

Review Article:

Evaluation of Calcium, Vitamin D and Parathormone Levels in Three Types of Bariatric Surgery; Sleeve Gastrectomy, One Anastomosis Gastric Bypass and Roux-en Y Gastric Bypass Before and After Surgery: A Mini-Review



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Please cite this article as Gholizadeh H & Yarigholi F. Evaluation of Calcium, Vitamin D and Parathormone Levels in Three Types of Bariatric Surgery; Sleeve Gastrectomy, One Anastomosis Gastric Bypass and Roux-en Y Gastric Bypass Before and After Surgery: A Mini-Review. *Annals of Bariatric Surgery*. 2021; 10(2):69-72. <http://dx.doi.org/10.32598/ABS.10.2.8>

doi: <http://dx.doi.org/10.32598/ABS.10.2.8>



Article info:

Received: 29 Nov 2021

Accepted: 15 Dec 2021

Publish: 31 Dec 2021

Keywords:

Calcium, Vitamin D, Parathyroid Hormone, Sleeve gastrectomy, Gastric bypass, Bariatric surgery

ABSTRACT

Due to the increasing prevalence of obesity and increasing the bariatric surgical procedures worldwide as the main treatments for severe obesity and the existence of calcium and vitamin D deficiency in these patients, it is necessary to evaluate and compare these elements in patients before and after bariatric surgery to perform proper treatment. Therefore, considering this necessity, the present review was designed. After searching in PubMed and Scopus database and screening the studies (in terms of quality and relevance), the contents were classified and the most important points were reported in this study.

1. Introduction

The high prevalence of overweight is a global health problem defined as a Body Mass Index (BMI) greater than 30 kg/m² and obesity refers to a condition in which the BMI of individuals over 40 who are candidates

for obesity surgery [1]. Bariatric surgical procedures are widely used to treat these patients, which can lead to significant weight loss and improve obesity related medical problems [2].

Currently, according to a global agreement, bariatric surgery is the most effective and long-lasting treatment

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for patients with severe obesity and due to the short-term and long-term beneficial effects associated with reduced BMI, bariatric surgery has been useful [3, 4]. Therefore, the number of patients candidates for these operations are increasing and it seems that these methods will soon be considered as the first choice for the treatment of obesity and its complications [5].

These surgeries also may lead to nutritional deficiencies and calcium and vitamin metabolism changes in different degrees [6]. In obese individuals, the level of vitamin D is insufficient [7], which can be effective in the pathogenesis of insulin resistance, type 2 diabetes, cardiovascular disease, hypertension and osteoarthritis [8].

However, patients undergoing bariatric surgery, despite taking supplements routinely, are prone to post-operative vitamin and mineral deficiencies.

Currently, Sleeve Gastrectomy (SG) and Roux-en-Y Gastric Bypass (RYGB) are currently the most common methods of bariatric surgery. Malabsorptive methods are associated with more nutritional deficiencies compare to restrictive methods, however, SG also may lead to nutrient deficiencies by decreased food intake. Vitamin D deficiency is more prevalent than other nutrients after these surgeries. It has been shown that there is a high prevalence of vitamin D deficiency in patients with severe obesity and there is some concerns that bariatric surgery may cause or exacerbate vitamin D deficiency. The duodenum is the main site of calcium absorption and the surgical procedures with duodenal bypass lead to calcium malabsorption and secondary hyperparathyroidism. Vitamin D plays an essential role in calcium and phosphorus homeostasis. Vitamin D deficiency may worsen secondary hyperparathyroidism, which means bone mineral disease [9, 10].

Vitamin D deficiency increases the production of Parathyroid Hormone (PTH) for calcium homeostasis, thus increasing intestinal reabsorption and bone reabsorption, which can lead to osteopenia or osteoporosis, as well as increased serum PTH, the risk of hypertension and heart disease [10]. Secondary Hyperparathyroidism (SHPT) occurs when serum vitamin D levels are less than 30 ng/L. Even after normalization of vitamin D levels, SHPT is seen after bariatric surgery [11]. SHPT, along with weight loss after surgery, increases the risk of bone fractures and musculoskeletal morbidities [12]. Despite supplements and vitamins prescription after bariatric surgery, osteopenia, osteomalacia and even osteoporosis may be seen in some patients [13].

Considering the importance of SHPT and its occurrence despite receiving supplements, there is need to compare the incidence of SHPT after different types of bariatric surgery [14-17]. In this study, we aimed to address this issue.

2. Materials and Methods

An online search of PubMed and Scopus was done to identify relevant clinical literature. To achieve this aim, one independent author was assigned. Any study discussing the different aspects of title was eligible to enter this review. No language limit was applied, but articles in non-English languages were excluded. There was no time period limitation for study selection.

To find all the papers related to the subject through PubMed and Scopus database, following search terms used: Calcium, Vitamin D, PTH, Sleeve Gastrectomy, One Anastomosis Gastric Bypass and Roux-en Y Gastric Bypass. Any original research concerning the topic were included and screened by title, abstract and full text.

3. Results

In a large study published by Qafiti Fred et al. in 2020, of 915,792 patients enrolled from 2010 to 2015, 43% underwent SG and 56% underwent RYGB surgery, and 589 were readmitted for hyperparathyroidism [14].

A systematic review of 14 studies by Switzen et al. in 2017 showed that after bariatric surgery, despite the fact that most patients receive calcium and vitamin D, hyperparathyroidism persists after 5 years of follow-up [15].

A study by P. Toelle, published in 2012 (with 180 obese patients), examined the risk factors for Secondary Hyperparathyroidism (SHPT) after bariatric surgery and compared the four methods of obesity and vitamin D receptor polymorphism in them and showed that SHPT after BP-DS occurs more frequently than other methods. It was also identified that vitamin D receptor polymorphisms play no role in the incidence of SHPT [16].

A study by Fernondo M. Mondonca et al., Published in 2021, examined 1,431 patients who underwent surgery. The results showed that the prevalence of SHPT before and 4 years after surgery is higher than its prevalence one year after surgery. This raised questions about the adequacy of supplements and long-term follow-up, especially after RYGB [1].

Mirian Alejo Ramos et al. in a study published in 2018 examined SHPT up to 10 years after BPD. In the two years after surgery, 33.9% of patients were deficient in vitamin D. In the ninth year of follow-up, SHPT reached 81.9%. The study showed that if the amount of vitamin D was sufficient, the increase in PTH was associated with a lack of modified serum calcium and showed the importance of adequate calcium intake after surgery [17].

4. Discussion

The prevalence of obesity in the world is increasing. Therefore, this issue has always been raised as one of the research hot spots in prestigious research institutes around the world. Calcium levels abnormalities, vitamin D and PTH levels following bariatric surgery are common. For this reason, measurement of calcium, vitamin D and PTH levels in patients undergoing bariatric surgery should be done periodically (before surgery, the third month, the sixth month, the twelfth month and the twenty-fourth month after surgery). This measurement periodically helps patients to take calcium and vitamin D supplements after surgery. Both surgeons and patients should be aware of these vitamin and mineral deficiencies to prevent or proper treatments.

Ethical Considerations

Compliance with ethical guidelines

This article is a meta-analysis with no human or animal sample.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

References

[1] Mendonça FM, Neves JS, Silva MM, Borges-Canha M, Costa C, Cabral PM, et al. Secondary hyperparathyroidism among bariatric patients: Unraveling the prevalence of an overlooked

foe. *Obesity Surgery*. 2021; 31(8):3768-75. [DOI:10.1007/s11695-021-05495-7] [PMID]

[2] Costa TL, Paganotto M, Radominski RB, Kulak CM, Borba VC. Calcium metabolism, vitamin D and bone mineral density after bariatric surgery. *Osteoporosis International*. 2015; 26(2):757-64. [DOI:10.1007/s00198-014-2962-4] [PMID]

[3] Sarwer DB, Spitzer JC, Wadden TA, Rosen RC, Mitchell JE, Lancaster K, et al. Sexual functioning and sex hormones in men who underwent bariatric surgery. *Surgery for Obesity and Related Diseases*. 2015; 11(3):643-51. [DOI:10.1016/j.soard.2014.12.014] [PMID] [PMCID]

[4] Puzziferri N, Roshek TB 3rd, Mayo HG, Gallagher R, Belle SH, Livingston EH. Long-term follow-up after bariatric surgery: A systematic review. *JAMA*. 2014; 312(9):934-42. [DOI:10.1001/jama.2014.10706] [PMID] [PMCID]

[5] Fazel I. [Surgical treatment of morbid obesity (Persian)]. *Iranian Journal of Surgery*. 2011; 19 (2):1-21. <https://www.sid.ir/en/Journal/ViewPaper.aspx?ID=259328>

[6] Whitlock KA, Gill RS, Ali T, Shi X, Birch DW, Karmali S. Early outcomes of Roux-en-Y gastric bypass in a publically funded obesity program. *ISRN Obesity*. 2013; 2013:296597. [DOI:10.1155/2013/296597] [PMID] [PMCID]

[7] Bell NH, Epstein S, Greene A, Shary J, Oexmann MJ, Shaw S. Evidence for alteration of the vitamin D-endocrine system in obese subjects. *The Journal of Clinical Investigation*. 1985; 76(1):370-3. [DOI:10.1172/JCI11971] [PMID] [PMCID]

[8] Grethen E, McClintock R, Gupta CE, Jones R, Cacucci BM, Diaz D, et al. Vitamin D and hyperparathyroidism in obesity. *The Journal of Clinical Endocrinology and Metabolism*. 2011; 96(5):1320-6. [DOI:10.1210/jc.2010-2202] [PMID] [PMCID]

[9] Fox A, Slater C, Ahmed B, Ammori BJ, Senapati S, Akhtar K, et al. Vitamin D status after gastric bypass or sleeve gastrectomy over 4 years of follow-up. *Obesity Surgery*. 2020; 30(4):1473-81. [DOI:10.1007/s11695-019-04318-0] [PMID]

[10] Jamil O, Gonzalez-Heredia R, Quadri P, Hassan C, Masrur M, Berger R, et al. Micronutrient deficiencies in laparoscopic sleeve gastrectomy. *Nutrients*. 2020; 12(9):2896. [DOI:10.3390/nu12092896] [PMID] [PMCID]

[11] Toelle P, Peterli R, Zobel I, Noppen C, Christoffel-Courtin C, Peters T. Risk factors for secondary hyperparathyroidism after bariatric surgery: A comparison of 4 different operations and of vitamin D-receptor-polymorphism. *Bariatric Operation and VDRP. Experimental and Clinical Endocrinology & Diabetes*. 2012; 120(10):629-34. [DOI:10.1055/s-0032-1321811] [PMID]

[12] Balsa JA, Botella-Carretero JJ, Peromingo R, Caballero C, Muñoz-Malo T, Villafruela JJ, et al. Chronic increase of bone turnover markers after biliopancreatic diversion is related to secondary hyperparathyroidism and weight loss: Relation with bone mineral density. *Obesity Surgery*. 2010; 20(4):468-73. [DOI:10.1007/s11695-009-0028-z] [PMID]

[13] Liu C, Wu D, Zhang JF, Xu D, Xu WF, Chen Y, et al. Changes in bone metabolism in morbidly obese patients after bariatric surgery: A meta-analysis. *Obesity Surgery*. 2016; 26(1):91-7. [PMID]

[14] Qafiti FN, Lopez MA, Kichler K, Parreco J, Buicko JL. Hospital readmissions for hyperparathyroidism after bariatric surgery in the United States: A national database review.

- Cureus. 2020; 12(9):e10585. [DOI:10.7759/cureus.10585] [PMID] [PMCID]
- [15] Switzer NJ, Marcil G, Prasad S, Debru E, Church N, Mitchell P, et al. Long-term hypovitaminosis D and secondary hyperparathyroidism outcomes of the Roux-en-Y gastric bypass: A systematic review. *Obesity Reviews*. 2017; 18(5):560-6. [DOI:10.1111/obr.12525] [PMID]
- [16] Toelle P, Peterli R, Zobel I, Noppen C, Christoffel-Courtin C, Peters T. Risk Factors for Secondary Hyperparathyroidism after Bariatric Surgery: A Comparison of 4 Different Operations and of Vitamin D-receptor-polymorphism. *Experimental and Clinical Endocrinology & Diabetes*. 2012; 120(10):629-34. [DOI:10.1055/s-0032-1321811] [PMID]
- [17] Alejo Ramos M, Cano Rodríguez IM, Urioste Fondo AM, Pintor de la Maza B, Barajas Galindo DE, Fernández Martínez P, et al. Secondary hyperparathyroidism in patients with biliopancreatic diversion after 10 years of follow-up, and relationship with vitamin D and serum calcium. *Obesity Surgery*. 2019; 29(3):999-1006. [DOI:10.1007/s11695-018-03624-3] [PMID]