

## Computerized Axial Tomography Role in Detection of Complications of Laparoscopic Sleeve Gastrectomy: Review Article

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### ABSTRACT

**Background:** Obesity usually refers to, very fat accumulation. On the other hand, overweight refers to moderate fat accumulation. Abdominal Computerized Axial Tomography (CAT) ideally completed by using oral and intravenous contrast agents. This CT study aimed to learn about and identify the normal anatomy following laparoscopic sleeve gastrectomy (LSG), as well as to identify any issues that may have developed as a result of this procedure.

**Objective:** Review of the computerized axial tomography role in detection of complications of laparoscopic sleeve gastrectomy.

**Methods:** We scoured scholarly journals and databases including PubMed, Google Scholar, and Science Direct for reports on laparoscopic sleeve gastrectomy and computerized axial tomography. Between November 2005 and April 2022, however, only the latest or most comprehensive study was considered. The authors also assessed the usefulness of references drawn from similar books. As a result, non-English documents have been overlooked due to a lack of resources to translate them. It was commonly recognized that scientific research did not include things like unpublished publications, oral presentations, conference abstracts, or dissertations.

**Conclusion:** CT is very important in the diagnosis of early complications after LSG. Splenic infarction was clearly observed with CT angiography, after dividing the short stomach vasculature, the ischemic patches were visible on inspection of the laparoscopic pictures, and it helped for differentiation and diagnosis of several early complications as hemorrhage, stricture, fistula, splenic infarction as well as other wound complications.

**Keywords:** Computerized axial tomography, Laparoscopic sleeve gastrectomy.

### INTRODUCTION

Obesity usually refers to, very fat accumulation, while overweight refers to moderate fat accumulation. Overweight refers to increase in weight of human body in comparison with typical standard values. Obesity implies exactly having unusually elevated fat percentage. Both terms have definitions that state the degree of excessive fat for health researchers<sup>(1)</sup>.

Body fat is found in storage and essential forms. Essential fat is vital for body normal functions and exists in all organs including the intestines and central nervous system. Storage fat is considered energy source and is found under the skin as (sub-cutaneous adipose tissue). Storage fat is influenced by food intake and workout, while quantity of essential fat stays fixed. WHO suggested a description of obesity depending on the person weight to height equation called body mass index (BMI), this equation is directly proportionate to indices of both morbidity occurrences and mortality rates<sup>(2)</sup>.

BMI is calculated by weight of the person by kilograms divided by person tall by meters squared (a man weighing 100 kg and measuring 1.6 m,  $BMI = 100 / (1.6 \times 1.6) = 39.06 \text{ kg/m}^2$ ). This BMI has no relation either to persons' age or sex. Obesity, considered when patient' BMI reaching about thirteen or more, and is directly proportionate to increasing rates of disease appearance and death rates<sup>(1)</sup>.

Measuring BMI as an indicator for overweight peoples as well as obese people, despite being not the ideal measures, but it represents usual values used. Usually males having excess BMI in contrast to

females, so generally more males are overweight than female. However, females are obese than male worldwide<sup>(3)</sup>. This epidemic is affected by the changes of countries social state, education and cultural state, as well as economic status of these countries. These are some factors that specify exact quantity of energy and the exact quality of this energy taken and energy spending like special types of nutrition intake and exercise. In 1996, about ten to twenty percent males and fifteen to twenty-five percent female were obese in European society, with expanding rate by about ten to forty percent in the following 10 years<sup>(4)</sup>.

More than fifteen percent of the 693 million obese patients in the earth present within ten governates named United States of America, Mexico from North America. Arab republic of Egypt from Africa. Russia and Germany from Europe, Brazil from South America. India, Indonesia China and Pakistan from Asia<sup>(5)</sup>.

Bariatric operations became one of the most famous and popular operation in the previous 10 years, about 1/2 million operations performed every year worldwide. Different surgical operations and techniques such as LSG represents about 58.5%, Roux-en-Y gastric bypass (RYGB) represents about 37%, Laparoscopic adjustable gastric banding (LAGB) (3%), and biliopancreatic diversion with duodenal switch (1%). RYGB is considered as the operation that facilitate excess loss of weight rather than other operations and documented during serial follow up. At 4-year follow-up previous study conducted for about 2410 persons with loss of weight the percentage

becomes as follow RYGB, LAGB, as well as SG the percentage gives 27%, 11%, and 18%, respectively <sup>(6)</sup>.

### Laparoscopic Sleeve Gastrectomy (LSG):

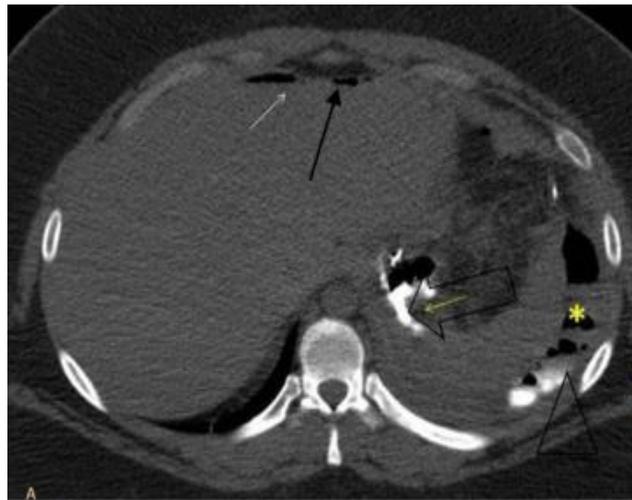
Due to its great efficacy for weight loss in the short-term follow-up, the LSG has recently gained popularity as a single-stage operation for the treatment of morbid obesity and its comorbidities <sup>(6)</sup>. LSG is described as one of the bariatric surgeries called restrictive operation, it affects body through making a sensation of early satiety for these persons. In addition to lowering level of ghrelin hormone, which secretes from gastric fundus, and this gastric fundus is resected at LSG operation <sup>(7)</sup>.

Reducing the stomach volume, that affecting and decreases food and diet intake, and it becomes the chief and basic fact described how LSG acts. So, the RGV is important to reach a good result to reach the needed weight loss. Many factors during and after surgeries may affects the RGV such as, size of bougie used in the surgery, the site between 1st section and pylorus of the stomach, the site in between the bougie and operation suture line, or reinforcement material and substances used in the gastric section <sup>(8)</sup>.

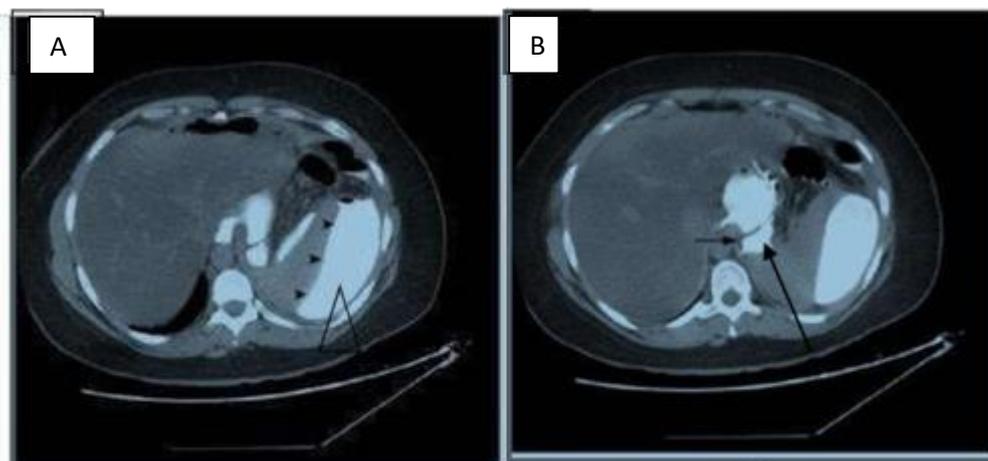
### Complications of sleeve gastrectomy:

The prevalence of complications after sleeve gastric resection according to the studies is to somewhat low. Historically, laparoscopic sleeve gastrectomy has been regarded as a technically straightforward bariatric procedure, with favourable outcomes in terms of weight loss, reduction of comorbidities, and postoperative complications. LSG is less invasive and dangerous than other weight loss surgeries like gastric bypass and biliopancreatic diversion <sup>(9)</sup>.

Abdominal CAT ideally completed by using oral and intravenous contrast agents. The aim of this CT study was to know and recognize the normal anatomy after laparoscopic sleeve gastrectomy and detecting any post-operative complications after this operation. The radiological findings favor fistula is described as follows: escaping or passage of oral contrast material through the wall of the gastric sleeve, contrast and fluid collection adjacent to the sleeve, presence of free fluid within abdomen, presence of liquid air within abdomen and detection of oral contrast material within the drainage tube situated after surgery <sup>(10)</sup>.



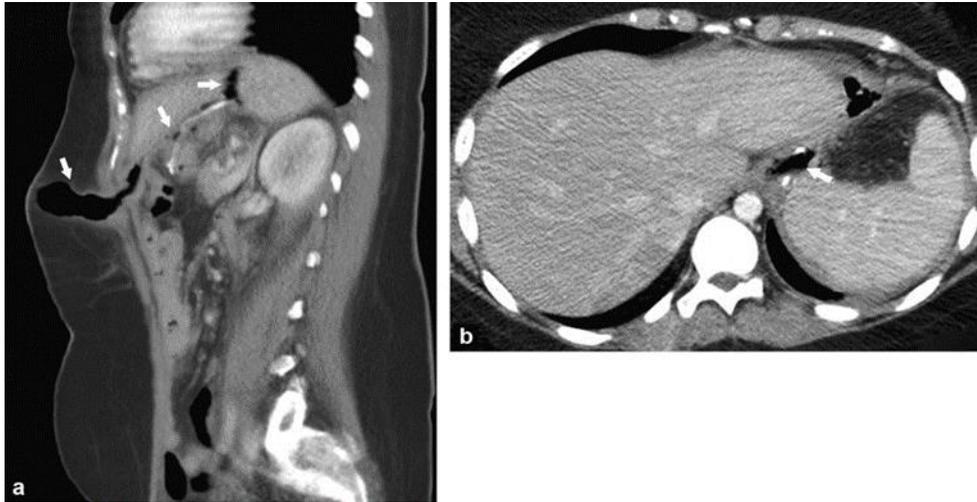
**Figure (1):** Axial CT image confirmed extravasation of contrast from the posterior aspect of the staple line (white arrow). Pneumoperitoneum (white and black arrow). It also showed disseminated contrast material in the left subphrenic area with air-fluid levels associated to abscess (arrow head) <sup>(11)</sup>.



**Figure (2):** Staple line in the upper leaking. (A) Upper abdominal fluid collection seen on axial CT scan (arrow heads). (B) Upper abdominal axial CT showing rich contrast material at the incision site (black arrow) <sup>(10)</sup>.

### Fistulas and Pleural Effusion:

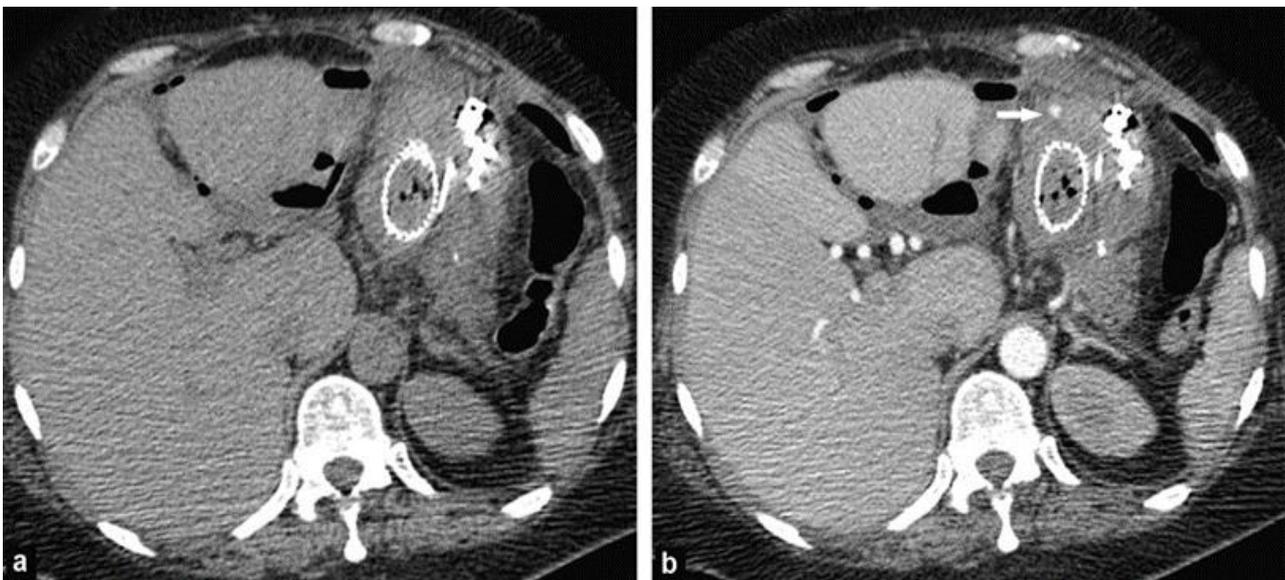
Most surgical procedures tend to mix up the terms fistula and leaking. Fistulas are abnormal openings that allow secretions and fluids to move from one organ to another. The causes of fistula are easy to deduce. Subphrenic infectious sequelae commonly result in gastrocutaneous fistula, lung infection, and pleural effusion because of a staple line leak. However, several reports of individuals developing a gastro-bronchial fistula following bariatric procedures have been documented. The most life-threatening consequences include gastric-to-cutaneous and gastric-to-bronchial fistulas <sup>(11)</sup>.



**Figure (3):** Gastro-cutaneous fistula. a: Gas bubbles (white arrow) can be seen extending from the gastro-cutaneous fistula in the upper part of the staple line on a sagittal CT of the abdomen taken following laparoscopic surgery for the gastrointestinal tract. b: This fistula was caused by a significant leak at the top of the staple line, as shown on axial CT <sup>(11)</sup>.

### Hemorrhage:

Hemorrhage during and after LSG may be problematic, as it may end into reoperation, abscess formation, blood transfusion and stay prolonged time at hospital. The LSG involves the longest gastric staple line of any procedure and is closest to the blood supply of the lesser curvature, and may therefore be able to bleed intra-operatively and postoperatively <sup>(12)</sup>.



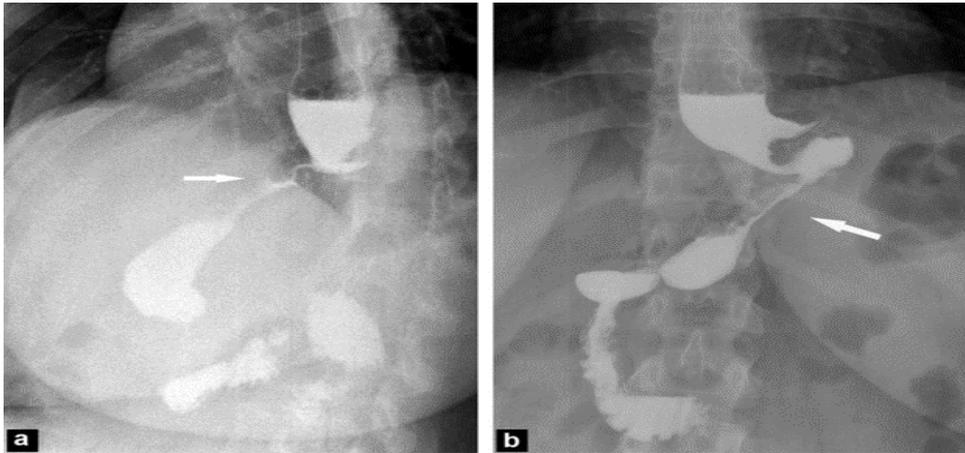
**Figure (4):** Case of post-LSG bleeding handled with percutaneous drainage and prosthesis. Patient had a history of upper stomach leak. Axial CT scan without contrast showed the prosthesis in the stomach, where it will be used to repair a leak at the top of the staple line. b: During endoscopic investigation, an arterial bleed was confirmed and treated, and enhanced axial CT showed early leakage of contrast material at the arterial phase (white arrow) <sup>(12)</sup>.

### Splenic infarction and splenic abscess formation:

The division of the short gastric vasculature after laparoscopic Nissen fundoplication has been linked to splenic infarction and splenic abscess development. LSG needs gastric fundus good mobilization and perfect division of short gastric vasculature. Hence, upper splenic pole ischemia and necrosis may be observed. Old reports have reported and documented splenic infarcts in the early postoperative course. Some cases may be much more complicated with development of splenic abscesses <sup>(13)</sup>.

### Stricture:

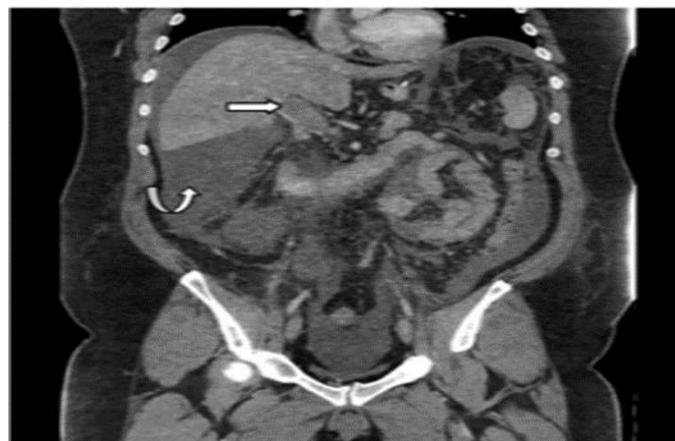
Gastric stricture is considered as one of documented post-operative complications after bariatric surgeries mainly laparoscopic sleeve gastrectomy (gastric conduit stricture), after LSG the remnant part of stomach becomes a narrow cylindrical and tubular structure, that is susceptible for stenosis and obstruction. On the in contrast to leaks, strictures rarely noticed or mentioned in clinical series <sup>(14)</sup>.



**Figure (5):** Stenosis. a: Right oblique view UGI image. b: UGI picture from the side. Two days after surgery, this series showed that postoperative edoema has caused some of the stomach stenosis to persist (white arrows) <sup>(15)</sup>.

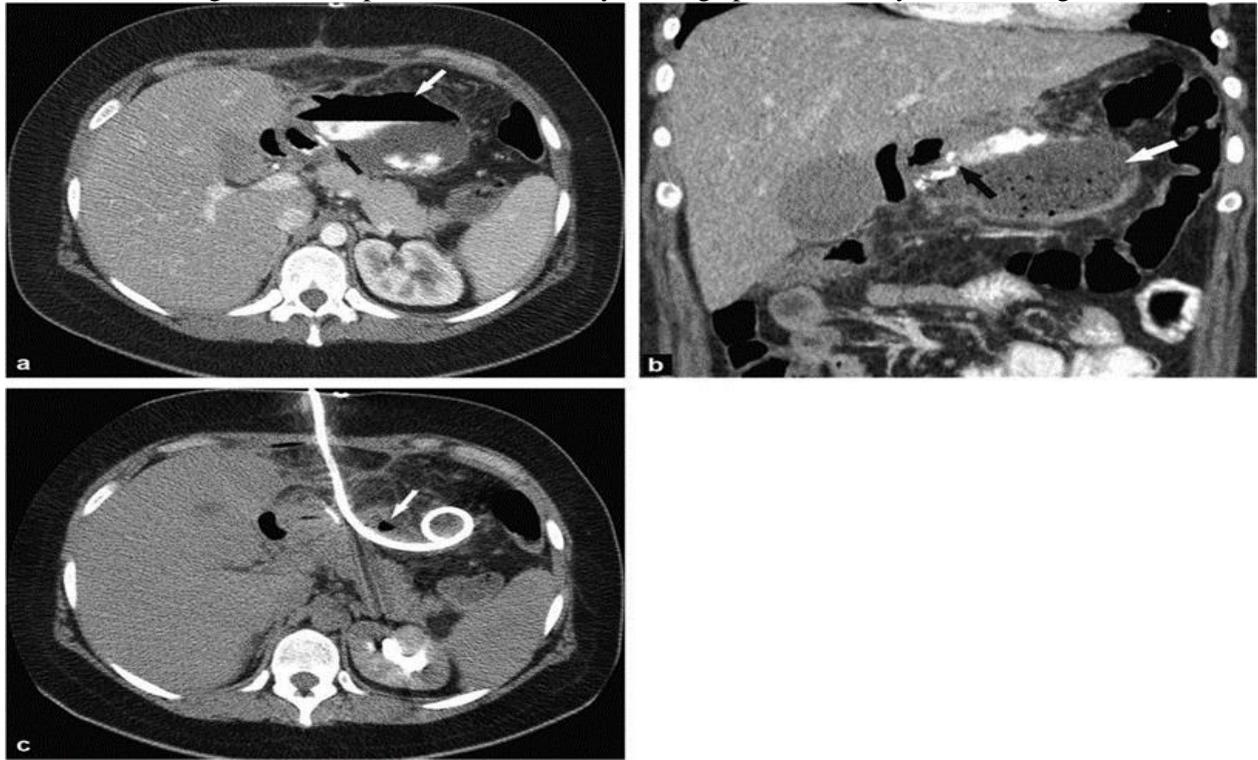
### Vascular Thrombo-embolism:

The bariatric individuals are at superior risk for development of deep venous thrombosis (DVT) and they have a slight cardiopulmonary reserve if a pulmonary embolus occurs. The prevalence of symptomatic pulmonary emboli after bariatric surgery as LSG is generally reported as 1%–2%, while a lot of patients are not diagnosed and the real incidence in these patients is probably much higher. Pulmonary embolism represents about 0.3% of complications after LSG <sup>(16, 17)</sup>.



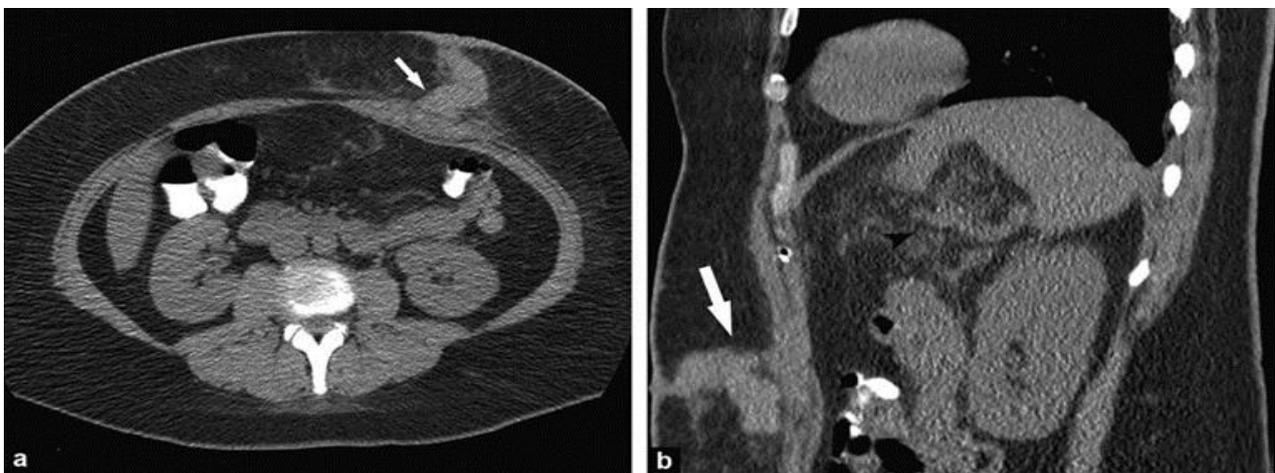
**Figure (6):** Coronal CT reconstruction with contrast showing portal vein thrombosis (arrow) and peri-hepatic ascites (curved arrow) <sup>(18)</sup>.

**Intra-abdominal abscess formation:** One of the possible complications following laparoscopic sleeve gastrectomy is intra-abdominal abscess. It typically appears with symptoms such as diffuse abdominal pain and discomfort, nausea and vomiting or fever/chills. If there are any doubt suspected clinically, doctors advised patient to do further assessment with contrast enhanced spiral CT to exclude presence of any intra-abdominal abscess. In a group of 164 patients following laparoscopic sleeve gastrectomy, Lalor and colleagues reported one person with intra-abdominal abscess (0.7%). Treating of this complication achieved by drainage percutaneously and covering antibiotics <sup>(19)</sup>.



**Figure (7):** Leak near the lower staple line causing an abscess. A: The axial CT image showed a large collection of fluid with air and fluid level (white arrow) containing contrast close to the staple line in the upper abdomen. B: Abscess and leaking staples on a coronal CT scan (black arrow). C: Axial CT scan demonstrating improvement following draining of an abscess <sup>(19)</sup>.

**Wound:** Although the risk of wound problems is reduced with laparoscopy, it is still possible for difficulties to arise. Small gas or fluid collections deep within the closed trocar incision and adjacent tissues can be seen on CT, aiding in early diagnosis of wound infection, which is typically confirmed clinically. The clinical diagnosis of a strangulated hernia through the trocar orifice is another type of wound complication. A hard, tiny defect in the abdominal wall allows a part of the anti-mesenteric wall of the intestine to protrude, and/or strangulate, through the defect; this is known as a Richter's hernia <sup>(20)</sup>.



**Figure (8):** Trocar incision site hematoma of the abdominal wall. A: A high-attenuation subcutaneous accumulation was observed over the trocar incision on an axial CT scan of the upper abdomen (white arrow). B: Upper abdominal subcutaneous hematoma as seen on sagittal CT (white arrow) <sup>(20)</sup>.

## CONCLUSION

CT is very important in the diagnosis of early complications after LSG. Splenic infarction was clearly observed with CT angiography, after dividing the short stomach vasculature, the ischemic patches were visible on inspection of the laparoscopic pictures, and it helped for differentiation and diagnosis of several early complications as hemorrhage, stricture, fistula, splenic infarction as well as other wound complications.

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**Competing interests:** Nil.

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