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HUMAN NUTRITION

RESEARCH NOTES

A COMPILATION OF VITAL RESEARCH UPDATES ON HUMAN NUTRITION

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Bariatric Surgery and Mineral Nutrition

The market surrounding weight loss is one of the largest in the USA and other industrialized nations. Many millions of people turn to diet, exercise, nutritional supplements, and pharmaceuticals to help in their fight against obesity. According to the US Center for Disease Control, morbid obesity (basically people who are at least 100 pounds over their ideal body weight) is the cause for over 500,000 deaths per year in the USA. The incidence of morbid obesity is growing, and is a major health concern. For people who are morbidly obese, and have tried diet and exercise, and the other possible weight loss programs, bariatric surgery may be their best or only hope to sustain weight loss and resolve health conditions. In the early 1990's, about 16,000 bariatric surgeries were performed in a year. By 2003 this number increased to 120,000 surgeries, and swelled to over 220,000 procedures in 2008, with no end to growth in sight. Long term studies have shown that these bariatric surgeries can cause significant long term weight loss, recovery from diabetes, improvement in cardiovascular risk factors, and a reduction in mortality by a rate of 43%.

Bariatric surgery, or weight loss surgery, includes a select variety of procedures. Bariatric surgery alters the digestive process. There are basically two types of bariatric surgery in practice today: restrictive and combined. The restrictive are those that limit food intake by narrowing the passage from the upper of the stomach to the lower part, known as lap band surgery, lap banding, or gastric banding. The combined methods are those that use stomach restriction and partial bypass of the small intestine. These can be the open Roux-en-Y gastric bypass, the duodenal switch, and the laparoscopic Roux-en-Y gastric bypass. The restrictive methods physically limit the quantity of food intake, but do not interfere with digestion. The combined operations (the most common used forms) physically restrict the amount of food intake, as well as the amount of nutrition that can be absorbed. The U.S. National Institute of Health recommend bariatric surgery for obese people with a body mass index (BMI) of at least 40, and for people with a BMI of 35 with serious coexisting medical conditions, such as diabetes. It is now thought that the minimum BMI for bariatric surgery needs to be lowered to 35 for obesity, and 30 for obesity with other co-morbidities, like diabetes.

The restrictive bariatric surgical method reduces the amount of food that one can ingest to one ounce per meal (possibly 2-3 ounces after months of stretching), while the combination methods reduce the amount of food one can ingest and also limit the surface area for nutrient absorption resulting in major nutritional effects.

In the figures to the right, the drawings represent a combination (figure 1) and a restrictive (figure 2) method for bariatric surgery.

Figure 1. Combination Method

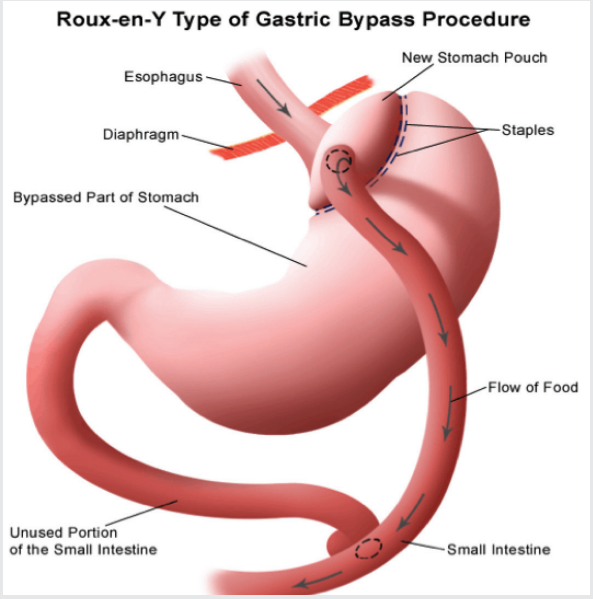
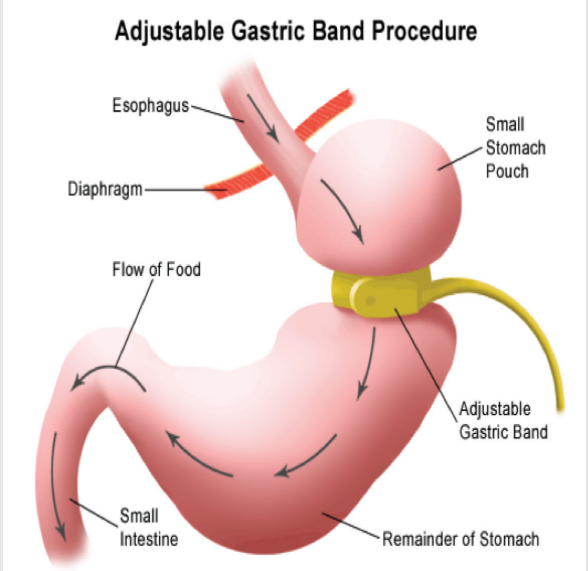


Figure 2. Restrictive Method



Effects on Mineral Nutrition

Of course, the intent of any of the forms of bariatric surgery is to cause a significant and sustained decrease in body weight. However, the benefits of bariatric surgery go beyond that, and with proper post surgical care, patients feel better and are healthier. The outcomes of bariatric surgery include:

- 90% of patients lose at least 50% of excess body weight
- Most people with hypertension and/or diabetes no longer need medication
- Young women with normal or absent menses may see a return of normal periods and improved fertility
- Many males experience improved sexual function
- A reduction in sleep apnea
- Improvement in arthritic symptoms
- Improved self esteem and energy

However, along with all this good can come some bad potential outcomes. There has been much research done on the aftermath of bariatric surgery. It has been commonly found that the bariatric surgical procedures can lead to a wide range of nutrient deficiencies. It would appear that certain types of bariatric surgery can impart a greater degree of nutrient deficiencies than other. Does the combination procedure cause more nutritional problems than the restrictive? Is the one that causes more deficiency problems also the one that is most effective for weight loss?

Here are the abstracts of a few of the many clinical reports on the nutrient deficiencies associated with bariatric surgery:

Origins of and Recognition of Micronutrient Deficiencies after Gastric Bypass Surgery

Bal BS; Finelli FC; Koch TR.
Curr Diab Rep. 2011; 11(2):136-41.

The gastric bypass surgery known as Roux-en-Y remains the major surgical option for individuals with medical obesity. The importance of preoperative evaluation to permit identification of micronutrient deficiencies is being re-evaluated. The risk of complications related to pregnancy after gastric bypass supports careful follow-up. Micronutrient deficiencies are common in post gastric bypass patients, despite the suggested use of routine vitamin and mineral supplements after surgery. Copper deficiency must be considered as an origin for visual disorders after gastric bypass. Vitamin D deficiency with metabolic bone disease remains common after gastric bypass and the results suggest that the present postoperative supplements of calcium and vitamin D are inadequate. Major nutritional complications of bariatric surgery are occurring more than 20 years after surgery. There is no evidence for intestinal adaptation as there remains decreased intestinal absorption of iron up to 18 months after gastric bypass surgery. This article supports ongoing examination of nutritional complications after gastric bypass surgery and supports the notion that the daily doses of micronutrient supplements, such as vitamin D, may need to be revised.

Altered Plasma Response to Zinc and Iron Tolerance Test after Roux-en-Y Gastric Bypass

Rosa FT; de Oliveira-Penaforte FR; de Arruda Leme I; Padovan GJ; Ceneviva R; Marchini JS.
Surg Obes Relat Dis. 2011; 7(3):309-14.

Roux-en-Y gastric bypass excludes the duodenum and proximal jejunum, however these sites are where iron and zinc are most absorbed. Therefore, they are among the nutrients whose digestive and absorptive process can be impaired after surgery. The aim of the present study was to investigate the iron and zinc plasma response to a tolerance test before and after bariatric surgery. The study was performed at São Paulo University School of Medicine of Ribeirão Preto, Brazil. In a longitudinal paired study, 9 morbidly obese women (body mass index ≤40 kg/m(2)) underwent an iron and zinc tolerance test before and 3 months after surgery. The iron and zinc levels were determined at 0, 1, 2, 3, and 4 hours after a physiologic unique oral dose. The mineral concentrations in the plasma and 24-hour urine sample were assayed using an atomic absorption spectrophotometer. The anthropometric measurements and 3-day food record were also evaluated. A linear mixed model was used to compare the plasma concentration versus interval after the oral dose, before and after surgery. The pre- and postoperative test results revealed a significantly lower plasma zinc response ($P < .01$) and a delayed response to iron intake after surgery. The total plasma iron concentration area, during the 4 hours, was not different after surgery ($P > .05$). The 24-hour urinary iron and zinc excretion did not differ between the pre- and postoperative phases. The present data showed a compromised response to the zinc tolerance test after gastric bypass surgery, suggesting an impaired absorption of zinc. More attention must be devoted to zinc nutritional status after surgery.

[Nutritional deficiencies in bariatric surgery patients: prevention, diagnosis and treatment]

Schweiger C; Keidar A.
Harefuah. 2010; 149(11):715-20, 748 .

The number of people requiring bariatric surgery in the western world is constantly growing. In 1997 the World Health Organization (WHO) defined obesity as a plague and one of greatest public health hazards of our time. The National Institution of Health (NIH) declared that surgery is the only long-term solution for obesity. Today there are four different types of bariatric surgery. Each variation has different implications on the nutritional status of bariatric surgery patients. Bariatric surgery candidates are at risk of developing vitamin and mineral nutritional deficiencies in the post-operative stage, due to vomiting, decrease in food intake, food intolerance, diminution of gastric secretions and bypass of absorption area. It is easier and more efficient to treat nutritional deficiencies in the preoperative stage. Therefore, preoperative detection and correction are crucial. Blood tests before surgery to detect and treat nutritional deficiencies are crucial. In the postoperative period, blood tests should be conducted every 3 months in the first year after operation, every six months in the second year and annually thereafter. Multivitamin is recommended to prevent nutritional deficiencies in all bariatric surgery patients. Furthermore, iron, calcium, Vitamin D and B12 are additionally recommended for Roux-en-Y Gastric Bypass patients. Patients with Biliopancreatic diversion and Duodenal Switch should also take fat soluble vitamins.

Obesity, Bariatric Surgery, and Iron Deficiency: True, True, True and Related

Love AL; Billett HH.
Am J Hematol. 2008; 83(5):403-9.

The health condition referred to as morbid obesity is defined by its nonresponsiveness to diet, exercise, and medical treatment. Surgeries designed to promote weight loss, termed bariatric surgery and typically involving a gastric bypass procedure, have recently been implemented to treat obesity with high success rates. However, long-term sequelae can result in micronutrient deficiencies. This review will focus on iron deficiency and its association with obesity and bariatric surgery. Iron deficiency develops after gastric bypass for several reasons including intolerance for red meat, diminished gastric acid secretion, and exclusion of the duodenum from the alimentary tract. Menstruating women, pregnant women, and adolescents may be par-

ticularly predisposed toward developing iron deficiency and microcytic anemias after bypass surgery. Preoperative assessment of patients should include a complete hematological work-up, including measurement of iron stores. Post-operatively, oral iron prophylaxis and vitamin C in addition to a multivitamin should be prescribed for bypass patients, especially for vulnerable populations. Once iron deficiency has developed, it may prove refractory to oral treatment, and require parenteral iron, blood transfusions, or surgical interventions. Bariatric surgery patients require lifelong follow-up of hematological and iron parameters since iron deficiency and anemia may develop years after surgery.

Summary of Findings

According to a review article by Ammor N, et al. [Rev Med Suiss; 2009; 5(196):676-9], overall 98% of patients undergoing gastric bypass develop multiple micronutrient deficiencies. The list of minerals that have been shown to become deficient due to malabsorption after the bariatric surgeries include:

Calcium	Magnesium	Iron
Zinc	Selenium	Copper

The potential seriousness of this malabsorption after bariatric surgery is exacerbated by the fact that most obese patients already have some mineral deficiencies. Iron deficiency anemia is seen in all forms of bariatric surgery, with an incidence as high as 67% seen in combined procedures, such as Roux-en-Y gastric bypass. Iron deficiency in bariatric surgical cases is made even more difficult to treat due to the high prevalence of anemia of chronic inflammation seen in the obese. Zinc deficiency, like iron deficiency is one of the most common mineral deficiencies associated with the bariatric surgeries. According to the study by Salle', A, et al [Obes Surg. 2010; 20(12):1660-70], concerning 324 morbidly obese patients who had one of three forms of bariatric procedures (gastric bypass, sleeve gastrectomy, or duodenal switch), 42 .5% were zinc deficient at month 12 post surgical. The patients who were given the duodenal switch procedure had an incidence of zinc deficiency at month 12 of an astonishing 91.7%. Research has also shown that in premenopausal women undergoing Roux-en-Y gastric bypass, there is calcium malabsorption that contributes to the development of secondary hyperparathyroidism in these patients. Some rarely seen deficiencies are occurring post bariatric surgery. Selenium deficiency induced cardiomypathy has been reported subsequent to bariatric surgery. It has been noted that the nutritional complications of bariatric surgery have been found 20 years post surgery, and that these patients should be under life long nutritional follow up.

The mineral deficiencies due to the bariatric surgical procedures can be due to the decrease in food volume, decrease in digestive time, lack of sufficient digestive juices, as well as the bypassing of key mineral absorptive spaces in the upper duodenum seen in some of the bariatric surgeries.

Given the overall effect that bariatric surgery has on the ability to digest and absorb minerals, trying to correct the associated mineral deficiencies becomes an imposing challenge. Most minerals, like the typical salt forms (sulfates, carbonates, citrates, and oxides) require acidification, in order to be absorbed. In addition, these types of minerals are absorbed in a very limited space high up in the duodenum. The very space that is often bypassed in the combination bariatric form of surgery.

The selection of what form of mineral to use in supplementing the post bariatric surgical patient would seem to be an important decision. In certain forms of bariatric surgery, like the combination form and the duodenal switch, it is even more of a concern. The properties of the mineral glycinate chelates (Albion TRAACS) make them one of the best forms of mineral for the bariatric supplementation formulas. These mineral glycinate chelates (more accurately bisglycinate) do not require acidification to set them up for absorption, and they are absorbed over a much longer segment of the small intestine. The mineral glycinate chelates are absorbed in the ileum and jejunum, giving the bariatric post surgical patient a much larger surface area for absorption.

Albion's Mineral Glycinate Chelates are:

- Higher in bioavailability
- Gentle on the GI tract
- Suffer from less dietary absorption interference
- 100% nutritional content
- Hypoallergenic

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