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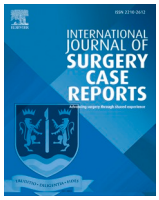

Case report

Acute splanchnic venous thrombosis following laparoscopic sleeve gastrectomy: A case report

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ABSTRACT

Introduction and importance: Splanchnic venous thrombosis is a rare but serious complication of bariatric surgery. This case report highlights a unique occurrence of acute portal, mesenteric, and splenic vein thrombosis in a 39-year-old woman three weeks after undergoing laparoscopic sleeve gastrectomy for severe obesity.
Case presentation: A 39-year-old woman with a BMI of 38.1 kg/m^2 and no prior medical history presented with a six-day history of diffuse abdominal pain, nausea and subjective fever but no change in bowel habits or blood in stool. A CT scan abdomen with IV contrast revealed extensive thrombosis involving the intrahepatic and extrahepatic veins, extending to the portal, splenic, and mesenteric veins. Laboratory findings supported a hypercoagulable state. Treatment included anticoagulation, intravenous antibiotics, supportive care, and close monitoring.
Clinical discussion: Diagnosing SVT is difficult due to its non-specific symptoms, relying on advanced imaging techniques like Doppler ultrasound, CT, or MRI. Anticoagulation therapy, such as low-molecular-weight heparin (LMWH) followed by direct oral anticoagulants (DOACs), is essential for managing SVT. Supportive treatments, including PPIs and antibiotics, improve outcomes, and surgery may be necessary for complicated cases like end organ damage for instance intestinal ischemia and necrosis.
Conclusion: This case underscores the need for high clinical suspicion of splanchnic venous thrombosis in post-bariatric surgery patients presenting with persistent abdominal pain. Proper patient selection and stratification, adequate thromboprophylaxis are crucial preventive strategies. Early diagnosis and aggressive management with multidisciplinary team approach are critical to preventing severe complications and improving outcomes.

1. Introduction

Bariatric surgery, particularly laparoscopic sleeve gastrectomy (LSG), is a widely accepted and effective intervention for managing obesity and its associated comorbidities. It has demonstrated significant benefits in terms of weight reduction, improved metabolic profiles, and enhanced quality of life. Despite its advantages, LSG is not without complications, which range from minor to potentially life-threatening. Among these, splanchnic venous thrombosis (SVT) is a rare but serious vascular complication that encompasses portal vein thrombosis (PVT), mesenteric vein thrombosis (MVT), and splenic vein thrombosis (SpVT) [1].

Splanchnic venous thrombosis following bariatric surgeries such as LSG, poses diagnostic and therapeutic challenges due to its nonspecific clinical presentation, which may include abdominal pain, nausea, and vomiting. These symptoms often mimic common postoperative findings,

Abbreviations: APTT, Activated partial thromboplastin time; BCS, Budd Chiari syndrome; BMI, Body mass index; CRP, C reactive protein; DUS, Doppler ultrasound; DVT, Deep venous thrombosis; INR, International randomized ratio; MRI, Magnetic resonance imaging; MVT, Mesenteric venous thrombosis; PT, Prothrombin time; PVT, Portal venous thrombosis; SVT, Splanchnic venous thrombosis; tPA, Tissue plasminogen activator; VKA, vitamin K antagonists; VTE, Venous thromboembolism.

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leading to delayed recognition and management. Failure to promptly identify and treat SVT can result in significant morbidity, including bowel ischemia and infarction [2].

The pathophysiology of SVT following bariatric surgery remains poorly understood, though several contributing factors have been identified. These include postoperative hypercoagulable state, venous stasis, technical aspects such as skeletonization of stomach blood supply as well as pneumoperitoneum and mechanical or anatomical changes following surgical intervention. Additional risks include obesity-related prothrombotic states and inadequate thromboprophylaxis [3,4].

This case report highlights the occurrence of SVT in a patient who underwent LSG, emphasizing the importance of early recognition and management. By examining this rare complication, we aim to raise awareness among clinicians and contribute to the body of literature regarding its presentation, diagnostic strategies, and therapeutic approaches. Early intervention with anticoagulation therapy is critical for favorable outcomes, and this case underscores the need for vigilance in postoperative care to mitigate the risks associated with SVT. This case has been reported in line with the SCARE criteria [5].

2. Case presentation

A 39-year-old female presented to the emergency department at our facility with complaints of severe abdominal pain for six days associated with nausea, and subjective fever but no vomiting, no blood in stool or vomiting that began three weeks after undergoing laparoscopic sleeve gastrectomy (LSG) for severe obesity management. The patient reported no previous history of thromboembolic events, liver disease, or known coagulopathies. She does not smoke cigarette or drink alcohol. Her postoperative course had initially been uneventful, with discharge on the third day post-surgery with oral analgesics without anticoagulant medications.

On examination, the patient appeared distressed in pain, not dyspneic, not pale, not jaundiced, with localized tenderness in the upper abdomen. Vital signs revealed tachycardia (heart rate 110 beats per minute) but no fever or hypotension. Laboratory investigations showed normal white blood cell count (10,780/mm^3), mild anemia (hemoglobin 10.8 g/dL), and raised D-dimer levels (7400 ng/mL). Liver function tests and coagulation profiles were within normal ranges.

Raised D-dimer and suspicious clinical presentation warranted a contrast-enhanced computed tomography (CT) of the abdomen which revealed thrombosis involving the portal vein, superior mesenteric vein, and splenic vein, consistent with acute splanchnic venous thrombosis (SVT) with accompanied mesenteric fat stranding. No evidence of bowel ischemia or infarction or cavernoma was noted Figs. 1, 2 & 3.

The patient was admitted and initiated on therapeutic anticoagulation with unfractionated heparin (UFH), which was later bridged to oral anticoagulation. A multidisciplinary team approach with general and laparoscopic surgeons, radiologists, nutritionist and medical gastroenterologist was employed. Investigations for underlying thrombophilia, including tests for factor V Leiden mutation, protein C and S deficiencies, and antiphospholipid syndrome, were done which were raised factor V activity suggestive of Factor V Leiden, significantly low protein S but normal protein C activity establishing an underlying thrombophilia state which could have predisposed her to formation of thrombus in unusual sites, splanchnic venous drainage.

Given the unspecific presentation, physical findings not correlating with severity of symptoms suggestive of ischemic intrabdominal pain, imaging findings suggestive of acute thrombosis without cavernoma formation or collaterals which are the usual case of chronic venous thromboembolism, VTE, underlying thrombophilia and previous recent laparoscopic bariatric surgery, sleeve gastrectomy, altogether increased the likelihood of acute thrombosis, multidisciplinary team discussion diagnosed the patient with acute SVT following recent surgery and was immediately started on respective treatment as stated early.

The patient responded well to anticoagulation therapy with subcutaneous UFH, with resolution of symptoms and gradual normalization of inflammatory markers and D-dimer. She was discharged on day five in the ward with oral anticoagulant, Rivaroxaban, and subsequent three clinic follow up visits revealed resolution of clinical symptoms and laboratory markers showed mildly elevated D-dimer at 1435 ng/mL and desired therapeutic, APTT range, and control was scheduled for control CT scan abdomen after 6 months of follow up when maximum rate of recanalization is expected.

2.1. Investigations

Upon arrival at the hospital Complete blood count, C-Reactive Protein (CRP) and D-dimer were done due to due clinical history and physical findings being suggestive an acute inflammatory process, which showed essentially normal CBC but raised CRP and D-dimer. The later warranted radiological investigation, CT scan abdomen with IV contrast in this case which showed extensive SVT and then liver chemistry, and clotting profiles were done to assess for liver status as well as Lactate as a marker of tissue perfusion which were all normal. From there the patient was kept on mentioned treatment plan and daily D-dimer was done to assess for clotting progress or resolution, Lactate to monitor perfusion status of bowels and mesenteries, clotting factors to monitor for hepatic dysfunction, treatment response with anticoagulants and monitoring risk of bleeding. And as part of definitive treatment plan and risk

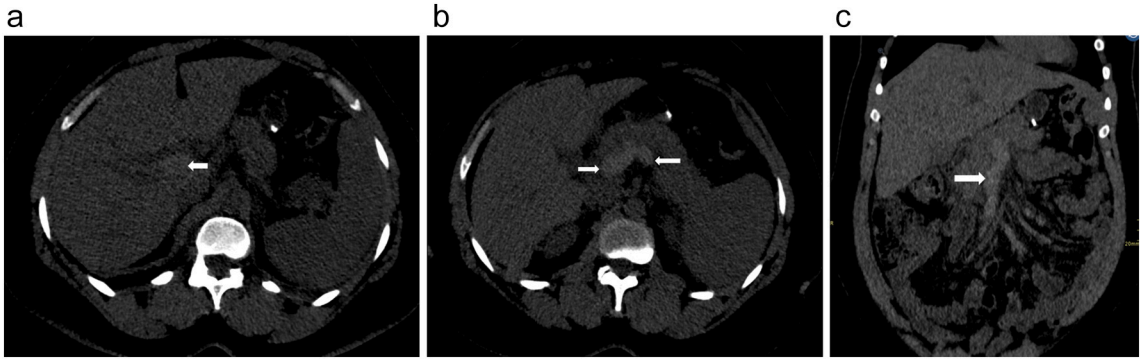

Fig. 1. a. Un-enhanced CT scan abdomen axial view demonstrating intrahepatic portal vein enlarged with spontaneous hyperdense material in keeping with acute thrombosis (arrow).
b. Un-enhanced CT scan abdomen axial view demonstrating main portal vein and splenic vein enlarged with spontaneous hyperdense material in keeping with acute thrombosis (arrows).
c. Un-enhanced CT scan abdomen coronal view demonstrating superior mesenteric vein enlarged with spontaneous hyperdense material in keeping with acute thrombosis (arrow).

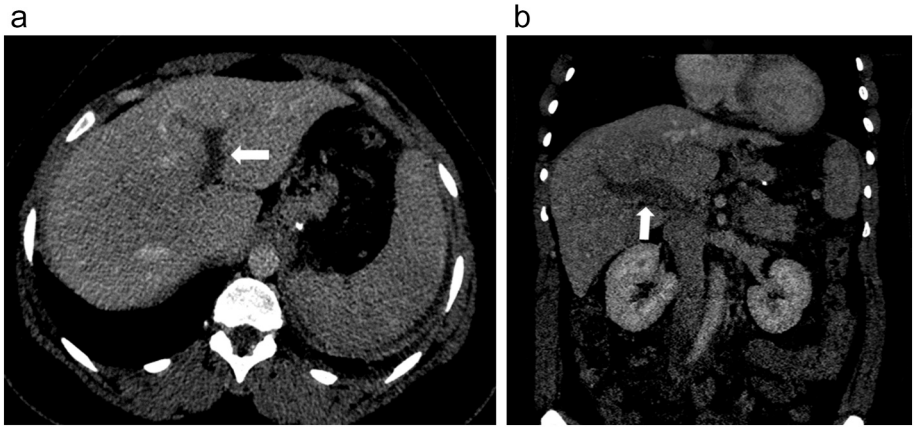

Fig. 2. a. Contrast enhanced CT scan abdomen Porto venous phase axial view demonstrating complete obstruction of the intrahepatic venous tract, no cavernous formation seen (arrow).
b. Contrast enhanced CT scan abdomen Porto venous phase coronal view demonstrating complete obstruction of the intrahepatic venous tract, no cavernous formation seen (arrow).

Fig. 3. a. Contrast –enhanced CT abdomen at Porto venous phase coronal section demonstrating diffuse mesenteric engorgement with patent distal vessels is noted and stranding was seen predominantly at the mesenteric roots (Arrows).
b. Contrast –enhanced CT abdomen at Porto venous phase coronal section. Showing evidence of mall-caliber tubular stomach post-resection along the greater curvature with visible surgical suture line, (Bracket) No fat stranding or collection is seen around.

stratification, screening for thrombophilia disorders factor V Leiden mutation, protein C and S activity, were done and revealed underlying thrombophilia state as factor V Leiden mutation and decreased protein S activity. The results are well described in Table 1.

2.2. Treatment

The patient was immediately started on:

- Octreotide: 50 μg intravenous stat, a somatostatin analogue to reduce intestinal secretions as part of bowel rest due to expected pathophysiological changes associated with complete thrombosis of splanchnic venous drainage such as bowel edema and ischemia.
- Intravenous paracetamol: 1 g as a stat dose, then every 8 h, as analgesic of choice
- Intravenous antibiotics: Metronidazole and piperacillin-tazobactam prophylaxis dose for 72 h in line of prevention of bacterial overgrowth and translocation due to anticipated impaired intestinal mucosa immune system due to bowel edema and ischemia.
- Subcutaneous unfractionated heparin: 80 units/kg stat dose then 30,000 units (maximum dose in 24 h) in three divided doses per 24 h.
- IV fluids: Dextrose normal saline (DNS) alternating with normal saline maintenance dose at maintenance rate of 137 mL/h since she was kept nil per oral as part of bowel rest.
- IV PPI with Pantoprazole 40 mg daily prophylactic dose in prevention of stress ulcers

She was kept nil per oral (NPO) immediately (nothing by mouth) and underwent serial abdominal examinations every 4 h assessing for signs of peritonism or resolution of initial abdominal tenderness. Daily monitoring of lactate, D-dimer, prothrombin time (PT), activated partial thromboplastin time (APTT), international normalized ratio (INR), and liver function tests were carried out for three consecutive days. These investigations demonstrated significant improvement in her condition clinically and laboratory wise.

The patient was kept on high therapeutic dose of UFH at 30,000 units divided in three doses/24 h and achieved target aPTT set (60–90 s) third day of treatment and day 5 of hospitalization she was transitioned to oral anticoagulants (rivaroxaban 15 mg twice daily for initial 21 days

Table 1
Depicting the results of laboratory investigations.

Investigation 3/10	Value	Normal range	4/10	5/10	6/10	7/10
WBC	10.78	4–10		7.52	8.13	
HB	11.8	12.3–15.3		10.6	10.5	
Platelets	226	150–450		245	264	
Amylase	72.48	28–100				
Bilirubin T		0–21	7.95	7.52		
Bilirubin D		0–3.4	4.36H	4.72		
AST		0–32	9.97	8.98		
ALT		0–33	17.5	14.41		
ALP		35–104	77.21	72.47		
Total protein		66–87	61.7 L	58.82 L		
Albumin		35–52	33.3 L	31.15 L		
Globulin		20–40	28.4	27.7		
GGT		5–36	22.98	22.23		
Creatinine	58.9	45–84				
CRP	291.57	0.5–5				
D-Dimer	7.4	0–0.5	6.67	7.14	6.83	5.08
Lactate		0.5–2.2	0.69	1.05	2.04	
APTT/INR		25–40	48H	58H	67H	72H
PT/INR		11.5–15/ 1–1.15	12/ 1.09	12.4/ 1.13	14.7/ 1.34H	15.2/ 1.38H
Factor V Leiden		<120				248.20H
Protein S		55–123				BELOW 8
Protein C		70–130				78

then 20 mg daily indefinitely) and oral analgesics as needed. She was gradually introduced to oral feeds starting with clear liquid diet day two of admission and slow stepwise escalation to full diet by day five as advised by nutritionist together with surgical team, and upon successful tolerance of enteral feeding and improvement in clinical signs, including a steady reduction in D-dimer levels, the patient was discharged. A follow-up plan was established in both surgery, gastroenterology and hematology clinics with a repeat CT scan with contrast scheduled after 6 months.

3. Discussion

Obesity is a complex chronic disease characterized by excessive body fat deposits, which contribute to a range of non-communicable diseases and have significant health implications [6] The World Health Organization (WHO) has declared obesity a global pandemic, with the World Obesity Atlas reporting that, as of 2022, 43 % of adults over 18 years old are overweight, and 16 % are obese. The projections suggest that by 2035, approximately 51 % of the global population will be living with overweight or obesity. Treatment options for obesity and its related metabolic complications include various medical and surgical interventions, with bariatric surgery demonstrating superior immediate results compared to non-surgical methods [7]. Among bariatric surgical techniques, laparoscopic sleeve gastrectomy (LSG) is the most employed restrictive procedure [8]. However, LSG is associated with complications, which may include immediate risks like hemorrhage (1–4.9 %) and leaks (1–3 %), as well as late complications such as stenosis, nutritional deficiencies, and rare occurrences of splanchnic venous thrombosis (SVT), which occurs in approximately 0.36 % of cases [9].

The mechanisms by which laparoscopic sleeve gastrectomy brings about Porto-mesenteric venous thrombosis remains unclear. But several studies have attributed this to venous stasis which is caused by pneumoperitoneum causes by gas insufflation of the abdomen with pressure above 14 mmHg, reverse Trendelenburg position which exhibits compressive effect of intraabdominal visceral to Porto-mesenteric vasculature, skeletonization of stomach vasculature causing vascular injuries and microthrombus nidi in the Porto mesenteric vasculature, the use of carbon dioxide may causes hypercapnic driven vasoconstriction and impaired venous return which causes release of vasopressin and eventual venous stasis [10–12].

Splanchnic venous thrombosis (SVT) encompasses portal vein thrombosis, mesenteric vein thrombosis, splenic vein thrombosis, and Budd-Chiari syndrome, with portal vein thrombosis being the most common [13]. The development of SVT may be influenced by several factors, including surgical techniques, the experience of the surgeon, prolonged immobilization, inflammation, and increased intra-abdominal pressure post-surgery, in addition to pre-existing conditions such as cirrhosis, malignancy, or underlying hypercoagulable states [14].

Diagnosing SVT is challenging due to the lack of classic clinical presentations. Most patients present with nonspecific abdominal pain that often does not correlate with physical examination findings, although other gastrointestinal symptoms such as nausea, vomiting, anorexia, and changes in bowel habits may also be observed. In rare acute cases, gastrointestinal bleeding may occur, typically seen in chronic SVT [15]. Identifying risk factors for venous thromboembolism is essential in assessing patients and planning treatment. Risk factor identification follows the framework of Virchow's triad, which helps guide clinical decisions, risk stratification, and individualized treatment. [16,17]. All patients undergoing bariatric surgery are at moderate to high risk of VTE and thus should be on pharmacologic thromboprophylaxis, with dosing and duration depending on the risk stratification in accordance with American College of Chest Physicians (ACCP) but in this case the patient was not on anticoagulation despite being in high risk population with factor V Leiden mutation and low protein S activity as recommended. [18].

The diagnosis of SVT heavily relies on radiological imaging, as clinical presentations are often vague, and laboratory markers such as D-dimer have low specificity [19]. Doppler ultrasound (DUS) has become the imaging modality of choice due to its lower radiation exposure compared to CT angiography, which also carries a risk of renal injury due to contrast use. DUS has high sensitivity and specificity for portal and splenic vein thrombosis, but its sensitivity for mesenteric vein thrombosis (MVT) is lower due to interference from bowel gases [20]. CT and MRI may be used to confirm the diagnosis, when necessary, with MRI offering the highest specificity for SVT [21]. Although D-dimer is often used in monitoring disease progression, it has low specificity and is generally not a reliable diagnostic tool for SVT. Serum lactate, while not a definitive marker, is commonly used to assess bowel tissue perfusion and monitor the resolution or progression of intestinal ischemia [16].

The treatment of SVT is urgent and critical, as the condition can be fatal if not detected and managed promptly [22]. The primary goals of treatment are to restore perfusion, prevent thrombus progression, and avoid complications such as bowel ischemia and portal hypertension (PHT) [23]. Resuscitation is achieved with goal directed IV fluids, with crystalloids preferred due to their availability and cost-effectiveness, although both crystalloids and colloids have been shown to provide similar survival benefits. Pharmacokinetic changes associated with sleeve gastrectomy such as reduced caloric intake, changes in absorptive surface, bioavailability changes especially for lipophilic drugs, and clearance have significant effect on the choice of anticoagulant in this population despite this, there is still limited literature existing for oral anticoagulants, vitamin K antagonists and even much less for direct acting oral anticoagulants [24,25].

Anticoagulation therapy is initiated with heparin (LMWH or UFH) as the first line, with treatment beginning within 1–2 weeks of diagnosis associated with a higher rate of recanalization [26,27]. The risk of major bleeding necessitates a thorough workup to rule out active bleeding, and in the case of esophageal varices, these should be managed accordingly. Once a therapeutic response is achieved, patients are transitioned to oral anticoagulants such as warfarin or DOACs.

There is ongoing debate regarding the choice of anticoagulant, vitamin K antagonist warfarin is preferred due to existing literature on

metabolic changes following LSG on its pharmacokinetics, monitoring and dose tailoring as compared to DOACs, but they're associated with high risk of bleeding [28]. But in cases when risks of bleeding are high and patient follow up is in question, DOACs Rivaroxaban is relatively safe compared to other DOACs are safe with almost equal outcome in term of recanalization and thromboprophylaxis but this should be a shared decision with the patient due to fairly lack of studies on long term use and follow up of DOACs in this population [25,28].

Treatment duration varies based on the patient's risk factors, with patients who have transient risks such as recent abdominal surgery or acute inflammation being treated for 3–6 months, while those with chronic conditions like cirrhosis or persistent hypercoagulable states may require lifelong anticoagulation [29]. In addition to anticoagulation, patients are often treated with proton pump inhibitors (PPIs) to prevent stress ulcers during periods of fasting, and antibiotics are used to reduce the risk of bacterial translocation and peritonitis in acute presentation, especially in cases of mesenteric ischemia [30]. Antibiotic regimens typically include metronidazole combined with a third-generation cephalosporin or piperacillin-tazobactam. Surgical intervention, such as thrombectomy or percutaneous thrombolysis with tissue plasminogen activator (tPA), is considered in cases where bowel viability is uncertain or if peritonitis develops. However, these procedures are associated with significant risks, including major bleeding events [31].

The prognosis for patients with acute SVT depends on several factors, including the patient's overall health, the timing of treatment initiation, and the effectiveness of recanalization [32]. Studies show that recanalization rates can reach up to 58 %, with a mortality rate of approximately 11 % and major bleeding events occurring in about 9 % [33]. However, when compared to no treatment, the outcomes for patients receiving early treatment are generally favorable, both in the short and long term [34,35]. Follow-up typically includes monitoring D-dimer levels, repeat abdominal CT scans, and checking bleeding indices to assess treatment efficacy and manage the risks of major bleeding associated with long-term anticoagulant therapy [36,37].

4. Conclusion

Obesity is a major global health issue, and bariatric surgery, particularly laparoscopic sleeve gastrectomy, is an effective treatment despite its associated risks, such as splanchnic venous thrombosis (SVT). Diagnosing SVT can be challenging, requiring high suspicion and imaging techniques like Doppler ultrasound. Proper patient selection, risk stratification and decision making on thromboprophylaxis is very crucial in this population to reduce the incidences of Porto mesenteric thrombosis. Early treatment with anticoagulants improves outcomes, and adjunctive therapies like PPIs and antibiotics help prevent complications. A little is known regarding the pharmacokinetic changes associated with bariatric surgery which affects the choice of anticoagulant as well as dose tailoring. While the prognosis varies, timely diagnosis and management, including ongoing monitoring, lead to better short- and long-term outcomes. A multidisciplinary approach is key to optimizing patient care and minimizing surgical risks.

CRediT authorship contribution statement

C.S: Study conception, data collection and production of initial manuscript

A.0: Production of initial manuscript, revision of the manuscript, proofreading

W.K: Revision of the manuscript, proofreading

C.W: Revision of the manuscript, proofreading

J.G: clinical radiologist for images review and reporting

A.N: manuscript revision, proofreading and supervision

Consent for publication

Written informed consent was obtained from the patient, preserved and ready to be submitted with editor's request.

Ethical approval

Not required for case reports at our hospital for single case reports.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author used Grammarly to correct sentence grammar and spelling. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of competing interest

The authors declare that they have no competing interests.

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Data availability

The datasets of the present study are available from the corresponding author upon request.

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