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Bariatric Surgery – Nutritional and Metabolic Complications

Module 23.4

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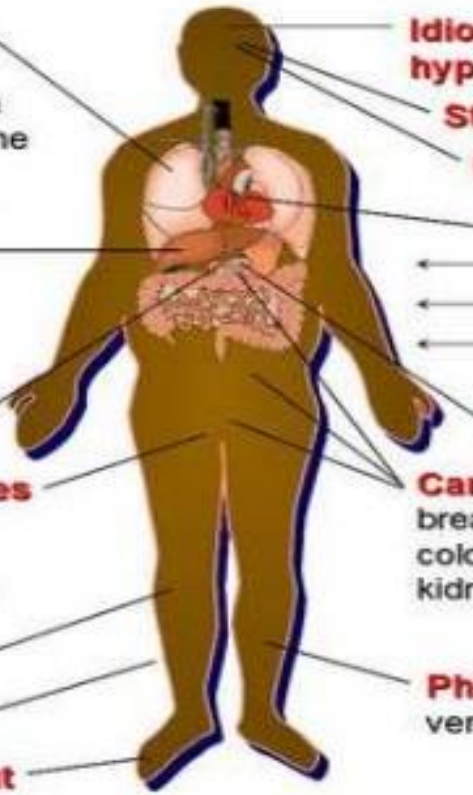
Learning objectives Bariatric surgery

- Principles of bariatric surgical techniques
- Nutritional and metabolic complications
- Appropriate post bariatric surgery follow-up
- Importance of protein intake after bariatric surgery
- Routine supplementation of micronutrients

Medical Complications of Obesity



Pulmonary disease
abnormal function
obstructive sleep apnea
hypoventilation syndrome

Nonalcoholic fatty liver disease
steatosis
steatohepatitis
cirrhosis

Gall bladder disease

Gynecologic abnormalities
abnormal menses
infertility
polycystic ovarian syndrome

Osteoarthritis

Skin

Gout

Idiopathic intracranial hypertension

Stroke

Cataracts

Coronary heart disease

Diabetes

Dyslipidemia

Hypertension

Severe pancreatitis

Cancer
breast, uterus, cervix
colon, esophagus, pancreas
kidney, prostate

Phlebitis
venous stasis

Pathophysiology of nutritional deficiencies

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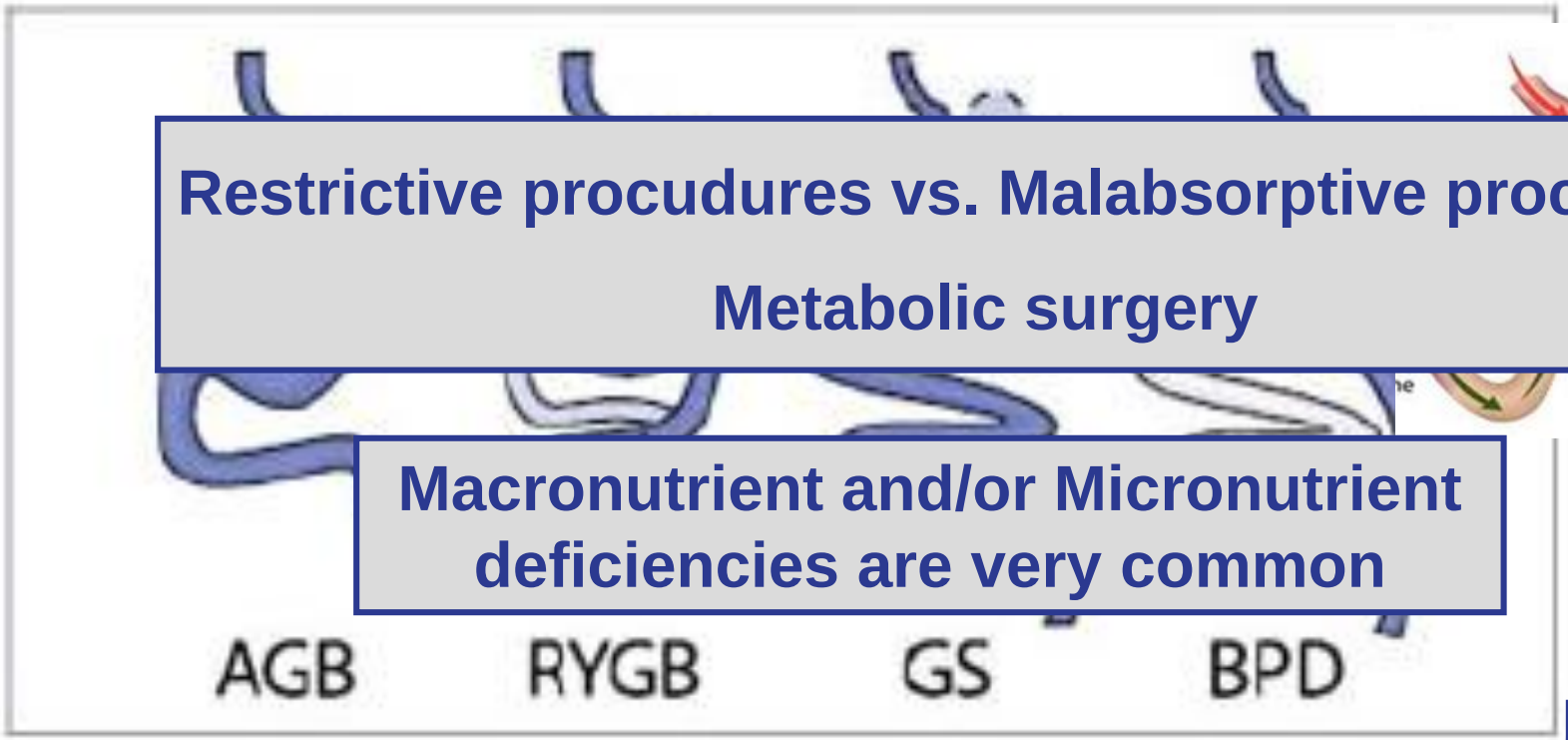

Restrictive procudures vs. Malabsorptive procedures

Metabolic surgery

Macronutrient and/or Micronutrient deficiencies are very common

Mini gastric bypass

Indications for bariatric surgery

- BMI ≥40
- BMI 35–40 kg/m2 with co-morbidities

Of the total population of England- ~8%
3,623,505 people eligible for bariatric surgery in 2014

specifically DM- consider on personal basis

- Interdisciplinary European Guidelines on Metabolic and Bariatric Surgery. OBES SURG (2014)
- Dixon JB. International Diabetes Federation Taskforce on Epidemiology and Prevention. Bariatric surgery: an IDF statement for obese type 2 diabetes. Diabet Med. 2011
- Obesity: identification, assessment and management NICE clinical guidelines; 2014
- Aminian A Surg Obes Relat Dis. 2018 ASMBS updated position statement on bariatric surgery in class I obesity (BMI 30-35 kg/m2).
- Desogus D et al. Obes Surg. 2019 May 25.

Improvement post bariatric surgery

Excessive weight loss

- Diabetes mellitus-
  - Lower HbA1C
  - Lower glucose levels
  - Less medications
- Hypertension
- Hyperlipidemia
- Non alcoholic hepatitis/cirrhosis (NASH)

Aminian A Surg Obes Relat Dis. 2018
ASMBS updated position statement on bariatric surgery in class I obesity (BMI 30-35 kg/m2).

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Obesity Reviews / Volume 19, Issue 4

Obes Rev. 2018 Full Access

Early major complications after bariatric surgery in the USA, 2003–2014: a systematic review and meta-analysis

S.-H. Chang ✉, N. L. B. Freeman, J. A. Lee, C. R. T. Stoll, A. J. Calhoun, J. C. Eagon, G. A. Colditz

….we found that the quality of complication reporting is lower than the reporting of other outcomes

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Europe

….as operating surgeons enter most of the data, it cannot be ruled out that there may be an underreporting bias for operative complications (excluding death) and an over reporting bias for the positive outcomes of surgery

Miras Surg Obes Relat Dis. 2018

Morbidity and mortality post bariatric surgery compared to general population

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13 273 patients between 1980-2006.

- Post surgery
  - Myocardial infarction X1.5
  - Angina pectoris X2
  - Stroke X2
  - Hypertension X3
  - Diabetes X2.5
  - Death X1.2 for all

Not healthy

Plecka Br J Surg 2011

Non surgical complications

Primary surgery

Major complications 2.8%

30 day mortality 0.08%*

- Major depression X1.7 (12 years)

England

0.08% is low, but if 3,623,505 undergo surgery

2900 die from the surgery

- Pregnancy outcomes

Seeras StatPearls [Internet] 2018
Lu CW Ann Med. 2018
Salehi J Clin Endocrinol Metab. 2018
***Poelemeijer Obes Surg. 2018**

Russell Int. J. Environ. Res. Public Health 2018
Emanuele Rausa, Obesity Surgery August 2016
Alam ,BJS Open. 2017

Inadequate energy and protein intake post RYGB

	Energy	Protein gr.
3 months	772±323	24.5±8
1 year	1075±378	23.3±6.5

A minimal protein intake of 60 g/d
up to 1.5 g/kg ideal body weight per day **should** be targeted

- **Obesity Management Task Force of the European Association for the Study of Obesity Released "Practical Recommendations for the Post-Bariatric Surgery Medical Management". Obes Surg. 2018**
- **Moize Obesity Surgery 2003**

Protein malnutrition after RYGB and BPD

	RYGB limb <150 cm	RYGB limb >150 cm	BPD
2 years	~5%	13%	3-18%

- An annual hospitalization rate of 1%/year after malabsorptive procedures
- ~50% of patients who developed hypoalbuminaemia needed revisional surgery'

Khalaj AObes Surg. **2019**

Chen Surg Obes Relat Dis. **2019**

Heber et al J Clin Endocrinol Metab, November 2010

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What about microelements?

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Table 1 Prevalence of micronutrient deficiencies following bariatric surgery. Data given as percentages [36, 38–41]

	LAGB	LSG	RYGB	BPDDS
Thiamin (B_1)	0	0	12	10–15
Folate (B_9)	10	10–20	15	15
Piridoxine (B_6)	0	0–15	0	10
Cobalamin (B_{12})	10	10–20	30–50	22
Vitamin A	10	10–20	10–50	60–70
Vitamin D (<30 ng/dL)	30	30–70	30–50	40–100
Vitamin E	0	0–5	10	10
Vitamin K	0	0	0	60–70
Iron	0–32	15–45	25–50	25
Copper	–	10	10	70
Zinc	–	7–15	20–37	25

(–) indicates that data not available

Abbreviations: *LAGB* laparoscopic-assisted gastric banding, *LSG* laparoscopic sleeve gastrectomy, *RYGB* Roux-en-Y gastric bypass, *BPDDS* biliopancreatic diversion with duodenal switch

Via MA, Mechanick JI. Curr Obes Rep. 2017 Jul 17

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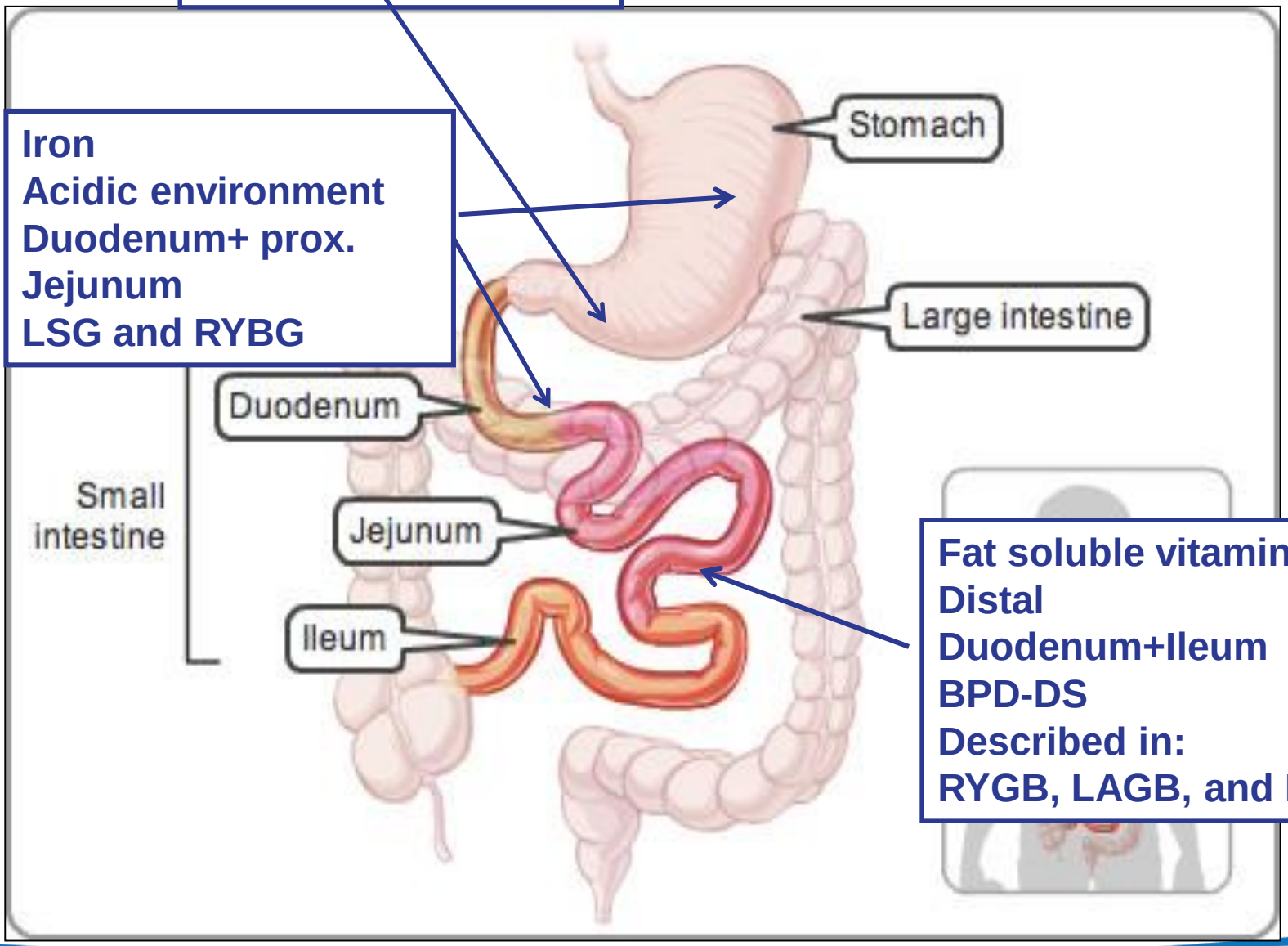
Intrinsic factor for B12
LSG and RYGB

Iron
Acidic environment
Duodenum+ prox. Jejunum
LSG and RYBG



Fat soluble vitamins
Distal Duodenum+Ileum
BPD-DS
Described in:
RYGB, LAGB, and LSG

Marcotte Surg Clin N Am

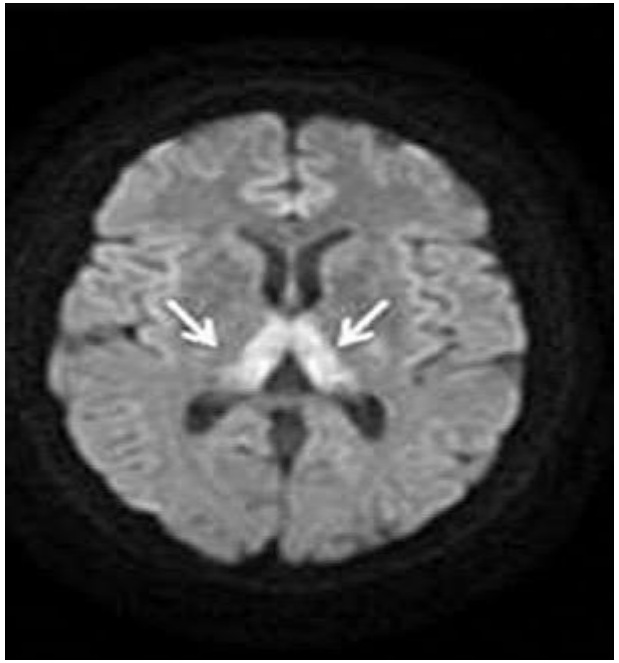
Wernicke's encephalopathy- B1- Thiamin deficiency

Case report
3 months post GB

CT

Normal

MRI



High signal intensities - Thalamic and hypothalamic lesions

>25% Thiamine deficiency
Tang Surg Obes Relat Dis. 2018

Pellagra-like dermatitis
Niacin deficiency

Case report
3 months post roux&y

- Diarrhea
- Dermatitis
- Dementia
- Death

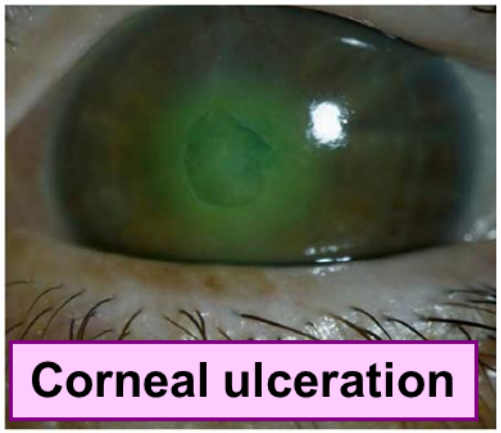
N Engl J Med. 2006

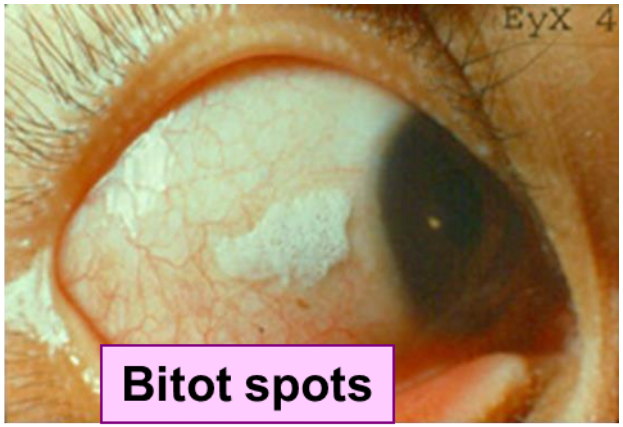
Vitamin A post Roux-en-Y Gastric Bypass Pregnancy

- 70-90 % deficiency (laboratory)

Night blindness

- Post Roux-en-Y Gastric Bypass 75.0 %





Machado OBES SURG 2015
Donaldson et al Cornea 2012

Vitamin B12 (Cobolamine)

- Up to ~40% if only multi vitamin used
- Deficiency due to
  - Intact stomach- not present
    - Gas release of iron
    - Intri r absorption
  - low intake (meat)
  - Bacterial overgrowth in bypassed limb
- Irreversible sequelae
- Blood level follow-up
- Routine supplementation needed

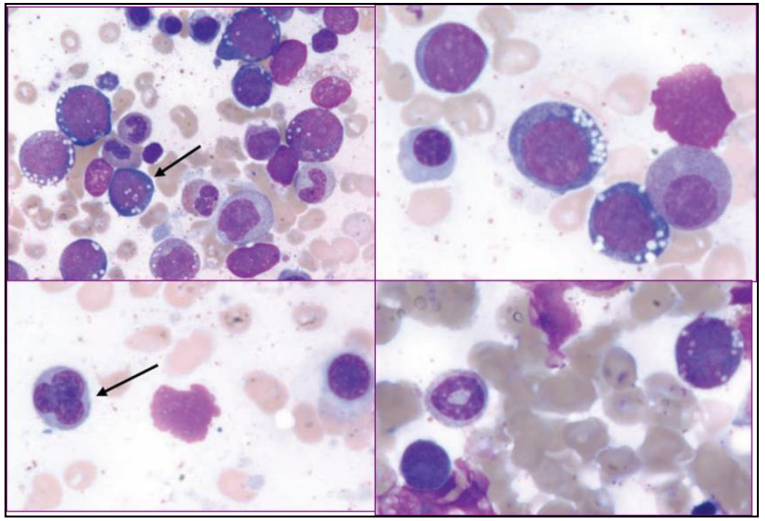
May take years

Halverson Am Surg 1982
Behrns Dig Dis Sci 1992
Shankar Nutrition 2010

Carrodeguas Surg Obes Relat Dis 2005
Carvalhoc Arq Bras Cir Dig 2012
Seeras StatPearls [Internet] 2018

Copper deficiency

- 6 & 24 months post RYGB ~ 10% and 20%
- Pancytopenia
- Neurologic manifestations
- Fatigue
- Myeloneuropathy like syndrome
  - spastic gait, sensory ataxia
- Sudden bilateral blindness



myelodysplastic syndrome like 20 years post gastric bypass

Watch out patients taking Zinc supplements

Gletsu-Miller et al. Int J Obes (Lond). 2012

Robinson *Proc (Bayl Univ Med Cent) 2013*

J R Coll Physicians Edinb. 2018

Bone density and lean body mass: 24 months post surgery vs. intensive medical therapy

	Intensive medical	Bariatric surgery	
Lean mass (kg)	-2.7	-12	P<0.001
Bone mass (kg)%	+0.3	-7	P<0.001
Total hip BMD%	-0.3	-9.5	P<0.001

Bariatric surgery increases risk of bone fractureX2**

**Fashandi Surg Endosc. 2018 Maghrabi Obesity 2015

Sarcpenia

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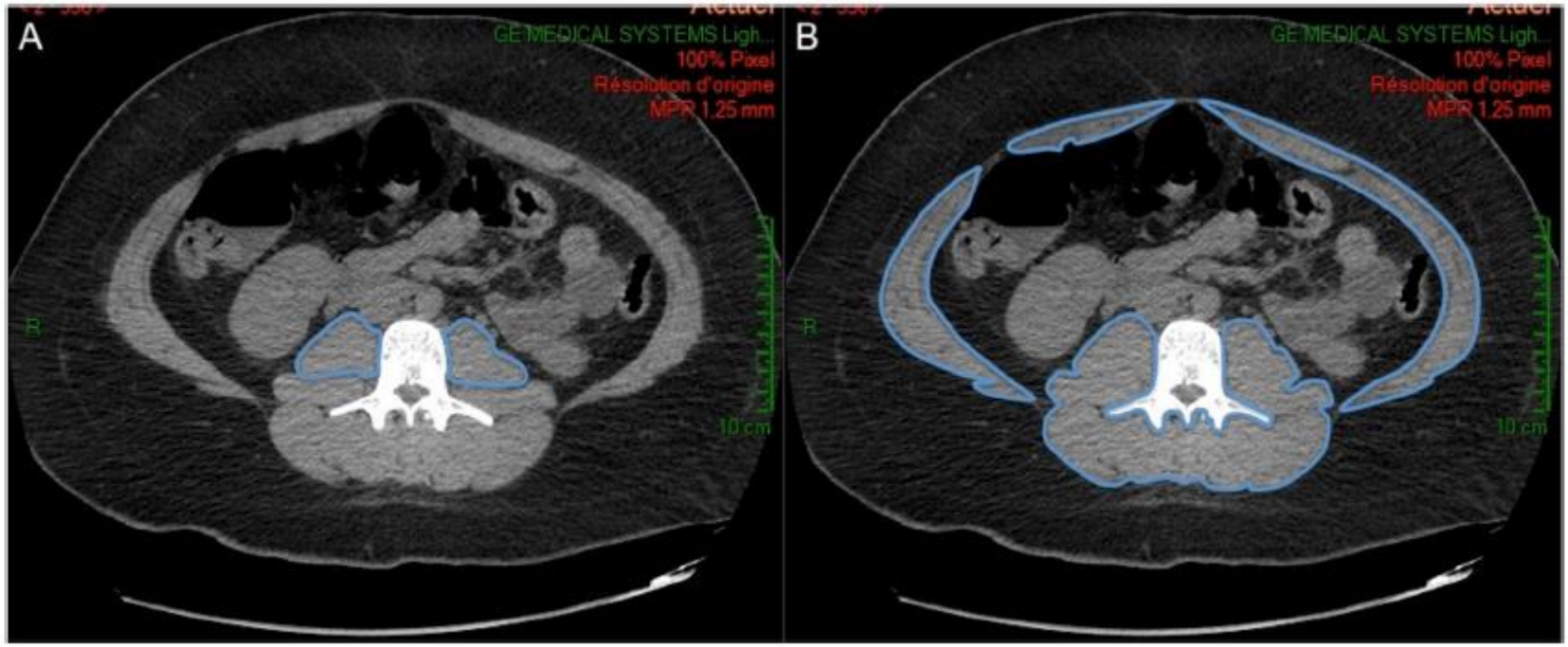
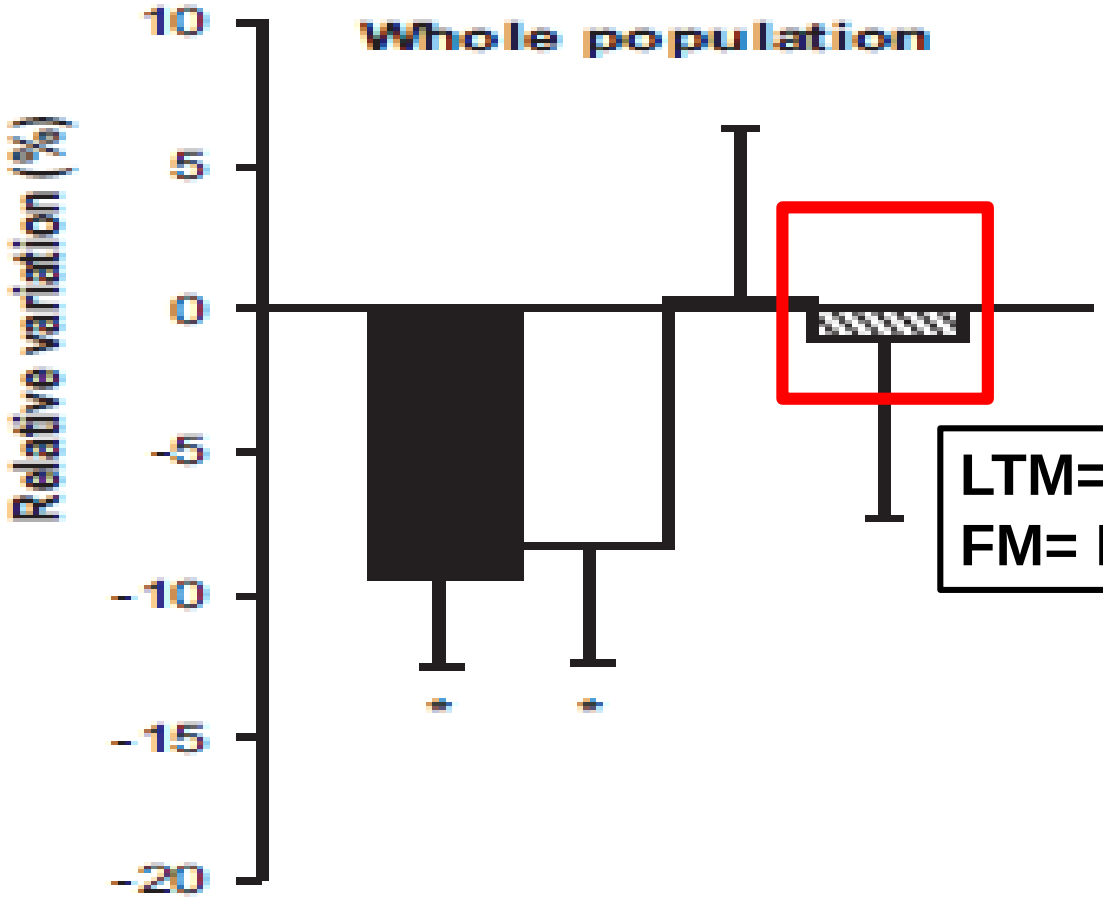
Assessment by CT



~1/4 de novo sarcopenia*

***Voican CS PLoS One. 2018**
Gaillard Obesity Surgery (2018) 28:2379–2385
Mastino OBES SURG (2016) 26:2355–2362

Body composition
1 month post sleeve



LTM= lean tissue mass
FM= Fat mass

LTM
FM (kg)
FM (%)
LTM/FM

Maïmoun Surgery forObesityandRelatedDiseases13(2017)780–787

Body composition post bariatric surgery

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Authors	Follow-up	Fat-free mass decrease from baseline (kg), except #fat-free mass index (kg/m²)
Schollenberger *et al.*, 2016 [13▪]	6 month	−7.8
Cole *et al.*, 2016 [14]	1 year 8.7 year	−16.3 −11.9

25-58% weight loss= loss of muscle mass

Muscle mass is important

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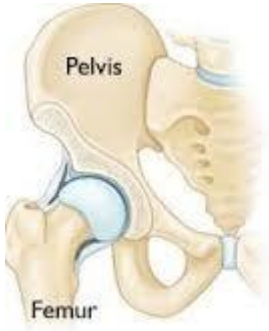
Sarcopenia = Loss muscle mass

- Frailty
- Falls
- Fracture
- Quality of life



Falls, Fractures and bariatric surgery

- 38,971 patients, 7758 with DM
- Median- 3.1 years post surgery
- Surgery associated with **>25% increased risk** of any fracture in all patients
- The fracture risk appeared **to increase with time**.
- The risk of fall injury without fracture was also increased

Axelsson J Bone Miner Res. 2018

Orthostatic intolerance

- 68 year old woman
- 1.18 mini bypass, since than recurrent falls and fractures due to orthostatic hypotension
- 5.18 fall with shoulder fracture
- 9.18 fall- fracture of femur
- Deep pressure sore on her buttocks

6.5 months

Department	Admission	Discharge
surgery	15/11/2018	11/12/2018
surgery	13/09/2018	
Internal medicine	07/09/2018	
Orthopedics	23/08/2018	
Internal medicine	22/05/2018	28/05/2018

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New-onset orthostatic intolerance following bariatric surgery.

Pacing Clin Electrophysiol. 2008 Billakanty SR, et. Al.

- **Orthostatic intolerance and autonomic dysfunction following bariatric surgery: A retrospective study and review of the literature.**

  Auton Neurosci. 2016 Ponnusamy et. Al.

- **The effects of body weight status on orthostatic intolerance and predisposition to noncardiac syncope**

  Obes Rev. 2017 Christou GA et. Al

Post-bariatric hypoglycemia Why?

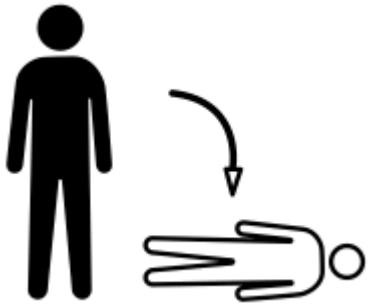
- >1 year post bariatric surgery
- Diabetes & non diabetes patients
- Increased sensitivity of beta-cells and/or proliferation

- Dumping syndrome- early/late

Guarino Diabetologia. **2019 Jan;62(1):178-186**

Hypoglycemia

‘Hypoglycemia, occurring after bariatric is increasingly encountered by clinical endocrinologists…Postbariatric hypoglycemia can be severe and disabling for some patients, with neuroglycopenia (altered cognition, seizures, and loss of consciousness) leading to falls, motor vehicle accidents, and job and income loss.



Dadheech Islets. 2018;10(6):213-220

Preterm birth and fetal growth outcomes for births of women with a history of bariatric surgery and matched controls

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Post bariatric- 2507 controls- 12338

	No (%) cases		Odds	
	Bariatric	controls	Odds	P value
Birth<37	243 (9.7)	750 (6.1)	1.7 (1.4-2)	P<0.001
SGA	131 (5.2	369 (3)	2 (1.5-2.5)	P<0.001
LGA	105 (4.2)	895 (7.3)	0.6 (0.4-0.7)	P<0.001

maternal age, parity, early pregnancy body mass index, early pregnancy smoking status, educational level, and year of delivery

Roos et al BMJ. 2013

Blume Obes Surg. 2018-
Lower birthweight of babies to mothers post bariatric surgery

Recommendations

- Continuous professional dietician follow-up and treatment
- Adequate protein ingestion 1.5 gr/ideal body weight
- Multivitamin supplementation
- Consider S/L B12
- Bone density follow-up
- Physical activity

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Table 1
Vitamin supplement recommendations

	Procedure			
Vitamins	**LAGB**	**LSG**	**RYGB**	**BPD-DS**
Multivitamin with minerals	✓	✓	✓	✓
Vitamin B_{12}	—	✓	✓	—
Calcium with vitamin D	✓	✓	✓	✓
Iron	—	—	✓	✓
Vitamin C	—	—	✓	—
Vitamin A	—	—	—	✓
Vitamin K	—	—	—	✓

Marcotte Surg Clin N Am 96 (2016)

Suggested- follow- up protocol

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TABLE 2. Schedule for clinical and biochemical monitoring

	Preoperative	1 month	3 months	6 months	12 months	18 months	24 months	Annually
Complete blood count	X	X	X	X	X	X	X	X
LFTs	X	X	X	X	X	X	X	X
Glucose	X	X	X	X	X	X	X	X
Creatinine	X	X	X	X	X	X	X	X
Electrolytes	X	X	X	X	X	X	X	X
Iron/ferritin	X			X[a]	X[a]	X[a]	X[a]	X[a]
Vitamin B12	X			X[a]	X[a]	X[a]	X[a]	X[a]
Folate	X			X[a]	X[a]	X[a]	X[a]	X[a]
Calcium	X			X[a]	X[a]	X[a]	X[a]	X[a]
Intact PTH	X			X[a]	X[a]	X[a]	X[a]	X[a]
25-D	X			X[a]	X[a]	X[a]	X[a]	X[a]
Albumin/prealbumin	X			X[a]	X[a]	X[a]	X[a]	X[a]
Vitamin A	X						Optional	Optional
Zinc	X			Optional	Optional		Optional	Optional
Bone mineral density and body composition	X				X[a]		X[a]	X[a]
Vitamin B1			Optional	Optional	Optional	Optional	Optional	Optional

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

[a] Examinations should only be performed after RYGB, BPD, or BPD/DS. All of them are considered as suggested for patients submitted to restrictive

Routine supplementation of vitamins and microelements

Heber et al J Clin Endocrinol Metab, November 2010

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Summary
Post bariatric surgery-

- Any abnormal manifestation- neurologic, dermal, laboratory- should arise suspicion of nutritional deficiency
- Nutritional deficiencies post surgery are common
- Routine vitamin and mineral supplementation required
- Life long nutritional consultation is mandatory
- Life long awareness of nutritional deficiencies is required
- Multi disciplinary care and evaluation- recommended