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THE UTILITY OF GASTROGRAFFIN AS A ROUTINE SCREENING TEST FOR POST-BARIATRIC SURGERY LEAKAGE: A RETROSPECTIVE STUDY

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ABSTRACT

Background: In Jordan, obesity prevalence is alarmingly high, affecting both men and women. Bariatric surgery has emerged as a critical solution to combat obesity. LSG is the most frequently performed procedure, although LRYGB has often been considered the gold standard. Gastrografin, a high-osmolality contrast medium, has diagnostic and therapeutic applications, particularly for post-bariatric surgery complications. In this study, we evaluated the role of Gastrografin in detecting and preventing leaks. **Methods**: This retrospective single-center study, conducted at Prince Ali Ben Al Hussein Hospital, Jordan, aimed to assess demographic, clinical, and post-operative characteristics associated with post-operative Gastrografin tests in patients who underwent bariatric surgeries. Data were collected from medical records, encompassing variables such as age, gender, body mass index (BMI), surgical type, and complications. **Results**: The study included 933 patients with a predominantly female population. The median age was 34, with the majority aged between 26 and 45. Sleeve gastrectomy was the most common procedure (93.6%), while LRYGB and gastric band surgeries accounted for 6.1% and 0.3%, respectively. Complications occurred in 4.7% of patients, with postoperative bleeding, deep venous thrombosis, and general weakness among them, with only one patient having a leak detected by gastrografin. **Conclusion**: Despite the routine use of gastrografin test in 933 patients, there was only one positive test. Our study suggests that there is no role for its routine use in primary bariatric surgery. Discontinuation of this practice would reduce cost and intra-operative time.

KEYWORDS: gastrografin; bariatric surgery; leak; cost; time.

INTRODUCTION

Obesity rates have tripled since 1975, and this is a concern that extends beyond adults. Recent data indicates that over 30 to 300 million children and adolescents globally fall into the category of being overweight or obese.[1] In Jordan, the obesity prevalence reached 77% in both men and women based on BMI>=25 kg/m^2 criteria.[2] Bariatric surgery has gained significant recognition as an effective approach to combat obesity, offering a long-term solution to this global health challenge. Consequently, various bariatric procedures have been developed.[3] While laparoscopic Roux-en-Y gastric bypass (LRYGB) has often been regarded as the gold standard among these procedures, laparoscopic sleeve gastrectomy (LSG) remains the most frequently performed option.[4]

An anastomotic leak is the most dreaded complication of any bariatric procedure as it increases overall morbidity to 61% and mortality to 15%.[5], [6] Its presentation ranges from being asymptomatic to the signs and symptoms of a septic shock including fever, abdominal pain, peritonitis, leukocytosis, tachycardia, and hypotension.[7] Interestingly leaks may occur as a late event, days or even weeks postoperatively.[8], [9] Also, a recent systematic review and meta-analysis revealed that the leak rate is low at 2.4%.[10]

Gastrografin is a contrast medium with high osmolality that is soluble in water. It has been employed for diagnostic purposes to define and for therapeutic reasons to alleviate adhesive small bowel obstructions.[11], [12] Several studies have shown that giving Gastrografin after bariatric surgeries can help detect anastomotic leak or obstruction.[13], [14]

In this study, we aim to retrospectively assess the demographic, clinical, and post-operative characteristics of the post-operative Gastrografin test in a population of Jordanian patients who underwent bariatric surgeries.

METHODS

Study Design

A retrospective, single-center, observational study was carried out at Prince Ali Ben Al Hussein Hospital in Jordan between the period 2019 to 2022. Patients who underwent bariatric procedures were recruited to examine the clinical, demographic, and prognostic characteristics of the gastrograffin test following bariatric surgery.

Data Collection

Data were collected retrospectively by accessing patients' hospital records. The following demographic and clinical variables were retrieved: age at operation, gender, body mass index (BMI), height (cm), weight (Kg), packed cell-volumes levels (PCV), white blood cell (WBC) levels, drains, surgery type (gastric band, Roux-en-Y gastric bypass, or sleeve gastrectomy), and post-operative complications.

Statistical Analysis

Continuous variables were expressed as means accompanied by their respective standard deviations (SD), while categorical variables were summarized using frequencies and percentages. To investigate the association between demographic, clinical, and operative variables, and the risk of mortality, we utilized the Wilcoxon (Mann-Whitney U) test for continuous variables. For categorical variables with a category count of less than 5, we applied the chi-squared (X2) test or Fisher's exact test. Statistical significance was determined when the p-value fell below 0.05. All statistical analyses were performed using R software (version 4.2.3, Vienna, Austria).

RESULTS

A total of 933 patients who underwent bariatric surgeries were included. Median age was 34.0 (27.0, 42.0), and median age at operation was 33.0 (26.0, 41.0), the majority of patients were females (92.1%, n=667), while 57 (7.9%) were males. The median BMI was 43.0 (40.2, 46.0), median height was 163.0 (159.0, 168.0) cm, and median weight was 114.0 (105.3, 124.8) kg. The median PCV 6 hours post-surgery was 39.0 (36.0, 42.0), and the median WBC 6 hours post-surgery was 10.0 (8.0, 12.0). Drains were seen in 729 (78.4%) of patients. Sleeve gastrectomy was performed on 873 (93.6%) of patients, while 57 (6.1%) of patients underwent Roux-en-Y Gastric Bypass (RYGB), and 3 (0.3%) patients underwent gastric band surgery. The median 24-hour post-operative PCV was 38.0 (35.0, 41.9), and the median 24-hour post-operative WBC was 12.0 (10.0, 15.0). A total of 12 (1.29%) patients had postoperative complications, of which 3 (0.3%) had post-operative bleeding, 1 (0.1%) patient had deep venous thrombosis (DVT), 2 (0.2%) patients had general weakness, 3 (0.3%) patients had hiatal hernia, 2 (0.2%) patients had intestinal obstruction, and 1 (0.1%) patient had intra-abdominal abscess. The post-operative leak was seen in 1 (0.1%) patient only, with concurrent complications of bleeding and hiatal hernia. **Table 1** shows the demographic and clinical characteristics of the patients included in our study.

When comparing patients who had drains, a significant difference in WBC levels was seen at two-time points, in which patients with drains had a significantly lower WBC level at 6 hours post-surgery (mean: 9.8 vs. 12.0, p-value<0.001), while patients with no drains had a significantly lower WBC level at 24-hours post-surgery (mean: 11.2 vs. 13.1, p-value=0.005) as shown in **Table 2**. No significant differences in other demographic or clinical characteristics were found. Patients with post-operative complications had a significantly higher age compared to those with no post-operative complications (mean: 41.0 vs. 39.0, p-value=0.030), in addition, patients with postoperative complications had a significantly elevated WBC level compared to those with no complications (mean: 16.7 vs. 12.4, p-value<0.001) as shown in **Table 3**.

Tables and Figures

Table 1: Demographic and clinical characteristics of all included patients.

Characteristic	**N = 933**[1]
Age	34.0 (27.0, 42.0)
Age at operation	33.0 (26.0, 41.0)
Sex	
Female	667 (92.1%)
Male	57 (7.9%)
BMI	43.0 (40.2, 46.0)
Height (cm)	163.0 (159.0, 168.0)
Weight (Kg)	114.0 (105.3, 124.8)
6-hours post-PCV	39.0 (36.0, 42.0)
24-hours post-PCV	38.0 (35.0, 41.9)
6-hours post-WBC	10.0 (8.0, 12.0)
24-hours post-WBC	12.0 (10.0, 15.0)
Drains	729 (78.4%)
Surgery Type	
Gastric band	3.0 (0.3%)

Roux-en-Y Gastric Bypass	57.0 (6.1%)
Sleeve Gastrectomy	873.0 (93.6%)
Complications	12.0 (1.29%)
Type of Complication	
Bleeding	3.0 (0.3%)
DVT	1.0 (0.1%)
General Weakness	2.0 (0.2%)
Hiatal Hernia	3.0 (0.3%)
Intestinal Obstruction	2.0 (0.2%)
Intra-abdominal Abscess	1.0 (0.1%)
Multiple	1.0 (0.1%)
Post-operative Leak	1.0 (0.1%)

[1]Median (IQR); n (%);
Abbreviations: PCV, packed cell volume, WBC, white blood cells, DVT, deep venous thrombosis, BMI, body-mass index.

Table 2: Comparison of demographic and clinical characteristics between patients with and without drains.

Characteristic	**No**, N = 201[1]	**Yes**, N = 729[1]	**p-value**[2]
Age	34 (8)	35 (9)	0.7
Sex			0.3
Female	138 (90%)	527 (93%)	
Male	15 (9.8%)	42 (7.4%)	
BMI	43.4 (4.7)	43.9 (4.6)	0.075
Height (cm)	166 (9)	164 (8)	0.13
Weight (Kg)	119 (20)	117 (15)	>0.9
6-hours post-PCV	39.5 (5.1)	39.6 (4.8)	0.6
24-hours post-PCV	38.8 (5.6)	38.3 (5.0)	>0.9
6-hours post-WBC	12.0 (3.4)	9.8 (3.1)	**<0.001**
24-hours post-WBC	11.2 (2.9)	13.1 (4.0)	**0.005**
Surgery Type			0.007
Gastric band	1 (0.5%)	2 (0.3%)	
Roux-en-Y Gastric Bypass	4 (2.0%)	53 (7.3%)	
Sleeve Gastrectomy	196 (98%)	674 (92%)	
Complications	2 (1.0%)	10 (1.4%)	>0.9
Type of Complication			0.091
Bleeding	0 (0%)	3 (0.4%)	
DVT	0 (0%)	1 (0.1%)	
General Weakness	0 (0%)	2 (0.3%)	
Hiatal Hernia	2 (1.0%)	1 (0.1%)	
Intestinal Obstruction	0 (0%)	2 (0.3%)	
Intra-abdominal Abscess	0 (0%)	1 (0.1%)	
Multiple	0 (0%)	1 (0.1%)	
Post-operative Leak	0 (0%)	1 (0.1%)	

[1]Mean (SD); n (%)
[2]Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test
Abbreviations: PCV, packed cell volume, WBC, white blood cells, DVT, deep venous thrombosis, BMI, body-mass index.

Table 3: Comparison of demographic and clinical characteristics between patients with and without post-operative complications.

Characteristic	**No**, N = 223[1]	**Yes**, N = 11[1]	**p-value**[2]
Age	34 (9)	41 (9)	**0.030**
Sex			>0.9
Female	169 (76%)	9 (82%)	
Male	54 (24%)	2 (18%)	
BMI	43.1 (4.5)	43.7 (4.0)	0.6
Height (cm)	165 (8)	161 (7)	0.2
Weight (Kg)	117 (16)	114 (15)	0.5

6-hours post-PCV	39.5 (4.8)	40.6 (6.4)	>0.9
24-hours post-PCV	38.4 (5.0)	38.9 (7.6)	0.8
6-hours post-WBC	10.4 (3.4)	9.5 (1.9)	0.6
Post-WBC	12.4 (3.8)	16.7 (3.5)	**<0.001**
Drains	174 (78%)	9 (82%)	>0.9
Surgery Type			0.3
Gastric band	2 (0.9%)	0 (0%)	
Roux-en-Y Gastric Bypass	5 (2.2%)	1 (9.1%)	
Sleeve Gastrectomy	216 (97%)	10 (91%)	

[1]Mean (SD); n (%)
[2]Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test
Abbreviations: PCV, packed cell volume, WBC, white blood cells, DVT, deep venous thrombosis, BMI, body-mass index.

DISCUSSION

The National Health and Nutrition Examination Survey (NHANES) consistently reports a rising incidence of obesity in adults and children of all genders. Obesity is linked to a range of significant concurrent medical conditions, such as type 2 diabetes, high blood pressure, elevated lipid levels, and coronary artery disease.[15], [16] The most critical complication linked to bariatric surgeries is the occurrence of a postoperative leak anywhere in the digestive system.[17] Thus, in this study, we aim to assess the use of the gastrograffin test following bariatric surgery in a Jordanian population.

Our findings showed only one positive result from the gastrograffin test. Multiple studies have shown similar results. In a study done by Wahby et al. on 712 cases, the gastrograffin test was negative for leakage in all cases, but intraoperative methylene blue testing detected leakage in 28 cases.[18] Another study done by Mizrahi et al. showed one abnormal gastrograffin study showing complete obstruction due to an incarcerated hiatal hernia and five patients presented with a leak, detected by CT scans were the UGI swallow studies failed to detect any of the leaks resulting in a sensitivity of 0%.[19] In a study aimed to identify the cost-effectiveness of gastrograffin studies, all patients had negative results, which led to an unnecessary increase in the overall costs.[20]

Our study reveals a predominantly female patient population, consistent with global trends, reflecting the increased prevalence of obesity among women. The median age of patients in this study falls within the 26 to 45-year range, which aligns with previous research indicating higher obesity rates among younger individuals. A study by Bustami et al. on the Jordanian population showed that the age-adjusted prevalence of obesity among women was 70.6%, with the highest association between obesity and age groups between 30-39 years. In addition, it was correlated with both a high number of pregnancies and lower educational attainment. Furthermore, this elevated prevalence contributes to an increased occurrence of chronic health conditions in obese women.[21] A systematic review by Afshin et al. of patterns in the occurrence of overweight and obesity reveals that the obesity rate stands at 12% among adults. This rate is higher among women and reaches its highest point among individuals aged 60-64 years.[22]

Our study highlights the frequent use of sleeve gastrectomy as the primary surgical approach, a common choice for its effectiveness and lower complication rates. Post-operative complications were observed in a small percentage of patients, primarily consisting of bleeding, deep venous thrombosis, general weakness, hiatal hernia, intestinal obstruction, and intra-abdominal abscess. Age was identified as a significant factor, with older patients experiencing more post-operative complications, possibly due to the impact of age-related comorbidities. In a large cohort study by Howard et al. involving a nationwide sample of 95,405 patients, it was observed that sleeve gastrectomy was linked to reduced mortality risk, fewer complications, and lower overall reintervention rates five years post-surgery. Nonetheless, patients who underwent sleeve gastrectomy had a heightened risk of requiring surgical revisions.[23]

Interestingly, the presence of drains affected the white blood cell (WBC) levels at different postoperative time points, suggesting a possible role in infection control. Patients with drains exhibited lower WBC levels at 6 hours post-surgery, while those without drains had lower levels at 24 hours post-surgery. These findings emphasize the importance of individualized care and monitoring based on clinical characteristics and the presence of drains. A study by Dallal et al. on 590 patients who underwent gastric bypass showed that it was connected with a substantial reduction in both WBC and platelet counts. These reductions do not appear to have significant clinical implications, in contrast to the considerable decline in red blood cell volume observed in premenopausal women.[24] In addition, a study by Cunha et al. of 764 patients who underwent bariatric surgeries revealed that all types of bariatric surgeries were associated with leukopenia and neutropenia. Monocyte counts were associated with a decrease in patients who underwent gastric bypass and sleeve gastrectomy while increased in patients who underwent gastric band.[25]

Our study provides several strong points. First, our study addresses the pressing issue of obesity, which has seen a

significant increase globally. It emphasizes the importance of bariatric surgery as an effective approach to combat obesity. Second, our study focuses on the Jordanian population, which is a unique demographic for such research. This adds to the diversity of data available on the topic. However, our findings should be interpreted carefully due to some limitations. First, this study is conducted at a single center, which may limit the generalizability of the findings to the broader population. Multi-center studies could provide more representative results. The retrospective nature of the study may introduce biases and limitations in data collection. Prospective studies may offer more robust findings. Future long-term follow-up studies are warranted to assess the sustained effects and complications of bariatric surgery on the Jordanian population.

CONCLUSION

Our study describes the demographic and clinical characteristics of post-operative Gastrograffin tests in a Jordanian population following bariatric surgeries. Our findings reveal that the age group between 26 and 45 years is the most susceptible to obesity, a trend also observed in other parts of the world. Importantly, it shows that gender does not significantly influence the distribution emphasizing that obesity affects both males and females of different age groups in Jordan. With a wealth of data collected, it provides valuable insights for healthcare professionals and policymakers in Jordan.

Furthermore, our study revealed only one positive result from the gastrograffin test. While the use of gastrograffin may reveal instances of technical failure, our study shows that its routine incorporation in primary bariatric surgery is not justified. Discontinuation of this practice would mitigate the risk of anaphylactic reactions, decrease associated costs, and reduce intra-operative time.

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