September 2006 Issue | Lee Trotter, DO

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Welcome to *Functional Medicine Update* for September 2006. We are in for a real treat this month with our clinician of the month, who will discuss bariatric surgery-a topic that we have never talked about in the 25 years of *Functional Medicine Update,* but I think is timely at this juncture in the evolution of medical technology and social history.

We are witnessing an epidemic rise in the prevalence of obesity in our society. Morbid obesity has a very dramatic relationship to chronic health problems, metabolic disturbances, and virtually every chronic, age-related disease: coronary artery disease, stroke, hypertensive-related disorders, renal failure, diabetes, cancer, osteoporosis, arthritis, and spinal compression fractures.

Many Variables Can Contribute to Obesity
Why are we seeing this rise in obesity? Is it just because of a luxurious diet that is rich in calories? Or is it a combination of the calories, plus the way calories are constructed in processed food that is sending signals to our genes and creating a different energy economy? What about psychosocial-related issues, such as post-traumatic stress syndrome and the neuroendocrine impact of our lifestyle on our appetite and eating behaviors? Just about every field is related somehow to this problem of epidemic obesity and its subsequent health problems.

In 2005, a landmark paper was published in *The New England Journal of Medicine* from a group of collaborative investigators, all of whom are leaders in their field.[1] This paper suggested that, based upon morbidity and mortality trends that are occurring in our society right now, children born today may be the first in the history of the United States to have mean average life expectancy lower than that of their parents. We have never seen this happen before. This appears to be a consequence of the rapidly rising prevalence of obesity, not just in the older-age portion of society, but also in our youth. These are dramatic social changes that are creating pressure on the healthcare system; a tremendous amount of human potential could be lost.

Who has looked inside the body and understands the technical consequences of these particular trends at a metabolic and physiological and anatomic level? A bariatric surgeon sees-firsthand-the physiological outcomes of these conditions. Our clinician of the month this month-Dr. Lee Trotter, is a bariatric surgeon and a person who has a remarkable collection of different skills and perspectives, including a background in nutrition.

To many of you, bariatric surgery may appear to be fairly esoteric and outside the range of your clinical experience. Because of the rapid rise in the frequency of this surgical procedure, I think it will become a

more important topic for everyone in health care. Bariatric surgery is the most dramatically increasing surgical procedure performed in the western world, and is included in more and more training programs for surgeons, particularly the new microsurgery technologies.

The Impact of Bariatric Surgery on Nutritional Status and Metabolism
Nutritional status can create the need for a bariatric procedure, but the procedure itself can also have an impact on nutritional status and metabolism. Some of the recent publications on nutritional management of patients after bariatric surgery are based on observations of professionals who have performed this procedure and have studied the outcome in their patients. One such article is 'Nutritional Management of Patients after Bariatric Surgery,' from the *American Journal of Medical Science*.[2]

Bariatric procedures are surgical procedures that change gastric physiology and absorptive surface areas. Malabsorption syndrome associated with deficiencies of iron, folate, vitamin B12, and even the fat-soluble vitamins (particularly vitamins A, K, and E) is being seen in these patients. Essential fatty acid malabsorption is suggested as well. Wernicke-Korsakoff Syndrome has also appeared in some bariatric surgery patients; this is a thiamin deficiency associated with hepatic encephalopathy and often connected with alcoholism. Some of these consequences are the exact conditions that a practitioner may be trying to treat by doing gastric bypass surgery on a morbidly obese patient.

Currently, there are nutritional guidelines for the management of bariatric surgical patients after surgery, but in most surgical centers these guidelines are not rigorously adhered to. Nutritional intervention is simplistic at best. A number of patients develop problems with hair loss, muscle wasting, skin problems, digestive difficulties (nausea and vomiting), and generally altered immunological status as a consequence of nutrient insufficiencies. These insufficiencies may be related to protein/calorie malnutrition (particularly protein), but also the micronutrient problems that I have been describing. It is really necessary to look at the results of bariatric surgery and learn from them.

Postoperative nutritional status is a very big area of concern; we know there is an impact of varying levels of protein intake on muscle mass accrual after bariatric surgery. In an article that appeared in *Obesity and Surgery*, the authors discuss how protein has a very important role to play in modulating body composition after surgery.[3] With bariatric surgery patients, it is not adequate to measure just the weight loss-you must also measure where that weight is being lost from. If weight loss is from the muscle mass compartment via the loss of body protein, this may result in the patient being in a less helpful situation postoperatively. We know from other studies that both the quality and quantity of protein in the diet can greatly influence the type of tissue that is maintained during weight loss; that is, whether or not lean mass is conserved compared to fat mass.

In ambulatory weight management programs, the goal is to improve body composition utilizing dietary and lifestyle intervention, and to retain muscle mass while losing body fat selectively. This is one of the reasons why things like bioimpedance analysis (BIA) of body composition is so important, because the scale alone may be misleading. If you just measure body mass index (a measurement of the weight-to-height ratio), it may not tell you where that weight is being lost. Is it being lost as water and muscle, or is it being lost as fat? The healthy outcome from a weight loss program (be it through bariatric surgery or diet and lifestyle intervention) is to lose body fat, particularly visceral adipose tissue fat, while maintaining body muscle stores.

Are there recommendations regarding obesity surgery in terms of nutritional follow-up? I would say these guidelines are still in a state of evolution. There are some enlightened surgeons who seem to have a better understanding of these nutritional variables, and then there are others who are fairly naïve about how to evaluate nutritional status properly and understand the trajectory that a patient has after surgery relative to his or her health.

In a 2005 article in *Current Gastroenterological Reports*, the authors state that 16 million Americans are currently candidates for weight loss surgery.[4] This could be more people than all of the surgical centers, surgeons, and surgical teams in the United States could handle. What are we going to do? We are going to have to utilize lifestyle, diet, and other technologies (maybe even pharmacology) to try to gain control over this epidemic. The problem may start early in life, as alterations in our lifestyle and eating habits. This includes the types of foods we eat, the information that food provides as signals to our genes (that create differences in insulin signaling), and this complex network of neuroendocrine hormones that regulate things like appetite, thermogenesis, metabolic function, and adipogenesis.

We are going to have to take a very different view of this whole problem-a view that looks beyond just calorie restriction and what I call the application of the first law of thermodynamics, which means you balance your calories in with your calories out. This concept has value, but what is forgotten is that in between calories in and calories out is what we call metabolism, and metabolism in the individual is controlled by many variables that are related to environmental and genetic factors. I think we need to address not only the calorie content, which is the energy/heat potential of food, but we also need to look at the metabolic implications and this neuroendocrineimmune signaling that controls and regulates things like appetite metabolism and cell signaling.

Endocrinological Improvements and Changes in Metabolism Following Surgery
Many of the problems that patients have as a consequence of morbid obesity may dramatically and rapidly improve after gastric bypass surgery. Ironically, those improvements often occur much more quickly than you would expect based upon the amount of weight that is lost. Why would that be? As I see it, bypass surgeries, such as the Roux-en-Y procedure, change the absorptive surface area and the size of the stomach. After surgery, the flux of information molecules from the diet is greatly reduced. This cools off (or calms down or quiets) the neuroendocrine arousal that has come from the loud voice-maybe even chaotic voice-that has come from excessive calories that contain the wrong information. By cooling that voice down-quieting it-the effect on gene expression that results in the stress responses that we see as insulin resistance and hyperlipidemia and inflammatory markers seem to all be remarkably improved. This implies that these metabolic consequences of obesity are not solely a consequence of the fat itself, but a consequence of what occurs metabolically from signaling that is associated with fat accumulation.

How much weight does a patient have to lose to get a dramatic and favorable impact on his or her metabolism? Could it be that just small amounts of weight loss (but improvements in physiological function), could then dramatically reduce some of the metabolic disturbances that associate themselves with diabetes and heart disease and cancer and so forth? It is an interesting question because for years it was felt that this was all a problem of excessive calories and extra body fat; there was a presumed direct relationship between incremental increase in body fat and decrease in metabolic performance. What we are talking about now is another variable beyond that of just fat itself. It has to do with the impact of diet and lifestyle on our gene expression patterns, which ultimately can regulate the metabolic outcomes that are associated with disease.

There was an article in *The New England Journal of Medicine* that focused on lifestyle, diabetes, and cardiovascular risk factors ten years after bariatric surgery.[5] This was a multi-center review, and the news was quite encouraging. After two years, weight had increased by 0.1 percent in the control group and had decreased 23.4 percent in the surgery group. There were also significant improvements in insulin sensitivity, serum lipids, and uric acid levels in the group that underwent bariatric surgery. In this particular study, the authors concluded that, compared with conventional therapy, bariatric surgery appeared to be a viable option for the treatment of severe morbid obesity, resulting in long-term weight-loss, improved lifestyle, and amelioration of the risk factors that were elevated at baseline. The one thing bariatric surgery does not appear to significantly improve over standard approaches is elevated serum cholesterol, which suggests that there are other factors associated with triggering the cholesterologenic process (seen as elevated LDL cholesterol).

I have talked about the nutrient deficiencies that are secondary to bariatric surgery. I have talked about the problems that are often seen with patients who have morbid obesity in which tissue integrity and the immune system are compromised. By having surgery, weight loss will improve some of these functions, but patients may then have new problems that are associated with macronutrient (for example, protein deficiencies) and micronutrient deficiencies. I have added the additional insight that after gastric bypass surgery, even before a significant amount of weight is lost, there has been demonstrated a dramatic improvement in metabolic function with reduction of risk to diabetes and heart disease and stroke. This implies that metabolism can be changed by reducing the stress on the body from extra calories containing the wrong information. A number of publications have included articles on this subject; one that I think is very interesting appeared in *Current Opinions in Clinical Nutrition and Metabolic Care* in 2004.[6]

A consequence of malabsorption syndrome relates to the fat-soluble vitamins, specifically vitamin D, which is necessary for bone health. We often see patients who, after bariatric surgery, end up with bone loss and increased parathyroid hormone levels-a nutritionally-induced secondary hyperparathyroidism-resulting in increased risk to osteoporosis. I think we can say that for virtually all nutrients that are malabsorbed, appropriate supplementation in a form that does not produce hyperosmolarity is a very desirable feature of postoperative nutrition care.

We have been discussing vitamin D at some length in *Functional Medicine Update* over the last several issues, but let me just give you a few additional insights that I think are interesting. We have talked about the role vitamin D has on the immune system and the fact that it can lower some of the pro-inflammatory cytokines that are produced in the neurological system-these are the discoveries of Dr. Colleen Hayes at the University of Wisconsin, Department of Biochemistry. She has demonstrated that in animal models of multiple sclerosis, you can lower some of the inflammatory mediators in the nervous system if you supplement the animals with vitamin D, particularly the 25-hydroxy derivative or the 1,25-dihydroxyvitamin D_3.

Vitamin D as a Potential Anti-Inflammatory Agent in the Future Treatment of Congestive Heart Failure
A study that was recently published in *The American Journal of Clinical Nutrition* supports another important role for vitamin D.[7] This was a study done on 123 human subjects, randomly receiving either 50 µg of vitamin D plus 500 mg of calcium per day or a placebo (that would be a placebo vitamin D plus 500 mg of calcium) for 9 months. Ninety-three of the 123 patients completed the study, and there was a significant treatment effect observed on the logarithmic-transformed serum concentrations of 25-hydroxyvitamin D. The supplemented group had a significantly increased level of the

25-hydroxyvitamin D_3, which is the biomarker for vitamin D status. There was also a decrease in parathyroid hormone, tumor necrosis factor α , and interleukin 10, suggesting that supplementation with vitamin D in humans has a dramatic positive effect on balancing the TH1/TH2 immune system and lowering inflammatory effects. The authors of this study concluded that vitamin D_3 reduces the inflammatory milieu in congestive heart failure (CHF), and might serve as a new anti-inflammatory agent for the future treatment for CHF.

In that same issue, in the editorial titled 'Vitamin D and Congestive Heart Failure,' the authors state that this is another thing that can probably be added to the list of positive benefits of vitamin D.[8] People with CHF may have adverse physiology/biochemistry of vitamin D metabolism and end up with secondary hyperparathyroidism, alterations in calcium physiology, and other effects on the immune system related to lowered vitamin D status. With vitamin D supplementation (about 2000 IUs per day; that is 50 µg), there can be amelioration of inflammatory mediators and improvement in parathyroid hormone and calcium levels.

Vitamin D and Metastatic Disease
The hormonal form of vitamin D (1α; ,25-dihydroxyvitamin D_3), in cell culture work, inhibits prostate cancer cell invasion and modulates the specific kinase pathways that are involved with cellular replication (and possibly metastases). These findings support the idea that vitamin D-based therapies might be beneficial in the management of advanced prostate cancer by improving immunological function and lowering metalloproteinase and cathepsin activities that are associated with metastatic disease. An article on this subject was published in the journal *Carcinogenesis* in 2006.[9]

Vitamin D is manufactured by photobiology in the skin. People are advised to stay out of the sun to prevent skin cancers, but doing so may increase risk to other cancers due to poor vitamin D status. This has been discussed at some length in various issues of *The Journal of the National Cancer Institute.* A recent editorial authored by Gary Schwartz and William Blot was titled 'Vitamin D Status and Cancer Incidence and Mortality: Something New Under the Sun.'[10] This piece discusses a number of studies (including the Health Professionals Follow-Up Study) that have found there is a correlation between sun exposure and lowered cancer incidence (overall cancer incidence, not just skin cancers). There is probably a bell-shaped curve between proper exposure to the sun and benefit in keeping vitamin D levels adequate, and too much sun exposure increasing risk to skin cancer. Supplementation with vitamin D may be an alternative. The authors state that sunlight, although generally an effective means of generating large amounts of vitamin D, may not be safe for all people. For many individuals, including those who are darkly pigmented and who live at northern latitudes, sunlight exposure may be insufficient to generate adequate vitamin D.

Most of us have carried a view that vitamin D is very toxic as a consequence of being a fat soluble vitamin that is stored. We know it is toxic when you have elevated levels of 25-hydroxy in an altered serum calcium-phosphorus ratio. In supplemental doses, vitamin D is now considered safer than it was previously. In the above-mentioned article, Drs. Schwartz and Blot point out that the present recommended allowance for vitamin D at 400 IUs for individuals 50-70 years of age is inadequate to maintain skeletal health and is probably too low for meaningful anti-cancer levels of 25-hydroxy-D3.

The world is changing, isn't it? Things that we thought were rules of nutrition that we learned and memorized to get good grades now appear to be the wrong answers. There is new information that has

caused us to reconsider the RDA and its adequacy. The full paper that relates to the editorial by Drs. Schwartz and Blot is titled 'Perspective Study and Predictors of Vitamin D Status and Cancer Incidence and Mortality in Men.'[11] The authors of this study state that low levels of vitamin D may be associated with increased cancer incidence and mortality in men, particularly for digestive-system cancers, and a vitamin D supplementation program may be necessary to achieve adequate levels of 25-hydroxyvitamin D in the range of 30 or more nmol/L.

Trying to establish the tolerable upper intake for vitamin D and safety is another part of our review. There is a discussion of this subject in the *Journal of Nutrition* that has suggests that if we really want to understand the upper tolerable level of vitamin D we should be measuring the 25-hydroxyvitamin D_3 level and the serum calcium-phosphorus ratio.[12] We do not want to get above 500 or so nmol/L for 25-hydroxyvitamin D_3, and we certainly do not want to cause hypercalcemia (as evidenced in the blood).

What are the barriers for optimizing vitamin D intake, particularly in older age individuals? This is the subject of an article by Dr. Robert Heaney that appeared in the *Journal ofNutrition*.[13] I think it is the fear that older-age people may have about sun exposure; they may be using high SPF formulas to block the risk to skin cancer. Also, they may have diets that are compromised relative to vitamin D, and so a supplementation program is probably desirable.

We recognize now that vitamin D as a hormonal form (the 25-hydroxy and then later the 1,25-dihydroxyvitamin D_3) can actually be formed *in situ* in certain tissues. The human mammary epithelial cells have been found to express CYP27B1, which converts 25-hydroxyvitamin D_3 to it active form. These studies (discussed in a recent issue of the *Journal of Nutrition*) demonstrate that nontransformed human mammary cells express as CYP27B1, that they are growth inhibited by physiologically relevant concentrations of 25-hydroxyvitamin D_3, and this provides a biological mechanism linking vitamin D status to breast cancer.[14]

Vitamin D and Male Osteoporosis
Osteoporosis is not just seen in females; it is also seen in older-age males. This is related to vitamin D status, so physicians ought to be measuring 25-hydroxyvitamin D_3 levels in males (relative to skeletal integrity) and coupling that together with bone mineral density and amyloid peptide studies for bone demineralization. This is discussed at some length in an article titled 'Assessment of Vitamin D Status in Male Osteoporosis' that appeared in *Clinical Chemistry*.[15]

Much of what we have witnessed with bariatric surgery and malabsorption syndrome could be related to vitamin D. A lot of other potential adverse downstream outcomes that I have just described (heart, endocrine, and skeletal problems) may be effects from some of the things that we are trying to use to treat problems. Life is always more confusing than it seems, but I think we are going to learn much more about how to make this complex topic understandable from our clinician of the month, Dr. Lee Trotter.

INTERVIEW TRANSCRIPT

Clinician/Researcher of the Month
Lee Trotter, DO
410 Fleischman Way
Carson City, NV 89703

(775) 887-8885

JB: Those of you who are long-time Functional Medicine Update subscribers know how fortunate we are to have remarkable clinicians and researchers of the month that continue to stimulate us and point us to the future of where medicine might be going. We are fortunate this month to have such a personality who will, I think, help us understand a major trend that is happening in medicine. I am speaking about bariatric surgery.

We have not done a lot on the subject of surgery on Functional Medicine Update over the last 25 years, but we are very fortunate to have a world leader in the area of bariatric surgery, Dr. Lee Trotter. Dr. Trotter has a dramatic and remarkable background, not just in the bariatric area, but also thoracic surgery, trauma-related surgery, cosmetic and reconstructive surgery, and endoscopy-related work. He had a tremendous reputation while serving as a surgeon in the military. Following his military service, he was medical director of the Black Hills Bariatric Center in Rapid City, SD. More recently, he is medical director of the Carson/Tahoe Hospital Medical Surgical Weight Loss Center (American Society of Bariatric Surgeons, Center of Excellence, provisional status approved). Dr. Trotter is a board-certified surgeon, and a member of the American Society of Bariatric Surgery. He has been a diplomat in the American College of Surgery since 1994. Beyond that, he is a dramatic broad thinker, and quite an interesting human being with a broad range of interests and you will hear about those as we have a chance to visit with him.

Dr. Trotter, it is wonderful to welcome you to Functional Medicine Update. My first question is, can you give us a little bit of your history in surgery over the last 15-20 years?

LT: It goes back to my early high school and college years. I always wanted to be a plastic surgeon, looking at reconstruction. You see the pictures on TV of some of these children with facial deformities, and that is kind of what got me moving toward the surgery area.

My father was a chiropractor, and so my upbringing was perhaps a little bit different than traditional-or allopathic-medicine. I ended up going to an osteopathic medical school. I believed it would give me a little broader aspect of teaching. A little-if you want to use the word-'holistic' approach to medicine, and not just strictly western medicine.

It was at that point that I joined the Air Force, and ultimately went through residency training with the Air Force at Keesler Medical Center. It was toward the latter part of my training that laproscopic surgery, as we know it today, came into being. For whatever reasons, I was given a gift for what people might term 'Nintendo' surgery, or the laproscopic techniques. Early on, I was able to perform surgeries that my professors were doing traditionally open. That is basically how I started on my surgical career, and ultimately got into the bariatric arena. That's me in a nutshell.

The Future of Surgery: Laproscopic Technology

JB: Having only observed laproscopic surgery a few times, it seems like it is a remarkable breakthrough in technology, relative to the field and the trauma of the patient, but it also seems like it selects for certain hand-eye coordination skills in the surgeon. It seems like maybe not everybody is capable of doing it as effectively as you. I would imagine, as we start to see this technique be used more and more in surgery, that it is going to select for certain skill sets within individuals who are in the surgical field. Has that been

your observation?

LT: Without a question. In fact, if I might be so bold to say so, I think in the next decade you are going to see that traditional surgery through large incisions, as has been done in the past, will be a thing of the past. Just about every surgery that we have done historically is now being done laproscopically, which, for the patient, is a tremendous benefit. It is a lot less invasive. The recovery times are significantly less. And in multiple studies it has been shown to have less of a complication rate and better overall success rate for the patient.

JB: With that, the other feature that you just alluded to briefly that paints a unique picture of you, is the interest that you have had in nutrition and how that ultimately will weave into this discussion that we are going to have around bariatric surgery, both pre- and post-recovery experiences. What was the connection you had to nutrition?

The History of Weight-Loss Surgery
LT: That started with my father (a chiropractor). I was raised to believe that nutrition was a very important aspect of overall health and well-being. I think this was solidified for me in my early surgery years, when we were reversing jejunoileal bypasses that were done in the early 50's as a weight-loss procedure.

Historically, it was in the early 50's when we started doing surgery specifically for weight loss. At that point, we had a very rudimentary understanding of the whole disease process. It was felt that if we could essentially bypass all the absorptive capabilities of the small bowel, the patients could continue to eat what they desired and they would be unable to absorb the nutrients, and therefore, they would lose weight.

It was in my early surgical years that we would see the end result of decades of malabsorption in these patients. They would come in with kidney and hepatic failure. They would have all kinds of metabolic disturbances that they were unable to manage. And so, I saw the end result of severe protein malnutrition, if you will. We were then reversing these procedures, and it came to my attention at that point (and this is what I was taught), that obesity was not a surgical disease. I really had a bad taste in my mouth about surgery for obesity, just from my early years and seeing the end result of malnutrition.

That brings us up to about eight years ago, when I was looking into obesity surgery and thinking about going into it. I had the laproscopic skills to do it, and it was actually the industry that came to me, asking me to perform these procedures laproscopically. When I started reviewing literature, I questioned what we are going to do differently now that we did not do in the 50's. What will make a difference in these people so we don't just repeat history? Of course, the biggest part of that was the nutrition aspect. That is where my nutrition focus kind of diverged from the surgical procedures.

JB: For the sake of some of our listeners who may not be familiar with what is happening in the field of bariatric surgery, can you tell us a little bit about what you see-as a surgeon-happening in the field of surgery and how it relates to bariatric surgery and what are the different procedures that people are using because often maybe we think there is just one procedure?

The Three Categories of Weight-Loss Surgery

LT: You bet. We can simplify the types of surgical procedures into basically three categories. One of them would be the malabsorptive category: bypass all of the intestines so that you can't absorb the amount of calories that you would otherwise absorb. The second category would be one of restriction: let's just make the stomach so small that one cannot put very much food in there, and so you get full very quickly and the calorie limitation is based on gastric size. And then the third category would be kind of a combination of both, where we take elements of the malabsorptive procedures and elements of the restrictive procedures and put them together.

Today, the gold standard is what we term the Roux-en-Y gastric bypass. This is in honor of Dr. Roux, who came up with this intestinal rearrangement that physically looks like the shape of a 'Y.' If I could draw it out for you, basically you would have this 'Y' of intestines, with one of the limbs going to a very small stomach pouch.

There are benefits and downsides to all of these procedures. The malabsorptive procedures are typically very high maintenance procedures, and as such (at least in the United States), we don't really do those routinely. However, they are the most effective for weight loss. If we had a patient with BMIs in the 60 to 70 range, that may be a nice alternative for them.

The restrictive procedures come in various flavors. Through the 70's and 80's, these were most notably known by the words, 'I had my stomach stapled.' For every surgeon there was a different version of how this might be performed, so it was very inconsistent. Perhaps one of the more common restrictive procedures is called the vertical banded gastroplasty. Basically, a staple line is made across the stomach, and then a small band is placed adjacent to that (at a 90 degree angle) to limit the opening of that small pouch. The point that needs to be made with this procedure is that the pylorus remains intact; the food goes first into a little 'staging' stomach, if you will (or the small stomach), and then drops in to the native larger stomach, and then goes through the pylorus as it normally would. This prevents what we term 'dumping syndrome.' That was the main benefit of that procedure, but patients would develop a maladaptive eating disorder and could eat high-calorie liquids. Therefore, the weight loss (long term) was very poor.

Today, we have a variation of this vertical banded gastroplasty, which we term the 'LAP-Band.' This is a device that is a plastic ring, and on the inside of this ring is a balloon that is attached to a tube and then a port that is placed in the subcutaneous tissue. A physician can inject saline into the balloon to inflate it, consequently making the opening of that stomach narrower because this ring is placed right up at the top of the stomach. If the patient has trouble swallowing, they can then deflate that balloon in a reverse manner so the patient can eat more effectively. Today, that has become a very popular device because it can be placed laproscopically in about a half-hour, and there is no dividing of any intestines, so therefore (it would seem) the complication rate overall may be less. However, that ring can be become displaced; it can erode into the stomach, and it can also cause difficulties with reflux (heartburn, esophagitis); the device is not without its problems.

The gold standard, of course, is the Roux-en-Y, which is probably performed laproscopically by most bariatric surgeons today. The benefit of that procedure is that there is a very small gastric pouch, about the size of a golf ball. The remainder of the stomach is left in place; there is no stomach resection. For purposes of understanding, should this procedure need to be reversed, all the pieces of the puzzle are still there. It could be reversed, although we don't do that routinely. So we've got the small stomach pouch,

then there is that Y-that Roux-en-Y-that I made reference to earlier. One of the limbs of that Y is pulled up to that small stomach pouch and attached, so that now the food that is eaten will go into the small, golf-ball-sized stomach pouch, then go through the anastomosis, which is a fixed diameter connection, into the jejunum. The problem with this is that it sets up what we call a 'dumping physiology,' where the small bowel will receive (without control) whatever foods are eaten. Should they be high in sugar content, this is usually not tolerated; the small bowel wants to eliminate it as fast as possible. Patients will experience cramping, flushing, nausea, and ultimately diarrhea, hence the name 'dumping syndrome.' This whole process takes place perhaps 15 to 20 minutes after they eat, and can last for several hours. One of the benefits is that this is a forced behavior modification. Those foods that these patients should not be eating typically are not eaten because of the dramatic penalty that occurs immediately after eating. The main portion of the stomach-the pylorus, the duodenum-have all been bypassed. That is important for later discussion when we start talking about malabsorptive issues and problems with vitamin and mineral absorption.

Basically, these are the three types of procedures. To summarize, we've got the LAP-Band, representing the restrictive type of procedures. We have the Roux-en-Y gastric bypass that represents a combination of both restrictive and malabsorptive procedures. And then, on the fringes and not used much in our country, but in other countries is used a little more frequently, is the pure malabsorptive (or duodenal switch); it is also referred to as biliopancreatic bypass.

JB: Lee, that was just a magnificent summary. Thank you. I know there is a tremendous amount of other stuff underneath that, but that really helps us to get a perspective. What are the thresholds that you as a surgeon use when you evaluate a patient for the Roux-en-Y? In terms of BMI or metabolic status, what are the criteria you would generally use?

Evaluating Patients for Bariatric Surgery

LT: We use the criteria that has been established by the National Institutes of Health (NIH), as well as through the World Health Organization (WHO) to evaluate patients for surgery. Back in 1991, a consensus panel for the NIH comprised of multiple disciplines ranging from internists to surgeons to endocrinologists-various organizations that had any type of interest in weight loss- published a consensus, and so I will make reference to that. This is the criteria we use even today in our offices.

The first thing is that patients must have tried a non-surgical approach to weight management. This may or may not necessarily include medication. We are all familiar with the phen-fen issue of years' past. Medicines do have their downsides and they may be contraindicated in some patients, for example, perhaps those with hypertension. So, they don't necessarily have to have taken medication, but they needed to have been overseen by a physician who has experience in weight loss. That is the entry gate-they have to have tried non-operative management and failed that. Statistics show that for people who are in the 80- to 100-pound overweight category, upwards of 95 percent of these patients will fail medical weight loss. That is looking at (roughly) the 3- to 5-year mark after making these attempts.

The second criteria that we look at would be that of their actual weight. We found that the more accurate way of assessing somebody's weight was with a Body Mass Index (BMI). That is a relationship between the patient's height versus their weight. We use a table to look it up and there is a formula that one could run things through. It is quite a bit better than the Metropolitan Life Insurance table that we are all familiar with, where we have the male/female chart, and then you decide if you are light-, medium-, or

heavy-boned. I think that data has been long since put to rest, and we now rely primarily on Body Mass Index. Those who have a BMI greater than 40 will be surgical candidates based purely on their weight. That is with stratifying the complications of surgery against the complications of non-surgical management. We find-in several studies-that those who have a BMI greater than 40 can have upwards of 10 times the mortality rate with non-operative management. This is why we would qualify those patients.

Let's say a particular patient already has comorbid conditions of their weight, such as obstructive sleep apnea, diabetes, or hypertension. If these types of problems are already present, we will reduce the weight requirement to a Body Mass Index of 35. Since these folks already have complications of their disease, we find they would benefit.

Patients also must go through a very comprehensive preoperative evaluation to stratify their surgical risk. This would include a psychiatric evaluation to determine if there are any eating disorders present. Why are they heavy? Do they use food to cope with stress? These types of issues do come up quite frequently. If we remove the ability to eat larger quantities of food, what is a patient going to replace that coping mechanism with? It is very important from a psychology standpoint that we figure out these patients.

They need to undergo standard blood work to make sure there is no obvious hormonal problem, perhaps with hypothyroidism. We need to check their lung functions and obtain EKG chest x-rays. And any other particular problems that they may have need to also be evaluated and controlled. For instance, with a lot of patients I see, we will be discussing various issues of their life, and I'll hear that they pull up to a stop sign and fall asleep. This is an indicator, perhaps, of sleep apnea. We will obtain a sleep study preoperatively and initiate treatment for that prior to surgery.

Those are some of the basics of what we look at in a patient. The patient also needs to be extensively educated on the types of procedures that are available. What are the life-long ramifications that are going to take place, not only from a nutritional standpoint, but from a physical activity standpoint? A lot of these people have disabilities from their weight; they have knee, ankle, and hip difficulties that don't permit them to do routine activities. This is vital to success, postoperatively, so we need to get them with an exercise physiologist and into physical therapy to help them with that preoperatively.

A lot of people think these heavy folks just sit around and eat, eat, eat all day long and (from a protein/nutritional standpoint) that these folks would be very robust and very healthy, but it is quite the opposite. These folks are typically severely malnourished. When you look at their body composition, they may have additional muscle mass for their size, but when you look at the composition with regard to lean mass versus fatty tissue mass, it is severely abnormal. I recognize this in surgery; the quality of their tissue is very poor. Oftentimes you can put a stitch in a healthy person's tissue and it holds very nicely. With these folks you'll put a stitch in and it will be like trying to stitch wet tissue paper together; it is very difficult. I can't really measure that, per se, but I can tell you that their body tissues are not healthy at all. So we start with a nutritional program preoperatively, trying to reverse some of these malnutrition issues so the patient will be able to tolerate the stress of the surgical procedure much better. That is kind of a long answer for criteria.

JB: That was very helpful. This is obviously a series of procedures that are being used more frequently in the United States and elsewhere in the developed world. How many procedures a year, approximately, are we talking about today?

LT: The statistics for 2005 put this procedure at about 140,000 to 150,000 just in our country alone. Every year it seems to be going up, geometrically. At one of our bariatric meetings (I'm sorry, I don't remember the speaker), a comment was made that we have seen an explosion of surgeries, and the speaker said that we have not seen the explosion yet, we have just lit the fuse. This begs multiple questions as far as why, in our country, are we seeing the preponderance of obesity that we are. What is different now than, say, 20 years ago, when there was just a fraction of what we are seeing, weight-wise? But it is not just limited to the United States. There is this fallacy that Americans are basically gluttonous-type people, but if you look at the weight of other (even third-world) countries, they are also seeing geometric rises in the weight of their own populations. It is not just the United States, it is a worldwide problem.

JB: I know that you have had extraordinary experience, yourself, in this procedure. How many patients have you operated on?

LT: I, personally, have operated (primary procedures, laproscopically) on about 600 people.

JB: Are there surgeons who have done thousands of these procedures?

LT: Absolutely. I am not going to profess to have a tremendous case load, but I can tell you that after the first 100 patients, you really get a good feel for what these patients' problems are and what their needs are. This is what got me into the nutrition arena. Surgeons, in general (and I am not trying to defend or talk down about a profession), go through our medical and our surgery residency training, and there really is very little emphasis placed on the nutritional aspects of our patients. We have become very talented and gifted-the laproscopic developments over the last decade have been extraordinary. I am awed-in just my short career in surgery-by the dramatic changes that have taken place. I could probably tell you that when I look back at when I first started surgery about 18 years ago, and I look at what I do today, the practice is 100 percent different. The things that I learned and the techniques I used 18 years ago are completely different (although I use the same principles). And that is just in one guy's short lifespan. It is exciting to think about what the future holds.

Although we have come so far on the technical side, the physiological side of surgery (and particularly the nutritional side of surgery) has kind of been left in the background and I think there is so much work that needs to be done. The understanding that could help our patients have better outcomes and more fuller lives-I think there is a lot there that can be offered. This is where I started with bariatric surgery.

As I mentioned, my earlier experience was that of a severe malnutrition issue in these weight-loss patients. I started doing the Roux-en-Y gastric bypass laproscopically on my patients, and technically I did really well. I can tell you that to date I have never had a leak, which is the most feared complication of these procedures. But I noticed that postoperatively in my patients, although I did what I would term a 'perfect surgery,' I was not obtaining perfect outcomes. I had patients with excessive hair loss, excessive fatigue, and-with the very things I was trying to remedy-I didn't seem to be making much headway.

Postoperative Challenge: Maintaining Lean Muscle Mass

Then I started looking into nutritional aspects because of my prior experiences. One of the interesting things I found, and I was very skeptical at first, was that of bioelectrical impedance analysis (BIA). That is a whole topic in and amongst itself, but suffice it to say that this body composition analysis for trending

was helpful (and, I found, accurate) and reflective of how patients were eating, how they were exercising, and how (overall) they were doing. Were they doing well? Were they utilizing that tool that I had given them properly or not? I am not trying to product name drop or degrade any of these, but I used Carnation Instant Breakfast. I used Flinstones Vitamins. And I found, when I looked at body composition analysis, that they were losing weight, yes, but they were not losing the proper weight. I saw excessive lean muscle mass loss, to the tune of upwards of about 25 percent. With my trauma background I knew that when you are talking about 25 percent lean mass loss it is extraordinary and unacceptable. But in the bariatric circles, as long as the scale showed that we had weight loss, that was our measurement of success, and I thought it was a very inaccurate measurement.

I started looking at various products and was disappointed in that going through a whole array of different products available on the market, I could not be successful in maintaining lean mass. You need to remember that these patients are limited in what they can eat. They have a golf-ball-sized stomach pouch and they would come back saying, 'Dr. Trotter, I cannot physically put another drop of liquid anything in me. I am full up to my eyeballs. There is just no way I can do any more of this.' And so I started thinking that perhaps it wasn't necessarily an intake problem, but perhaps rather an absorption problem. Since I wasn't really able to alter the patient's anatomy, I needed to look at the quality of what patients were taking.

That is what got me looking into the nutritional aspects, and I had a lot to learn. The learning did not come from medical sources, and I was a little disappointed. In talking to some very knowledgeable people throughout the country, I slowly picked up that not all food and not all supplements are created equal. There are benefits from specially 'engineered'-type products that were much more specific for these patients so that their tool (that I had given them surgically) could be used much more efficiently, and that we could meet the goals not only of weight loss, but improved health. For me, that is where the nutrition and the surgery now come together. We have great surgical skills, and I do believe we have great knowledge today about some of the nutritional dynamics in how to truly fool Mother Nature in a way that we can lose the weight, but do it responsibly while maintaining health.

I do believe it is possible, and, in fact, over the last seven or eight years or so, I have demonstrated that we can minimize lean muscle mass loss. That reflects in the patient's well-being, not only in the biological markers that I can measure through blood draws, but also in sitting and talking to a patient. How do you feel? How is your life now, quality-wise, compared to before? There is a marked difference.

JB: That is an extraordinary story. Using engineered foods both pre- and post-op to improve nutritional status would imply both macronutrients (things that are protein, carbohydrate, or fat) as well as micronutrients. What kind of biomarkers and outcome do you look at? For instance, you mentioned hair loss. Are there other kinds of biomarkers that you use as indicators of the nutritional status of the patient?

Biomarkers of Nutritional Status
LT: In our office, what we use routinely, as I made reference to, is a body composition analysis. That gives us kind of an overall picture. Remember, these are trends that we follow. On our first visit with these patients, I obtain a baseline study. From that study, we compare subsequent studies, pre- and post-op. That gives us an overall look.

There are several labs that I believe are very important. I have found that following albumin and pre-

albumin levels has not been as helpful to me in determining how well a patient is doing as the body composition analysis, although we do follow those. Some of the other markers that we look at are vitamin B12 levels, thiamin, vitamin A, 25-hydroxyvitamin D, parathyroid levels, serum iron, folate, and then just a comprehensive metabolic panel that would comprise electrolytes, glucose, kidney function, and hepatic function. For diabetics, we will obtain hemoglobin A1Cs, and for those who have prior history of hyperlipidemias, we will obtain a lipid profile as well. So, that would be kind of a standard blood profile that we would look at. All of these are important.

There are a lot of potential long-term complications, even with the Roux-en-Y gastric bypass. We don't see these things as frequently with the restrictive procedures, such as the LAP-Band, because patients are able to eat essentially everything they would like without consequence, as far as dumping syndrome goes. With the Roux-en-Y, though, the duodenum has been bypassed (your listeners may recall that the duodenum is an important area for iron absorption and for the B-complex vitamin absorption). Also, more distally, you can have B12 malabsorption. There is not really an intrinsic factor-bound B12 complex because that portion of the stomach has been bypassed, so B12 can become an issue. Vitamin A can become an issue. It is, of course, one of the fat soluble vitamins. If you have a patient who has had a malabsorptive procedure, you really have to watch the fat soluble vitamins (A, D, E, and K) because I can guarantee you will have malabsorption of these, and then vitamin deficiencies that go along with them. With the Roux-en-Y, osteoporosis and anemia, as well as thiamin deficiencies, have been quite prevalent. In even the surgical literature, these problems are being brought up more frequently. For osteoporosis, instead of waiting until you can actually, on study, identify bone mineralization problems, I follow parathyroid hormone levels, and find that they will be slightly elevated. When I encounter this, typically the vitamin D levels may actually be low-normal, but I find that if you push those low-normal levels up into a mid- or upper-normal range with added calcium, parathyroid hormone level will drop down into the normal range. I think this will go a long way in preventing the osteoporosis that we have been seeing in these patients.

JB: I am going to have to break in because I know you have a busy schedule and we are coming to the end of our time. I think that what you have brought to us is an absolutely fascinating example of how functional thinking in medicine can create a different and more improved patient outcome. The coupling of extraordinary skills in surgery with the kind of mindset you have about patient outcome and looking at metabolic and nutritional parameters produces an outcome that probably has not been seen by most of your colleagues who are doing the surgery. It sounds to me like your patients remarkably benefit from this kind of thinking and I bet you get tremendous patient satisfaction and referral based on the way you are approaching this.

I want to thank you. I think this is a conversation that we need to continue to explore because it has so many interesting implications relative to why we are getting obese: what are the nutritional problems, why do people who look like they have too much nutrition because they are so ponderous actually have undernutrition, and what are the metabolic consequences of this? If you wouldn't mind, I'd like to come back and revisit with you at another time for a continuation of this discussion because I believe it has an implication not just solely on the morbid obesity-related problem, but this whole epidemic that we are seeing of metabolic transitions in our society.

LT: Absolutely. Right now, obesity and the problems associated with it has surpassed tobacco-related deaths. We have over 300,000 deaths directly related to obesity in our country every year. This is a

problem that is not going away; it is being amplified every year. We've got, as you referenced, metabolic syndrome issues, and this is all part of this big picture. There are so many areas to explore that are very exciting and I'd be happy to discuss some of these things.

For physicians, if they do not have bariatric patients now, they will in the future, and knowing some of the anatomy and some of the pathophysiologic conditions that can occur as a result of the altered anatomy will go a long way in helping patients. In closing, for every one patient I've operated on, I probably see ten patients that have had procedures elsewhere that were done very well; it is not a procedure-related issue.

JB: I can't thank you enough. What an extraordinary course you have given us here in really a very short period of time. I am going to take you up on your willingness to revisit this topic at a future time. I wish you and your patients the very best. I think those people who go to the Carson-Tahoe Hospital Medical-Surgical Weight Loss Center and are seen by you and your staff are getting a tremendous benefit. Thank you very much and we'll be in touch soon.

What a marvelous job Dr. Trotter did in describing a very complex topic in a very short period of time. I think you are probably as amazed as I am at how well he could cover this expansive amount of material in such a clear and understandable way. We are not experts in the field of bariatric surgery and how nutrition relates to it at the end of this discussion, but certainly we know a lot more now than we did before we had the pleasure of listening to Dr. Trotter.

One of the things I would like to follow up with in close this month is how this all relates to some of the more garden-variety problems that we are experiencing in populations that are not morbidly obese. That is, what role does the flux of molecules that come from our highly processed, shelf stable, convenience diet have on things like longevity and health and disease patterns? These are questions that obviously will be debated, discussed, defined, and massaged for years to come, but I think it is important for us to at least continue to put stakes in the ground as we learn more about this-trying to understand the complex issues and then how to translate this into individualized, personalized patient management through our functional medicine approach

A Clinical Study on Calorie Restriction

With that in mind, I was very impressed when I saw a paper published in The Journal of the American Medical Association titled 'Effect of 6-Month Calorie Restriction on Biomarkers of Longevity, Metabolic Adaptation, and Oxidative Stress in Overweight Individuals.'16 For those of you who are not familiar with this particular study, let me just give you give you a couple of quick insights into it. This was a randomized, controlled trial of healthy (or presumed healthy), sedentary men and women (about 48 of them) conducted between 2002 and 2004 at the Pennington Center in Baton Rouge, Louisiana. The participants were randomized into four groups for six months: controls; calorie restriction; calorie restriction with exercise; and very low-calorie diet (this was an 890 calorie-per-day diet until 15 percent weight reduction was achieved). It is a very interesting study. What did they find? They found that the mean weight change at six months in the four groups was as follows: the control group had a loss of weight of about 1 percent on average; the calorie restriction group without exercise had about a 10.5 percent weight reduction; the calorie restriction with exercise had about a 10 percent reduction (so it was about the same); and the very low calorie diet had about a 14 percent weight reduction.

The very low calorie diet group had the greatest amount of weight reduction. At six months, however, the metabolic principals were as follows: fasting insulin levels were significantly reduced from baseline in the intervention groups (all were P<.01), whereas DHEAS and glucose levels were unchanged; core body temperature was reduced in the calorie restriction and the calorie restriction with exercise groups, but not the very low-calorie group or the control group. After adjusting for changes in body composition, sedentary 24-hour energy expenditure was unchanged in controls, but decreased in the calorie restriction group, the calorie restriction with exercise group, and the very low-calorie diet group. The authors point out that these 'metabolic adaptations,' (based upon loss of metabolic mass) were statistically different from controls.

This is where the study gets kind of interesting. Protein carbonyl concentrations were not changed from baseline to month six in any group, whereas DNA damage was reduced from baseline in all intervention groups. The findings suggest that two biomarkers of longevity (fasting insulin levels and body temperature) were found to decrease by prolonged calorie restriction in humans and support the theory that metabolic rate is reduced beyond the level expected from reduced metabolic body mass.

What I take away from this is that if you look at a 12.5 percent calorie restriction with a 12.5 percent increase in calorie use by modest exercise, that that is an achievable value for most individuals by dietary and lifestyle modification; it does not put them at high risk and does not make them feel like they are starving and moving to some kind of a deprivation lifestyle. And yet the effects that it had on the flux of molecules over the genes that created excessive mitochondrial oxidative fire and oxidative injury and glucose intolerance was dramatic.

I think what we are learning about bariatric surgery in the extreme can be applied in ambulatory care centers by diet and lifestyle modification that is very modest-a 12 percent reduction in calories, a 12 percent increase in energy expenditure by regular exercise. Food for thought, as we move to next month's October Functional Medicine Update. Thanks so much.

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