

Septic Thrombophlebitis of the Portal Venous System: Clinical and Imaging Findings in Thirty-Three Patients

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Abstract

Aim Our purpose was to review the clinical and imaging findings in a series of patients with septic thrombophlebitis of the portal venous system in order to define criteria that might allow more confident and timely diagnosis.

Materials and Methods This is a retrospective case series. The clinical and imaging features were analyzed in 33 subjects with septic thrombophlebitis of the portal venous system.

Results All 33 patients with septic thrombophlebitis of the portal venous system had pre-disposing infectious or inflammatory processes. Contrast-enhanced CT studies of patients with septic thrombophlebitis typically demonstrate an infectious gastrointestinal source (82%), thrombosis (70%), and/or gas (21%) of the portal system or its branches, and intrahepatic abnormalities such as a transient hepatic attenuation difference (THAD) (42%) or abscess (61%).

Conclusions Septic thrombophlebitis of the portal system is often associated with an infectious source in the gastrointestinal tract and sepsis. Contrast-enhanced CT demonstrates an infectious gastrointestinal source, thrombosis or gas within the portal system or its branches, and intrahepatic abnormalities such as abscess in most cases. We report a THAD in several of our patients, an observation that was not made in prior reports of septic thrombophlebitis.

Keywords Septic thrombophlebitis · Portal vein thrombosis · Portal venous gas · Diverticulitis · Transient hepatic attenuation difference

Introduction

Septic thrombophlebitis of the portal venous system is an uncommon infection that often originates from a gastrointestinal source [1–3]. Typical causes include colonic diverticulitis, appendicitis, and inflammatory bowel disease. The inflammatory process is thought to extend into the mesenteric veins and precipitate septic clot, which embolizes centrally and causes thrombosis [2]. The clinical presentation can be confusing. Patients are usually septic with non-specific abdominal pain and contrast-enhanced CT (computed tomography) is helpful in making the diagnosis. The typical CT findings include a source of infection (such as diverticulitis) and thrombi and/or gas in the portal venous system [2–4]. Early intrahepatic findings include low-density regions on the portal venous phase due to decreased hepatic blood flow [2, 3]. Later, hepatic abscesses often form, which appear as heterogeneous low attenuation lesions [2, 3]. Treatment consists of immediate broad-spectrum antibiotic therapy and anticoagulation; abscesses may require drainage and elective surgery is often performed for the infectious source [5]. Although the death rate associated with septic thrombophlebitis can be as high as 20% [6], early recognition may reduce the morbidity and mortality.

Prior reports of the role of imaging in the diagnosis of portal septic thrombophlebitis are limited to isolated case reports and small case series [1–3]. The purpose of this investigation was to review a larger series of patients with

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septic thrombophlebitis of the portal venous system in an attempt to derive imaging and clinical findings that might provide a more timely and confident diagnosis.

Materials and Methods

Patient Selection Criteria

This is a retrospective case series performed with the approval of our Institutional Review Board. Patients seen from Jan 1, 2000 to Jan 1, 2009 with a diagnosis of septic thrombophlebitis were identified by means of a computer-based search of radiology records using the key

phrases “septic thrombophlebitis,” “portal vein thrombosis,” “intrahepatic gas,” and “hepatic abscess.” The database search identified 136 patients and all available scans and reports were reviewed; the 33 patients with imaging evidence of septic thrombophlebitis were included in the study. Ten cases of diverticulitis and hepatic abscess without an imaging abnormality of the portal venous system were considered to be due to septic emboli because no other source of hepatic infection was identified and were included in the study. All 33 patients had undergone contrast-enhanced abdominal CT examination at a tertiary care center and had imaging available on a picture archiving and communication system (iSite Radiology, Philips, Amsterdam, the Netherlands).

Table 1 Clinical and CT findings in 33 patients with septic thrombophlebitis

Patient no.	Infectious source	Portal venous system clot	Portal venous system gas	Hepatic abscess	THAD
1	Diverticulitis	Y	Y	N	NA
2	Diverticulitis	Y	N	N	Y
3	Diverticulitis	Y	Y	N	NA
4	Diverticulitis	Y	N	Y	NA
5	Inflammatory bowel disease	Y	N	N	NA
6	Diverticulitis	Y	N	N	Y
7	Abdominal abscess	Y	N	Y	Y
8	Appendicitis	Y	N	N	N
9	Diverticulitis	Y	Y	N	Y
10	Abdominal abscess	Y	Y	N	NA
11	Necrotizing pancreatitis	Y	Y	Y	Y
12	Diverticulitis	Y	N	Y	N
13	Retained pancreatic stent	Y	N	Y	Y
14	Cholangitis	Y	N	Y	Y
15	Diverticulitis	Y	N	Y	Y
16	Diverticulitis	Y	Y	N	N
17	Diverticulitis	N	N	Y	Y
18	Diverticulitis	N	N	Y	N
19	Diverticulitis	N	N	Y	N
20	Diverticulitis	N	N	Y	NA
21	Abdominal abscess	Y	N	N	N
22	Diverticulitis	N	N	Y	NA
23	Diverticulitis	N	N	Y	Y
24	Abdominal abscess	Y	N	N	Y
25	Diverticulitis	Y	Y	N	NA
26	Diverticulitis	Y	N	Y	Y
27	Diverticulitis	N	N	Y	NA
28	Diverticulitis	Y	N	Y	NA
29	Diverticulitis	Y	N	Y	NA
30	Diverticulitis	N	N	Y	Y
31	Appendicitis	Y	N	N	NA
32	Diverticulitis	N	N	Y	NA
33	Diverticulitis	N	N	Y	Y

NA not applicable due to portal venous phase only imaging that prevented evaluation for a THAD

Imaging Protocols

CT evaluation was performed on a variety of helical CT scanners with 4–64 detector rows (General Electric Medical Systems, Waukesha, WI). Contiguous 5-mm-thick axial sections were displayed from the diaphragm to the symphysis pubis. All patients had intravenous bolus injection of contrast medium (ioversol, Optiray 350, Mallinckrodt Medical, St. Louis, MO), with a volume of approximately 125 ml and a rate of 3 ml/s. Multiphase scans were performed with unenhanced, hepatic arterial dominant phase, and portal venous dominant phase images. Arterial and portal venous phases of intravenous contrast were timed using bolus tracking software (SmartPrep software, GE Medical Systems). Oral contrast medium was given in all but one case (3% diatrizoate meglumine saline solution, Gastrografin, Bristol-Myers Squibb, Wallingford, CT).

Image Analysis

Images were analyzed by an expert in abdominal imaging with over 30 years of experience. Portal vein thrombosis was defined as a non-enhancing filling defect in the lumen of the vein [7]. A THAD (transient hepatic attenuation difference) was defined as an attenuation difference in the liver of lobar or segmental distribution [8].

The clinical notes were reviewed to assess for a diagnosis of shock, acidosis, and hypercoagulable state. Bacteremia was defined as the detection of bacteria in a blood culture.

Results

Key clinical and imaging findings are summarized in Table 1. All 33 patients with septic thrombophlebitis of the portal venous system had pre-disposing infectious or inflammatory processes. Twenty-three had colonic diverticulitis, four had recent abdominal surgery resulting in abscesses, and two had appendicitis. There was one patient each with necrotizing pancreatitis, inflammatory bowel disease, a retained pancreatic stent, and a choledochal cyst with cholangitis. No patients had shock or acidosis. Blood cultures were performed in all but three patients. Sixteen were eventually diagnosed with sepsis or bacteremia on the basis of blood cultures. In addition, three patients had an underlying hypercoagulable state; one patient each had a lupus anticoagulant, protein C deficiency, and a prior deep venous thrombosis. All but one patient survived the acute episode of septic thrombophlebitis.

The ages of the patients with septic thrombophlebitis ranged from 30 to 78 years with a mean age of 58. Twenty were male and 13 were female. All patients were evaluated with intravenous contrast-enhanced CT. Nineteen patients were

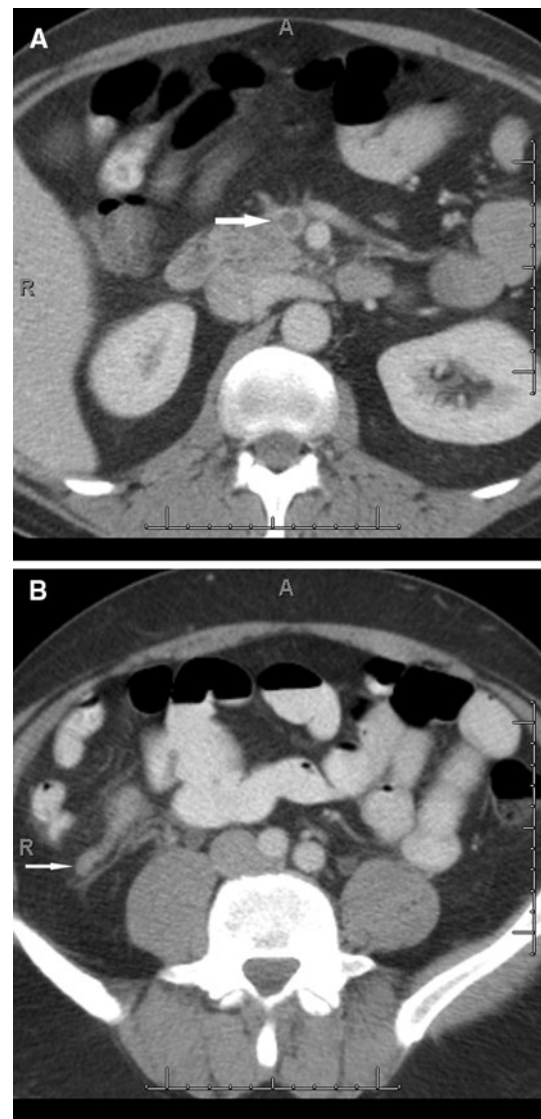


Fig. 1 **a** 48-year-old man with appendicitis, septic thrombophlebitis, and hepatic abscesses. There is thrombus in the superior mesenteric vein (*arrow*) on portal venous phase CT. **b** 48-year-old man with appendicitis, septic thrombophlebitis, and hepatic abscesses. The appendix is enlarged and has adjacent inflammation (*arrow*) on portal venous phase CT

evaluated with portal venous phase contrast-enhanced imaging and 14 underwent multiphase contrast-enhanced imaging.

Imaging findings in the patients with septic thrombophlebitis included the primary source of infection, thrombosis and/or gas within the portal venous system, and intrahepatic abnormalities. Twenty-seven of 33 patients (82%) with septic thrombophlebitis had imaging evidence of a gastrointestinal source of infection such as appendiceal and periappendiceal inflammation or colonic diverticulosis with pericolonic inflammation. Twenty-three patients (70%) had clot in the portal venous system (Fig. 1). In seven patients (21%), gas was present in the portal or mesenteric veins (Figs. 2, 3). Twenty patients (61%) developed hepatic

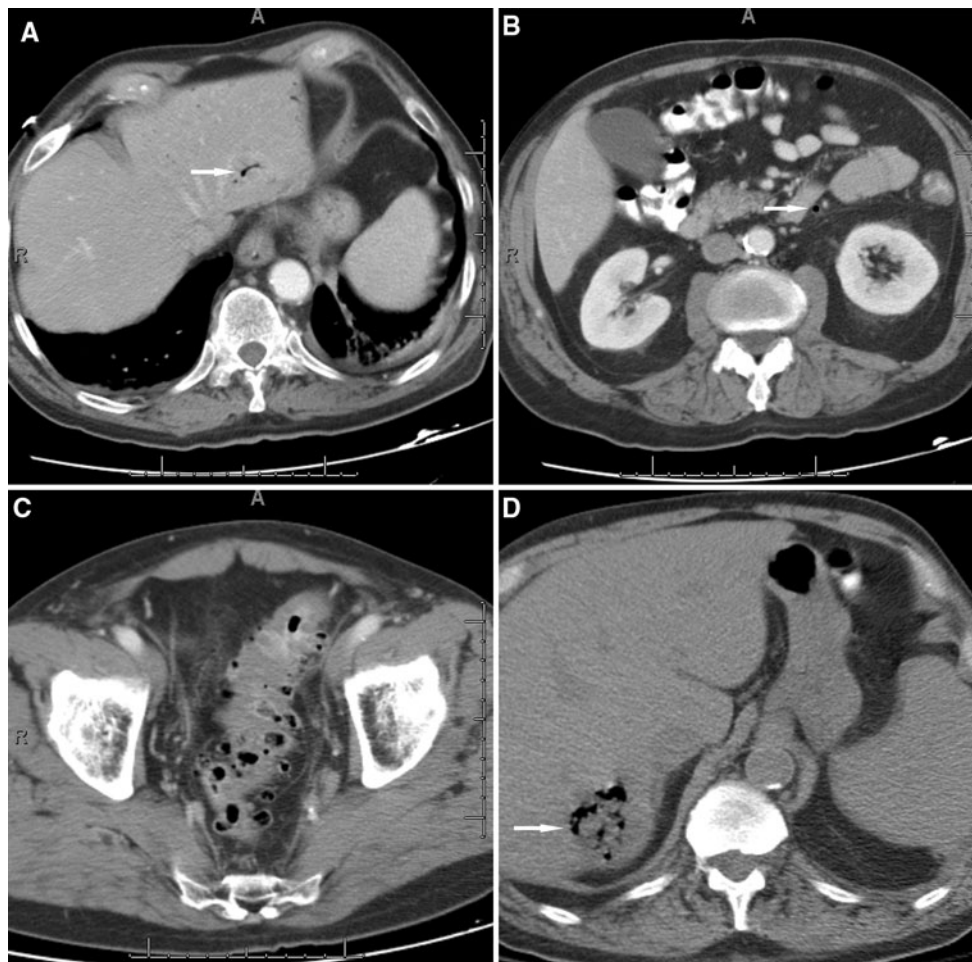


Fig. 2 **a** 75-year-old man with diverticulitis and septic thrombophlebitis. Gas is present in the portal venous system on CT (*arrow*). **b** 75-year-old man with diverticulitis and septic thrombophlebitis. CT shows gas in the inferior mesenteric vein (*arrow*). **c** 75-year-old man

with diverticulitis and septic thrombophlebitis. Sigmoid diverticulitis is present on CT, with relatively mild pericolonic inflammatory changes. **d** 75-year-old man with diverticulitis and septic thrombophlebitis. A liver abscess (*arrow*) developed several days later

abscesses (Figs. 2, 4); two patients developed hepatic abscess after the diagnosis of septic thrombophlebitis.

Fourteen patients (42%) displayed a transient hepatic attenuation difference (THAD), an observation that was not made in prior reports of septic thrombophlebitis. This number may be an underestimate because only 14 of the 33 patients underwent multiphase imaging (Fig. 5). The majority of patients (57%) who had multiphase CT displayed a THAD. Six patients with single phase imaging displayed a THAD because images were obtained in a late arterial/early portal venous phase. Nine patients had both a THAD and a hepatic abscess at the time of diagnosis.

Discussion

Septic thrombophlebitis of the portal vein and its tributaries is an uncommon infection that can be caused by inflammatory

processes including colonic diverticulitis, appendicitis, and inflammatory bowel disease [2, 3]. The inflammatory process is thought to extend into the mesenteric veins and form septic clot, which embolizes centrally to cause thrombosis of the main and intrahepatic portal veins. The clinical presentation can be confusing and CT can be helpful in making the diagnosis and identifying the infectious source.

We have identified or confirmed several clinical and imaging findings of septic thrombophlebitis of the portal vein and its tributaries. Septic thrombophlebitis of the portal system is often associated with an infectious source in the gastrointestinal tract and sepsis. Contrast-enhanced CT studies of patients with septic thrombophlebitis typically demonstrate an infectious gastrointestinal source, thrombosis and/or gas of the portal system or its branches, and intrahepatic abnormalities such as a THAD or abscess.

Our findings add to prior reports of the imaging appearance of septic thrombophlebitis of the portal vein



Fig. 3 67-year-old man with sigmoid diverticulitis, septic thrombophlebitis, and extensive portal venous gas on portal venous phase CT. There was no clinical or imaging evidence of bowel ischemia



Fig. 4 30-year-old man with retained pancreatic stent. CT shows extensive left portal vein thrombus (*black arrow*) and hepatic abscesses (*white arrow*)

and its tributaries [2–6, 9]. Balthazar et al. [2] and Lim et al. [9] described contrast-enhanced CT findings of portal system septic thrombophlebitis including an infectious gastrointestinal source, thrombosis of the portal system or



Fig. 5 36-year-old woman with choledochal cyst, cholangitis, and septic thrombophlebitis. CT shows intrahepatic abscess and THAD (*arrow*). Note the straight line demarcation with increased attenuation throughout the posterior hepatic segments due to occlusion of the posterior segment of the right portal vein. Biliary ductal dilatation is present

its branches, and intrahepatic abscess. Ours is the first case series to report the observation of a transient hepatic attenuation difference (THAD) in several of our patients with septic thrombophlebitis. We attribute the difference between our experience and these prior reports to the absence of an arterial phase of contrast enhancement in these prior investigations. In this setting, a THAD reflects increased arterial and decreased portal venous blood supply to a segment of the liver due to portal vein branch occlusion and/or parenchymal hyperemia due to hepatic infection. Other causes of THAD include hypervascular masses or inflammatory process, portal venous compression, and arteriovenous shunts [8].

Septic thrombophlebitis of the portal venous system has been ascribed a mortality rate of 20% [6]. Balthazar reported that 10% of their patients with septic thrombophlebitis died, which is closer to the 3% mortality rate we observed [2]. Lim et al. [9] reported no deaths in their series of seven patients with septic thrombophlebitis. The lower mortality rate in our series may reflect improvements in treatment.

Seven (21%) of our patients had CT evidence of portal venous gas. The differential of portal venous gas is broad and includes bowel ischemia [10]. The presence of portal venous gas in the setting of septic thrombophlebitis is likely to be interpreted as evidence of bowel ischemia. However, distinction of the two entities is important

because their treatments are so different. Absence of other clinical (e.g., acidosis) and CT features (e.g., bowel wall pneumatosis) are important clues. Our other observations (e.g., presence of diverticulitis, THAD, and hepatic abscess) also help to distinguish septic thrombophlebitis from bowel ischemia.

In the setting of septic thrombophlebitis of the portal venous system, we believe it is important to treat not only the hepatic inflammatory process but also the underlying disorder. However, many of the patients with hepatic inflammation or abscess would have had the gastrointestinal source of infection overlooked without careful attention to CT interpretation. Therefore, a deliberate search for a gastrointestinal source of infection is critical.

The different types of portal system thrombosis can be difficult to distinguish. However, distinction is important because their clinical significance is quite different. Distinction of benign portal venous thrombus (such as septic thrombophlebitis) from malignant thrombus due to hepatocellular carcinoma has been addressed by prior investigators [11]. The presence of tumor adjacent to the portal venous thrombus, mean diameter of the main portal vein greater than 23 mm, and neovascularity of the clot are all associated with malignant portal vein thrombus.

We believe that septic thrombophlebitis may be identified and distinguished from cirrhosis with portal vein thrombosis through pertinent clinical history and characteristic imaging findings. Patients with cirrhosis and portal vein thrombosis are less likely to exhibit signs of sepsis. Cirrhotic livers also have a characteristic morphology on CT and MRI; hepatic fissures are widened and the caudate lobe is enlarged [12]. Finally, patients with cirrhosis often have stigmata of portal hypertension including splenomegaly, ascites, and varices.

Limitations of this study include a retrospective design, reliance on search terms to identify patients, and an absence of pathologic proof of septic thrombophlebitis.

In summary, septic thrombophlebitis is an uncommon but important cause of acute disease, and is unlikely to be

diagnosed by clinical findings alone. CT will demonstrate the infectious etiology in the great majority of cases, along with portal venous system thrombosis or gas and intrahepatic abnormalities such as THAD or abscess. The presence of diverticulitis, THAD, and hepatic abscess helps to distinguish septic thrombophlebitis from bowel ischemia in the setting of portal venous gas.

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