Evaluation of the role of Computed tomography in detection of complications after laparoscopic sleeve gastrectomy

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Article

Keywords:

Posted Date: May 25th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2897300/v1

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Abstract

Aim

Obesity is a significant global health care issue with a huge impact on individuals' well being. Sleeve gastrectomy is a surgical procedure involving the resection of part the stomach leading to reduction in its volume resulting in reduced food intake and weight loss. The objective of our study is to ascertain whether a routine postoperative CT scan is an effective tool for early detection of complications post LSG or not.

Methods

A retrospective descriptive study conducted in a single tertiary center hospital in Jeddah, Saudi Arabia through a period of three months from January to March 2022. Only those patients who had done a sleeve-gastrectomy plus post-operative computed tomography scan were included.

Results

A total of 112 patients were a part of this study. Among the included patients, 73 (65.2%) were females, and 39 (34.8%) were males, with a mean age of 36.2 [14–70] years; furthermore, the mean body mass index of those patients was shown to be 46.3 [29–77] kg/m². For surgical complications, 18 (16.1%) cases of anastomotic leaks were radiologically diagnosed making it the most frequent type of surgical complications. Morbidity according to non-surgical complications includes atelectasis, which was diagnosed in 33.9% (38) of the patients in contrast to cases of pleural effusions which were less occurring in 23.2% (26) of the patients.

Conclusion

In summary, among our studied cohort, we found that the most commonly detected surgical complication using CT post sleeve gastrectomy was anastomotic leaks, whereas the most non-surgical complication was found to be atelectasis.

Introduction

Obesity is a significant global health care issue with a huge impact on individuals' well being. World health organization published data stating that 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese. Moreover, 39 million children under the age of 5 were overweight or obese in 2020.[1] Obesity is highly associated with multiple complications like cardiovascular disease, stroke, type 2 diabetes, gallstones, fatty liver disease, sleep apnea and hypventilation syndrome leading to significantly increased morbidity compared to the general population.[2] Sleeve gastrectomy is a surgical procedure involving the resection of part the stomach leading to reduction in its volume resulting in reduced food intake and weight loss.[3] Sleeve gastrectomy is a relatively simple procedure that is now considered one of the most prevalent bariatric surgeries.[4] It was first introduced in 1990 and the first laparoscopic sleeve gastrectomy was performed in 1999. [4] Laparoscopic sleeve gastrectomy (LSG) is regarded as one of the safest bariatric operations as it is a somewhat simple procedure with a low rate of complication.[3] The main goal of LSG is to reduce the morbidities associated with obesity thus improving the general health. However, as it is with any surgical procedure, laparoscopic sleeve gastrectomy poses a risk of postoperative complications which can be divided into early postoperative and late postoperative complications. Early complications include hemorrhage, and leak. Late complications include gastroesophageal reflux, stricture, and nutritional deficiencies.[4] The utilization of computed tomography in early detection and management of early postoperative complications has been increasing in the recent years. [3] The objective of our study is to ascertain whether a routine postoperative CT scan is an effective tool for early detection of complications post LSG or not. Table 1 is a summary of the outcomes of previous literature relevant to our study.
<table>
<thead>
<tr>
<th>Reference number</th>
<th>First Author</th>
<th>Title</th>
<th>Sampled population</th>
<th>Mean age</th>
<th>Gender</th>
<th>Weight</th>
<th>Mean BMI</th>
<th>Comorbidities</th>
<th>Surgical Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5]</td>
<td>Lainas et al.</td>
<td>Prospective evaluation of routine early computed tomography scanning in laparoscopic sleeve gastrectomy</td>
<td>1000 3 patient excluded from analysis.</td>
<td>40.1</td>
<td>female/male: 845/155 (kg) 118(84–222)</td>
<td>(42.6 kg/m²)</td>
<td>Diabetes: 14.8% Hypertension: 36% Dyslipidemia: 19.4% OSAS: 56.1% Previous abdominal surgery: 49.5%</td>
<td>Bleeding or hematoma: 32 patients Staple line leak 13 patients</td>
<td></td>
</tr>
<tr>
<td>[6]</td>
<td>Diego et al.</td>
<td>Leakage Risk Stratification After Laparoscopic Sleeve Gastrectomy (LSG): Is There a Role for Routine Postoperative CT Scan?</td>
<td>262 12 patients excluded</td>
<td>42.7</td>
<td>Female/male: 164/86</td>
<td>Not discussed mean BMI, 43.5 kg/m²</td>
<td>Not discussed</td>
<td>Perigastric air bubble: 10 patients Perigastric fluid collection: 10 patients Perigastric hematoma: 40 patients Type B twisting of gastric remnant: 70 patients Leak: 1 patient</td>
<td></td>
</tr>
<tr>
<td>[7]</td>
<td>Vemuri et al.</td>
<td>Post-operative CT imaging of laparoscopic sleeve gastrectomy: our initial experience</td>
<td>43 43</td>
<td>Female/male: 11/32</td>
<td>Not discussed</td>
<td>41 kg/m²</td>
<td>Obstructive sleep apnea, hypertension and diabetes mellitus Numbers are not discussed</td>
<td>Gastric leak: 12 patients Gastric leak resulting in abdominal collections in 8 patients Perigastric hematoma: 4 patients Pleurogastrocolonic fistula 1 patient Gastric dilatation: 2 Splenic infarcts 10 patients SMV thrombosis 7 patients Acute pyelonephritis: 2 Patients acute pancreatitis: 1 patient Port site infection 2 patients Kinking of stomach 2 patients</td>
<td></td>
</tr>
</tbody>
</table>
Methods

Study design and setting: A retrospective descriptive study conducted in a single tertiary center in Jeddah, Saudi Arabia through a period of three months from January to March 2022.

Study population and sampling technique: All patients who presented to the bariatric surgery clinic through the time frame between January to March of 2022 were sampled for the study. Among those sampled, only those patients who had done a sleeve-gastrectomy plus post-operative computed tomography scan were included. Patients who had undergone imaging using any other modalities, or a bariatric surgery using any other approach were excluded from the study.

Study tool: Certain demographic, preoperative, and postoperative data were collected from the medical records per patient eligible to be included in the study. The data collected was stored on a secured computer only accessible by the research team for the sake of ensuring data confidentiality. The data collected was then analyzed using SPSS v23 to obtain descriptive results.

Ethical considerations: Approval from the Ethics and Scientific committees of the Saudi German Hospitals in Jeddah was obtained prior to the conduction of the study. All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all subjects and/or their legal guardian(s).

Results

A total of 112 patients were a part of this study. Among the included patients, 73 (65.2%) were females, and 39 (34.8%) were males, with a mean age of 36.2 (14–70) years; furthermore, the mean body mass index of those patients was shown to be 46.3 (29–77) kg/m². Basic demographic and clinical data are shown in Table 2. According to comorbidities the patients included in the study were shown to have a relatively low incidence, with history of abdominal surgery being the highest, occurring in 18.6% (21) of the patients as well as hypertension with an incidence of 13.4% (15) in addition to diabetes present in 12.5% (14) of the patients. The least frequent comorbidity was history of cardiac surgery, which was shown in 1.8% (2) of the patients, and no patient had chronic renal insufficiency (0). According to the American Society of Anesthesiologists (ASA) physical status classification, 18 (16.1%) patients were classified as ASA I; 71 (63.4%) patients as ASA II; 23 (20.5%) patients as ASA III, and no patient was classified under ASA IV (0). Morbidity is categorized according to surgical and non-surgical complications. The morbidity data are presented in Table 3.

Firstly, for surgical complications, 18 (16.1%) cases of anastomotic leaks were radiologically diagnosed making it the most frequent type of surgical complications, yet no stenosis, obstructions nor superficial surgical site infections have occurred. Re-laparoscopy was not needed in any of the patients. The second most common surgical complication is hematoma which occurred in 7 (6.3%) patients; subsequently cases of dilatation of the lower esophageal lumen occurred in 4 (3.6%) patients. The least common surgical complication was intraluminal bleeding which was present in one patient (0.9%).

Morbidity according to non-surgical complications includes atelectasis, which was diagnosed in 33.9% (38) (of the patients in contrast to cases of pleural effusions which were less occurring in 23.2% (26) of the patients, moreover, 9 (8.03%) patients were diagnosed with pneumonia. Cardiac complications have occurred in 3 (2.7%) patients making it the least occurring non-surgical complication. None of patients have developed renal failure (0), yet 6 (5.4%) patients showed kidney stones. The most frequently occurring non-surgical complication is pneumoperitoneum which was seen in 50% (56) of the patients, the second most commonly occurring complication is fat stranding present in 33.9% (38) of the patients and Lastly atelectasis which was diagnosed in 33.9% (38) of the patients.
Table 2
Patient demographic and clinic data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Data, n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>112</td>
</tr>
<tr>
<td>Age, yr</td>
<td>36.2(14–70)</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>46.3 (29–77)</td>
</tr>
<tr>
<td>Female</td>
<td>73(65.2)</td>
</tr>
<tr>
<td>Male</td>
<td>39(34.8)</td>
</tr>
<tr>
<td>ASA I</td>
<td>18(16.1)</td>
</tr>
<tr>
<td>ASA II</td>
<td>71(63.4)</td>
</tr>
<tr>
<td>ASA III</td>
<td>23(20.5)</td>
</tr>
<tr>
<td>ASA IV</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>14(12.5)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>15(13.4)</td>
</tr>
<tr>
<td>History of abdominal surgery</td>
<td>21 (18.6)</td>
</tr>
<tr>
<td>Chronic renal insuiciency</td>
<td>0</td>
</tr>
<tr>
<td>History of cardiac surgery</td>
<td>2(1.8)</td>
</tr>
</tbody>
</table>

Table 3
Morbidity according to surgical and non-surgical complications

<table>
<thead>
<tr>
<th>Surgical</th>
<th>Non-surgical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anastomotic leak 18 (16.1)</td>
<td>Atelectasis 38(33.9)</td>
</tr>
<tr>
<td>Hematoma 7(6.3)</td>
<td>Pleural effusion 26(23.2)</td>
</tr>
<tr>
<td>Superficial surgical site infection 0</td>
<td>Pneumonia 9 (8.03)</td>
</tr>
<tr>
<td>Intraluminal bleeding 1(0.9)</td>
<td>Cardiac complications 3(2.7)</td>
</tr>
<tr>
<td>Dilatation of lower esophageal lumen 4(3.6)</td>
<td>Renal failure 0</td>
</tr>
<tr>
<td>Re-laparoscopy 0</td>
<td>Kidney stone 6(5.4)</td>
</tr>
<tr>
<td></td>
<td>Fat stranding 38 (33.9)</td>
</tr>
<tr>
<td></td>
<td>Pneumoperitoneum 56(50)</td>
</tr>
</tbody>
</table>

Discussion

Obesity is a common disease affecting both adults and children worldwide.

With the increased prevalence of obesity and obesity related co-morbidities an increase in bariatric surgery is noted. Sleeve gastrectomy successfully became the most prevalent bariatric surgery due to its relatively low complication rate and effective outcome in weight loss. However, like all surgeries there’s an inherent risk of potential post operative complications. Acute post operative complications of LSG include hemorrhage, leak, and abscess. [9]

Detection and management of these complications lowers morbidity and mortality rates, hence; the diagnostic capabilities of radiologic imaging plays an important role in the management of these patients. The two primary imaging modalities used for post LSG are upper gastrointestinal series (UGI) and computed tomography (CT). [10]

Gastric leak is the most dreaded complication which can lead to peritonitis, sepsis, and abscess formation. The incidence of gastric leaks post LGS ranges between 1.09 and 5.3%. [3] In our study 18 patients were found to have anastomotic leaks all of which were diagnosed by CT. Latif et al. [10] observed that a UGI has a sensitivity of 70% and a specificity of 94% in detecting leaks, while CT has a sensitivity of 95% and a specificity of 95%. Radiographically, UGI detects leaks when collections of extraluminal contrast medium is present. But, the low detection rate of UGI renders CT as the superior radiologic choice for diagnosing a suspected gastric leak.

The low sensitivity of UGI may be due to the timing at which it’s done, for an early leak is not always detected by UGI. Other factors contributing to low sensitivity of UGI may be the size of leak, contrast used, or experience of the radiologist. [11]
Nedelcu et al. [12] created a new CT classification of leak after LSG. They classified leakage into type I, a collection less than 5 cm in the left upper quadrant (LUQ), type II, a collection more than 5 cm in LUQ, type III, a diffuse abdominal collection, and type IV where a pleural (thoracic) collection is present. This classification aids in the management of gastric leakage as a treatment plan is tailored according to the type of leak for each patient.

Bleeding post LSG may be a result from staple line bleeding, or from an extraluminal source like spleen, liver, or abdominal wall at the sites of trocar entry. [9] CT angiography is the investigation modality of choice for the detection of bleeding site and estimating the volume of blood, granted the patient is hemodynamically stable, otherwise, unstable patients need urgent intravascular intervention. [3]

Another complication detected by CT scan is intraabdominal abscess. Any patient with abdominal pain, fever, nausea, and a clinical suspicion a CT scan should be obtained for an appropriate management. [9]

The presence of co-morbidities can affect the postoperative outcome. Co-morbidities found in our study included previous abdominal surgery, hypertension and diabetes, previous cardiac surgery. Husain et al. mentioned that there is a relation between previous abdominal surgery and the occurrence of deep surgical site infection and leaks, but no correlation with urinary infection or respiratory complications. In addition male sex, presence of DVT, the use of therapeutic anticoagulant, pulmonary embolism, hypertension, and COPD found to be major preoperative morbidities warranting for further investigations post operatively. [13]

Due to the superiority of CT scan over UGI it has been utilized as the primary imaging modality of choice in our hospital and others.

**Conclusion**

In summary, among our studied cohort, we found that the most commonly detected surgical complication using CT post sleeve gastrectomy was anastomotic leaks, whereas the most non-surgical complication was found to be atelectasis.

**Declarations**

**Ethical Approval**

Ethical committees and Internal Review Boards approval were obtained from Saudi German Hospitals in Jeddah)

**Competing interests**

All authors declare no competing interests.

**Authors' contributions**

All authors approved the final version.

**Funding**

No funding

**Availability of data and materials**

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request

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