

Portomesenteric Venous Thrombosis Post-Laparoscopic Sleeve Gastrectomy: Do Energy Systems Pose as Instigating Factor to This Infrequent Complication?

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ABSTRACT

BACKGROUND: Portomesenteric venous thrombosis (PMVT), a rare complication after laparoscopic sleeve gastrectomy (LSG). Severe consequences are owed to a high risk of bowel ischemia. Our aim is to present a series of patients who developed PMVT after LSG, highlighting the potential role of the vessel sealer and divider as a risk factor.

METHODS: Medical records of seven patients who underwent LSG and developed PMVT from April 2010 to January 2019, at King Abdullah University Hospital and Jordan University Hospital, Jordan were reviewed. Our findings were studied, audited, and compared with published data.

RESULTS: A sum of 4900 patients underwent LSG, 7 (0.14%) developed PMVT. The mean age and body mass index (BMI) were 36.8 years and 45 kg/m², respectively. Four were women. Epigastric pain radiating to the back was the presenting symptom at a median time of 9 days after surgery. Computed tomography (CT) of the abdomen confirmed the diagnosis. Five patients presented with a total portal vein thrombosis (PVT), one with splenic vein thrombosis and one with dual portal and mesenteric vein thrombosis.

CONCLUSION: Portomesenteric venous thrombosis is a relatively uncommon complication following LSG. Early recognition is required to avoid catastrophic outcomes. The role of energy systems in the development of PMVT remains unknown and requires further elaboration.

KEYWORDS: laparoscopic sleeve gastrectomy, bariatric surgery, portomesenteric vein thrombosis, thrombophilia, vessel-sealing system

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Introduction

Portomesenteric venous thrombosis (PMVT) is a rare and dangerous phenomenon, associated with elevated estimates of morbidity and mortality, closely tied with bowel ischemia and infarction.¹⁻³ The unique pathophysiological events that link laparoscopic sleeve gastrectomy (LSG) to portal vein thrombosis (PVT) are yet to be elucidated due to the scarce resources and lack of standardized precepts for the prevention of thromboembolic events. The incidence of this complication after sleeve gastrectomy varies, but it can be as high as 1%.⁴ Herein, we want to raise the potential role of the vessel sealer and divider in the development of PMVT after LSG, while also exploring other risk factors.

Materials and Methods

A multicenter retrospective study was conducted upon a prospectively collected database of patients who underwent LSG and developed PVT. Surgeries were performed at the General Surgical Department, King Abdullah University Hospital (KAUH) Irbid, Jordan and Jordan University Hospital (UJ

Amman, Jordan, between April 2010 and January 2019. The following variables were studied as follows: age, sex, body mass index (BMI), thrombosis risk factors, family history, surgical technique, and thromboembolism prophylaxis. Incidence of PVT in patients who underwent laparoscopic gastrectomy for bariatric purposes was analyzed, recorded, and followed.

As for surgical technique, the patient is placed in the steep reverse Trendelenburg position. Intermittent pneumatic compression is not used during surgery. The surgeon is situated between the legs of the patient with an assistant present at the left side of the patient at all times. Surgery is performed with a five-trocar technique. Ingress into the peritoneal cavity is obtained with a supraumbilical open-access technique. The pneumoperitoneum is insufflated up to 15 mm Hg. A liver retractor is not used. The gastric greater curvature is dissected starting 4 cm from the pylorus, dividing the gastro splenic ligament as well as the gastrocolic omentum, ensuring the gastric antrum remains intact. A bougie 36 Fr to calibrate the gastrectomy is stationed across the lesser curvature. The gastric section is performed with a flexible stapler, orientated toward the



Table 1. Patient's characteristics and risk factors.

PATIENT'S CHARACTERISTICS AND RISK FACTORS	VALUE
Number of cases, (incidence)	7:4900 (0.14%)
Sex: male:female	3:4
Age (years): mean (range)	36.8 (19-50)
BMI (kg/m ²): mean (range)	45 (37-50)
Active smoking (%)	2 (29)
History of previous thrombosis (%)	2 (29)
Hormonal contraception	None
Positive thrombophilia study	None

Abbreviation: BMI, body mass index.

angle of His. Reinforcement of the staple line is not carried out. Additional clips are placed to control persistent bleeding (if needed). Methylene blue (120 mL) is injected to assess for any leaks. Abdominal drain is placed. The right flank port side is used as the gateway for the extraction of the resected stomach, without the use of a retrieval bag.

Result

Between 2010 and 2019, a sum total of 4900 LGSs were performed. Of the seven patients (0.14%) who presented with PMVT, four were women. Two had a history of smoking, none were using combined oral contraceptive pills or any other method of hormonal contraception. A personal history of deep vein thrombosis (DVT) was observed in two of the seven patients. The mean age was 36.8 years, while the mean BMI was 45 kg/m². The mean surgical time and hospital stay were 60 minutes and 3 (mean: 2-5) days, respectively. None of the cases required the conversion from laparoscopic to open technique. Subcutaneous enoxaparin (40 mg) was administered to all seven patients daily. The initial dose was given 12 hours after surgery. The mean postoperative anticoagulation prophylaxis duration was 8.5 (7-10) days. Clinical presentation was epigastric pain radiating to the back and vomiting in all patients. No patient developed peritonitis or required surgical intervention. The symptoms presented at a median of nine (range: 5-17) days postoperative. A high level of suspicion was adopted while investigating all seven patients, ensuring early detection and prompt management (Table 1).

Abdomen and pelvis computed tomography (CT) with oral and intravenous (IV) contrast was diagnostic in all cases, with findings of variable extensions. A total PMVT was presented in five cases, one patient presented with thrombosis of the superior mesenteric vein and portal vein, and one patient presented with thrombosis of the splenic vein.

Patient management consisted of hospitalization, rehydration, bowel rest, and full anticoagulation with subcutaneous

low molecular weight heparin (1.5-2 mg/kg, divided into two daily doses), noting that the aforementioned regimen was adopted in all seven patients as none had presented with bowel ischemia. This treatment was switched to oral anticoagulants (target international normalized ratio, 2.5-3) in six patients. The remaining patients were left on low-molecular-weight heparin that was continued for several months (3-6), a decision based on hematological tests and individualized risk factors. None of the patients presented with bowel infarction, peritonitis, sepsis, or perforation thus immediate surgical intervention and bowel resection was not indicated.

Remission of symptoms was established in all patients within the first week following admission, at which oral intake was recommenced. Asymptomatic patients were discharged, after a mean hospital stay of 5 (mean: 4-6) days. The tendency to develop thrombosis was assisted in all seven patients as thrombophilia studies were instructed once the CT confirmed the diagnosis of PMVT, none came back positive.

A 6-month follow-up CT scan was performed on six of the seven patients. Unavailability of the last patient hindered obtaining a follow-up CT. Imaging demonstrated complete recanalization in five patients and partial recanalization in one patient.

Discussion

Portal vein thrombosis has been described as a condition stemming from the abnormal development of a thrombus in the extrahepatic portion of the portal vein resulting in total or near-total obstruction. Much of its advantages have been derived from its locational variability; as it can extend to the liver involving intra-hepatic portal veins or upstream to involve the splenic and/or mesenteric veins. When the extension of the thrombosis reaches the proximal mesenteric venous arches, it may possibly lead to intestinal ischemia, infarction, and secondary peritonitis.⁵

The incidence of PMVT is inconstant, Salinas et al,⁴ reported an incidence of 1% in a retrospective analysis of 1713 LSG patients, whereas, Villagran et al⁶ reported an incidence of 0.4% in 1236 consecutive LSG cases. Boza et al⁷ described 17 (1%) patients with PVT after LSG but none following gastric bypass. According to input from our study, the incidence was found to be (0.14%) derived from seven patients out of 4900 total. However, other studies showed no incidence of PMVT after bariatric surgery. Customized presurgical anticoagulation prophylaxis, early recognition of PVT symptoms, and expeditious management with rapid IV fluids and anticoagulants have all contributed to resolution without the materialization of intestinal infarction or ischemia in any of our reported cases.

A number of hypotheses have been postulated to explicate this occurrence, such as venous stasis, metabolic syndrome, undiagnosed thrombophilia, operative intervention in splanchnic vasculature, and dehydration, as possible causative factors for PMVT; in addition to other patient-linked risk factors, such as oral contraceptive pills and smoking.

Venous stasis, a condition thought to have multiple contributing factors, including raised intra-abdominal pressure (CO₂

pneumoperitoneum) in laparoscopic procedures, although unclear, may cause different hemodynamic changes promoting venous thrombotic events in the splanchnic region due to the depleted flow within the portal and splanchnic venous systems.^{8,9} This inverse relationship between intra-abdominal pressure and portal flow was confirmed in a porcine model.³ Second, the intra-operative release of vasopressin due to hypercarbia might cause visceral vasoconstriction and thereby implementing a reduction in portal flow;¹⁰ in addition to the reverse Trendelenburg position, which may further augment the portal venous stasis.

Metabolic syndrome, a group of medical conditions occurring simultaneously, such as visceral obesity, increased blood pressure, high blood sugar, high serum triglycerides, and low levels of high-density lipoprotein (HDL). These patients are prone to develop hypercoagulable states that may occur as a result of increased serum levels of fibrinogen, plasminogen activator inhibitor-1 (PAI-1), factor VII, factor VIII, and von Willebrand factor.¹¹

Thrombophilia, another risk factor that should be explored in patients with PMVT, upon the most common findings are prothrombin 20210 mutation, protein C deficiency, protein S deficiency, factor V Leiden mutation, and lupus anticoagulant.^{12,13} None of our patients had a positive thrombophilia test. Past history of DVT was found in two patients, and they were addressed and strictly placed on anticoagulants before and after surgery, but in spite of the followed protocol, the duo still developed PMVT.

Skeletonization of the greater curvature by dividing the left gastroepiploic arcade and short gastric vessels may encourage change in venous blood flow from the stomach, infarction or ischemia in the upper pole of the spleen occurring occasionally causing the release of inflammatory mediators.^{14,15} In addition to the damage of the splanchnic endothelium triggering a local thrombus formation that may propagate to PMVT.^{4,16} Some condemn a direct contact with splenic and mesenteric veins as a potential originator for thrombus formation.¹⁷

Dehydration is a serious risk that has to be considered by surgeons and patients alike, after gastric sleeve surgeries. Numerous patients who have undergone LSG have noticed that they are not staying well hydrated, due to the limiting element faced after bariatric surgeries; also, patients find that they often experience fewer sensations of hunger and thirst.¹⁰ Dehydration is a condition that may cause vessels to narrow and blood to thicken, making those patients vulnerable to thrombus formation, especially when they are discharged early from the hospital and face difficulties reaching the suggested 2 to 3L/day fluid intake, or 8 ounces of water every 2 hours throughout the day. Our patients are advised to stay well hydrated especially during the first few weeks.

Energy systems available to perform bariatric surgeries are many. Contrasts in mechanisms of action are present, while

upholding different degrees of mechanical and thermal energy as a unifying factor between said devices. At our center, we use a vessel-sealing and dissecting device that uses ultrasonic mechanical vibration to coagulate and dissect blood vessels. These devices use a combination of mechanical vibration and pressure to coagulate and dissect tissue. The jaw compresses the tissue against the blade to produce frictional heating which leads to coagulation and cutting, simultaneously. The ultrasonic motion in the blade causes the hydrated tissue to heat up, and collagen and elastin molecules within the tissue melt and fuse back together creating a seal while maintaining hemostasis during the procedure. We hypothesize that the mechanical and thermal energy emitted from the device may provide the ideal medium required for the formation of a local thrombus that may then disseminate all through the portal venous system.

Our theory is further reinforced by the high incidence of PVT in LSG, exceeding the reported incidences following Laparoscopic Gastric Bypass (LRYGB) because of the higher time needed to dissect the stomach than to a more limited usage of vessel sealing in LRYGB.¹⁸ Second, it is the common device used to perform bariatric surgeries which gave us the notion to explore any potential role it may have.

To prevent or reduce such complications, acknowledging PVT as a complication following bariatric surgery has become a necessity, especially for emergency clinicians, surgical residents, general and bariatric surgeons, since bariatric surgery has become a popular choice for those seeking weight loss spanning a wide range of demographics. Antithrombotic prophylaxis should be administered routinely although there are no specific recommendations regarding dosing and duration. Close intraoperative monitoring to avoid hypercapnia and maintaining the intra-abdominal pressure at the lowest acceptable levels and practicing methodical intermittent disinflation of gas are also parameters that should be closely monitored throughout the procedure. Retaining adequate levels of hydration after patient discharge is highly advised.

Portomesenteric venous thrombosis is a disease lacking specific symptoms, ranging from mild abdominal pain and vomiting to severe manifestations such as hematemesis, bloody diarrhea, and back pain, and it could also remain asymptomatic and only manifest after the progression into portal hypertension. Regarding diagnostic modalities; a contrast-enhanced abdomen and pelvis CT scan has been regarded as the modality of choice in the diagnosis of portal thrombosis, attributed to its sensitivity that reaches up to 90%.¹⁹ In addition to confirming the diagnosis, a CT scan aids in excluding other conditions, gauges for signs of intestinal ischemia and estimates the vastness of the thrombosis.

A number of limitations were faced during the conduction of this study. First, this is a retrospective study, not designed to comprehensively compare those who were diagnosed with PMVT after LSG with a control group, and second, the number of patients was too small to adequately draw a conclusion. Regardless of the aforementioned limitations, we were persuaded

to compose this study to increase the scale of awareness regarding complications surrounding bariatric surgery, especially PVT, a complication that harbors obscure elements and variable degrees of presenting symptoms, signifying the possibility of misdiagnosis. We were also encouraged to add our experience to the pool of pre-existing data, accentuating the potential role of energy systems in the instigation of PMVT after LSG.

In conclusion, PMVT is an atypical presentation after LSG. However, it is a consequential complication that requires an escalated level of vigilance and awareness. Untimely detection and management could be achieved by accustoming health care personnel to such complications. Uncomplicated cases are usually managed conservatively; anticoagulants and thrombolytics are thoroughly effectual and are considered as the main therapeutic option. Thus, we recommend that patients who undergo bariatric surgery be kept on anticoagulants for at least 10 days beyond hospital discharge and remain well hydrated. The role of the vessel sealer and divider still remains vague, with no enough data and evidence to explicitly describe the part energy systems play in the development to PMVT, as the events revolving around this phenomenon continue to be indistinct and multifactorial, preserving room for speculation and curiosity.

Author Contributions

MNBH: Surgical procedures, manuscript writing and data collection. ARAAm: Manuscript writing and data analysis. FO: Surgical Procedures and literature review. MHA-O Radiologic analysis and data collection. FBH: Manuscript writing, data collection and review of literature.

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