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Original Research Article

Post-operative CT imaging of laparoscopic sleeve gastrectomy: our initial experience

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ABSTRACT

Background: Laparoscopic sleeve gastrectomy (LSG) is a restrictive type of bariatric surgery. It is safe and effective with its many advantages like relative simplicity of the procedure, lack of malabsorption component and anastomoses and retaining the anatomical gastrointestinal continuity. Obesity, a chronic disease, with the significant rise of its comorbidities and mortality is attributing to the major financial and health burden globally.
Methods: We conducted a prospective study of over 43 patients (male 32, female 11) over 5 years period i.e., from 2012 to 2017. These patients were assessed with contrast enhanced computerized tomography (CECT) for detection of post-operative complications.
Results: The patients with the body mass index (BMI) >40 kg/m^2 and or with a BMI >35 and <40 kg/m^2 but with significant weight related comorbidities underwent Laparoscopic sleeve gastrectomy. Both intravenous (IV) and oral contrasts are used accordingly. With increasing number of surgeries and with associated co-morbidities complications following LSG are increasing, necessitating the need for a good understanding of clinical symptoms and post-operative complications of LSG. Post-operative imaging plays a crucial role in the early detection of complications resulting in reduced mortality rate.
Conclusions: We suggest multidetector computed tomography (CT) with oral and IV contrast as an excellent tool for the patients having a nonspecific abdominal symptom post LSG.

Keywords: Sleeve gastrectomy, Gastric leak, Bariatric surgery, Gastrectomy complications, Obesity

INTRODUCTION

Obesity, a chronic disease, with the significant rise of its comorbidities and mortality is attributing to the major financial and health burden globally. As per the World Health Organization (WHO) calculations, about 10% of the world's populations were obese by 2014.[1] The bariatric surgeries are effective in maintaining the stability of weight loss as well as minimizing the comorbidities related to obesity. Of the many procedures, the second most commonly performed bariatric surgery is laparoscopic sleeve gastrectomy (LSG).

LSG is a restrictive type of bariatric surgery that is safe and effective with its many advantages like relative simplicity of the procedure, lack of malabsorption component as well as anastomoses and retains the anatomical gastrointestinal continuity. However, the

major disadvantages being the innate complications of a stapling procedure and the irreversible nature of the procedure. The post-operative complications are leaks in the staple line, hemorrhage and stenosis.[2]

In the past, upper gastro-intestinal (UGI) swallow studies were used to assess the leaks post-operatively. Currently UGI imaging endoscopy and computed tomography (CT) are used to assess the post-operative leaks, in order to plan an accurate management of those early complications of the procedure.

METHODS

We have evaluated 43 (male 32, female 11) sleeve gastrectomy patients over a period of 5 years from 2012 to 2017. Post LSG procedure, these 43 patients were assessed with CECT for detection of postop complications at Radiology department, Global hospitals, Vijayawada. The patients with the body mass index (BMI) >40kg/m^2 and or with a BMI >35 and <40 kg/m^2 but with significant weight related comorbidities like obstructive sleep apnea (OSA), hypertension and diabetes mellitus were included in the study. The mean age of the patients was 43 years (24-53 years). The mean BMI of patients was 41 kg/m^2 (range).

CT with oral and IV contrast were used as the first investigation to evaluate the LSG patients for post-operative complications. The similar conventional abdominal CT technique was used in the study. KVp was adjusted according to the body habitus of patients. We have administered oral gastrografin (water soluble contrast) solution of about 80-100 ml prior to CT examination for all the patients. After acquiring plain CT scan intravenous (IV) contrast with standard protocol of 70 second venous delay was preferred to detect vascular complications. Dose of IV contrast was administered on weight based sliding scale.

Surgical procedure

Sleeve gastrectomy is a restrictive surgical procedure which consists of vertical gastrectomy including entire greater curvature of stomach. All the surgeries were performed under general anesthesia. Surgeon advanced the bougie of size 36F along the lesser curvature of stomach distally up to duodenal bulb. Stapling of stomach was performed with gold reload of endoscopic linear cutter from ethicon endosurgery. Stapling was done 6-8 cm proximal to pylorus to prevent functioning of antral pump mechanism.

Normal post-operative imaging appearance of residual stomach

Post operatively on CT scan the stomach appears grossly reduced in volume giving a tubular or banana shape which can be better appreciated on coronal images. The stapled gastric suture line appears hyperdense which should not be confused with contrast leak along the suture. Prone and lateral decubitus positions were helpful for better demonstration of gastric contrast leak. In few patients the given oral contrast may hold up in proximal sleeve due to loss of gastric antral pump mechanism which is called as "stunning" in early post-operative period.

RESULTS

Among the 1026 patients who underwent LSG**,** 43 patients showed early postop complications. We broadly classified the complications into local and systemic (Table 1). Local complications included gastric leak (Figure 1), gastric dilatation, peri-gastric hematoma (Figure 2) and kinking of stomach (Figure 4). Systemic complications were superior mesenteric vein (SMV) thrombosis, splenic infarcts, acute pancreatitis, acute pyelonephritis and gastro-colonic-pleural fistula (Figure 3). Gastric leak was seen in 12 patients, this resulting in abdominal collections in eight patients. Gastric dilatation was seen in 2 patients. Splenic infarcts were seen in 10 patients. SMV thrombosis was seen in 7 patients, 4 patients presented with peri-gastric hematoma, 2 patients developed acute pyelonephritis, 1 patient had acute pancreatitis, 2 patients had port site infection and 2 patients had kinking of stomach.

Figure 1: Gastric leak. Perigastric leakage of oral contrast at GE junction with small fluid collection adjacent to it. Note the focal eventration of diaphragm.

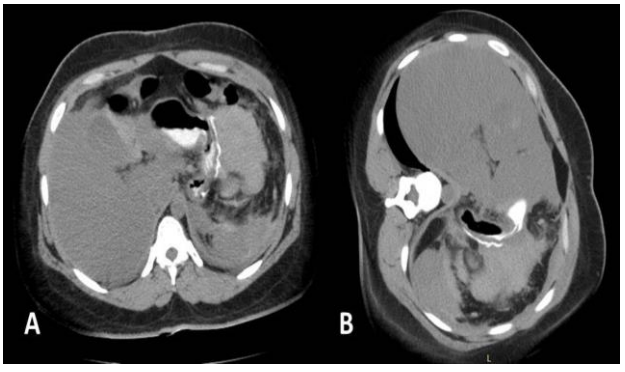

Figure 2: Large perigastric hematoma of more than 5 m close to the staple line showing hyperdense collection with no active contrast leak.

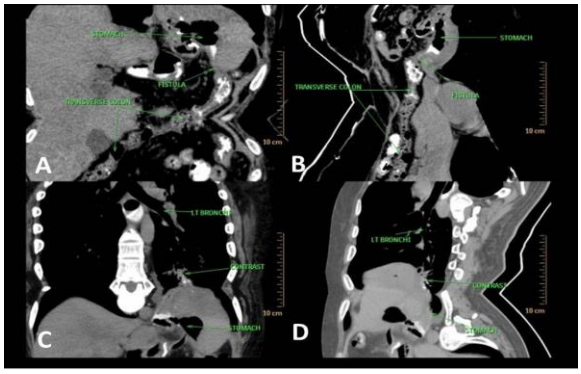

Figure 3: Fistulous communication outlined with contrast showing communication with left pleural cavity, colon and residual stomach (A: right lateral decubitus; B and D: oblique reconstructed image; C: coronal image).

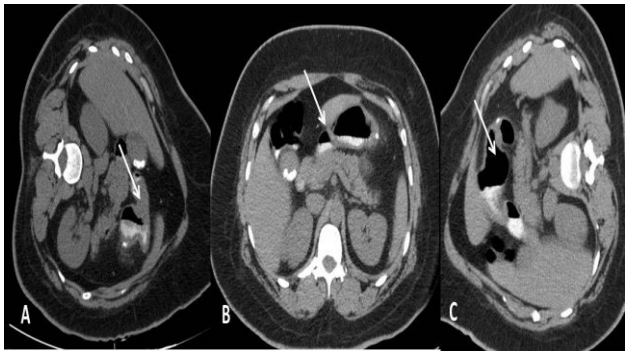

Figure 4: Kinking of residual post operative stomach-Left lateral decubitus (A) and supine (B) CT images showing kinking of distal residual stomach, right lateral decubitus (C) showing mild dilatation of proximal residual stomach.

Table 1: Post-operative complications and management of laparoscopic sleeve gastrectomy detected on CECT.

Complications	Number of patients	Post - operative day	Imaging finding	Management
Gastric leak	12	2nd-15th day	Active leakage of oral contrast with fluid collection	8-Relaparoscopy and drainage 4-conservative
Perigastric hematoma	4	2nd-5th day	Hyperdense perigastric fluid of blood attenuation	3-Relaparoscopy and drainage 1-Conservative
SMV thrombosis	7	3rd-12th day	Thrombotic occlusion of SMV	Anticoagulants 6-Recovered 1-Expired
Pleuro-gastro-colonic fistula	1	12th day	Pleuro-gastro-colonic fistula	Surgical drainage with correction—recovered well
Port site /wound infection	2	6th-10th day	Inflammatory fat stranding with fluid collection in the peritoneal cavity adjacent to infected port site	Antibiotics with external drainage of collection
Acute pancreatitis	1	3rd day	Enlarged pancreas with peripancreatic fast stranding and fluid	Conservative management
Acute pyelonephritis	2	6th day	Enlarged left kidney with perinephric fat stranding	Conservative management
Splenic infarct	10	2nd-15th day	Wedge shaped non-enhancing area of superomedial aspect of spleen	Usually don't need any treatment. It is a common incidental finding noted during surgery after dividing short gastric arteries.
Gastric dilatation	2	4th day	Proximal dilatation of stomach	Conservative management-Recovered well
Kinking of stomach	2	3rd day	Kinking of residual stomach with pooling of contrast proximally	Conservative management

DISCUSSION

Obesity is a very costly problem that has become an epidemic with its many comorbidities contributing to a significant financial and health burden. Of all the comorbidities, the notorious ones are obstructive sleep apnea, osteoarthritis, diabetes mellitus, dyslipidemia, hypertension, ischemic heart disease and psychological morbidity. Lifestyle modifications along with pharmacological interventions had been the preferred choice by the healthcare professionals. Of late there is increasing literature establishing the many advantages of bariatric surgery. It had been suggested by recent studies that in addition to inducing weight loss, these bariatric

surgeries may help in reversing a few of the metabolic derangements associated with obesity.[3] According to the recent evidence, there is a reduction of about 29-40% long-term mortality.[4,5]

Bariatric surgeries are categorized into 3 main types namely restrictive procedures, malabsorptive procedures and combined procedures. Combined procedures include both restrictive and malabsorptive procedures. Restrictive bariatric procedures like sleeve gastrectomy reduce the gastric capacity that in-turn prompts an early satiety. Whereas in malabsorptive procedures like jejuno-ileal bypass, there will be decrease in the absorption of nutrients from the small intestine. Roun-en-Y gastric bypass (RYGB) is a combined procedure.[6]

Bariatric surgery is the most effective, safe and evidence-based treatment which was proven beyond doubt with multiple long-term follow-up studies. Though proven beyond doubt, even in USA less than 1% of eligible patients opt for it because of fear of complications which usually take widespread media attention. This happened because of the following misconceptions firstly that majority of the society does not accept obesity as a disease secondly bariatric surgery is considered a cosmetic surgery.

With the increasing demand for bariatric surgeries, there is also an increase in need for prompt assessment of the postoperative complications and their early management. SG also carries complications like leak, hemorrhage, hematoma, abscess, portal vein thrombosis, gastric dilatation and splenic rupture. When there is a suspicion of a partial complication related to the bariatric surgery, an appropriate imaging modality helps in an early identification. Of the UGI studies, CT is the most indicated imaging modality for the early detection of these post-operative complications.[7]

Post-operative complications are the Achilles heel of bariatric surgery. Early detection is the key to prevent mortality because morbid obese patients have less reserves and succumb early even for mild complications sometimes. So for early detection we need high index of suspicion and low threshold for thorough investigation. We preferred CECT with oral and IV contrast. Oral contrast has the highest sensitivity for leak detection. It can be performed in the same time giving IV contrast for SMV thrombosis and other associated complications like pancreatitis etc.

In our study 12 patients were detected with leak from the staple line. This group of patients had leak from zero to <15 post-operative days and were further evaluated for the presence of abscess. One leak patient had an abscess with rupture in to lung forming pleuro-gastro-colonic fistula. In a study by Lainas et al 28 patients were identified to have leak from the staple line. This was identified by performing CT on postop day 2 (POD2).[2]

In a study by Sakran et al, 25 patients had leak from zero to >7 post-operative days. They resolved after treating by multiple modalities like image guided percutaneous drainage, endoscopic stenting, clipping etc.[1]

In our study 4 patients had either hematoma formation or hemorrhage. In a study by Lainas et al 3 patients had either hematoma formation or hemorrhage.[2] In a study by Chivot et al 1.1% of the patients evaluated for postoperative complications had either hemorrhage or hematoma.[8]

In our study 7 patients had SMV thrombosis. All these patients are sleeve gastrectomy patients. Usually in gastric bypass patients c.f. sleeve there is less chance of thrombosis in SMV or PV because there is less dissection in gastric bypass. In sleeve gastrectomy entire greater curvature is dissected and about 20 small branches from the gastro-epiploic arcade burned and cut with ultrasonic scalpel. Maybe this injury to the small vessels which drain in to SMV and PV is contributing to the high incidence of SMV thrombosis. In a study by Villagran et al 5 patients (0.4%) had portal vein thrombosis. None of these patients had neither a past history of thrombosis nor cirrhosis of liver.[9] In a study by Belnap et al 5 patients had portal vein thrombosis of which one patient was referred to another center.[10]

In our study 10 patients had splenic infarct. In a study by Chivot et al splenic infarct was the most common injury among the splenic injuries. They also identified laceration and also sub-capsular hematoma but to a lesser extent.[8]

In patients with gastric leak we have performed peri-gastric collection drainage. In those patients who had large collections with severe abdominal pain relaparoscopy was performed with peri-staple line drainage tube and patients were discharged only when they are symptom free. In the study done by Lainas et al, endoscopic internal drainage (EID) with surgical drainage gave better outcome in patients with gastric leaks.

In one patient, a peri-gastric hematoma of size 3cm and not compressing the staple line was managed conservatively whereas one patient who had a huge peri-gastric hematoma of size >5 cm underwent relaparoscopy with drainage. Following the surgery patient recovered well. According to Lainas et al hematomas of size more than 5 cm with compression of staple line and >2 cm contact with staple line, relaparoscopy with drainage is advised.[2]

Patients with SMV thrombosis and splenic infarct were managed with heparin followed by oral anticoagulants, with which patients were symptom free after 2-3 weeks. All the post-operative complications and their management has been listed in Table 1.

CONCLUSION

Laparoscopic sleeve gastrectomy is a commonly performed and safe surgery in the present era. Understanding the normal post-operative imaging of stomach is essential for radiologists. With increasing number of surgeries and with associated co-morbidities, complications following LSG are increasing and bariatric surgeons should be aware of clinical symptoms and complications following LSG. Post-operative imaging plays a crucial role in early detection of complications which reduces the mortality rate. We suggest MDCT with oral and IV as an excellent tool for the patients having a nonspecific abdominal symptoms post laparoscopic sleeve gastrectomy.

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