METABOLIC COMPLICATIONS OF BARIATRIC SURGERY

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Case presentation

• 55 year old female was transferred to Downstate Medical Center on March 31, 2006 for management of metabolic encephalopathy and pancreatitis following gastric bypass procedure performed in January 2006
Case presentation

• HPI:
  – Nausea, vomiting and RUQ pain x 3 days
  – Altered mental status: disoriented x 10 days
  – Patient was not compliant with medications and medical follow up
  – Patient was treated in referring hospital for pancreatitis and encephalopathy
Case presentation

• PMH:
  – Morbid obesity
  – Pancreatitis
  – Cholelythiasis
  – Hypertension
  – DM
  – Sleep apnea
  – Hyperlipedemia
  – Osteoarthritis
Case presentation

- **PSH:**
  - Gastric bypass (January 2006)
- **All:**
  - NKA
- **Meds:**
  - Metochlopramide
  - Roxicet
  - Protonix
  - Amitriptyline
Case presentation

- **Vital Signs**
  - T = 97.3
  - B/P = 116/73
  - Pulse = 79

- **PE significant findings**
  - Lethargic, confused, impaired short term memory
  - No neurological deficits
  - Morbid obesity
Case presentation

- Labs:
  - 12 | 144 | 114 | 24 | 173
  - 7.3 | 283 | 4.5 | 18 | 1.1
  - 37

- Ca = 9, Mg = 1.6, P = 3
- Alb = 3.1, AST/ALT = 25/41, AP = 63, TB = 3
- Amy = 134, Lip = 433
Case presentation

- Labs microelements:
  - Vit B1 = 22 nmol/L (87-280)
  - Vit B6 = 3 ng/ml (2-26)
  - Vit B12 = 852 pg/ml (211-911)
  - FA = 3.5ng/ml (3-16)
  - Zn – 905 mcg/L (580-1060)
Case presentation

- Imaging
  - CT head – no acute changes
  - CTA chest negative for PE
Case presentation

• Hospital course complications:
  – RUE DVT, likely secondary to PICC line,
  – LGIB due to stercoral ulcer and anticoagulation
  – Bacteremia and fungemia
  – Renal failure
  – Aspiration pneumonitis, intubation
  – Sepsis
Case presentation

• Treatment
  – Vitamin, nutritional supplements
  – ICU management for respiratory, renal and septic complications
BARIATRIC SURGERY
AND
POSTOPERATIVE
METABOLIC
COMPLICATIONS
Obesity Epidemic

- 2004 – 20 million morbidly obese Americans
- Percentage of obese people in US is the highest in the world
- BMI of obese people in US higher than in Europe
- 35% of adolescents in US are obese
- Obesity is the second leading cause of preventable death in the United States after tobacco use (280 000 deaths per year)
Common Complications of Obesity

- Osteoarthritis, joint degeneration – 50%
- HTN – 30%
- Asthma – 25%
- Diabetes – 20%
- GERD – 20%
Morbid Obesity

• Definition – Morbid obesity is defined as being either 100 pounds above ideal body weight, twice ideal body weight, or having a body mass index (BMI, measured as weight in kilograms divided by height in meters squared) of 40 kg/m².
Obesity Classification

- BMI > 25 – overweight
- BMI > 30 – obesity
- BMI > 35 – severe obesity
- BMI > 40 – morbid obesity
Pathophysiology of Obesity

• Genetic:
  – Leptin receptor (*LEPR*) gene and melanocortin 4 receptor (*MC4R*) mutation

• Hormonal disbalance
  – CCK and Ghrelin regulate satiety

• Environmental:
  – Food availability
  – Decreased physical activity
Bariatric Surgery

- "Baros" greek word meaning weight
- "Iatrike" meaning treatment
- 1889 by an OB/GYN surgeon at John’s Hopkins, who performed lipectomies on women during routine surgical procedures used word bariatric surgery
History of Bariatric Surgery

• 1895 – Anton Eiselsberg (Billroth’s student) made a notice of weight loss in patients after gastric or small bowel resection

• 1950’s Jejunoileal Bypass the first Bariatric procedure was presented to a peer reviewed surgical society.
History of Bariatric Surgery

• Malabsorbtive procedures – 1st generation
  – 1953: Varco et al described Jejunoileal Bypass

  • Excellent weight loss
  • Complications:
    – Gas bloat syndrome
    – Diarrhea
    – Electrolyte imbalance
    – Hepatic fibrosis and failure
    – Nephrolithiasis
    – Cutaneous eruption
    – Impaired mentation
History of Bariatric Surgery

- Malabsorptive procedures – 2\textsuperscript{nd} generation
  - 1970s: Biliopancreatic diversion (BPD)
    - Nicola Scopinaro
  - 1990s: Duodenal switch
    - No segment of intestine left without flow
      - Biliary limb
      - Enteric limb
      - Common channel
History of Bariatric Surgery

- Biliopancreatic diversion (BPD)
  - Partial horizontal gastrectomy
  - Closure of duodenal stump
  - Gastrojejunostomy with long Roux limb
  - Enteric anastomosis 50 cm from ileocecal valve
History of Bariatric Surgery

- Biliopancreatic diversion (BPD)
  - IEWL (initial excess weight loss) at 1 yr – 70%
  - Maintained for 20 yrs
  - Complications:
    - Diarrhea
    - Flatulence
    - Anemia
    - Stomal ulcer
    - Bone demineralization
    - Protein malabsorption
History of Bariatric Surgery

- Duodenal switch introduced by Marceau
  - Lesser curvature gastric tube
  - Vertical resection of 2/3 of the stomach
  - Preserving pylorus
  - Anastomosing enteric limb to proximal duodenum
  - Cross-stapling the distal duodenum with division
  - Common channel 100 cm
History of Bariatric Surgery

• Duodenal switch
  – IEML at 18 mo – 80%
  – Complications
    • Flatulence
    • Malodorous stools
    • Iron and calcium malabsorption
History of Bariatric Surgery

• Malabsorptive/restrictive procedures
  – 1960: combination of malabsorption and restriction elements
  – 1966: Mason and Ito introduced Gastric Bypass (GB)
  – 1977: Griffen published results of Roux modification
History of Bariatric Surgery

- Malabsorptive/restrictive procedures
  - GB
    - Restrictive element
      - 30 ml gastric pouch
    - Malabsorptive element
      - Jejunal loop reconstruction
      - Roux limb gastrojejunostomy
History of Bariatric Surgery

• Malabsorptive/restrictive procedures
  – Long limb GB
    • Roux limb 150 cm (vs. standard 75 cm)
    • Used for super obese patients (>= 200 lbs overweight)
    • IEWL 64% at 24 mo
History of Bariatric Surgery

- Malabsorptive/restrictive procedures
  - Laparoscopic GB
    - Most common laparoscopic bariatric surgery in US
    - IEWL 80% at 1 year
History of Bariatric Surgery

- GB: laparoscopic vs. open

<table>
<thead>
<tr>
<th>Variables</th>
<th>Laparoscopic gastric bypass</th>
<th>Open gastric bypass</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>225 ± 40</td>
<td>195 ± 41</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Leak</td>
<td>1.3%</td>
<td>2.6%</td>
<td>0.61</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1.3%</td>
<td>10.5%</td>
<td>0.02</td>
</tr>
<tr>
<td>Incisional hernia</td>
<td>0.0%</td>
<td>6.6%</td>
<td>0.02</td>
</tr>
<tr>
<td>Anastomotic stricture</td>
<td>11.4%</td>
<td>2.6%</td>
<td>0.06</td>
</tr>
<tr>
<td>IEWL at 1 year</td>
<td>68%</td>
<td>62%</td>
<td>NS</td>
</tr>
</tbody>
</table>

History of Bariatric Surgery

- **Restrictive procedures**
  - 1971: Mason and Printen performed first gastroplasty
    - Horizontal gastric division
    - Greater curvature conduit
  - 1980: Mason:
    - Vertical gastroplasty with Marlex mesh around outlet channel
History of Bariatric Surgery

• Restrictive procedures
  – 1981: Fabito
    • 1st stapled vertical banded gastoplasty
  – 1994: Hess and Hess
    • Laparoscopic vertical banded gastoplasty
History of Bariatric Surgery

- **Restrictive procedures**
  - 1978: Wilkinson and Pelosi
    - Gastric banding
  - 1986: Kusmak
    - Inflatable band with subcutaneous port
History of Bariatric Surgery

• Restrictive procedures
  – 1993: Forsell
  • Laparoscopic placement of adjustable gastric band
History of Bariatric Surgery

• Gastric banding
  – Italian Collaborative Study Group (2001)
    • 5 year experience with 1,265 patients
    • BMI reduction 30.8% at 2 years
    • Operative mortality – 0.55%
    • Conversion rate – 1.7%
    • Pouch dilation 5.2%
    • Band erosion 1.9%
History of Bariatric Surgery

• Other procedures
  – Stereotaxic stimulation of sites in lateral hypothalamus (Quaade et al, 1974)
  – Gastric and vagal pacing
    • Preliminary human trials
    • Device reduces circulating levels of cholecystokinin, somatostatin, GLP-1, and leptin
Indications for bariatric surgery

- BMI > 40 kg/m² or BMI > 35 kg/m² with associated medical comorbidity exacerbated by obesity
- Failed dietary therapy
- Psychiatrically stable
- Knowledgeable about operation and its sequelae
- Motivated
- Medical problems do not preclude likely survival from surgery
Contraindication for bariatric surgery

- Active substance abuse
- Noncompliance with previous medical care
- Active peptic ulcer disease
Metabolic Complications

- Anemia
- Vitamin B12 deficiency
- Folate deficiency
- Iron deficiency
- Vitamin D deficiency
- Wernicke’s encephalopathy
- Vitamin A deficiency
### Metabolic Complications of Different Bariatric Procedures

<table>
<thead>
<tr>
<th></th>
<th>VBG, gastric banding</th>
<th>Gastric bypass</th>
<th>BPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess body weight lost</td>
<td>40%–50%</td>
<td>65%–75%</td>
<td>70%–80%</td>
</tr>
<tr>
<td>Protein malnutrition</td>
<td>No</td>
<td>Rare</td>
<td>Yes</td>
</tr>
<tr>
<td>Anemia</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Vitamin deficiency</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Iron deficiency</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Calcium deficiency</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Follow-up labs</td>
<td>None</td>
<td>CBC, iron studies, B12, folate</td>
<td>CBC, iron studies, B12, folate, albumin, electrolytes, fat-soluble vitamins, PTH, INR</td>
</tr>
<tr>
<td>Standard supplements</td>
<td>None</td>
<td>Multivitamin, iron</td>
<td>Multivitamin, iron, calcium, vitamins A and D</td>
</tr>
</tbody>
</table>
Anemia

• 36.8 % (post GB)
• 3.5% require transfusion
• Iron deficiency 20-49%
  – Decreased stomach acid
  – No exposure of nutrients to duodenum and proximal jejenum
• B12 deficiency 26-70%
  – Decreased intake
  – Diminished intrinsic factor secretion
• Folate deficiency 9-35%
Anemia

• Prevention
  – Folate deficiency
    • MVI
    • Higher doses for reproductive age women
  – B12
    • 350 µg crystalline oral Vit B12
    • IM supplementation
Vitamin D deficiency

• Parathyroid axis abnormalities in obese patients
  – Increased PTH and 1,25 hydroxy-vitamin D
  – Decreased 25 hydroxy-vitamin D
• After weight loss procedure
  – Decreased absorption of Ca and Vit D
  – Alteration in mechanical load of the skeleton
Vitamin D deficiency

• Osteomalatia
  – Microfractures, diffuse bone pain
  – Proximal myopathy

• Prevention
  – Daily 1200 mg of Ca, and 400-800 IU Vit D
Wernicke’s Encephalopathy

• Thiamine (Vit B1) deficiency
  – Water soluble vitamin
  – Absorbed in small intestine

• By 2005 11 cases reported after GB
Wernicke’s Encephalopathy

- Clinical triad
  - Nystagmus and ocular nerve palsies
  - Ataxia
  - Apathetic mental confusion

- MRI findings
  - Injury to mamillary body

- Treatment
  - Thiamine 100 mg Q8 hr
Vitamin A deficiency

- Reported only after BPD
- 69% by 4 years after surgery
- Occasionally symptomatic
- Resolution of symptoms after supplementation
Metabolic Complications

- Recommendations for prevention
  - Outpatient semi-annual follow-up
    - Serum iron
    - Hct
    - 25 hydroxy-vitamin D
    - Parathyroid hormone
    - Vit B12
    - Vit A
Metabolic Complications

• Recommendations for prevention
  – Supplements
    • MVI
    • Folate 400 µg
    • Vit B12 350 µg
    • Ca 1500 mg
    • 25 hydroxy-vitamin D 800-1000 IU
    • Thiamine parenterally for patients with poor intake
Future of Bariatric Surgery

• An algorithm is needed
  – for selecting the most appropriate operation for a given patient
  – to take into consideration
    • Weight
    • Age
    • Gender
    • Comorbidities
    • Race
    • Nationality
    • Outcomes expectations
    • Body habitus
    • Operative safety
    • Side effects
    • Long-term complications.
Summary

• Morbid obesity reached epidemic level in US. Presently bariatric surgery is the most effective treatment option available

• Metabolic benefits of bariatric surgery significantly outweigh complications.
Summary

• Prevention and early medical intervention essential to avoid metabolic complications of bariatric surgery
• Integrated medical team care necessary for the management of bariatric patient