

Early and late complications arising from various bariatric surgical procedures in a tertiary center in Saudi Arabia

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Background

Individuals who are obese or morbidly obese face a significantly higher risk of experiencing postoperative complications. To evaluate high-risk patients undergoing bariatric surgery and mitigate the likelihood of further postoperative complications, various indicators are utilized. There are no prior reports about bariatric surgical procedures-related early/late complications that came out from the western region of Saudi Arabia.

Aim

This retrospective study aims to evaluate both short-term and long-term postoperative complications after several bariatric surgeries, including sleeve gastrectomy, Roux-en-Y gastric bypass, and revisional bariatric surgery.

Patients and methods

The assessment of complications in 328 patients who underwent bariatric surgery involved analyzing demographic data, medical and surgical history, preoperative and postoperative BMI, histopathologic findings, and early and late complications. These data were obtained from a prospectively maintained database.

Results

Of the total participants, 241 underwent sleeve gastrectomy, 43 underwent gastric bypass, and 44 had revisional bariatric surgery. Complication rates varied among the different bariatric surgeries. Specifically, SG patients had the lowest early major complication rate (2.1%), while gastric bypass patients had a rate of 4.7%. Conversely, the 'revisional' operations reported the highest rate of early complications at 9.1%. Late complications demonstrated varying rates, with sleeve gastrectomy patients experiencing the highest incidence of gastroesophageal reflux disease at 39%, and gastric bypass patients showing the highest rate of nutritional deficiency at 58%.

Conclusion

The study found that the baseline characteristics of patients did not exert a statistically significant influence on the occurrence of postoperative complications. However, different types of bariatric surgeries presented varying complication rates. Patients who underwent gastric bypass tended to have the highest rate of nutritional deficiency, while sleeve gastrectomy patients exhibited the highest rate of gastroesophageal reflux disease. Selecting the appropriate bariatric surgical procedure warrants careful consideration of patients' preferences, demographic characteristics, presence of other medical conditions, and a comprehensive understanding of the potential advantages and disadvantages of each surgical option. Collectively, our findings would help discussing the expected outcome with the patients before surgery.

Keywords:

bariatric surgery, obesity, postoperative complications, Roux-en-Y gastric bypass, sleeve gastrectomy, weight loss surgery

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Introduction

The escalation of obesity prevalence in Saudi Arabia has resulted in a noteworthy increase in the frequency of bariatric procedures [1]. As noted in the 2018 Al-Arabiya article, it has been estimated that there are around 62 procedures per 100 000 individuals, demonstrating the growing reliance on such measures [2]. Despite the high demand and effective

outcomes in addressing obesity, bariatric operations, comprising laparoscopic sleeve gastrectomy and laparoscopic gastric bypass, have been associated

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with both short-term and long-term complications, with anastomotic or staple leaks and intra-abdominal bleeding being among the most severe [3]. Notably, the mortality rate following bariatric surgery is below 0.1% [4–6].

A retrospective study from Finland revealed that Roux-en-Y gastric bypass (RYGB) carries the highest incidence of late complications [7] with an increased susceptibility to small bowel obstruction [8]. Furthermore, a separate systematic review study indicated that the most prevalent complication in laparoscopic RYGB procedures was the stenosis of the gastrojejunal anastomosis [5]. However, a 2018 meta-analysis reported decreased anastomotic leaks following gastric bypass surgery, as opposed to sleeve gastrectomy [9].

Notably, a noticeable gap exists in Jeddah, Kingdom of Saudi Arabia, concerning the evaluation of complications and outcomes associated with bariatric surgery. The significance of examining postoperative complications stemming from varied bariatric surgical procedures across diverse age cohorts from these reasons. Obtaining a comprehensive understanding of the projected outcomes arising from any bariatric treatment holds substantial importance, especially given the mounting obesity rates and the subsequent rise in bariatric surgical procedures in recent years. An evaluation of the disparities and consequences will significantly contribute to decreasing the morbidity and mortality rates linked to bariatric surgery. Consequently, this study aimed to investigate the early and late postoperative complications associated with bariatric surgery conducted at King Abdulaziz University Hospital in Jeddah, Kingdom of Saudi Arabia.

Patients and materials

Study design and data collection

This study comprises a retrospective analysis of a prospectively maintained database that included 366 patients who underwent various types of bariatric surgery at King Abdulaziz University Hospital in Jeddah, Saudi Arabia, from 2010 to 2020. The surgical procedures included sleeve gastrectomy, RYGB, and revisional bariatric surgery (involving the conversion of one bariatric operation to another, such as converting laparoscopic band or sleeve gastrectomy to RYGB).

Preoperative endoscopies were not done routinely but selectively depending on the patient's symptoms. They

were done routinely only in the redo operations. Four different surgeons performed a mixture of both sleeves and bypasses. All the sleeves were done by either echelon or endo GIA staplers. All bypasses were done by staplers including the gastrojejunostomy.

The dataset encompassed all individuals who underwent bariatric surgeries during the designated research timeframe. Patients lacking documentation of the surgical operation or operative notes in the database, which impeded sufficient information for analysis, were excluded. A total of 38 patients were excluded from the study. Complications occurring within the initial month following the surgery are classified as early or short-term complications, while those occurring after that up to 6 months postsurgery are termed late or long-term complications.

Questionnaire variables

Demographic information, such as sex, age, nationality, smoking status, and marital status, was extensively documented for all patients. To facilitate analysis, patients were categorized into five distinct age groups. The BMI was categorized into four different groups: (a) overweight (BMI: 25–29.9), (b) obesity class I (BMI: 30–34.9), (c) obesity class II (BMI: 35–39.9), and (d) morbid obesity (BMI ≥ 40). Preoperative data, including preoperative BMI, prior medical history encompassing various conditions, surgical history, and medication usage, were meticulously examined and documented. Perioperative data included details such as the type of surgery, the date of surgery, histological findings, and early outcomes and mortality rates within a 30-day postoperative period. Additionally, long-term outcomes and death rates were assessed, specifically focusing on issues occurring beyond the initial 30-day postoperative period up to the 6th-month follow-up. The early major complications assessed were leak, bleeding, and obstruction, while the late complications included nutritional deficiency, gastroesophageal reflux disease (GERD), and biliary and internal hernia.

Ethical approval

This investigation was carried out in compliance with the 1964 Helsinki Declaration and its subsequent revisions, following the acquisition of ethical clearance from the research ethics committee at King Abdulaziz University Hospital, Jeddah, Saudi Arabia.

Statistical analysis

The data underwent a rigorous examination to ensure accuracy and comprehensiveness. Categorical variables

were depicted using frequencies and percentages, while numeric variables were reported as mean±SD. The association between the type of bariatric surgery and the occurrence of complications was assessed using the χ^2 test. An independent samples *t* test was also conducted to assess the association between BMI and the occurrence of complications. All analyses were performed utilizing a 95% confidence interval, employing the Statistical Package for Social Science (SPSS), version 23.0, developed by IBM (Armonk, New York, USA).

Results

In this study, a cohort of 328 individuals underwent bariatric surgery, of which 61.9% were females, totaling 203 individuals. The majority of the participants were identified as Saudi Arabian citizens, constituting 84.5% of the entire cohort. Baseline patient characteristics are presented in Table 1, revealing median preoperative and postoperative BMIs of 42.7 and 34.1 kg/m², respectively.

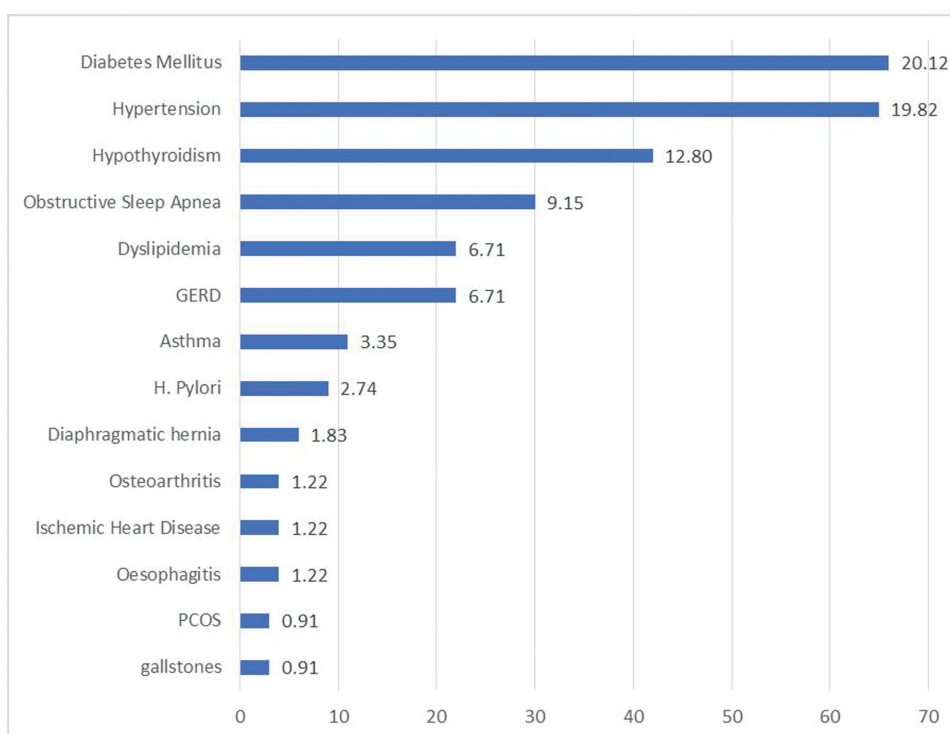
The medical history of participants demonstrated positive results in 57.3% of cases (Fig. 1), while the surgical history showed positive results in 43.3% of the total sample (Fig. 2). The most prevalent comorbidity was diabetes mellitus, recorded in 20.12% of cases,

followed closely by hypertension at 19.82%. Cholecystectomy was the most frequently performed surgical procedure, accounting for 7.62% of cases, followed by cesarean delivery at 6.1%.

Table 1 Baseline characteristics of the study population

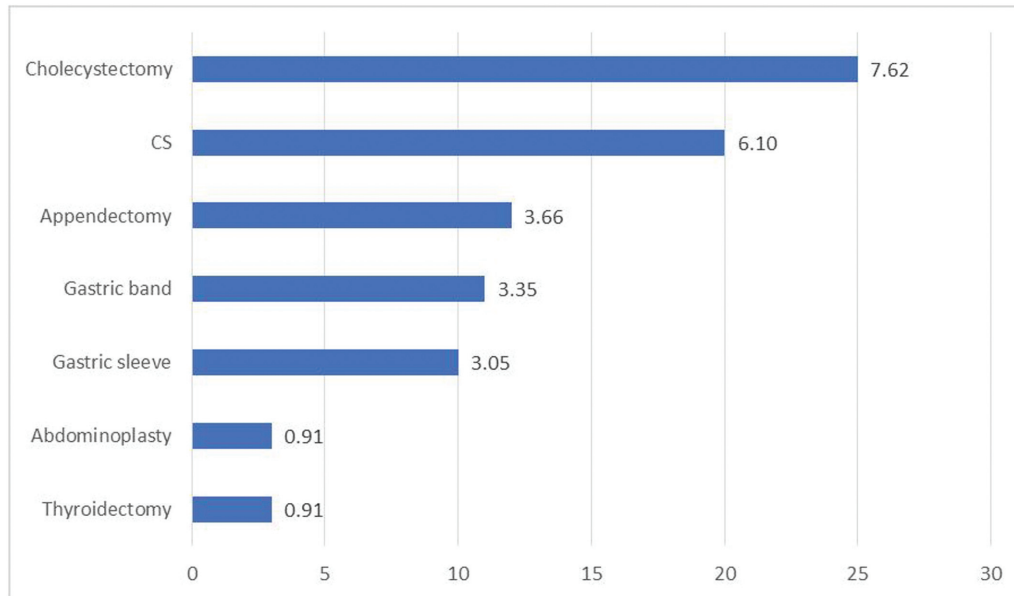
Characteristics	n (%)
Sex	
Female	203 (61.9)
Male	125 (38.1)
Age group (years)	
<20	8 (2.4)
20–30	64 (19.5)
31–40	108 (32.9)
41–50	89 (27.1)
51–60	46 (14.0)
>60	13 (4.0)
Nationality	
Saudi	277 (84.5)
Non-Saudi	51 (15.5)
Marital status	
Single	67 (20.4)
Married	147 (44.8)
Other	114 (34.8)
On medication	
Yes	159 (48.5)
No	169 (51.5)
Smoker	
Yes	32 (9.8)
No	296 (90.2)

Figure 1



Prevalence and distribution of past medical history of the study population.

Figure 2



Prevalence and distribution of past surgical history of the study population.

Short-term postoperative complications were observed: leak occurred in 1.2% of cases, stricture in 0.6% of cases, and bleeding in 1.2% of cases. Additionally, one patient experienced an early port site hernia associated with bowel obstruction. Long-term postoperative complications during the 6-month follow-up included GERD in 32% of cases, hepatobiliary difficulties in 4.3% of cases, nutritional inadequacy in 41.8% of cases, and internal hernia in 0.6% of cases (Table 2).

Varying rates of complications were observed among different bariatric surgery types (Table 3). Specifically, sleeve gastrectomy cases had the lowest early complication rate at 2.1%, followed by gastric bypass at 4.7%, and the highest early complication rate of 9.1% was observed for 'revisonal' operations (Table 3). Moreover, the overall complication rates also varied

among the different bariatric procedures, with sleeve gastrectomy cases exhibiting the lowest overall complication rate at 50.6%, followed by RYGB at 57.5%, and revisonal procedures at the highest overall complication rate of 66.7%.

Notably, baseline patient characteristics did not exert a statistically significant influence on the occurrence of postoperative complications. This lack of significance was evident in both preoperative and postoperative BMI values among patients who experienced complications and those who did not encounter complications. Specifically, no statistically significant difference was observed in preoperative BMI (45.0 vs. 43.9, $P=0.250$) or postoperative BMI (35.8 vs. 36.3, $P=0.786$) between these two groups.

Table 2 Prevalence of postoperative complications

Complications	n (%)
Short-term (30 days)	
Leak	4 (1.2)
Stricture	2 (0.6)
Bleeding	4 (1.2)
Port site hernia	1 (0.3)
Long-term (6 months follow up)	
GERD	105 (32)
Hepatobiliary	14 (4.3)
Nutritional deficiency	137 (41.8)
Internal hernia	2 (0.6)

GERD, gastroesophageal reflux disease.

Discussion

Bariatric surgical approaches, such as laparoscopic RYGB and laparoscopic sleeve gastrectomy, have been recognized as effective solutions for managing obesity and its associated conditions in individuals with moderate to severe obesity [10].

Our study aimed to assess the occurrence of short-term and long-term complications following various bariatric procedures. Notably, the study predominantly included female patients, constituting a 61.9% of the overall sample. This aligns with earlier findings indicating a higher utilization of bariatric procedures among females than males [11]. Women,

Table 3 Postoperative complications stratified by bariatric surgery type

Short-term complications			
Complication type	Bariatric surgery type	Complication rate [n (%)]	P value
Leak	Sleeve gastrectomy (N=241)	2 (0.8)	1.000
	Gastric bypass (N=43)	0	
	Revisional (N=44)	2 (4.5)	
Stricture	Sleeve gastrectomy (N=241)	1 (0.4)	1.000
	Gastric bypass (N=43)	0	
	Revisional (N=44)	1 (2.3)	
Bleeding	Sleeve gastrectomy (N=241)	2 (0.8)	0.779
	Gastric bypass (N=43)	1 (2.3)	
	Revisional (N=44)	1 (2.3)	
Port site hernia	Sleeve gastrectomy (N=241)	0	1.000
	Gastric bypass (N=43)	1 (2.3)	
	Revisional (N=44)	0	
Late complications			
Complication type	Bariatric surgery type	Complication rate [n (%)]	P value
GERD	Sleeve gastrectomy (N=241)	94 (39)	<0.0001*
	Gastric bypass (N=43)	4 (9.3)	
	Revisional (N=44)	7 (15.9)	
Hepatobiliary	Sleeve gastrectomy (N=241)	9 (3.7)	0.046
	Gastric bypass (N=43)	3 (1.2)	
	Revisional (N=44)	2 (4.5)	
Nutritional deficiency	Sleeve gastrectomy (N=241)	91 (37.8)	<0.0001*
	Gastric bypass (N=43)	25 (58.1)	
	Revisional (N=44)	21 (47.7)	
Internal hernia	Sleeve gastrectomy (N=241)	0	1.000
	Gastric bypass (N=43)	2 (4.7)	
	Revisional (N=44)	0	

GERD, gastroesophageal reflux disease.

particularly those of reproductive age, face specific challenges related to obesity, necessitating consideration of bariatric surgery to manage potential complications during pregnancy, such as gestational diabetes mellitus, gestational hypertension, and preeclampsia, in addition to reducing the risk of congenital malformations. Prior research has also highlighted the prevalence of bullying among females and its potential effect on bolstering self-esteem [12].

Our findings indicate that 57.3% of patients had a positive medical history, while 43.3% had a history of prior surgical interventions. However, the incidence of complications in these patients did not show a statistically significant difference compared to individuals without such histories. It is essential to recognize that previous research illustrates significant improvements or complete resolution of patients' complications following bariatric surgery [11]. While obesity is a recognized risk factor for various comorbidities, addressing its root cause of obesity may lead to a reduction in the severity of associated medical conditions.

Our results suggest no substantial association between age or any demographic factor and the rate of complications. However, the modest variability in complication rates among different age groups might be linked to age-related declines in immunity or the presence of prior medical and surgical conditions. Previous studies have also emphasized that age does not significantly influence the outcomes of postbariatric surgeries [13,14].

No statistically significant association was observed between preoperative and postoperative BMI and the rate of complications. GERD was the most observed gastrointestinal complication, representing 32% of cases. These findings align with previous research highlighting acid reflux as a prevalent postoperative sequelae [15,16]. Postbariatric patients often experience nutritional deficiencies, including deficiencies in vitamin D, vitamin B12, ferritin, magnesium, calcium, and folate. The present study revealed a notable prevalence of nutritional insufficiencies, particularly vitamin D deficiency in 119 individuals and ferritin deficiency in 54 individuals. Regarding histological findings, chronic

inactive gastritis emerged as the most frequently encountered outcome, although the overall histological observations were inconclusive.

In a study by Kassir *et al.* [17], peritonitis emerged as the most common major complication during the initial 10-day period. Various issues may potentially arise in association with particular surgical procedures. For example, the occurrence of nutritional deficiencies was higher in patients who underwent RYGB compared to those who underwent sleeve gastrectomy, as evidenced by the study conducted by Lin and colleagues, which also reported similar results. According to a study conducted by researchers [18], a correlation was observed between gastric bypass surgery and an increased prevalence of nutritional inadequacies. This can be rationalized based on the premise that the technique entails circumventing the duodenum, which plays a crucial role in the absorption of essential macronutrients and micronutrients. Consequently this bypass may result in deficiencies that can have severe consequences if not addressed through appropriate supplementation protocols. Furthermore the investigations conducted by Enani *et al.* [19] and Khalaj *et al.* [20] have identified iron, vitamin B12, and vitamin D as the most often impacted nutrients following gastric bypass surgery. The revisional bariatric procedures exhibited the highest incidence of early major complications, particularly leaks. This is explained by the presence of scar tissue and weakening of the gastric and bowel wall.

Previous research has yielded consistent results, as demonstrated in a meta-analysis, indicating that sleeve gastrectomy outperforms alternative forms of bariatric surgery in terms of surgery duration and early complications [21,22].

The present study is subject to certain limitations that have constrained the scope of our findings. The observational capacity and longitudinal tracking of patients in this analysis have been denied due to its retrospective character, particularly in cases where patients were referred from multiple hospitals. Furthermore, inadequate documentation within the hospital system, specifically regarding the recording of weight fluctuations presurgery and postsurgery, has resulted in the omission of certain files. Finally, the study was conducted at a singular institution, limiting the sample size. It is suggested that prospective research be undertaken to facilitate a more comprehensive monitoring of patients, allowing for a more precise characterization of both short-term and long-term issues. This would

ultimately aid in determining the optimal surgical approach that yields the most favorable long-term results.

In summary, the results of this retrospective study suggest that the difference between preoperative and postoperative BMI does not necessarily reflect the success of bariatric surgery. Regarding early major complications, revisional bariatric surgery showed the highest complication rate. With respect to long-term complications, gastric bypass patients had the highest incidence of nutritional deficiencies, while sleeve gastrectomy patients exhibited the highest rate of symptoms associated with GERD. Though the baseline characteristics of patients did not demonstrate a statistically significant influence on the occurrence of postoperative complications, it is crucial to emphasize the importance of carefully selecting the appropriate bariatric surgical procedure. This decision should consider the patient's personal preferences, demographic factors, medical background (including comorbidities), and a comprehensive understanding of the potential advantages and disadvantages associated with each surgical intervention. Making an informed choice based on these factors can significantly impact the overall success and safety of bariatric surgery.

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Conflicts of interest

There are no conflicts of interest.

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