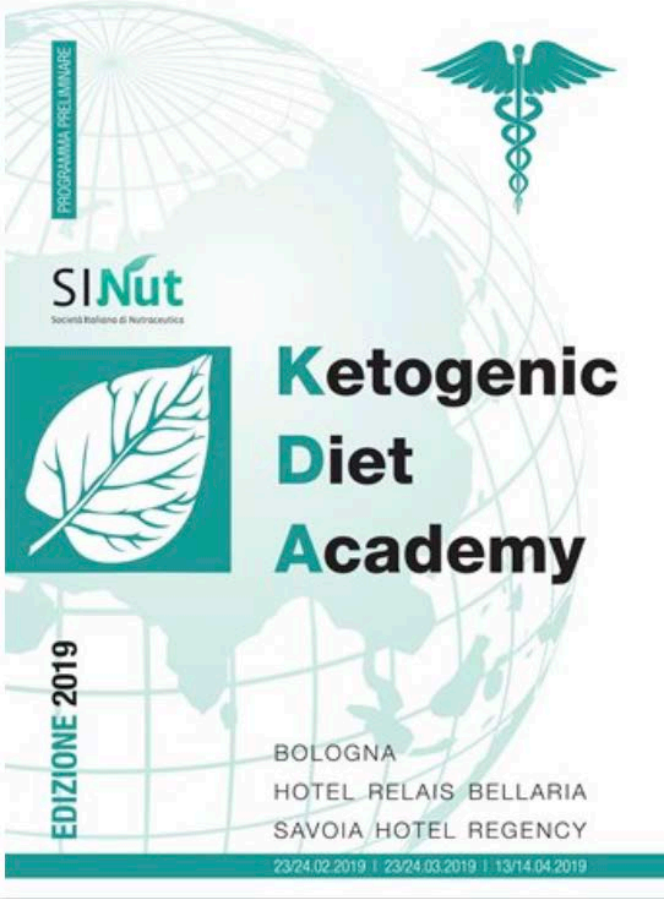

Ketogenic Diet Academy

Bologna, 13-14 aprile 2019

Il ruolo della dieta chetogenica in chirurgia bariatrica

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Centro per i Disturbi Alimentari e l'Obesità

Inquadramento clinico del paziente destinato alla chirurgia bariatrica

Le attuali indicazioni alla chirurgia bariatrica fanno riferimento alla gravità dell'obesità e alla potenziale reversibilità del quadro clinico.

BMI >40 kg/m^2, in assenza di ogni altra comorbilità;
BMI >35 kg/m^2, in presenza di comorbilità fra quelle classicamente considerate come associate all'obesità, tra cui il diabete mellito di tipo 2 resistente al trattamento medico.

Ma il BMI è un indice appropriato?

Il BMI ha rivelato limiti importanti non essendo in grado di evidenziare:

- la distribuzione e la ripartizione dell'accumulo lipidico sotto forma di grasso viscerale, fattore chiave nel determinare la sindrome metabolica;
- la diversa distribuzione del grasso in relazione all'età, al sesso e alla etnia.
- Il grado di comorbidità: l'obeso sano ha un alto BMI ma nessuna comorbidità; l'obeso di I grado (BMI<35 kg/m^2) può avere numerose comorbidità

Per tali motivi il BMI è considerato un importante parametro di riferimento…
…. ma molto impreciso

World J Gastroenterol. 2016 Jan 14;22(2):681-703. doi: 10.3748/wjg.v22.i2.681.

New obesity classification criteria as a tool for bariatric surgery indication.

De Lorenzo A[1], Soldati L[1], Sarlo F[1], Calvani M[1], Di Lorenzo N[1], Di Renzo L[1].

Author information

Abstract

Obesity plays relevant pathophysiological role in the development of health problems, arising as result of complex interaction of genetic, nutritional, and metabolic factors. Due to the role of adipose tissue in lipid and glucose metabolism, and low grade inflammation, it is necessary to classify obesity on the basis of body fat composition and distribution, rather than the simply increase of body weight, and the Body Mass Index. The new term of adiposopathy ("sick fat") clearly defines the pathogenic role of adipose tissue. Four phenotypes of obese individuals have been described: (1) normal weight obese (NWO); (2) metabolically obese normal weight; (3) metabolically healthy obese; and (4) metabolically unhealthy obese or "at risk" obese. Moreover, sarcopenic obesity has been related to all the phenotypes. The category of normal weight lean, represented by metabolically healthy normal weight has been classified to distinguish from NWO. It is crucial to recommend a bariatric surgery taking into account adiposopathy and sick fat that occurs with the expansion of fat mass, changing the inflammatory and metabolic profile of the patient. Body fat percentage and genetic polymorphism have to be evaluated to personalize the best bariatric surgery intervention.

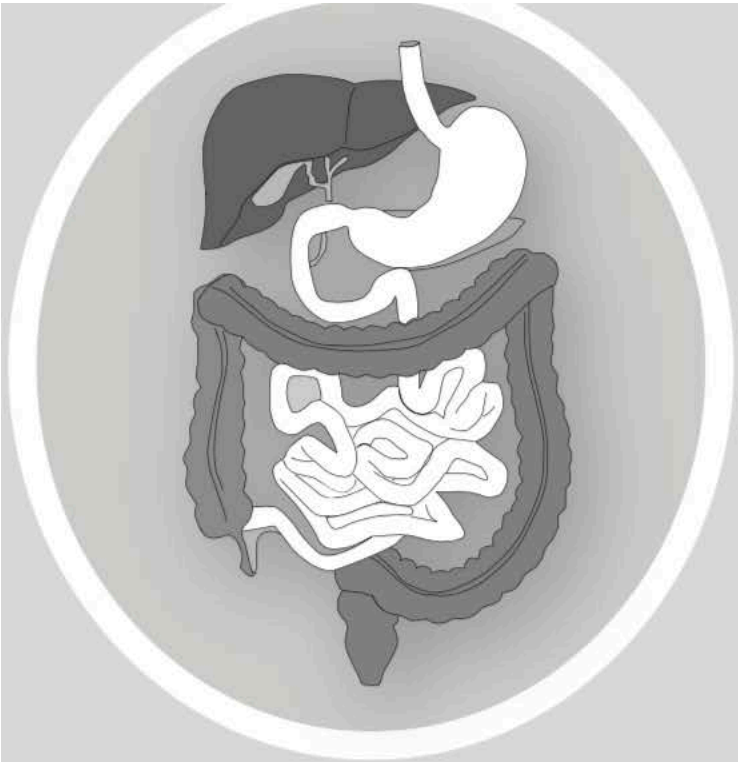
Quale tipo di chirurgia bariatrica?

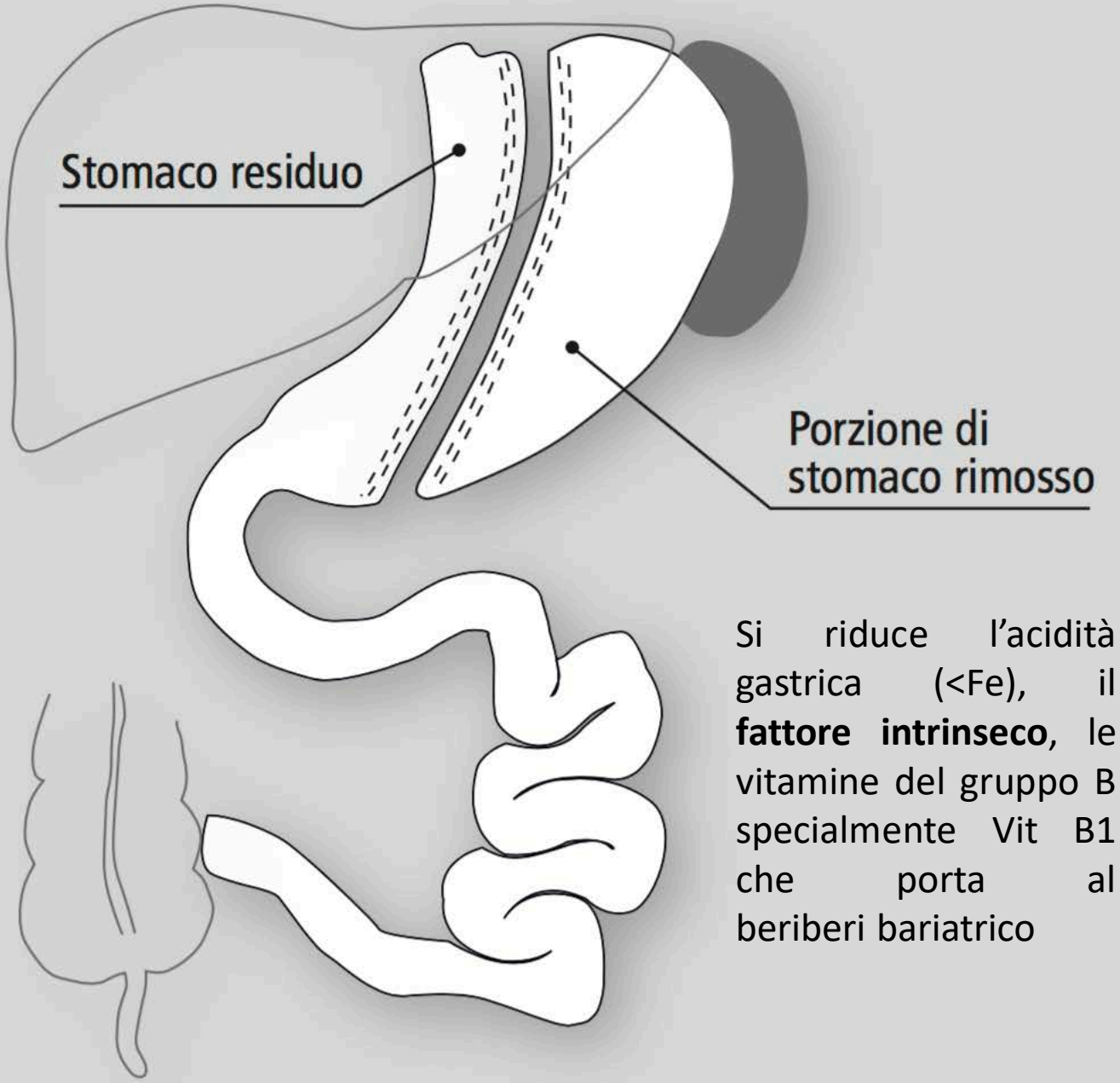
Secondo S.I.C.OB.

Ogni scelta chirurgica deve essere legata: alle caratteristiche del paziente
alle sue comorbidità
all'esperienza del chirurgo
al livello organizzativo della struttura
alla valutazione del bilancio rischio/ beneficio nel breve e nel lungo termine

Attenzione quindi alla possibilità di una reale adesione del paziente ai criteri di follow-up stabiliti per gli interventi, specie quelli malassorbitivi, che comportano un maggiore rischio di effetti collaterali anche a lungo termine legati a deficit nutrizionali

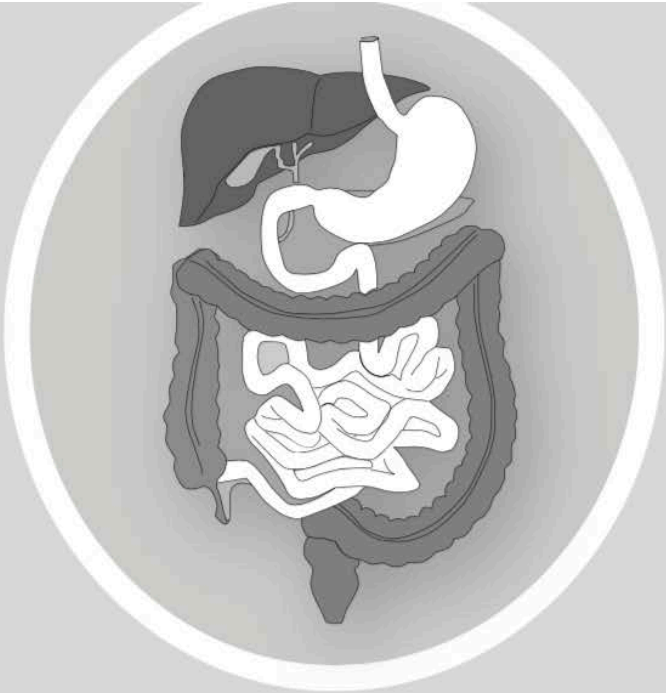
Sleeve gastrectomy

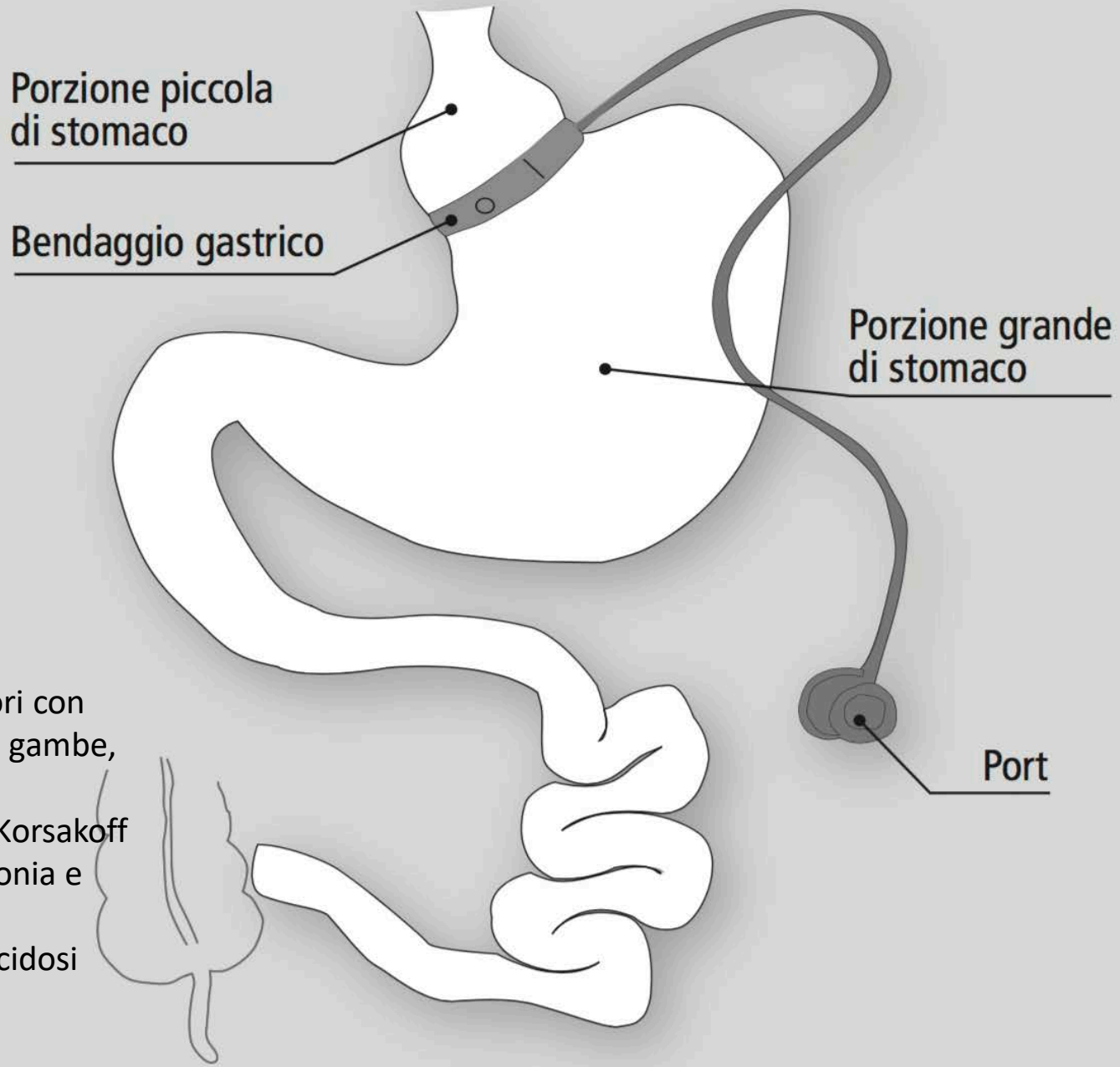




Perdita di peso per:
-Restrizione dell'ingestione del cibo dovuta alla riduzione del volume dello stomaco
-Diminuzione della fame per riduzione **dell'azione dell'ormone GHrelina**, i cui recettori sono asportati con la parte di stomaco rimosso.

Si riduce l'acidità gastrica (<Fe), il **fattore intrinseco**, le vitamine del gruppo B specialmente Vit B1 che porta al beriberi bariatrico



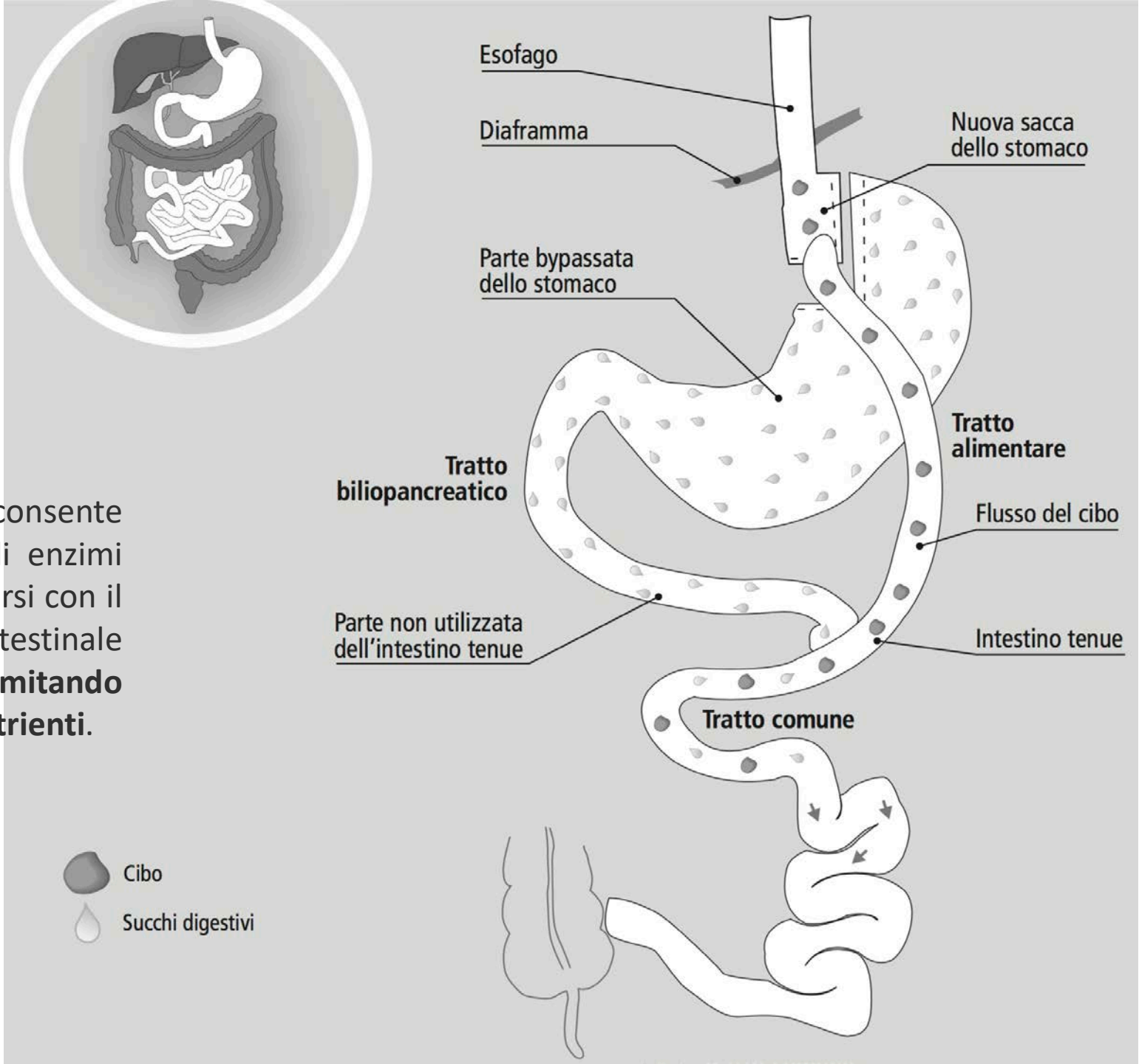


Deficit di vitamine del gruppo B

Beriberi bariatrico: carenza di tiamina

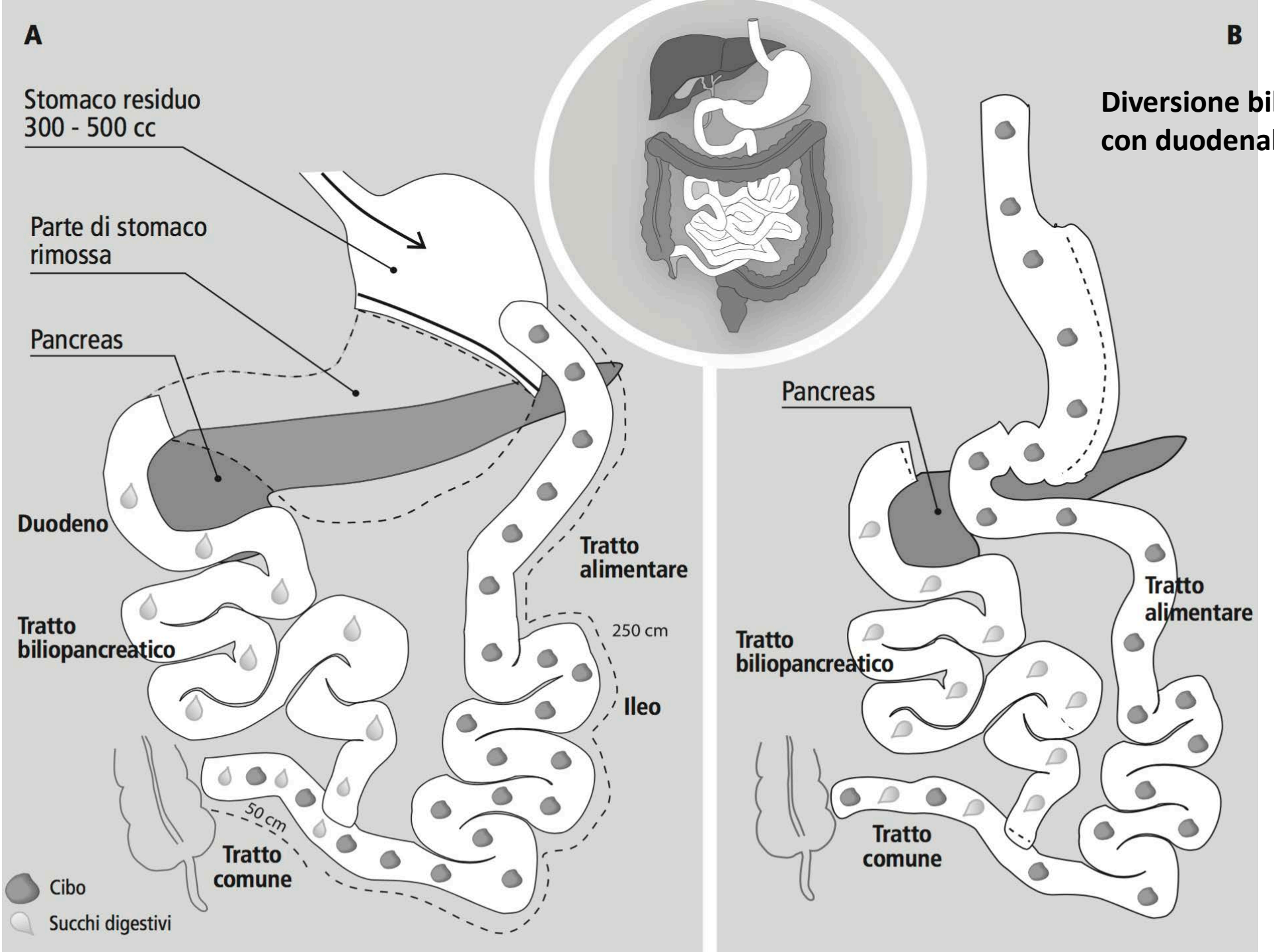
- neuropatie periferiche a carico de gli arti inferiori con parestesie, bruciore ai piedi crampi e dolori alle gambe, atrofie muscolari e paralisi.
- polineuropatia diffusa e sindrome di Wernicke-Korsakoff con nistagmo, atassia, confusione mentale, disfonia e alterazione della memoria.
- disturbi cardiovascolari: aritmia, tachicardia e acidosi lattica sino all'insufficienza cardiaca
- gastrointestinali

By-pass gastrico



Questa disposizione consente agli acidi biliari e agli enzimi pancreatici di mescolarsi con il contenuto gastrointestinale più in basso, **limitando l'assorbimento dei nutrienti**.

Ferro, ferritina, Ca, Mg, folati, Vit. B_1, B_{12} e D_3, >PTH, deficit proteico



Diversione biliopancreatica con duodenal switch

Ferro, ferritina, Ca, Mg, zinco, rame, folati, proteine, Vit.B_1, B_{12}, A, E, K e D

ESCLUSIONE DI PARTE DI STOMACO, DUODENO E PARTE SUPERIORE DEL DIGIUNO DAL PASSAGGIO GASTROINTESTINALE PROVOCANO CARENZA DI:

FERRO: malassorbimento del ferro per esclusione del duodeno e ridotta acidità gastrica. Ridotto apporto dietetico (es mangiano meno carne rossa). Succede nella DBP, nel RYGB e nel duodenal switch.

ACIDO FOLICO: l'assorbimento **dell'acido folico** avviene prevalentemente nel digiuno prossimale ed è influenzato dal pH.

VIT GRUPPO B: specialmente negli interventi restrittivi **PER RIDOTTA QUANTITÀ E QUALITÀ DI FOOD INTAKE**.
- B_1 o TIAMINA: assorbita nella parte prossimale dell'intestino tenue. Bereberi bariatrico per: prolungata dieta liquida, ridotto contenuto dietetico, inadeguato intake per vomito persistente, anoressia (caratteristica dei primi mesi successivi alla BPD)
- B_{12}: riduzione di acido gastrico e di fattore intrinseco. Il **fattore intrinseco** è essenziale per l'**assorbimento** della **vitamina B_{12}**, che avviene nell'ileo. A livello gastrico, la pepsina e la forte acidità facilitano il rilascio della cobalamina legata alle proteine alimentari.

Anemia x basso Fe, ma anche per bassi folato e B_{12}. Se carenza marziale: glossite, fatica, debolezza, alterate difese immunitarie. Donne in età fertile hanno maggiore rischio di anemia. Acido ascorbico (vitamina C) e acido citrico favoriscono l'**assorbimento** del **ferro** mantenendolo nella forma Fe^{2+}.

VIT. LIPOSOLUBILI: **A, E, D, K** assorbite a livello intestinale, carenti nella DBP/DS

Table 5. Major vitamins and minerals deficiencies after bariatric surgery: clinical manifestations and estimated frequency according to the bariatric procedure

Deficiency	Key clinical manifestations	Procedure-related frequency
Iron	microcytic anaemia	AGB + SG ++ RYGB, BPD, BPD/DS +++
Vitamin B12	megaloblastic anaemia neurologic abnormalities	SG, RYGB, BPD, BPD/DS ++
Vitamin D (and calcium)	bone demineralization increased risk of fractures	RYGB ++ BPD, BPD/DS +++
Vitamin A	ocular xerosis night blindness symptoms	BPD, BPD/DS +++
Vitamin E	anaemia ophthalmoplegia peripheral neuropathy	BPD, BPD/DS +++
Vitamin K	easy bleeding	BPD, BPD/DS +

AGB = Adjustable gastric banding; SG = sleeve gastrectomy; RYGB = gastric bypass; BPD = biliopancreatic diversion; BPD/DS = biliopancreatic diversion with duodenal switch.

Postoperative Metabolic and Nutritional Complications of Bariatric Surgery

Timothy R. Koch, MD[a,b,*], Frederick C. Finelli, MD, JD[c,d]

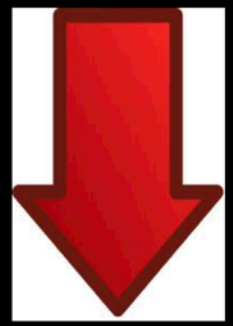
Gastroenterol Clin N Am 39 (2010) 109–124

Laboratory testing for nutritional disorders after bariatric surgery

Disorder	Laboratory Blood Tests
Anemia	Ferritin; vitamin B12; folate & then consider vitamin A; vitamin E; zinc; copper
Neurologic disorders	Vitamin B12; whole blood thiamine & then consider vitamin E; copper; plasma niacin
Visual disorders	Vitamin A; vitamin E; whole blood thiamine
Skin disorders	Vitamin A; zinc; plasma niacin
Edema	Selenium; whole blood thiamine; plasma niacin

CARENZA PROTEICA DOPO CHIRURGIA BARIATRICA

- INTOLLERANZA AGLI ALIMENTI
  - RICCHI IN PROTEINE
    - +
  - MALASSORBIMENTO



L'**apporto proteico raccomandato** è di **60-120 g/die** per ottenere il quale si può eventualmente ricorrere a supplementi proteici

È buona regola stabilire l'apporto proteico (**1-1,50 g/kg peso ideale al giorno**) e aggiungere carboidrati e grassi fino al raggiungimento dell'introito energetico desiderato

STATO DI MALNUTRIZIONE PROTEICA

- (ALBUMINEMIA <3,5 g/dL)

Malnutrizione proteica: può essere causata da vomito o anoressia protratti, o insufficiente apporto proteico con la dieta (avversione per i cibi carnei), o dal grado di malassorbimento, o dalle abitudini alimentari. Incoraggiare l'ingestione di cibi ricchi di proteine (> 60 g/di, almeno 90 g/di) suddivisi in diversi pasti. Apporto di proteine pari a 1,5 g/kg di peso ideale al giorno; in casi particolari 2,1 g/kg di peso ideale/die (se aumenta il fabbisogno....come in gravidanza....). Dare integratori proteici liquidi (30 gr/di) può facilitare un adeguato introito proteico nel primo periodo postoperatorio.

Perdita di massa magra: fare attività fisica per prevenire la sarcopenia. Moderata attività aerobica (almeno 150 min/settimana con un obiettivo di 300 min/settimana) e un allenamento di forza 2-3 volte/settimana

Le LINEE GUIDA SICOB suggeriscono screening PREOPERATORIO per

- Ferro, vitamina B_{12}, acido folico e vit. D

ANCHE PRIMA DELLA DIETA CHETOGENICA VA EFFETTUATO UNO SCREENING

- Elettroliti azotemia creatinina acido urico ECG

Assetto epatico, glicidico e lipidico Es urine

NUMEROSI PUNTI DI CONTATTO
TRA TRATTAMENTO CHIRURGICO E TRATTAMENTO VLCKD

SI PARTE DA UN PAZIENTE COMUNE

Tabella 3. Comorbilità dell'obesità

Malattie metaboliche	Neoplasie	
• Diabete mellito di tipo 2 • Dislipidemia • Iperuricemia e gotta • Infertilità femminile • Sindrome dell'ovaio policistico	• Mammella • Colon-retto • Endometrio • Esofago • Rene • Ovaio	• Pancreas • Prostata • Fegato • Colecisti • Leucemie
Malattie cardiovascolari	**Altre**	
• Ipertensione arteriosa • Cardiopatia coronarica • Cardiopatia congestizia • Embolia polmonare • Ictus	• Asma • Apnee ostruttive notturne • Steatoepatite non alcolica • Colecistopatia • Osteoartrite • Pseudotumor cerebri	• Disordini psicologici • Reflusso gastroesofageo • Incontinenza urinaria • Intertrigine • Fascite plantare

Sono considerati ostativi all'intervento:

- abuso di sostanze stupefacenti in atto
- schizofrenia non stabilizzata, disturbo bipolare non stabilizzato, pregressi tentativi di suicidio, oligofrenia grave (IQ inferiore a 50), deficit cognitivi acquisiti nelle diverse forme
- abuso di alcolici
- insufficiente comprensione della procedura chirurgica
- scarsa aderenza ai programmi terapeutici

Controindicazioni **relative** suscettibili di rivalutazione dopo terapia adeguata

- i disturbi d'ansia e/o di depressione in atto, quelli dell'umore endogeni o reattivi alla condizione di obesità in atto,
- i disturbi della condotta alimentare (Binge Eating Disorder, Night Eating Syndrome, Bulimia Nervosa, Disturbi Alimentari con perdita di controllo)
- i disturbi di personalità

Controindicazioni alla dieta chetogenica

ADI 2014;6:38-43
FONDAZIONE ADI: POSITION PAPER

- Disturbi psichici e comportamentali
- Gravidanza e allattamento
- Abuso di alcol e altre sostanze
- Insufficienza epatica o renale
- Diabete mellito tipo 1
- Porfìria
- Insufficienza cardiaca (angina instabile, infarto miocardico acuto recente, blocco atrioventricolare, aritmie maggiori)
- Età giovanile (infanzia e adolescenza sono escluse da questo tipo di trattamento)

Follow-up post-bariatrico ……

Posto che non vi siano complicanze di tipo post-chirurgico, ad ogni visita valutare:

- l’andamento clinico delle comorbilità e della perdita di peso
- il comportamento alimentare e l’aderenza alla dieta suggerita
- la frequenza e l’intensità dell’attività fisica
- lo stato elettrolitico-nutrizionale

… analogo a follow-up per trattamento dietoterapico ketogenico……..

Follow-up: controlli postchirurgici generali

- Esami ematochimici: emocromo, **elettroliti**, glicemia, azotemia, creatinina,acido urico, albumina, funzionalità epatica ad intervalli regolari. HbA_{1c} e lipidi se alterati pre-intervento

- Peso e pressione arteriosa

- Verificare eventuali **cambiamenti in risposta ai farmaci antipertensivi, all'insulina, agli ipoglicemizzanti orali o ai farmaci ipolipemizzanti** durante il periodo di rapida perdita di peso post-intervento.

- Ridurre al minimo il rischio di **ipoglicemia** nei pazienti con diabete (dovuta ad una maggiore sensibilità all' insulina dopo chirurgia bariatrica) ovvero regolare la dose di insulina e diminuire/eliminare gli ipoglicemizzanti orali (in particolare le sulfoniluree). Dumping syndrome con **ipoglicemie reattiva** (1-3 ore dopo il pasto)

Rimodulazione del trattamento farmacologico

Paziente che a 60 anni BMI 38.6 kg/m^2, scompenso diabetico. Da tempo è abbastanza attento alla dieta ma si dedica poco all'attività fisica.

Nell'aprile 2016 inizia VLCKD

Data	Peso (Kg)	Circonf. Addome (cm)	BMI (kg/m^2)	PA (mmHg)	Glicemia a digiuno (mg/dl)
inizio	119	126	38,6	142/68	260
1 settim.	117	123	38,23	130/62	124
2 settim.	115	121	37,58	129/66	127
4 settim.	113	119	36,92	121/66	110
11 settim.	109	118	35.62	117/60	132
16 settim.	102	114	33,3	120/56	128

VLCKD E TERAPIA FARMACOLOGICA

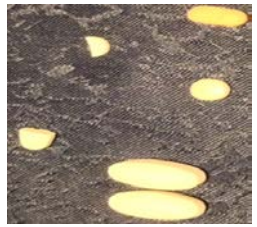
Data	Peso	Terapia farmacologica
inizio	119	Olmesartan 40; Furosemide 25 mg; Atenololo 50; Glimepiride 4; Metformina 1000 mg x 2; Insulina lispro 10+25+25^{U}; Insulina glargine 35^{U}; ASA 100; Simvastatina 40; Omeprazolo 20.
1 settim	117	Olmesartan 40 mg; Furosemide 25; Atenololo 50; Metforal 1000 x 2; Lantus 16 ^{U}; ASA 100; Simvastatina 40 mg; Omeprazolo 20.
11 settim	109	Olmesartan 20 mg; Furosemide 12,5 mg; Metforal 500 mg X 2; ASA 100; Simvastatina 20 mg; Omeprazolo 20 mg a dì alterni.

Rimodulazione del trattamento farmacologico

Attenzione alle ipoglicemie!!!

TERAPIA FARMACOLOGICA PRIMA DELLA VLCKD

TERAPIA FARMACOLOGICA DOPO 16 SETTIMANE VLCKD



Chirurgia bariatrica e Diabete Mellito

Eurasian J Med. 2019 Feb;51(1):85-89. doi: 10.5152/eurasianjmed.2018.18298.

Bariatric/Metabolic Surgery in Type 1 and Type 2 Diabetes Mellitus.

Akcay MN[1], Karadeniz E[1], Ahiskalioglu A[2].

Author information

Abstract

The prevalence of type 2 diabetes mellitus (T2DM) and obesity shows a gradual increase nowadays. Despite the introduction of multiagent treatment modalities, many patients with T2DM still do not have good results. Bariatric/metabolic surgery performed in obese patients to attain weight loss has been shown to improve T2DM. Type 1 diabetes mellitus is another type of diabetes that also shows an increase in prevalence. The aim of the present study was to evaluate the literature about the bariatric/metabolic surgical procedures performed in patients with type 1 and type 2 diabetes.

Arch Endocrinol Metab. 2018 Apr 5;62(2):172-178. doi: 10.20945/2359-3997000000021. Print 2018 Mar-Apr.

The effect of metabolic surgery on type 1 diabetes: meta-analysis.

Hussain A[1].

CONCLUSION: Current metabolic/bariatric surgery is improving T1DM in obese and morbidly obese patients. This is not exclusively related to excess weight loss (EWL) as previously thought. Therefore, there is a role for other factors, which are potential players to reproduce the same effect in nonobese T1DM patients.

Obes Surg. 2019 Apr 10. doi: 10.1007/s11695-019-03861-0. [Epub ahead of print]

The Effect of Bariatric Surgery on Asian Patients with Type 2 Diabetes Mellitus and Body Mass Index < 30 kg/m^2: a Systematic Review and Meta-analysis.

Ji G[1], Li R[1], Li W[1], Sun X[1], Yu Z[1], Li R[1], Zhu L[2], Zhu S[3].

Author information

Abstract

BACKGROUND: The effect of bariatric surgery on the glycemic control of patients with obesity and type 2 diabetes mellitus is obvious. However, the effect in patients with body mass index (BMI) < 30 kg/m^2 especially Asian population has not been widely reported and acknowledged.

METHODS: We performed a literature search in Medline, Embase, and the Cochrane Library from January 2000 to March 2018. All the studies involving the effect of bariatric surgery on patients with type 2 diabetes and BMI < 30 kg/m^2 from Asian countries or regions were included in this meta-analysis.

RESULTS: Twelve studies including 697 patients were examined in this meta-analysis. Clinical indexes in 6, 12, and 24 months follow-up were analyzed, respectively. BMI and waist circumference reduced by 2.88 kg/m^2 and 12.92 cm, respectively, at 12 months postoperatively. There were reductions in fasting plasma glucose, 2-h postprandial plasma glucose, and glycated hemoglobin A1c at all the three time points after surgery, 3.13 mmol/L, 5.46 mmol/L, and 2.13% at 6 months; 3.22 mmol/L, 6.46 mmol/L, and 2.38% at 12 months; 1.99 mmol/L, 5.84 mmol/L, and 1.58% at 2 years. Insulin only reduced by 1.70 μU/ml at 12 months. C-peptide reduced by 0.70 ng/ml and 0.40 ng/ml at 6 months and 2 years. Bariatric surgery led to reduction in total cholesterol, triglyceride, and low-density lipoprotein cholesterol, while augment in high-density lipoprotein cholesterol at 6 and 12 months. Glucagon-like peptide 1 increased by 2.48 pmol/L and 4.00 pmol/L at half a year 1 year.

CONCLUSIONS: Asian patients with type 2 diabetes and BMI < 30 kg/m^2 could achieve significant improvement in weight, glycemic control, lipid profiles, and β-cell function in short and medium terms after bariatric surgery, but long-term follow-up is necessary to evaluate the effectiveness.

PLoS One. 2011 Apr 20;6(4):e18604. doi: 10.1371/journal.pone.0018604.

Reversal of diabetic nephropathy by a ketogenic diet.

DIABETE E VLCKD

Poplawski MM[1], Mastaitis JW, Isoda F, Grosjean F, Zheng F, Mobbs CV.

Author information

Abstract

Intensive insulin therapy and protein restriction delay the development of nephropathy in a variety of conditions, but few interventions are known to reverse nephropathy. Having recently observed that the ketone 3-beta-hydroxybutyric acid (3-OHB) reduces molecular responses to glucose, we hypothesized that a ketogenic diet, which produces prolonged elevation of 3-OHB, may reverse pathological processes caused by diabetes. To address this hypothesis, we assessed if prolonged maintenance on a ketogenic diet would reverse nephropathy produced by diabetes. In mouse models for both Type 1 (Akita) and Type 2 (db/db) diabetes, diabetic nephropathy (as indicated by albuminuria) was allowed to develop, then half the mice were switched to a ketogenic diet. After 8 weeks on the diet, mice were sacrificed to assess gene expression and histology. Diabetic nephropathy, as indicated by albumin/creatinine ratios as well as expression of stress-induced genes, was completely reversed by 2 months maintenance on a ketogenic diet. However, histological evidence of nephropathy was only partly reversed. These studies demonstrate that diabetic nephropathy can be reversed by a relatively simple dietary intervention. Whether reduced glucose metabolism mediates the protective effects of the ketogenic diet remains to be determined.

Complicanze (1)
Disordini elettrolitici-Disidratazione

sia dopo interventi restrittivi: **vomito, nausea, sazietà precoce, inappetenza**

riduzione dell'introito calorico per ridotta dimensione dello stomaco

Assumere liquidi costantemente e lontano dai pasti!!!!

Fare pasti piccoli, frequenti, ricchi in fibre e proteine (masticare bene), senza zuccheri semplici, distanziati almeno 30 minuti dall'assunzione di bevande

sia dopo interventi malassorbitivi: **diarrea e steatorrea**

urgenza fecale, aumento dei borborigmi, gonfiore addominale, flatulenza legati al malassorbimento di grassi e carboidrati e alla proliferazione batterica nei tratti intestinali esclusi dal transito alimentare - dieta con forte riduzione di cibi grassi o ricchi di amido + uso regolare o intermittente di antibiotici intestinali (rifamixina 200-400 mg/bid per 7 giorni al mese).

Attenzione alla disidratazione!!!

Linee Guida SICOB 2018

ANCHE IN CORSO DI VLCKD POSSONO VERIFICARSI DISTURBI ELETTROLITICI

Endocrine. 2017 Sep 15. doi: 10.1007/s12020-017-1405-3. [Epub ahead of print]

Acid-base safety during the course of a very low-calorie-ketogenic diet.

Gomez-Arbelaez D[1], Crujeiras AB[1,2], Castro AI[1,2], Goday A[2,3], Mas-Lorenzo A[2,3], Bellon A[4], Tejera C[5], Bellido D[5], Galban C[6], Sajoux I[7], Lopez-Jaramillo P[8], Casanueva FF[9,10].

Author information

Abstract

BACKGROUND AND AIMS: Very low-calorie ketogenic (VLCK) diets have been consistently shown to be an effective obesity treatment, but the current evidence for its acid-base safety is limited. The aim of the current work was to evaluate the acid-base status of obese patients during the course of a VLCK diet.

METHOD: Twenty obese participants undertook a VLCK diet for 4 months. Anthropometric and biochemical parameters, and venous blood gases were obtained on four subsequent visits: visit C-1 (baseline); visit C-2, (1-2 months); maximum ketosis; visit C-3 (2-3 months), ketosis declining; and visit C-4 at 4 months, no ketosis. Results were compared with 51 patients that had an episode of diabetic ketoacidosis as well as with a group that underwent a similar VLCK diet in real life conditions of treatment.

RESULTS: Visit C1 blood pH (7.37 ± 0.03); plasma bicarbonate (24.7 ± 2.5 mmol/l); plasma glucose (96.0 ± 11.7 mg/l) as well as anion gap or osmolarity were not statistically modified at four months after a total weight reduction of 20.7 kg in average and were within the normal range throughout the study. Even at the point of maximum ketosis all variables measured were always far from the cut-off points established to diabetic ketoacidosis.

CONCLUSION: During the course of a VLCK diet there were no clinically or statistically significant changes in glucose, blood pH, anion gap and plasma bicarbonate. Hence the VLCK diet can be considered as a safe nutritional intervention for the treatment of obesity in terms of acid-base equilibrium.

- disturbi elettrolitici possono derivare dall'eccessiva perdita renale di cationi (Na, K, Ca, Se e Mg) indotta dai corpi chetonici
- i corpi chetonici sono molecole fortemente anioniche e si legano agli elettroliti di carica positiva per essere eliminati con le urine
- l'eventuale perdita elettrolitica va attentamente monitorizzata
- il paziente deve capire l'importanza del supporto minerale associato ad abbondante idratazione

Complicanze della dieta chetogenica

Breve termine	Medio – lungo termine
nausea e vomito, diarrea	alterazioni alvo (stipsi, diarrea)
rifiuto del cibo, inappetenza	iperuricemia, ipoproteinemia, iperlipidemia,
letargia transitoria	ipocalcemia, osteopenia
ipoglicemia	calcolosi renale
disidratazione	infezioni ricorrenti
acidosi	acidosi
	ritardo crescita

I CONTROLLI POST-OPERATORI INFLUENZANO L'ESITO DELLA CHIRURGIA

Table 2 Recommended postoperative nutritional monitoring* [112]

Recommendation	AGB	VSG	RYGB	BPD-DS
Bone density (DXA) at 2 years →	Yes	Yes	Yes	Yes !!!
24 hour urinary calcium excretion at 6 months and annually	Yes	Yes	Yes	Yes
Vitamin B_{12} annually (methylmalonic acid and homocysteine optional) then every 3-6 months if supplemented →	Yes	Yes	Yes	Yes
Folic acid (red blood cell folic acid optional), iron studies, vitamin D, intact parathyroid hormone	No	No	Yes	Yes
Vitamin A initially and every 6-12 months thereafter	No	No	Optional	Yes
Copper, zinc, and selenium evaluation with specific findings	No	No	Yes	Yes
Thiamine evaluation with specific findings →	Yes	Yes	Yes	Yes

*AGB=adjustable gastric banding; BPD-DS=biliopancreatic diversion with duodenal switch; DXA=dual energy X ray absorptiometry; RYGB=Roux-en-Y gastric bypass; VSG=vertical sleeve gastrectomy.

World J Diabetes. 2017 Nov 15;8(11):464-474. doi: 10.4239/wjd.v8.i11.464.

Bariatric surgery and long-term nutritional issues.

Lupoli R[1], Lembo E[1], Saldalamacchia G[1], Avola CK[1], Angrisani L[2], Capaldo B[1].

Author information

Abstract

Bariatric surgery is recognized as a highly effective therapy for obesity since it accomplishes sustained weight loss, reduction of obesity-related comorbidities and mortality, and improvement of quality of life. Overall, bariatric surgery is associated with a 42% reduction of the cardiovascular risk and 30% reduction of all-cause mortality. This review focuses on some nutritional consequences that can occur in bariatric patients that could potentially hinder the clinical benefits of this therapeutic option. All bariatric procedures, to variable degrees, alter the anatomy and physiology of the gastrointestinal tract; this alteration makes these patients more susceptible to developing nutritional complications, namely, deficiencies of macro- and micro-nutrients, which could lead to disabling diseases such as anemia, osteoporosis, protein malnutrition. Of note is the evidence that most obese patients present a number of nutritional deficits already prior to surgery, the most important being vitamin D and iron deficiencies. This finding prompts the need for a complete nutritional assessment and, eventually, an adequate correction of pre-existing deficits before surgery. Another critical issue that follows bariatric surgery is post-operative weight regain, which is commonly associated with the relapse of obesity-related co-morbidities. Nu-tritional complications associated with bariatric surgery can be prevented by life-long nutritional monitoring with the administration of multi-vitamins and mineral supplements according to the patient's needs.

Saudi J Gastroenterol. 2015 Sep-Oct;21(5):269-77. doi: 10.4103/1319-3767.164183.

Endocrine and metabolic complications after bariatric surgery.

Jammah AA[1].

Author information

Abstract

Bariatric surgery is the most effective therapeutic option for obese patients; however, it carries substantial risks, including procedure-related complications, malabsorption, and hormonal disturbance. Recent years have seen an increase in the bariatric surgeries performed utilizing either an independent or a combination of restrictive and malabsorptive procedures. We review some complications of bariatric procedures more specifically, hypoglycemia and osteoporosis, the recommended preoperative assessment and then regular follow up, and the therapeutic options. Surgeon, internist, and the patient must be aware of the multiple risks of this kind of surgery and the needed assessment and follow up.

Monitorare i livelli di PTH: **l'iperparatiroidismo secondario è frequente**. MOC lombare/femorale sempre.

Osso e dieta chetogenica

Nutrition. 2014 Jun;30(6):726-8. doi: 10.1016/j.nut.2014.01.005. Epub 2014 Jan 29.

Long-term effects of a ketogenic diet on body composition and bone mineralization in GLUT-1 deficiency syndrome: a case series.

Bertoli S[1], Trentani C[2], Ferraris C[2], De Giorgis V[3], Veggiotti P[3], Tagliabue A[4].

Author information

Abstract

OBJECTIVE: The only known treatment of glucose transporter 1 deficiency syndrome (GLUT-1 DS) is a ketogenic diet (KD), which provides the brain with an alternative fuel. Studies in children with intractable epilepsy have shown that a prolonged KD can induce a progressive loss of bone mineral content associated with poor bone health status, probably as a consequence of a chronic acidic environment. The aim of this study is to determine the long-term effects of a KD on body composition and bone mineral status of patients with GLUT-1 DS, is currently unknown.

METHODS: In this case series, we report the changes in body composition and bone mineral status observed in three adult patients with GLUT-1 DS who have been treated with a KD for more than 5 y.

RESULTS: A long-term KD did not produce appreciable changes in weight and body composition of adults with GLUT-1 DS. Moreover, we found no evidence of potential adverse effects of a KD on bone health. In summary, this case series contributes to a small but growing body of literature that investigated the potential long-term effects of a KD on bone health.

CONCLUSIONS: Our data suggest that maintaining a KD for more than 5 y does not pose any major negative effects on body composition, bone mineral content, and bone mineral density in adults with GLUT-1 DS, a finding that is at variance with previous reports focusing on children with intractable epilepsy. Further studies with larger sizes are needed to confirm and expand our findings.

Health Expect. 2017 Feb;20(1):35-46. doi: 10.1111/hex.12423. Epub 2015 Nov 2.

What are the support experiences and needs of patients who have received bariatric surgery?

Sharman M[1], Hensher M[2], Wilkinson S[3], Williams D[4], Palmer A[1], Venn A[1], Ezzy D[5].

Author information

Abstract

OBJECTIVE: To explore the support needs and experiences of patients who had received publicly or privately funded bariatric surgery and the importance of this support in mediating outcomes of surgery.

METHODS: Seven semi-structured focus groups were conducted. A broad interview schedule guided the discussions which were audio-recorded and transcribed verbatim. Data were analysed thematically.

RESULTS: Twenty-six women and 15 men with a mean age of 54 years (range 24-72) participated in the study. Participants described support needs from health professionals, significant others (family and friends), peers (bariatric surgery recipients) and the general community. Peer, dietetic and psychological support were identified as important factors influencing the outcomes (e.g. weight reduction or health improvement) or experience of bariatric surgery but were identified as infrequently received or inadequately provided. Psychological support was proposed as one of the most significant but commonly overlooked components of care. Support needs appeared higher in the first year post-surgery, when subsequent related or unrelated surgeries were required and following significant life change such as worsening health. For some participants, deficits in support appeared to negatively influence the experience or outcomes of surgery.

CONCLUSION: Providers of bariatric surgery should discuss support needs and accessibility regularly with patients especially in the first year post-surgery and following significant change in a patient's life (e.g. declined health or childbirth). Nutrition, psychological and peer support (e.g. through support groups) may be especially important for some patients.

RIABILITAZIONE

Adozione di una serie di misure che coinvolgono, in comunanza d'intenti,
chirurgo
dietologo
psicologo
endocrinologo
psichiatra

RIABILITAZIONE NUTRIZIONALE

La riabilitazione nutrizionale influenza l'esito della chirurgia bariatrica e permette

- il riadattamento funzionale dell'apparato digerente modificato
- una perdita di peso di qualità

Postoperative Metabolic and Nutritional Complications of Bariatric Surgery

Timothy R. Koch, MD[a,b,*], Frederick C. Finelli, MD, JD[c,d]

Gastroenterol Clin N Am 39 (2010) 109–124

Vitamin and mineral supplements after malabsorptive bariatric surgery

1. MULTIVITAMIN with MINERALS: 1 chewable tablet, daily to twice a day
2. CALCIUM SUPPLEMENTS: chewable tablets, 1.2 g elemental calcium, daily

Specific deficiencies

3. THIAMINE: 100 mg tablet, twice daily or THIAMINE: 100–250 mg intramuscular, monthly
4. NIACIN: 500 mg orally, 3 times daily
5. FOLIC ACID: 1–5 mg orally, daily
6. VITAMIN B12: 1000 μg, intramuscular, monthly or SUBLINGUAL VITAMIN B12: 500 μg tablet once daily
7. VITAMIN A: 10,000 IU orally, daily
8. VITAMIN D (ergocalciferol): 50,000 IU with a meal once weekly (up to 12 weeks) followed by VITAMIN D3 (cholecalciferol): 1000 IU with a meal twice daily
9. VITAMIN E: 800–1200 IU orally, daily
10. VITAMIN K: 5–20 mg orally, daily
11. IRON: iron/vitamin C complex, 1 tablet daily before a meal, iron elixir (through a straw), or parenteral iron
12. ZINC SULFATE: 220 mg capsule, daily to every other day
13. COPPER GLUCONATE: 2 mg capsule, daily to every other day

Casi di obesità in cui è meglio non fare chirurgia

PROGRESS in NUTRITION
Giornale Italiano del Metabolismo e della Nutrizione

OBESITÀ IN POST-TRAPIANTO DI RENE: EFFICACIA E SICUREZZA DI UNA DIETA CHETOGENICA

L. Vigna, C. Barberi, D. Sommaruga, et al.

Abstract

Viene illustrato il report clinico di un uomo di 26 anni con BMI di 41,86 kg/m2, affetto da Nefrite Interstiziale Idiopatica dall'età di 10 anni e sottoposto a trapiantato di rene a 19 anni, trattato con un programma di dieta proteica chetogenica (Very low calorie diet VLCD) per 11 settimane. Il soggetto ha perso peso durante tutto il trattamento, mantenendo un buono stato di idratazione e senza effetti collaterali. Il soggetto, dopo una pausa di 5-6 mesi, si è sottoposto ad un nuovo ciclo di dieta proteica chetogenica con ulteriore calo di peso pari a 8,9 kg. Questo report è un esempio di come, sotto stretta sorveglianza medica, questo tipo di dieta oltre che efficace, si dimostra sicura anche in soggetti con un quadro clinico complesso.

Obesity after kidney transplant: Efficacy and safety of a ketogenic VLCD diet
We report a case of a 26-year-old man with BMI about 41,86 kg/m2, suffering from Interstitial idiopathic nephritis since he was 10, submitted to kidney transplantation when he was 19; we treated him with a ketogenic diet (Very low calorie diet VLCD) for 11 weeks.The patient lost weight during the treatment, keeping a good state of hydratation and without side effects. This clinical report indicate that VLCD (ketogenic diet), under close medical supervision, besides an efficient method to slim, is applicable also to patients with a complex clinical history.

Obesità e Trapianto d'Organo

L'obesità viene considerata una controindicazione al trapianto.

Questa posizione si basa sul razionale che l'eccesso ponderale possa esercitare un effetto negativo in termini di:

complicanze peri- e postoperatorie

durata dell'organo trapiantato

prognosi quoad vitam del paziente

End-Stage Liver Disease

SHORT COMMUNICATION

Very low calorie ketogenic weight reduction diet in patients with cirrhosis: a case series

JC Temmerman[1,3] and AN Friedman[2]

Weight reduction may be necessary in patients with end-stage liver disease (ESLD) before liver transplantation. Although very low calorie diets (VLCDs) are a highly effective weight loss strategy, they risk inducing protein-calorie malnutrition, sarcopenia and hepatic encephalopathy in ESLD patients. We report for the first time on the use of VCLDs in ESLD. Two severely obese individuals with ESLD underwent a modified VLCD to become eligible for liver transplantation. Patients consumed four protein supplements and one lean meal daily, equivalent to 800 kilocalories (kcal) and were closely monitored during the diet period. Subject 1,

Citation: Nutrition & Diabetes (2013) **3**, e95; doi:10.1038/nutd.2013.36
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www.nature.com/nutd

Caso 1

Uomo 46 anni Cirrosi alcolica
Peso iniziale 145,8 Kg BMI 50 kg/m²

44,1 Kg persi in 28 settimane di VLCD

Funzione epatica e parametri MELD (model for end-stage liver disease) migliorati al punta tale da

far uscire il paziente dalla lista per trapianto!

Table 1. Characteristics before and after a modified VLCD

Variable	*Patient 1*	
	Before	*After* 28 weeks
Anthropometrics[a]		
Weight (kg)	145.8	101.7
Height (cm)	170.2	170.2
Body mass index (kg m^{-2})	50	35
Waist circumference (cm)	143.5	111.8
% Body Composition[b]		
Fat mass	53.6	44
Lean mass	46.4	56
Blood chemistries		
White blood count (k mm^{-3})	2.4	3.1
Hemoglobin (g dl^{-1})	11.9	13.7
Platelets (k mm^{-3})	68	56
Fasting blood sugar (mg dl^{-1})	90	71
Serum BUN (mg dl^{-1})	21	16
Serum creatinine (mg dl^{-1})	1.3	0.88
Estimated GFR (ml min^{-1} 1.73 m^{-2})	>60	>60
Serum bilirubin (mg dl^{-1})	1.80	2.0
Alkaline phosphatase (IU l^{-1})	139	79
AST (IU l^{-1})	48	40
ALT (IU l^{-1})	37	22
INR	1.20	1.25
Ammonia level (mCmol l^{-1})	36	44
MELD score	14	10

Caso 2

Donna di 64 anni Cirrosi non alcolica

peso iniziale 125,9 Kg BMI 49 kg/m^2

39,7 Kg persi in 30 settimane di VLCD

Parametri MELD (model for end-stage liver disease) stabili

Paziente ancora in lista per trapianto

Conclusioni

Sotto stretta supervisione medica anche la VLCD può essere sicura ed efficace nel trattamento di una grave patologia epatica (End Stage Liver Disease):

- Riducendo il peso corporeo
- Migliorando la funzione epatica
- Favorendo lo scorrimento o la fuoriuscita dalla lista trapianto

OBESITÀ, CUORE, CHIRURGIA BARIATRICA E VLCKD

Surg Obes Relat Dis. 2018 Jan;14(1):117-122. doi: 10.1016/j.soard.2017.09.534. Epub 2017 Oct 2.

Bariatric surgery as a treatment for heart failure: review of the literature and potential mechanisms.

Kindel TL[1], Strande JL[2].

Author information

Abstract

Heart failure due to severe obesity is a complex disease due to multiple mechanisms, including increased body mass, inflammation, and impaired cardiac metabolism that is complicated by obesity-associated co-morbidities, such as type 2 diabetes and obstructive sleep apnea. Bariatric surgery significantly improves cardiac geometry, function, and symptoms related to obesity cardiomyopathy. There is a consistently positive impact of bariatric surgery on diastolic function with the potential to significantly improve systolic function as measured by ejection fraction in patients with advanced heart failure. For end-stage heart failure patients, including those requiring mechanical circulatory support who are ineligible for organ transplant due to morbid obesity, bariatric surgery has been successfully used for weight loss as a bridge to cardiac transplantation.

Metabolism. 2017 Dec;77:65-72. doi: 10.1016/j.metabol.2017.08.005. Epub 2017 Aug 31.

The diabetic heart utilizes ketone bodies as an energy source.

Mizuno Y[1], Harada E[2], Nakagawa H[3], Morikawa Y[4], Shono M[2], Kugimiya F[2], Yoshimura M[5], Yasue H[2].

Author information

Abstract

BACKGROUND: Diabetic heart is characterized by failure of insulin to increase glucose uptake and increasingly relies on free fatty acids (FFAs) as a source of fuel in animal models. However, it is not well known how cardiac energy metabolism is altered in diabetic hearts in humans. We examined cardiac fuel metabolism in the diabetics as compared to non-diabetics who underwent cardiac catheterization for heart diseases.

MATERIAL AND METHODS: The study subjects comprised 81 patients (male 55, female 26, average age 63.0±10.0years) who underwent the cardiac catheterization for heart diseases. Thirty-six patients were diagnosed as diabetics (diabetic group) and 45 as non-diabetics (non-diabetic group). Blood samplings were done in both the aortic root (Ao) and coronary sinus (CS) simultaneously and the plasma levels of FFAs, glucose, lactate, pyruvate, total ketone bodies and β-hydroxybutyrate were measured and compared between the two groups.

RESULTS: The myocardial uptake of glucose, lactate and pyruvate were decreased, whereas those of total ketone bodies, β-hydroxybutyrate and acetoacetate were increased in the diabetics as compared to the non-diabetics. However, the myocardial uptakes of FFAs were not significantly increased in the diabetics as compared to the non-diabetics.

CONCLUSIONS: Cardiac uptakes of carbohydrate (glucose, lactate and pyruvate) were decreased, whereas those of total ketone bodies and β-hydroxybutyrate were increased in the diabetics as compared to the non-diabetics in humans. Ketone bodies therefore are utilized as an energy source partially replacing glucose in the human diabetic heart.

Circulation. 2016 Feb 23;133(8):706-16. doi: 10.1161/CIRCULATIONAHA.115.017545. Epub 2016 Jan 27.

Evidence for Intramyocardial Disruption of Lipid Metabolism and Increased Myocardial Ketone Utilization in Advanced Human Heart Failure.

Bedi KC Jr[1], Snyder NW[1], Brandimarto J[1], Aziz M[1], Mesaros C[1], Worth AJ[1], Wang LL[1], Javaheri A[1], Blair IA[1], Margulies KB[1], Rame JE[2].

Author information

Abstract

BACKGROUND: The failing human heart is characterized by metabolic abnormalities, but these defects remains incompletely understood. In animal models of heart failure there is a switch from a predominance of fatty acid utilization to the more oxygen-sparing carbohydrate metabolism. Recent studies have reported decreases in myocardial lipid content, but the inclusion of diabetic and nondiabetic patients obscures the distinction of adaptations to metabolic derangements from adaptations to heart failure per se.

METHODS AND RESULTS: We performed both unbiased and targeted myocardial lipid surveys using liquid chromatography-mass spectroscopy in nondiabetic, lean, predominantly nonischemic, advanced heart failure patients at the time of heart transplantation or left ventricular assist device implantation. We identified significantly decreased concentrations of the majority of myocardial lipid intermediates, including long-chain acylcarnitines, the primary subset of energetic lipid substrate for mitochondrial fatty acid oxidation. We report for the first time significantly reduced levels of intermediate and anaplerotic acyl-coenzyme A (CoA) species incorporated into the Krebs cycle, whereas the myocardial concentration of acetyl-CoA was significantly increased in end-stage heart failure. In contrast, we observed an increased abundance of ketogenic β-hydroxybutyryl-CoA, in association with increased myocardial utilization of β-hydroxybutyrate. We observed a significant increase in the expression of the gene encoding succinyl-CoA:3-oxoacid-CoA transferase, the rate-limiting enzyme for myocardial oxidation of β-hydroxybutyrate and acetoacetate.

CONCLUSIONS: These findings indicate increased ketone utilization in the severely failing human heart independent of diabetes mellitus, and they support the role of ketone bodies as an alternative fuel and myocardial ketone oxidation as a key metabolic adaptation in the failing human heart.

Cuore e dieta chetogenica

J Am Coll Cardiol. 2008 Sep 16;52(12):1006-12. doi: 10.1016/j.jacc.2008.04.068.

Prolonged caloric restriction in obese patients with type 2 diabetes mellitus decreases myocardial triglyceride content and improves myocardial function.

Hammer S[1], Snel M, Lamb HJ, Jazet IM, van der Meer RW, Pijl H, Meinders EA, Romijn JA, de Roos A, Smit JW.

Author information

Abstract

OBJECTIVES: This study sought to assess the effects of prolonged caloric restriction in obese patients with type 2 diabetes mellitus (T2DM) on myocardial triglyceride (TG) content and myocardial function.

BACKGROUND: Myocardial TG content is increased in patients with T2DM and may reflect altered myocardial function. It is unknown whether myocardial TG content is influenced during a therapeutic intervention.

METHODS: Myocardial TG content (magnetic resonance [MR] spectroscopy), myocardial function (MR imaging), plasma hemoglobin A1c, and body mass index (BMI) were measured in 12 obese, insulin-treated T2DM patients before and after a 16-week very-low-calorie diet (VLCD) (450 kcal/day) to achieve substantial weight loss. Insulin was stopped during the VLCD.

RESULTS: The BMI decreased from 35.6 +/- 1.2 kg/m(2) (baseline, mean +/- SEM) to 27.5 +/- 1.3 kg/m(2) (after the VLCD, $p < 0.001$) and was associated with an improvement in hemoglobin A1c from 7.9 +/- 0.4% (baseline) to 6.3 +/- 0.3% (after the VLCD, $p = 0.006$). Myocardial TG content decreased from 0.88 +/- 0.12% to 0.64 +/- 0.14%, respectively ($p = 0.019$), and was associated with improved diastolic function (reflected by the ratio between the early and atrial filling phase) from 1.02 +/- 0.08 to 1.18 +/- 0.06, respectively ($p = 0.019$).

CONCLUSIONS: Prolonged caloric restriction in obese T2DM patients decreases BMI and improves glucoregulation associated with decreased myocardial TG content and improved diastolic heart function. Therefore, myocardial TG stores in obese patients with T2DM are flexible and amendable to therapeutic intervention by caloric restriction.

Obesity (Silver Spring). 2012 Aug;20(8):1572-6. doi: 10.1038/oby.2011.390. Epub 2012 Jan 26.

Long-term beneficial effect of a 16-week very low calorie diet on pericardial fat in obese type 2 diabetes mellitus patients.

Snel M[1], Jonker JT, Hammer S, Kerpershoek G, Lamb HJ, Meinders AE, Pijl H, de Roos A, Romijn JA, Smit JW, Jazet IM.

Int J Cardiovasc Imaging. 2014 Jan;30(1):121-7. doi: 10.1007/s10554-013-0302-y. Epub 2013 Oct 16.

Sustained cardiac remodeling after a short-term very low calorie diet in type 2 diabetes mellitus patients.

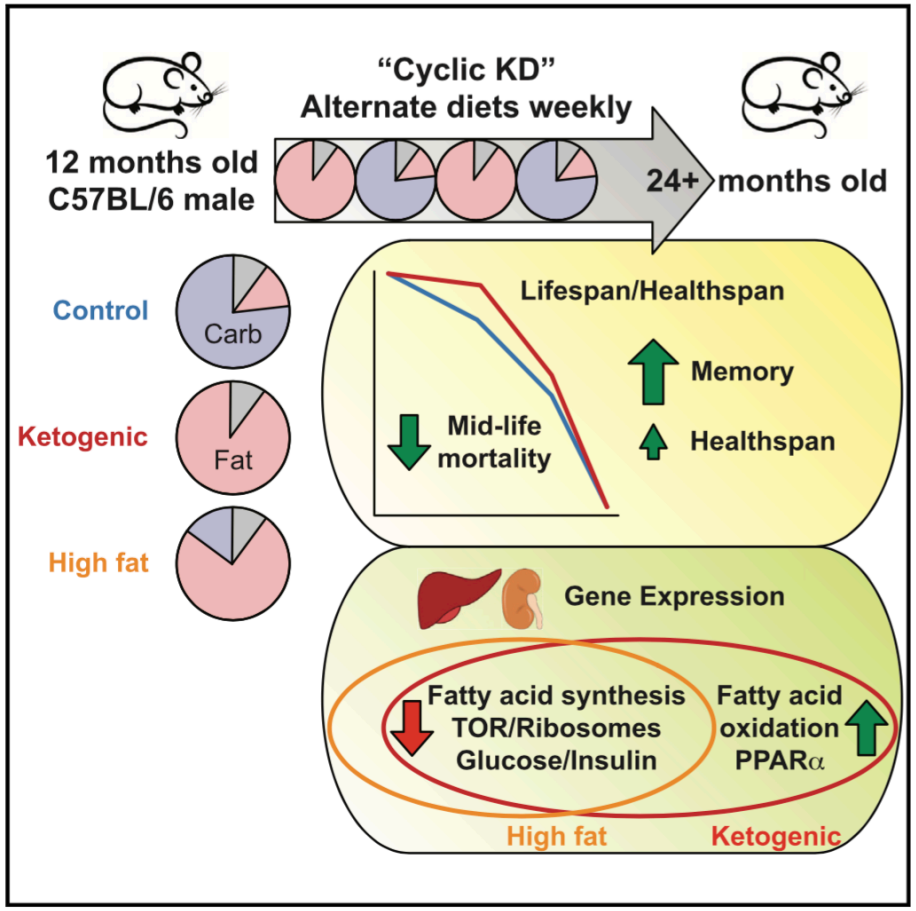
Jonker JT[1], Snel M, Hammer S, Jazet IM, van der Meer RW, Pijl H, Meinders AE, de Roos A, Smit JW, Romijn JA, Lamb HJ.

Short Article

Cell Metabolism

Ketogenic Diet Reduces Midlife Mortality and Improves Memory in Aging Mice

Graphical Abstract



Authors

John C. Newman,
Anthony J. Covarrubias,
Minghao Zhao, ..., Yu Huang,
Saptarsi Haldar, Eric Verdin

Highlights

Un'alimentazione isoproteica chetogenica a settimane alterne (Cyclic KD) nei topi:

- riduce la mortalità di mezza età
- previene il declino della memoria
- evita l'obesità
- preserva il "fenotipo cardiaco giovane" nei topi anziani e migliora lo score cardiaco composito (frequenza cardiaca, massa ventricolare sinistra, gradiente pressorio valvola aortica e contrazione parziale).

Cell Metab. 2017 Sep 5;26(3):547-557.e8.

OSAS, OBESITÀ, BARIATRICA E VLCKD

La chirurgia bariatrica determina la risoluzione o il miglioramento dell'OSAS nell'88,5% dei pazienti a un follow-up medio di 21,8 mesi

Efficacia di ogni singolo intervento:

Diversione Biliopancreatica	99% dei casi
Sleeve Gastrectomy	85,7%
By-pass Gastrico	79,2%
Bendaggio Gastrico	77,5%

AHI	Grado di apnea
5-15 h^{-1}	Apnea di grado lieve
15-30 h^{-1}	Apnea di grado moderato
>30 h^{-1}	Apnea di grado severo

BMJ

RESEARCH

Longer term effects of very low energy diet on obstructive sleep apnoea in cohort derived from randomised controlled trial: prospective observational follow-up study

Kari Johansson, PhD student,[1] Erik Hemmingsson, postdoctoral research fellow,[1] Richard Harlid, physician,[2] Ylva Trolle Lagerros, physician,[1,3] Fredrik Granath, statistican,[3] Stephan Rössner, professor,[1] Martin Neovius, associate professor[3]

SARCOPENIA: il calo ponderale ha effetto sulla massa magra

Table 4 Summary of the effects of surgical weight loss interventions on the %FFML

Author	*Year*	*Intervention*	*Study type*	*FFM loss (%Weight loss)*	*Weight loss (kg)*	*Duration (wks)*	*n*	*Sex*	*Initial BMI*	*Method*
Vettor *et al.*[42]	2003	BPD	Obs	17.5	43.5	78	10		49.8	TBW
Tacchino *et al.*[43]	2003	BPD	Obs	19.2	31.7	26	101	F	45.5	DEXA
Gniuli *et al.*[44]	2005	BPD	Obs	20.0	47.6	104	10		45.3	TBW
Tacchino *et al.*[43]	2003	BPD	Obs	20.1	43.3	52	101	F	45.5	DEXA
Tacchino *et al.*[43]	2003	BPD	Obs	22.0	46.0	104	101	F	45.5	DEXA
Mingrone *et al.*[45]	2002	BPD	RCT	25.1	35.1	52	31	F	48.3	DEXA
Fabris *et al.*[46]	2004	BPD	Obs	26.2	48.6	78	10		49.0	TBW
Mingrone *et al.*[45]	2002	BPD	RCT	27.8	52.1	52	15	M	48.4	DEXA
Valera-Mora *et al.*[47]	2005	BPD	Obs	29.1	55.0	104	85	F	48.9	TBW
Benedetti *et al.*[48]	2000	BPD	CCT	31.5	60.4	130	14		48.1	DEXA
Greco *et al.*[49]	2002	BPD	CCT	48.5	33.0	26	8		49.4	DEXA
Valera-Mora *et al.*[47]	2005	BPD	Obs	52.7	55.0	104	22	M	48.1	TBW
Das *et al.*[50]	2003	RYGB	Obs	21.2	53.4	61	30		50.1	TBW
Carey *et al.*[51]	2006	RYGB	Obs	29.3	12.3	4	19		48.7	UWW
Carey *et al.*[51]	2006	RYGB	Obs	33.2	39.7	26	19		48.7	UWW
Carey *et al.*[51]	2006	RYGB	Obs	36.3	25.9	13	19		48.7	UWW
Coupaye *et al.*[52]	2005	LAGB	Obs	12.7	23.7	52	36	F	47.2	DEXA
Pugnale *et al.*[53]	2003	LAGB	Obs	14.1	27.7	52	31	F	43.6	DEXA
Sergi *et al.*[54]	2003	LAGB	Obs	14.1	17.0	26	6	F	42.8	DEXA
Gasteyger *et al.*[55]	2006	LAGB	Obs	16.4	39.6	104	36	F	43.8	DEXA
Giusti *et al.*[56]	2005	LAGB	Obs	16.9	29.5	52	37	F	43.7	DEXA
Giusti *et al.*[57]	2004	LAGB	Obs	17.4	27.6	52	31	F	43.6	DEXA
Gasteyger *et al.*[55]	2006	LAGB	Obs	17.5	29.7	52	36	F	43.8	DEXA
Pugnale *et al.*[53]	2003	LAGB	Obs	17.8	18.5	26	31	F	43.6	DEXA
Giusti *et al.*[56]	2005	LAGB	Obs	17.9	39.1	104	37	F	43.7	DEXA
Giusti *et al.*[57]	2004	LAGB	Obs	18.7	18.7	26	31	F	40.5	DEXA
Giusti *et al.*[56]	2005	LAGB	Obs	19.3	19.2	26	37	F	43.7	DEXA
Gasteyger *et al.*[55]	2006	LAGB	Obs	19.7	19.3	26	36	F	43.8	DEXA
Garrapa *et al.*[58]	2005	LAGB	Obs	23.6	23.3	26	15		42.2	DEXA

Abbreviations: BPD, biliopancreatic diversion; CCT, clinical controlled trial; DEXA, dual energy X-ray absorptiometry; LAGB, laparoscopic adjustable gastric banding; Obs, observational; RCT, randomized controlled trial; RYGB, roux en Y gastric bypass; TBW, total body water.

Changes in fat-free mass during significant weight loss: a systematic review

Lo scarso apporto proteico è una delle cause della riduzione del metabolismo basale durante i regimi fortemente ipocalorici

Chaston TB et al. Int J Obes 2007;31:743

La perdita di massa magra ha effetto sulla prognosi

- La perdita di muscolo scheletrico è il fattore che contribuisce maggiormente a

- Instabilità posturale
- Debolezza
- Rallentamento del metabolismo
- Perdita di massa ossea

Possiamo prevenire la perdita di massa magra

Protein intake should be individualized, assessed, and guided by an RD, in reference to gender, age, and weight (**Grade D**). A minimal protein intake of 60 g/d and up to 1.5 g/kg ideal body weight per day should be adequate; higher amounts of protein intake—up to 2.1 g/kg ideal body weight per day—need to be assessed on an individualized basis (**Grade D**).

Recommendations for protein intake are variable but studies suggest higher protein levels (80-90 g/d) are associated with reduced loss of lean body mass (267 [EL 4, NE]; 268 [EL 2, PCS]; 269 [EL 3, SS]). Protein intake is generally reduced following surgery (270 [EL 2, PCS]) and adequate intake can be facilitated through the use of protein supplements, though a causal effect of protein supplement use and favorable body composition change has not been demonstrated (271 [EL 2, PCS]).

AACE/TOS/ASMBS Guidelines

Obesity 2013;21:S1

Aspetti nutrizionali: sarcopenia e prevenzione della perdita di massa magra

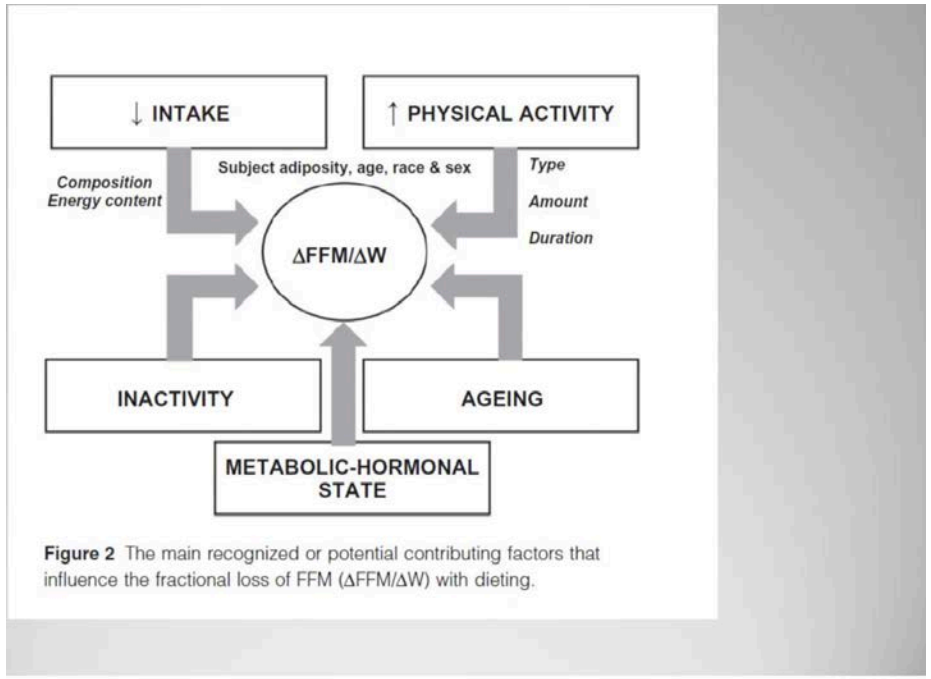


Figure 2 The main recognized or potential contributing factors that influence the fractional loss of FFM (ΔFFM/ΔW) with dieting.

Heymsfield SB et al. Obes Rev 2014

SI ATTIVITÀ AEROBICA

- conveniente perché permette al muscolo di produrre una maggiore quantità di ATP
- non porta all'accumulo di sostanze tossiche di scarto (acido lattico)
- Substrato utilizzato per produrre energia: GRASSI
- Da eseguire con una frequenza di 3 volte/settimana
- Consigliabile esercizio isometrico intervallato (ad es. 3 minuti di lavoro → 3 minuti di riposo) che impegni a rotazione diversi gruppi muscolari

NO ATTIVITÀ ANAEROBICA

- attività esplosive e violente che comportano una rapida richiesta di energia e di ossigeno (corsa di velocità, il salto, nuoto)
- Substrato utilizzato per produrre energia: GLICIDI, PROTEINE

VLCKD pre-bariatrica

La diminuzione preoperatoria del peso corporeo riduce notevolmente le dimensioni del grasso viscerale e del fegato

Ciò facilita l’esecuzione degli interventi laparoscopici riducendo il tempo di esecuzione e il rischio di conversione e migliora i risultati a breve e lungo termine soprattutto nei pazienti super-obesi.

The American Journal of
CLINICAL NUTRITION

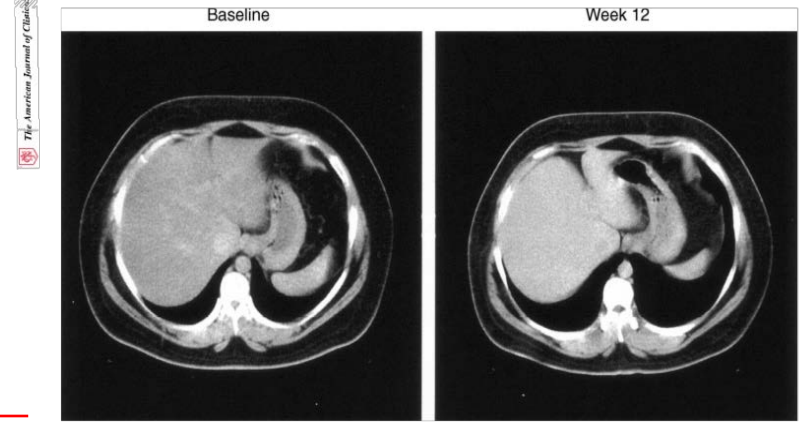
Preoperative weight loss with a very-low-energy diet: quantitation of changes in liver and abdominal fat by serial imaging[1–3]

Susan L Colles, John B Dixon, Paul Marks, Boyd J Strauss, and Paul E O'Brien

Results: Mean (±SD) LV, VAT/SAT, and body weight decreased significantly ($P < 0.001$ for all). The degree of LV reduction was directly related to the reduction in relative body weight ($r = 0.54$, $P = 0.001$) and initial LV ($r = 0.43$, $P = 0.015$). Eighty percent of the reduction in LV occurred between weeks 0 and 2 ($P < 0.001$). Reductions in body weight and VAT were uniform over the 12-wk period. Attrition was 14%. Acceptability was adequate but waned over time, and mild transitory side effects occurred.

Conclusions: Given the observed early reduction in LV and the progressive reduction in VAT, we suggest that the minimum duration for a preoperative VLED be 2 wk. Ideally, the duration should be 6 wk to achieve maximal LV reduction and significant reductions in VAT and body weight without compromising compliance and acceptability. *Am J Clin Nutr* 2006;84:304–11.

Single cross-sectional images of the liver performed by computed tomography at baseline and week 12 of a very-low-energy diet.



Susan L Colles et al. Am J Clin Nutr 2006;84:304-311

©2006 by American Society for Nutrition

Extent of the change in liver volume with weight loss in a 35-y-old man with an initial liver volume of 3.7 L and a final liver volume of 2.4 L. A 35% reduction in liver size and a weight loss of 18 kg were observed.

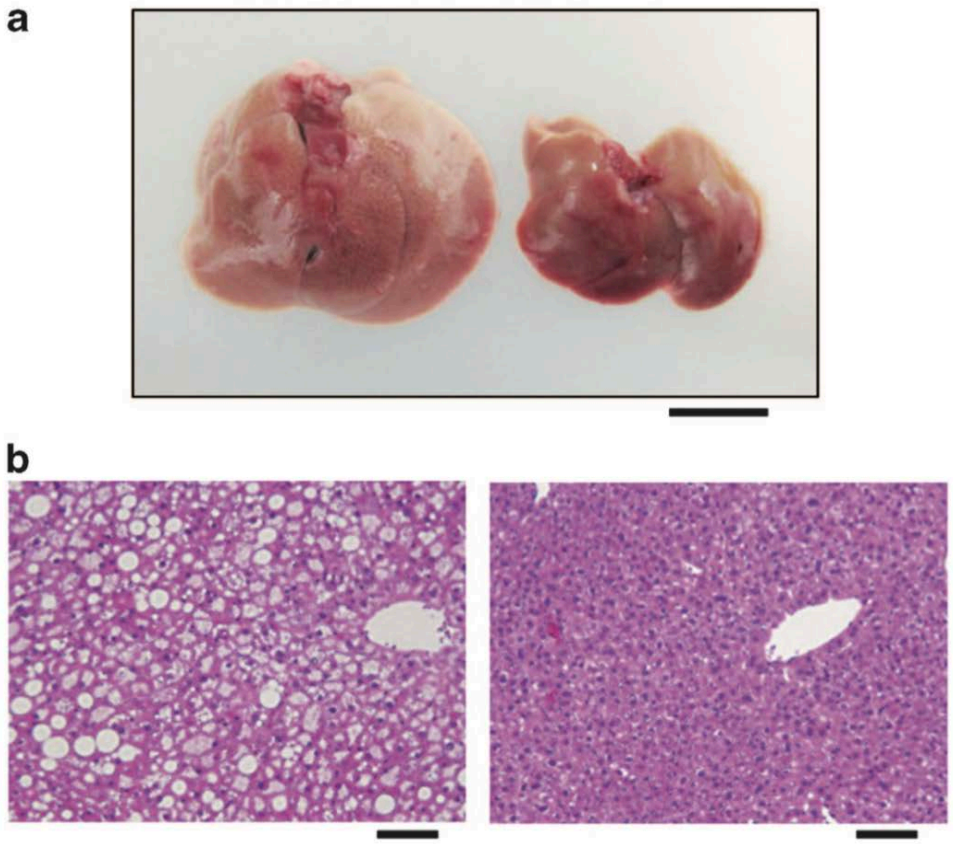
Citation: Nutrition and Diabetes (2012) **2**, e50; doi:10.1038/nutd.2012.24
© 2012 Macmillan Publishers Limited All rights reserved 2044-4052/12
www.nature.com/nutd

ORIGINAL ARTICLE

A very low carbohydrate ketogenic diet prevents the progression of hepatic steatosis caused by hyperglycemia in a juvenile obese mouse model

T Okuda and N Morita

Next, we examined the morphology of several organs and tissues derived from each mouse. The progression to hepatic steatosis was observed in the liver of chow-fed *ob/ob* mice, but not in KD-fed *ob/ob* mice (Figure 2a). No apparent morphological changes could be observed in the other organs and tissues. The average weight of the liver from KD-fed *ob/ob* mice was approximately 30% of that of the chow-fed *ob/ob* mice (Table 1). In the



Surg Obes Relat Dis. 2018 Jul;14(7):1013-1019. doi: 10.1016/j.soard.2018.03.018. Epub 2018 Mar 21.

Metabolic effects, safety, and acceptability of very low-calorie ketogenic dietetic scheme on candidates for bariatric surgery.

Pilone V[1], Tramontano S[2], Renzulli M[3], Romano M[3], Cobellis L[4], Berselli T[5], Schiavo L[6].

Author information

Abstract

BACKGROUND: Previous studies have demonstrated significant advantages from a preoperative dietetic regimen for candidates to bariatric procedure.

OBJECTIVES: Evaluation of safety, efficacy, and acceptability of a very low-calorie ketogenic diet in patients before bariatric surgery.

SETTING: University Hospital.

METHODS: A standardized 30-day sequential preoperative diet regimen has been analyzed, optimizing metabolic response with gradual carbohydrate reintroduction. Patients were given a dedicated KetoStationkit, for use during the first 10 days of the scheme, followed by a hypocaloric scheme for 20 days. The study group underwent routine laboratory tests and anthropometric measurements (percent weight loss, body mass index, waist circumference) at enrollment (T0), after 10 days (T1), and after 30 days (T2). Ketone body levels were measured in the plasma and urine.

RESULTS: Between January 2015 and September 2015, 119 patients were included in the study. Mean body mass index was 41.5 ± 7.6 kg/m^2. Weight, body mass index, and waist circumference at T0 and T1, T0 and T2, and T1 and T2 decreased significantly ($P<.05$). A bioelectrical impedance assay determined a significant reduction in visceral fat at T1 and T2. We observed a significant ($P<.05$) improvement in several clinical parameters, including glycemic and lipid profile parameters. We also observed a mean 30% reduction in liver volume. The majority of patients declared satisfied or very satisfied. The adverse effects were mild, of short duration, and not clinically relevant.

CONCLUSION: Our results confirm the acceptability, safety, and significant advantage of a very low-calorie ketogenic diet for reducing weight and liver volume of patients in preparation for bariatric surgery.

Obes Surg. 2018 Aug;28(8):2215-2224. doi: 10.1007/s11695-018-3145-8.

A 4-Week Preoperative Ketogenic Micronutrient-Enriched Diet Is Effective in Reducing Body Weight, Left Hepatic Lobe Volume, and Micronutrient Deficiencies in Patients Undergoing Bariatric Surgery: a Prospective Pilot Study.

Schiavo L[1,2], Pilone V[3], Rossetti G[4], Barbarisi A[5,6], Cesaretti M[7,8], Iannelli A[9,10,11].

Author information

Abstract

BACKGROUND: Before bariatric surgery (BS), moderate weight loss, left hepatic lobe volume reduction, and micronutrient deficiency (MD) identification and correction are desirable.

OBJECTIVES: The objective of this study was to assess the safety and the effectiveness of a 4-week preoperative ketogenic micronutrient-enriched diet (KMED) in reducing body weight (BW), left hepatic lobe volume, and correcting MD in patients scheduled for BS.

MATERIALS AND METHODS: In this prospective pilot study, a cohort of morbidly obese patients (n = 27, 17 females, 10 males) with a mean body mass index (BMI) of 45.2 kg/m^2 scheduled for BS underwent a 4-week preoperative KMED. Their BW, BMI, fat mass (FM), fat-free mass (FFM), resting metabolic rate (RMR), left hepatic lobe volume, micronutrient status, and biochemical and metabolic patterns were measured before and after the 4-week KMED. Patient compliance was assessed by validated questionnaires (3-day estimated food records and 72-h recall). Qualitative methods (5-point Likert questionnaire) were used to measure diet acceptability and side effects.

RESULTS: All patients completed the study. We observed highly significant decreases in BW (- 10.3%, $p < 0.001$, in males; - 8.2%, $p < 0.001$, in females), left hepatic lobe volume (- 19.8%, $p < 0.001$), and an amelioration of patient micronutrient status. All patients showed a high frequency of acceptability and compliance in following the diet. No adverse side effect was reported.

CONCLUSION: This study demonstrates that a 4-week preoperative KMED is safe and effective in reducing BW, left hepatic lobe volume, and correcting MD in obese patients scheduled for BS.

Very Low-Carbohydrate Ketogenic Diet Before Bariatric Surgery: Prospective Evaluation of a Sequential Diet

Frida Leonetti • Fabio Cesare Campanile • Federica Coccia • Danila Capoccia • Laura Alessandroni • Alessandro Puzziello • Ilenia Coluzzi • Gianfranco Silecchia

1–10°Days VLCKD | 11–20°Days VLCD | 21–30°Days LCD

	*T*0	*T*1	*T*2	*T*3
Patients (*n*)	50	48	48	48
Weight (Kg)	150.4±26.3	139.2±22.8*	138.7±25.3*	137.6±22.5*
BMI (Kg/m^2)	53.5±8.4	49.7±8.4*	49.6±8.1*	49.2±8.7*
Waist (cm)	145.0±15.6	127.5±18.4#	126.4±16.5#	125.9±16.3#
Neck (cm)	44.0±3.3	42.3±4.3#	41.7±4.0 £	41.1±5.2 §
SBP (mmHg)	128.5±14.4	126±14.3	125.5±14.6	123±26.4
DBP (mmHg)	80±8.6	74.4±11.9	72.6±24.4	72.7±9.9
Creatinine (mg/dl)	0.79±0.3	0.87±0.3	0.95±0.3	0.80±0.2
Urea (mg/dl)	35.6±19.8	40.3±19.8	43.6±22.5	39.1±19.7
GFR (ml/min)	98.3±19.7	86.6±17.4	80.5±27.7	97.3±29.6
Ketonemia (mmol/l)	0.02±0.06	0.16±0.2§	0.1±0.1	0.08±0.09
Ketonuria (mg/dl)	0	20.0±44.1§	0	0
Hunger (VAS scale)	7.1±3.2	3.8±2.8	2.9±2.1	2.9±2.1

Obes Surg. 2019 Jan;29(1):292-296. doi: 10.1007/s11695-018-3523-2.

Pre-operative Very Low Calorie Ketogenic Diet (VLCKD) vs. Very Low Calorie Diet (VLCD): Surgical Impact.

Albanese A[1], Prevedello L[2], Markovich M[2], Busetto L[2], Vettor R[2], Foletto M[2].

Author information

Abstract

BACKGROUND: Pre-operative diet may play an important role as far as patients' fitness for surgery, post-operative outcomes, and successful weight loss. Our aim was to compare surgical outcome and weight loss in two groups of patients who were offered two different pre-operative kinds of diet: very low calorie diet (VLCD) and very low calorie ketogenic diet (VLCKD).

METHODS: Patients candidate for bariatric surgery (laparoscopic sleeve gastrectomy) were registered and assessed according to pre- and post-diet BMI, operative time, hospital stay, drainage output, and hemoglobin (Hb) levels. Patients' preference influenced the type of diet.

RESULTS: From January to December 2016, 178 patients (139 F and 39 M) were enrolled in this study. The mean age was 43 years. In total, 72 patients were on VLCKD while 106 patients on VLCD. Pre-diet mean BMI was 46.3 ± 6.3 kg/m^2 for VLCKD group and 43.1 ± 6.9 kg/m^2 for VLCD group, while immediately pre-op BMI were 43.9 ± 5.9 kg/m^2 and 41.9 ± 6.8 kg/m^2, respectively. Drainage output and hemoglobin levels after surgery resulted significantly correlated with diet induced BMI reduction (141.2 ± 75.8 vs. 190.7 ± 183.6 ml, $p = 0.032$; 13.1 ± 1.2 vs. 12.7 ± 1.5 g/l, $p = 0.04$). The percentage of patients requiring a hospital stay longer than anticipated (> 3 days) was 2.8% in the VLCKD group and 10.4% in the VLCD group ($p = 0.048$).

CONCLUSIONS: In our experience, VLCKD showed better results than VLCD on surgical outcome, influencing drainage output, post-operative hemoglobin levels, and hospital stay.

VLCKD post-bariatrica

NEL CASO DI MANCATO DIMAGRIMENTO DEL PAZIENTE…
… INSODDISFAZIONE E NUOVA RICHIESTA DI CALO PONDERALE

Il paziente può avere modificato il tipo di alimentazione (possibile in particolare dopo gli interventi restrittivi), divenendo un "mangiatore di continuo" o "un amante di dolci"

Adattamento volumetrico dello stomaco con aumento della capacità di ricezione che vanifica la possibilità di mantenere il risultato conseguito.

BMJ Case Rep. 2018 Aug 17;2018. pii: bcr-2018-225643. doi: 10.1136/bcr-2018-225643.

Successful treatment of obesity and insulin resistance via ketogenic diet status post Roux-en-Y.

Handley RT[1,2], Bentley RE[3], Brown TL[4], Annan AA[3].

Author information

Abstract

This is a single case of a 65-year-old American woman who presented with substantial weight gain and insulin resistance (IR) post-Roux-en-Y gastric bypass (RYGB) surgery. Before RYGB, she had reached 340 lbs (155 kg) and a body mass index (BMI) of 56.6 kg/m^2 The surgery resulted in a 70 lbs (32 kg) weight loss, bringing her BMI, per cent total weight loss (%TWL) and per cent excess weight loss (%EWL) to 44.9 kg/m^2, 20.6% and 36.8%, respectively. Unfortunately, her BMI would return to 53.6 kg/m^2, nearly her pre-RYGB BMI. It was then she sought the guidance of a primary care physician with expertise in nutrition and medical management of obesity, who placed her on a ketogenic diet. One year later, she had lost 102 lbs (46.4 kg), resulting in a BMI, %TWL and %EWL of 36.6 kg/m^2, 31.7%, and 63.1%, respectively, also further resulting in significant improvements of her inflammatory biomarkers. This case presentation will explore current literature, covering the effects of obesity on IR, pre-diabetes and other disease-provoking inflammatory biomarkers.

Ann Ital Chir. 2017;88. pii: S0003469X17026550.

A very low calorie ketogenic diet improves weight loss and quality of life in patients with adjustable gastric banding.

Taus M, Fumelli D, Busni D, Borroni F, Sebastianelli S, Nicolai G, Nicolai A.

Abstract in **English**, Italian

BACKGROUND: Often, in severe obesity, diet and physical activity are not enough to achieve a healthy BMI. Bariatric surgical approach, in particular laparoscopic adjustable gastric banding (LAGB), has encouraging results in terms of weight loss and resolution of obesity-related comorbidities. However, several months after LAGB, some patients are enable to lose weight anymore and don't tolerate a further calibration because of its collateral effects (excessive sense of fullness, heartburn, regurgitation and vomiting).

AIM: The aim of this study is to identify the potential role of high protein-low carbohydrate ketogenic diet (KD) in managing weight loss in patients who underwent gastric banding and didn't lose weight anymore.

METHODS: 50 patients underwent LAGB between January 2010 and December 2013. In twenty patients (GROUP A) we observed a stop in weight loss so we divided this patients into two groups. One group (group A1: 10 patients) continued to follow a LCD low calorie diet and underwent a further calibration; the other group (group A2: 10 patients) started to follow a KD for the next 8 weeks.

RESULTS: Both group resumed a significant weight loss, however group A1 patients reported collateral effects due to calibration and a higher Impact of Weight on Quality of Life - Lite (IWQOL-Lite) that correlates with a lower quality of life than patients following KD.

CONCLUSIONS: KD can improve the weight loss and quality of life in patients who underwent LAGB and failed at losing more weight allowing a weight loss comparable to that obtained with a further calibration and it is useful to avoid drastic calibrations and their collateral effects.

Obes Surg. 2018 Dec;28(12):3733-3737. doi: 10.1007/s11695-018-3448-9.

Improving Weight Loss by Combination of Two Temporary Antiobesity Treatments.

Genco A[1], Ienca R[2], Ernesti I[2], Maselli R[3], Casella G[1], Bresciani S[2], Mariani S[2], Soricelli E[1], Baglio G[1], Lorenzo M[4], Monti M[1].

Author information

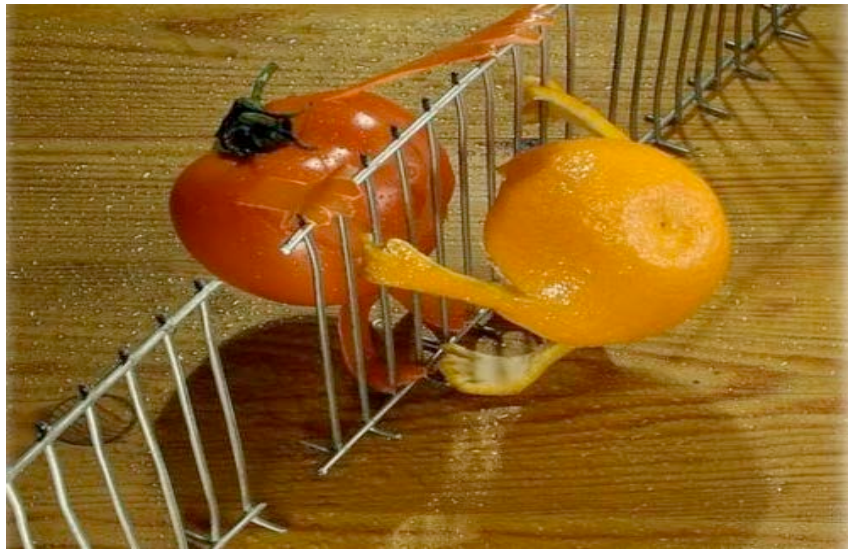
Abstract

BACKGROUND: It is generally accepted that the efficacy with an intragastric balloon decreases after the first 4 months of treatment. Aim of this study is to evaluate if the association of a very low-calorie ketogenic diet (VLCKD) can improve the results in terms of weight loss parameters and co-morbidities, as compared to usually prescribed low-calorie diet (LCD).

METHODS: For the present study (January 2016-June 2017), 80 patients (20 M/60 F, mean age 37.8 ± 6.1 years; excess weight 56 ± 10 kg; mean BMI 37.2 ± 3.8 kg/m^2) underwent Orbera positioning. After 4 months, they were randomized into two groups according to the type of treatment: group A (Bioenterics intragastric balloon - Orbera + VLCKD) (n = 40), and group B (Orbera + LCD) (n = 40).

RESULTS: All patients completed the study with good adherence to diet therapy treatment allocation. After the 6-month treatment period, at time of Orbera removal, mean weight loss was 19 kg and 12 kg in groups A and B respectively ($p < 0.05$). Mean BMI was 28.9 ± 2.8 and 31.6 ± 3.1 kg/m^2 ($p < 0.05$), and %EWL was 33.1 ± 3.3 and 21.1 ± 2.9 ($p < 0.05$) in groups A and B respectively. During the last 2 months in group A, the mean weight loss was 8 kg, while in Group B, the main weight loss was 3 kg ($p < 0.001$). The VLCKD treatment induced a more significant reduction of major comorbidities related to metabolic syndrome.

CONCLUSIONS: This study clearly indicates the efficacy of the prescription of very low-calorie ketogenic diet improving the efficacy of intragastric balloon positioning.



Grazie per l’attenzione