



Original Article

Determining the prevalence and causes of anaemia in patients after bariatric surgery in a Saudi hospital



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المخلص

أهداف البحث: تعد السمنة مرضاً مزمناً مع وجود انتشار واسع لها بين سكان المملكة العربية السعودية. وبينما تعد جراحات السمنة طريقة فاعلة لإنقاص الوزن، لوحظ نقص عدد من العناصر الغذائية لدى الخاضعين لهذه الجراحات، مما يرفع نسبة إصابة المرضى بفقر الدم. وتهدف هذه الدراسة لوصف معدلات الإصابة بفقر الدم بعد عمليات جراحة السمنة.

طرق البحث: شملت هذه الدراسة الوصفية الاستيعابية ٧٠ مريضاً تجاوزت أعمارهم ١٦ عاماً، من الجنسين، خضعوا لجراحات السمنة في الفترة ما بين فبراير ٢٠١٦ ومارس ٢٠١٨، الذين قضوا فترة لا تقل عن ٦ أشهر بعد إجراء عمليات السمنة. ولقد تم جمع البيانات القياسية والمخبرية قبل وبعد العملية على فترات زمنية موحدة. علماً بأنه قد تم وصف فيتامينات تكميلية بعد العملية لجميع المرضى.

النتائج: ٤١ من العينة كانوا إناثاً (٥٨.٥٧٪)، و٢٩ منهم كانوا ذكوراً (٤١.٤٢٪)، بمتوسط عمري ٣٨,٥ عاماً، حيث كانت أعمار المرضى تتراوح بين ١٦ و٦٥ عاماً. ولقد تمت متابعة المرضى لمدة متوسطة ٨ أشهر، حيث تراوحت مدة المتابعة للمرضى بين ٦-٢٤ شهراً بعد العملية. وبينت الدراسة أن ١٦ من جميع المرضى (٢٢.٩٪) أصيبوا بفقر الدم، وكان جميعهم من الإناث (٣٩٪). ولوحظ أن ١٥ من أصل ١٦ مريضة (٩٣.٨٪) مصابات بفقر الدم لديهم صغر حجم كريات الدم الحمراء. اثنتان من أصل ١٦ مريضة (١٢.٥٪) أصيبتا بفقر الدم خضعتا لجراحة تغيير مسار المعدة، بينما خضعت ١٤ مريضة (٨٧.٥٪) لتكميم المعدة.

الاستنتاجات: يعد فقر الدم ونقص العناصر الغذائية المرتبط به أحد المضاعفات الشائعة بعد جراحات السمنة، الأمر الذي له أثر كبير على صحة المرضى بعد هذا النوع من العمليات، خصوصاً عند الإناث. لذلك نوصي بالمتابعة الدقيقة بعد العملية وإعطاء المكملات الغذائية المناسبة.

الكلمات المفتاحية: فقر الدم؛ جراحات السمنة؛ تكميم المعدة؛ تغيير مسار المعدة

Abstract

Objectives: Obesity is a chronic disease with high prevalence in Saudi population. Bariatric surgery is an effective method for significant weight reduction. However, various types of nutritional deficiencies occur after weight loss surgery which increase the risk of anaemia. In this study, we aimed to determine the incidence of anaemia after bariatric surgery.

Method: A retrospective descriptive study was conducted with 70 patients of both genders aged over 16 years. These patients underwent bariatric surgery between February 2016 and March 2018 and had completed 6 months or more of post-surgery follow-up. Anthropometric and laboratory data were obtained before and after surgery at standard time intervals. All patients were on postoperative vitamin supplements.

Results: Of the total study patients, 41 were women (58.57%) and 29 were men (41.42%) with a median age of 38.5 years (range, 16–65). The median follow-up time was 8 months (6–24 months). Postoperatively, 16 patients (22.9%) developed anaemia, and interestingly, all of them were women (39%). Fifteen of these sixteen patients (93.8%) had microcytic anaemia. Two of those sixteen patients (12.5%) had Roux-en-Y gastric bypass, while fourteen (87.5%) had sleeve gastrectomy.

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Conclusion: Anaemia and its related nutritional deficiencies are a common complication after bariatric surgery which exerts a major impact on health, particularly in women. Hence, a strict post-operative follow-up and appropriate supplementation are recommended to combat anaemia and its related nutritional deficiencies.

Keywords: Anaemia; Bariatric surgery; Roux-en-Y gastric bypass; Sleeve gastrectomy

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Introduction

The prevalence of obesity has significantly increased over the past few decades worldwide and in KSA. The prevalence of obesity worldwide almost tripled between 1975 and 2016. In 2016, the prevalence of obesity among world's adult population was about 13% involving 11% of male and 15% of female adults.¹ The overall rate of obesity in KSA is 33.7% and estimated to reach 59.5% in 2022.² A recent study showed that the prevalence of obesity in the Almadinah Almunawwarah population is 29.6%.³ Obesity is considered a chronic disease which may lead to serious complications, such as diabetes mellitus, cardiovascular disease, osteoarthritis, dyslipidaemia, and psychological disability.⁴ The effectiveness of medical treatment and lifestyle modification is limited and shows a high rate of relapse⁵; hence, bariatric surgery is a reasonable option considered for significant and long-standing weight loss and remarkable reduction in comorbidities.⁶ The most commonly performed bariatric procedures are laparoscopic Roux-en-Y gastric bypass (RYGB) and laparoscopic sleeve gastrectomy (SG).⁷

Despite the benefits, various types of anaemia have been linked to bariatric surgery as long-term complications.^{8,9} Iron deficiency and B12 deficiency are the most commonly reported.^{10–12} It is generally thought to be due to malabsorption of iron and B12 apart from food intolerance in some patients. Regardless of bariatric surgery, obese patients have a higher tendency to develop anaemia because of systemic inflammation associated with impaired duodenal iron absorption due to low expression of duodenal ferroportin along with elevated hepcidin concentrations leading to decreased serum iron.^{12,13} Anaemia typically presents with symptoms of fatigue, dyspnoea, and palpitations; however, obese patients are susceptible to more serious complications with an increased risk of long-term adverse cardiovascular events and deaths.¹⁴ In the United States, the rate of bariatric surgery had increased nearly six fold from 1990 to 2000 and almost doubled over the past 3 years.¹⁵ Anaemia may affect as many as two-thirds of patients. The American Society of Hematology noted that people who underwent bariatric procedures are among those with the highest risk of experiencing iron deficiency anaemia (33%–49%), and it typically occurs 8 weeks to 2 years after surgery.¹⁶ The American

Association of Clinical Endocrinologists and the Obesity Society and American Society for Metabolic and Bariatric Surgery medical guidelines recommend that nutritional deficiencies including iron status should be monitored in all patients who underwent bariatric surgery by conducting a continuous follow up.¹⁷

Since the number of local studies which described the haematological complications following surgery is limited compared with the number of studies which measured the effectiveness and which need a larger number of patients and longer periods of time to detect long-term side effects, the rate of anaemia is underestimated. In this study, we aimed to determine the association between different types of bariatric surgery and anaemia and the leading factors contributing to the development of obesity in Saudi population. We also aimed to evaluate the currently applied preventive measures and follow-up plans to fill the gaps in the management of the patients weighing the benefits of the surgery along with the risk of anaemia and its complications.

Materials and Methods

Study design and participants

A retrospective descriptive study was conducted in patients who underwent bariatric surgery between February 2016 and March 2018 at Prince Mohammed Bin Abdulaziz Hospital in Almadinah Almunawwarah. The patients were retrospectively identified using the surgery and haematology electronic database. Electronic chart reviews were conducted after obtaining the ethical approval. Patients aged more than 16 years of both genders who underwent bariatric surgery between February 2016 and March 2018 and completed 6 months or more after bariatric surgery were included. Those with coeliac disease, chronic GI bleeding related to any underlying cause, pernicious anaemia, menorrhagia, haemolytic anaemia including inherited and acquired causes, hereditary anaemia, autoimmune connective tissue diseases, chronic kidney disease, chronic liver disease, and hypersplenism and pregnant women were excluded.

Data collection and analysis

The data collection spreadsheet was designed in a comprehensive manner and contained the following data: patients' demographics, bariatric surgery perioperative-related data including the anthropometric measurements, postoperative complications and interventions, type of transfusion required after surgery, and postoperative medications and/or supplements and duration. The collected data also included the laboratory tests performed at the time of surgery and at the last visit based on availability, including blood count indices, iron profile, serum ferritin level, serum vitamin B12 level, serum folate level, thyroid function test, and renal function tests. A statistical analysis was performed using the Statistical Package for the Social Sciences, version 22.0. Descriptive data were expressed as frequencies and percentages.

Results

Seventy patients who underwent bariatric surgery between February 2016 and March 2018 were included in the analysis, of whom 41 were women (58.57%) and 29 were men

Table 1: Patient characteristics (n = 70).

Median Age (Y)		38.5 (range 16–65 Y)
Gender	Female	41 (58.57%)
	Male	29 (41.42%)
Nationality	Saudi	61 (88.5%)
	Non-Saudi	8 (11.5%)
Preoperative BMI (kg/m ²) Mean ± SD		43.28 ± 6.53
Comorbidities	Diabetes mellitus	12 (17.14%)
	Hypertension	8 (11.43%)
	Smoking	16 (22.86%)
	Chronic kidney disease	0
Type of surgery	Gastric sleeve	62 (88.6%)
	Roux-en-Y gastric bypass	7 (10%)
	Both	1 (1.4%)
Median Follow-up period (M)		8 M (6–24 M)

Table 2: Preoperative compared to postoperative hemoglobin level (g/dL).

Patients	Preoperative ^a	Postoperative ^a
All patients (n = 70)	13.70 ± 1.90	13.48 ± 6.24
Female patients (n = 41)	12.75 ± 1.26	12.02 ± 1.49
Male patients (n = 29)	15.29 ± 1.47	15.29 ± 1.45

^a Mean ± SD.

(41.42%) with a median age of 38.5 years (range, 16–65). The median follow-up time was 8 months (6–24 months). Patients’ demographics and type of procedures are provided in Table 1. Of the 41 female patients, 30 (73.17%) were in their premenopausal age, while 11 (26.82%) were in their menopausal stage. With regard to the type of bariatric surgery, 62 patients underwent gastric sleeve (88.6%), 7 underwent RYGB (10%), and 1 underwent gastric sleeve followed by bypass surgery (1.4%). The mean body mass index (BMI) before surgery in all patients was 43.28 ± 6.53 (kg/m²). Based on the World Health Organization (WHO) BMI classification,¹ 5 patients (5.7%) had class I, 19

(27.1%) had class II, and 47 (67.1%) had class III obesity. With regard to comorbidities at the time of surgery, 12 patients had a history of diabetes mellitus (17.1%), 8 had hypertension (11.4%), and 16 were smokers (22.9%). Furthermore, all patients completed a minimum of 6 months of follow-up and had regular intake of vitamin supplements.

The mean postoperative level and preoperative haemoglobin level are shown in Table 2 and Figure 1. A line chart of haemoglobin levels of all patients after Roux-en-Y bypass and gastric sleeve is shown in Figures 2 and 3. According to the WHO criteria for diagnosing anaemia, postoperatively, 16 patients (22.9%) had anaemia, and all of them were women (39.0%) (Figure 4). Of those 16 patients, 2 (12.5%) had RYGB and 14 (87.5%) had gastric sleeve. Moreover, 15 (93.8%) had microcytic anaemia. Twelve of them had low serum iron levels, while three had not only low serum iron but also vitamin B12 deficiency indicated by low levels of B12 (<140 ng/L). Data on serum iron levels were not available in the remaining four patients; however, three of them had microcytic anaemia. Vitamin B12 levels were normal in nine patients, but were not available in four patients. Preoperatively, two anaemic patients showed low vitamin B12 level, but was corrected preoperatively and maintained.

However, of 54 patients (77.1%) who showed normal haemoglobin levels 6 months after surgery, 4 (7.4%) had low vitamin B12 level, 2 had gastric sleeve, 1 had gastric bypass, and 1 had both. Nonetheless, data on vitamin B12 levels and iron profile were not available during follow-up visit postoperatively in 21 (38.8%) and 35 (64.8%) non-anaemic patients, respectively. Folate levels were not measured in all patients postoperatively.

Thirteen patients developed mild to severe complications after surgery. One patient had left-sided plural effusion, splenic vein thrombosis with infected haematoma, and healthcare-associated pneumonia. She required transfusion of 2 units of packed red blood cells. The patient’s haemoglobin levels were 12.8 g \dL and 13.0 g \dL preoperatively and 13 months postoperatively, respectively. The other 12 patients had persistent GI symptoms related to surgery and dehydration-related symptoms. Of the 13 patients, 8 (12.9%) underwent gastric sleeve, 4 (57.1%) underwent gastric bypass, and 1 underwent both procedures.

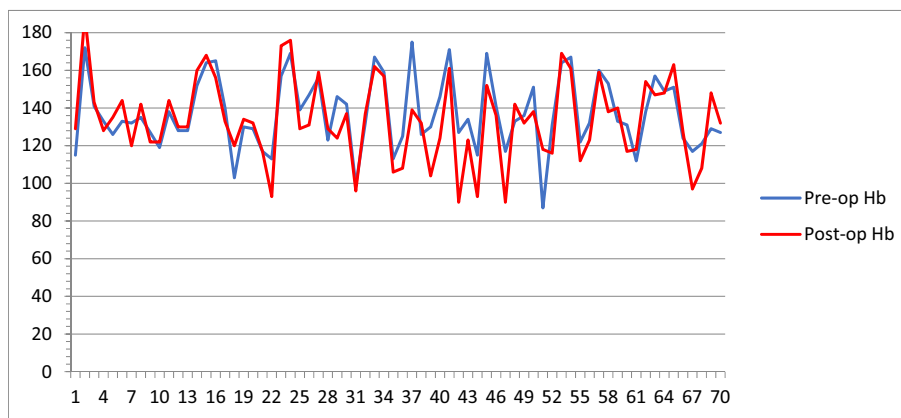


Figure 1: Preoperative compared to Postoperative Hemoglobin level (g/dL) for All patients (n = 70).

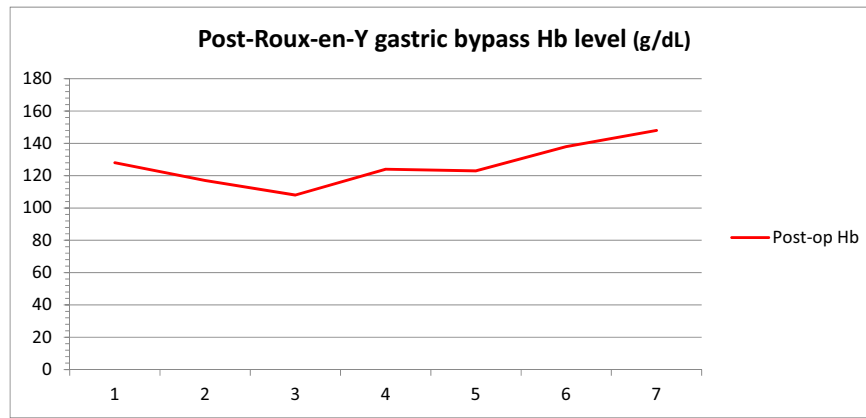


Figure 2: Post Roux-en-gastric bypass Hb level (g/dL) (n = 7).

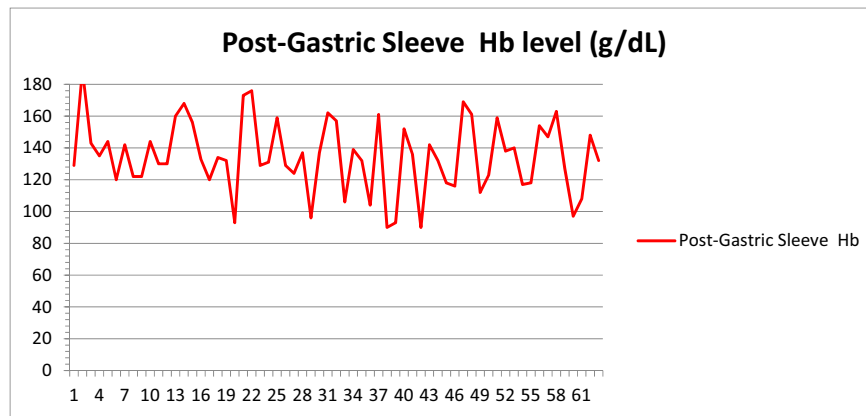


Figure 3: Post gastric sleeve Hb level (g/dL) (n = 62).

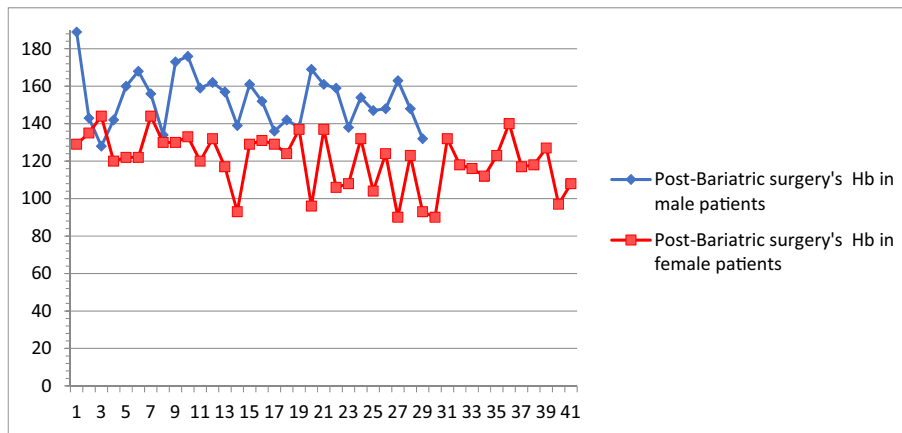


Figure 4: Comparing Post-Bariatric surgery's Hb levels for male and female patients.

Discussion

The prevalence of anaemia post-bariatric surgery in our study was 22.9% despite the relative short median follow-up time of 8 months (6–24 months). This value was consistent with that reported in previously published studies, which showed that the prevalence of anaemia post-bariatric surgery

ranged between 18% and 53%. Bariatric surgery decreases the surface area and, thus, the capacity of the stomach; B12 and iron are among the most common nutrients absorbed in the stomach.¹⁸ The mechanism is only partially known. Decreased iron or B12 levels are well-studied factors contributing to anaemia.^{19–21} The reported incidents of anaemia which occur after bariatric surgery were due to

iron deficiency (20%–49%), folate deficiency (up to 18%), and vitamin B12 deficiency (26%–70%).^{22–27}

Preoperatively, 17.1% ($n = 12$) of our patients were anaemic, and all of them were women. This could be due to the obesity-related systemic inflammation associated with impaired duodenal iron absorption resulting from low expression of duodenal ferroportin and elevated hepcidin concentrations leading to decreased serum iron and low intake of nutrients.^{12,13} This finding highlights the importance of preoperative assessment and investigations of serum iron, folate, and B12 levels. However, they were not performed in most of our patients whose aforementioned levels need to be corrected before surgery to prevent the development of anaemia and its related complications after surgery. However, nine patients with preoperative anaemia were found to be anaemic postoperatively and one of those patients had post-RYGB. The incidence of anaemia was 9.7% post-gastric sleeve and 14.3% post-RYGB.

There are three main categories of surgical techniques which can be used to induce weight loss; they can be divided into three types of procedures. First, gastric restrictive procedures are performed by removing approximately 80% of the stomach, which reduces the total capacity of the stomach to promote satiety with very little food intake. The second type is malabsorptive procedures; in this type, the rate of nutrient absorption is significantly high due to the anatomical changes made in the stomach or small intestine by bypassing a portion of the small intestine to varying degrees. The third type is mixed procedures, which is a combination of both. RYGBP is the best example of a mixed procedure, which combines gastric restriction and malabsorption.²⁸ In our study, in 16 patients (22.9%) had anaemia, 2 (12.5%) had RYGB and 14 (87.5%) had gastric sleeve.

The vast majority of the anaemic cases in our study were microcytic anaemia (93.8%). The duodenum and proximal jejunum are the main sites of iron absorption. In patients with RYGB, iron deficiency is related to a reduction in organic (heme) iron intake and bypassing the acidic environment of the stomach and the absorptive surface of the duodenum and proximal jejunum.²⁹ In literature, the incidence of iron deficiency 1 year after surgery was lowest in patients who underwent gastric restrictive procedures compared with those who underwent other types of bariatric surgery.³⁰ In our study, all patients were prescribed omeprazole 40 mg tablets and calcium carbonate 600 mg tablets. These possibly contributed to the reduction in iron levels by decreasing gastric acidity and, thus, absorption of iron in those taking omeprazole or inhibiting its absorption in those taking calcium. The supplements which were prescribed to the patients postoperatively did not contain iron. Iron supplementation could be helpful in preventing the occurrence of anaemia by increasing the recommended daily intake of elemental iron, which is 45 mg–60 mg for male patients and 100 mg for female patients.

Vitamin B12 absorption involves a complex series of metabolic steps; vitamin B12 in food is bound to protein and requires pepsin and hydrochloric acid to degrade it from

protein. Free vitamin B12 will bind with intrinsic factor, which is produced by parietal cells in the stomach. Then, it enters the small intestine and absorbed in the terminal ileum. After gastric sleeve surgery, the stomach contents are rapidly emptied into the small intestine, which reduces vitamin B12 bioavailability.³¹ In the case of gastric bypass, vitamin B12 will not be released from food or bind to an intrinsic factor. Other contributing factors could be intolerance to cow milk and red meat. The daily minimal dose of vitamin B12 in healthy individual is 2 µg, and the human body can store up to 2000 µg of vitamin B12, which should last for 2 years. Vitamin B12 deficiency is more commonly observed after a gastric bypass. The incidence of B12 deficiency ranged between 26% and 70%.²⁴ In our study, vitamin B12 deficiency was found in 3 patients (4.3%) who also had low iron levels despite the relative short median follow-up time of 8 months (6–24 months). A longer follow-up period may show an increase in the incidence. Our patients were on vitamin B complex, which contains 250 mcg of vitamin B12. A daily dose of vitamin B12 (300–500 µg) is proven efficient in several studies.^{21–25,27} However, the prescribed omeprazole could be a contributing factor in patients with B12 deficiency, as it reduces its absorption as well.

Although we were unable to measure the folate levels of our patients, the literature showed that it only has a minor role. In a study of 1067 patients reported by Mallory and Macgregor,³² only 1% of patients who underwent RYGB developed folate deficiency. This can be due to the fact that folate absorption is adequate in the distal segment of the small intestine.³² Another study of 61 patients found that folate deficiency was evident as early as 6 months after surgery.³⁰ The recommended dose of folic acid after bariatric surgery is at least 400 mcg per day. In our study, the patients received 1 mg of folic acid supplement.

There were several limitations to our study including its retrospective design, single centre site, the small sample size, and the short follow-up period; hence, the results may not represent our population on the long term. Moreover, data on patients' pre- and postoperative folate levels were not available. Furthermore, our study showed that women are more likely to be anaemic shortly after undergoing bariatric surgery possibly due to menstruation with low intake of nutrients. Hence, further studies should be conducted to evaluate women who underwent bariatric surgery with strict postoperative follow-up by a dietician. The appropriate dosages of supplements should be determined and treatment adherence should be encouraged to achieve significant weight loss with proper nutrient intake.

Conclusion

Anaemia is a common complication after bariatric surgery and has a major health impact. It was observed in 22.9% of our patients, all of whom were women. A majority of the patients had anaemia due to iron deficiency within a short follow-up period. Vitamin B12 deficiency was observed in a minority of patients, which may increase in the long-term follow-up. Although bariatric surgery is generally safe,

careful preoperative assessment and follow-up are necessary to avoid the occurrence of complications.

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Conflict of interest

There is no conflict of interest.

Ethical approval

The College of Medicine Research Ethical Committee approved the conduction of this research. All procedures performed and data collection in this retrospective study involving human participants were in accordance with the ethical standards of the institutional research committee.

Authors contributions

T.W. designed the study. All authors preformed the study equally, contributed to the extraction of data, analysed the data, wrote the paper, and approved the manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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