Review

Post-operative bariatric surgery complications: Deficiency of nutrients

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Abstract

Since more than half of the population in America falls under the category of obesity, scientists have discovered a surgical technique to reduce the weight of the obese patients. Bariatric surgery or gastric bypass surgery is a procedure that has been successful in reducing the weight for obese people. This technique requires a permanent gastric bypass (Roux-en-Y) where part of the stomach and duodenum is removed. Since the size of the stomach is reduced to 20% of its original size along with the removal of duodenum – this may lead to improper absorption of several vitamins and minerals. This review showed that several vitamins and mineral deficiencies are observed in patients, post-operative bariatric surgery. Thiamin, folate, and B12 deficiencies were most commonly observed, and Vitamin A, D, C and B6 deficiencies were also seen in some cases. Iron and calcium deficiencies were also reported by some of the studies.

Key words: Bariatric surgery, deficiency, nutrients, Roux-en-Y

Epidemic of obesity has been haunting the United States for the past decade. Healthamericans.org reported in 2005 that the number of people in America suffering from obesity was 24.5 percent in the year 2004. This number has drastically increased by the year 2011 to 35.7 percent as reported by the Center of Disease Control and Prevention (CDC). Healthcare professionals of different majors from exercise scientists to nutritionists, dietitians and physicians have put forth their efforts to control this dramatic increase in the number of people with obesity. Obesity is now risking the life of millions of people living in America because it is one of the root causes of the chronic conditions like diabetes, hypertension and other cardiovascular diseases.

This increasing concern among the healthcare professionals has led to the discovery of Bariatric surgery. It was understood that one of the major reasons for the increase of weight was because of higher caloric intake. So, the surgeons decided to reduce the size of the gastric pouch and hence to decrease the amount of caloric intake. These procedures have helped many numbers of obese people across America to lose their weight in a couple of months or in less than a year. It was expected that around 220,000 surgeries were performed in the year 2008 as reported by American Society for Metabolic and Bariatric Surgery (ASMBS). Several options and types of bariatric surgeries are now available.
One of the most common procedures performed now is Roux-en-Y. Although the results of this procedure are shown to be very effective in terms of weight loss, there have been several complications reported. This is because the procedure required the removal of gastric pouch up to the size of 30 percent along with the duodenum—which is the most common site of food/nutrient absorption. Because the major absorption site of the nutrients is removed from the body, this may lead to several complications including deficiency of several nutrients.

This paper will review the complications that are observed post-operative bariatric surgery, especially associated with Roux-en-Y procedure, emphasizing nutrient deficiency in this group of people.

Bariatric surgery

After the first gastric bypass was performed in May 1966 by Dr. Edward W. Mason for morbid obesity, bariatric surgeons have used different sizes and locations for weight reduction in patients with the BMI≥40 or BMI≥35 according to National Institutes for Health established guidelines. The main idea behind gastric bypass was to reduce the size of gastric pouch. Based on these size reductions, different terminologies were used to name bariatric gastric bypass surgery. Different types include biliopancreatic diversion with duodenal switch, laparoscopic adjustable gastric banding, sleeve gastrectomy, and the standard Roux-en-Y gastric bypass.

Roux-en-Y Gastric Bypass: Roux-en-Y Gastric Bypass is the most commonly performed weight loss surgery in the United States as reported by American Society for Metabolic and Bariatric Surgery.

Procedure:

As shown in the figure 1, the procedure required the removal of most of the part of gastric pouch, up to 70 percent including a portion of the small intestine (duodenum). The aim is to reduce the gastric size by 70–80 percent. The reduced gastric pouch of 20–30ml is connected to the jejunum forming Roux limb. The cut off duodenal limb is anastomosed 75–150cm along the Roux limb which forms the Y shape. This allows the distal part of the stomach and duodenum to bypass.

Advantages:

Through bariatric surgery, effective weight loss was achieved in morbidly obese patients post bariatric surgery. Improvement was noticed in the majority of patients with diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea. Several studies have proven it to be safe, minimally invasive with reduced intra-abdominal adhesions and diminution in the incidence of small bowel obstruction.

Anatomical considerations

Roux-en-Y gastric bypass requires removal of more than 70 percent of gastric pouch and a part of small intestine (duodenum).

Roles of Stomach: The stomach is the main gastric pouch of the gastrointestinal tract and is responsible for the absorption of alcohol and aspirin (a common pharmaceutical drug).

Roles of Duodenum: Duodenum is the first part of small intestine that is bypassed in the Roux-en-Y gastric bypass surgery along with the major portion of the gastric pouch. The major role of duodenum is absorption of different nutrients that majorly include minerals—calcium, magnesium, sodium and iron; carbohydrates; proteins and vitamins—vitamin D, thiamin, B₁₂, B₆, etc.

Therefore, by bypassing the major portion of gastric pouch and duodenum may result in the deficiency of several nutrients. This paper discusses the complications or deficiency of most common micronutrients post-operative Roux-en-Y gastric bypass surgery.

Complications: deficiency of nutrients

Several studies were reviewed to determine the deficiency of major minerals and vitamins in the
obese patients who have undergone Roux-en-Y gastric bypass surgery. Complications included death, pulmonary embolism, anastomotic leak, Roux limb necrosis, deficiency of nutrients, anemia, bleeding, infection, deep vein thrombosis, pneumonia, bowel obstruction, cholelithiasis, etc. Several vitamin deficiencies were observed after Roux-en-Y gastric bypass; some studies showed vitamin D, B12, thiamine, and folate deficiencies as the most common after surgeries and other studies reported that other fat and water soluble vitamins deficiency is lower. Mineral deficiency is the most common one that was observed because duodenum is the major site of mineral absorption. Most commonly seen deficient elements are mentioned below.

Vitamins:

Thiamine

Thiamine deficiency is one of the recognized deficiencies post bariatric surgery. A review by Marc R. Matrana compiled several studies that supported the hypothesis of thiamine deficiency. The review included around ten different studies which showed that thiamin deficiency was the most commonly found one after Roux-en-Y gastric bypass surgery. The study considered symptoms that are seen due to thiamine deficiency that includes Wernicke encephalopathy, Korsakoff syndrome and beriberi. The study confirmed the presence of above mentioned deficiencies in patients who have undergone gastric bypass. The author further explained that the major symptom (beriberi) was confirmed through these studies. There are two forms of beriberi, dry and wet form. Restrictive caloric intake is associated with dry form of beriberi and severe exercise and high carbohydrate intake. During this study it was confirmed that only dry form of beriberi was reported and there were no cases of wet form of beriberi reported in patients after Roux-en-Y gastric bypass.

Another study by Jacqueline I. Alvarez-Leite on nutrient deficiencies secondary to bariatric surgery further explains how these deficiencies are a result of not only the reduction of gastric pouch but also the other associated factors like – reduced acid production because of the removal of the large amount of area and frequent episodes of vomiting because of the surgery adaptations. This leads to the deficiency of thiamine as well. The study further explains that because of these conditions, where thiamine levels are low, if the high carbohydrate diet is given to these patients, the conditions may precipitate more because thiamine is responsible for the metabolism of carbohydrates. A total of 168, 010 bariatric surgery related deficiency cases were reported in this study by members of the American Society of Bariatric Surgery. Suggesting 50–100 gm of thiamine may correct these deficiencies in patients who have undergone bariatric surgery.

A study by Ronald H. Clements conducted an experimental study on patients in university of Alabama hospital settings at Birmingham, Alabama. The researchers collected data available from the hospital records of the patients who have undergone laparoscopic gastric bypass (LBG) performed by one surgeon from January 2002 to December 2004. A Total of 493 patients were followed for the period of two years out of which 65% had vitamin results during the first year and 35% during the second year follow up. Clinical manifestations were noted to identify the vitamin related deficiency. However, there were only 2 cases out of 493 reported with the thiamin related deficiency by the end of the study.

Vitamin B12

Another important vitamin deficiency associated to the bariatric surgery was B12. A review by John Seeniyan on nutritional deficiencies after gastric bypass surgery reported B12 deficiency after reviewing more than 5 studies related to B12 deficiency after bariatric surgery. The study explains the importance of B12, its sources, and functions in the human body. The author supports the statement of B12 deficiency by further talking about different studies that showed that alteration of gastric pouch and duodenum may result in deficiency of this vitamin because B12 binds with parietal cells in the duodenum for its absorption. Some of the complications like anemia, neuropathy, and cognitive difficulties associated to B12 deficiency were also reported in different studies.

Another study by Matrana on vitamin deficiencies first explains all the deficiencies that can be seen because of the B12 deficiency. The author also writes in the study that B12 deficiency is one of the most common deficiencies that are reported in 30% of the patients after 1 year follow up who have undergone obesity surgery. These numbers were increased after a long term follow up ranging from 36–70%. Some patients may even require higher doses of B12 i.e. 1000–3000 microgram per dose in order to prevent the deficiency and therefore the associated disorders.

Alvarez-Leite et al reported in her study that the deficiency of B12 is seen post-operative bariatric surgery because of the failure of the separation of
B12 from protein food stuff and also because of the failure of the absorption of crystalline B12 because of the deficiency of the Intrinsic factor as explained in the first study. This study reported that 12–33% of the patients who undergo gastric bypass are prevalent to deficiency of B12. 350 microgram per day is reported to prevent the deficiency after the surgery.

A prospective experimental study conducted by Ronald H. Clements at the university of Alabama reported B12 deficiency of 3.6 and 2.3 percent after the follow up of one and two year respectively. Another study was reported 12 percent of B12 deficiency after surveying 109 patients who have undergone bariatric surgery. The probability of such a low incidence compared to other studies discussed earlier was perhaps due to intake of 1000 microgram of B12 administration or 500 microgram intranasal self-administration of B12 in addition to chewable vitamin during the study, as reported by the authors.

Folate deficiency is less common compared to other vitamins like B12 and Thiamine. This is because although folate absorbs predominantly from the proximal part of the intestines, it can still get absorbed along the entire small bowel because of the adaptation after surgery. Folate deficiency may be seen with a wide range of symptoms that include but are not limited to diarrhea, anorexia, weight loss, weakness, headache, and behavioral changes. However, it is not easy to identify if the symptoms are really associated with the folate deficiency after surgery and the author explains that need to follow or treat the low levels of folate has been questioned in patients after bariatric surgery. Studies showed that this deficiency can be corrected by recommending the dose of 1mg/kg of multivitamins every day. In fact most of the time deficiencies related to folate may disappear with the vitamin supplementation alone and mostly the deficiency of folate is not considered to be clinically important after Roux – en – Y Gastric Bypass.

Clements et al reported some studies in their article on vitamin D deficiency where 26 female patients with 10 years of follow up after Roux–en–Y Gastric Bypass surgery and 7 females were included in the study who lost weight by dietary restriction as a control group. There was no significant difference found between both the groups. However, another study where 144 morbidly obese patients were studied showed the deficiency of 43.2 percent in surgery group and 27.5 in the control group but the results obtained in this study were not statistically significant. The deficiency seen in some of the patients was reported to be because of the mal absorption according to authors.

Another study reported that the deficiency of vitamin D is seen because the hormonal levels may alter after bariatric surgery. The Recommended dose of vitamin D to correct these deficiencies ranges between 5–15 micrograms.

Vitamin C and Vitamin A

The incidence of vitamin C deficiency after following for first and second year was found to be 34.6 and 35.4 percent, respectively. Whereas for vitamin A it was found to be 11 and 8.3 percent after one and two years of follow up respectively. Another study reported 65 percent after 4 year follow up of a biliopancreatic diversion with and without duodenal switch procedure. However, in case of vitamin C deficiency, the amount of literature is very limited to compare with the other studies.

Vitamin B6

B6 deficiency is rarely seen in patients who have undergone bariatric surgery. One of the studies reported that the incidence of B6 after laparoscopic gastric bypass was found to be 17.6 and 14.2 percent at one and two years follow up, respectively. It was reported that the deficiency was seen more significantly among blacks compared to white especially in case of laparoscopic gastric bypass. However, these differences were seen only during the first year follow up and by the second year, there was no significant difference observed.

Minerals:

Deficiency of minerals is rarely observed after bariatric surgery. This is maybe because the amount of minerals required for the body is very less. However, iron and calcium deficiency is reported post-surgery follow up.

Iron deficiency is one of the most commonly seen mineral deficiencies after bariatric surgery. Aileen L. Love reported in the study that there are several reasons for the development of iron deficiency. Several reasons that have been discussed in this study include intolerance for red meat, diminished gastric acid secretion, and exclusion of the duodenum from the alimentary tract which is the major site of absorption for iron. The author assumes that menstruating women, pregnant women, and adolescents, who have previously undergone the surgery, may be particularly predisposed towards developing iron deficiency. This deficiency may develop anemia once developed due to iron deficien-
cy. Therefore, bariatric surgery patients need a regular checkup after surgery in order to avoid serious consequences.

One of the other studies also reported calcium deficiency after bariatric surgery. Calcium deficiency is mostly associated with the vitamin D deficiency. Absorption of vitamin D is preferentially from jejunum and ilium. When there is improper absorption of fat and fat soluble vitamins like vitamin D, the process aggravates the mal absorption of calcium. This results in the stimulation and secretion of parathyroid hormone and results in the production of 1,25-dihydroxyvitamin D and increases the release of calcium from bones. This may result in bone related diseases. Supplementing properly with the food sources rich in calcium or direct calcium supplementation may help in avoiding the calcium deficiency.

Conclusion
One of the major complications after bariatric surgery that is emphasized in this paper is deficiency of nutrients. Vitamins like B12, B6, Thiamine, and vitamin D deficiency were found because of the removal of the part of the absorption site (duodenum) from the body after surgery. Other vitamins like folate, vitamin A and C; and minerals including calcium and iron were found deficient most likely because of either insufficient intake through diet or gastric intolerance to several diets or decreased gastric secretions. However, limited literature is available for vitamin C, vitamin A, and B6. Calcium deficiency was found to be associated with vitamin D deficiency. Although these deficiencies can be corrected by providing parental supplementation, further research in the area of surgery is needed to find out the long term complications and their treatment after bariatric surgery.

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References