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Dietary Carbohydrate Restriction in The Treatment of Diabetes and Metabolic Syndrome

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Learning Objectives:

After reading this article, the participant should be able to:

1. Recall the benefits of carbohydrate restriction for treatment of diabetes and the metabolic syndrome.
2. Cite the findings of clinical studies on low-carbohydrate diets for the treatment of diabetes.
3. List the patient resources and support available for diets requiring carbohydrate restriction.

Diabetes is fundamentally a disease of carbohydrate intolerance. Reduction in dietary carbohydrate, alone or as an adjunct to pharmacology, is, therefore, an intuitive approach to treatment. The major therapy before the discovery of insulin, low-carbohydrate diets (carbohydrate-restricted diets [CRDs]) still are perceived as a component of diabetes therapy by many physicians and laymen alike. Recently, however, the standard diet has emphasized fat reduction, and health agencies have specifically discouraged the use of CRDs, although the American Diabetes Association (ADA)[1] recently gave limited acceptance to the concept, at least for weight loss.

The argument also has been made that carbohydrate restriction improves all the features of metabolic syndrome and, as such, provides an operational definition of the syndrome[2] as well as a treatment modality, an idea supported by prospective studies.[3,4]

The practitioner contemplating the use of CRD must understand the basic rationale for a course of action different from standard recommendations. Guidance on implementation is also required, especially for patients already taking medication, where one has to avoid the risk of hypoglycemia due to the combined drug and diet effects.

CASE STUDY: TYPE 2 DIABETES MELLITUS

A 56-year-old white male presented with a 3-year history of type 2 diabetes, coronary artery disease, hyperlipidemia, hypertension, gastroesophageal reflux disease, sleep apnea, and depression. His weight was 131.1 kg, with a BMI of 41.4 kg/m^2. His blood glucose varied, from 130 to 390 mg/dL, and his hemoglobin A1c was 8.2%.

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Dr. Feinman has disclosed that he has no significant relationships with or financial interests in any commercial organizations pertaining to this educational activity. Dr. Volek has disclosed that he is/was the recipient of grant/research support from the Robert C. Atkins Foundation and is/was a consultant/advisor for the Scientific Advisory Board of Atkins Nutritionals, Inc. Dr. Westman has disclosed that he is/was the recipient of grant/research support from the Robert C. Atkins Foundation.

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In This Issue:

Protein Restriction in Kidney Disease: Is It Effective?.....5
Bypass vs. Lap Band: Patient Profile Can Aid Decision-Making.....7
CME Quiz.....11
News Bites.....12

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Medications included Lantus insulin, 46 units daily; Byetta (exenatide), 5 μg twice daily; glipizide, 10 mg twice daily; Nexium (esomeprazole, AstraZeneca), 40 mg daily; Toprol (metoprolol, Astra-Zeneca), 100 mg daily; enalapril, 20 mg daily; Cymbalta (duloxetine, Eli Lilly), 40 mg twice daily; and Lyrica (pregabalin, Pfizer), twice daily.

The patient was started on a CRD (< 20 g/day) and was followed at 1- to 2-week intervals. Because reductions in dietary carbohydrate allow more normal glycemic control and lessen insulin fluctuations, insulin and other glucose-lowering drugs also must be reduced in advance. On initiation of the CRD, the patient's Byetta was discontinued, and insulin was reduced to 30 units, but glipizide was continued. After 2 weeks, blood glucose was 94 to 172, with several readings below 100 mg/dL, and insulin was discontinued. By month four, the patient had reduced his weight by 8%, to 120.6 kg (BMI 38.1 kg/m^2), blood glucose was 111 to 156 (HbA1c = 5.7%), and he was able to discontinue all diabetes medication.

RATIONALE FOR CARBOHYDRATE RESTRICTION

A recent review summarized reports in the scientific literature that, consistent with the case study, provide support for CRD as an attractive alternative if not the preferred treatment in diabetic and pre-diabetic states.[5] The major principles emphasized were as follows:

- Carbohydrate restriction improves glycemic control, the primary target of nutritional therapy, and reduces insulin fluctuations.
- CRDs are at least as effective for weight loss as low-fat diets.
- Substitution of fat for carbohydrate is generally beneficial for markers of and incidence of cardiovascular disease.
- Carbohydrate restriction ameliorates the features of metabolic syndrome.
- Beneficial effects of carbohydrate restriction do not require weight loss.

The support of CRDs and the position that benefits accrue even without weight loss are of particular importance. The 2008 ADA Recommendations and Interventions[1] received some attention for granting, for the first time, that "for weight loss, either low-carbohydrate or low-fat calorie-restricted diets may be effective in the short term (up to 1 year)." The ADA's emphasis on weight loss rather than glycemic control seems odd to many, but given how difficult it is to lose weight by any method, it is significant that benefits accrue to CRD even if weight reduction is not attained.

PRACTICAL CONSIDERATIONS: MEDICATIONS

It often is suggested that lifestyle interventions are as successful as pharmacology in treating diabetes, but traditional lifestyle changes that involve high carbohydrate intake have the potential for increasing the need for drugs. The 2008 ADA Recommendations state: "Sucrose-containing foods can be substituted for other carbohydrates in the meal plan or, if added to the meal plan, covered with insulin or other glucose lowering

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medications. Care should be taken to avoid excess energy intake."

One irony in this recommendation is that insulin therapy is known to predispose to weight gain, and patient apprehension of such insulin-related increase in weight may be a barrier to insulin use.

Reduction in medication, as in the case study above, is characteristic of CRD interventions and remains one of their strongest benefits (see reference 6 for further discussion). At the Duke Lifestyle Medicine Clinic, using a very-low-calorie ketogenic diet (Table 1) it has been possible for patients to eliminate as many as 280 units of insulin in 3 weeks. Because of the immediate improvement in glycemic control, patients already on glucose-lowering drugs must have medication reduced or eliminated *before* a change in diet is instituted. Blood pressure also improves, so patients taking antihypertensive medication also must be monitored.

METABOLIC SYNDROME

The concept of metabolic syndrome, or insulin-resistance syndrome, suggests that a seemingly disparate set of conditions—overweight, hypertension, and atherogenic dyslipidemia (high triglycerides and small dense-LDL-C and low HDL-C)—have a common origin. The underlying factor most likely is insulin resistance, which also is a feature of either the diabetic or pre-diabetic state. Recent reports have raised the question as to whether the concept is really useful for the clinician.[7] That is, would characterization as a syndrome lead to different treatment than the sum of the treatments for each individual risk indicator?

The observation that the markers of metabolic syndrome are precisely those that are targeted by CRD provides evidence for the appropriateness of the designation "syndrome" and also suggests a unique method of treatment.[2] Many approaches may be used to treat

Table 1. Example of Low-Carbohydrate Ketogenic Diet Instructional Handout From the Duke Lifestyle Medicine Clinic

ALLOWED FOODS

This is the first and most restrictive phase of the program. For now, keep the total number of carbohydrate grams to less than 20 grams per day. Your diet is to be made up exclusively of foods and beverages from this page. If the food is packaged, check the labels and make sure that the carbohydrate count is zero or 1 gram per serving.

EAT AS MUCH AS YOU WISH OF THE FOLLOWING FOODS:

Meat: Beef (e.g. hamburger, steak), pork, ham (unglazed), bacon, lamb, veal, or other meats. With processed meats (e.g. sausage, pepperoni, hot dogs), check the label to make sure that the carbohydrate count is less than 1 gram per serving.

Poultry: Chicken, turkey, duck, or other fowl.

Fish and shellfish: Any fish, including tuna, salmon, catfish, bass, trout shrimp, scallops, crab, lobster.

Eggs: Whole eggs are permitted without restrictions; do not use egg substitutes.

FOODS THAT MUST BE EATEN EVERY DAY

Salad greens: 2 *cups a day.* Includes arugula, celery, Chinese cabbage, chives, cucumber, endive, lettuce (all varieties), parsley, spinach, radicchio, radishes, scallions, sprouts (bean and alfalfa), and watercress. (If it is a leaf–you can eat it.)

Vegetables: 1 *cup (measured uncooked) a day.* Includes artichokes, asparagus, beet greens, bok choy, broccoli, Brussels sprouts, cabbage, cauliflower, chard, Chinese cabbage, collard greens, eggplant, green beans, jicama, kale, leeks, mushrooms, turnip and mustard greens, okra, onions, peppers, pumpkin, shallots, snow peas, spinach, string beans, sugar-snap peas, summer squash, tomatoes, rhubarb, wax beans, zucchini.

Bouillon: 2 *cups daily.* Clear broth (consommé) is strongly recommended unless you are on a sodium-restricted diet for hypertension or heart failure.

FOODS ALLOWED IN LIMITED QUANTITIES

Cheese: 4 *ounces a day.* Includes hard, aged cheeses such as Swiss, cheddar, brie, camembert, bleu, mozzarella, Gruyere, cream cheese, goat cheeses. Avoid processed cheeses, cheese spreads, or cheese foods such as Velveeta.

Olives (black or green): 6 *a day.*

Avocado: ¼ *of a fruit a day.*

Lemon/lime juice: 4 *teaspoonfuls a day.*

Cream: 4 *tablespoonfuls a day.* Includes heavy, light, or sour cream.

Soy sauces: 4 *tablespoons a day.*

Mayonnaise: 4 *tablespoons a day.*

Pickles, dill or sugar-free: 2 *a day.*

Caution: use this dietary approach only under the supervision of trained professionals.

obesity, but none is as effective as carbohydrate restriction at improving triglycerides. Similarly, several pharmacologic approaches raise HDL-C or improve hypertension, but few target the other markers. In addition, low-fat diets seem to require weight loss for beneficial effects, whereas CRDs do not. CRDs are of obvious value in improving glycemic and insulin responses.

It may not be evident that a collection of markers that is improved by a single type of intervention argues for the existence of a common (carbohydrate-sensitive) mechanism and suggests to the physician that treating any one marker by reducing carbohydrate has the potential to prevent the onset of others. This hypothesis was tested in a prospective study in which 40 overweight subjects with atherogenic dyslipidemia were randomly assigned to dietary interventions restricted in fat (low-fat diet, LFD) or carbohydrate (CRD). Subjects consuming the CRD had improved glycemic control and insulin sensitivity, greater reductions in weight and adiposity, and improvements in several inflammatory markers (Figure 1).[3,4]

CASE STUDY: METABOLIC SYNDROME

A 48-year-old white man with metabolic syndrome, taking no medication, began a CRD (< 20 g/day) and was followed every 1 to 2 months to reinforce adherence for 1 year. No medications were instituted. Results were as follows:

	Baseline	12 Months
Serum triglyceride (mg/dL)	473	218
Blood glucose (mg/dL)	117	92
Waist circumference (cm)	111	99
Blood pressure (mmHg)	128/81	125/80
Body weight (kg)	110.8	98.4
BMI (kg/m^2)	31.3	27.8

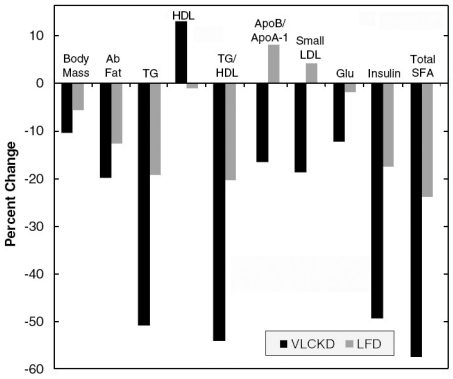

Figure 1. Effect of diet on changes in subjects with metabolic syndrome. Forty overweight patients with atherogenic dyslipidemia were randomly assigned to a very-low-carbohydrate ketogenic diet (VLCKD: 1504 kcal: %CHO:fat:protein = 12:59:28) or a low-fat diet (LFD: 1478 kcal: %CHO:fat:protein = 56:24:20), for 12 weeks. Mean changes in all categories were significantly different between the VLCKD and LFD. Ab Fat, abdominal fat; ApoA-1, apolipoprotein A-1; ApoB, apolipoprotein B; Glu, glucose; HDL, high-density lipoproteins; LDL, low-density lipoproteins; SFA, plasma saturated fatty acid; TG, triglycerides. Data from reference 3.

PRACTICAL CONSIDERATIONS: WHAT TO EAT

Implementation of a low-carbohydrate diet is complicated by the lack of clear definitions. Many studies show benefits proportional to the reduction in carbohydrate, but there also appears to be a threshold effect reflected in the so-called "induction period" of popular diets such as the Atkins Diet. Table 2 lists definitions that would be accepted by most researchers who study low-carbohydrate diets.

CRDs usually do not specify what the carbohydrate is to be replaced with, leading critics to characterize them as high-fat or high-protein. Several researchers have shown that, in practice, many dieters simply reduce calories by removing carbohydrates without replacement.[8] Protein in the diet generally tends to be relatively stable, and the key question is the relative amounts of fat and carbohydrate. According to the rationale for carbohydrate restriction, where glucose and insulin are control elements, fat is expected to play a relatively passive role, and recommendations to reduce fat are unnecessary. Undesirable effects of high fat probably are seen only under conditions of moderate to high carbohydrate intake. Substitution of carbohydrate for fat almost always is deleterious.[3,9]

A survey of an online support group, the Active-Low Carber Forums, showed, perhaps surprisingly, that the major change for dieters was an increase in the consumption of nonstarchy vegetables.[10] Low-carbohydrate diets may, in some sense, be characterized as high-vegetable diets. Regarding food choices, thousands of recipes and strategies are now available on the Internet (e.g. http://lowcarbdiets.about.com/).

PRACTICAL CONSIDERATIONS: COMPLIANCE

Side effects and, conversely, the ability to realize therapeutic goals, strongly affect adherence to any intervention, but compliance with a diet is largely separate from the efficacy of the diet itself and depends on motivation, external support, and the overall features of the patient-physician interaction. In experimental trials, CRDs attain at least as high a degree of compliance as low-fat diets, but such experiments may not offer the full potential for patient support.

The Internet provides opportunities for people attempting to follow a CRD. The Active-Low Carber Forums (http://forum.lowcarber.org/) has more than 110,000 members, and similar

Table 2. Suggested Definitions for Low-Carbohydrate Diets

Low-carbohydrate ketogenic diet (LCKD): <50 g per day (<10% of calories) Induction period of Atkins diet <20 g per day (2 weeks)
Low-carbohydrate diet (LCD): 50–130 g per day (10%–26% of calories)
Moderate-carbohydrate diet (MCD): 130–225 g per day (26%–45% of calories)

groups specifically targeting diabetes offer support and suggestions for implementing dietary plans. The widespread use of glucometers suggests that people with diabetes have unique opportunities to participate in their own medical nutrition therapy. Education and support from physicians will be most successful in patients who are able to discover for themselves which foods or combinations of food will allow good glycemic control.

SUMMARY

In treating patients already receiving medication, physicians may need training in the use of low-carbohydrate diets, but the literature and case studies support the intuitive value of such diets.

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Protein Restriction in Kidney Disease: Is It Effective?

Kevin Lomangino

Editor, *Clinical Nutrition Insight*

Learning Objective:

After reading this article, the participant should be able to describe the clinical evidence supporting protein restriction in kidney disease.

Low-protein diets (LPDs) are a common treatment intervention for patients with chronic kidney disease. But the value of such diets is questionable for patients whose nephropathy results from diabetes, a new meta-analysis suggests. "LPD was not associated with a significant improvement of renal function in patients with either types 1 or 2 diabetic nephropathy," say authors Yu Pan, of the Shanghai Jiao Tong University School of Medicine, Shanghai, China, and colleagues.[1]

The findings are likely to generate debate about whether LPDs are worth the effort. Most clinicians agree that LPDs are very difficult for most of their patients to comply with. And the results of the new analysis by Pan et al. suggest that the benefits of compliance are marginal when it comes to renal protection.

There also is evidence that LPDs could have a larger downside than some clinicians may realize. Published LPD recommendations call for protein intake ranging from 0.60 to 0.80 g/kg/d. However, as we

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reported in our October issue, recent research suggests that the current RDA for protein, 0.8 g/kg/d, may be inadequate to prevent age-related muscle wasting even in otherwise healthy older adults. Moreover, studies have reported a variety of benefits, including increased muscle mass, strength, and cardiovascular function, in older adults consuming more protein than the current RDA.

Reflecting increased concern about the potential adverse effects of reduced protein intake, some kidney specialists offer only a lukewarm endorsement for LPDs in chronic kidney disease. The *Oxford Textbook of Clinical Nephrology* recommends that patients "avoid a high-protein diet," but adds that "caution should be exerted when recommending dietary protein restriction (0.6 g/kg/d) with its inherent risk of undernutrition."[2]

BENEFITS BEYOND RENAL PROTECTION

Despite these emerging data, LPDs today are a mainstay in the conservative management of chronic renal failure. And that appears unlikely to change if comments from William E. Mitch, MD, director of the nephrology division at Baylor University, are any indication.

Mitch says that the new meta-analysis by Pan et al. addresses just one among many issues that are important to consider in the evaluation of LPDs. "The *only* meta-analyses that address low-protein diets for patients with kidney disease are those that address whether the diet can slow the rate of loss of kidney function," Mitch points out in an e-mail. "The outcome and interpretation of this issue is certainly controversial, but there are many other reasons to manipulate the diet of patients with kidney disease," he adds.

Chief among those reasons, says Mitch, is the need to avoid the build-up of nitrogen-containing waste products that are formed when protein intake increases. "When excretion is impaired (i.e. in patients with kidney disease), then producing more unexcreted waste products is counterproductive" because it "causes the symptoms and problems of patients with kidney failure." These include "the accumulation of phosphates and secondary hyperparathyroidism, the accumulation of sodium and the predictable increase in blood pressure, the accumulation of uric acid associated with high protein feeding and the risk of gout (and probably aggravation of hypertension)."

Ultimately, Mitch contends, LPDs might be instrumental in helping to stave off dialysis by preventing symptoms of uremia. "Introducing a delay in reaching the stage when dialysis is required is controversial," he says, "but to deny a patient any potential will not be in the patient's best interests."

META-ANALYSIS OF EIGHT TRIALS

In the study by Pan et al., the researchers searched the literature for studies involving low-protein diets in patients with type 1 or type 2 diabetic nephropathy. To be included in the meta-analysis, studies had to have a randomized controlled design and a duration of at least 6 months, and report data on changes in glomerular filtration rate (GFR) or creatinine clearance rate (measures of renal function), as well as albuminuria or proteinuria.

The authors found eight studies, involving 519 participants, that met their inclusion criteria. Two of the trials focused on patients with type 2 diabetes, four involved patients with type 1 diabetes, and the other two trials included patients with both conditions. Most of these studies involved patients with stage 2 (mild decrease in GFR) or stage 3 (moderately decreased GFR) kidney disease at baseline.

The results show that LPDs significantly reduced albuminuria and proteinuria. Low-protein diets also were associated with a significant reduction in glycated hemoglobin (HbA1c), the authors report.

Despite these improvements, LPDs had no statistically significant effect on the primary outcome of GFR. This finding suggests the need for caution when prescribing LPDs for diabetic nephropathy, the authors say. "Although these results do not rule out the possibility that an LPD is beneficial for patients with T1DM or T2DM, there does not seem to be a large benefit with respect to renal function, and the potential for harm due to malnutrition should be not ignored," they conclude.

CAVEATS AND CONFOUNDERS

The results contradict those of previous meta-analyses, which reported a beneficial effect of LPDs on GFR in diabetic nephropathy. The authors say this difference can be ascribed to their exclusion of crossover trials, which were included in the prior studies. They claim that the crossover strategy is "seriously flawed" and "often leads to biased conclusions" because the treatment effect can carry over into the control period.

But as Joel D. Kopple, of the David Geffen School of Medicine at UCLA, notes in an accompanying editorial, numerous other factors may explain the lack of a beneficial effect from LPDs in this study.[3] He observes that the actual protein intakes in the LPD groups, which ranged from 0.71 to 1.10 g/kg/d, were higher than the levels recommended in most LPD regimens. He adds that the duration of treatment, which was a year or less in half of the studies, may have been too short to discern a difference between the LPD groups and controls.

The results also could have been confounded by differences in medication use between the LPD groups and controls, Kopple points out. "It is possible that the different effects of varied doses of [antihypertensive drugs] may have obscured the effects of LPDs on the progression of CKD," he says. In addition, he notes that the patients in these studies generally had mild to moderate kidney impairment. He asks, "Is it possible that persons with a lower GFR [i.e. more severe impairment] may respond more effectively to LPDs?"

CLINICAL RECOMMENDATIONS

Acknowledging that the benefits of LPDs on kidney function, if any, are likely to be small, Kopple believes they should remain an option for the minority of patients who can tolerate them relatively easily . "In my experience, ~15% of CKD patients, with or without diabetes mellitus, are able to follow these diets rather comfortably," he says. Thus, in addition to other therapies, "such patients could be offered treatment with LPDs providing 0.60–0.80 g protein/kg/d, adjusted for nephritic range proteinuria if present."

Mitch, however, said he disagreed with Kopple's approach, and suggested that every patient with kidney disease should be encouraged to follow an LPD. He insisted that clinicians cannot ignore the possibility that LPDs may, by reducing uremic toxicity, help delay the initiation of dialysis. "Since the mortality rate of patients being treated by hemodialysis approaches >20%/year, it is difficult to understand how one can promote a treatment strategy that relies on providing [kidney disease] patients with precursors of unexcreted waste products (e.g. dietary protein)," he said.

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Bypass vs. Lap Band: Patient Profile Can Aid Decision-Making

Kevin Lomangino
Editor, *Clinical Nutrition Insight*

Learning Objective:
After reading this article, the participant should be able to recall the comparative risks and benefits of gastric bypass and laparoscopic banding for weight loss.

Americans struggling with obesity are faced with tough choices about how to manage their weight. One of the most difficult questions for those who pursue weight loss surgery is whether to choose the established Roux-en-Y gastric bypass procedure or the increasingly popular, but less proven, laparoscopic band.

Although gastric bypass is still considered the gold standard for weight loss surgery in the United States, laparoscopic banding procedures are on the rise following FDA approval of the Lap Band device (Allergan, Inc.) and increasing insurance coverage for the procedure. Advantages of the band include lower surgical mortality rates and fewer short-term complications than gastric bypass. However, studies show that weight loss is generally slower and smaller with the band than with bypass. And there is concern about longer-term complications associated

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with having a foreign body in the abdomen (e.g. mechanical failure, erosion into the stomach wall).

TWO-YEAR WEIGHT LOSS COMPARISON

A new study reporting 2-year outcomes with both procedures should aid decision-making on this issue. Nanci Puzziferri, MD, and colleagues from the University of Texas Southwestern Medical Center, Dallas, Texas, studied 1733 patients (85% female) who met NIH criteria for bariatric surgery and who received either a gastric bypass or gastric band.[1] They followed the patients for 2 years, collecting weight loss data at 6-month intervals and comparing the proportion of successful vs. unsuccessful surgeries. "Successful" procedures were defined as those in which patients lost at least 40% of their excess weight.

The results suggest a sizable weight loss advantage for gastric bypass over the band. After 6 months, 78% of gastric bypass patients had lost 40% or more of their excess bodyweight (i.e. treatment "success"), compared to just 17% of band patients. After 2 years, this gap had tightened somewhat, but the bypass group retained a significant weight loss edge: Their success rate had climbed to 94%, compared with 62% for the gastric band group.

"Weight loss for individuals after bypass was greater, faster, and less likely to be negated by intermittent transient weight gains than after gastric band," the authors conclude.

These results are consistent with previous studies, which generally show improved weight loss outcomes with gastric bypass compared with the band. But the findings also are the first to demonstrate the extent to which weight loss can vary between individual gastric banding patients, according to Puzziferri. "There are superachievers with the band, certainly, but for every superachiever there's somebody who just shouldn't have bothered having the surgery because they only lost about 20 pounds," she commented in an interview. By contrast, "everyone who gets the bypass pretty much does well" with respect to weight loss, Puzziferri said.

This reflects basic differences in how the two procedures produce weight loss, Puzziferri and her coauthors comment. They note that bypass results in anatomic changes that "confer hormonal and malabsorptive weight loss advantages in addition to restriction." The band, on the other hand, is a purely restrictive procedure that "is thought to depend on adequate band adjustments to optimize restriction and dietary compliance." Thus, weight loss following bypass is a function of changed physiology and varies less from individual to individual. By contrast, the band involves more subjective components, such as compliance with frequent follow-up visits, that can affect treatment success rates. "Behavioral practices may be more critical to weight loss success in gastric band than in gastric bypass," the authors say.

Table 1. Bypass vs. Band: An Overview

	Gastric Band	Gastric Bypass
Description and background	• Purely restrictive procedure • Simplest, least invasive • Reversible • Less clinical experience in U.S.	• Restrictive and malabsorptive procedure • Minimally invasive approach now common • Greater clinical experience in U.S.
Weight loss outcomes	• Slower weight loss • Less total weight loss • Greater individual variability	• Fastest weight loss • Greater total weight loss • More uniform outcomes
Short-term complications	• Very low perioperative mortality • Fewer short-term complications	• Low perioperative mortality, but higher for high-risk patients and low-volume surgeons • Short-term complications relatively common
Long-term complications	• Most related to device malfunction • Reoperation necessary in a minority of cases • Lack of good monitoring data	• Variety of issues ranging from deficiency to infection • Lack of good monitoring data
Lifestyle issues	• Faster recovery, return to work • More frequent follow-up required • Patient compliance more of a factor	• Slower recovery • Less frequent follow-up • Patient compliance less integral to successful weight loss

WEIGHING BYPASS RISKS

Does this mean that gastric bypass should be the preferred method of weight loss surgery? Not necessarily. Although the preponderance of evidence suggests that bypass is more effective for promoting weight loss, these benefits come at the expense of increased procedural complications and early postoperative mortality (Table 1). Studies suggest that bypass mortality is about 0.50% for experienced surgeons operating on relatively healthy patients; however, the rate can be much higher for low-volume surgeons operating on high-risk patients. Mortality from gastric banding was reported to be very rare, about 0.1%, in a pooled analysis of 57 studies performed by the Blue Cross/Blue Shield Technology Evaluation Center.[2] Short-term complication rates also are lower for the simpler gastric banding procedure.

The longer-term the risk-benefit picture becomes more clouded due to a lack of good follow-up data. According to a Blue Cross/Blue Shield review, band slippage is reported to be a problem in anywhere from 1% to 36% of patients, depending on the study. And lack of access to the device's port (required to inflate and adjust the restrictive band) is reported in anywhere from 2% to 20% of patients. These types of problems resulted in reoperation in 12% to 25% of patients, said review author Frank Lefevre, MD, of the Northwestern University Feinberg School of Medicine.

But as Lefevre also points out, "It is likely that complications are underreported in many studies due to incomplete follow-up and a lack of systematic surveillance." Thus, it is difficult to compare these risks to the known long-term risks that accompany gastric bypass. Bypass risks include problems such as leaks and strictures, abdominal hernias, infections, and nutritional deficiencies.

Evidence suggests that bypass is more effective for promoting weight loss; however, these benefits come at the expense of increased procedural complications and early postoperative mortality.

A SURGEON'S PERSPECTIVE

Puzziferri says the choice of procedure comes down to each patient's individual risk-benefit calculation. "People who choose the band want to live through the operation, and there's no argument there," she said. "The bypass is a higher risk operation, but you are pretty much guaranteed that you are going to lose a tremendous amount of weight in the first year."

"The thing about the band," she added, "is that you still have to watch your diet. It makes you feel full with much less food, but you can't eat those high-sugar, high-fat foods, or it's not going to work." Another drawback to the band is that it requires adjustments every 6 weeks to ensure optimal weight loss. She said this can be problem when patients have to travel long distances to get to the clinic.

"If you live two or three hours away, and you want a band, are you really going to want to come back every six weeks to have a band adjustment?" she asks. "Before the operation people will say, 'Yeah, I'll do it,' but afterward the reality is that they don't want to travel that far or they don't have the money for gas because they're on a fixed income."

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2. Lefevre F. Laparoscopic adjustable gastric banding for morbid obesity. *TEC Assessment Program* 2007;21(13):1-49; www.bcbs.com/blueresources/tec/vols/21/21_13.pdf.

Coming in Jan.

Reasons for Failed Weight Loss Surgery, by Mark D. Rusch, PhD, Deborah Andris, MSN, and James R. Wallace, MD, PhD, Medical College of Wisconsin

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Diet and C-Reactive Protein, by Peter Clifton, MBBS, PhD, University of Adelaide, Australia

1. According to Richard D. Feinman, PhD, and coauthors of this month's lead article, the dietary intervention that is most effective, calorie for calorie, for reducing plasma triglycerides is
   A. low total fat
   B. low saturated fat
   C. low carbohydrate
   D. high fiber

2. In 2008, the American Diabetes Association recommended that, "for weight loss, either low-carbohydrate or low-fat calorie-restricted diets may be effective in the short term (up to 1 year)."
   A. True
   B. False

3. When instituting a low-carbohydrate diet for people with diabetes, it usually is advisable, in practice, to
   A. reduce or eliminate insulin or other glucose-lowering drugs
   B. increase the dose of insulin or other glucose-lowering drugs
   C. maintain constant levels of insulin or other glucose-lowering drugs
   D. none of the above

4. Popular low-carbohydrate diets generally recommend that carbohydrate be replaced with what nutrient?
   A. Fat
   B. Protein
   C. Both fat and protein
   D. They generally don't specify what to replace the carbohydrate with.

5. The meta-analysis by Yu Pan et al. reported what outcomes regarding low-protein diets (LPDs) in diabetes?
   A. LPDs increased albuminuria and proteinuria.
   B. LPDs increased glycated hemoglobin (HbA1c).
   C. LPDs had no statistically significant effect on glomerular filtration rate.
   D. None of the above

6. According to Joel Kopple, MD, approximately what percentage of patients with kidney disease are able to tolerate an LPD comfortably?
   A. 85
   B. 60
   C. 30
   D. 15

7. Why does William E. Mitch, MD, Director of the Nephrology Division at Baylor University, believe LPDs are a useful tool in the treatment of kidney disease?
   A. They may help prevent accumulation of nitrogen-containing waste products.
   B. They may help prevent uremia and delay initiation of dialysis.
   C. They may help prevent accumulation of sodium and associated hypertension.
   D. All of the above

8. In the study by Nanci Puzziferri, MD, et al., what percentage of patients receiving gastric bypass achieved treatment success (40% excess weight loss) after 2 years?
   A. 94
   B. 62
   C. 40
   D. 17

9. Which one of the following is an advantage of the laparoscopic band compared with gastric bypass?
   A. Less frequent follow-up visits
   B. Faster weight loss
   C. Lower perioperative mortality
   D. None of the above

10. Gastric bypass results in anatomic changes that are believed to confer hormonal and malabsorptive weight loss advantages in addition to restriction.
    A. True
    B. False

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newsbites

DOES DAIRY CALCIUM BURN FAT?

A new study casts doubt on the mechanism through which dairy products have been purported to promote weight loss. "The present observations do not support the hypothesis that increasing the calcium intake of overweight or obese low consumers of calcium increases energy expenditure and fat oxidation," report authors Murielle Bortolotti, of the University of Lausanne, Swizterland, and colleagues. (See *Am J Clin Nutr* 2008;88:877-885.)

The findings appear to rebut a central tenet of the argument advanced by the dairy industry. That argument holds that dietary calcium helps regulate fat metabolism in adipocytes through its effects on plasma 1,25-dihydroxyvitamin D3 (calcitriol) concentrations. Despite some supporting evidence from in vitro and rodent studies, human intervention studies have failed to find clear evidence of a beneficial effect of calcium on weight loss.

Some researchers have suggested that calcium's effects may be more pronounced in individuals with low calcium intakes. So Bartolotti and colleagues performed a crossover study involving 10 overweight or moderately obese individuals with low habitual calcium intake (mean daily intake was 586 mg/d). The subjects received 800 mg of dairy calcium for 5 weeks or a similar placebo treatment after a washout period. The authors determined energy expenditure using indirect calorimetry and performed a battery of measures of total body and adipose tissue lipid metabolism.

The results show no changes in resting energy expenditure, fat oxidation, lipolysis, or metabolic gene expression following calcium supplementation. "In summary....5 wk of dairy calcium supplementation at 800 mg/d failed to alter a number of indexes of adipose tissue lipolysis and lipid oxidation," the authors concluded.

The study, in combination with other data, "appears to provide sufficient evidence to refute the hypothesis that dietary calcium plays an important role in human energy balance through calcium-controlled pathways in adipose tissue," according to Arne Astrup, MD, PhD, a researcher who consults for the dairy industry. However, he believes that an innate appetite for calcium may still play an important role in regulating body-weight, especially during attempted weight loss. He suggests that a calcium-deficient diet has the potential to "amplify hunger and impair compliance with a diet aiming at weight control or loss."

■

STUDY FINDS BPA RISKS

Exposure to the chemical bisphenol A (BPA) is associated with increased risk of cardiovascular disease and diabetes, according to a recent cross-sectional study. The compound, which is commonly found in plastics and in epoxy resins that line food and beverage containers, is receiving increased scrutiny from investigators concerned about the potentially toxic effects of long-term, low-dose intake.

The authors looked at urine BPA levels in nearly 1500 adults participating in the National Health and Nutrition Examination Survey 2003-2004. They compared these findings with self-reported prevalence of a number of chronic diseases as well as several blood markers of disease risk. After statistical adjustments, subjects in the highest quartile of BPA concentrations had higher prevalence of cardiovascular disease and diabetes compared with those in the lowest quartile. Increased BPA levels also were associated with clinical abnormalities in three liver enzymes. (See *JAMA* 2008;300:1303-1310.)

The investigators point out that their study does not provide causal evidence of a link between BPA and chronic disease. An alternate explanation could be that high BPA levels correspond to increased consumption of unhealthy foods or drinks that have BPA in their packaging.

The findings come as the FDA recently reaffirmed the safety of food packaging containing BPA.

■

VITAMIN C MAY PROTECT BONE

Increased vitamin C intake from foods may help protect against bone loss in older men, a new study suggests. Shivani Sahni, from the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, and colleagues studied data from 334 men and 540 women (average age 75) participating in the Framingham Osteo-porosis Study. They assessed dietary intakes with a food frequency questionnaire and evaluated bone loss using dual x-ray absorptiometry at baseline and again four years later. The researchers found that total vitamin C intake (foods and supplements) was positively associated with bone mineral density (BMD) at the femoral neck in non-smoking men. In addition, higher total vitamin C intake was associated with less femoral neck and trochanter-BMD loss in men with low calcium or vitamin E intakes. "The dietary rather than the supplement component of vitamin C intakes appeared most strongly protective against bone loss," the researchers said. No protective effects of vitamin C were seen in women, and male smokers with increased vitamin C intake had reduced trochanter BMD. The latter finding probably is explained by the fact that smokers with low BMD tend to take more vitamin C supplements, which did not seem to be as protective as dietary vitamin C, the researchers said. (See *J Nutr* 2008; 138:1931-1938.)

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