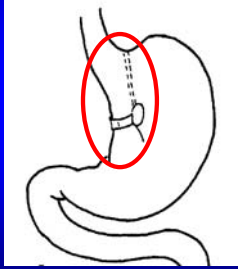


- ### Operative Strategies: Bariatric Surgery
- Global malabsorption
 - JI bypass
 - Pure restriction
 - Vertical banded gastroplasty
 - Laparoscopic adjusted silicone gastric band
 - Combined restriction/minimal malabsorption
 - Roux-en-Y gastric bypass
 - Selective maldigestion and malabsorption
 - Bilio-pancreatic diversion (BPD)

Jejunioileal Bypass

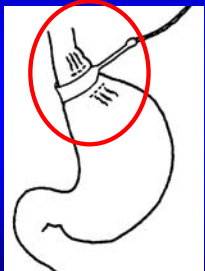
- Defunctionalized segment drains into sigmoid colon
- Bacterial overgrowth risk
- Cirrhosis/hepatic failure
- High nutrient/vitamin malabsorption risk
- No longer performed
- Colonoscopy before conversion

Restrictive Surgery: Vertical Banded Gastroplasty(VGB)



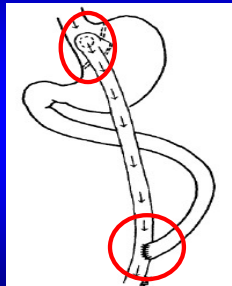
- Vertical gastric pouch
- Calibrated to 15 cc
- Reinforced mesh collar
- Laparoscopic approach possible
- Significant dietary restrictions needed
- Dilation rarely effective

Restrictive Surgery: Lap. adjustable silicon gastric band



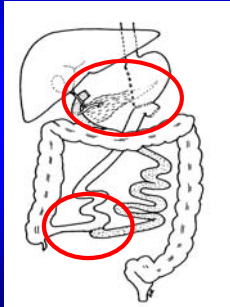
- Newest attempt
- “Minimally invasive”
- Silicone collar
?prevents erosion
- Ability to adjust gastric outflow tract

Roux-en-Y Bypass



- Combines restriction minimal malabsorption
- Most frequently done
- 30 cc gastric pouch
- 1 cm anastomosis to jejunum
- Length typically 75cm longer (150) for super-morbid BMI>50
- Dumping syndrome if large sugar content

Biliopancreatic diversion



- No blind limb
-avoids overgrowth
- Selective malabsorption
-fat/starch
- Biliary/pancreatic secretion enters distally
- 50 cm common channel
- Super obese
- Need fat soluble vitamins

Bariatric Surgery Complications

- Early: First 30 days
 - Leaks
 - Bowel obstruction
 - GI or intra-abdominal bleeding
 - Wound infection
 - DVT
 - Pulmonary embolism

Bariatric Surgery Complications

- Late: > 30 days
 - Anastomotic stricture
 - Bowel obstruction
 - GI or intra-abdominal bleeding
 - Cholelithiasis
 - Incisional hernia
 - Marginal ulceration
 - Dehiscence/fistulization
 - Nutritional deficiencies

**Risks of Bariatric Surgery
Incidence Data**

- 10-20% patients require f/u operations to correct complications
 - Abdominal hernia most common
- 30% develop nutritional deficiencies
 - Anemia, osteoporosis, metabolic bone disease
 - Vitamin and trace element deficiency

www.niddk.nih.gov/health/nutrit/pubs/gastsurg.htm

**Pre-Endoscopic Evaluation of the
Post Operative Bariatric Patient**

- Know the anatomy!
- Discuss with the surgeon if possible
 - modifications are common!
- Review all imaging studies
- Select the equipment and accessories to meet the need
- Set appropriate goals and time frames

**Bariatric Surgery
Endoscopic Evaluation**

Indications for Endoscopy Postoperative Bariatric Patient

- Evaluation of symptoms
- Management of complications
- Evaluation of failure of weight loss

Nausea and Vomiting

- Nausea extremely common
- Vomiting
 - Most commonly due to inappropriate eating habits
 - Large volumes or bolus size
 - Remember low volume preps for colonoscopy
- Intractable vomiting
 - protein calorie malabsorption /Wernicke's/ neuropathy
 - Remember THIAMINE before glucose!

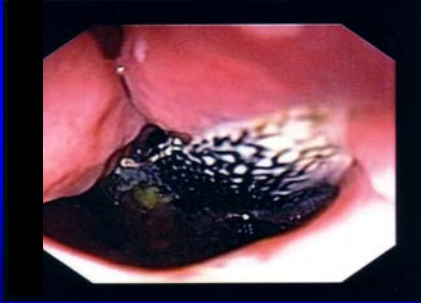
J Clin Gastro 1987;9:549-52
Obes Surg 2002;12:213

Abdominal/Retrosternal Pain

- Think stomal ulceration
- If prosthetic device- ?erosion

Obes Surg 1998;8(5):505-16
Nature Gastro Hepatol 2007;4(3):13-47

Prosthesis erosion



Prosthesis erosion



**Stomal Complications:
Gastric Bypass**

- Stomal ulceration 2-16%
- Stenosis 9-20%
- Risks of development highest first 2 months
- Gastrografin studies with the first 2 weeks?
- Usually managed by conservative therapy
 - Pharmacologic/endoscopic

Obes Surg 1998;8(5):505-16
Nature Gastro Hepatol 2007;4(3):13-47

Stomal Ulceration

- Most commonly staple line failure
 - ?development of fistula
- NSAID use
 - ?overt or surreptitious
- Ischemia at anastomosis site
- Bleeding risk

Amer Surg 1991;57:286-8
Obes Surg 2002;12:30-3

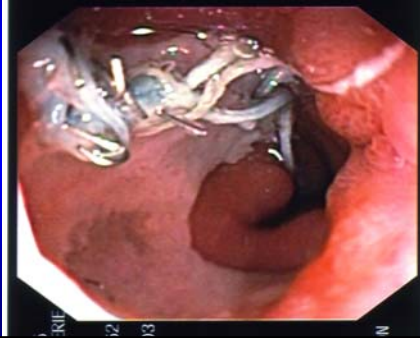
Marginal Ulcer



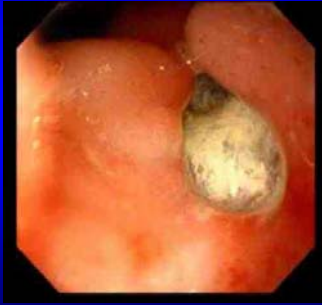
Dehiscence/Fistulization



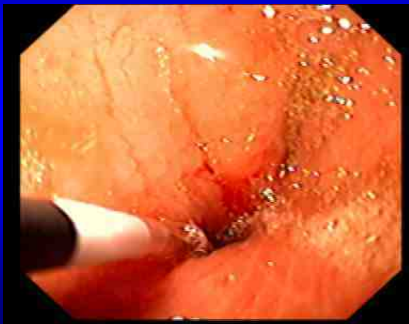
Marginal Ulcer-Ischemia



Marginal Ulcer-NSAID



Stenosis



KEY POINT

**Anastomotic Stricture Dilation
Higher risk: Go SLOWLY**

Anastomotic Ulcer: Bleeding



Post-Bariatric Nutritional Problems

- Macronutrient (such as protein) and micronutrient deficiencies are common.
- Type of bariatric surgery potential risk rising risk

laparoscopic adjustable gastric banding
vertical sleeve gastrectomy
divided Roux-en-Y gastric bypass
bilio-pancreatic diversion

**VITAMIN AND MINERAL SUPPLEMENTS
MALABSORPTIVE BARIATRIC SURGERY**

- MULTIVITAMIN with MINERALS: 1 Chewable Tablet, Daily to Twice a Day
- CALCIUM SUPPLEMENTS: Chewable Tablets, 1.2 grams Elemental Calcium, Daily
- Vitamin D: 800 IU daily
 - PTH/absortometry scan -prolonged

Isolated serum calcium measurement is not an adequate marker of calcium metabolism.

Obesity Surgery Doubles Fracture Risk

Koch/Finelli. GI Clin NA 2010 (in press)

**VITAMIN AND MINERAL SUPPLEMENTS
MALABSORPTIVE BARIATRIC SURGERY**

SPECIFIC DEFICIENCIES

- THIAMINE: 100 mg tablet, twice daily or THIAMINE: 100-250 mg IM monthly
- NIACIN: 500 mg orally, three times daily
- FOLIC ACID: 1-5 mg orally, daily
- VITAMIN B12:
 - 1000 mcg, intra-muscular, monthly or
 - 500 mcg tablet sublingual once daily

Koch/Finelli. GI Clin NA 2010 (in press)

**VITAMIN AND MINERAL SUPPLEMENTS
MALABSORPTIVE BARIATRIC SURGERY**

SPECIFIC DEFICIENCIES

- VITAMIN A: 10,000 IU orally, daily
- VITAMIN D (Ergocalciferol): 50,000 IU with a meal once weekly (up to 12 weeks) followed by VITAMIN D3 (Cholecalciferol): 1000 IU with a meal twice daily
- VITAMIN E: 800 to 1200 IU orally, daily
- VITAMIN K: 5 to 20 mg orally, daily

Koch/Finelli. GI Clin NA 2010 (in press)

**VITAMIN AND MINERAL SUPPLEMENTS
MALABSORPTIVE BARIATRIC SURGERY**

- IRON: Iron/Vitamin C complex, 1 Tablet Daily before a Meal, Iron Elixir (through a straw), or Parenteral Iron
- ZINC SULFATE: 220 mg capsule, daily to every other day
- COPPER GLUCONATE: 2 mg capsule, daily to every other day

Koch/Finelli. GI Clin NA 2010 (in press)

**WATER-SOLUBLE VITAMINS AS
COENZYME PRECUSORS AND
DEFICIENCY DISORDERS**

<u>Vitamin</u>	<u>Coenzyme Derivative</u>	<u>Deficiency Disorders</u>
• Thiamine (Vitamin B1)	Thiamine Pyrophosphate (TPP)	Beriberi
• Riboflavin (Vitamin B2)	Flavin Adenine Dinucleotide (FAD)	Eye Disorders, Glossitis, Dermatitis
• Niacin (Nicotinic Acid)	Nicotinamide Adenine Dinucleotide	Pellagra

Koch/Finelli. GI Clin NA 2010 (in press)

**WATER-SOLUBLE VITAMINS AS
COENZYME PRECUSORS AND
DEFICIENCY DISORDERS**

<u>Vitamin</u>	<u>Coenzyme Derivative</u>	<u>Deficiency Disorders</u>
• Folate	Tetrahydrofolate	Macrocytic Anemia
• Biotin	Pyruvate Carboxylase	
• Pantothenic Acid	Coenzyme A	
• Pyridoxine (Vitamin B6)	Pyridoxal Phosphate	Dermatitis
• Vitamin B12	5'-Deoxyadenosyl-Cobalamine	Neuropathy; Anemia

Koch/Finelli. GI Clin NA 2010 (in press)

TRACE ELEMENTS AS COFACTORS FOR ENZYMES/PROTEINS AND ASSOCIATED DEFICIENCY DISORDERS

<u>Element</u>	<u>Enzymes/Proteins</u>	<u>Deficiency Disorders</u>
• Copper	Cytochrome Oxidases Cytosolic Superoxide Dismutase	Anemia, Neutropenia Myelopathy
• Zinc	Cytosolic Superoxide Dismutase	Dermatitis, Alopecia Glossitis, Nail Dystrophy
• Manganese	Mitochondrial Superoxide Dismutase	
• Selenium	Glutathione Peroxidase	Cardiomyopathy
• Iron	Catalase/Hemoglobin	Anemia

Koch/Finelli. GI Clin NA 2010 (in press)

ROUTINE LABORATORY TESTING MALABSORPTIVE BARIATRIC SURGERY

<u>INTERVAL</u>	<u>LABORATORY TESTING</u>
• At 3 Months	CBC,BS,CMP, HBG 1AC*
• q6 Months	CBC, CMP
• Yearly	Lipids; Ferritin; Zinc; Copper; Magnesium; Vitamin A; Total 25-Hydroxy Vitamin D; Folate; Whole blood thiamine; Vitamin B12;24-hour Urinary calcium

• *If diabetes mellitus is present pre-operatively

NUTRITIONAL CONSEQUENCES OF BARIATRIC SURGERY

Specific Clinical Patient Presentations

HYPERINSULINEMIC HYPOGLYCEMIA

- Present with complaints of dizziness, syncope, or near-syncope following Roux-en-Y gastric bypass
- Hyperinsulinemia in response to oral glucose in Roux-en-Y gastric bypass, both in patients who are symptomatic or asymptomatic

Obes Surg, in press, 2009

MACRONUTRIENTS PROTEIN DEFICIENCY

- In weight reduction protocols, post-operative bariatric patients are instructed to maintain intake of 60 to 70 grams of protein daily.
- Although it can occur after Roux-en-Y gastric bypass, significant protein malabsorption is most likely after a bilio-pancreatic diversion.

MACRONUTRIENTS PROTEIN DEFICIENCY

- Present with hypoalbuminemia:
 - it is important to consider inflammatory processes such as small intestinal bacterial overgrowth as the source
- Monitoring a patient's response to nutritional therapy, a shorter half-life protein such as prealbumin may be followed over time.

Endocrin Practice 2007; 13(3): 277-82.

**MACRONUTRIENTS
PROTEIN DEFICIENCY**

- Hair loss is a common early manifestation of post-operative protein malnutrition -alopecia can also occur during zinc deficiency).
- Long-term manifestations of protein malnutrition can include muscle mass wasting and edema
- Protein deficiency similar to Kwashiorkor has been described after Roux-en-Y gastric bypass

Am J Clin Nutr 2009; 90(1): 15-22.

Anemia

- Common post-operative finding
- Microcytic anemia ?iron deficiency
- Macrocytic anemia ?vitamin B12 or folate

Persistent Iron Deficiency Anemia

- Despite oral supplementation consideration of iron loss from a colon source, from a stomal ulcer, or from the excluded pancreaticobiliary limb (duodenal ulcer or gastric ulcer/antritis in the excluded stomach)
- Refractory iron deficiency may require parenteral iron (often seen in premenopausal women with menses)

Anemia not corrected by iron or vitamin B12

- Vitamin E deficiency can induce hemolytic anemia
- Copper deficiency anemia and neutropenia
- Addressing the question of potential blood loss from the gastric remnant/excluded stomach or the small intestine
- Exclude other nutritional origins of anemia by examining blood levels of vitamin A, vitamin E, folate, zinc, and copper

Nutr Clin Pract 2009; 24: 217-26. South Med J 2008; 101: 1024-31

NEUROLOGIC DISORDERS

- Peripheral neuropathy most common neurologic symptom
- Neurologic complaints are reported by 1.3% to 4.6% of post-operative patients in surveys
- Neurologic emergencies include Wernicke's encephalopathy (thiamine deficiency) and Guillain-Barre syndrome

Muscle Nerve 2006; 33: 166-76.

GI Complications of Obesity Thiamine Deficiency-Wernicke's

- Wernicke's Encephalopathy
:Developed 2-18 months post op
- Classic triad
: ataxia, confusion, nystagmus
: evident in only 20%
- Other symptoms/signs: seizures, asterixis
- Clinical setting of intractable vomiting

Neurology 2007;68:807-11

**OTHER CLINICAL PRESENTATIONS
THIAMINE DEFICIENCY**

BERIBERI SUBTYPES SYMPTOMS/FINDINGS

- Neuropsychiatric: Hallucinations/Aggressive Behavior/Confusion/Nystagmus/Ataxia/Ophthalmoplegia
- Wet beriberi: Tachycardia/Respiratory Distress/Leg Edema/Right Ventricular Dilation/Lactic Acidosis
- Dry beriberi: Numbness/Muscle Weakness and Pain Lower>UpperExtremities/Convulsions/Exaggerated Tendon Reflexes

**CLINICAL PRESENTATIONS OF
THIAMINE DEFICIENCY**

BERIBERI SUBTYPES SYMPTOMS/FINDINGS

- Gastrointestinal: Nausea/Emesis/Megajejunum/Constipation/Megacolon
- Bariatric beriberi: Symptoms corrected by antibiotics, not by oral thiamine

Koch/Finelli. GI Clin NA 2010 (in press)

**NEUROLOGIC DISORDERS
Deficiency Related**

- Niacin deficiency (pellagra): headaches, ataxia or myoclonus, anxiety-depression, delusions, hallucinations
- Vitamin E deficiency symptoms: ataxia, loss vibration/position sensation, muscle weakness, ptosis
- Vitamin B12 deficiency peripheral neuropathy
- Copper deficiency: myelopathy (with spastic gait and sensory ataxia) mimics findings B12 deficiency

Neurologic symptoms w/t: blood levels niacin, vitamin B12, vitamin E, copper, whole blood thiamine

Muscle Nerve 2006; 33: 166-76. Mayo Clinic Proc 2006; 81: 1371-84.

VISUAL DISORDERS

- Vitamin A deficiency include nocturnal visual difficulty and decreased visual acuity
- Vitamin E deficiency visual symptoms retinopathy
- Thiamine deficiency difficulty focusing their vision or persistent blurred vision
 - physical examination, nystagmus is often identified

Laboratory evaluation:
serum vitamin A, vitamin E, whole blood thiamine

Koch/Finelli. GI Clin NA 2010 (in press)

SKIN DISORDERS

- Vitamin A deficiency: xerosis and pruritus
- Essential fatty acid deficiency, niacin deficiency, and riboflavin deficiency can cause a scaly dermatitis
 - Essential fatty acids, linoleic acid and linolenic acid in flaxseed oil, soybean oil, and canola oil.
- Symptoms of zinc deficiency include a dermatological eruption

Evaluation : serum vitamin A, niacin and zinc

EDEMA

- Underlying heart failure is a major consideration when a patient presents with edema
- Thiamine deficiency can develop high output cardiovascular disease (wet beriberi)
 - Tachycardia, respiratory distress, or lower extremity edema, with right > left ventricular dilation and lactic acidosis.
- Selenium deficiency cause of heart failure in a patient with edema
- Underlying hepatic disorder NAFLD/cirrhosis

Work up: blood selenium, whole blood thiamine, and plasma niacin

Edema

- Serious syndrome of post-operative diarrhea associated with hypoalbuminemia and diffuse edema
- Severe protein/calorie malnutrition Bil/panc diversion: extended (distal) Roux-en-Y GJB or duodenal switch -procedures severe steatorrhea/malabsorption
- Small intestinal bacterial overgrowth -response to antibiotics
- Niacin deficiency: development of hypoalbuminemia - diarrheal illness or colitis

Obes Surg 2008; 18(1): 139-43

Absorptive Complications: Gastric Bypass

- Iron deficiency- common
- B12 deficiency – common - reported also for the restrictive surgeries
- Vitamin D deficiency- common
- Trace element deficiency rare - more common in long segment exclusions - present with neuropathy/muscular weakness
- JI bypass steatosis/encephalopathy issues

Obes Surg 2005;15:145-54

SIBO

GI Complications of Obesity Elements and Vitamin Deficiency

- Calcium (duodenum/proximal jejunum)
- Vitamin D (jejunum/ileum)
- Fat soluble vitamins- esp. A and E -Most common post BPD
- Trace elements- rare -Zinc, Magnesium, selenium

Obes Surg 2005;15:145-54

Conclusions Post Bariatric Complications

- Understand the anatomy! **Possible SIBO**
- Endoscopic assessment options
- Patients require indefinite, regular follow up
 - macronutrient micronutrient malnutrition
- Physicians who care for these patients
 - need to be familiar with common post-operative syndromes that result from specific nutrient deficiencies.
