

Portomesenteric Venous Thrombosis in Patients after Laparoscopic Bariatric Surgery

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Abstract

Objective: Obesity has become a worldwide epidemic that is directly related to chronic tissue inflammation and impaired fibrinolysis, both of which lead to an increased risk of thrombosis. The management of complications after bariatric surgery is still a challenge. The study aims to report the incidence of portomesenteric venous thrombosis (PMVT) in patients undergoing bariatric surgery. **Introduction:** Bariatric surgery is the procedure of choice for the treatment of obesity type III. Despite the safe technique, the surgeon must be aware of the risks linked to laparoscopy such as the PMVT. Computed tomography (CT) with intravenous contrast was the imaging method of choice for diagnosis. **Materials and Methods:** We performed a retrospective analysis of 4790 patients from August 1999 to June 2020 was observed the incidence of PMVT in this group. Of all patients, 72.8% were female and 27.2% male. The mean age was 46.3 years (34 - 72) and the mean BMI before bariatric surgery was 41.4 kg/m². **Results:** The study showed an incidence of PMVT of 0.12% (N = 6), portal vein thrombosis was of 0.10% (n = 5) and 0.03% of MVT (n = 1). Of these, 72.5% (n = 3473 patients) underwent laparoscopic gastric bypass, 23.6% (n = 1131 patients) were submitted to the laparoscopic sleeve gastrectomy and 3.8% (n = 186 patients) to other procedures. The mean postoperative hospital stay for bariatric surgery was 3.3 days. The average time of hospital stay of patients complicated with PMVT range from 5 to 14 days. No patient died of complications related to PMVT. **Conclusion:** Portomesenteric vein thrombosis is a rare presentation after laparoscopic bariatric surgery. However, it is a serious complication that has a high index of suspicion for making its diagnosis. Conservative treatment using anticoagulants and thrombolytics is effective, it should always be considered the main treatment option. However, these patients must be followed up in the long term, as late

complications can occur in high numbers of patients.

Keywords

Morbid Obesity, Laparoscopy, Portomesenteric Venous Thrombosis, Bariatric Surgery

1. Introduction

World Health Organization (WHO) data show that about 11% of the world population suffers from obesity (body mass index above 30 kg/m²). In the US, it is considered a major public health problem, affecting more than one third of the adult population [1]. According to the Brazilian Ministry of Health (MH), the percentage of adults overweight is 51% [2].

The clinical treatment of morbid obesity with low-calorie diets and changes in lifestyle with or without pharmacological therapy does not present good results when compared to surgical treatment, now considered the gold standard [3] [4] [5].

Among surgical procedures, the most performed techniques are gastric bypass and sleeve gastrectomy, being surgeries safe, with greater maintenance of weight loss and lower rates of complications. However, surgeons should be aware of all possible complications [6] [7] [8] [9].

Of the possible postoperative events, we focus on the complication that every surgeon should be aware of in patients with abdominal symptoms after undergoing bariatric surgery: portal vein thrombosis (PVT) and the superior mesenteric vein thrombosis (SMVT), previously uncommon in other abdominal surgeries with similar complexities.

Portal vein thrombosis is a very uncommon complication after laparoscopic surgery. The development of thrombosis and coagulation disorders in patients undergoing laparoscopy with pneumoperitoneum has been described previously, but thrombosis of the portal vein (PVT) and the superior mesenteric vein (SMVT) is not a common complication after laparoscopic surgery.

In this report, we present five cases of PVT and one case of SMVT, after laparoscopic bariatric surgery, operated at this facility, reporting the clinical features and treatment of patients involved in such addressed complication.

2. Materials and Methods

There was a retrospective analysis of 4790 patients who underwent laparoscopic bariatric surgery at São José do Avaí Hospital (HSJA) from August 1999 to June 2020. Of these, 72.5% (n = 3473 patients) underwent laparoscopic gastric bypass (LGBP), 23.6% (n = 1131 patients) were submitted to the laparoscopic sleeve gastrectomy (LSG) and 3.8% (n = 186 patients) to other procedures.

Of all patients, 72.8% were female and 27.2% male. The mean age was 46.3

years (34 - 72) and the mean BMI before bariatric surgery was 41.4 kg/m².

The types of variables used in the study were gender, age, BMI and the surgical techniques were LGBP or LSG or other procedures. Data was based on median, analyzing minimum and maximum values, organized in percentage. Data was collected using the Exemplo Medical program, version eMD Central 7.

Surgical indication followed the criteria was defined by the 1991 Consensus; BMI > 40 kg/m² and/or BMI > 35 kg/m² associated with comorbidities. All patients were evaluated by a multidisciplinary team consisting of psychologist, nutritionist, physical therapist, endocrinologist, surgeon and anesthesiologist.

The following exams were preoperatively performed in all cases: Complete blood count and platelet parameters, serum urea, creatinine, glucose, prothrombin time, alanine aminotransferase (ALT), aspartate aminotransferase (AST), ferritin, vitamin B12, magnesium, zinc, selenium, 25 (OH) vitamin D3, serology for hepatitis B and C, blood gas analysis, lipid profile, upper endoscopy with urease test, total abdominal ultrasound, bone densitometry and echocardiography. Mammography, prostate antigen or follicle stimulating hormone, myocardial scintigraphy and Doppler carotid arteries were performed in selected cases.

The surgical technique used for gastric bypass was the making of a gastric pouch, cutting the stomach with 3 or 4 applications of the linear stapler. The jejunum was sectioned at a location 50 cm from the Treitz angle with 1 application of the linear stapler. A 100-cm-long Roux limb was used. A lateral jejunojejunostomy was done with 1 load of the linear stapler and completed with hand-sewn stitches. The distal jejunum was anastomosed to the gastric pouch by gastrojejunostomy (G-J anastomosis), performed via the antecolic antegastric route, using the flip-top 25-mm circular stapler or applications of the linear stapler, and tested by injecting 50 mL of methylene blue through the nasogastric tube, closing the mesenteric spaces with hand-sewn stitches.

Sleeve gastrectomy was performed releasing the gastroepiploic arcade of vessels up to about 5 cm from the pylorus, introduction of orogastric tube 36 Fr size, sleeve gastrectomy was done with six to eight linear staplers loads, reinforce the staple line with running sutures using 3.0 polypropylene.

The prevention of thromboembolic events was performed in patients with BMI 35 to 49.9 by air compressors in the legs intraoperative and early ambulation 3 - 4 hours after surgery and in each hour after.

Drug prophylaxis was used in selected patients considered as high risk, such as a history of deep venous thrombosis, lympho venous stasis, previous episode of erysipelas of the lower limbs and/or postphlebotic syndrome, patients with atheromatous plaque in the carotid arteries and/or atrial fibrillation and super obese patients (BMI > 50 kg/m²). These patients received pharmacological prophylaxis with 5000 IU of unfractionated heparin, SC 8/8h, postoperatively.

PMVT patients seek assistance in the emergency room of our hospital or reported symptoms at the follow-up visit, were admitted for investigation and further tests were performed: CT scan with venous contrast, blood tests, blood tests for thrombosis: PT-INR, activated partial thromboplastin time (aPTT), fi-

brinogen level, complete blood count (CBC), genetic tests, including factor V Leiden (activated protein C resistance) and prothrombin gene mutation, antithrombin activity, protein C activity, protein S activity, fasting plasma homocysteine levels.

The selected patients were all those who had previously undergone bariatric surgery, with nonspecific symptoms, including nausea, abdominal pain, abnormal bowel movement, malaise, asthenia and fever. The diagnosis of thrombosis was confirmed by radiological imaging (CT scan with venous contrast, angiography) associated with the laboratory tests mentioned above.

After the diagnostic, patients were rehydration and bowel rest, were treated by full anticoagulation with subcutaneous low-molecular-weight heparin or intravenous unfractionated heparin, followed by oral coagulant that should be continued for several months.

3. Statistical Analysis

Data were obtained with the help of software Exemplo Medical program, version eMD Central 7.

The variables are summarized using median, minimum, maximum values and percentages.

In the images below it is possible to observe and diagnose three patients with PVT or SMVT using CT scan with venous contrast.

In **Figure 1** is coronal section evidencing the absence of the passage of contrast in the portal vein since its origin (SMVT).



Figure 1. Coronal scan with venous contrast showing no portal vein since its origin at the confluence of the splenic vein and superior mesenteric vein (mesenteric venous thrombosis).

In **Figure 2** is coronal section in the portal phase, showing no opacification of the portal vein by means of contrast (PVT).

In **Figure 3** there is an axial section of the CT scan with venous contrast evidencing failure in filling of the mesenteric vein at the junction with the splenic vein.

4. Results

There was a retrospective analysis of 4790 patients who underwent laparoscopic bariatric surgery from August 1999 to June 2020. The mean age was 46.3 years, and on the day of bariatric surgery the average BMI was 41.4 kg/m² and on the day of PMVT the average BMI was 26.6 kg/m².

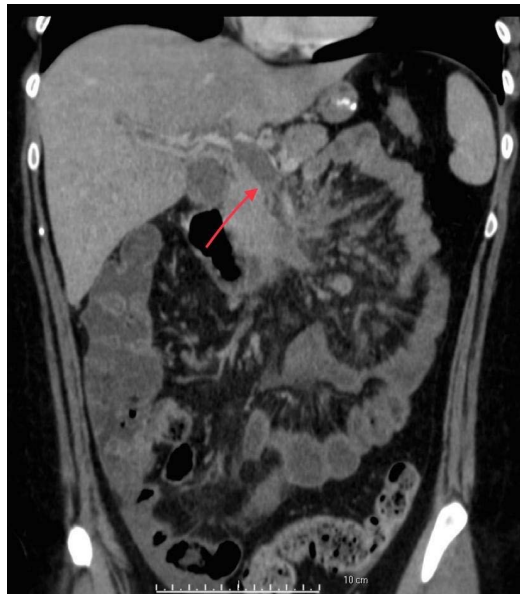


Figure 2. Coronal tomography scan with contrast in the portal phase, showing no opacification of the portal vein by means of contrast (portal vein thrombosis).

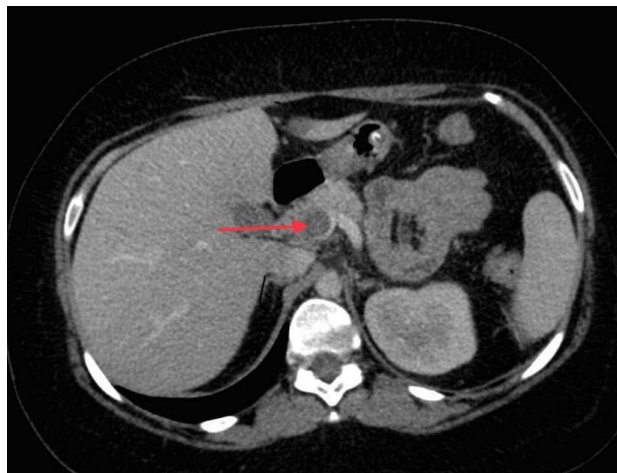


Figure 3. Axial CT scan with failure of intra-luminal filling of the mesenteric vein at the junction with the splenic vein.

Of these, 72.5% (n = 3473 patients) underwent gastric bypass, 23.6% (n = 1131 patients) were submitted to the sleeve gastrectomy and 3.8% (n = 186 patients) to other procedures.

The six patients evolved in this study haven't presenting any preoperative history for hypercoagulable, intraoperative and early postoperative complications.

Patients showed: leukocytosis with a left shift, and abdominal CT with intravenous contrast where thrombi were diagnosed (**Figures 1-3**).

Out of our 6 patients, the additional laboratory tests in a patient (16.6%) showed anti-thrombin III of 58%; positive lupus anticoagulant.

The study revealed an incidence of PMVT of 0.12% (6 patients), PVT of 0.10% (5 patients) and 0.03% of MVT (1 patients). We observed that three (50%) patients had undergone gastric bypass and three (50%) underwent sleeve gastrectomy.

The operative time ranged from 55 min to 210 min, with average time 123 min. The mean postoperative hospital stay after bariatric surgery was 4.3 days (range 2 - 10). After undergoing bariatric surgery, the patients in this study had an average time of readmission with a diagnosis of PMPM of 285.5 days, ranging from 7 to 638 days.

The average length of hospital stay after PMVT was 8.3 days, ranging from 7 to 14 days (**Table 1**).

Table 1. Characteristics demographic, clinical and follow-up of patients with porto-mesenteric venous thrombosis.

Patient	I	II	III	IV**	V***	VI
Sex	F	F	M	F	F	F
Age	30	41	35	34	28	47
Comorbidities	Sleep apnea	–	–	SAH* High triglyceride	SAH* Hypothyroidism	SAH*
Surgery	Bypass	Bypass	Bypass	Sleeve	Sleeve	Sleeve
Initial BMI (kg/m ²)	52.3	42	42.6	35.6	38.2	37.6
PMVT day (days)	575	150	334	7	9	638
BMI at PMVT (kg/m ²)	26.1	23.5	25.6	35.6	25.8	22.9
Thrombosis place	Portal vein	Portal vein	Portal vein	Superior mesenteric vein	Portal vein	Portal vein
Symptoms	Abdominal pain Melena	Abdominal pain Diarrhea Fever Vomiting	Fever diarrhea	Fever Diarrhea Vomiting	Abdominal pain constipation	Abdominal pain
Risk factor	BMI > 50 kg/m ²	–	–	–	–	–
Prophylactic heparin	Yes	–	–	–	–	–
Hospital discharge (days)	7	8	10	6	14	5

*Systemic arterial hypertension; **CT with intravenous contrast the patient IV (**Figure 1**); ***CT with intravenous contrast Patient V (**Figure 2, Figure 3**).

There was late complication in three patients, patient number I: esophageal varices after four months, patient number III: cavernous transformation of the portal vein with turbulent flow and splenomegaly after 11 months, patient number VI: after one year in upper digestive endoscopy, presented large-caliber varicose veins in the lower 1/3 of the esophagus, that bleed, need endoscopic variceal ligation, low platelet (59 thousand), splenomegaly, had normal elastography and normal liver function tests.

No patient died due to complications related to PMVT.

5. Discussion

The actual incidence of post-surgical PMVT is not clearly determined and especially by the unknown number of subclinical and undiagnosed cases [10].

PMVT has been reported after laparoscopic surgery such as cholecystectomy, right hemicolectomy, fundoplication and splenectomy [11] [12]. The pathophysiological mechanism and the specific risk factors remain unclear. Pigeyre M. published a case report of vein thrombosis port associated with severe neuropathy vitamin deficiency in patients submitted to bypass [13]. Bruno Berthet *et al.* reported a case of PVT in patients with mutation in Leiden factor 2 who underwent sleeve gastrectomy [14]. Out of our 6 patients who showed this of complication, in the additional laboratory investigations only one showed anti-thrombin III of 58%; positive lupus anticoagulant.

It is believed that the increased risk of splanchnic vessels thrombosis is due to changes in hemodynamic conditions determined by pneumoperitoneum, which includes visceral vasoconstriction, secondary to vasopressin secretion; anti-Trendelenburg position, commonly used in laparoscopic surgery; and the increase of portal pressure by CO₂ retention [15] [16] [17]. Obesity may play a supporting role in the development of venous thromboembolism in hospitalized patients with other risk factors [18].

Another theory, after bariatric surgery, patients are usually discharged from the hospital early after the procedure. Some patients find it difficult to ingest the amount of fluids suggested at 2 L/d and experience varying degrees of dehydration. Being able to put them at greater risk of thrombotic complications such as DVT, pulmonary embolism and PMVT [19] [20].

In my point of view, complex surgical procedures by laparoscopy have never been performed on patients at high risk for thrombotic events and with routine monitoring for so many years. Probably due to these facts, we diagnosed PMVT more frequently. The most recent IFSO Worldwide Survey) reported that 634,897 bariatric operations were performed worldwide in 2016 [21].

PMVT is an uncommon surgical complication secondary to laparoscopic bariatric surgery. In 20% to 35% of cases, LSG remains the primary cause of PMVT [22]. However, in this study, we found PMVT in 50% of patients submitted to LGBP and 50% to LSG.

Goitein D *et al.* showed in their multicenter studies an incidence of 0.3% of PMVT after laparoscopic bariatric surgery, they used routinely venous throm-

botic event prophylaxis [23]. Prophylaxis related to venous thrombotic events were used in all papers that studied the emergence of PMVT, however, it did not prevent this complication in any patient [24].

In the present study, routinely prophylaxis for venous thrombotic events was not used for low-risk patients, which suggests that non-pharmacological prophylaxis does not increase the incidence of PMVT as deep vein thrombosis [25] [26]. The number of patients with this pathology was 0.12% lower than the literature.

The diagnosis of PVT or SMVT postoperatively is often difficult. The symptoms are nonspecific. Among them we mention nausea, vomiting, abdominal pain, changes in bowel movement and fever. When in doubt, laboratory tests are requested, also nonspecific, where leukocytosis may be present. Prolongation of prothrombin time (PT) and falling levels of protein S suggest vitamin K deficiency, which predisposes the body to thromboembolic events, in patients with a history of treatment for phlebitis [27]. To confirm the diagnosis, CT scan with intravenous contrast, angiography, is the best method to assess cases. Literature reviews show that treatment of choice is the immediate intravenous anticoagulation, followed by oral anticoagulation, the latter being maintained for at least 3 to 6 months. Clinical follow-up should be performed by the clinical evaluation of the patient, INR and CT series. Other treatment options include thrombolysis catheter, percutaneous balloon dilation or stent, however for PMVT, those therapy is ineffective [28]. The main complication is cavernous transformation of the portal vein [13]-[28]. All our patients had diagnostic confirmation with CT scan with venous contrast and therapeutic success with anticoagulation without the need for additional therapies. However, we found late complications in 50% of the patients: patient number I: esophageal varices after four months, patient number III: cavernous transformation of the portal vein with turbulent flow and splenomegaly after 11 months, patient number VI: after one year in upper digestive endoscopy, presented large-caliber varicose veins in the lower 1/3 of the esophagus and splenomegaly.

6. Conclusion

Portomesenteric vein thrombosis is a rare presentation after laparoscopic bariatric surgery. However, it is a serious complication that has a high index of suspicion for making its diagnosis. Conservative treatment using anticoagulants and thrombolytics is effective, it should always be considered the main treatment option. However, these patients must be followed up in the long term, as late complications can occur in high numbers of patients.

Conflicts of Interest

The authors declare that they have no conflict of interests.

References

- [1] Moy, J., Pomp, A., Dakin, G., Parikh, M. and Gagner, M. (2008) Laparoscopic

- Sleeve Gastrectomy for Morbid Obesity. *The American Journal of Surgery*, **196**, e56-e59. <https://doi.org/10.1016/j.amjsurg.2008.04.008>
- [2] Saúde, B.M.D. (2016) Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília Ministério da Saúde. https://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2016_fatores_risco.pdf
- [3] MacLean, L.D., Rhode, B.M. and Nohr, C.W. (2000) Late Outcome of Isolated Gastric Bypass. *Annals of Surgery*, **231**, 524-528. <https://doi.org/10.1097/0000658-200004000-00011>
- [4] Hickey, M.S., Arbeit, J.M. and Way, L.W. (1994) Surgical Metabolism and Nutrition. Current Surgical Diagnosis and Treatment. 10th Edition, Appleton and Lange, Norwalk, Connecticut, 143-173.
- [5] Buchwald, H. and Oien, D.M. (2009) Metabolic/Bariatric Surgery Worldwide 2008. *Obesity Surgery*, **19**, 1605-1611. <https://doi.org/10.1007/s11695-009-0014-5>
- [6] Fuks, D., Verhaeghe, P., Brehant, O., et al. (2009) Results of Laparoscopic Sleeve Gastrectomy: A Prospective Study in 135 Patients with Morbid Obesity. *Surgery*, **145**, 106-113. <https://doi.org/10.1016/j.surg.2008.07.013>
- [7] Nocca, D., Krawczykowsky, D., Bomans, B., et al. (2008) A Prospective Multicenter Study of 163 Sleeve Gastrectomies: Results at 1 and 2 Years. *Obesity Surgery*, **18**, 560-565. <https://doi.org/10.1007/s11695-007-9288-7>
- [8] Frezza, E.E., Reddy, S., Gee, L.L. and Wachtel, M.S. (2009) Complications after Sleeve Gastrectomy for Morbid Obesity. *Obesity Surgery*, **19**, 684-687. <https://doi.org/10.1007/s11695-008-9677-6>
- [9] El-Kadre, L., Tinoco, A.C., Tinoco, R.C., Aguiar, L. and Santos, T. (2013) Overcoming the Learning Curve of Laparoscopic Roux-en-Y Gastric Bypass: A 12-Year Experience. *Surgery for Obesity and Related Diseases*, **9**, 867-872. <https://doi.org/10.1016/j.soard.2013.01.020>
- [10] Shaheen, O., Siejka, J., Thatigotla, B. and Pham, D.T. (2017) A Systematic Review of Portomesenteric Vein Thrombosis after Sleeve Gastrectomy. *Surgery for Obesity and Related Diseases*, **13**, 1422-1431. <https://doi.org/10.1016/j.soard.2017.03.015>
- [11] Sternberg, A., Alfici, R., Bronek, S. and Kimmel, B. (1998) Laparoscopic Surgery and Splanchnic Vessels Thrombosis. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **8**, 65-68. <https://doi.org/10.1089/lap.1998.8.65>
- [12] Baixauli, J., Delaney, C.P., Senagore, A.J., Remzi, F.H. and Fazio, V.W. (2003) Portal Vein Thrombosis after Laparoscopic Sigmoid Colectomy for Diverticulitis: Report of a Case. *Diseases of the Colon & Rectum*, **46**, 550-553. <https://doi.org/10.1007/s10350-004-6599-9>
- [13] Pigeyre, M., Seguy, D., Arnalsteen, L., Pattou, F. and Romon, M. (2008) Laparoscopic Gastric Bypass Complicated by Portal Venous Thrombosis and Severe Neurological Complications. *Obesity Surgery*, **18**, 1203-1207. <https://doi.org/10.1007/s11695-008-9467-1>
- [14] Berthet, B., Bollon, E., Valero, R., Ouaiissi, M., Sielezneff, I. and Sastre, B. (2009) Portal Vein Thrombosis Due to Factor 2 Leiden in the Post-Operative Course of a Laparoscopic Sleeve Gastrectomy for Morbid Obesity. *Obesity Surgery*, **19**, 1464-1467. <https://doi.org/10.1007/s11695-009-9910-y>
- [15] Sternberg, A., Alfici, R., Bronek, S. and Kimmel, B. (1998) Laparoscopic Surgery and Splanchnic Vessel Thrombosis. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **8**, 65-68. <https://doi.org/10.1089/lap.1998.8.65>
- [16] Viinamki, O. and Punnonen, R. (1982) Vasopressin Release during Laparoscopy:

- Role of Increased Intra-Abdominal Pressure. *Lancet*, **1**, 175-176.
[https://doi.org/10.1016/S0140-6736\(82\)90430-5](https://doi.org/10.1016/S0140-6736(82)90430-5)
- [17] Haglund, U., Norlen, K.R.R., et al. (1995) Complications Related to Pneumoperitoneum. In: Bailey, R.W. and Flowers, J.L., Eds., *Complications of Laparoscopic Surgery*, Quality Medical Publishing, St. Louis, 45-48.
- [18] Rocha, A.T., de Vasconcellos, A.G., da Luz Neto, E.R., Araujo, D.M., Alves, E.S. and Lopes, A.A. (2006) Risk of Venous Thromboembolism and Efficacy of Thromboprophylaxis in Hospitalized Obese Medical Patients and in Obese Patients Undergoing Bariatric Surgery. *Obesity Surgery*, **16**, 1645-1655.
<https://doi.org/10.1381/096089206779319383>
- [19] Barba, C.A, Harrington, C. and Loewen, M. (2009) Status of Venous Thromboembolism Prophylaxis among Bariatric Surgeons: Have We Changed Our Practice during the Past Decade? *Surgery for Obesity and Related Diseases*, **5**, 352-356.
<https://doi.org/10.1016/j.soard.2008.10.016>
- [20] Becattini, C., Agnelli, G., Manina, G., Noya, G. and Rondelli, F. (2012) Venous Thromboembolism after Laparoscopic Bariatric Surgery for Morbid Obesity: Clinical Burden and Prevention. *Surgery for Obesity and Related Diseases*, **8**, 108-115.
<https://doi.org/10.1016/j.soard.2011.09.005>
- [21] Angrisani, L., Santonicola, A., Iovino, P., et al. (2018) IFSO Worldwide Survey 2016: Primary, Endoluminal, and Revisional Procedures. *Obesity Surgery*, **28**, 3783-3794.
<https://doi.org/10.1007/s11695-018-3450-2>
- [22] Kumar, S., Sarr, M.G. and Kamath, P.S. (2001) Mesenteric Venous Thrombosis. *The New England Journal of Medicine*, **345**, 1683-1688.
<https://doi.org/10.1056/NEJMra010076>
- [23] Goitein, D., Matter, I., Raziell, A., et al. (2013) Portomesenteric Thrombosis Following Laparoscopic Bariatric Surgery: Incidence, Patterns of Clinical Presentation, and Etiology in a Bariatric Patient Population. *JAMA Surgery*, **148**, 340-346.
<https://doi.org/10.1001/jamasurg.2013.1053>
- [24] Muneer, M., Abdelrahman, H., El-Menyar, A., et al. (2016) Portomesenteric Vein Thrombosis after Laparoscopic Sleeve Gastrectomy: 3 Case Reports and a Literature Review. *American Journal of Case Reports*, **17**, 241-247.
<https://doi.org/10.12659/AJCR.896892>
- [25] Tinoco, R.C., Tinoco, A., Sueth, D.M., Farfan, S.R., Conti, L.C.A. and Gottardi, L.F. (2017) Venous Thrombosis and Venous Thromboembolism in Bariatric Laparoscopic Surgery. *GED-Gastrenterologia Endoscopia Digestiva*, **36**, 7-10.
- [26] Hills, N.H., Pflug, J.J., Jeyasingh, K., Boardman, L. and Calnan, J.S. (1972) Prevention of Deep Vein Thrombosis by Intermittent Pneumatic Compression of Calf. *The British Medical Journal*, **1**, 131-135. <https://doi.org/10.1136/bmj.1.5793.131>
- [27] Mijares, M.E., Nagy, E., Guerrero, B. and Arocha-Pinango, C.L. (1998) [Vitamin K: Biochemistry, Function, and Deficiency. Review]. *Investigacion Clinica*, **39**, 213-229.
- [28] Tateishi, A., Mitsui, H. and Oki, T., et al. (2001) Extensive Mesenteric Vein and Portal Vein Thrombosis Successfully Treated by Thrombolysis and Anticoagulation. *Journal of Gastroenterology and Hepatology*, **16**, 1429-1433.
<https://doi.org/10.1046/j.1440-1746.2001.02557.x>