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Health Review

Hypovitaminosis D in post bariatric patients: Narrative review

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Abstract: Obesity can be associated with several diseases, signs, and symptoms. Among them, there is nutrient deficiency, especially vitamin D, which regulates calcium and phosphate and helps in bone remodeling. Vitamin D deficiency is related directly to the inadequate intake of foods rich in vitamins, less exposure to the sun and, mainly, to the sequestration of fat-soluble vitamins by the adipose tissue, making it even more difficult for the body to absorb them. Among these complications is the worsening of vitamin deficiency, with a focus on vitamin D, which is already present before the patient undergoes bariatric surgery. Regarding the types of bariatric surgery, each one establishes a degree of vitamin D deficiency that the patient will have postoperatively. That is, each type of bariatric surgery, as they are performed in different ways, directly interfere with the patient's absorption of vitamins. Postoperatively, vitamin D supplementation is recommended for all patients. However, due to poor patient compliance and lack of consent among physicians on the best form of supplementation, the deficiency is maintained, further impairing the treatment, and causing a worsening of the bariatric patient's condition.

Keywords: Obesity; Bariatric Surgery; Vitamin D; Supplementation.

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1. Introduction

The obesity epidemic is a rapidly growing global problem and is associated with several non-communicable diseases, mainly metabolic, cardiovascular, pulmonary, and psychological diseases, with obesity being defined by BMI (body mass index) greater than or equal to 30 kg/m2 also associated with noncommunicable diseases and cancer [1-3]. Bariatric surgery stands out as the most effective therapy for sustained weight loss for obese patients, despite being associated with several long-term complications, such as hypovitaminosis D, which is already documented during the preoperative period and seen in several age groups [2-4].

Deficiency of several vitamins may be associated with obesity, among them, the focus is on vitamin D, which has a range of 40-80% deficiency in patients with severe obesity [5-8]. Adipose tissue can sequester vitamin D, resulting in its dilution, low sun exposure and high inflammatory factors [4, 9]. Vitamin D is a steroid molecule that has two forms: vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol) [4,5,10]. Its actions include calcium and phosphate regulation and bone remodeling, it also indirectly increases intestinal calcium absorption, and it also stimulates the innate immune response and appears to be important in the prevention of autoimmune diseases [5].

After bariatric surgery, the concentration of vitamin D is the result of multiple processes, such as a decrease in body mass, behavior changes in diet and sun exposure, and changes in the absorption of calcium and vitamin D, therefore the vitamin supplementation in the postoperative can both prevent and correct vitamin deficits [5, 12-14]. As there is a great relationship between vitamin D deficiency and its worsening after bariatric surgery, candidates to undergo the surgical procedure are considered a vulnerable population due to the various complications that these procedures can generate [4].

This study aims to review narratives and demonstrate how vitamin D supplementation is done today and why this vitamin is deficient in bariatric patients. In addition, relate this deficiency with the types of bariatric surgery.

2. Bariatric surgeries and nutrient deficiencies

Vitamin D2 (ergocalciferol) is a plant source product of the ultraviolet irradiation of ergosterol, whereas Vitamin D3 (cholecalciferol) is a product of UVB radiation after skin exposure to the sun and is also found in large amounts in some fish and shellfish. The actions of vitamin D include calcium and phosphate regulation and bone remodeling, it also indirectly enhances intestinal calcium absorption [4-5, 11]. Both vitamin D2 and D3 are better absorbed in the jejunum and ileum, together with fats, with the help of the bile salts [4-5, 10].

For ergocalciferol and cholecalciferol to be transformed into the active form of vitamin D, activation mechanisms are necessary, mainly mediated by cytochrome P450, which transforms D2 and D3 into 25-hydroxyvitamin D (25-OHD) [13].The relationship of vitamin D to fat mass is negatively related to inadequate intake of food and supplements, less exposure to sunlight and sequestration of fat-soluble vitamins in expanded fat mass and increased metabolic clearance. For this reason, decreasing the absorptive area of the small intestine and altering the release of pancreatic secretions and bile with bariatric surgery may therefore lead to decreased absorption of vitamin D [9, 10].

It is important to say that even if the patient loses weight, the vitamin D deficiency will not necessarily improve. Also, vitamin D supplementation will not help weight loss.

Bariatric surgery is a procedure that brings together a set of stomach reduction techniques aimed at reducing weight in obese patients. Benefits associated with bariatric procedures include permanent weight loss, lower blood pressure, and reductions in serum cholesterol and medication use, as well as reducing or resolving the development of coronary heart disease, hypertension, sleep apnea, stroke, osteoarthritis, diabetes, non-alcoholic steatohepatitis, and cancer [12].

The type of bariatric surgery will influence the degree of weight loss, caloric deficit, and malabsorption, the most used currently are 4: gastric ring or gastric band (AGB), longitudinal gastrectomy or vertical gastrectomy called "sleeve gastrectomy" (SV) and Roux-en-Y gastric bypass (RYGB) [6]. These techniques can be classified as restrictive, disabsorptive or a combination of both, depending on the traditional understanding of how the surgery promotes weight loss [5, 6]. Procedures that reduce the volume of the gastric reservoir and limit the transit of food are generally called restrictive procedures such as the adjustable gastric band (AGB) and sleeve gastrectomy (GV), which, therefore, do not affect absorption and are less able to induce nutritional deficiencies. Procedures that prevent the absorption of nutrients are widely called disabsorptive [5, 9].

In terms of epidemiology, the most common are Roux-en-Y gastric bypass (RYGB, 58.6%), sleeve gastrectomy (GV; 36.3%) and adjustable gastric banding (AGB, 4.1%). While AGB only restricts food intake, GV and RYGB involve neurohormonal changes, reduced absorption along the digestive tract (less in GV), as well as food restriction [2, 4].

The RYGB, the most common procedure, consists of creating a small gastric pouch connected to the jejunum through the member of Roux, bypassing the rest of the stomach, duodenum, and proximal small intestine. the degree of malabsorption. In this way, limiting the absorption of macronutrients (fat, carbohydrates and proteins) as well as micronutrients, including vitamin D, iron, vitamin B12, folic acid and calcium that are normally

absorbed in the duodenum and proximal jejunum (2, 4) At a microstructural level, cortical thickness decreases and cortical porosity increases in the appendicular skeleton after RYGB and estimated bone strength decreases, which raises concerns about bone fragility as the risk of fracture increases [11].

Currently, RYGB is being replaced by sleeve gastrectomy (SG) due to its better efficacy and lower rate of complications [2]. In SG, three-quarters of the stomach is removed, leaving a small tube or banana-shaped stomach, which can result in lesser degree of malabsorption, particularly for vitamin B12 and iron. However, the adjustable gastric band (AGB) only restricts food intake [4].

The anatomical changes resulting from each of the 4 most common bariatric surgeries suggest that the greatest impact on vitamin D absorption occurs after malabsorptive surgeries [9].

According to the US Endocrine Society, serum 25(OH)D deficiency is characterized by values <20 ng/mL (50 nmol/ L), insufficiency as serum 25(OH)D between 21 and 29 ng/mL (51– 74 nmol/L), and sufficiency as ≥30 ng/mL (75 nmol/L) [5, 7, 9]. In contrast, the Institute of Medicine says that serum 25(OH)D ≥20 ng/mL (50 nmol/L) is sufficient to cover the needs of 97.5% of the population, and overt deficiency occurs when 25 (Serum OH) D is <12 ng/mL (30 nmol/L) [10]. Vitamin D deficiency is multifactorial, in addition to changes in the metabolism of the vitamin and low exposure to sunlight, there is a deficit in adherence to the recommendations given by physicians [2].

3. Postoperative care for bariatric patients

Five years after RYGB, with calcium and vitamin D supplementation in most patients, they are only sufficient vitamin D at about 50 nmol/L but have parathyroid hormone above the reference range. Bone density and microarchitecture deteriorated for at least two years after the procedure, in addition to body weight stabilization despite vitamin D supplementation which maintained serum 25OHD well in the full range [8]. In the BPD procedure, despite supplementation with a very good dose after this surgery, more than 50% of patients have vitamin D deficiencies [6, 12].

Analysis of several studies of patients undergoing RYGB showed preoperative and postoperative vitamin D deficiency [4, 12]. Despite well-documented preoperative vitamin D deficiency, AGB does not appear to interrupt serum vitamin D levels. D, which remains stable or increases, as well as the PTH rate, which remains stable. However, in GV, it was demonstrated that 95% of patients had vitamin D deficiency and high levels of PTH in the study prior to surgery and in the postoperative period, 25 OH D levels increased and PTH levels decreased [6].

4. Vitamin D supplementation

Vitamin supplementation is recommended for all patients undergoing bariatric surgery, yet deficiency is found mainly due to problems with adherence to replacement therapy and its effectiveness.

In general, the ideal dose of vitamin D replacement is not consensual. The typical dose is between 1,000 - 2,000 IU/day [15,16]. Some guidelines recommend a vitamin D supplementation of at least 3,000 IU per day and titration to the therapeutic dose when reaching sufficient serum levels and showing improvement, in parallel, several studies have shown that bariatric surgery patients (RYGB and BPD) had a significant increase in 25 OH D after receiving an additional monthly oral dose of 100,000 IU ergocalciferol for one year after bariatric surgery. [5,7,9,15]. Most studies agree that a daily dosage below 800 IU of vitamin D3 is not sufficient to treat hypovitaminosis D in bariatric patients, and other studies have suggested the use of a combination of 50,000 IU of vitamin D2 weekly, in addition to a daily dose [1, 4]. Therefore, today, many societies suggest supplementing vitamin D doses at 3000 IU/d and up to 50,000 IU 1 to 3 times a week, in case of deficiency, with routine follow-up.

Furthermore, as discussed in this article, vitamin D is a product of ultraviolet radiation after the skin is exposed. Therefore, a measure that can contribute to the elevation of vitamin D levels in bariatric patients would be sun exposure. It is important to remember that sun exposure should be done with caution and with the use of sun protection. It is possible to individualize the amount of sun exposure for each group of people.

5. Conclusions

In conclusion, vitamin D plays a key role in human metabolism. However, in obese patients, vitamin D and other nutrients are compromised due to poor absorption. In this case, the biggest villain of vitamin D deficiency in obese people is the adipose tissue itself, which sequesters vitamin D due to its liposolubility, making it difficult for it to be absorbed by the body.

In this case, bariatric surgery is currently the best treatment for obesity, especially severe obesity. However, this type of surgery, depending on the technique used, further impairs the absorption of nutrients, more specifically, vitamin D. This postoperative deficiency, in addition to the decrease in absorption, is also contributed by poor adherence to treatment. by most patients and the lack of consensus among professionals in choosing the best vitamin D replacement method. Therefore, the purpose of bariatric surgery is weight loss, however, in the long term, it contributes even more to hypovitaminosis.

In the postoperative period, as mentioned earlier in the article, the dosage of vitamin D replacement is not consensual, but it is recommended for all bariatric patients in their postoperative period. The typical dose value is between 1,000 - 2,000 IU/day, however, it can be changed by each professional. Thus, as stated by Peterson et al., personalized supplementation is more effective, as it is difficult to determine the ideal dose of vitamin D both in patients who are candidates for bariatric surgery and in the general population [4].

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