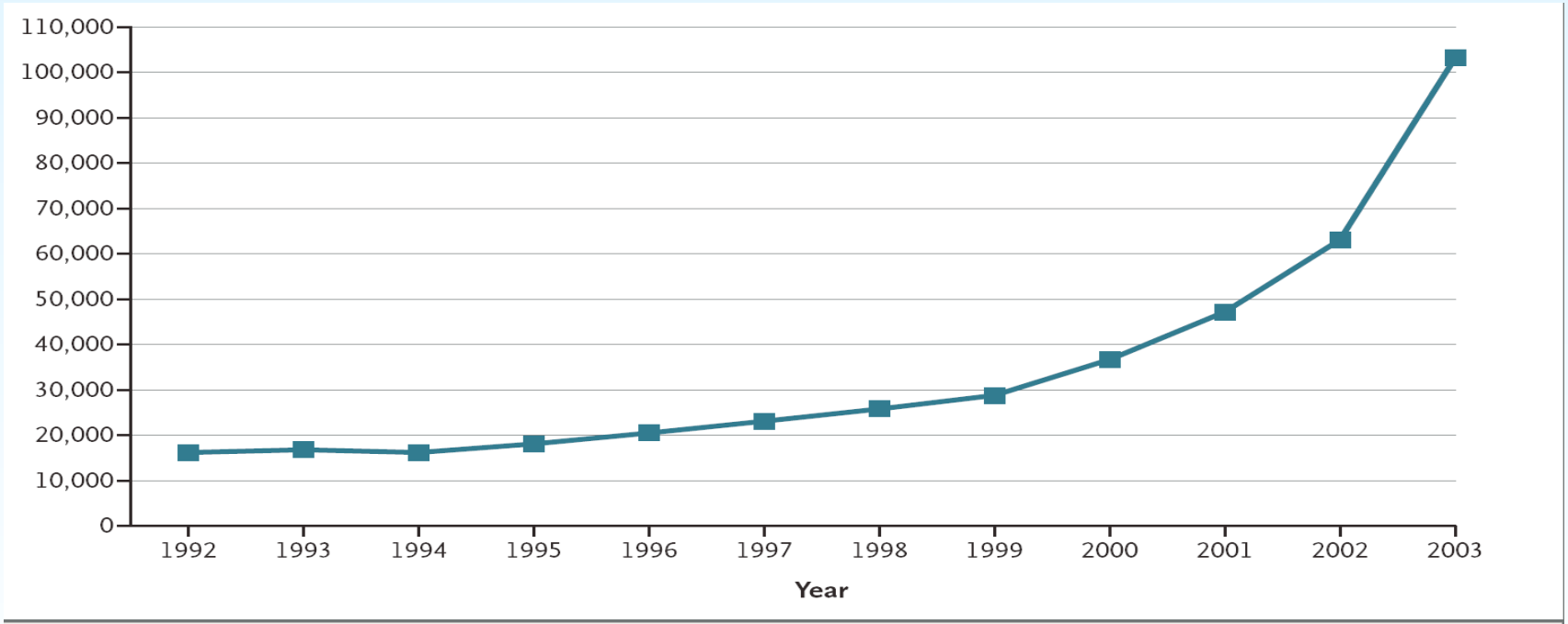
CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL SUPPORT OF BARIATRIC SURGERY

Fabienne Tamion
Inserm U644, Service de Réanimation Médicale
Faculté de Médecine Pharmacie - Rouen

Estimated Number of Bariatric Operations Performed in the United States, 1992–2003.

Overweight and obesity are at epidemic proportions in the USA, affecting nearly 65% (or ~130 million) of the adult population

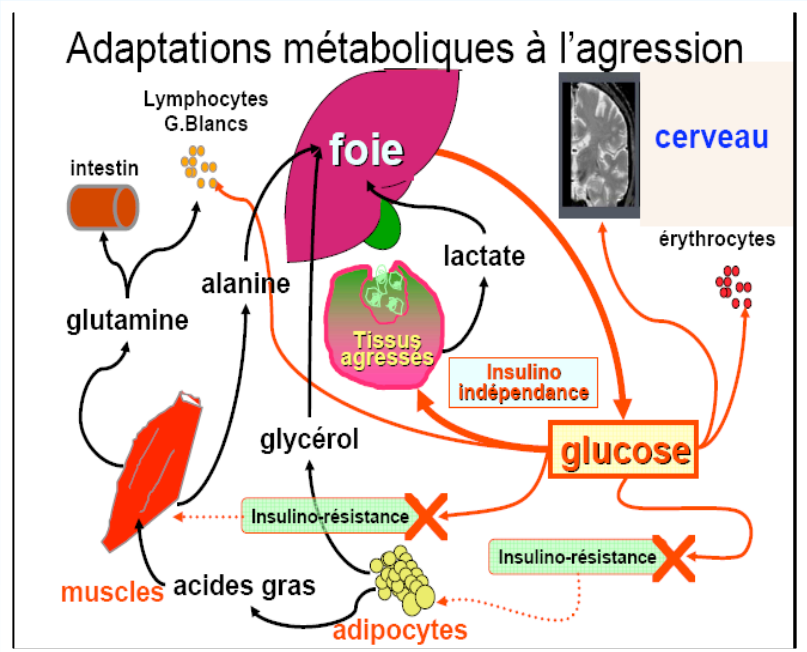


e 1. Estimated Number of Bariatric Operations Performed in the United States, 1992–2003.
are from the American Society for Bariatric Surgery.

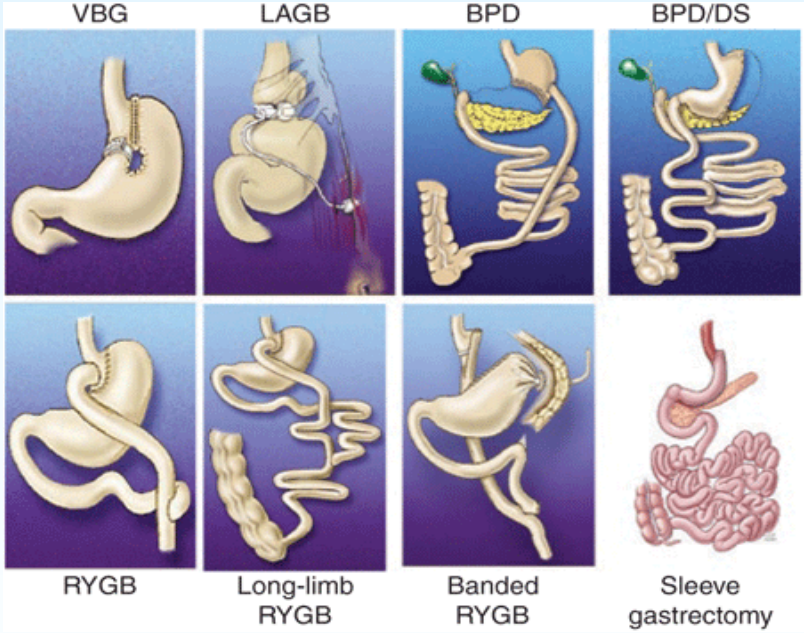
BARIATRIC SURGERY

The management of the obese patient after bariatric surgery present major challenges :

- The management of the obese critically ill patient
- The specific nutritional support



+



Evidence for the Necessity to Systematically Assess Micronutrient Status Prior to Bariatric Surgery

Ernst B et al, Obesity Surg 2009, 19:66-73.

Table 3 Absolute values and rates of prevalence of deficiency in micronutrients

	Total (n=232)	BMI				P (trend)
		35 – <40 (n=47)	40 – <45 (n=87)	45 – <50 (n=56)	>50 (n=42)	
Absolute values						
Albumin (µmol/l)	612.9±65.2	637.6±66.7	626.0±66.7	597.0±46.4	581.0±66.7	<0.001
Total calcium (mmol/l)	2.3±0.1	2.3±0.1	2.3±0.1	2.2±0.1	2.2±0.1	0.045
Phosphate (mmol/l)[a]	1.0±0.2	1.0±0.2	1.0±0.2	1.0±0.2	1.0±0.2	0.993
Magnesium (mmol/l)[b]	0.9±0.1	0.9±0.9	0.9±0.1	0.9±0.2	0.8±0.1	0.708
Ferritin (pmol/l)	165.2±163.8	132.5±122.0	171.1±169.4	200.5±193.4	142.4±143.1	0.145
Hemoglobin (mmol/l)	8.9±0.9	8.9±0.8	9.1±0.7	8.8±0.9	8.7± 1.1	0.123
Zinc (µmol/l)	12.2±1.8	12.3±1.6	12.4±1.9	12.2±1.6	11.9±1.8	0.458
Folate (nmol/l)	13.1±8.4	11.3±4.8	13.6±8.6	14.7±11.3	12.0±6.8	0.170
Vitamin B_{12} (pmol/l)	202.2±81.9	192.6±73.1	206.5±78.4	218.0±94.4	182.5±78.1	0.144
25-OH-D3 (nmol/l)	47.0±36.4	50.3±28.2	51.1±49.3	44.5±24.5	38.2±23.1	0.241
IPTH (pmol/l)	6.2±2.9	5.4±2.1	5.9±2.5	6.7±3.9	6.9±2.8	0.046
Deficiencies (%)						
Albumin <536.0 µmol/l	12.5	8.5	9.2	8.9	28.6	0.007
Phosphate <0.8 mmol/l[a]	8.0	12.8	7.2	5.5	7.7	0.573
Magnesium <0.7 mmol/l[b]	4.7	4.5	0	10.0	7.5	0.052
Ferritin <18.0 pmol/l	6.9	10.6	4.6	5.4	9.5	0.494
Hemoglobin <8.7 mmol/l[c]	10.1	15.4	3.0	17.4	10.0	0.313
Hemoglobin <7.5 mmol/l[d]	5.9	2.0	1.4	8.0	18.8	0.003
Zinc <11.0 µmol/l	24.6	25.5	23.0	17.9	35.7	0.229
Folate <4.5 nmol/l	3.4	0	3.4	5.4	4.8	0.474
Vitamin B_{12} <133.0 pmol/l	18.1	17.0	16.1	16.1	26.2	0.516
25-OH-D <76.0 nmol/l	89.7	85.1	89.7	89.3	95.2	0.481
25-OH-D <50.0 nmol/l	61.2	53.2	58.6	60.7	76.2	0.139
25-OH-D <25.0 nmol/l	25.4	23.4	20.7	26.8	35.7	0.317
IPTH>6.5 pmol/l	36.6	25.5	36.8	42.9	40.5	0.296

Data are the mean±SD, or percentage. P values derive from χ^2 test or ANOVA as appropriate.
[a] Measured in 224 patients.
[b] Measured in 213 patients.

Present data indicate a high prevalence (>10%) of albumin, zinc, and vitamin deficiency

Obese patient may have protein depletion

Prevalence of nutrient deficiencies in bariatric patients

Toh SY et al, Nutrition 2009, 25:1150-11156

Table 2
Prevalence of preoperative abnormalities

Biochemistry	Abnormal level	n (no. of available results)	Prevalence
Albumin	<38 g/L	2 (219)	0.9%
Hb			
Total		14 (220)	6.4%
Men	<30 g/L	7 (79)	8.7%
Women	<119 g/L	7 (141)	5.0%
Iron	<9.0 μmol/L	29 (185)	15.7%
Ferritin	<15 μg/L	2 (189)	1.1%
25(OH)D			
Total		24 (42)	57.1%
Mild	25–50 nmol/L	19 (42)	45.2%
Moderate	12.5– < 25 nmol/L	4 (42)	9.5%
Severe	<12.5 nmol/L	1 (42)	2.4%
iPTH	>6.9 pmol/L	4 (16)	25.0%
Vitamin B_{12}	<145 pmol/L	3 (165)	1.8%
Folate	<7.0 nmol/L	0 (121)	0%
RBC folate	<776 nmol/L	9 (158)	5.7%
tHcy			
Total		12 (149)	8.1%
Men	>14.0 μmol/L	7 (55)	12.7%
Women	>12.0 μmol/L	5 (94)	5.3%
CRP	>5.0 mg/L	90 (154)	58.4%

CRP, C-reactive protein; Hb, hemoglobin; iPTH, parathyroid hormone; RBC, red blood cell; tHcy, homocysteine; 25(OH)D, 25-hydroxy-vitamin D.

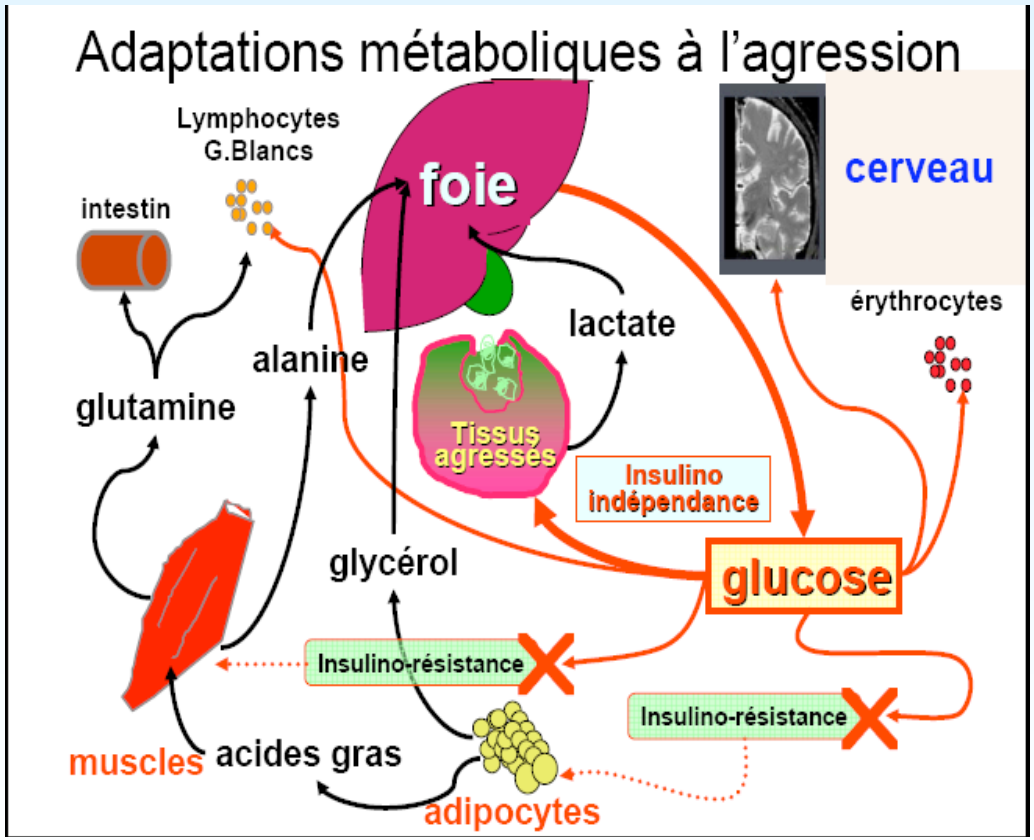
The prevalence of preoperative deficiencies : iron (16%) with a low prevalence of anemia (6.4%), Vit D (57%), Vit B12 (<2%) or folates (< 6%)

Obese patient may have nutritional deficiencies or other nutritional inadequacies preoperatively

BARIATRIC SURGERY

The management of the obese patient after bariatric surgery present two major challenges :

- **The management of the obese critically ill patient**
- The specific nutritional support



Reeds DN, Curr Opin Gastoenterol 2009, 25:151-154

Obesity and the Metabolic Response to Severe Multiple Trauma in Man

Malayappa Jeevanandam, David H. Young, and William R. Schiller
Trauma Center, St. Joseph's Hospital and Medical Center, Phoenix, Arizona 85013

A reduced net fat oxidation rate

Loss of lean body mass

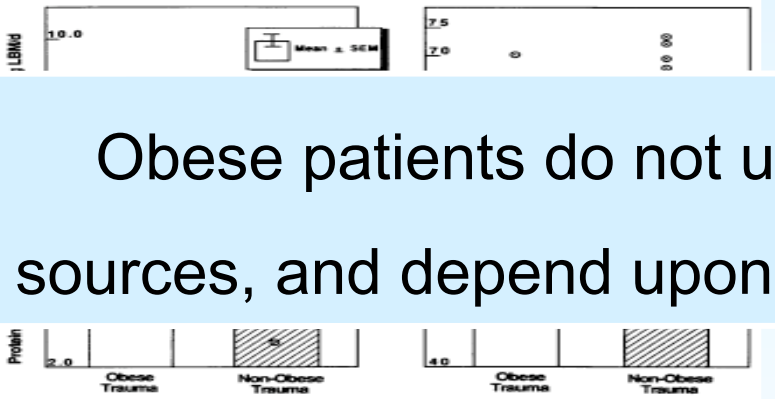


Figure 1. Protein turnover rate and protein synthesis efficiency in obese and nonobese patients.

Obese patients do not use their most abundant fat fuel sources, and depend upon other fuel sources such as protein

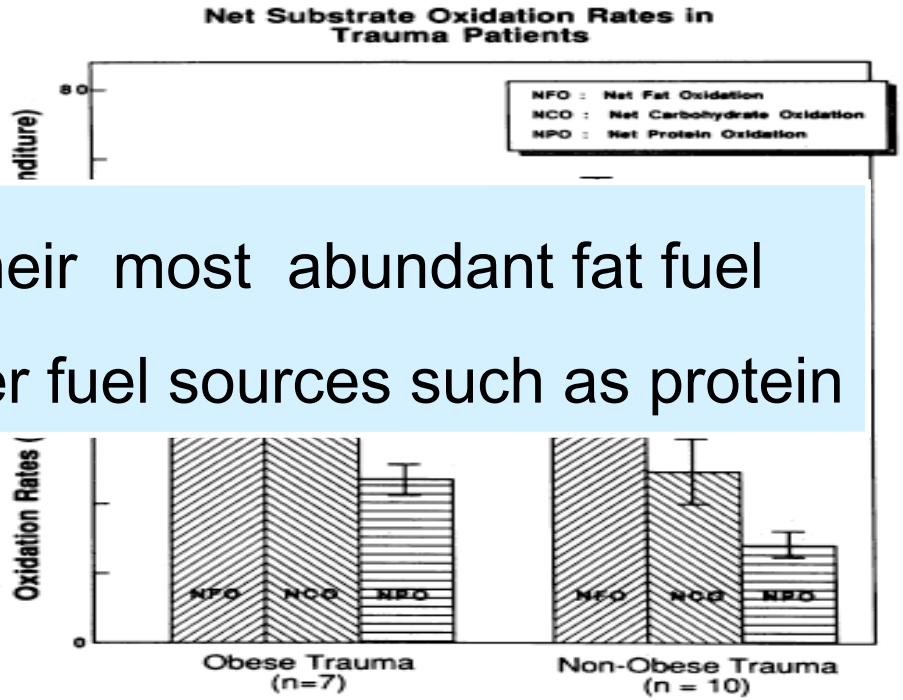
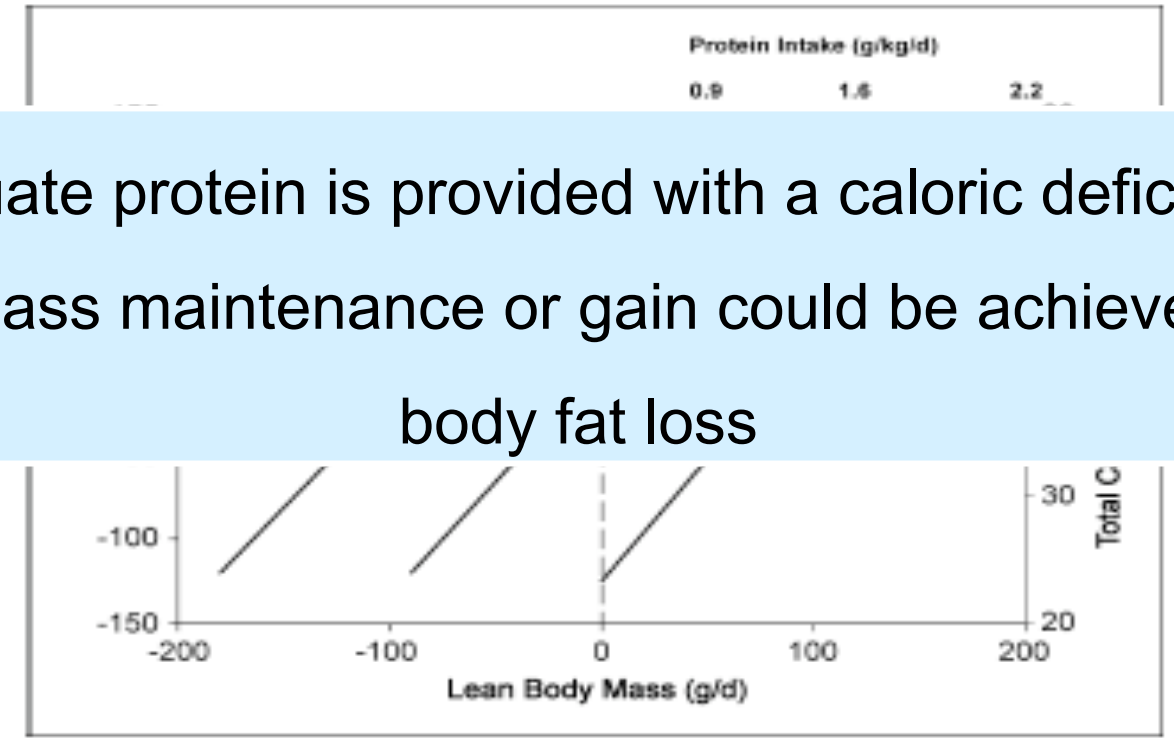


Figure 3. Whole-body net oxidation rates (as percentage of resting energy expenditure) of NFO, NCO, and NPO in obese ($n = 7$) and nonobese ($n = 10$) trauma patients. $P = 0.01$ for NFO; $P = 0.05$ for NCO; $P = 0.025$ for NPO (obese vs. nonobese trauma).

Jeevanandam M et al, JCI 1991, 87: 262

Energy and protein intake interactions upon body composition

Figure 2. Body composition changes with varying parenteral calorie and protein intakes in a typical 60 kg surgical patient with 10% weight loss



Adapted from Hill and Church [17].

If adequate protein is provided with a caloric deficit , lean body mass maintenance or gain could be achieved with body fat loss

Dickerson RN, Curr Opin Clin Nutr Metab Care 2005; 8:189

Hypocaloric total parenteral nutrition: Effectiveness in prevention of hyperglycemia and infectious complications—A randomized clinical trial

Karen C. McCowen, MB, MRCPI; Charles Friel, MD; Jeffrey Sternberg, MD; Samuel Chan, MD; R. Armour Forse, MD, PhD, FCCM; Peter A. Burke, MD; Bruce R. Bistrian, MD, PhD

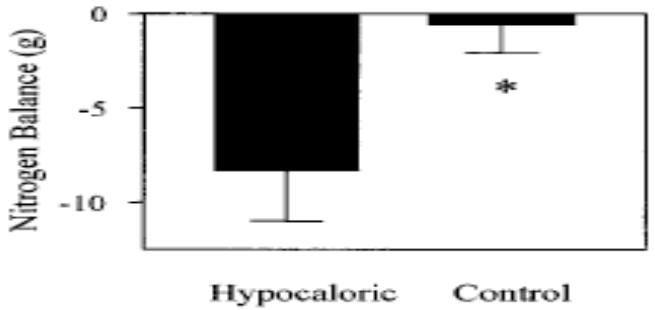
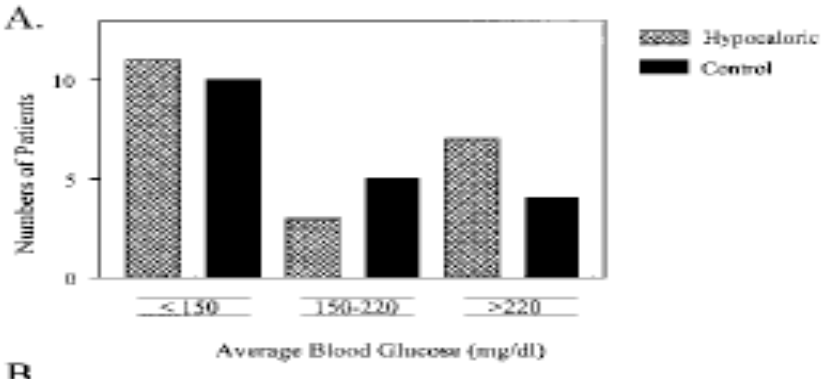


Figure 2. *Nitrogen balance* measured after 5 days of TPN, mean ± standard error. *$p < .03$ for the difference between the *hypocaloric* and *control* groups.

Control : 25 Kcal/ Kg + P 1.5 g / Kg
Hypocaloric : 1000 Kcal /J + P 70gr t/J

Glycemic control : NS



Hypocaloric feeding may improve insulin sensibility in protein and glucose metabolism

Mc Cowen KC et al, Crit Care Med 2000; 28:3606

APPLIED NUTRITIONAL INVESTIGATION

Hypocaloric Enteral Tube Feeding in Critically Ill Obese Patients

Roland N. Dickerson, PharmD, Kathryn J. Boschert, MA, RD, Kenneth A. Kudsk, MD, and Rex O. Brown, PharmD

30 Kcal/IBW/J 22 Kcal/IBW/J + 2 gr/IBW /J protein

PATIENT DEMOGRAPHICS DATA

	Eucaloric feeding*	Hypocaloric feeding†	*P*
Male/female	4/8	10/18	NS
Age (y)	43.3 ± 15.5	45.0 ± 16.6	NS
Weight (kg)	102 ± 36	118 ± 41	NS
Weight (%IBW)	168 ± 62	188 ± 65	NS
BMI (kg/m^2)	36.0 ± 12.4	41.3 ± 13.7	NS

These data may indicate promise for the clinical superiority of a hypocaloric high-protein regimen over a conventional regime

	Eucaloric feeding*	Hypocaloric feeding†	*P*
Duration of hospital stay (d)	37.2 ± 22.7	29.6 ± 14.0	NS
Duration of ICU stay (d)	28.5 ± 16.1	18.6 ± 9.9	<0.03
Duration of mechanical ventilation (d)	23.7 ± 16.6	15.9 ± 10.8	<0.09
Episodes of pneumonia	8	12	NS
IAA or empyema	0	1	NS
Sepsis	4	4	NS
Duration of antibiotic therapy (d)	27.4 ± 17.3	16.6 ± 11.7	<0.03
Survival	11/12	28/28	NS

Dickerson RN et al, Nutrition 2002, 18:241

Clinical Commentary

Clinical Approach to the Critically Ill, Morbidly Obese Patient

Ali A. El-Solh

Am J Respir Crit Care Med 2004; 169:557

Nutritional requirements

The primary goal of nutrition support should to achieve of net protein anabolism

- Calorie requirement : 30-60% of estimated caloric needs,
20-30 Kcal/Kg/J on the basis of ideal body weight

- Protein requirement : 2 gr/Kg/J on the basis of ideal body weight

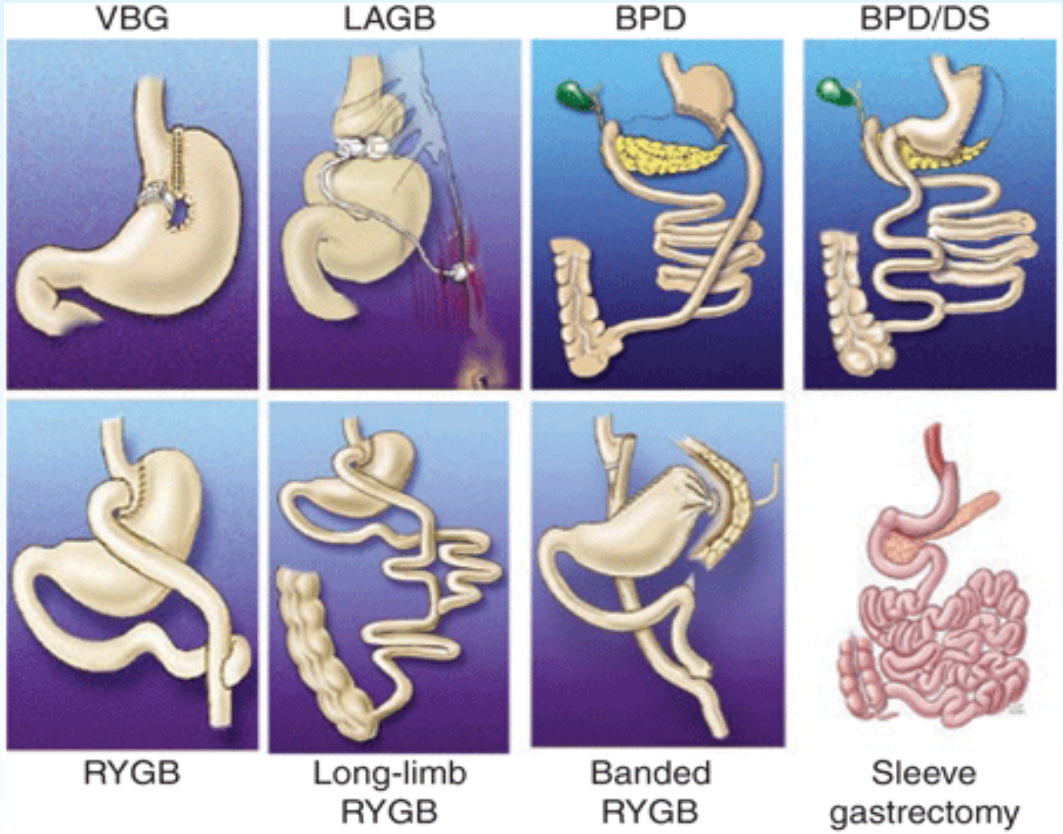
- Enteral nutrition should be prefered

- The nutritional regiment should be readjusted for additional protein

BARIATRIC SURGERY

The management of the obese patient after bariatric surgery present two major challenges :

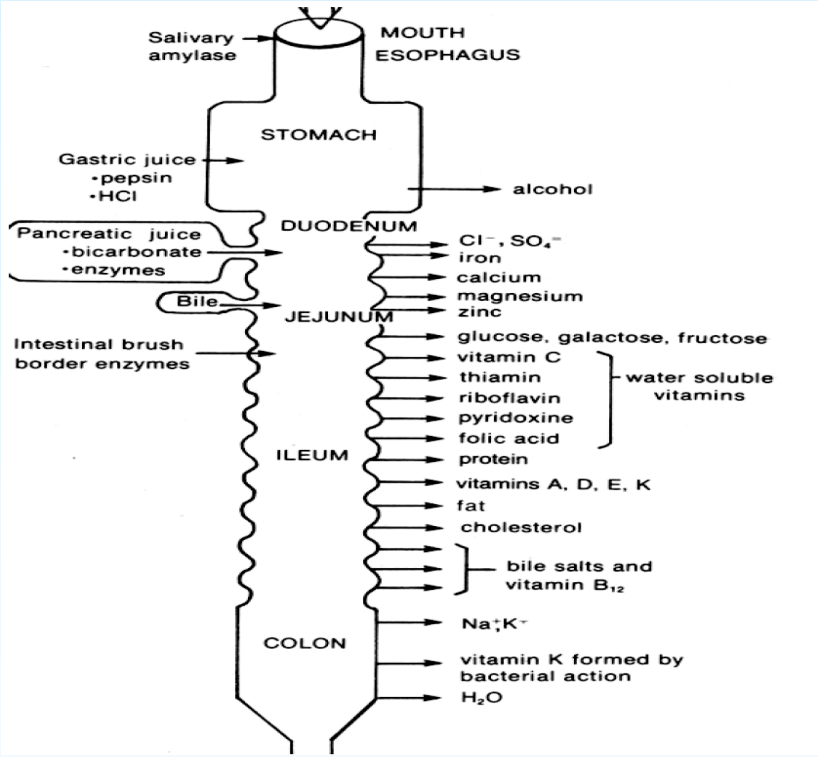
- The management of the obese critically ill patient
- **The specific nutritional support**



RD Bloomberg et al, Obesity Surgery 2009, 15:145-154

Nutritional deficiencies following bariatric surgery : What have we learned ?

RD Bloomberg et al, Obesity Surgery 2009, 15:145-154

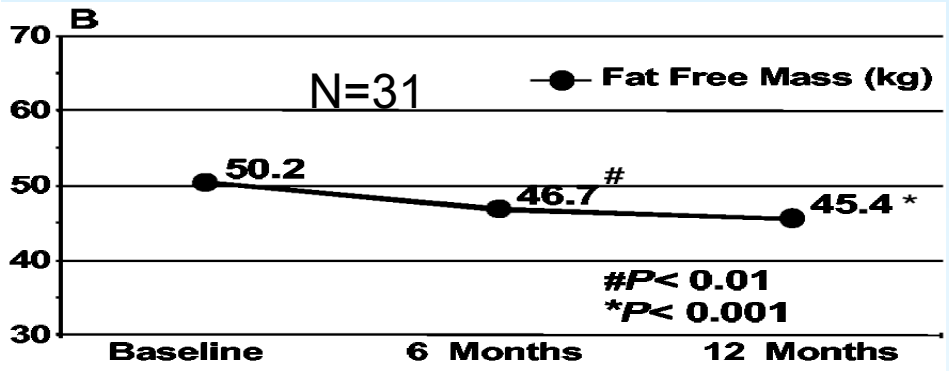


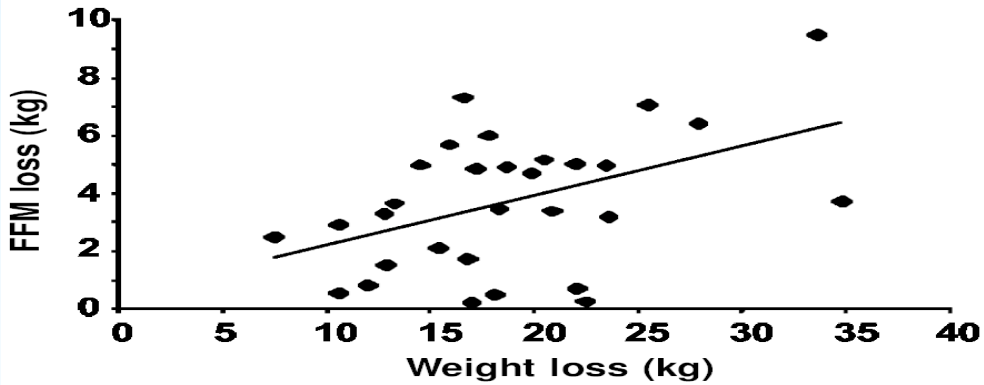
In comparison with purely restrictive procedures (VBG, LAGB, sleeve gastrectomy), more extensive perioperative nutritional evaluations are required for malabsorptive procedures

The extent of metabolic and nutritional evaluation completed after bariatric surgery should be guided by the type of surgical procedure performed

Effects of laparoscopic gastric banding on body composition, metabolic profile and nutritiona status of obese women

Glusti V et al, Obesity Surgery 2004 , 14:239-245





There was a 23.3% reduction of total body weight and 9.6% of Fat Free Mass (FFM)

Reduction of FFM was positively correlated with the rapidly of weight loss

Severe protein-calorie malnutrition after bariatric surgery procedures

Faintuch J et al, Obesity Surgery 2004, 14: 175-185

236 consecutive RYGBPs : 11 patients with severe malnutrition were identified (4.7%), 17.9 +/- 15.8 months after RYGBP

Table 4. Principal clinical and biochemical findings

Serum albumin	24.0 ± 8.2 g/L (10 – 40)
Hemoglobin	97.0 ± 23.0 g/L (69 – 141)*
Total cholesterol	135 ± 41 mg/dL (54 – 216)
Triglycerides	102 ± 26 mg/dL (69 – 144)
Edema (peripheral or generalized)	45.5% (5/11)
Extreme weakness, bedridden	36.4% (4/11)

This is attributed to the development of intolerance of protein-rich foods

Protein malnutrition remains the most severe macronutrient complication

Severe protein-calorie malnutrition after bariatric surgery procedures

Faintuch J et al, Obesity Surgery 2004, 14: 175-185

Table 7. Clinical outcome

Additional hospitalization	54.5% (6/11)*
Duration of hospitalization	0.7 ± 1.4 months (0 –5)
Reoperation 36.4% (4/11)	Substitution of gastric band: 3/4**
	Knee prosthesis: 1/4
Relative mortality	18.2% (2/11)
Absolute mortality (studied subjects)	1.0% (2/205)
Absolute mortality (total group)	0.8% (2/236)

*Hospitalization for other reasons was not considered
**One stenotic band was endoscopically dilated with good results

Morbidity and mortality rates were fairly high in this special group

Careful clinical and nutritional follow-up should be useful to prevent these uncommon but very dangerous complications

AACE/TOS/ASMBS Guidelines

AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS, THE OBESITY SOCIETY, AND AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY MEDICAL GUIDELINES FOR CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL, METABOLIC, AND NONSURGICAL SUPPORT OF THE BARIATRIC SURGERY PATIENT

Protein depletion and supplementation

- Routine metabolic and nutritional monitoring is recommended after all bariatric surgical procedures (**Grade A**).

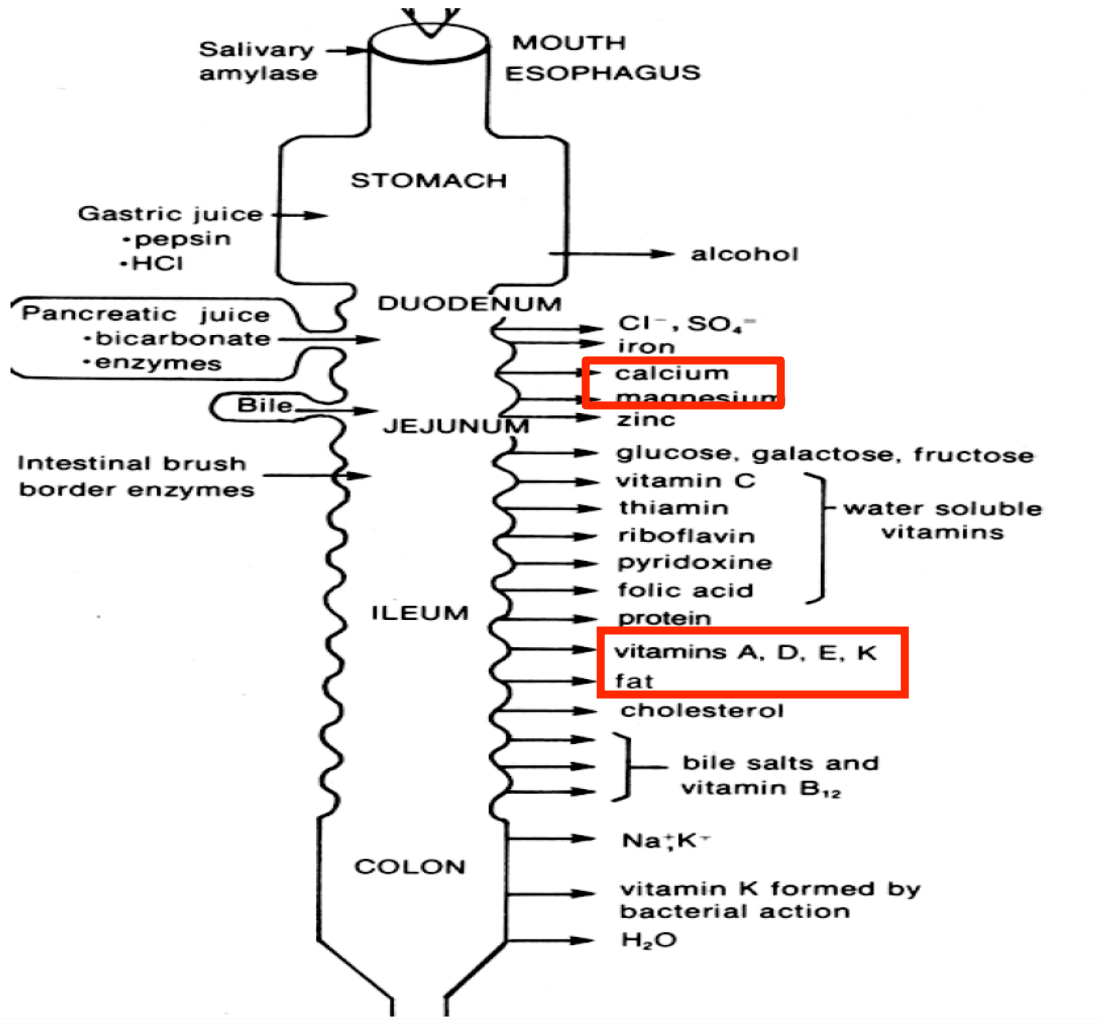
- Protein intake should be quantified periodically (**Grade D**).

- Ideally, protein intake with meals, including protein supplementation, should be in the range of 80–120 g/day for patients with a BPD or BPD/DS and 60 g/day for those with RYGB (**Grade D**).

- In patients with severe protein malnutrition not responsive to oral protein supplementation, PN should be considered (**Grade D**).

Obesity 2009, Supplement 1, S1-S70

Fat malabsorption : EFA and fat-soluble vitamins



Steatorrhea induced by malabsorptive surgical procedures can lead to deficiencies in fat-soluble vitamins

Energy and nitrogen absorption after biliopancreatic diversion.

Scopinaro N et al, Obesity Surgery 2000;10:436-41

15 operated subjects were maintained at an isoenergetic and isonitrogenic diet as similar as possible to their usual diet

Table 2. Energy, fat, nitrogen and calcium intestinal apparent absorption in 15 subjects with stable body w years after biliopancreatic diversion

		alimentary intake	fecal loss	apparent absorption	apparent absorp
energy (kcal/24h)	mean	3070	1329	1741	57
	range	1840-4060	210-2590	1012-2827	32-71
fat (g/24h)	mean	130	89	41	32
	range	88-185	22-160	13-94	12-59
nitrogen (g/24h)	mean	27	12	15	56
	range	15-48	2.5-36	6.7-20	25-82
calcium (mg/24h)	mean	1994	1443	551	28
	range	1037-3979	453-2565	-251-1414	-24-69

Weight loss after biliopancreatic diversion or duodenal switch is due to decreased calorie absorption secondary to fat malabsorption.

Fat malabsorption may induce essential fat-soluble vitamin deficiencies

Class III obesity and its relationship with the nutritional status of vitamin A in pre- and postoperative gastric bypass

Preira S et al, Obesity Surgery 2009;19:738-44.

Vitamin A nutritional status :
biochemical indicators (retinol and beta-carotene serum levels)

Table 2 Means of retinol in the three times analyzed according to interval classification

Times	Severe VAD <0.35 μmol/L		Moderate VAD 0.35–0.69 μmol/L		Light VAD 0.70–1.05 μmol/L		Adequate serum retinol ≥1.05 μmol/L		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
T1	2	1.7	4	3.5	10	8.8	98	86	114	100
T2	5	4.4	11	9.6	39	34.3	59	51.7	114	100
T3	0	0	12	10.5	32	28.1	70	61.4	114	100

T1, preoperative; T2, 30 postoperative days; T3, 180 postoperative days

+ supplementation of retinol acetate

Class III obesity showed high percentage of VAD even during supplementation
A fact attributed to the increase of oxidative stress on account of the chronic inflammatory condition presented by patients with obesity

Prevalence of Vitamin D Insufficiency and Deficiency in Morbidly Obese Patients : A Comparison with Non-Obese Controls

Goldner WS et al, Obesity Surgery 2008;18:145-50

Table 4 Summary of vitamin D deficiency, vitamin D insufficiency, and elevated iPTH

Variable count (column %)	Surgery patients (n=41)	Controls (n=41)	P value
25 OH Vitamin D			
<50 nmol/l	25 (61%)	5 (12%)	<0.0001
<75 nmol/l	37 (90%)	13 (32%)	<0.0001
PTH			
≥70 pg/ml	20 (49%)	1 (2%)	<0.0001

Vitamin D insufficiency and deficiency (25-OH-D <75 nmol/l) are extremely common in obese populations,

Vitamin D deficiency suggests a sequestration of vitamin D in adipose tissue despite potentially adequate amounts of sunlight exposure or oral vitamin D

AACE/TOS/ASMBS Guidelines

AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS, THE OBESITY SOCIETY, AND AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY MEDICAL GUIDELINES FOR CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL, METABOLIC, AND NONSURGICAL SUPPORT OF THE BARIATRIC SURGERY PATIENT

Fat and fat-soluble vitamin deficiency and supplementation

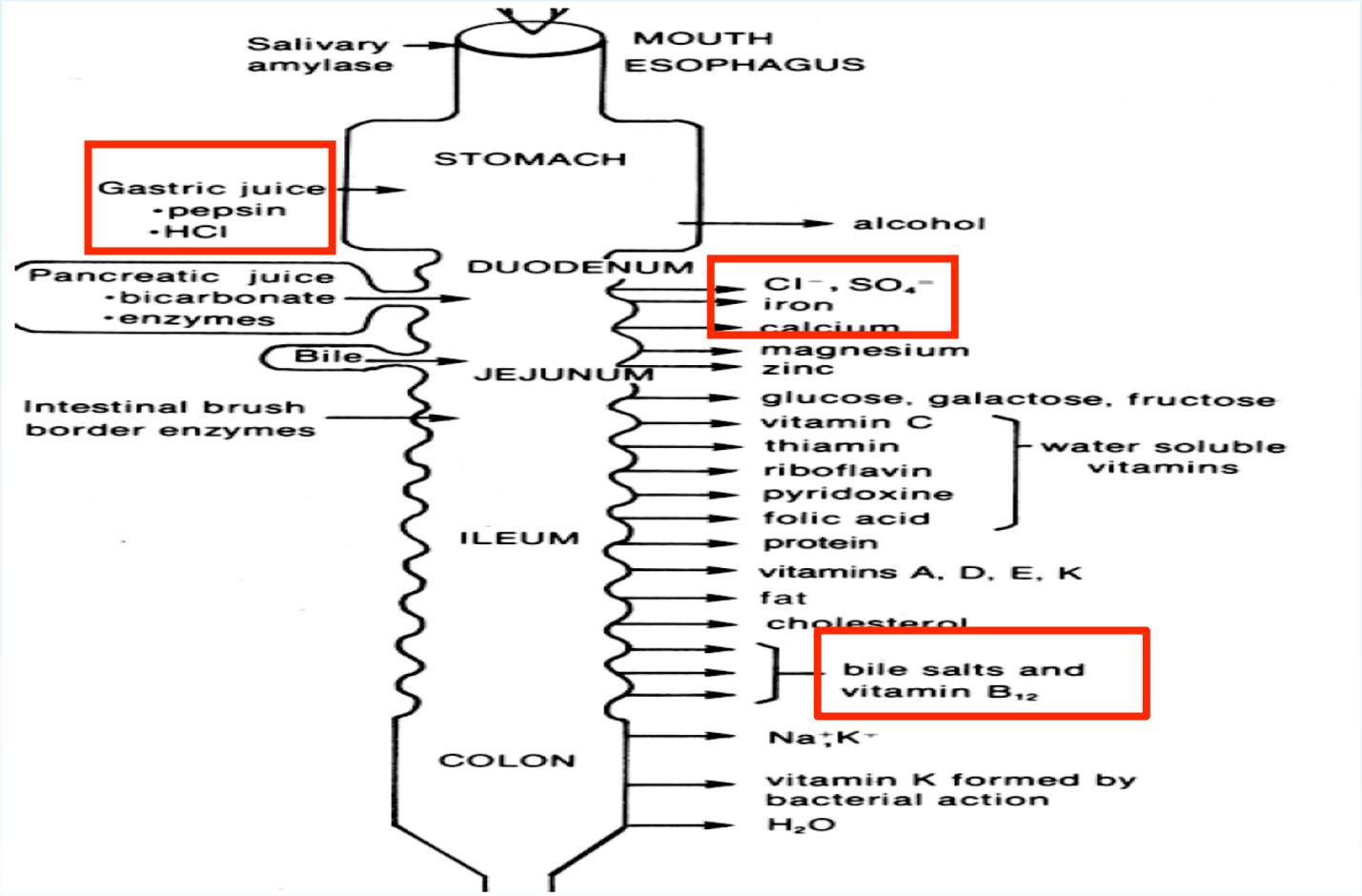
• The routine use of serum fatty acid (FA) chromatography to detect essential FA (EFA) deficiency should not be performed because this deficiency has not been reported **(Grade D)**

• Routine supplementation of vitamin A is usually not necessary after purely restrictive procedures **(Grade C; BEL 3)**.

• In contrast, routine screening for vitamin A deficiency is recommended, and supplementation is often needed after malabsorptive bariatric procedures **(Grade C; BEL 3)**.

• Supplementation may be provided with use of vitamin A alone or in combination with the other fat-soluble vitamins (D, E, and K) **(Grade C; BEL 3)**.

Anaemia in bariatric surgical patients

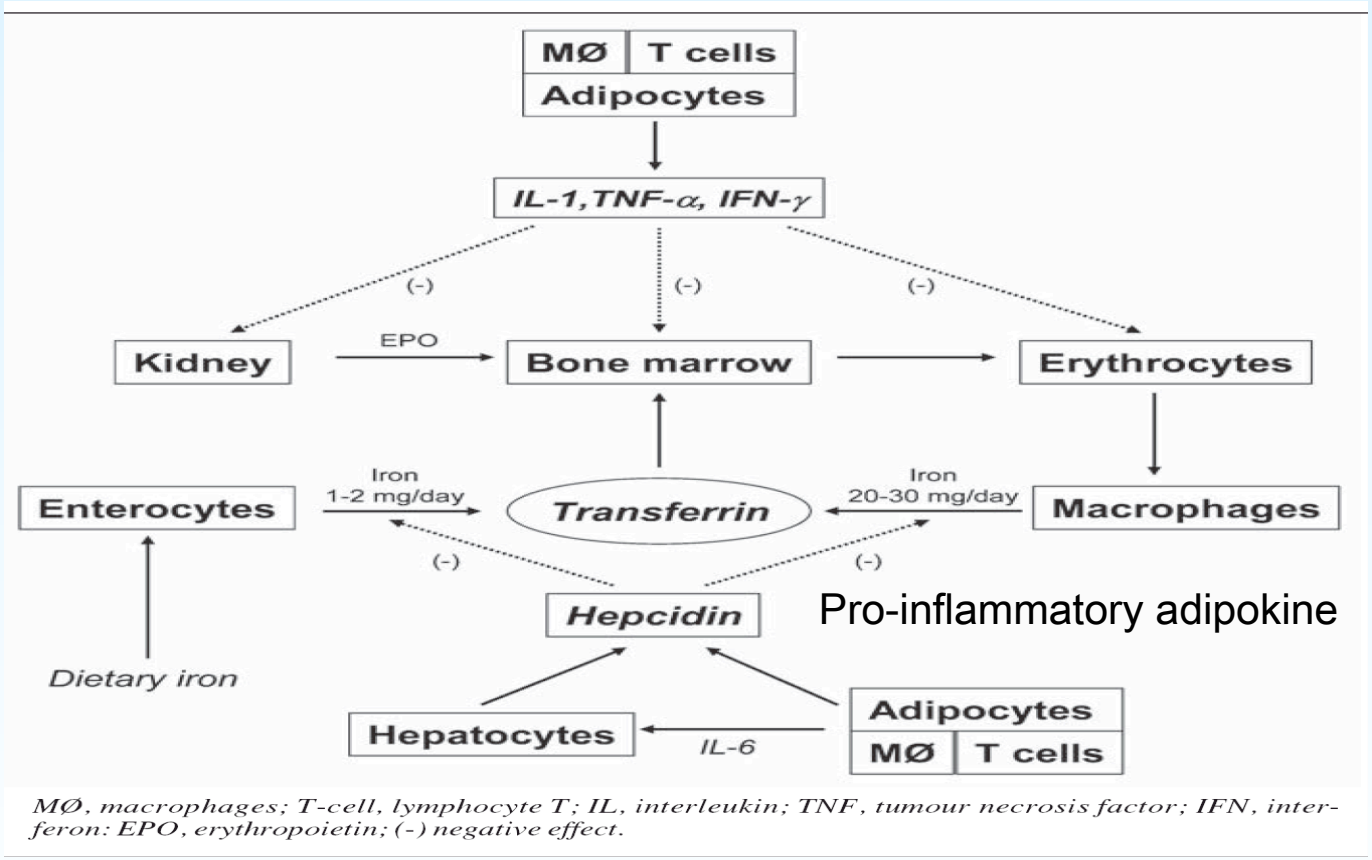


Decreased liberation and absorption of heme are caused from bypass of the acid environment in the lower portion of the stomach and the absorptive surfaces of the duodenum and upper jejunum

Iron deficiency and anaemia in bariatric surgical patients : causes, diagnosis and management

Munoz M et al, Nutr Hosp 2006, 24:640-654

Effects of chronic inflammation on iron metabolism in obese patients



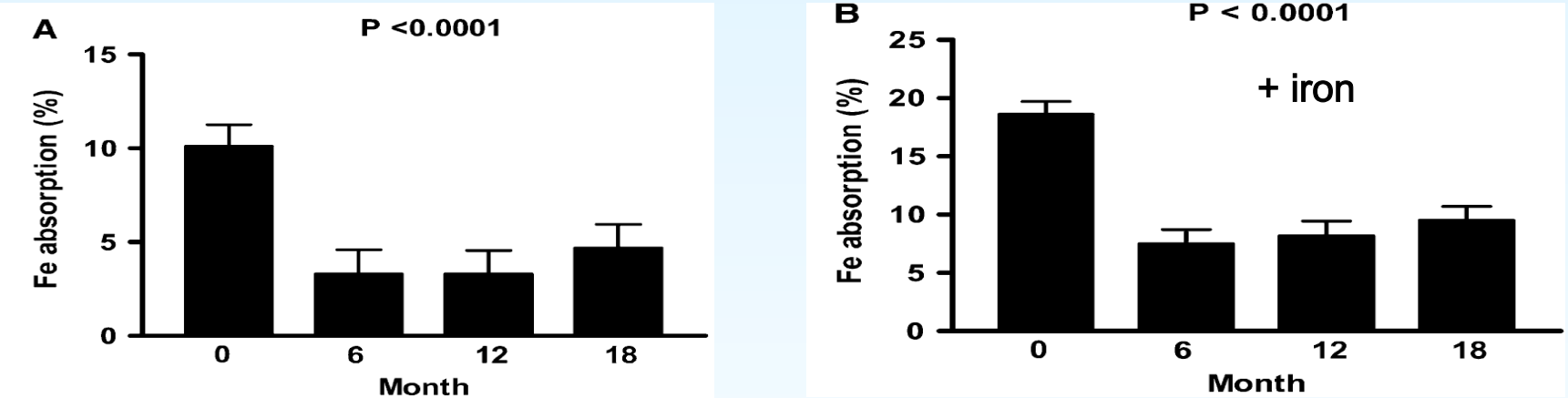
MØ, macrophages; T-cell, lymphocyte T; IL, interleukin; TNF, tumour necrosis factor; IFN, interferon: EPO, erythropoietin; (-) negative effect.

Bariatric surgery leads to a greater decrease in pro-inflammatory adipokines and an improvement in iron homeostasis should be expected

Iron absorption and iron status are reduced after Roux-en-Y gastric bypass

Ruz M et al , Am J Clin Nutr 90: 527-532, 2009

Geometric mean (±1 SE) iron absorption from a standard test meal (A) and from a standard dose of ferrous ascorbate (B)



Iron-absorption capacity appears to be a main determinant of reduced iron stores

Improved highly available iron formulations or, possibly, periodic parenteral infusions are likely necessary to prevent iron-status impairment after gastric bypass

Iron deficiency and anaemia in bariatric surgical patients : causes, diagnosis and management

Munoz M et al, Nutr Hosp 2006, 24:640-654

Table II
Prevalence of preoperative iron deficiency (ID) and anaemia in bariatric surgical patients

Author, year (ref.)	*n*	*Type of surgery*	*ID definition*	*ID prevalence, n (%)*	*Anaemia definition*	*Anaemia prevalence, n (%*
Skroubis et al., 2002[38]	174	RYGBP (79) BPD (95)	sFe < 50 µg/dL	51 (29.3)	Hb < 13.5 g/dL ♂ Hb < 11.9 g/dL ♀	30 (17.2)
Vázquez Prado et al., 2008[13]	110	DS	sFe < 60 µg/dL	18 (16.3)	Hb < 11.8 g/dL	6 (5.5)
Muñoz et al., 2008[28]	67	AGB (39) RYGBP, BPD (28)	sFe < 60 µg/dL TSat < 20%	18 (26.9)	Hb < 13 g/dL ♂ Hb < 12 g/dL ♀	9 (13.4)
Coupaye et al., 2009[39]	70	AGB (21) RYGBP (49)	sFe < 60 µg/dL TSat < 20%	32 (45.7)	Hb < 11.5 g/dL	4 (5.7)
Flancbaum et al., 2009[40]	379	RYGBP	sFe < 60 µg/dL	167 (44.1)	Hb < 13 g/dL ♂ Hb < 12 g/dL ♀	83 (21.9)
Ernst et al., 2009[41]	232	RYGBP	Ferritin < 9 ng/mL	26 (6.9)	Hb < 12 g/dL	26 (6.9)
Toh et al., 2009[42]	220	AGB (43) RYGBP (113) SG (63)	sFe < 50 µg/dL	35 (17.5)	Hb < 13 g/dL ♂ Hb < 11.9 g/dL ♀	14 (6.4)
Overall				347/1252 (**27.7**)		172/1252 (**13.7**

RYGBP, Roux-en-Y gastric bypass; BPD, biliopancreatic diversion; DE, duodenal switch; SV, sleeve gastrectomy; sFe, serum iron; sTfR, serum transferr receptor; Hb, haemoglobin. * Excluded for calculation of mean ID prevalence.

Bariatric surgery may induce or aggravated iron deficiency

The risk for iron deficiency increases with time, with some series reporting more than half of the subjects after RYGB, BPD, or BPD/DS

Nutritional deficiencies following bariatric surgery : What have we learned ?

RD Bloomberg et al, Obesity Surgery 2009, 15:145-154

Table 4. Studies of vitamin B_{12} deficiency

Study	Study Type	N=	Operation	Vitamin B_{12} Deficiency Rate and Length of Follow-up
Scroubis, 2002[5]	Retrospective	79	RYGBP	33% at 4 years
Brolin, 2002[3]	Prospective	298	RYGBP	33-37% at 3 years
			Distal RYGBP	8% at 3 years
Marcuard, 1989[18]	Retrospective	429	RYGBP	36% at 22 mo.
Halverson, 1986[12]	Retrospective	74	RYGBP	33% at 1 year
Brolin, 1991[13]	Retrospective	140	RYGBP	37% at 2 years
Scroubis, 2002[5]	Retrospective	95	BPD	22% at 4 years
Cooper, 1999[16]	Retrospective	26	VBG	0% at 1 year

Vitamin B12 deficiency :

malabsorption and inadequate of intrinsic factor secretion

AACE/TOS/ASMBS Guidelines

AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS, THE OBESITY SOCIETY, AND AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY MEDICAL GUIDELINES FOR CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL, METABOLIC, AND NONSURGICAL SUPPORT OF THE BARIATRIC SURGERY PATIENT

Iron deficiency and supplementation

• Iron status should be monitored in all bariatric surgery **(Grade D)**.

•. Orally administered (320 mg twice a day) may be needed to prevent iron deficiency in patients who have undergone a malabsorptive bariatric surgical procedure, **(Grade A; BEL 1)**.

• Vitamin C supplementation should be considered because vitamin C can increase iron absorption and ferritin levels **(Grade C; BEL 3)**.

• Intravenous iron infusion may be needed if oral iron supplementation is ineffective at correcting the iron deficiency **(Grade D)**.

AACE/TOS/ASMBS Guidelines

AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS, THE OBESITY SOCIETY, AND AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY MEDICAL GUIDELINES FOR CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL, METABOLIC, AND NONSURGICAL SUPPORT OF THE BARIATRIC SURGERY PATIENT

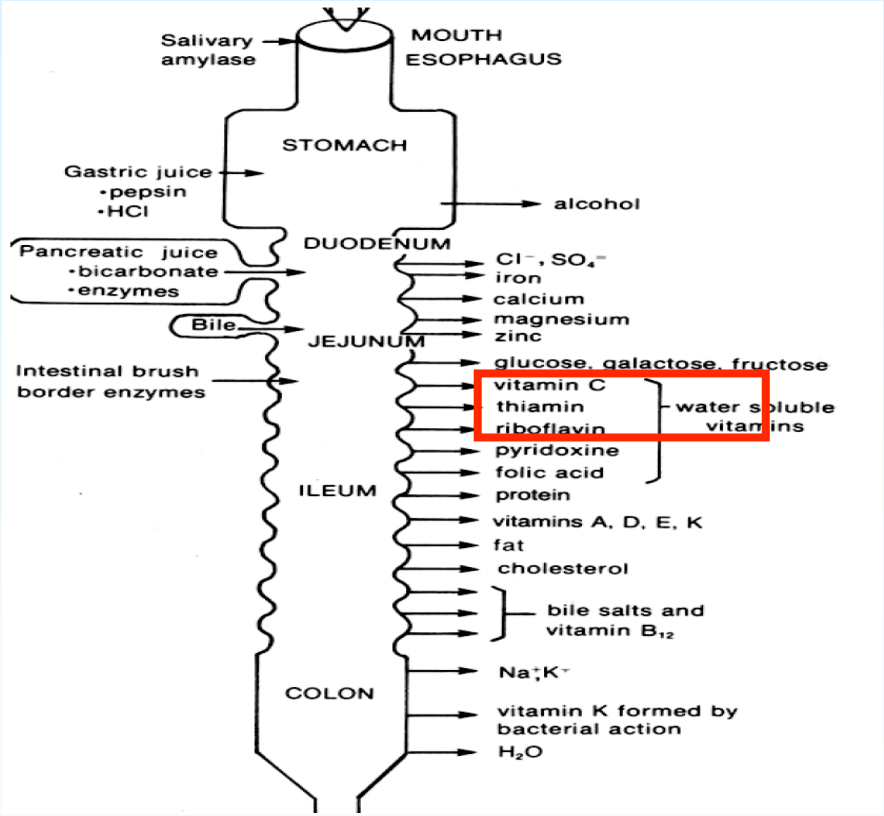
Vitamin B_{12} deficiency and supplementation

• Evaluation for vitamin B_{12} deficiency is recommended in all bariatric surgery patients **(Grade B; BEL 2 (nonrandomized))**.

•Oral supplementation with crystalline vitamin B_{12} at a dosage of 350 g daily may be used to maintain vitamin B_{12} levels **(Grade B; BEL 2 (nonrandomized))**.

•Parenteral supplementation with either 1,000 g of vitamin B_{12} monthly or 1,000–3,000 g every 6–12 months is necessary if vitamin B_{12} sufficiency cannot be maintained by means of oral supplementation **(Grade C; BEL 3)**.

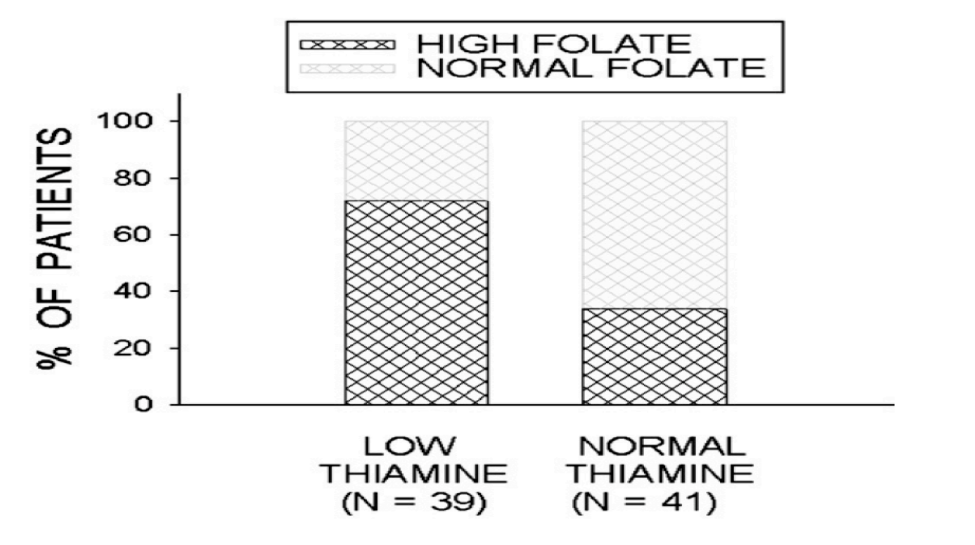
Neurologic complications in bariatric surgical patients



Thiamine deficiency can occur as a result of bypass of the jejunum, where thiamine is primarily absorbed, or as a result of impaired nutritional intake from the result of prolonged nausea and vomiting

Small intestinal bacterial overgrowth and thiamine deficiency after Roux-en-Y gastric bypass surgery in obese patients

Lakhani SV et al, Nutr Res. 2008;28:293-8.



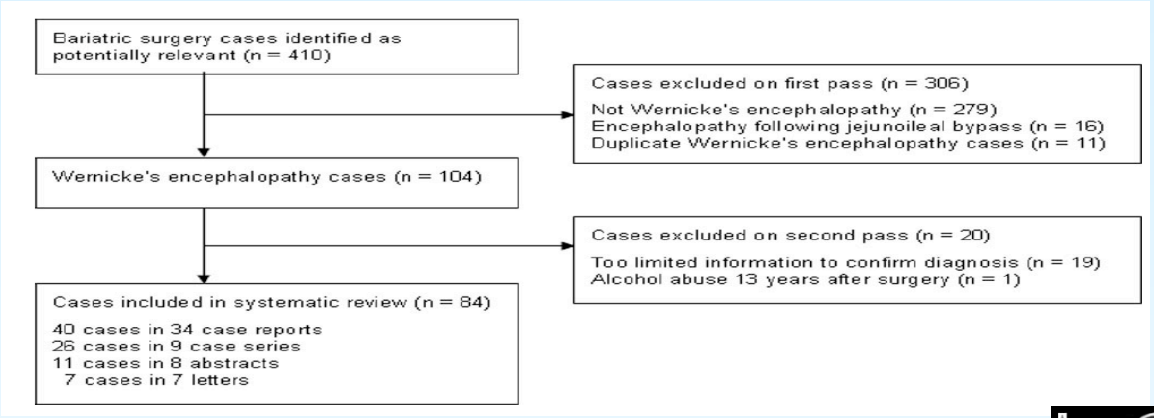
elevated serum folate levels = an indirect marker of small bowel bacterial overgrowth

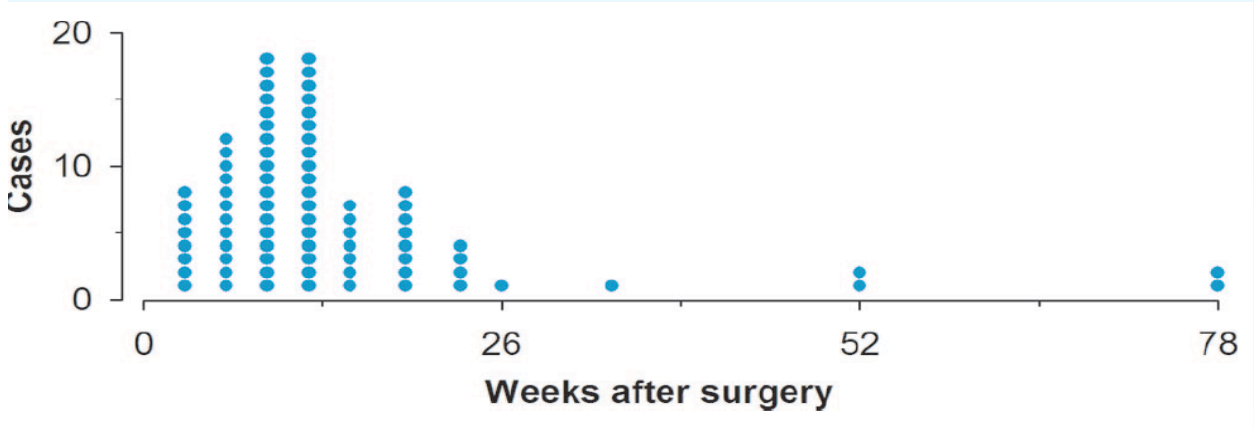
antibiotic therapies designed to treat small intestinal bacterial overgrowth reverse thiamine deficiency

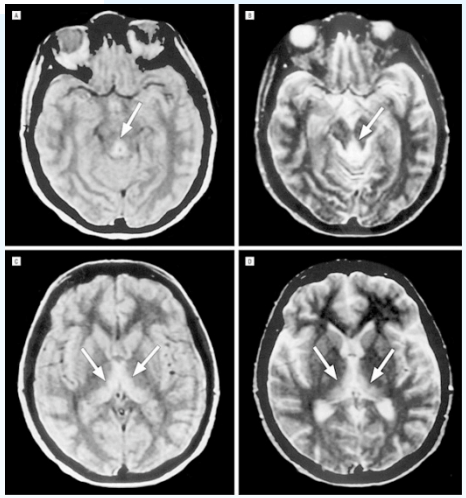
These results support the hypothesis that small intestinal bacterial overgrowth results from altered gut ecology and induces thiamine deficiency after gastric bypass surgery in obese patients

Wernicke encephalopathy after bariatric surgery: a systematic review.

Aasheim ET, Ann Surg. 2008;248:714-20





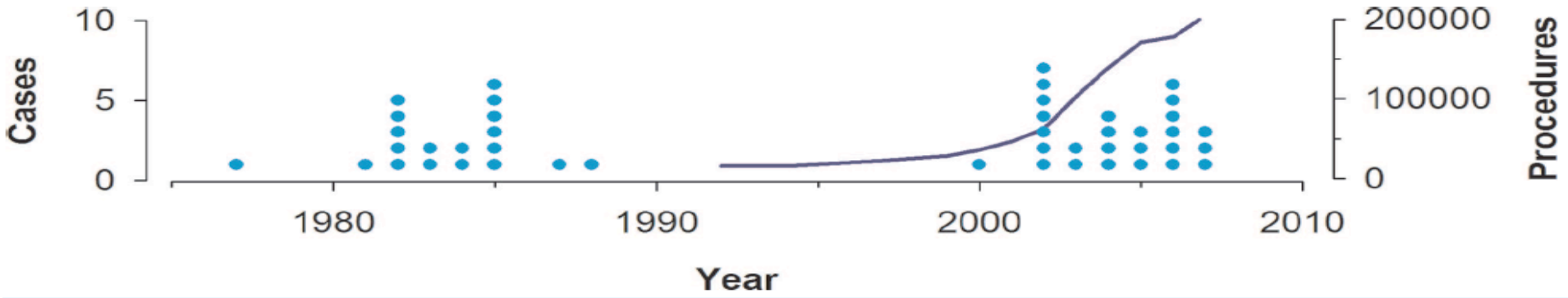


Wernicke's encephalopathy is a medical emergency that may occur after any weight-loss operation.

All reported cases presented after a few weeks of vomiting and within 6 months of surgery

Wernicke encephalopathy after bariatric surgery: a systematic review.

Aasheim ET, Ann Surg. 2008;248:714-20



- In patients presenting with neurologic symptoms suggestive of thiamine deficiency, aggressive parenteral supplementation with thiamine (100 mg/day) should be administered for 7–14 days **(Grade C; BEL 3)**.
- Subsequent oral thiamine supplementation (100 mg/day) should be continued until neurologic symptoms resolve **(Grade C; BEL 3)**.

A controlled study of peripheral neuropathy after bariatric surgery.

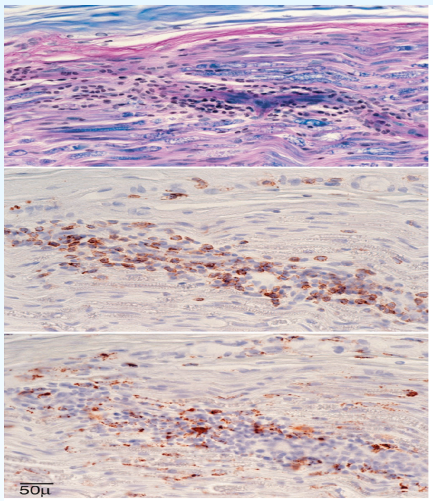
Thaisetthawatkul P et al, Neurology 2004 26;63:1462-70.

Patients developed PN more often after BS than after obese patients undergoing cholecystectomy (p < 0.001).

Table 3 *Subgroup analysis of factors associated with peripheral neuropathy after bariatric surgery according to type of peripheral neuropathy*

	Polyneuropathy				Mononeuropathy				Radiculoplexus neuropathy				
	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range	*p**
Continuous													
Postsurgery serum albumin,† g/dL	27	3.3	0.7	1.5–4.6	23	3.8	0.5	3.0–4.6	3	3.8	0.4	3.4–4.1	0.02
Postsurgery serum transferrin,† μg/dL	12	230	123	73–451	17	332	45	221–396	2	224	62	180–268	0.009
Dichotomous	n	Yes	%		n	Yes	%		n	Yes	%		
Diabetes	27	1	4		39	7	18		5	3	60		0.009
Surgery at Mayo Clinic	27	2	7		39	22	56		5	3	60		<0.0001
Prolonged nausea and vomiting	22	13	59		30	5	17		3	1	33		0.003
Attendance at nutritional clinic	27	1	4		37	13	35		4	2	50		0.002

* Analysis of variance for continuous data and Fisher exact test for dichotomous data.
† Comparing polyneuropathy with mononeuropathy using the Bonferroni test; $p < 0.05$.



Peripheral neuropathy (PN) occurs more frequently after bariatric surgery (BS) than after another abdominal surgery.
Inflammation and altered immunity may play a role in the pathogenesis, but further study is needed.

AACE/TOS/ASMBS Guidelines

AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS, THE OBESITY SOCIETY, AND AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY MEDICAL GUIDELINES FOR CLINICAL PRACTICE FOR THE PERIOPERATIVE NUTRITIONAL, METABOLIC, AND NONSURGICAL SUPPORT OF THE BARIATRIC SURGERY PATIENT

Thiamin deficiency and supplementation

• All bariatric surgery patients should be provided with an oral multivitamin supplement that contains thiamine **(Grade D)**.

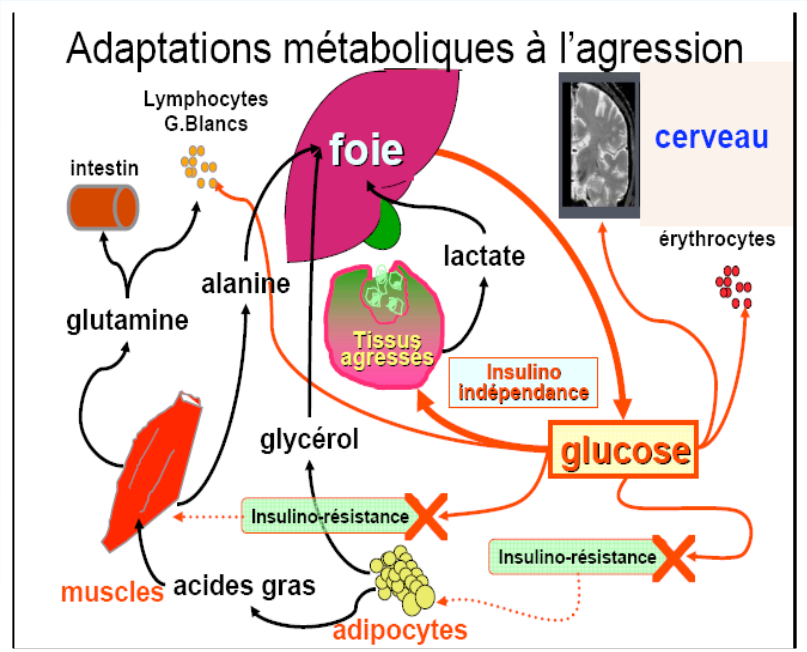
• Routine screening for thiamine deficiency is not recommended in bariatric surgery patients who are already routinely receiving a multivitamin supplement that contains thiamine **(Grade C; BEL 3)**.

•Patients with protracted vomiting should be screened for thiamine deficiency **(Grade C; BEL 3)**.

•In patients with persistent vomiting after *any* bariatric procedure, aggressive supplementation with thiamine is imperative; intravenously administered glucose should be provided judiciously **(Grade C; BEL 3)**.

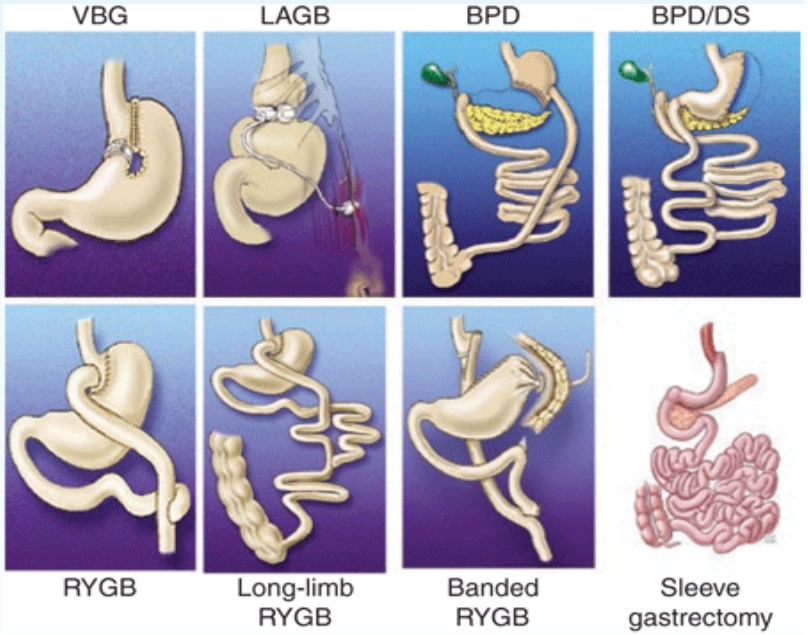
BARIATRIC SURGERY

The management of the obese critically ill patient



The specific nutritional support

+



CLINICAL PRACTICE FOR THE NUTRITIONAL SUPPORT OF BARIATRIC SURGERY

Early Postoperative Care (<5 Days)

- The primary goal of nutrition support should to minimize the loss of lean body Protein intake should average 60–120 g daily **(Grade D)**

- Minimal nutritional supplementation includes one to two adult multivitamin–mineral supplements containing iron, calcium, and a vitamin B-complex preparation **(Grade B; BEL 2 (nonrandomized))**

- Parenteral nutrition (PN) should be considered in high-risk patients, such as critically ill patients unable to tolerate sufficient enteral nutrition **(Grade D)**.

- Gastric bypass-specific problem : dumping syndrome should be managed **(Grade D)**

Medical follow up after bariatric surgery : nutritional and drug issues general recommendations for the prevention and treatment of nutritional deficiencies

Ziegler O et al, Diabetes Metab 2009;35:544-57.

Table 2
Routine nutrient supplementation for prevention and treatment of nutritional deficiencies

Deficiency or metabolic complication	Prevention	Treatment
Dehydration, hypokalaemia	Vomiting prevention, ©uid intake guidance	Parenteral nutrition and hydration
Iron	Routine supplementation: iron (40–60 mg/day) plus vitamin C after BPG and for menstruating women	Iron tablets (180 mg/day for 3 months), iron + vitamin C, intravenous iron infusion (Venofer©)
Vitamin B12	Oral supplementation (GBP): 1000 µg/week (1 ampoule) orally or ©250–350 µg/day orally or 1000 µg/month intramuscularly or 3000 µg every 6 months intramuscularly	1000 or 2000 µg/day (1–2 ampoules) orally or 1000 µg/week intramuscularly
Calcium, vitamin D	Calcium citrate: 1200–2000 mg/day with vitamin D (400–800 U/day) [ergocalciferol (vitamin D2) or cholecalciferol (vitamin D3)] or 100,000 U/3–6 months orally (vitamin D3, Uvedose®)	Severe vitamin D deficiency: 50,000–150,000 U/day; if necessary: calcitriol [1,25(OH)2D] orally (bisphosphonates to be considered if T score ©2.5)
Vitamin B9 (folate)	Routine multivitamin preparation during weight-loss phase, 400 µg/day for all women of childbearing age	1–5 mg/day orally
Protein depletion	Recommended intake: 60–120 g/day (dairy, fish, eggs, meat) or oral protein supplementation	Oral protein supplementation, artificial nutrition if necessary
Vitamin B1 (thiamine)	Routine multivitamin preparation during weight-loss phase; if vomiting, aggressive thiamine supplementation → parenteral supplementation with thiamine 100 mg/day for 7–14 days	Gayet–Wernicke encephalopathy treatment [42]: 500 mg 3 times per day for 2–3 days (infusion of thiamine hydrochloride dissolved in 100 mL of normal saline for 30 min) → 250 mg/day intravenously for 5 days → 30 mg twice a day orally
Zinc, selenium	Routine multivitamin preparation during weight-loss phase	Specific supplementation
Other vitamins (A, E, K)	Routine multivitamin preparation during weight-loss phase	Specific supplementation

All data are adapted from references 3–6, 8, 11, 12

CONCLUSION

- Bariatric surgery has a major impact on obesity-related co-morbidity and decreased mortality rates

- Providing nutritional support after bariatric surgery represents a unique challenge to the medical team

- Any deficiencies can easily be avoided by an adequate strategy of nutritional support

- Recommendations for appropriate supplements and monitoring compliance are imperative

Clinical guidelines have been developed and recently published