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Effective elements for the standardization of sleeve gastrectomy

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ABSTRACT

Introduction: Morbid obesity is one of the most common health-care issues in our present day. Various surgical methods were developed to combat obesity. Laparoscopic sleeve gastrectomy (LSG) is the most common surgical treatment in the world and our country. In the present study, the purpose was to share the 6-year results of bariatric surgeries performed in our center.

Materials and Methods: The retrospective records of the patients who underwent bariatric surgery between 2015 and 2021 were examined, and demographic data, indications for surgery, preparation for surgery, surgical technique, post-operative follow-up steps, post-operative complications, recovery rates of comorbid diseases, and the changes in post-operative biochemical parameters were evaluated.

Results: A total of 457 patients underwent LSG over 6 years. The median age of the patients was 34.3 years (13–68) and the median body mass index was 43.74 (35.60–66.72) kg/m^2. Among the patients, 261 (57.1%) were female and 196 (42.9%) were male. The mean surgery time was 58 (32–88) min. Improvements were detected in 91.6% of patients with pre-operative hypertension, in 87.3% of patients with diabetes, 91.6% of patients with sleep apnea, and 84.3% of patients with hyperlipidemia. Iron deficiency anemia was detected in 11 (2.4%) of the patients as a biochemical abnormality in the post-operative follow-ups, the folic acid deficiency was detected in 3 (0.7%) patients, Vitamin D deficiency in 6 patients (1.31%), and Vitamin B12 deficiency in 5 patients (1.1%).

Conclusion: LSG is a safe method in the treatment of obesity facilitating weight loss and regressing comorbidities accompanying obesity. Although the decrease in biochemical parameters in the long-term follow-up is a disadvantage, it can be treated with replacement therapy.

Keywords: Comorbidity short, Laparoscopic sleeve gastrectomy, Obesity

Introduction

Obesity is a chronic disease directly affecting life expectancy and comfort. It is one of the increasingly serious health-care issues, especially in developed countries.[1,2] The World Health Organization (WHO) reported that 13% of adults aged 18 and over in the world in 2016, in other words, more than 650 million adults, were obese.[3] Obesity is not only a weight problem but also brings with it additional diseases such as diabetes, hypertension (HT), venous circulation disorders, cardiac output disorders, orthopedic disorders, and an increase in some cancers. It was shown that insulin resistance decreases after bariatric surgery and 90% of HT and respiratory system diseases regress.[4]

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Many different techniques were applied in the surgical treatment of morbid obesity. Although radical interventions (i.e., Jejuno Ileal Bypass and Biliopancreatic Bypass) were applied in the beginning, less invasive and physiology-appropriate approaches started to come to the forefront because many metabolic problems were faced. With this transformation, adjustable gastric banding started to be applied in European countries. Its easy application and less invasiveness compared to other methods caused it to find more application areas. However, complications such as esophagitis, intolerance, esophageal dilatation, and band migration are among the disadvantages of this method.[5] For this reason, it was replaced by laparoscopic roux-n-y gastric bypass and laparoscopic sleeve gastrectomy (LSG), which are more effective and most frequently applied methods in our present day. Roux-en-Y gastric bypass is accepted as the gold standard in bariatric surgery in the USA.[6] However, this changed in favor of LSG (46%) over time and LSG became the most used technique worldwide.[7]

Materials and Methods

In the present study, the records of 457 patients who underwent laparoscopic bariatric surgery were reviewed retrospectively, covering the years January 2015–January 2021. The indication for surgery was decided in line with the criteria that were recommended by the WHO. Surgery was offered as an option to patients with a BMI >40 kg/m^2 or >35 kg/m^2 and comorbid diseases such as HT or Type 2 diabetes.

After a detailed physical examination, abdominal ultrasonography was requested from all patients, and gastric endoscopy was requested from patients who were over 40 years of age along with hemogram and biochemical tests. Furthermore, endocrinology, psychiatry, cardiology, chest diseases, and anesthesiology consultations were requested and risk assessment was performed with (American Society of Anesthesiologists) classification. After the evaluations, the possible benefits and risks of the surgical method that was deemed appropriate were explained to the patients and informed consent was obtained from each patient.

Low molecular weight heparin 100 IU/kg (Clexane®, Aventis Pharma, Turkey) was administered to all patients before and after the surgery. During the hospital stay, two-sided compression stockings were worn. Broad-spectrum cephalosporin group antibiotics were administered preoperatively as one dose and two post-operative doses. The duration of surgery, length of hospital stay, and hemodynamic parameters of the patients were recorded. The weight, BMI changes, and percent weight loss values of the patients were recorded at the post-operative 1st month, 3rd month, 6th month, and 12th month.

As the surgical technique; 2 × 12 mm and 2 × 5 mm trocars were entered and the omentum was separated from the stomach with a vessel sealing device (Ligasure™ 5 mm blunt, LF1637) starting from approximately 2–3 cm proximal to the pylorus and up to the his angle. Then, especially after the posterior surface of the stomach and the fundus level was completely liberated, a 32 F silicone gastric tube was inserted through the orogastric route. The stomach was dissected proximally to the pylorus (starting at the crow's foot level) up to his angle with the help of an endoscopic stapler. At this step, care was taken to leave a small antrum and to create a narrow tube in a straight line (with the anterior and posterior walls at equal widths). Echelon flex™ Endo path® staplers (60 mm) were used in the antrum and staples suitable for medium-thickness tissues (Echelon Flex™ Endo path® [60 mm] Articulating medium/thick reload with) were used in the rest of the stomach.

After the stomach was separated, a leak test was performed by giving 50 cc of methylene blue from the orogastric calibration tube. The staple line was supported with hemoclip at 5 mm intervals along its length to strengthen the staple line and control bleeding. An aspiration drain was placed parallel to the suture line after the leakage control.

The patients were usually discharged on the 2nd day of the post-operative period. Analgesics, protein supplements, multivitamins, and anticoagulants were prescribed routinely at discharge. It was recommended to continue anticoagulant support for the first 1 month, and protein and multivitamin support for the first 6 months. One week after the discharge, all patients were called for physical examination. Hemogram and routine biochemical tests were checked at 1, 3, 6, and 12 months. Annual follow-ups were performed after the 1st year.

Blood pressure and fasting blood glucose values of all patients and comorbid diseases accompanying obesity were noted before the bariatric surgery. Iron, Vitamin B12, folic acid, and Vitamin D levels were also checked in the post-operative follow-ups. For (HT), which is among the co-

morbid factors, a measurement of systolic blood pressure >140 mmHg or diastolic blood pressure >100 mmHg or a history of antihypertensive drug use for blood pressure control were taken as the reference. For diabetes mellitus (DM), fasting blood glucose value >125 mg/dl, or a previous diagnosis of diabetes, use of anti-diabetic medication or use of insulin were taken as the reference. Sleep apnea syndrome was referenced as patients with apnea symptoms or whose diagnosis was confirmed by a sleep study. Hyperlipidemia was defined as elevated triglyceride or total cholesterol levels. Remission of HT was referenced as systolic blood pressure <120 mmHg and diastolic blood pressure <80 mmHg without antihypertensive drug use. Remission of diabetes was defined as a decrease in fasting blood sugar <100 mg/dl or hemoglobin A1c (HbA1C) level without the use of diabetes medications or insulin. Remission of sleep apnea syndrome was defined as the absence of sleep apnea symptoms and no need for continuous positive airway pressure treatment. Remission of hyperlipidemia was defined as triglycerides and total cholesterol levels being within the normal range.

Results

A total of 457 patients underwent LSG over 6 years. The median age of the patients was 34.3 (13–68) and the median body mass index score was 43.74 (35.60–66.72) kg/m^2. Among the patients, 261 (57.1%) were female and 196 (42.9%) were male. The mean surgery duration was 58 (32–88) min. The mean blood loss was 40 (0–250) cc and the mean hospital stay duration was 2 days. Omentopexy was performed by suturing the staple line in only one patient because of the opening of the intraoperative staple line. No mortality was observed in any patient. Bleeding developed in six patients on the 1st post-operative day and was controlled with medical treatment. Post-operative atelectasis developed in seven patients and deep vein thrombosis developed in one patient and improved with medical treatment. Trocar site hernia occurred in three patients. Surgical treatment was performed 1 year after the surgery. As an additional disease, 80 (17.5%) patients had HT, 59 (12.9%) Type 2 diabetes, 24 (5.2%) patients had sleep apnea, and 86 (18.8%) patients had hyperlipidemia. A total of 91.6% of patients with HT improved in the preoperative period along with 87.3% of patients with DM, 91.6% of patients with sleep apnea, and 84.3% of patients with hyperlipidemia (Table 1).

The mean BMI score of the patients was 27.3 kg/m^2 in female patients and 29.2 kg/m^2 in male patients in the 1st year postoperatively (Table 2). The mean BMI score of all patients was 28.6±2.8 kg/m^2 and the mean weight loss was 43.8 kg (23.6–84.8).

The most common biochemical abnormality in the long-term follow-up after the surgery was iron deficiency anemia. Although iron deficiency anemia was detected in 11 of the patients (2.4%), the folic acid deficiency was detected in 3 (0.7%) patients, Vitamin D deficiency in 6 patients (1.31%), and Vitamin B12 deficiency in 5 patients (1.1%).

Table 1. Recovery rates of comorbid diseases

Disease	Preoperative	Postoperative	Recovery %
Hypertension	80	7	91.6
Tip 2 Diabetes	59	7	87.3
Hyperlipidemia	86	14	84.3
Sleep Apnea	24	2	91.6
Infertility	8	3	62.5

Table 2. The mean BMI score of the patients

Gender	Number of Patients	Preoperative Mean BMI (kg/m^2)	Postoperative 1st Year Mean BMI (kg/m^2)
Female	261	42.2	27.3
Male	196	47.3	29.2

BMI: Body mass index.

Discussion

Obesity is among the most common primary health-care issues. Physical activity insufficiency and changes in dietary habits together with the advancement of technology in societies with a high socioeconomic level are the most important environmental causes of obesity. As the age progresses, the frequency of obesity increases with the decreased basal metabolic rate.[8,9] The goal of obesity surgery is to provide adequate weight loss in obese patients. With the technological developments and their increased use in medicine, different methods were developed in bariatric surgery. The most effective method in the treatment of obesity is surgery. The open surgical method has left its place to laparoscopic and robotic surgery over time. Laparoscopic surgery is preferred because of less pain, high comfort, short mobilization, wound infection, and fewer complications of incisional hernia.[10] LSG is the most commonly used bariatric surgical technique in our present day and is a restrictive procedure in which the gastric volume is reduced.[11,12] LSG has become a more preferred method when compared to other methods because it can be performed technically more easily, parameters such as surgery time and blood loss are lower, and it not only provides weight loss but also contributes to metabolic recovery.[13-15] Furthermore, LSG is superior to other methods in that it can be performed with post-operative upper gastrointestinal system endoscopy, no change in absorption in oral drugs, no dumping syndrome, and malabsorption, and is easy to convert to other bariatric surgical procedures. The most important and feared complication of LSG is leakage (2%) and it is often seen near the his angle. Leakage occurs mostly due to ischemic and technical reasons but changes in stapler technology have made its use quite safe.[16] This minimized the risk of leakage because of technical reasons. The leak rate was found to be 2.9% in a sleeve gastrectomy analytical study conducted with 4.888 people who underwent MEDLINE screening.[17] It is a complication difficult to treat and sometimes mortal. LSG technique was applied to all of the patients in the present study and there was no leakage in any of our patients. The popularity of the LSG technique among surgeons is increasing with each passing day and it is promising with its easy technical applicability.[6,7]

The goal of bariatric surgery is to contribute to the weight loss of the patient and the treatment of additional diseases. Studies are reporting that three-quarters of patients who underwent bariatric surgery improved at significant levels in terms of comorbidities.[18,19] About 68% of morbidly obese adult patients also have HT,[20] and both medical and surgical treatments are used in the treatment of HT. The literature reported that the HT remission rate varies between 43% and 83% after 1 year of bariatric surgery.[21] In the present study, 17.5% of the patients had HT and 91% at the end of the 1st post-operative year. Improvement was observed in six patients. Similar findings were seen in studies that compared bariatric surgery with intensive medical/lifestyle intervention. In these studies, HT remission rates were reported to be higher in patients who underwent surgery when compared to those using antihypertensive drugs.[22-24]

One of the most important outcomes in the field of bariatric surgery is its effect on Type 2 diabetes remission. The results of surgical procedures used in Type 2 diabetes patients are usually evaluated by the level of glycosylated HbA1c. In the literature, HbA1c levels were reported to have decreased by 1.8–3.5% with surgical treatment, and this rate was 0.4–1.5% in patients who received medical treatment.[25-27] In the present study, a decrease of 2.4–3.1% was observed in HbA1c levels, which is consistent with the literature data. The fasting blood glucose measurement of the patients was also evaluated in the present study and it was found that 87.3% of the fasting blood glucose levels were <100 mg/dl. It was also found that bariatric surgery had better remission and recurrence rates in early-stage Type 2 diabetes, newly-diagnosed Type 2 diabetes patients, and patients who needed low insulin doses.[28-30]

Approximately 64% of adult patients admitted for bariatric surgery have dyslipidemia.[20] A total of 18.8% of the patients in the present study had dyslipidemia and dyslipidemia improved after LSG in 84.3%. Another problem in overweight or obese patients is sleep apnea syndrome. Although 5.2% of the patients had sleep apnea, recovery was observed in 91.6% of them after bariatric surgery. Weight loss improves obstructive sleep apnea, and for this reason, it must be recommended in all overweight or obese patients.[31] Losing 15–50% of excess weight after bariatric surgery is considered a success.[32,33] In the present study, the average weight loss of the patients in the 1 year period was 34.6%, which proves the effectiveness of the method used.

Bariatric surgery has also some disadvantages in addition to the positive effects. According to the latest report of the American Society of Hematology, the most important disadvantage is the deficiency of micronutrients, for exam-

ple, iron (16–44%), Vitamin D (33–80%), and Vitamin B12 (13%).[34]

Patients who undergo bariatric surgery are those who have the highest risk of anemia. It was reported that anemia was detected in 33–49% of patients 2 years after the surgery.[35] The mean prevalence of anemia following surgery was reported to be 17% in patients who had LSG surgery.[36] The reason for this is the mechanical digestion and decreased gastric acid secretion, and, therefore, the absorption of iron, Vitamin B12, and other protein-bound nutrients, which are affected adversely. Decreased secretion of intrinsic factors impairs Vitamin B12 absorption. Furthermore, decreased serum ghrelin levels cause decreased appetite and absorption of nutrients by causing low food intake.[37] In the long-term follow-up after the surgery, iron deficiency anemia was detected in 11 (2.4%) of our patients. The reason for the low number of our patients is that we recommended oral iron supplementation to all patients undergoing bariatric surgery as a preventative measure. Since we used LSG method in all our patients, which does not usually cause Vitamin B12 deficiency, it was detected in only 5 patients (1.1%). The possible mechanism in patients developing Vitamin B12 deficiency is insufficient secretion of the intrinsic factor and insufficient gastric acidity after the surgery. Folic acid deficiency is among the potential complications of bariatric surgery that can cause anemia because folate is absorbed throughout the small intestine, deficiency is primarily because of inadequate dietary intake as a result of changing dietary habits after the surgery rather than malabsorption. Folic acid (0.7%) deficiency was detected in three of our patients. Folate deficiency could be easily treated with oral supplementation.[38] Vitamin D deficiency was detected in six of our patients (1.31%). The prevalence of applications such as bariatric surgery and its ability to cause malabsorption increased its incidence.[39] The reason for the low incidence in the present study was that routine replacement was initiated in the early period and checked at regular intervals.

Conclusion

It was observed that patients who underwent LSG with the diagnosis of obesity had significant weight loss and positive results in the recovery of comorbidities. We associated this result with the fact that our surgical technique was performed in line with the standards. We think that supplementation must be made in the micronutrient deficiencies that may develop and early initiation of this replacement treatment can prevent hematological, dermatological, neurological, and cardiac system disorders that might occur after the surgery. Bariatric surgery is an effective and reliable application in the treatment of obesity and metabolic surgery if it is performed in experienced centers with the correct indication.

Disclosures

Ethichs Committee Approval: Retrospective study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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References

1. Türkiye Endokrinoloji ve Metabolizma Derneği Obezite ve Lipid Metabolizması Çalışma Grubu. Ulusal Obezite Rehberi; 1999.
2. McInnis KJ. Diet, exercise, and the challenge of combating obesity in primary care. J Cardiovasc Nurs 2003;18:93–100.
3. WHO. Obesity and overweight. 2018 Feb 16. Available at: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight. Accessed Aug 30, 2018.
4. Spivak H, Hewitt MF, Onn A, Half EE. Weight loss and improvement of obesity-related illness in 500 U.S. patients following laparoscopic adjustable gastric banding procedure. Am J Surg 2005;189:27–32. [CrossRef]
5. Fielding GA, Ren CJ. Laparoscopic adjustable gastric band. Surg Clin North Am 2005;85:129–40. [CrossRef]
6. Angrisani L, Santonicola A, Iovino P, Formisano G, Buchwald H, Scopinaro N. Bariatric Surgery Worldwide 2013. Obes Surg 2015;25:1822–32. [CrossRef]
7. Welbourn R, Hollyman M, Kinsman R, Dixon J, Liem R, Ottoson J, et al. Bariatric surgery worldwide: baseline demographic description and one-year outcomes from the Fourth IFSO Global Registry Report 2018. Obes Surg 2019;29:782–95.
8. Baysal A. Aksoy M, Bozkurt N. Diyet el kitabı. Ankara: Hatiboğlu Yayınevi; 2011.
9. Kırım S. Obez hastalarda diyet, egzersiz ve ilaç tedavisinin homosistein düzeylerine etkisi. Yandal Uzmanlık Tezi. Adana: Çukurova Üniversitesi; 2005.
10. Atila K. Morbid obezitenin cerrahi tedavisi. Arc Clin Toxicol 2014;1:23–7.
11. Lazzati A, Guy-Lachuer R, Delaunay V, Szwarcensztein K, Azoulay D. Bariatric surgery trends in France: 2005-2011.

Surg Obes Relat Dis 2014;10:328–34. [CrossRef]
12. Reames BN, Finks JF, Bacal D, Carlin AM, Dimick JB. Changes in bariatric surgery procedure use in Michigan, 2006-2013. JAMA 2014;312:959–61. [CrossRef]
13. Rogula T, Khorgami Z, Bazan M, Mamolea C, Acquafresca P, El-Shazly O, et al. Comparison of reinforcement techniques using suture on staple-line in sleeve gastrectomy. Obes Surg. 2015;25:2219–24. [CrossRef]
14. Elder KA, Wolfe BM. Bariatric surgery: a review of procedures and outcomes. Gastroenterology 2007;132:2253–71.
15. Sheetz KH, Woodside KJ, Shahinian VB, Dimick JB, Montgomery JR, Waits SA. Trends in bariatric surgery procedures among patients with ESKD in the United States. Clin J Am Soc Nephrol 2019;14:1193–9. [CrossRef]
16. Giordano S, Salminen P, Biancari F, Victorzon M. Linear stapler technique may be safer than circular in gastrojejunal anastomosis for laparoscopic Roux-en-Y gastric bypass: a meta-analysis of comparative studies. Obes Surg 2011;21:1958–64. [CrossRef]
17. Aurora AR, Khaitan L, Saber AA. Sleeve gastrectomy and the risk of leak: a systematic analysis of 4,888 patients. Surg Endosc 2012;26:1509–15. [CrossRef]
18. Simard B, Turcotte H, Marceau P, Biron S, Hould FS, Lebel S, et al. Asthma and sleep apnea in patients with morbid obesity: outcome after bariatric surgery. Obes Surg 2004;14:1381–8.
19. D'Hondt M, Vanneste S, Pottel H, Devriendt D, Van Rooy F, Vansteenkiste F. Laparoscopic sleeve gastrectomy as a single-stage procedure for the treatment of morbid obesity and the resulting quality of life, resolution of comorbidities, food tolerance, and 6-year weight loss. Surg Endosc 2011;25:2498–504. [CrossRef]
20. Courcoulas AP, King WC, Belle SH, Berk P, Flum DR, Garcia L, et al. Seven-year weight trajectories and health outcomes in the longitudinal assessment of bariatric surgery (LABS) study. JAMA Surg 2018;153:427–34. [CrossRef]
21. Climent E, Goday A, Pedro-Botet J, Solà I, Oliveras A, Ramón JM, et al. Laparoscopic Roux-en-Y gastric bypass versus laparoscopic sleeve gastrectomy for 5-year hypertension remission in obese patients: a systematic review and meta-analysis. J Hypertens 2020;38:185–95. [CrossRef]
22. Schauer PR, Bhatt DL, Kirwan JP, Wolski K, Aminian A, Brethauer SA, et al; STAMPEDE Investigators. Bariatric surgery versus intensive medical therapy for diabetes - 5-year outcomes. N Engl J Med 2017;376:641–51. [CrossRef]
23. Mingrone G, Panunzi S, De Gaetano A, Guidone C, Iaconelli A, Nanni G, et al. Bariatric-metabolic surgery versus conventional medical treatment in obese patients with type 2 diabetes: 5 year follow-up of an open-label, single-centre, randomised controlled trial. Lancet 2015;386:964–73. [CrossRef]
24. Pareek M, Bhatt DL, Schiavon CA, Schauer PR. Metabolic surgery for hypertension in patients with obesity. Circ Res 2019;124:1009–24. [CrossRef]
25. Ikramuddin S, Korner J, Lee WJ, Thomas AJ, Connett JE, Bantle JP, et al. Lifestyle intervention and medical management with vs without roux-en-y gastric bypass and control of hemoglobin A1c, LDL cholesterol, and systolic blood pressure at 5 years in the diabetes surgery study. JAMA 2018;319:266–78. [CrossRef]
26. Courcoulas AP, Gallagher JW, Neiberg RH, Eagleton EB, DeLany JP, Lang W, et al. Bariatric surgery vs lifestyle intervention for diabetes treatment: 5-year outcomes from a randomized trial. J Clin Endocrinol Metab 2020;105:866–76.
27. Courcoulas AP, Belle SH, Neiberg RH, Pierson SK, Eagleton JK, Kalarchian MA, et al. Three-year outcomes of bariatric surgery vs lifestyle intervention for type 2 diabetes mellitus treatment: a randomized clinical trial. JAMA Surg 2015;150:931–40. [CrossRef]
28. Still CD, Wood GC, Benotti P, Petrick AT, Gabrielsen J, Strodel WE, et al. Preoperative prediction of type 2 diabetes remission after Roux-en-Y gastric bypass surgery: a retrospective cohort study. Lancet Diabetes Endocrinol 2014;2:38–45.
29. Aminian A, Brethauer SA, Andalib A, Nowacki AS, Jimenez A, Corcelles R, et al. Individualized metabolic surgery score: procedure selection based on diabetes severity. Ann Surg 2017;266:650–7. [CrossRef]
30. Shen SC, Wang W, Tam KW, Chen HA, Lin YK, Wang SY, et al. Validating risk prediction models of diabetes remission after sleeve gastrectomy. Obes Surg 2019;29:221–9. [CrossRef]
31. Gottlieb DJ, Punjabi NM. Diagnosis and Management of Obstructive Sleep Apnea: A Review. JAMA 2020;323:1389–400.
32. Freeman JB, Burchett H. Failure rate with gastric partitioning for morbid obesity. Am J Surg 1983;145:113–9. [CrossRef]
33. Halverson JD, Zuckerman GR, Koehler RE, Gentry K, Michael HE, DeSchryver-Kecskemeti K. Gastric bypass for morbid obesity: a medical--surgical assessment. Ann Surg 1981;194:152–60. [CrossRef]
34. Snyder-Marlow G, Taylor D, Lenhard MJ. Nutrition care for patients undergoing laparoscopic sleeve gastrectomy for weight loss. J Am Diet Assoc 2010;110:600–7.
35. American Society of Hematology. Iron-deficiency anemia. Available at: https://www.hematology.org/education/patients/anemia/iron-deficiency. Accessed Jun 10, 2022.
36. Weng TC, Chang CH, Dong YH, Chang YC, Chuang LM. Anaemia and related nutrient deficiencies after Roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. BMJ Open 2015;5:e006964. [CrossRef]
37. Mohapatra S, Gangadharan K, Pitchumoni CS. Malnutrition in obesity before and after bariatric surgery. Dis Mon 2020;66:100866. [CrossRef]
38. von Drygalski A, Andris DA, Nuttleman PR, Jackson S, Klein J, Wallace JR. Anemia after bariatric surgery cannot be explained by iron deficiency alone: results of a large cohort study. Surg Obes Relat Dis 2011;7:151–6. [CrossRef]
39. Jorde R, Sneve M, Torjesen P, Figenschau Y. No improvement in cardiovascular risk factors in overweight and obese subjects after supplementation with vitamin D3 for 1 year. J Intern Med 2010;267:462–72.