

Trends in bariatric surgery and incidentalomas at a single institution in Saudi Arabia: a retrospective study and literature review

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BACKGROUND: Data are lacking on trends in bariatric surgery and the frequency of incidental findings in Saudi Arabia.

OBJECTIVES: Report on trends in bariatric surgery as well as our experience in incidental findings along with a literature review (mainly on gastrointestinal stromal tumor).

DESIGN: Retrospective chart and literature review.

SETTINGS: Academic tertiary care center.

PATIENTS AND METHODS: We conducted a retrospective study at King Khalid University Hospital and analyzed the data collected from 2009 to 2019. We collected data on age, body mass index (BMI), H pylori infection, type of bariatric surgery performed, and type and location of incidental findings.

MAIN OUTCOME MEASURES: Incidental findings during or after bariatric surgery (in pathology specimen).

SAMPLE SIZE: 3052 bariatric surgeries, 46 patients with incidentalomas.

RESULTS: The mean and standard deviation for the age of the 46 patients with incidentalomas was 42.1 (13.9) years and the mean (SD) preoperative BMI was 43.4 (6.4) kg/m². Of 3052 bariatric surgeries performed, the most common type was sleeve gastrectomy (93.9%), followed by gastric bypass surgery (4.58%) and gastric banding (1.47%). The total frequency of incidentalomas was 1.5%; 10.8% of patients had gastrointestinal stromal tumors (GIST), with the stomach being the commonest site for incidental findings. Eighty percent of the patients with GIST were positive for H pylori ($P=.01$ vs negative patients).

CONCLUSION: The number of incidentalomas and other findings were consistent with other reports. All these findings suggest that bariatric surgeons should take special care before, during, and after a laparoscopic operation in obese patients.

LIMITATIONS: Since this is a single-center, retrospective study, we did not collect data on important variables such as gender, socioeconomic status of the patient, and family history of obesity, and we did not perform a preoperative esophagogastroduodenoscopy.

CONFLICT OF INTERESTS: None.

Different laparoscopic bariatric surgeries including laparoscopic sleeve gastrectomy (LSG), Roux-en-Y gastric bypass surgery (RYGB), and adjustable gastric banding (AGB) have become increasingly popular and successful treatments for obesity.^{1,2} Therefore, more incidental pathologies can be found either during bariatric surgery or in the pathology specimen being sent after bariatric surgery, which is termed as incidentaloma. Even with a thorough preoperative examination, unexpected and incidental pathologies or findings, such as polyps, metaplasia, and tumors in the small bowel, liver, and stomach, have been noticed in 2-8% of bariatric operations.^{3,4} In addition, pathology or unexpected findings may be missed when procedures are performed laparoscopically.⁵ Thus, such incidental findings may create a dilemma that may result in misdiagnosis (if the surgeon encounters a pathology and diagnoses it as a tumor while it is a normal anatomical variation, i.e., pancreatic heterotopia in the duodenum), protracted operative course, tumor spillage, incomplete oncologic resection, or other complications.⁶

Bariatric surgery is also on the rise in the Middle East including Saudi Arabia.^{7,8} However, there are a dearth of published data about bariatric surgeries performed in Saudi Arabia in terms of number of operations and their clinical outcomes. In addition, there is also a scarcity of research on the frequency of incidental findings or unexpected pathologies, especially incidental findings of gastrointestinal stromal tumor (GIST) across the Eastern Mediterranean countries or in any given institution of Saudi Arabia. Hence, there is a need to understand the patterns and trends of bariatric surgeries along with their associated incidental findings.

PATIENTS AND METHODS

We conducted a retrospective study to understand the trends in bariatric surgeries and to calculate the frequency of incidentaloma, mainly for GIST for patients admitted to our institution, King Khalid University Hospital (KKUH). In addition, we also conducted a literature review to compare the findings related to frequency of GIST from our data with the findings available in the existing literature.

We conducted a retrospective analysis of the data collected from 2009 to 2019 in KKUH, which is a tertiary academic hospital and a center of excellence for obesity, colorectal surgeries, hernia surgeries, and obesity anesthesia. This provided us with an opportunity to look at the trends for recent years concerning the various types of surgeries we performed to manage obesity. Also, we collected data on age, body mass index (BMI), and the status of *H pylori* infection by examining postopera-

tive pathology specimens. The source of data was our bariatric center database, which included any abnormal finding before, during, or after surgery in addition to our pathology department data through the Electronic System for Integrated Health Information program.

The primary outcome was the incidentaloma, which was defined as any incidental or unexpected finding while performing bariatric surgery or after sending a specimen for histopathology. We collected data on the type of incidental findings such as intestinal metaplasia, polyps, nodular hyperplasia, GIST, leiomyoma, gastric adenocarcinoma, pancreatic heterotopia, submucosal hemangiomas, and well-differentiated neuroendocrine tumor as well as the location of these incidental findings. Moreover, we collected data on the size of the tumor, but we did not use this data as it was not measured for all of the tumors.

We used descriptive analyses to report frequencies and proportions to describe the characteristics of the study population for the categorical variables such as the presence of *H pylori*, type of incidental finding, and location of an incidental finding. We checked the normality assumption for continuous variables by histograms superimposed with the normal curve. We calculated the mean and standard deviation (SD) for normally distributed continuous variables such as patient age and BMI.

We used the chi-square test to assess the association between categorical variables. Before using the chi-square test, we checked for its assumptions. All analyses were performed using IBM SPSS version 25 (Armonk, NY: IBM Corp).

For the literature review, we searched databases such as Google Scholar, PubMed, and Science Direct and compared our findings with other reports of incidental findings. The authors conducted controlled vocabulary and text-word searches in the above-mentioned databases. All articles published on the topic of GIST as an incidental finding of bariatric surgery from 2005 to 2020 were included in this review. We searched all the articles by using search terms such as 'GIST,' 'GIST and Bariatric Surgery,' 'GIST as an incidental finding,' 'GIST and incidentaloma,' 'Gastrointestinal Stromal tumor,' 'Gastrointestinal Stromal tumor and Bariatric Surgery,' and 'Gastrointestinal stromal tumor as an incidental finding.' Studies were limited to human studies reported in the English language, and studies conducted both in developing and developed countries were included. We examined all primary and original articles pertinent to our objective while conducting this review. After conducting the search of the electronic databases, we conducted snowball sampling through backward

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reference searching and forward reference searching of qualified articles. In addition, we also reviewed all references of the eligible article to avoid missing any article germane to the topic of interest.

RESULTS

The mean (SD) age of the 46 participants who had incidental findings was 42.1 (13.9) years and the mean (SD) BMI was 43.4 (6.4) kg/m² (**Table 1**). The frequency of patients diagnosed with any type of incidental finding (incidentaloma) was 1.5%. All of our incidentalomas were discovered postoperatively, except one (pancreatic heterotopia in the duodenum, which was managed with wedge resection. The frequency of GIST was 10.8% (n=5). In addition, 20 (45.7%) were positive for *H pylori*. The most common bariatric surgery was sleeve gastrectomy (n=2867; 93.9%) followed by bypass (n=140; 4.58%) and band procedures (n=45; 1.47%) (**Figure 1**). Initially the number of surgeries performed (mainly sleeve gastrectomies) from 2009 to 2015 was

Table 1. Demographic and clinical characteristics of the patients who underwent bariatric surgery and were diagnosed with incidental findings in our institution from 2009 to 2019 (n=46).

Age (years)	42.1 (13.9), range 15-77
Body mass index (kg/m ²)	43.4 (6.4)
<i>H pylori</i>	
Positive	21 (45.7)
Negative	25 (54.3)
GIST found	
Yes	5 (10.8)
No	41 (89.2)
Type of bariatric surgery	
Sleeve gastrectomy	2867 (93.9)
Gastric bypass surgery	140 (4.6)
Gastric banding	45 (1.5)
Incidence of incidentaloma	46 (1.5)
Site of incidentaloma	
Stomach	42 (91.3)
Liver	2 (4.3)
Duodenum	1 (2.2)
Gallbladder	1 (2.2)

Data are number (%) or mean (standard deviation).

very low. However, the number gradually changed from one year to the other from 2009 to 2015 followed by a significant upsurge in the number of surgeries after 2016 that persisted until 2018. Only 167 surgeries are recorded for 2019 because we stopped data collection after September 17, 2019. Therefore, we interpreted this decline given the context and time of data collection. Other types of surgeries, such as bypass and band surgeries, were not commonly performed in our institution and there were no specific patterns or trends for these types of surgery.

The most common type of incidental finding was intestinal metaplasia (43.4%), followed by polyp (21.7%) and leiomyoma (10.8%); 10.8% of the patients had GIST (**Figure 2**). Most (91.3%) of the incidental findings were found on the stomach, followed by the liver (4.3%), duodenum (2.2%), and gallbladder (2.2%). We found that there was some relationship between the type of incidentaloma and status of *H pylori* (**Table 2**). However, our findings should be interpreted with caution due to the small sample size and the only one or no values for some cells. We found that 80.0% of the patients with GIST were positive for *H pylori*, and this finding was statistically significant ($P=.01$). Moreover, all of the patients diagnosed with gastric adenocarcinoma and nodular hyperplasia in the liver, and 75.0% of the patients diagnosed with intestinal metaplasia were positive for *H pylori*.

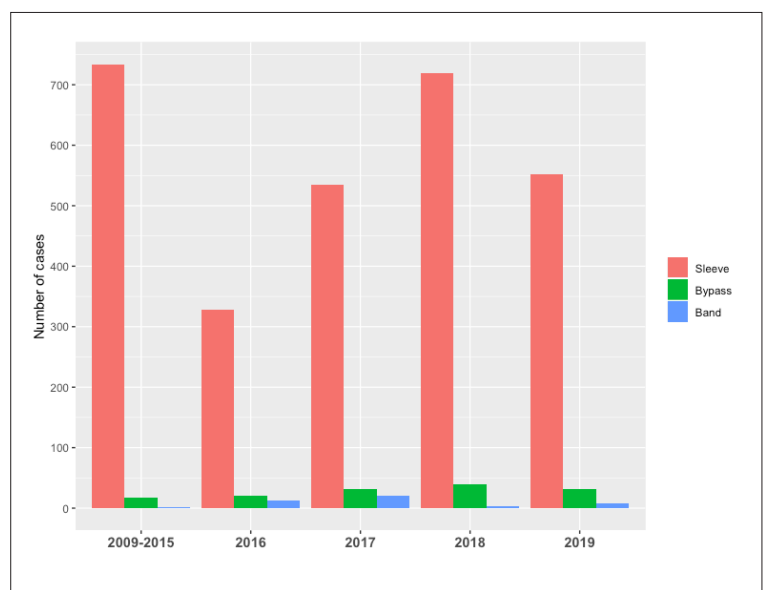


Figure 1. Trend in bariatric surgeries over the last ten years by the three most common types of surgeries performed in our institution from 2009 to 2019 (Sleeve: sleeve gastrectomy; bypass: gastric bypass surgery; band: gastric banding).

original article

In the literature review, the fewest number of GIST were in one patient and the maximum was in 16 patients (Table 3). The most common site of the GIST was the stomach, which was consistent with our findings. This was followed by the small intestine, mainly the jejunum, with a low frequency as compared to the stomach. Moreover, we also found that GIST had affected different parts of the stomach; for example, the fundus was the commonest site for stomach infiltration, followed by the antrum. On the other hand, a few studies reported the greater curvature as the site for GIST

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within the stomach. Not all the studies measured the size of the GIST, which varied among those that did, but we could not compare these because of the differences in units used for measurement.

DISCUSSION

Generally, we found that the most common bariatric surgery performed in our institution was LSG followed by RYGB and AGB surgeries. In addition, we also observed an increasing trend of LSG in our institution over the last decade without any similar pattern or trend for other types. The frequency of incidental findings in our study was 1.5% (46/3052), which is consistent with other studies in different parts of the world.^{3,4} However, we found that the overall frequency of the unexpected findings for our study was lower when compared to some studies.^{3,4} These differences could be because of differences in the sample size, timeline, and methodologies of identifying incidental findings in different studies. Therefore, it is important to note that a direct comparison of our findings with earlier studies conducted in other parts of the world may not be possible because of the differences in the number and composition of the study subjects enrolled, study settings, and socio-cultural circumstances.

LSG was the most commonly performed procedure in our institution. This could be due to the long-term weight reduction associated with it.⁹ For instance, weight loss following LSG is durable with a sustained loss of over 50% of excess weight after 5 years.¹⁰ Regarding the incidental findings, we found that the most common type of incidental finding was intestinal metaplasia followed by polyps, GIST, and leiomyoma.

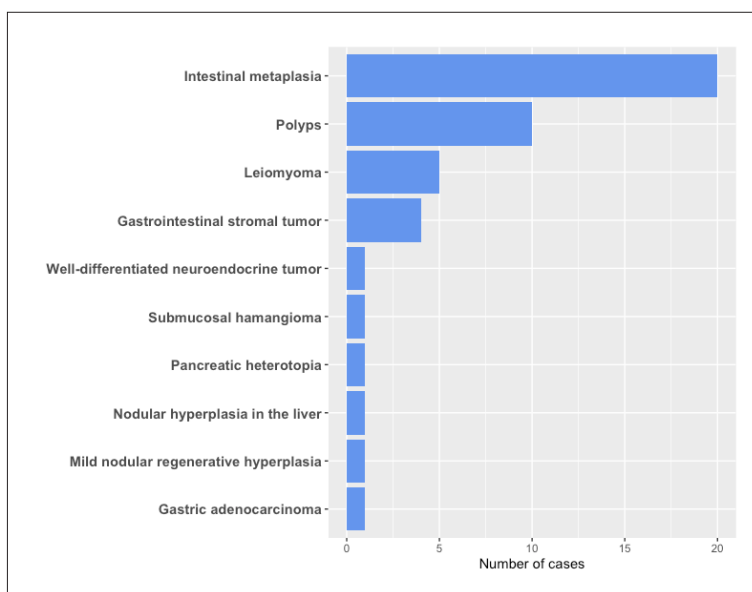


Figure 2. Frequency of incidental findings (incidentaloma) identified or diagnosed on histopathology during bariatric surgery from 2009 to 2019.

Table 2. Type of incidentaloma by *H pylori* status among patients who underwent bariatric surgery from 2009 to 2019.

<i>H pylori</i>	Leiomyoma	Gastric adenocarcinoma	Gastrointestinal stromal tumor	Intestinal metaplasia	Mild nodular regenerative hyperplasia	Nodular hyperplasia in the liver
Negative	5 (100.0)	0 (0.0)	1 (20.0)	5 (25.0)	1 (100.0)	0 (0.0)
Positive	0 (0.0)	1 (100.0)	4 (80.0)	15 (75.0)	0 (0.0)	1 (100.0)
Total	5 (100.0)	1 (100.0)	5 (100.0)	20 (100.0)	1 (100.0)	1 (100.0)

<i>H pylori</i>	Pancreatic heterotopia	Polyps	Submucosal hemangiomas	Well-differentiated neuroendocrine tumor
Negative	1 (100.0)	10 (100.0)	1 (100.0)	1 (100.0)
Positive	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	1 (100.0)	10 (100.0)	1 (100.0)	1 (100.0)

Data are number (%). Chi-square for negative vs positive *H pylori* (P = .01)

Table 3. Findings of the literature review on gastrointestinal stromal tumors (GIST) as an incidental finding while performing bariatric surgery.

Study and authors	Number of patients	Frequency of GIST	Location of GIST	Size of the GIST (range if applicable)
Finnell et al, 2007 ³	398	2	Stomach	Not measured
Greenbaum and Friedel, 2005 ⁴	400	2	Stomach	Not measured
Crouthamel et al, 2015 ⁶	1415	12	Stomach (antrum: three cases; fundus: six cases; body: three cases)	0.3-2.9 cm
Lauti et al, 2016 ⁹	976	4	Stomach	Not measured
Nickel et al, 2016 ¹¹	1	1	Stomach	0.9 cm
Bilecik et al, 2018 ¹²	1	1	Stomach (posterior surface)	0.5 cm
Sanchez et al, 2005 ¹³	517	4	Stomach (greater curvature: one case; fundus: two cases; serosa: one case)	0.5–0.8 cm
Safaan et al, 2017 ¹⁵	1555	11	Stomach	Not measured
Beltran et al, 2010 ²¹	1	1	Stomach (antrum)	1.5 x 1 cm
Leuratti, Alfa-Wali, and Bonanomi, 2013 ²²	2	1	Stomach (greater curvature)	Not measured
Roshanravan et al, 2014 ²³	1	1	Stomach	0.5 x 0.5 cm
Yuval et al, 2014 ²⁴	827	5	Stomach (fundus, lesser curvature, but not determined)	0.3-2 cm
Chiappetta et al, 2015 ²⁵	2603	8	Stomach (fundus: six cases; corpus: two cases)	0.5-13 cm
Ohanessian, Rogers, and Karamchandani, 2016 ²⁶	310	3	Stomach (intermural, intramural/subserosal, muscularis propria)	0.4-0.6 cm
Miller, Reid, and Brown, 2016 ²⁷	1463	4	Stomach	0.2-1.1 cm
Atas et al, 2016 ²⁸	2	2	Stomach (major curvature) Small intestine (serosa layer)	1 x 1.5 cm 4 cm
Kinsinger, Garber, and Whipple, 2016 ²⁹	241	3	Stomach	1-4.5 cm
Kopach et al, 2017 ³⁰	511	5	Stomach	Not measured
Viscido et al, 2017 ³¹	915	5	Stomach (fundus: three cases; antrum: one case; body: one case)	0.3–1.5 cm
Walędziak et al, 2017 ³²	1252	16	Stomach (fundus: nine cases; corpus: seven cases)	0.3–2 cm
Saurabh, 2017 ³³	1	1	Stomach (anterior surface)	1 cm
Cazzo et al, 2018 ³⁴	1502	14	Stomach (body: twelve cases; fundus: two cases)	0.3–1 cm
Braghetto et al, 2018 ³⁵	400	1	Stomach (distal stomach)	Not measured
Ge et al, 2019 ³⁶	649	3	Not mentioned	Not measured
Johanet et al, 2019 ³⁷	12	10	Stomach (fundus: nine cases; antrum: one case)	2-5 cm
Joo et al, 2019 ³⁸	405	3	Stomach (fundus and antrum: each one case) Jejunum (one case)	Not measured
Lyros et al, 2019 ³⁹	707	9	Stomach (fundus: four cases; corpus: two cases; antrum: one case) Jejunum (two cases)	0.2-3.7cm

These findings are consistent with other studies in other parts of the world.^{11,12} Also, we found that the most common site for the incidental finding was the stomach, which is comparable to other studies.^{12,13} However, our study differs from other studies due to a comparatively larger sample size than other studies as well as in the categories of a few incidental findings. Indeed, the discrepancies that appeared in the histopathological classifications employed by different researchers made it challenging to reach precise and relevant comparisons of findings across studies. Although there are multiple studies in the literature about GIST, none were from Saudi Arabia.

Almost half of our patients were positive for *H pylori*, and there was an association of *H pylori* with some incidental findings such as gastric adenocarcinoma, nodular hyperplasia in the liver, intestinal metaplasia, and GIST. Our findings are consistent with other studies conducted across the world where it has been found that *H pylori* is associated with incidental findings.^{14,15} With regard to *H pylori* infection as a risk factor, it was diagnosed in almost half of the incidental findings in our study, which is much higher than in the United States, Kuwait, and New Zealand (5.2%, 7.3%, and 8.6%, respectively).¹⁶⁻¹⁸ Such a high prevalence of *H pylori* in our study might suggest a high prevalence in our community generally.¹⁹ However, the overall evidence on the association is scarce except for two studies reporting a strong association between GIST and *H pylori*. To the best of our knowledge, there is no study to date that has explored the association between *H pylori* infection and GIST.^{14,15} Future inquiries could benefit from confirming or refuting such an association, particularly that most GISTs could be potentially malignant.^{14,20}

Our study is one of the first conducted in Saudi Arabia to measure the frequency of incidental findings

among patients who underwent bariatric surgery over one decade. Secondly, no studies have conducted a literature review simultaneously on GIST incidence and prevalence to the best of our knowledge, which makes this study unique. Besides, the stringent data collection of the last ten years suggests that these data are representative of the overall population in the area of our institution and can be generalized to other areas of Saudi Arabia or neighboring countries. Furthermore, our study had a comparatively larger sample size, providing more robust results. However, there are some inherent limitations. First, the cross-sectional nature of the survey does not allow temporal precedence to be unambiguously determined. Secondly, we did not collect data on the important variables such as gender, socioeconomic status, family history of obesity, and yearly record of incidental findings. Moreover, unlike other studies, we also did not perform a routine preoperative esophagogastroduodenoscopy.

With the increasing use of laparoscopic bariatric procedures, more incidental findings will likely be encountered. Therefore, it is important to inspect important potential organs for incidentalomas before planning and performing any type of bariatric surgery. Moreover, surgeons need to plan bariatric surgery more effectively by completing a thorough and comprehensive clinical workup of the patients. In addition, future research is required to assess the temporal association between sociodemographic and clinical parameters of patients with incidental findings.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors. For this type of study, formal consent is not required.

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