Vascular Specialist International
Vol. 34, No. 4, December 2018
pISSN 2288-7970 • eISSN 2288-7989

Original Article

Clinical Manifestations of Superior Mesenteric Venous Thrombosis in the Era of Computed Tomography

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Purpose: Thrombosis of the portal vein, known as pylephlebitis, is a rare and fatal complication caused by intraperitoneal infections. The disease progression of superior mesenteric venous thrombosis (SMVT) is not severe. This study aimed to determine the clinical features, etiology, and prognosis of SMVT.

Materials and Methods: We retrospectively reviewed the medical records of 41 patients with SMVT from March 2000 to February 2017. We obtained a list of 305 patients through the International Classification of Disease-9 code system and selected 41 patients with SMVT with computed tomography. Data from the medical records included patient demographics, comorbidities, review of system, laboratory results, clinical courses, and treatment modalities.

Results: The causes of SMVT were found to be intraperitoneal inflammation in 27 patients (65.9%), malignancy in 7 patients (17.1%), and unknown in 7 patients (17.1%). Among the patients with intraperitoneal inflammation, 14 presented with appendicitis (51.9%), 7 with diverticulitis (25.9%), and 2 with ileus (7.4%). When comparing patients with and without small bowel resection, the differences in symptom duration, bowel enhancement and blood culture were significant (P=0.010, P=0.039, and P=0.028, respectively).

Conclusion: SMVT, caused by intraperitoneal inflammation, unlike portal vein thrombosis including pylephlebitis, shows mild prognosis. In addition, rapid symptom progression and positive blood culture can be the prognostic factors related to extensive bowel resection. Use of appropriate antibiotics and understanding of disease progression can help improve the outcomes of patients with SMVT.

Key Words: Mesenteric ischemia, Vascular insufficiency mesenteric

Received May 28, 2018
Revised (1st) July 9, 2018
(2nd) August 14, 2018
Accepted September 11, 2018

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Conflict of interest: None.

Vasc Spec Int 2018;34(4):83-87 • https://doi.org/10.5758/vsi.2018.34.4.83

INTRODUCTION

Thrombosis of the portal vein, also known as pylephlebitis, is a rare and fatal complication caused by intraperitoneal infections associated with several symptoms, such as fever, abdominal pain, hepatic dysfunction, and bacteremia [1]. Its mortality rate was reportedly 10% to 32%. It was universally fatal before the availability of antibiotics [2].

Reported incidence of portomesenteric venous thrombosis, a type of pylephlebitis, is 2.7 per 100,000 person-years [3,4]. However, only case reports and empirical managements were available on these incidences, with no large-scale studies conducted regarding its management.

Unlike pylephlebitis with portomesenteric venous thrombosis, disease progression may not be severe in superior mesenteric venous thrombosis (SMVT). Mesenteric venous thrombosis (MVT) reportedly consisted 5% to 15% of mesenteric ischemia [5]. Recent improvements in imaging technique and generalization of computed tomography (CT) increased the discovery of SMVT with mild symptoms. Understanding the etiology of SMVT has also been improved. The appropriate usage of antibiotics and anticoagulants allows physicians to provide better outcomes [6].

However, systematic review or advancement from the research regarding the disease has been limited in the literature. This study aimed to determine the clinical features, etiology, and prognosis of SMVT, which can be distinguished from those of the other forms of pylephlebitis.

MATERIALS AND METHODS

The study protocol was approved by the Institutional Review Board of Inje University Ilsan Paik Hospital (IRB no. 2018-03-021). This study was a retrospective study that did not cause any harm to the study subjects; therefore, the requirement of informed consent was waived by the board. We retrospectively reviewed the medical records of 41 patients with SMVT at a single center, from March 2000 to February 2017. As the exact code for SMVT is not yet available in the International Classification of Disease-9 code system, we established a list of 305 patients with suspected SMVT using five codes (K55.0, K55.1, I82.2, I82.8, and I82.9). Next, a reviewer (HJ) assessed the abdominal CT images and selected 41 patients with SMVT.

SMVT that extended to less than the distal one third of the portal vein and to the inferior mesenteric and splenic veins was included. Portal vein thrombosis in hepatic carcinoma and liver cirrhosis was excluded. Other studies have mainly investigated the MVT; however, MVT was defined as thrombosis of the SMV or its branch. Finally, MVT was used in the same way as SMVT [7].

Data from the medical records included patient demographics, comorbidities, reviews of system, CT findings, laboratory results, clinical courses, and treatment modalities. CT findings demonstrated decreased bowel enhancement and bowel swelling, which were observed on the portal vein, splenic extension, and inferior MVT in SMVT. Laboratory tests included white blood cell count, C-reactive protein, and blood culture. Treatment modalities included small bowel resection (SBR), vascular intervention and anticoagulation.

Results were reported as mean±standard deviation or numbers (percentages). All statistical analyses were performed with SPSS Statistics ver. 17.0 software (SPSS Inc., Chicago, IL, USA) using the Fisher's exact test for categorical variables and the Mann-Whitney U-test for continuous variables. The P-value of <0.05 was considered statistically significant.

RESULTS

In 41 patients with isolated SMVT, the mean age was 62.11±12.14 years, and 31 patients (75.6%) of them were men. The causes of SMVT were found to be intraperitoneal inflammation in 27 patients (65.9%), malignancy in 7 patients (17.1%), and unknown in 7 patients (17.1%). In 27 patients with intraperitoneal inflammation, 14 had appendicitis (51.9%), 7 had diverticulitis (25.9%), 2 had ileus (7.4%), 1 had pancreatitis (3.7%), and 1 had pyelonephritis (3.7%). In the seven patients with malignancy, three presented with

Table 1. Baseline and clinical characteristics of the patients with SMV thrombosis

Characteristic	Patients (n=41)
Male	31 (75.6)
Age (y)	62.11±12.14
Hypertension	8 (19.5)
Diabetes	7 (17.0)
Liver cirrhosis	3 (7.3)
Stroke	3 (7.3)
Smoking history	17 (41.5)
Cause of SMV thrombosis	
Intraperitoneal inflammation	27 (65.9)
Malignancy	7 (17.1)
Unknown	7 (17.1)
Abdominal pain	33 (80.5)
Fever	13 (31.7)
Symptom duration (d)	12.34±11.23
Computed tomography findings	
Decreased bowel enhance	6 (14.6)
Bowel swelling	21 (51.2)
Portal vein extension	16 (39.0)
Splenic vein extension	10 (24.4)
IMV thrombosis	2 (4.9)
White blood cell ($\times 10^3/\mu L$)	9.63±3.56
C-reactive protein (mg/dL)	8.98±6.12

Values are presented as number (%) or mean±standard deviation.
SMV, superior mesenteric vein; IMV, inferior mesenteric vein.

stomach cancer, three with colon cancer, and one with hepatocellular carcinoma, which were all in advanced states.

Regarding the clinical manifestations, 33 presented with abdominal pain (80.5%) and 13 with fever (31.7%). The symptom duration was 12.34±11.23 days. Based on CT findings of SMVT, 6 showed decreased bowel enhancement (14.6%), 21 showed bowel swelling (51.2%), 16 showed portal vein extension of SMVT (39.0%), 10 showed splenic vein extension (24.4%), and 2 showed concomitant inferior MVT (4.9%) (Table 1).

Sixteen patients showed positive blood culture (39.0%), with *Escherichia coli* and *Streptococcus pyogen*. The duration of antibiotic use was 10.23±4.65 days. Anticoagulation modalities including warfarin, low-molecular-weight heparin, and new oral anticoagulants were postoperatively administered in 33 patients (80.5%). Surgical thrombectomy or interventional thrombolysis was considered in the case of whole small bowel swelling and necrosis, but no case had been found. Two patient (4.9%) died during the hospitalization. One patient expired from sepsis due to bowel necrosis and the other patient expired from septic pancreatitis.

In four patients (9.8%), small bowel segmental resection was performed for suspected wide bowel necrosis and peritonitis in physical examination or CT finding. When comparing patients with and without SBR, the differences in short symptom duration, decreased bowel enhancement and positive blood culture were significant (P=0.010, P=0.039, and P=0.028, respectively) (Table 2).

DISCUSSION

1) Considerations on pylephlebitis

Pylephlebitis was first described by Waller in 1846, when he treated a patient with liver abscess [8]. Pylephlebitis starts with thrombophlebitis in the portal and mesenteric veins caused by an uncontrolled infection in the portal system or intra-abdominal infection, and leads to hematogenous dissemination of sepsis [9,10]. Subsequently, thrombosis of the mesenteric veins can lead to mesenteric ischemia. Pylephlebitis was defined as the presence of portal mesenteric venous thrombosis with or without bacteremia within 30 days of intra-abdominal inflammatory processes [9]. Pylephlebitis shows thrombus extension, and in 42% of patients it extended to the superior mesenteric vein and 12% to the splenic vein [10].

The most common causes of portal pylephlebitis are diverticulitis, acute appendicitis, inflammatory bowel disease, pancreatitis, and gastroenteritis [9]. However, according to Waxman et al. [11], the primary cause was not clearly identified in 70% of the cases. Pylephlebitis is usually diagnosed with an abdominal infection and portal vein thrombosis on abdominal CT, showing poor prognosis, with 11% to 32% mortality [1,2].

2) Considerations on MVT

MVT was first reported by Elliot [12] in 1895 when he operated on intestinal infarction case. MVT accounts for 5% to 15% of all mesenteric ischemic events [5] and is usually caused by inflammatory bowel disease, intra-abdominal infection, or abdominal trauma [13]. In particular abdominal surgery can cause endothelial injury in the vessel and intra-abdominal inflammation, which can lead to MVT. In patients with malignancy, 4% to16% shows MVT [7]. Intestinal infarction caused by venous obstruction impairs the arterial flow, which leads to extensive bowel necrosis, thus resulting in poor prognosis [14]. With these reasons, acute

Table 2. The comparison of risk factors between with and without SBR in SMV thrombosis (n=41)

Characteristic	With SBR (n=4)	Without SBR (n=37)	P-value
Male	4 (100.0)	27 (73.0)	0.564
Age (y)	70.00±2.82	58.94±12.15	0.235
Symptom duration (d)	1.70±0.74	12.98±13.27	0.010
Decreased bowel enhance	2 (50.0)	4 (10.8)	0.039
Bowel swelling	2 (50.0)	19 (51.4)	0.843
Portal vein extension	2 (50.0)	14 (37.8)	0.853
Splenic vein extension	2 (50.0)	8 (21.6)	0.532
IMV thrombosis	0 (0.0)	2 (5.4)	0.673
White blood cell ($\times10^3/\mu L$)	13.57±0.98	9.13±3.15	0.093
C-reactive protein (mg/dL)	6.54±0.85	9.01±7.45	0.478
Positive blood culture	4 (100.0)	12 (32.4)	0.028

Values are presented as number (%) or mean±standard deviation.
SBR, small bowel resection; SMV, superior mesenteric vein.

https://doi.org/10.5758/vsi.2018.34.4.83

MVT shows an average 30-day mortality of up to 32.1% in severe cases. With prompt diagnosis and proper treatment, mortality had been shown to decline to <10% [15].

Unlike the previously mentioned reports, many cases of SMVT have been reported with less severe progression. In Ilsan Paik Hospital, bowel resection was performed in 7.4% of cases, and 3.7% after operation. Recently in Korea, CT scan has been widely used, which enabled diagnosis of SMVT in asymptomatic or less severe cases, and thus improving its prognosis with early medical treatment including anticoagulation and antibiotics.

3) Considerations on prognostic factors

Positive blood cultures are found in 50% to 88% of patients with pylephlebitis [1]. From the blood culture, bacteria, such as *Bacteroides fragilis* and *E. coli* are known to be well isolated [10]. However, reports on pylephlebitis or prognostic factors of MVT are extremely limited. Only case reports are occasionally reported [7]. In this report, extensive SBR has been performed in patients with positive blood cultures. The use of appropriate antibiotics is important in the view of the uncontrolled intraperitoneal infection promoting SMVT. Mortality research could not be conducted due to the small number of patients.

The use of anticoagulation for SMVT is controversial, and no randomized controlled trial was available to investigate its efficacy [16]. However, Kanellopoulou et al. [10] reported that in MVT, anticoagulation is effective in patients with hypercoagulability or *Bacteroides* pathogens. Condat et al. [17] reported that symptom duration related to recanalization was an important prognostic factor of MVT in the portal vein thrombosis, and recommended early anticoagulation. Results in our center also revealed that short symptom duration was related to severe clinical manifestations and can encourage extensive SBR. Anticoagulation was performed when possible. Although the number of patients was small and did not lead to statistical significance, the patients with older, high WBC count, positive blood culture should be observed more carefully and the operation should be decided in advance.

In conclusion, due to the recent generalization of CT, SMVT has been increasingly discovered. SMVT, caused by intraperitoneal inflammation, unlike portal vein thrombosis including pylephlebitis, shows many cases with mild prognosis. In addition, rapid symptom progression and positive blood culture can be the prognostic factors related to extensive bowel resection. Therefore, the use of appropriate antibiotics and understanding of disease progression can help improve the outcomes in patients with SMVT.

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https://doi.org/10.5758/vsi.2018.34.4.83