



## Regular Article

# Risk Factors and Outcome of Splanchnic venous thrombosis in Patients with necrotizing acute pancreatitis



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## ABSTRACT

**Background:** Splanchnic venous thrombosis (SVT) is considered a rare but important complication in patients with acute pancreatitis (AP) and literatures regarding this topic were sparse. The aim of the present study was to investigate the risk factors of SVT in necrotizing acute pancreatitis (NAP) and assess the prognosis of these patients.

**Methods:** Both univariate and multivariate logistic regression analyses were applied using 15 indices including age, gender, Acute Physiology and Chronic Health Evaluation II scores (APACHE II), CRP (C-reactive protein) levels, etc to explore potential risk factors for the development of SVT in NAP patients. Moreover, clinical outcome measures such as mortality, organ failure and length of hospital and ICU stay were also compared between NAP patients with or without SVT.

**Results:** According to the statistical results, only intra-abdominal pressure (IAP) was proved to be an independent risk factor for SVT (OR, 1.283; 95% CI, 1.091–1.509,  $P = 0.003$ ). In addition, Balthazar's CT score and occurrence of IPN (infected pancreatic necrosis) also reached statistical significance ( $P = 0.040$  and  $0.047$ , respectively), but the 95% confidence interval shown in the multivariate logistic regression suggested that the observed ORs are not significant (1.326; 95% CI 0.984–1.787 and 2.61; 95% CI 0.972–7.352, respectively), which indicates weaker association between the two parameters and SVT. Regarding the clinical outcomes, patients with SVT showed higher mortality, longer hospital and intensive care unit duration, higher rates of a variety of complications and more utilization of invasive interventions.

**Conclusions:** IAP is an independent risk factor for the development of SVT in patients with NAP, while Balthazar's CT score and occurrence of IPN are also associated with SVT, although not as strong as IAP. Moreover, occurrence of SVT relates with extremely poor prognosis in NAP patients, evidenced by increased mortality, morbidity and need for invasive interventions.

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## Introduction

Complications of acute pancreatitis (AP) can be broadly categorized as systemic (organ failure) and local (pancreatic necrosis and/or fluid

collections) ones [1–3], both of which lead to prolonged hospital course, significant morbidity and mortality [4]. As one of local complications, splanchnic venous thrombosis (SVT) does not cause any additional symptom in most cases and is usually detected incidentally on radiological imaging performed to evaluate the severity of pancreatitis [5]. It often involves portal vein (PV), splenic vein (SplV) and superior mesenteric vein (SMV), either separately or in combination [6]. Even though overlap with clinical manifestations of pancreatitis, gastric or esophageal vessels varices, bleeding, bowel edema, ascites, portal hypertension and liver failure caused by SVT have been reported more frequently in recent studies [7–9] and these consequences may have significant adverse effects on the course of the disease and the ultimate prognosis.

Up till now, the detailed pathogenesis underlying SVT in patients with AP remains unclear and may involve many clinical factors. It is reported that SVT happens more in patients with more severe type of pancreatitis [10], but there is little data regarding risk factors for this complication. Therefore, in the present study, we analyzed the data

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from patients with necrotizing acute pancreatitis (NAP) to explore the risk factors for developing SVT. Moreover, we also studied the prognosis of NAP patients with or without SVT.

## Materials and Methods

### Patients

From January 2012 to January 2013, patients with a primary diagnosis of AP admitted to the surgical intensive care unit (SICU) of Jinling Hospital within 72 h from the onset of the disease were screened for enrollment and only those with pancreatic necrosis were included. Pancreatic necrosis was defined as nonviable tissue located in the pancreas alone, or in peripancreatic tissues alone, or in the pancreas and peripancreatic tissues. It can be solid or semisolid and is without a radiologically defined wall. The presence of pancreatic infection can be presumed when there is extra luminal gas in the pancreatic and/or peripancreatic tissues on CECT or when percutaneous, image-guided, fine-needle aspiration (FNA) is positive for bacteria and/or fungi on Gram stain and culture. Our criteria are consistent with that recommended in the Determinant-Based Classification of Acute Pancreatitis and the revision of the Atlanta classification [11,12].

Patients who met the following criteria were excluded: (1) younger than 18 years old age; (2) older than 70 years old age; (3) previous diagnosis of chronic liver disease; (4) pregnancy or severe immune system disorders; (5) end-stage chronic disease. All the patients initially received standard medical treatment according to the recent international guidelines [13]. IPN was managed in a step-up fashion including percutaneous or endoscopic drainage as the first-line approach. Patients underwent surgical interventions when mini-invasive drainage failed.

### Imaging Protocols

The diagnoses of SVT was based on the results of Computed tomography venography (CTV), which was a quick, safe, noninvasive and widely-available procedure. All CTV was performed with a dual-source CT scanner (Somatom Definition, Siemens Medical Solutions). We first performed a non-contrast CT scan of the whole abdomen. Then 70 ml of iopromide (Ultravist; 300 mg I/mL, Bayer Schering Pharma, Berlin, Germany) is injected with a power injector at rate of 3 ml/s via an 18 gauge catheter typically positioned in the antecubital vein. This study was approved by the ethic committee of Jinling Hospital with fast-track process (for observational studies). Besides, the consents for this

study were obtained from each patient or his next of kin. Arterial and portal venous phase images are acquired at a 25 s and 60s delay, respectively, from the start of intravenous contrast injection in helical mode 120 kVp 90 mAs. Axial images were reconstructed with a slice thickness of 1.25 mm at an interval of 0.625 mm and stored as source images for further image analysis. CT scans for patients with positive findings were reviewed by two expert radiologists with rich experience in abdominal imaging. The radiologists were blinded to the clinical history and the patients. Thrombosis was defined as a filling defect within the lumen of the vessel seen on contrast enhanced images.

### Data Collection

Both univariate and multivariate logistic regression analyses were performed to explore the risk factors of SVT. The metrics analyzed in the present investigation included demographic characteristics like age, gender, cause of illness, smoking and drinking habits and clinical parameters such as BMI levels, APACHE II score, hematocrit, C-reactive protein (CRP) level, IAP, D-dimer, AT-III and platelet at admission, Balthazar's CT score and occurrence of IPN. The time interval between blood sample collection and admission ranges from 30–45 minutes in our center. All the laboratory results were obtained at the Central Laboratory of Jinling Hospital according to the standard protocols. IAP was measured with a catheter inserted into the bladder, according to the standard technique established by WSACS in 2006 [14]: 25 ml of 0.9% NaCl was instilled, and the midaxillary line was considered as level 0. For every patients, IAP was recorded every 6 h during the first 24 hours after admission and intra-abdominal hypertension (IAH) was defined according to the WSACS recommendations as a sustained or repeated pathological elevation in IAP  $\geq 12$  mmHg.

Moreover, the management strategies (e.g. endoscopic and surgical), hospital and ICU length of stay, rate of systemic and local complications including MODS, pancreatic infection, and mortality—were recorded to compare the prognosis of patients with or without SVT.

### Statistical Analysis

Results are expressed as the median (interquartile range) unless mentioned otherwise. Categorical variables were described in absolute numbers and in percentages. Continuous variables were compared using the Mann–Whitney U-test, and categorical data were analyzed with the chi-squared test. To identify the risk factors for SVT, several series of univariate logistics regression analyses using 15 above

**Table 1**  
General characteristics of the patients.

Characteristic	Total(n = 115)	SVT (n = 42)	Non-SVT(n = 73)	P value
Age, years (range)	46(37-57)	45 (37-59)	46(37-56)	NS(0.975)
Gender, M/F	66/49	30/12	36/37	0.007
Etiology				
Biliary	63	22	41	
Alcohol	6	3	3	
Hyperlipidemia	30	15	15	
Idiopathic	16	2	14	
APACHE II score	9(8-11)	9(8-12)	9(8-10)	0.005
SOFA score	3(2-4)	3(2-4)	3(2-4)	0.01
Ranson score	4(3-5)	4(3-6)	4(3-5)	0.03
Balthazar's CT score	8(6-8)	8(7-10)	6(6-8)	<0.001
BMI	24.3(21.1-27.5)	24(20-28.3)	24.3(21-27.5)	0.879
Hematocrit	0.286(0.25-0.349)	0.278(0.231-0.337)	0.296(0.257-0.355)	NS(0.088)
CRP level(mg/dl)	125.0(64.6-173.0)	134.0(84.0-171.0)	120.1(59.6-178.8)	NS(0.786)
IAP(mmHg)	9(7.25-11.75)	11.25(9-13.75)	8(6.5-9.25)	<0.001
INR	1.14(1.04-1.23)	1.13(1.06-1.22)	1.17(1-1.24)	NS(0.418)
D-D	0.71(0.34-0.98)	0.7(0.27-1.03)	0.72(0.35-0.87)	NS(0.79)
AT-III	70.9(60.8-85.8)	74.1(60.3-88.3)	70.5(61.5-84.0)	NS(0.713)
PLT	209(119-317)	214(128-340)	203(99.25-294)	NS(0.42)

M male, F female, NS not significant, APACHE Acute Physiology and Chronic Health Evaluation, SOFA sequential organ failure assessment, CT computed tomography, BMI body mass index, CRP C-reactive protein ,IAP intra-abdominal pressure, INR international normalized ratio, D-D d-dimer, AT-III Anti-thrombin III, PLT platelet.

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