ACG Annual Scientific Meeting
Symposium 4A – Obesity: The Hunger Games

Postoperative Complications: Metabolic and Nutritional

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Learning objectives

- Recognize and diagnose nutritional disorders occurring after bariatric surgery
- Implement the appropriate nutritional monitoring and treatment of nutritional disorders occurring after bariatric surgery

Nutritional complications after bariatric surgery

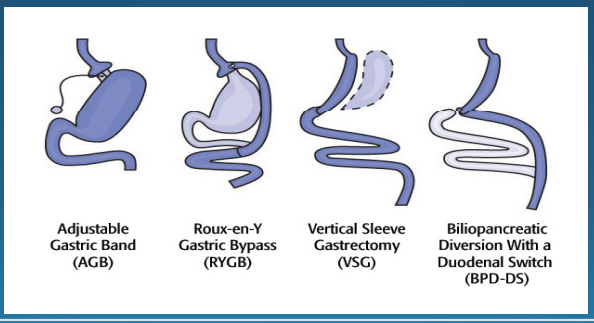
- Occur in up to 30%
  - Macronutrient, micronutrient or both
  - Cause variety of disorders
    - Most occur insidiously, many clinically silent
  - Most common - iron, calcium, vitamin D and vitamin B12
  - Potentially most devastating – thiamine
  - Most often multifactorial etiology
    - Operation performed
    - Post-op GI symptoms, SIBO
    - Post-op food intolerances
    - Modified meals/eating patterns
    - Non-adherence to diet recommendations

Remember that micronutrient deficiencies are commonly present in obese individuals

Stein J et al. APT 2014

Nutritional risk relates to type of surgery

LAGB < VSG < RYGB < BPD

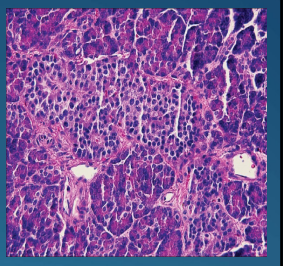


- 40 year old woman presents 6 years after RYGB
  - Episodic diaphoresis, profound weakness and dizziness
    - Nausea and emesis also
    - Typically occur postprandially
  - Hypoglycemia associated with increased insulin and C peptide
- All diagnostic modalities for localizing an insulinoma were negative
- Diet modifications failed to control symptoms

What's the diagnosis?

Nesidioblastosis

- Hyperinsulinemic hypoglycemia
  - Noninsulinoma pancreatogenous hypoglycemia syndrome (NIPHS)
- Episodic dizziness, diaphoresis, confusion, fatigue and syncope/presyncope
  - Usually 1-2 hrs postprandially
  - Usually > 1 year after RYGB; rare
- Histology shows diffuse islet cell hypertrophy, islet cell pleomorphism and ductal insular complex



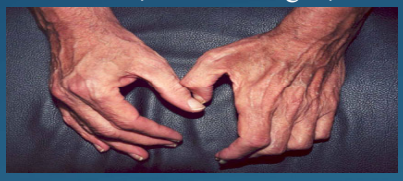
Service GJ, et al. NEJM 2005
Campos GM et al. Surg Obes Rel Dis 2013

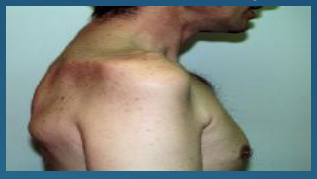
Nesidioblastosis

- DDx – late dumping syndrome, insulinoma, exogenous insulin use
- Diagnosis
  - Exclude insulinoma
  - Functional imaging by (18)F-DOPA- and (11)C-HTP-PET can accurately visualize diffuse endocrine pancreatic activity
- Diet – low carbohydrate
- Medical treatments – octreotide, diazoxide, nifedipine
- Surgical treatments – reversal of bypass, pancreatic resection

Service GJ, et al. NEJM 2005
Campos GM et al. Surg Obes Rel Dis 2013

- 58 year old man presents 4 years post BPD with DS
  - Did well (except foul smelling stools) after surgery (297# to 145#) until 1 year ago
    - Increased foul smelling diarrhea, nausea, emesis, anorexia, edema, weight loss, fatigue, FTT
    - Easy bruising, hair falling out, nails not growing
    - Cachectic appearing, ketone smell to breath, 3+ pretibial edema, smooth tongue, brittle nails/hair, several ecchymoses





  - Decreased lymphocytes; albumin 2.3 g/dL; fecal fat loss 85g/d
  - EGD/Colon w/bxs – negative; positive SIBO

Protein-energy malnutrition

- Postoperative protein malnutrition
  - Similar to kwashiokor
- Described mainly after very long-limb RYGB and BPD
  - 7-21% after BPD (less with duodenal switch); up to 5% after long-limb RYGB
- Multifactorial causes of reduced protein intake
  - Intolerance of red meat
  - GI symptoms limiting oral intake
- Protein maldigestion and PLE also may contribute

Fujioka, DiBaise JPEN 2011

Protein-energy malnutrition

- Signs/symptoms
  - Muscle wasting
  - Edema
  - Hair loss (common early manifestation)
    - DDx – zinc deficiency
- Diminished visceral protein markers
  - Albumin, prealbumin
- Recommend 60-80 g protein daily
  - ? Importance of BCAA (leucine)
- Treatment in severe cases
  - Nutrition support, surgical revision (1-2% BPD) or reversal

Fujioka, DiBaise JPEN 2011

Fat malabsorption

- Expected consequence of very long-limb RYGB and BPD
  - Severity depends on common channel length
  - Reduced bile/pancreatic enzyme mixing; SIBO may contribute in some
- Steatorrhea, fat-soluble vitamin deficiencies (common), essential fatty acid deficiency
- Treatment
  - Fat restricted diet ± MCT oil
  - Fat soluble vitamin and EFA supplements as needed
  - ? Role of pancreatic enzymes
  - Surgical revision in refractory cases

Fujioka, DiBaise JPEN 2011

SIBO after bariatric surgery

- Prevalence unclear
  - Up to 40% in bypass operations
- Implicated in
  - Deficiencies of thiamine, B12, copper
  - Protein and fat maldigestion
- Exact mechanism(s) unclear
- Diagnosis of SIBO controversial
  - ? Small bowel aspirate, ? Breath testing, ? Elevated folate
- Reports of correction of deficiencies with antibiotics when supplementation ineffective

Lakhani et al. Nutr Res 2008
Machado JD et al. Obes Surg 2008

- 46 year-old woman presents with complaints of feeling weak and tired with easy fatigue for few months
- 3 years ago, underwent LVSG (sleeve)
  - No recent follow-up; on no medications or supplements
- Exam notable for pale skin and conjunctivae and "spoon" nails
- Hgb 6.7 g/dL, MCV 70

What's the diagnosis?

Anemia

- Common occurrence postoperatively
- Iron deficiency – 17-50%
  - Microcytic
  - Multifactorial
    - Reduced intake/absorption (hypochlorhydria/bypass duodenum)
    - GI blood loss occasionally
  - IV replacement sometimes needed
  - Once corrected, daily supplementation recommended
- Persistent IDA despite oral supplementation
  - Anastomotic ulceration, Other GI source (colon cancer), Excluded stomach/pancreaticobiliary limb

Drygalski and Andris. Nutr Clin Pract 2009

Other causes of anemia

- Vitamin B12, folate deficiencies
  - Macrocytic, megaloblastic
  - Neurologic sequelae (B12)
- Vitamin E deficiency
  - Hemolysis
- Copper deficiency
  - Anemia and neutropenia
- Vitamin A deficiency

Consider combination of deficiencies when difficult to correct

Vitamin B12 and folate deficiencies

- Common
  - B12 deficiency (25-70%) takes years to develop
  - Folate deficiency (9-35%) occurs more rapidly
- Multifactorial
  - B12 - hypochlorhydria, inadequate secretion/mixing with intrinsic factor, reduced consumption
  - Folate – reduced consumption, low B12
- Clinical manifestations
  - Macrocytic anemia, pancytopenia, glossitis
  - B12 only – neurologic sequelae
    - Subacute combined degeneration – rare

Oral replacement usually effective for both

- 32 year-old woman presents to ER with 2 week h/o nausea, vomiting and dehydration
- Underwent RYGB 10 months prior (42 kg/m^2 to 31 kg/m^2)
- Exam unremarkable initially
- EGD – patent anastomosis
- Over the next few days
  - Diplopia, weakness in both upper and lower extremities, urinary incontinence, and memory loss to recent events.
- Neurological examination
  - Moderate cognitive impairment, confabulation, nystagmus, quadriparesis, and absent deep tendon reflexes

What's the diagnosis?

Post bariatric neurologic disorders

- Neurologic complaints reported by 1% to 5%
- Peripheral neuropathy most common
- Neurologic emergencies
  - Wernicke's encephalopathy ('dry' beriberi)
  - Guillain-Barre syndrome

Wernicke's encephalopathy

- Develops from 2 to 18 months postop
- Classic triad
  - Ataxia, confusion and nystagmus
  - Evident in only 20%
  - Seizures, asterixis may also occur
  - Incomplete recovery is common
  - Fatalities reported
  - Can be precipitated by IV glucose administration
- Often occurs in the clinical setting of intractable vomiting (lasting about 3 weeks on average)

- Easily treatable if detected early
- Can be prevented by daily MVI in those doing well

Aasheim ET. Ann Surg 2008

Other presentations of thiamine deficiency

- Bariatric beriberi
  - GI > cardiac ('wet' beriberi)
    - Nausea, vomiting, constipation
    - Megajejunum, megacolon
    - High output congestive heart failure
  - Symptoms corrected by antibiotic not by oral thiamine
    - SIBO implicated
- Korsakoff's psychosis
  - Confabulation

Other neurologic deficiency disorders

- Pellagra
  - Niacin
  - "4 D's" – diarrhea, dermatitis, dementia, death
- Subacute combined degeneration
  - Vitamin B12
- Myeloneuropathy
  - Copper
  - Spastic gait and sensory ataxia

Muscle Nerve 2006;33:166-176
Mayo Clin Proc 2006;81:1371-1384

- 37 year-old man presents for his annual visit 3 years post-BPD with duodenal switch
  - BMI from 43 kg/m2 to a stable 28 kg/m2
- Doing well but frequent, foul smelling stools
- Has noticed some blurring in his vision and more difficulty driving at night

What's the diagnosis?

Visual disorders

- Vitamin A deficiency
  - Night vision problems early
  - Blindness late (severe corneal drying)
- Vitamin E deficiency
  - Retinopathy
- Thiamine deficiency
  - Difficulty focusing, blurred vision, nystagmus

Finelli and Koch. GI Clin N Am 2010;3:45-53

Skin disorders

- Generally associated with RYGB/BPD
  - Vitamin A deficiency (xerosis, pruritus)
  - Niacin deficiency
  - Zinc deficiency (acrodermatitis, dysgeusia, hair loss)
  - Riboflavin deficiency
  - Essential fatty acid deficiency (scaly dermatitis)
  - Vitamin K deficiency (bruising)
- Oral replacement usually successful

Dalcanale L et al. Obes Surg 2010

Metabolic bone disease

- Calcium and vitamin D deficiencies (15-45%) occur commonly after bariatric surgery
  - Can be severe with secondary hyperparathyroidism
- Multifactorial – diversion of nutrient flow, reduction in nutrient intake, bone response to weight loss
- Periodic monitoring of bone density, vitamin D, calcium, magnesium, phosphorus, PTH, ? markers of bone turnover
- Daily supplementation of calcium (citrate better absorbed) and vitamin D recommended after bariatric surgery
  - 1200-2000 mg/d; higher doses if deficiency identified
- Bisphosphonates occasionally needed
  - IV preferred

Heber D et al. J Clin Endocrinol Metab 2010
McMahon MM et al. Mayo Clin Proc 2006

Medical follow-up

- Routine postoperative laboratory testing and surveillance is advised
  - Every 6 months for first 2 years, annually thereafter
    - CBC, chemistries, vitamin D, ferritin, vitamin B12, PTH, folate
  - Annually
    - Bone mineral density and body composition

Heber D et al. J Clin Endocrinol Metab 2010

Lab testing as indicated

- Visual symptoms: vitamin A, vitamin E, whole blood thiamine
- Bleeding disorder: INR
- Neurologic symptoms: vitamin B12/methylmalonic acid, vitamin E, copper, whole blood thiamine, plasma niacin
- Anemia: ferritin, vitamin B12, folate, zinc, copper, vitamin A, vitamin E
- Hair loss: serum/leukocyte zinc, protein
- Skin rash: vitamin A, serum/leukocyte zinc, essential fatty acid profile, plasma niacin

Heber D et al. J Clin Endocrinol Metab 2010
Bal B et al. Nat Rev Gastroenterol Hepatol 2010

Routine micronutrient supplements

- Multivitamin with iron: 1 chewable tablet, twice a day
- Calcium + vitamin D: chewable tablets, total dose of 1 to 1.5 g elemental calcium daily
- Vitamin B12: 500 – 1000 mcg tablet PO/SL or intranasally daily (gastric bypass/BPD)
- Iron + vitamin C (gastric bypass/BPD)

Heber D et al. J Clin Endocrinol Metab 2010

Micronutrient supplements PRN

- Vitamin B12: 1,000 mcg IM monthly
- Iron: Parenteral iron
- Thiamine: 100 mg tab, twice daily or 100-250 mg IM once monthly
- Zinc sulfate: 220 mg tablet daily to qod
- Copper gluconate: 2 mg capsule daily to qod
- Selenium: 100 mcg daily
- Vitamin D (ergocalciferol): 50,000 IU with meals, once weekly (for up to 12 weeks) followed by vitamin D3 (cholecalciferol): 1,000 IU with meals, twice daily
- Folic acid: 1 mg tab daily in women of child-bearing age

Bal B et al. Nat Rev Gastroenterol Hepatol 2010

Take-home points

- Nutrition and metabolic disturbances are common following bariatric operations
  - Most common after RYGB and BPD
  - Both macronutrient and micronutrient deficiencies
  - Some can be severe and life-threatening
  - May not be prevented by routine supplementation
- Counseling, lifelong periodic micronutrient monitoring and routine supplementation recommended