DS(^g)</td>
<td>65–83</td>
</tr>
</tbody>
</table>

\(^a\) American Society for Metabolic and Bariatric Surgery 2007.  
\(^b\) National Institutes of Health 2009.  
\(^c\) American Society for Metabolic and Bariatric Surgery 2006.  
\(^d\) American Society for Metabolic and Bariatric Surgery 2004.  
\(^e\) American Society for Metabolic and Bariatric Surgery 2003.  
\(^f\) American Society for Metabolic and Bariatric Surgery 2002.  
\(^g\) American Society for Metabolic and Bariatric Surgery 2001.
Morbidity of Obesity

- Migraines: 57% resolved
- Pseudotumor Cerebri: 96% resolved
- Dyslipidemia, Hypercholesterolemia: 63% resolved
- Non-Alcoholic Fatty Liver Disease: 90% improved
- Steatosis: 37% resolution of inflammation
- 20% resolution of fibrosis
- Metabolic Syndrome: 80% resolved
- Type II Diabetes Mellitus: 83% resolved
- Polycystic Ovarian Syndrome: 79% resolution of hirsutism
- 100% resolution of menstrual dysfunction
- Venous Stasis Disease: 95% resolved
- Depression: 55% resolved
- Obstructive Sleep Apnea: 74-98% resolved
- Asthma: 82% improved or resolved
- Cardiovascular Disease: 82% risk reduction
- Hypertension: 52-92% resolved
- GERD: 72-98% resolved
- Stress Urinary Incontinence: 44-88% resolved
- Degenerative Joint Disease: 41-76% resolved
- Gout: 77% resolved

Quality of Life - improved in 95% of patients
Mortality - 89% reduction in 5-year mortality
In a randomized controlled trial with 5 year follow up, type 2 diabetes mellitus is best treated by

- lifestyle changes
- sleeve gastrectomy
- Roux-en-Y gastric bypass
- Both sleeve gastrectomy and Roux-en-Y gastric bypass
Reduction in Diabetes: STAMPEDE 5 year follow up

Quality of Life Outcomes
Decreased Risk of Dying

Sjostrom et al. NEJM. 2007; 357(8): 741-752.
Complications

- Procedure specific
- Perioperative complications
- Nutritional complications
- Weight loss complications
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Complication</th>
<th>0-2 wks</th>
<th>2-4 wks</th>
<th>4-8 wks</th>
<th>2-6 mo</th>
<th>6-12 mo</th>
<th>1-5 yrs</th>
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<td>Gastric Bypass And Duodenal Switch</td>
<td>Leak</td>
<td>++</td>
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<td>+</td>
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<tr>
<td></td>
<td>PE</td>
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<td>+</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Pneumonia</td>
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<td>Wound Infection</td>
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<tr>
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<td>Stomal Stenosis</td>
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<td>+++</td>
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<tr>
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<td>Nausea</td>
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<td>Incisional Hernia (open)</td>
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<td>Nutritional Complications</td>
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<td>+++</td>
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<td>Suboptimal Weight Loss</td>
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<td>Gastric Bypass only</td>
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<td>Gastro-gastric fistula</td>
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<td>Esophageal Dilation</td>
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<tr>
<td></td>
<td>Band Erosion</td>
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<tr>
<td></td>
<td>Port/Tubing Problems</td>
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<td>+</td>
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<td></td>
<td>Maladaptive Eating</td>
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<td>+</td>
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<tr>
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<td>Suboptimal Weight Loss</td>
<td></td>
<td>+</td>
<td>+</td>
<td>++</td>
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</tr>
</tbody>
</table>
Complications: Uncommon but Severe

- Death within 3 months of surgery
  - Gastric bypass: 0.7%
  - Band: 0.1%
  - Sleeve Gastrectomy: 0.5%
  - Duodenal switch: 1.1%

- Heart Attack: 1%

- Pulmonary Embolism (Blood Clot): 2-4%

- Leak: 1-4%
  - Gastric bypass: 0% in 2016
  - Sleeve Gastrectomy: 1.19% in 2016

- Not always fatal, but can be severe enough to cause death even when detected and treated
Complications: Common but Less Severe
Adjustable Gastric Band

- Band Erosion 1-2%
- Band Slippage 2-4%
- Port and Tubing Problems 5-10%
- Esophageal Dilation
What is the most common cause of readmission for patients undergoing laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass?

- staple line or anastomotic leak
- pulmonary embolism
- nausea, vomiting, and dehydration
- gastroesophageal reflux disease
Nausea, Vomiting, & Dehydration

• Up to 7-11% risk of readmission for these complains

• Secondary to:
  • Difficulty with habit changes
  • Inadequate protein intake

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**ACT:**
- Create Nausea Scoring System

**PLAN:**
- Collect Rhodes nausea score POD0, POD1, POD2, 1 week follow up, and 6 week follow up at baseline and after nausea protocol implementation

**CHECK:**
- Collect Rhodes nausea scale data after optimizing nausea regimen and compare to baseline

**DO:**
- Nausea protocol implementation
- Anesthesia Perioperative Prophylactic Protocol
- Multi-modal pain and nausea control post-operatively
- Nausea medications at discharge
Complications: Common but Less Severe Sleeve Gastrectomy

- Wound Infection (1%)
- **Nausea & Vomiting**
- Hernia (<5%)
- Gallstones
- Stricture
- Acid Reflux
Gastroesophageal Reflux Disease

- 10-20% risk
- Higher risk in patients with hiatal hernias
- Increased risk of Barrett’s esophagus
Gallstone Formation

- 35-50% incidence without treatment
- 10% will become symptomatic
- Use Actigall (Ursodiol) 300mg twice a day by mouth for 6 months post-operatively
  - Decreases gallstone formation by 15-30%
Complications: Common but Less Severe Gastric Bypass

- Wound Infection (1%)
- Nausea & Vomiting
- Dumping Syndrome
- Hernia (<5%)
- Gallstones
- Stomal Stenosis
- Marginal Ulcers
- Gastrogastric Fistula
- Bowel Obstruction
- Decreased absorption of medications
  - Anticoagulation
  - Immunosuppression
- Kidney stones
- Oxalosis
Marginal Ulcer

- Incidence 4-15% over many years

- Risk factors = NSAIDs, Tobacco, Steroids

- Rare for duodenal ulcer to occur, but poor access may warrant routine H pylori screening and treatment

- Often responds to acid suppression and sucralfate

- Ischemia and gastro-gastric fistula may play role in refractory ulcers

- Rarely requires reoperation
Small Bowel Obstruction

- Incidence ~1-3%
- Must take care during Roux limb creation not to rotate the bowel
- Close mesenteric defect at jejunojejunostomy and transverse mesocolon
- Roux limb may be placed retrocolic or antecolic
  - Retrocolic = 3 mesenteric defects
  - Antecolic = 2 mesenteric defects
Dumping Syndrome

• Early Dumping Syndrome
  • A dense mass of food “dumps” into your small intestine at an earlier stage of digestion
  • Fluid shifts from the bloodstream into the small intestines
  • Symptoms:
    • Bloating
    • Diarrhea 30—60 minutes later
    • Lightheadedness
    • Sweating
  • Abdominal cramps
  • Nausea
  • Facial flushing
  • Heart palpitations

• Late Dumping Syndrome
  • Reactive hypoglycemia 1 to 3 hours after a large surge of insulin

• Higher risk with high starch, high sugar, and high carbohydrate foods
Stomal stenosis

- Incidence 3-10%

- Stereotypical time course, occurs 4-8 weeks post-operatively

- Generally well treated with single endoscopic balloon dilation using 15 mmHg
Complications: Common but Less Severe
Duodenal Switch

- Wound Infection (1%)
- Nausea & Vomiting
- Hernia (<5%)
- Stomal Stenosis
- Bleeding
- Dumping Syndrome
- Diarrhea
- Vitamin Deficiencies
- Malnutrition
Protein Energy Malnutrition

- Primary PEM: insufficient dietary intake
- Secondary PEM: impaired utilization of nutrients, increased requirements, increased metabolic losses
- Symptoms
  - Fatigue, thin, brittle hair, fat and muscle wasting
  - Regurgitation of saliva/phlegm, gagging, dysphagia
  - Infection, dental cavities
  - Diarrhea, anemia, edema, ascites

L. John Hoffer CMAJ 2001;165:1345-1349
Protein Energy Malnutrition

- 1-8% after RYGB (1-2yr)
- 4-19% after BPD/DS (1-2yrs)

- Studies
  - CC lengths RYGB 150-250cm vs 50cm BPD
  - Albumin <3 g/dl (catabolic/starving)
  - 15-30gm protein/day
  - 400cal/day

- Treatment
  - Goal 80-90 grams protein/day
  - Symptomatic treatment (nausea, emesis, abdominal pain)
  - IVF, electrolyte replacement
  - TPN or Tube Feeding

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Anthropometric changes after 3 months</strong></td>
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<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Initial data</td>
<td>Weight</td>
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<tr>
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<td>BMI</td>
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<tr>
<td>3 Months</td>
<td>Weight</td>
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<tr>
<td></td>
<td>BMI</td>
</tr>
<tr>
<td></td>
<td>%FWI</td>
</tr>
</tbody>
</table>

Llano Nutr Hosp. 2015
Strohmayer 2010

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Nutritional Deficiencies

• Most common long term complication

• Less common with the adjustable gastric band

• Requires yearly follow up

• Causes
  • Persistence of pre-operative deficiency
  • Inadequate micronutrient and protein intake
  • Poor quality of diet
  • Altered digestion and absorption
  • Non-adherence to vitamin and mineral supplementation
  • Small intestine bacterial overgrowth
  • Alcohol and Substance abuse
  • Eating Disorder
# Micronutrient Deficiency Risk by Surgery

<table>
<thead>
<tr>
<th>Surgery Type</th>
<th>Vitamins at Risk</th>
<th>Minerals at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roux-en-Y Gastric Bypass</td>
<td>Vitamin B12&lt;br&gt;Vitamin D&lt;br&gt;Folate&lt;br&gt;Thiamin</td>
<td>Calcium&lt;br&gt;Iron</td>
</tr>
<tr>
<td>Sleeve Gastrectomy</td>
<td>Vitamin B12&lt;br&gt;Thiamin</td>
<td>Calcium&lt;br&gt;Iron</td>
</tr>
<tr>
<td>Duodenal Switch</td>
<td>Vitamin A&lt;br&gt;Vitamin D&lt;br&gt;Vitamin K</td>
<td>Calcium&lt;br&gt;Iron&lt;br&gt;Zinc</td>
</tr>
<tr>
<td>Adjustable Gastric Banding</td>
<td>Vitamin B12&lt;br&gt;Folate&lt;br&gt;Thiamin</td>
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# Post-operative Vitamin Deficiencies

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Normal Range</th>
<th>Postoperative Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitamin A</strong></td>
<td>20-80 µg/dL</td>
<td>Common (50%) with BPD/DS after 1 year, up to 70% after 4 years; may occur with RYGB/AGB</td>
</tr>
<tr>
<td><strong>B1 (thiamine)</strong></td>
<td>10-64 ng/mL</td>
<td>Rare; occurs with RYGB, AGB, BPD/DS</td>
</tr>
<tr>
<td><strong>B6 (pyridoxine)</strong></td>
<td>5-24 ng/mL</td>
<td>Rare</td>
</tr>
<tr>
<td><strong>B12 (cyanocobalamin)</strong></td>
<td>200-1,000 pg/mL</td>
<td>Common with RYGB in absence of supplementation</td>
</tr>
<tr>
<td><strong>Folate (Folic Acid)</strong></td>
<td>280-791 ng/mL</td>
<td>Uncommon; occurs in the absence of supplementation; critical for childbearing women</td>
</tr>
<tr>
<td><strong>Vitamin D</strong></td>
<td>25-40 ng/mL</td>
<td>Common with BPD/DS after 1 year; may occur with RYGB; decreased Vitamin D absorption from proximal small bowel</td>
</tr>
<tr>
<td><strong>Vitamin E</strong></td>
<td>5-20 µg/mL</td>
<td>Uncommon</td>
</tr>
<tr>
<td><strong>Vitamin K</strong></td>
<td>PT: 10-13 seconds</td>
<td>Common with BPD/DS after 1 year</td>
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# Post-operative Mineral Deficiencies

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Normal Range</th>
<th>Postoperative Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>4.8-5.6 mg/dL (ionized calcium)</td>
<td>Serum calcium usually maintained WNL</td>
</tr>
<tr>
<td>Iron</td>
<td>15-200 ng/mL (males) 12-150 ng/mL (females)</td>
<td>20-49% of patients; common w/ RYGBP for menstruating women or super obese patients</td>
</tr>
<tr>
<td>Zinc</td>
<td>60-130 µg/dL</td>
<td>Common w/ BPD/DS post 1 year; may occur with RYGBP</td>
</tr>
<tr>
<td>Copper</td>
<td>Copper: 70 - 145 µg/dL Ceruloplasmin: 27 - 37 mg/dL</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Selenium</td>
<td>70-150 ng/mL</td>
<td>Uncommon</td>
</tr>
</tbody>
</table>
QUESTIONS?

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