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**Splanchnic vein thrombosis in necrotizing acute pancreatitis: Detection with computed tomographic venography**

Jiang W *et al*. Detecting SVT in necrotizing AP

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**Abstract**

**AIM:** To assess the computed tomographic venography (CTV) diagnostic accuracy for splanchnic vein thrombosis (SVT) detection in necrotizing acute pancreatitis (AP) patients.

**METHODS:** Forty-three patients with necrotizing AP who underwent both CTV and digital subtraction angiography (DSA) within 3 d were analyzed in this retrospective comparative study. All CTVs were performed on a dual-source CT. The SVT presence and location were determined via blinded imaging data analyses.

**RESULTS:** According to the DSA results, 17 (39.5%) of the total 43 patients had SVTs. The CTV sensitivity, specificity, positive and negative predictive values for SVT detection were 100% [95% confidence interval (CI): 77.1%-100%], 92.3% (95%CI: 73.4%-98.7%), 89.5% (95%CI: 65.5%-98.2%) and 100% (95%CI: 82.8%-100%), respectively.

**CONCLUSION:** CTV is an effective examination for SVT detection in patients with necrotizing AP with high positive and negative predictive values.

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**Key words:** Splanchnic vein; Thrombosis; Necrotizing acute pancreatitis; Computed tomography venography; Digital subtraction angiography

**Core tip:** Computed tomographic venography (CTV) is an effective examination for splanchnic vein thrombosis (SVT) detection in necrotizing acute pancreatitis (AP) with high positive and negative predictive values. As a non-invasive and quick procedure, CTV might effectively replace digital subtraction angiography and be the routine imaging method for screening and assessing SVT in necrotizing AP patients.

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**INTRODUCTION**

As a well-recognized acute pancreatitis (AP) complication, splanchnic vein thrombosis (SVT) may lead to clinical consequences, such as hemorrhage due to local portal hypertension and the formation of gastric varices, small bowel ischemia due to superior mesenteric vein (SMV) occlusion, and hepatic failure due to portal vein (PV) occlusion[[1-3](#_ENREF_1)]. In previous studies, the SVT incidence varied from 1% to 24% depending on the severity of study population and the detecting technique that was utilized[[1](#_ENREF_1)]. SVT is more often associated with necrotizing acute pancreatitis and a recent study showed that SVT was associated with the presence, location, and extent of pancreatic necrosis[[4](#_ENREF_4)].

With the development of computed tomography (CT) techniques as non-invasive and quick examinations, computed tomographic venography (CTV) has become a routine procedure for assessing the abdominal vascular system, such as collateral vessels[[5](#_ENREF_5),[6](#_ENREF_6)]. Few studies, however, have evaluated the effectiveness of this technique for SVT detection in necrotizing AP patients. In our study, we aimed to assess the CTV diagnostic accuracy for SVT detection in necrotizing AP as compared with digital subtraction angiography (DSA).

**MATERIALS AND METHODS**

We reviewed data from patients diagnosed with necrotizing AP in our center from July 1, 2011 to June 30, 2013. Those underwent both CTV and DSA within 3 d were included in this study. AP was diagnosed according to clinical presentation (typically abdominal pain), laboratory parameters (serum amylase or lipase levels that exceeded three times the normal upper limit) and abdominal imaging by contrast-enhanced CT (CECT). The severity and pancreatic or peripancreatic necrosis were defined according to the Determinant-Based Classification of Acute Pancreatitis Severity[[7](#_ENREF_7)]. Patients with chronic pancreatitis, malignancy and cirrhosis were excluded. The study center was a tertiary referral pancreatic critical center at Jinling Hospital, Nanjing, and the local research ethics committee approved the study.

***Imaging protocols***

All CTVs were performed with a dual-source CT scanner (Somatom Definition, Siemens Medical Solutions). A non-contrast CT scan of the entire abdomen was initially performed. Then, 70 mL of iopromide (Ultravist; 300 mg I/mL, Bayer Schering Pharma, Berlin, Germany) was injected with a power injector at rate of 3 mL/s *via* an 18 gauge catheter that was typically positioned in the antecubital vein. Arterial and portal venous phase images were acquired at a 25 s and 60 s delay from the start of the intravenous contrast injection, respectively. Axial images were reconstructed with a slice thickness of 1.25 mm at an interval of 0.625 mm and were stored for analysis.

Patients underwent DSA for a continuous regional arterial infusion, for hemorrhage spot detection or when there was a significant clinical SVT manifestation such as an ascites. DSA was performed using Seldinger technique through femoral artery with biplane digital subtraction angiography unit (Axiom Artis dTA; Siemens Healthcare). After selective catheterization of the splenic, superior mesenteric and inferior mesenteric arteries, 25-40 mL of iopromide (Ultravist; 300 mg I/mL, Bayer Schering Pharma) was injected with a power injector at rate of 5-10 mL/s *via* a 5 F catheter. The views were acquired during the hepatic arterial and portal venous phases for analysis.

***Image analysis***

All image resources were stored on a commercial workstation (Syngo VE32E, Siemens Medical Solutions). Two experienced gastrointestinal radiologists who were blinded to the clinical and DSA data, reviewed all of the CT data separately. An experienced interventional radiologist and an experienced endovascular gastrointestinal surgeon who were blinded to the clinical and CT data, reviewed all of the DSA data separately. The presence and location of the SVTs were assessed, and any diagnostic differences between the two doctors were resolved by a discussion after which a consensus on the results was reached.

***Statistical analyses***

**The data analyses were performed using SPSS 20.0 (IBM SPSS Statistics; IBM Corporation). In our study, with DSA as the comparison, the CTV sensitivity, specificity, positive predictive value, and negative predictive values were determined, and 95% confidence interval (CI) were calculated according to the efficient-score model. A kappa value was used to quantify the inter-reader agreement for detecting the presence of SVTs with CTV and DSA. A *P* value of < 0.05 was regarded as statistically significant (2-tailed test).**

**RESULTS**

Between July 1, 2011 and June 30, 2013, of all of the 358 patients with clinical, laboratory, or radiographic AP evidence, 43 patients with pancreatic or peripancreatic necrosis underwent CTV and DSA within 3 d. Their mean ± SD age was 44.6 ± 13.3, and 30 (69.8%) of them were male. Twenty-seven (62.8%) patients had critical acute pancreatitis, 5 (11.6%) had severe acute pancreatitis, and 11 (25.6%) had moderate acute pancreatitis.

According to the DSA results, 17 (39.5%) of the 43 total patients had SVTs (the SVT locations and numbers are presented in Table 1), while according to the CTV results, 19 (44.2%) patients had an SVT. CTV identified all of the DSA-positive cases, but it also resulted in 2 false-positive diagnoses. One was diagnosed as a multiple filling defect, and the other was not clearly displayed with the CTV. Thus, the CTV positive predictive and negative predictive values for SVT detection were 89.5% (95%CI: 65.5%-98.2%), and 100% (95%CI: 82.8%-100%), respectively (Table 2). The **kappa value was 0.91, which indicated an** excellent inter-reader agreement.

**DISCUSSION**

In our study, we observed that SVT has a high incidence in patients with necrotizing AP, and CTV has high positive and negative predictive values for detecting SVTs. That finding suggests that CTV could serve as an alternative examination for screening and assessing SVT in this entity.

The SVT incidence for all AP patients is relatively low, and the complications directly related to SVT is rare[[4](#_ENREF_4),[8](#_ENREF_8)]. However, perivascular inflammation and compression by peripancreatic collections or pancreatic necrosis increases the SVT frequency[[1](#_ENREF_1),[2](#_ENREF_2)]. A retrospective study recently showed that 53% of patients with necrosis developed SVT[[4](#_ENREF_4)]. Our study suggested that approximately 4 out of 10 patients with necrotizing AP have SVT.

It has been reported that SVT can lead to hemorrhage, bowel ischemia, and liver failure, but the signs and symptoms may overlap with those of pancreatitis[[2](#_ENREF_2),[9](#_ENREF_9)]. Additionally, collaterals and varices caused by SVT increase the risk of hemorrhage during minimally invasive approaches[[3](#_ENREF_3)]. Thus, it is important to establish a protocol for screening SVT in patients with necrotizing AP.

DSA is an invasive and time-consuming examination that usually is performed only when the thrombosis causes clinical conditions or is significantly suspected. In contrast, CTV is a non-invasive and quick procedure that can be easily added after performing CECT[[10](#_ENREF_10),[11](#_ENREF_11)]. Additionally, CTV also reveals extravascular abnormalities, mesenteric edema, and the relationship between peripancreatic necrosis and blood vessels[[1](#_ENREF_1)]. Thus, CTV serves as a more suitable screening tool for patients with necrotizing AP. In addition to the technical matters, CTV results are more likely influenced by extravascular abnormalities. In our study, CTV made 2 diagnoses that were different than the DSA diagnoses.

One limitation of our study is that during the interval between CTV and DSA, the splanchnic system status may have changed. Additionally, the sample size was not large enough and it was a single-center retrospective study.

Although more experience should be gained to determine the role of CTV for detecting SVT in necrotizing AP patients, our study findings suggest that CTV might effectively replace DSA and be the routine imaging method.

**COMMENTS**

***Background***

Splanchnic vein thrombosis (SVT) may cause severe clinical conditions like hemorrhage, small bowel ischemia and hepatic failure. Its incidence in acute pancreatitis (AP) patients varied widely in different studies. In necrotizing AP patients, the perivascular inflammation and compression by peripancreatic collections or pancreatic necrosis increases the SVT frequency.

***Research frontiers***

SVT is a well-recognized acute pancreatitis complication and more often occurred in severe patients, especially those with necrosis collections. Few studies have evaluating the computed tomographic venography (CTV) effectiveness for SVT detection in necrotizing AP patients. In this study, the authors show that CTV could serve as an alternative examination for SVT screening with high accuracy.

***Innovations and breakthroughs***

Recent studies have suggested that it is important to establish a protocol for screening SVT in patients with necrotizing AP. This is the first article which shows CTV is an effective examination for SVT detection in patients with necrotizing acute pancreatitis.

***Applications***

By showing SVT has a high incidence in patients with necrotizing AP and CTV has high accuracy for detecting it, this study suggest that CTV might effectively replace DSA and be the routine imaging method.

***Peer review***

This paper is well written and very interesting. It indicates that CTV is an effective examination for SVT detection in patients with necrotizing AP with high positive and negative predictive values. It has great clinical significance.

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**Table 1 Distribution of splanchnic vein thrombosis**

|  |  |
| --- | --- |
| **Location of SVT** | **No. of Patients**  |
| PV isolated | 1 |
| SplV isolated | 7 |
| SMV isolated | 5 |
| SMV + PV | 1 |
| PV + SplV | 0 |
| SplV + SMV | 2 |
| SMV + PV + SplV | 1 |

SVT: Splanchnic vein thrombosis; PV: Portal vein; SplV: Splenic vein; SMV: Superior mesenteric vein.

**Table 2 Diagnostic accuracy of computed tomographic venography in splanchnic vein thrombosis in patients with necrotising acute pancreatitis**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|

|  |  |  |  |
| --- | --- | --- | --- |
| **Findings** | **Positive (DSA)** | **Negative (DSA)** | **Total** |
| Positive (CTV) | 17 | 2 | 19 |
| Negative (CTV) | 0 | 24 | 24 |
| Total | 17 | 26 | 43 |
| Sensitivity | 100% (95%CI: 77.1%-100%) |
| Specificity | 92.3% (95%CI: 73.4%-98.7%) |
| Positive predictive value | 89.5% (95%CI: 65.5%-98.2%) |
| Negative predictive value | 100% (95%CI: 82.8%-100%) |

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CTV: Computed tomographic venography; SVT: Splanchnic vein thrombosis; AP: Acute pancreatitis; DSA: Digital subtraction angiography; CI: Confidence interval.

**Figure 1** S**planchnic vein thrombosis in necrotizing acute pancreatitis detected by computed tomographic venography.** Black arrow denote the filling defects suggesting the formation of splenic vein thrombosis. SVT: Splanchnic vein thrombosis; AP: Acute pancreatitis; CTV: Computed tomographic venography.

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