Hospital discharge: and now?

Late nutritional complications of bariatric surgery

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Welcome to the 39th ESPEN Congress

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‘Nutrition meets innovation’
Late nutritional complications of bariatric surgery

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Disclosure for **Emilie Montastier**

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<tr>
<th>Role</th>
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Introduction

• Bariatric surgery (BS) = the most efficient long-term treatment for massive and complicated obesity:
  – weight loss,
  – comorbidities
  – quality of life improvement,
  – mortality reduction

• Immediate and late adverse events.
  – operative risk,
  – surgical,
  – nutritional,
  – psychological events
Introduction (2)

• Nutritional deficiencies are common and require lifelong screening

• Mechanisms:

  - Food intolerance
    - Nausea, vomiting:
      - 30-60% of patients
      - Thiamine deficiency

  - Food intake

  - Nonadherence with dietary supplements

  - Gastrointestinal absorption
Plan

• Nutritional deficiencies lead to diseases:
  – Anemia, asthenia
  – Loss of fat free mass, protein deficiency
  – Loss of bone mineral density, vitamin D deficiency
  – Neurological complications

• Other late complications after BS:
  – Gastro esophageal reflux disease
  – Hypoglycemia
  – Weight regain
  – Psycho-social complications
What are “late” nutritional complications after BS?

- Neurological complications
- Loss of bone mineralization
- Protein deficiency
- Loss of lean mass
- Anemia
Anemia

• The most frequent long-term complications of all bariatric procedures:
  – prevalence of 17% (LSG) to 30% (malabsorptive procedures) after 2 years
  – 45% after 5 years (BPD, RYGB) (Munoz M, Nutr Hosp, 2009; Obinwanne KM, J Am Coll Surg, 2014)

• Iron deficiency, along with vitamin B12 deficiency, = the most common cause of anemia, occurring on average in 15% of patients after 2 years and 31% after 5 years (LSG, BPD, RYGB)

Anemia (2): Iron supplementation

- European guidelines recommend the use of oral iron supplementation following obesity surgery only in the context of a preventive regimen (Fried M, IJO, 2007)
- The separation of calcium and iron supplements is recommended (Isom KA, Nutr Clin Pract, 2014)
- For the correction of iron deficiency, intravenous iron supplementation should be preferred (ferric carboxymaltose) and is highly effective (Malone M, Surg Obes Relat Dis, 2013)
Anemia (3): Vitamin B12 supplementation

- After malabsorptive procedures, oral supplementation at a dosage of 1000 µg per week is recommended (Mechanick JL, Obesity, 2013)
- After restrictive BS, no evidence to support the use of high-dose vit B12 supplementation
- In the case of existing vit B12 deficiency, parenteral administration: 1000 µg vit B12 i.m/s.c. daily for 5–7 days, followed by four or five further weekly injections of 1000 µg (Hvas AMHaematologica, 2006)
**Protein deficiency - Loss of lean mass**

- Greater loss of lean mass after BS VS non-surgical weight loss
- Prevalence of protein deficiency (serum albumin level <3.5 mg/dL): 5% of morbidly obese patients 2 years after proximal RYGB (Stein J, Aliment Pharmacol Ther, 2014)
- Muscle mass ↓ over time and → protein malnutrition (usually observed 3–6 months post-surgery) (Heber D, JCEM, 2010)
- Signs: weakness, ↓ muscle mass, hair loss, peripheral edema (severe protein malnutrition), poor wound healing
Protein deficiency - Loss of lean mass (2)

- Dual X-ray absorptiometry (DEXA): 3 months after BS
- Consensus guidelines recommend average daily protein intake:
  - 60–120 g after RYGB,
  - 60–80 g or 1.1 g/kg of ideal body weight after LSG to maximise post-surgical LBM (Branched-chain AA, leucine ++++) (Rennie MJ, J Nutr, 2006)
- Regular resistance training and aerobic exercise improve preservation of LBM, (muscle mass), during weight loss (Rice B, Diabetes Care, 1999)
Loss of bone mineralization (1)

- Bone Mass Density (BMD) \( \downarrow \) in the 1\textsuperscript{st} year after surgery (skeletal adaptation)
- Bone loss continues even after weight loss has stopped (Yu EW, JCEM, 2015; Vilarrasa N, Obes Surg, 2011, Shanbhogue VV, EJE, 2017)
- Lower calcium absorption and vitamin D insufficiency leading to II\textsuperscript{ry} hyperparathyroidism
- The exact mechanisms underlying bone loss after RYGB are probably multifactorial (Shanbhogue VV, EJE, 2017)
- The extent to which such changes have long-term deleterious effects on bone health are unknown
Loss of bone mineralization: clinical relevance

• The prevalence of osteopenia/osteoporosis many years after bariatric surgery is controversial:
  – Lower bone mineral density than expected (Duran de Campos C, Obes Surg, 2008)
  – No difference compared with age- and post bariatric BMI-matched controls (Vilarrasa N, Obes Surg, 2011; Marceau P, J Gastroint, 2002)

• The risk of fractures is as yet unclear:
  – no significant increase in fracture risk after 3 to 5 years following any bariatric surgery procedure (Lalmohamed A, BMJ, 2012)
  – increased fracture risks over a 12-year follow-up period restricted to mal-absorptive procedures (Lu CW, Medicine, 2015)
Supplementation in Calcium and Vitamin D

• Before surgery:
  – BMD measurements with use of axial (spine and hip) dual-energy x-ray absorptiometry (DXA)

• After surgery:
  – BMD measurements with use of axial (spine and hip) dual-energy x-ray absorptiometry (DXA) at 2 years
  – In patients who have undergone RYGB, BPD, or BPD/DS, treatment with oral calcium citrate and vitamin D (D$_2$ or D$_3$), is indicated to prevent or minimize secondary hyperparathyroidism without inducing frank hypercalciuria
Supplementation in Ca: calcium citrate and dietary intake should reach 1200-1500 mg/d (1800-2400 after BPD)

Vit D: 3000 IU/d (titration to reach 30 ng/ml); correction of deficiency = 50000 IU/wk for 8 wk
Neurological complications (1)

- Prevalence after BS: from 1.3 to 16% (neuropathy) 
  (Koffman BM, Muscle Nerve, 2006; Thaisetthawatkul P, Neurology, 2004)
- Main mechanism: nutritional deficiencies, most common: B12, B9, B1, and D, B3, B6, E and copper 
  (Landais A, Obes Surg, 2014)

**Early complications (< 1 year):**
- Immediate peripherical nerve injury,
- Wernicke’s encephalopathy
- Polyradiculoneuropathy

**Late complications:**
- Optic Neuropathy
- Myelopathy (Subacute Combined Degeneration)
- Peripherical Neuropathy
- Myopathy
**Late neurological complications (2)**

- **Optic Neuropathy:**
  - 3.5% to 8% of patients with neurological complications (Juhasz-Pocsine K, Neurology, 2007; Koffman BM, Nerve, 2006)
  - blurred vision with central scotoma, night blindness
  - associated with copper, carotene and B12 deficiencies,
  - reported between 1.5 and 3 years after BS,
  - more frequent following biliopancreatic bypass

- **Myelopathy (Subacute Combined Degeneration):**
  - Juhasz-Pocsine described 12 patients with posterolateral myelopathy, which started insidiously, with mean latency of 9.9 years
  - disabling gait ataxia, spasticity in legs with pyramidal signs, paresthesias, loss of proprioception and vibratory sensations in legs
  - Mostly: copper or vitamin B12 deficiency or both.
  - Treatment: oral or parenteral correction of nutritional deficiencies and increase caloric intake
Late neurological complications (3)

**Peripheral Neuropathy:**
- symmetric, distal, painful paresthesias, loss of pinprick …
- Most common deficiencies: B1, B12, B6, E, copper, B3, and possibly vitamin D and B9
- Nutritional supplementation can partially improve symptoms
- Risk factors: amount of weight loss, prolonged gastrointestinal symptoms, ↓ serum albumin and transferrin, post operative surgical complications

**Myopathy:**
- mainly in patients with global protein, vitamin D, copper deficiencies, or hypokalemia
- only 2 % of cases of myopathy among 139 subjects with neurological complications (*Juhasz-Pocsine K, Neurology, 2007*)
- weakness, diffuse pain
- myopathy may improve with treatment
<table>
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<tr>
<th>Vitamin/mineral</th>
<th>Routine supplementation for deficiency prevention</th>
<th>Treatment for deficiency</th>
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<tr>
<td>Multivitamin-mineral</td>
<td>Two adult multivitamin-mineral supplements/d (only 1 supplement/d is required after LAGB) containing iron, folic acid, zinc, copper, selenium, and thiamin (200% of the RDA)</td>
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<tr>
<td>Calcium citrate</td>
<td>600-mg Ca supplement/d (1200 mg/d after BPD) or more²</td>
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<td>Vitamin D</td>
<td>3000 IU/d [as ergocalciferol (vitamin D₂), or cholecalciferol (vitamin D₃)]; titration should be done to reach normal concentrations of 30 ng/mL</td>
<td>50,000 IU vitamin D₃ or D₄ 1 time/wk for 8 wk, followed by maintenance therapy of 1500–2000 IU/d to achieve normal concentrations 150–200 mg elemental Fe supplements/d</td>
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<tr>
<td>Iron³</td>
<td>45–60 mg elemental Fe/d from multivitamin and supplements (after LAGB, iron supplementation is necessary if iron intake from food is insufficient)</td>
<td>1000–2000 µg/d sublingual</td>
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<tr>
<td>Vitamin B₁₂</td>
<td>250–350 µg/d or 1000 µg/wk sublingual, 1000 µg/mo i.m., or 3000 µg every 6 mo i.m. after RYGB and BPD After LSG or LAGB, the use of vitamin B₁₂ supplements should be considered as needed to maintain vitamin B₁₂ concentrations and should be included in the multivitamin supplement</td>
<td>Intramuscular or subcutaneous vitamin B₁₂ is necessary when oral therapy does not repair deficiency 500 mg thiamin/d i.v. for 3–5 d, then 250 mg/d for 3–5 d or until the symptoms disappear and then further treatment by oral administration of 100 mg/d as needed 1000 µg folic acid/d</td>
</tr>
<tr>
<td>Thiamin</td>
<td>DRI for thiamin should be included in the routine multivitamin supplement</td>
<td>Vitamin A deficiency without corneal changes: 10,000–25,000 IU/d orally to achieve clinical improvement When changes in the cornea appear, 50,000–100,000 IU i.m. for 3 d followed by 50,000 IU/d for 2 wk i.m. is recommended Vitamin K deficiency: 10 µg i.m. or subcutaneous, followed by 1–2 µg/wk parenterally or orally Vitamin E deficiency: 800–1200 IU/d to reach normal serum concentrations 60 mg Zn 2 times/d</td>
</tr>
<tr>
<td>Folic acid</td>
<td>400 µg/d should be included in the routine multivitamin; pregnant women or those planning to conceive should take 800–1000 µg folic acid/d included in a multivitamin supplement or separately</td>
<td>—</td>
</tr>
<tr>
<td>Fat-soluble vitamins (A, K, and E)⁴</td>
<td>6000 IU vitamin A should be included in the routine multivitamin; for pregnant women or those planning to conceive, the β-carotene form of vitamin A is preferred over retinol After BPD: 10,000 IU vitamin A/d, 300 µg vitamin K/d, and 400 IU vitamin E/d (included in a multivitamin or separately)</td>
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<tr>
<td>Zinc</td>
<td>The routine daily multivitamin should contain 15 mg/d ≥1 mg Cu per 8–15 mg Zn to prevent copper deficiency is recommended</td>
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<tr>
<td>Copper</td>
<td>The routine daily multivitamin should contain 2 mg Cu</td>
<td>Severe deficiency requires 2–4 mg Cu/d i.v. for 6 d 100 mg vitamin C 3 times/d or 500 mg/d for 1 mo</td>
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<tr>
<td>Vitamin C</td>
<td>The routine daily multivitamin should follow the DRI recommendation for vitamin C</td>
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Gastro esophageal reflux disease (GERD)

- Obesity is a known risk factors for GERD
- Effect of BS on GERD depends to the procedure
- RYGB ↓ GERD
- LSG: post operative incidence of GERD as high as 31% (Rosenthal RJ, Surg Obes Relat Dis, 2012)
- Risk = Barrett's Esophagus developpment which may lead to adenocarcinoma of the esophagus
- Few cases of adenocarcinoma after LSG reported in the literature (Wright FG, Inter j surg case rep, 2017)
Hypoglycemia

- Sometimes called “late dumping syndrome”, appears 1-3h after a meal => reactive hypoglycemia
- Likely caused by a combination of changes within the pancreatic β-cells and abnormal insulin response to glucose (Ritz P, Diabetes Obes Metab, 2016)
- Symptoms: sweating, tremor, hunger and confusion up to syncope
- First line of treatment: dietary measures:
  - Avoidance of high glycemic index food
  - More frequent meals
  - Increasing fiber and protein content
  - Slow gastric emptying…
- Second line: acarbose, somatostatin
**Weight regain**

- It is possible! 15 to 33%, 2y after BS *(Odom J, Obes Surg, 2010; Tamboli RA, Obesity, 2015)*

- Factors related to weight regain after BS:
  - Postoperative time
  - Poor diet quality *(Freire RH, Nutrition, 2012; Da Silva FBL, Nutrition, 2016)*
  - Eating disorders:
    - Food urges or “cravings”
    - Grazing *(Kofman MD, Obesity, 2010)*: at least 2X/w
  - Concerns regarding addictive behaviors,
  - lack of self-monitoring,
  - fewer postoperative follow-up visits *(Odom J, Obes Surg, 2010)*

- Physical activity has been considered to protect against weight regain *(Freire RH, Nutrition, 2012)*
Psycho-social complications

- BS => improvements in psychosocial status including:
  - Social relations and employment opportunities (Herpertz S, IJO, 2003)
  - Improved quality of life (Bocchieri LE, J Psychosom SE, 2002)
  - Decreased prevalence of depressive disorders at 24-36 months (De Zwaan M, J Affect Disord, 2011)

- However, subsequent elevations in depressive symptoms in longer term follow-up (Dawes AJ, JAMA, 2016; Booth H, J Affect Disord, 2015)

  => Need for further research to provide more comprehensive understanding of long-term psychological well-being post surgery
Long-term nutritional follow-up

- Regular and supportive management by qualified health care professionals (Mechanick JI, Obesity, 2013)
- By a multidisciplinary medical team: surgeon, bariatric dietitian, psychologist and family physician and/or endocrinologist
- Adherence to follow-up:
  - fewer postoperative adverse events
  - greater excess body weight loss
  - fewer comorbidities (Moroshko I, Obes Surg, 2012)
- Low compliance with follow-up after BS, with attrition rates: 3% to 63% (Gourash WF, Surg Obes Relat Dis, 2016)
- Visits: screening for micronutrient deficiencies, bone health, and control of nutrition-related diseases
Take-home messages

• Nutritional deficiencies after BS can lead to diseases and require lifelong screening

• Never forget to make a neurological examination in patients with BS

• Medical follow-up to life = the key
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<th>Vitamin/nutrient</th>
<th>Neurological complications</th>
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<tr>
<td>Vitamin A</td>
<td>Night blindness, optic neuropathy, (xerophthalmia)</td>
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<tr>
<td>Vitamin B1</td>
<td>Wernicke’s encephalopathy, Korsakoff’s syndrome, acute polyradiculoneuropathy, neuropathy (dry beriberi), optic neuropathy</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Peripheral neuropathy, optic neuropathy, myelopathy</td>
</tr>
<tr>
<td>Vitamin B9 (folate)</td>
<td>Peripheral neuropathy, optic neuropathy, restless leg syndrome, (affective disorders?)</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Myelopathy, peripheral neuropathy, optic neuropathy, (dementia and mental disorders?)</td>
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<tr>
<td>Vitamin D</td>
<td>Myopathy</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Myelopathy, peripheral neuropathy</td>
</tr>
<tr>
<td>Copper</td>
<td>Myelopathy, Peripheral neuropathy, optic neuropathy, myopathy</td>
</tr>
<tr>
<td>Global protein</td>
<td>Myopathy</td>
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