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Laparoscopic Sleeve Gastrectomy: A Radiological Guide to Common Postsurgical Failure

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Abstract

Laparoscopic sleeve gastrectomy is one of the most common bariatric procedures worldwide. It has recently gained in popularity because of a low complication rate, satisfactory resolution of comorbidities, and excellent weight loss outcome. This article reviews the surgical technique, expected postsurgical imaging appearance, and imaging findings of common complications after laparoscopic sleeve gastrectomy. Understanding of the surgical technique of laparoscopic sleeve gastrectomy and of the normal postsurgical anatomy allows accurate interpretation of imaging findings in cases of insufficient weight loss, weight regain, and postsurgical complications.

Résumé

La gastrectomie longitudinale par laparoscopie figure parmi les interventions bariatriques les plus courantes à l'échelle mondiale. Depuis peu, elle gagne en popularité, car elle entraîne un faible taux de complications, une résolution satisfaisante des comorbidités et une perte de poids importante. Le présent article traite de la technique chirurgicale, des aspects d'imagerie postchirurgicaux attendus et des résultats d'imagerie associés aux complications courantes suivant la gastrectomie longitudinale par laparoscopie. La compréhension de cette technique chirurgicale et des caractéristiques anatomiques normales suivant l'intervention permet une interprétation juste des résultats d'imagerie dans les cas de perte de poids insuffisante, de reprise de poids et de complications postchirurgicales.

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Obesity continues to be a major public health problem in the United States, with more than one-third of adults considered obese in 2009–2010, as defined by a body mass index (BMI) >30 kg/m² [1–3]. Bariatric surgery procedures are indicated for patients with a BMI >40 kg/m² without coexisting medical problems and for whom bariatric surgery would not be associated with excessive risk should they be eligible for a bariatric procedure [4]. Patients with a BMI >35 kg/m² and 1 or more severe obesity-related comorbidities may also be offered a bariatric procedure [4,5].

Among different surgical options, laparoscopic sleeve gastrectomy (LSG) has demonstrated benefits comparable to

other bariatric procedures and is currently becoming one of the most common bariatric procedures worldwide. In comparison with other bariatric surgeries such as the laparoscopic Roux-en-Y gastric bypass (LRYGB), LSG is a shorter and more technically straightforward procedure that leads to fewer changes to the body's normal anatomy and physiology. It has recently increased in popularity because of proven efficacy in achieving considerable weight loss and comorbidities resolution without increasing the risk of complications [6,7].

Sleeve gastrectomy was originally performed by Hess [8] and Marceau [9] in 1998 as the first part of the duodenal switch operation. In high-risk and super-obese patients (BMI >50 kg/m²), the gastric sleeve part of the duodenal switch operation was often performed alone in an attempt to reduce morbidity and mortality, and to facilitate the laparoscopic approach [10]. In the past 15 years, LSG has increasingly been used as a stand-alone primary bariatric procedure and has

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gained popularity among patients and bariatric surgeons [11]. In a meta-analysis published in 2013 by Buchwald and Oien [12] LSG appears to be the second leading bariatric operation in the world, only surpassed by LRYGB. Moreover, LSG has surpassed LRYGB as the most frequently performed bariatric procedure in American academic centres since 2013 [13].

The ultimate goal of the procedure is to remove between 60%-70% of the stomach, including the fundus, leaving only a thin “banana-shaped” gastric tube from the esophagus to the duodenum. The narrowing of the stomach results in a significant restriction of the gastric capacity as well as in other metabolic modifications. Interestingly, ghrelin, one of the main hormones that stimulates and increases the patient’s appetite, is primarily produced by cells located in the fundus [14,15]. Resection of the fundus dramatically decreased the basal level of ghrelin, reducing appetite in patients who underwent LSG [16–18].

We discuss the surgical technique of LSG and imaging appearance of failure including insufficient weight loss, weight regain, and the most frequently encountered surgical complications.

Surgical Technique of LSG

After the creation of a pneumoperitoneum, 5 laparoscopic ports are placed across the upper abdomen. The first step of the procedure is to divide the vascular attachments of the gastroepiploic arcade and the short gastric vessels. The stomach and fundus must be fully mobilized during the dissection. The presence of a hiatal hernia is verified and repaired if necessary.

Subsequently, gastric transection begins 4-6 cm proximal to the pylorus by successive application of a laparoscopic linear stapler, using a gastric calibration bougie (36-40 F). This bougie is essential, as it helps to prevent excessive narrowing of the gastric tube (Figure 1).

The position of the final staple firing is critical to avoid a leak. Leaving a significant portion of fundus will not be optimal in terms of weight loss or gastroesophageal reflux disease (GERD) in the long term. Approximately 1 cm of cardia should be left after the last stapler is fired [19]. Intraoperative endoscopy can be useful in ruling out leaks, abnormal angulation of the sleeve, or gastric stenosis [20].

Failure After LSG

LSG has demonstrated its effectiveness in achieving weight loss and resolution of obesity-related comorbidities [21]; the concept of sleeve gastrectomy is simple, but some components of the operation, if performed incorrectly, can result in serious complications. A recent expert panel consensus statement has been published with a resulting drive toward standardization, providing guidance for essential aspects of the procedure, indications and contraindications, surgical technique, management, and prevention of complications [7].

Nevertheless, even in the hands of expert surgical teams and high-volume bariatric centres, failure exists. LSG failure can be classified as insufficient weight lost (defined as an

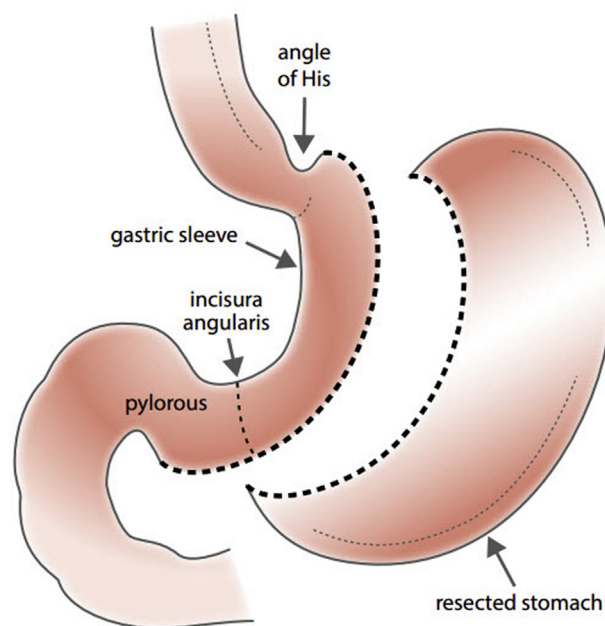


Figure 1. Diagram showing the normal surgical anatomy following laparoscopic sleeve gastrectomy. The resected stomach is removed out of the abdomen through a small incision. The thick interrupted line outlines the gastric transection plane along the greater curvature from the proximal antrum to the gastroesophageal junction. The thin interrupted line outlines the incisura angularis. Illustration courtesy of Ildiko A. Horvath, Medical Illustrator, McGill University Health Center, Montreal General Hospital, Montreal, Quebec, Canada.

excess weight loss <50%) [22,23] or weight regain and surgical complications.

Radiological Evaluation of Complications of LSG

The imaging evaluation of patients following LSG relies primarily on fluoroscopy or upper gastrointestinal (UGI) series and computed tomography (CT) scan and to a limited extent on plain radiographs (Figure 2). Radiologists should therefore be familiar with the weight and size limitations of their equipment since a subset of a bariatric population is likely to exceed these limitations [24].

Imaging plays an essential role in the evaluation of postoperative failure and in the detection of postsurgical complications, although its routine use in the postoperative period is debated [24]. According to the American Society for Metabolic and Bariatric Surgery, the decision to perform routine vs selective fluoroscopy studies should be left to the discretion of the surgeon, depending on factors related to the system of care in place including available expertise and on patient characteristics such as size, the ability to swallow, the ability to stand, and the ability to be cooperative [24]. The routine use of CT scan following LSG has been sparsely investigated [25] and to the best of our knowledge almost never performed in clinical practice.

At our institution, conventional fluoroscopy of the UGI tract is used for the evaluation of gastric leaks and stenosis and less commonly in cases of weight loss failure or weight

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