Case presentation

Nutrition surveillance in bariatric surgery - Case discussion

M. Ballesteros (Spain)
Nutrition surveillance in bariatric surgery
Case discussion
Bariatric Surgery Worldwide 2008

Number of Procedures Worldwide

- Total: 344,221
- RYGB: 168,597
- AGB: 145,563
- BPD/DS: 18,098
- SG: 6,845

40,000 BS procedures recorded in 1988

Buchwald. Obesity surgery 2009
Metabolic and nutritional complications

- Most of them are predictable and treatable.

Related to

- Anatomic changes induced in GI tract by surgery
- Patient compliance with nutritional supplementation
- Dietary changes
- Nutritional follow-up.
Our patient

- Female
- 51 years-old
- Family history:
  - Both parents obese
  - Mother: Type 2 diabetes, high blood pressure, died at 59 (stroke)
  - Father: High blood pressure, dyslipidemia, died at 43 after a heart attack
  - Only one younger brother, also obese and T2 DM
Our patient 2

• Past medical history:
  – High blood pressure, diagnosed when 36
  – Gestational diabetes in 2/2 pregnancies
  – Type 2 diabetes diagnosed when 46
  – Mixed dyslipidemia
  – Sleep apnea, currently on CPAP
  – Ostheoarthritis, proposed for knee replacement
  – Current treatment: enalapril 20 mg, metformin 850 mg bid, atorvastatin 40 mg
Our patient 3

- Heavy baby, born 4300 g, after normal pregnancy
- “Always overweight”, worsened during her two pregnancies (+ 22 and + 25 kg)
- Maximum weight reached: current weight
- Multiple attempts to lose weight, on many different diets, but only small initial weight loss and huge weight regain after withdrawal
Our patient 4

- Height 1.55 m
- Weight 132.1 kg  BMI 54.9 kg/m²
- Excess weight + 78.6 kg
- Waist circumference 138 cm
- Hip circumference 148 cm
- Blood pressure (on meds) 140/95
- No relevant findings in physical exam
Body composition (DXA, Lunar)

<table>
<thead>
<tr>
<th>Region</th>
<th>% Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left arm</td>
<td>51.4</td>
</tr>
<tr>
<td>Left leg</td>
<td>50.5</td>
</tr>
<tr>
<td>Right arm</td>
<td>51.4</td>
</tr>
<tr>
<td>Right leg</td>
<td>50.5</td>
</tr>
<tr>
<td>Trunk</td>
<td>53.1</td>
</tr>
<tr>
<td>Android region</td>
<td>57.6</td>
</tr>
<tr>
<td>Gynoid region</td>
<td>51.9</td>
</tr>
<tr>
<td>Total</td>
<td>49.6</td>
</tr>
</tbody>
</table>
Dietary assessment (3 day recall)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Energy</td>
<td>3683 Kcal</td>
</tr>
<tr>
<td>Protein</td>
<td>150.2 g</td>
</tr>
<tr>
<td>Fat</td>
<td>175.6 g</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>375.1 g</td>
</tr>
<tr>
<td>Fibre</td>
<td>31.3 g</td>
</tr>
</tbody>
</table>
### PRUEBAS RHEUMATAS

- **PRUEBA**: F-Creatinina
- **RESULTADO**: 0.503 mg/dl
- **Rango Referencia**: 0.647 - 1.31 mg/dl

### VITAMINAS

- **VITAMINA A (ALFA-TOCOFEROL) SUERO**: 4.7 µg/dl
- **VITAMINA D (RETOINOL) SUERO**: 0.9 ng/ml

### ZINC SUERO

- **Resultado**: 67 µg/dl

### 25 HIDROXI VITAMINA D

- **Resultado**: 16 ng/ml

### T4 LIBRE

- **Resultado**: 1.37 ng/ml
- **Rango Referencia**: 0.9 - 1.7 ng/ml

### FSH

- **Resultado**: 1.92 mIU/ml

### NUTRICION

- **PREALBUNINA EN SANGRE**: 22.3 mg/dl
- **PROT TRANS RETINOL (PHR)**: 3.52 mg/dl

### ESTUDIO HEMOGLOBINAS

- **HB-GLUCOSILADA A1C (NGSP/DCCT)**: 7.6 %
- **Rango Referencia**: 4.8 - 5.9 %

### PRUEBAS BIOQUIMICAS SUERO

<table>
<thead>
<tr>
<th>PRUEBA</th>
<th>RESULTADO</th>
<th>UNIDADES</th>
<th>RANGO REFERENCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CREATININA</strong></td>
<td>0.56</td>
<td>µmols/L</td>
<td>[0.6 - 1.1]</td>
</tr>
<tr>
<td><strong>AST</strong></td>
<td>15</td>
<td>UI/L</td>
<td>[0 - 37]</td>
</tr>
<tr>
<td><strong>ALT</strong></td>
<td>56</td>
<td>UI/L</td>
<td>[0 - 40]</td>
</tr>
<tr>
<td><strong>ALP</strong></td>
<td>176</td>
<td>UI/L</td>
<td>[70 - 208]</td>
</tr>
<tr>
<td><strong>GOT</strong></td>
<td>9</td>
<td>UI/L</td>
<td>[10 - 50]</td>
</tr>
<tr>
<td><strong>GPT</strong></td>
<td>5</td>
<td>UI/L</td>
<td>[62 - 8]</td>
</tr>
</tbody>
</table>

### PRUEBAS BIOQUIMICAS SUERO (continuación)

<table>
<thead>
<tr>
<th>PRUEBA</th>
<th>RESULTADO</th>
<th>UNIDADES</th>
<th>RANGO REFERENCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GLUCOSA</strong></td>
<td>156</td>
<td>mg/dl</td>
<td>[70 - 110]</td>
</tr>
<tr>
<td><strong>MINS</strong></td>
<td>15</td>
<td>ng/mL</td>
<td>[10 - 50]</td>
</tr>
<tr>
<td><strong>HDL COLESTEROL</strong></td>
<td>56</td>
<td>mg/dl</td>
<td>[0.35 - 1.15]</td>
</tr>
<tr>
<td><strong>LOD COLESTEROL</strong></td>
<td>59.6</td>
<td>mg/dl</td>
<td>[0.35 - 1.15]</td>
</tr>
</tbody>
</table>

### PRUEBAS BIOQUIMICAS SUERO (continuación)

<table>
<thead>
<tr>
<th>PRUEBA</th>
<th>RESULTADO</th>
<th>UNIDADES</th>
<th>RANGO REFERENCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CALCIO</strong></td>
<td>9.1</td>
<td>mg/100mL</td>
<td>[8.1 - 10.3]</td>
</tr>
<tr>
<td><strong>FOSF DIORG</strong></td>
<td>3.18</td>
<td>mg/100mL</td>
<td>[2.6 - 4.6]</td>
</tr>
<tr>
<td><strong>HIBURUBINA TOT.</strong></td>
<td>0.40</td>
<td>mg/100mL</td>
<td>[0.1 - 1.2]</td>
</tr>
<tr>
<td><strong>MAGNESIO</strong></td>
<td>1.8</td>
<td>mg/100mL</td>
<td>[1.7 - 2.55]</td>
</tr>
<tr>
<td><strong>HIERRO</strong></td>
<td>50</td>
<td>ng/100mL</td>
<td>[50 - 140]</td>
</tr>
<tr>
<td><strong>TRANSFERRINA</strong></td>
<td>249</td>
<td>mg/100mL</td>
<td>[200 - 400]</td>
</tr>
<tr>
<td><strong>INDICE SATURACION TRANSFERRINA</strong></td>
<td>38</td>
<td>%</td>
<td>[17 - 48]</td>
</tr>
<tr>
<td><strong>FERRITINA</strong></td>
<td>40</td>
<td>ng/1mL</td>
<td>[10 - 50]</td>
</tr>
<tr>
<td><strong>ALBUMINA</strong></td>
<td>3.66</td>
<td>mg/L</td>
<td>[3.5 - 5]</td>
</tr>
<tr>
<td><strong>CIORO</strong></td>
<td>104</td>
<td>mmol/L</td>
<td>[3.5 - 5]</td>
</tr>
<tr>
<td><strong>SODIO</strong></td>
<td>141</td>
<td>mmol/L</td>
<td>[135 - 145]</td>
</tr>
<tr>
<td><strong>POTASIO</strong></td>
<td>5.07</td>
<td>mmol/L</td>
<td>[3.6 - 5]</td>
</tr>
</tbody>
</table>
Candidate for BS

• Concerned about her cardiovascular risk

• Her family doctor refers her for considering bariatric surgery

• Considered to be a good candidate by the multidisciplinary team
  – BMI 54 kg/m² with co-morbidities in which surgically induced weight loss is expected to improve the disorder
  – No contraindications, acceptable surgical risk
  – Fully informed, highly compliant
Surgical procedure choice

- Super obese BMI 54.9 kg/m²
- Central distribution:
  - waist 138 cm
  - ↑ android fat mass
- Comorbidities:
  - High blood pressure
  - Type 2 diabetes
  - Mixed dyslipidemia
  - Sleep apnea
  - Ostheoarthritis

BILIOPANCREATIC DIVERSION WITH GASTRIC PRESERVATION
Bariatric surgical procedures

- Restrictive
  - Vertical banded gastroplasty
  - Adjustable gastric banding
  - Sleeve resection
  - Gastroplication

- Malabsorptive
  - Bileopancreatic diversion
  - Bileopancreatic diversion with duodenal switch

- Combined
  - Roux-en-Y gastric bypass
Biliopancreatic diversion
SOS – Weight change

Sjostrom L et al. NEJM 2007;357:741-752
Bariatric surgical procedures- Summary

- Restrictive
  - Less pronounced weight loss
  - Effect on comorbidities?
  - Reduced risk of serious complications
  - High incidence of need for revisional surgery
    - Weight regain
    - Mechanical complications

- Malabsorptive
  - Most pronounced weight loss
  - High risk of long-term complications
    - Metabolic/nutritional

- Roux-en-Y gastric bypass (“combined”)
  - “Optimal” balance between “aggressiveness” and effectiveness?
  - “Gold standard” in many countries
IS PREOPERATIVE WEIGHT LOSS ADVISABLE?
BENEFITS OF PREOPERATIVE WEIGHT LOSS:

• Decrease in liver size and intra-abdominal fat
• Fewer post-operative complications
• Improvement of comorbidities (DM2, HTA, ..)
• Improves surgical field and intra-operative view
• Indicator of better response to postoperative dietary modifications
INDICATOR OF BETTER RESPONSE TO POSTOPERATIVE DIETARY MODIFICATIONS:

• A program of preoperative weight loss may motivate patients to acquire healthy dietary and physical activity habits ¹

• No consensus on the effect of preoperative weight loss in predicting medium or long term results after bariatric surgery ²

1. Ali et.al; Alavardo et.al; Alger-Mayer et.al; Alami et.al; Van de Weijgert et.al; Still et.al
2. Busetto et.al; Huerta et.al; Jamal, Mrad, Riess et.al; Carlin et.al; Taylor et.al
WHEN SHOULD DIETARY INTERVENTION START AND HOW MUCH WEIGHT SHOULD BE LOST BEFORE SURGERY?

• Dietary intervention should start 6 months prior to surgery in order to monitor and redirect eating habits.

• A very low calorie diet (VLCD) should be started 2 weeks before the procedure to achieve a greater reduction in liver volume.

• A 5 to 10% weight loss is advisable.
HOW SHOULD PREOPERATIVE WEIGHT LOSS BE ACHIEVED?
IMPORTANCE OF DIETARY INTERVENTION BEFORE BARIATRIC SURGERY

Assessment of dietary habits

Personalized dietary intervention

- Improve preoperative nutritional behaviour
- Education for post-operative nutritional adaptation

Achieve preoperative weight loss (surgical and nutritional benefits)

• Dietary and nutritional history
  - INDIVIDUAL NUTRITIONAL EDUCATION
  - NUTRITIONAL EDUCATION GROUP
NUTRITIONAL EDUCATION:

Elaborate a personalized dietary intervention according to daily routine and habits:

Balanced diet (55% CH, 15% prot and 30% fat)

Facilitate behavioral strategies to achieve dietary modifications.

Educational support groups
OBJECTIVES:
• Optimize the dietary management of patients with MO for BS
• Promote dialogue and empathy between patients.
• Treat emotional aspects of patient
• Help patients achieving maximum weight loss
• Preventing weight regain after BS

Composition of the groups
• 8 patients. Mixed groups
• 5 sessions in consecutive weeks (1 per week, 1 hour duration)
TOOLS:

- 3-day dietary records (at the beginning and at the end of the programme)
- Physical activity record
- Recipes
- Interpreting food labels
MODIFICATION OF EATING HABITS:

• Encourage slow eating and chewing food
• Planning meals and snacks
• Avoid eating and drinking at the same time
• 5 dietary intakes per day
• Serve food on a smaller plate
• Avoid alcohol and carbonated drinks
• Increase the amount of fiber in the diet
• Reduce sweet and fat consumption.
Fasting before bariatric surgery

- Is it wise? -

And what about hypocaloric diet post operation?
Effect of fasting - urea output

Sobotka L. et al. 2001
Effect of fasting - body composition

Sobotka L. et al. 2001

ICW  ECW  Fat

1.-7. den  7.-14. den
Obesity decreases protein oxidation during fasting period

Elia M, 2000
Obesity decreases protein oxidation during fasting period

Elia M, 2000
Large infected wound after Aortocoronary by-pass
Low energy high protein diet - weight loss 18 kg
Complete wound healing - within 5 months
In the stabilized patient healing is possible during hypocaloric nutrition
Preoperative weight loss

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>6 weeks after VLCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>132.1</td>
<td>117.6</td>
</tr>
<tr>
<td>BMI</td>
<td>54.9</td>
<td>48.9</td>
</tr>
<tr>
<td>% Body fat</td>
<td>49.6</td>
<td>46.6</td>
</tr>
<tr>
<td>BP</td>
<td>140/95</td>
<td>120/80</td>
</tr>
</tbody>
</table>

• ...and she underwent biliopancreatic diversion without complications.

• Discharged on day 4 after surgery
WHAT TYPE OF DIETARY ADVICE SHOULD THEY RECEIVE AT DISCHARGE?
First phase: **Liquid diet**
- Duration: 2 weeks: from discharge until the next follow-up visit
- Amount: 50-100 ml per intake / 6 per day
- Foods: skimmed milk and yoghurt, juice, broth, tea
- Hyperproteic nutritional supplements and protein powder. Multivitamin preparations.

Second phase: **Mashed diet**
- Duration: 2 weeks: follow-up visits 1-2.
- Amount: 100-150 ml per intake / 6 per day
- Foods: Mashed cooked vegetables, cereals, fish, eggs and cooked fruit
- Supplements: Protein powder. Multivitamin supplements

Third phase: **Regular solid diet**
- Duration: 1 month
- Amount: Dessert plate / Intakes: 6 per day
- Foods: as prescribed by nutritionist
- Supplements: Multivitamin preparations
DIETARY INTERVENTION FOR NUTRITIONAL COMPLICATIONS AFTER BS

- **Nausea and vomiting:**
  Eat slowly and savor each mouthful in a quiet atmosphere, eat adequate amounts of food, do not drink and eat at the same time, choose recommended food according to the phase and texture.

- **Dumping:**
  Avoid eating simple sugars, fatty foods and liquids with meals. Frequent small meals are important.

- **Constipation:**
  Increase fluid intake, dietary fiber intake and avoid sedentary lifestyle.
Life-long nutritional education and dietary follow-up are key factors for long-term success of surgical treatment of obesity

GOALS TO ACHIEVE

- NEGATIVE ENERGY BALANCE
- ADEQUATE PROTEIN INTAKE
- LOW FAT INTAKE
- LIMITED CARBOHYDRATE INTAKE

ADEQUATE PROTEIN INTAKE

- BS is associated with a greater loss of fat-free mass when compared to other forms of caloric restriction
- An elevated protein intake improves fat-free mass (Recommended protein intake: 0.8-2.1 g/Kg ideal body weight)
- Patients choosing high-protein foods are more likely to maintain a low-energy intake over time because of the satiation while they ensure they meet their protein needs

50% of patients present intolerance to high-protein foods
LOW FAT INTAKE

30% of total energy

Olive oil and oils rich in W3

LIMITED CARBOHYDRATE INTAKE

Bread, rice and pasta are poorly tolerated after bariatric surgery

Dumping syndrome:

~ 25-50% but only 5-10% develop clinically significant syndromes

~ Avoid simple sugars, increase fiber intake and complex carbohydrates

~ Six meals a day

~ Avoid fluid intake during meals
1 year after surgery...

<table>
<thead>
<tr>
<th>Time</th>
<th>Weight</th>
<th>BMI</th>
<th>%BF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>132.1</td>
<td>99.5</td>
<td>90.9</td>
</tr>
<tr>
<td>1 mo</td>
<td>99.5</td>
<td>37.8</td>
<td>42.1</td>
</tr>
<tr>
<td>3 mo</td>
<td>90.9</td>
<td>37.8</td>
<td>42.1</td>
</tr>
<tr>
<td>6 mo</td>
<td>82.8</td>
<td>34.4</td>
<td>38.5</td>
</tr>
<tr>
<td>9 mo</td>
<td>73.2</td>
<td>30.4</td>
<td>35.5</td>
</tr>
<tr>
<td>1 y</td>
<td>69.1</td>
<td>30.4</td>
<td>35.5</td>
</tr>
</tbody>
</table>

- Weight
- BMI
- %BF
1 year after surgery...

<table>
<thead>
<tr>
<th></th>
<th>Before BS</th>
<th>1 mo</th>
<th>3 mo</th>
<th>6 mo</th>
<th>9 mo</th>
<th>1 year after BS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>132.1</td>
<td>99.5</td>
<td>90.9</td>
<td>82.8</td>
<td>73</td>
<td>69.1</td>
</tr>
<tr>
<td>BMI</td>
<td>54.9</td>
<td>41.4</td>
<td>37.8</td>
<td>34.4</td>
<td>30.4</td>
<td>28.8</td>
</tr>
<tr>
<td>% Bodyfat</td>
<td>49.6</td>
<td>46</td>
<td>44.2</td>
<td>40.4</td>
<td>38.5</td>
<td>35.5</td>
</tr>
<tr>
<td>BP</td>
<td>140/95</td>
<td>120/75</td>
<td>130/80</td>
<td>120/80</td>
<td>110/80</td>
<td>120/70</td>
</tr>
<tr>
<td>Metformin, atorvastatin and enalapril discontinued. CPAP withdrawn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Multivitamin x2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D 2000 U/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium citrate 1000 mg/d</td>
<td></td>
<td></td>
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</tbody>
</table>
1 year after surgery...: Dietary intake

<table>
<thead>
<tr>
<th></th>
<th>Value (DS)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY (kcal)</td>
<td>1772.4 (565.5)</td>
<td>-1900</td>
</tr>
<tr>
<td>Carbohydrates (g)</td>
<td>178.0 (50.7)</td>
<td>-197</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>82.8 (28.5)</td>
<td>-67.2</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>79.9 (38.8)</td>
<td>-95.7</td>
</tr>
<tr>
<td>Fibre (g)</td>
<td>15.3 (5.1)</td>
<td>-16</td>
</tr>
</tbody>
</table>

*Carbohydrate 41% Protein 16% Fat 43%*
Which are the most prevalent nutritional deficiencies found after bariatric surgery?
Nutritional deficiencies after bariatric surgery

• Macronutrient deficiencies
  – Protein-calorie malnutrition
  – Fat malabsorption
• Micronutrient deficiencies
  – Iron
  – Vitamin B12 (Coblamine)
  – Folic acid
  – Calcium and vitamin D
  – Vitamin B1 (Thiamine)
Protein malnutrition after RYGB and BPD

- Up to 13% of Super obese patients 2 yr after a distal RYGB with Roux limb >150 cm
- 3–18% after BPD
- Protein malnutrition causes an annual hospitalization rate of 1% per year after malabsorptive procedures

Prevention: **Average of 60–120 g of protein daily**

Heber et al  J Clin Endocrinol Metab, November 2010
The likelihood of vitamin/mineral deficiencies after various bariatric procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Iron</th>
<th>Folate</th>
<th>Vitamin B&lt;sub&gt;12&lt;/sub&gt;</th>
<th>Calcium</th>
<th>Vitamin D</th>
<th>Thiamine</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAGB/VBG</td>
<td>**</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>RYGBP</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>BPD</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
</tbody>
</table>

*Not very likely; **somewhat likely; ***highly likely.

BPD, biliopancreatic diversion; LAGB, laparoscopic adjustable gastric band; RYGBP, Roux-en-y gastric bypass; VBG, vertical banded gastroplasty.
Vitamin B1 (Thiamine)

• Deficiency (rare) due to
  – Vomiting
  – Gastric acid

• Severe complications of deficiency Beriberi  Wernicke-Korsakoff encephalopathy

• No routine blood levels

• Multivitamin supplementation

• In case of protracted vomiting- consider parenteral

Shankar Nutrition 2010
### Suggested follow-up protocol

#### TABLE 2. Schedule for clinical and biochemical monitoring

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>1 month</th>
<th>3 months</th>
<th>6 months</th>
<th>12 months</th>
<th>18 months</th>
<th>24 months</th>
<th>Annually</th>
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<tbody>
<tr>
<td>Complete blood count</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>LFTs</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Glucose</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Creatinine</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Electrolytes</td>
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<td>X</td>
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<td>Vitamin A</td>
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<td>Zinc</td>
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<td>Bone mineral density and body composition</td>
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<tr>
<td>Vitamin B1</td>
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</tbody>
</table>

Data indicate the suggested schedule for laboratory monitoring after bariatric surgery. LFT, Liver function tests.

* Examinations should only be performed after RYGB, BPD, or BPD/DS. All of them are considered as suggested for patients submitted to restrictive procedures.
## TABLE 3. Diagnosis and treatment of nutritional deficiencies

<table>
<thead>
<tr>
<th>Deficiency</th>
<th>Symptoms</th>
<th>Treatment second phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein malnutrition</td>
<td>Weight loss, hair loss, edema</td>
<td>Enteral or parenteral nutrition; reversal of surgical procedure</td>
</tr>
<tr>
<td>Calcium/vitamin D</td>
<td>Hypocalcemia, hypophosphatemia, rickets</td>
<td>Calcitriol oral vitamin D 1,000 IU/d</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Pernicious anemia, alopecia, dermatitis, anemia</td>
<td>1,000–2,000 μg/2–3 months im</td>
</tr>
<tr>
<td>Folic acid</td>
<td>Megaloblastic anemia, neurologic symptoms</td>
<td>Oral folate, 1,000 μg/d</td>
</tr>
<tr>
<td>Iron</td>
<td>Depressed mood, fatigue, koilonychia, pica, brittle hair, anemia</td>
<td>Parenteral iron administration</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Xerophthalmia, loss of nocturnal vision, decreased immunity</td>
<td>Oral vitamin A, 5,000–10,000 IU/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oral vitamin A, 50,000 IU/d</td>
</tr>
</tbody>
</table>

A life-long Multivitamin-mineral supplement is recommended after BS. The intervention and follow-up of a nutritionist specialized in BS is essential to prevent nutritional deficiencies.

Details are shown for the diagnosis and treatment for specific nutritional deficiencies.

Heber et al  J Clin Endocrinol Metab, November 2010
Bacterial changes after bariatric surgery
Normal bacterial flora

≅ 95%
✓ Bacteroidetes (mostly G- anaerobic)
✓ Firmicutes (mostly G+ aerobic & anaerobic)

≅ 5%
✓ Actinobacteria (G+ aerobic + anaerobic)
✓ Proteobacteria (G- aerobic LPS)
Experimental bariatric surgery

Li JV et al. Metabolic surgery profoundly influences gut microbial-host metabolic cross-talk. Gut 2011;60:1214-23
Experimental bariatric surgery

Li JV et al. Metabolic surgery profoundly influences gut microbial-host metabolic cross-talk. Gut 2011;60:1214-23
D-Lactic acidosis 25 years after bariatric surgery due to Salmonella enteritidis

Small intestinal bacterial overgrowth and thiamine deficiency

SHOULD WE WORRY ABOUT WEIGHT REGAIN?

HOW SHOULD IT BE PREVENTED?

SHOULD THEY CONTINUE A WEIGHT REDUCING DIET?
FACTORS THAT INFLUENCE WEIGHT MAINTAINANCE OR REGAIN

- Type of surgery performed: restrictive, malabsortive...
  - Presence of binge eating disorders:
  - Patient adherence to support groups:
    - Frequency of follow-up visits:
    - Presurgical body mass index
Weight regain can be anticipated, in part, during the preoperative evaluation and potentially reduced with self-monitoring strategies after BS.
HOW TO AVOID WEIGHT REGAIN?

• Encourage lifestyle changes
• Nutritional education and follow-up
  • Regular structured exercise
  • Increased lifestyle physical activity
    • Stress management
  • Realistic weight-goal setting
SOS – Weight change

No. Examined

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Banding</th>
<th>Vertical-banded gastroplasty</th>
<th>Gastric bypass</th>
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<td>376</td>
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<td></td>
<td>190</td>
<td>52</td>
<td>108</td>
<td>10</td>
</tr>
</tbody>
</table>

Sjostrom L et al. NEJM 2007;357:741-752
Controversies

- Definition of ”weight regain”? (failure, success)
  - 50% EWL?
- Difference: Unsatisfactory weight loss vs weight regain?
- How exclude ”surgical failure”?
- What could surgeon offer
  - In ”surgical failure”
  - If not ” surgical failure”
- What surgical technique should be used?
Literature (summary)

- Little evidence
- No randomized studies
- Few review articles
- Small series ("feasibility")
- Few long-term follow-up

- Failure efter
  - AGB/VBG
  - GBP
Summary revision AGB

- Revision due to mechanical problems:
- AGB OK (if not esophageal dysmotility)

- Revision due to weight regain:
- LRYGB
  - Improved weight development
  - Complications in the range of primary operation
Revision Gastric bypass

– Addition of band
– Conversion to BPD/DS
– Endoscopic techniques
Summary

- Revisional bariatric surgery:
  - Relatively safe
  - Acceptable (but increased) rates of complications
  - Serious complications with more aggressive tech.
Summary

- Revisional surgery after Band procedures:
  - New band ok if mechanical complications
  - If weight regain LRYGB/RYBP
    - Satisfactory weight development
    - Acceptable rates of complications
Summary

- Revisional surgery in weight regain after LRYGB/RYBP:
  - Less well documented
  - Addition of band no effect (?)
  - Endoscopic techniques?
  - More aggressive techniques might improve
    - No long-time follow up data
    - Complications?
And what has happened since then?
And what has happened since then?

<table>
<thead>
<tr>
<th></th>
<th>Before BS</th>
<th>1 y after</th>
<th>2 y</th>
<th>3 y</th>
<th>4 y</th>
<th>5y</th>
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<td>70</td>
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<td>68.8</td>
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<td>29.2</td>
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<tr>
<td>%EWL</td>
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<td>77.8</td>
<td>77.7</td>
<td>79.5</td>
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<tr>
<td>% BF</td>
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<td>35.5</td>
<td>36.4</td>
<td>38.2</td>
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<td>120/70</td>
<td>130/70</td>
<td>120/70</td>
<td>110/70</td>
<td>130/80</td>
<td>125/75</td>
</tr>
<tr>
<td>HBP, T2DM, OSA, OA</td>
<td>No comorbidities PTH 145-189 pg/mL and low 25 OH vitamin D during 1st and 2nd year. Normal after increasing vit D daily dose to 4500 UI</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Metabolic and nutritional complications

- Most of them are predictable and treatable.

- Related to
  - Anatomic changes induced in GI tract by surgery
  - Patient compliance with nutritional supplementation
  - Dietary changes
  - Nutritional follow-up.
Vertical banded Gastroplasty (VBG)
Adjustable Gastric Banding
Sleeve resection
Gastroplication
Biliopancreatic diversion with duodenal switch
Roux-en-Y Gastric bypass

Roux-en-Y stomach bypass: large portion of stomach and duodenum are bypassed
4 studies, n = 193

- Initial BMI: 45 - 48 kg/m²
- BMI pre reop: 32 - 38 kg/m²
- BMI post reop: appr 37 kg/m²
- Complications: 0 – 19%

AGB → LRYGB

- 4 studies, n = 214
- Initial BMI: 45 – 48 kg/m²
- BMI pre reop: 38 – 46 kg/m²
- BMI post reop: 26 – 38 kg/m² (12 – 18 mån)
- Complications: 0 – 19%

Revision Gastric bypass
-Addition of band

- RYGB + AGB (Bessler et al Surg Obes rel Dis 2010)
- n = 22

- BMI pre revision 45
- BMI post revision (60 months) 39 (EWL 47%)

- Complications increased compared to primary procedure
- Mechanical problems common
Revision Gastric bypass - Addition of band

- RYGB + AGB (Gobble RM et al Surg Endosc 2008)

- n = 11

- BMI pre RYGB 53

- BMI pre LAGB 47

- BMI post revision (13 m, n=?) 37

- Complications increased compared to primary procedure

- Mechanical problems?
Revision Gastric bypass - Addition of band

- RYGB + Silicone ring (Dapri G Obes Surg 2010)
- n = 6
- BMI pre RYGB: 36
- BMI pre revision: 29.5
- BMI post revision (14 m): 26.4 (ns)
- Few complications
Revision Gastric bypass
- Conversion to BPD/DS

- Few publications!
- Conversion to DS (Keshishian et al Obes Surg 2004)
- n = 47 (26 RYGB, 16 VBG, 5 VBG → RYGB)
- 40 weight regain
- BMI pre revision 47.3 kg/m²
- BMI post (30 mån) revision 31.4 kg/m²
- 8.5% leak rate
- 2.1% wound infection
- No data on metabolic/nutritional complications