Splenectomy Causes 10-Fold Increased Risk of Portal Venous System Thrombosis in Liver Cirrhosis Patients

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Background: Portal venous system thrombosis (PVST) is a life-threatening complication of liver cirrhosis. We conducted a retrospective study to comprehensively analyze the prevalence and risk factors of PVST in liver cirrhosis.

Material/Methods: All cirrhotic patients without malignancy admitted between June 2012 and December 2013 were eligible if they underwent contrast-enhanced CT or MRI scans. Independent predictors of PVST in liver cirrhosis were calculated in multivariate analyses. Subgroup analyses were performed according to the severity of PVST (any PVST, main portal vein >50%, and clinically significant PVST) and splenectomy. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported.

Results: Overall, 113 cirrhotic patients were enrolled. The prevalence of PVST was 16.8% (19/113). Splenectomy (any PVST: OR=11.494, 95%CI=2.152–61.395; MPV thrombosis >50%: OR=29.987, 95%CI=3.247–276.949; clinically significant PVST: OR=40.415, 95%CI=3.895–419.295) and higher hemoglobin (any PVST: OR=0.974, 95%CI=0.953–0.996; MPV thrombosis >50%: OR=0.936, 95%CI=0.895–0.980; clinically significant PVST: OR=0.935, 95%CI=0.891–0.982) were the independent predictors of PVST. The prevalence of PVST was 13.3% (14/105) after excluding splenectomy. Higher hemoglobin was the only independent predictor of MPV thrombosis >50% (OR=0.952, 95%CI=0.909–0.997). No independent predictors of any PVST or clinically significant PVST were identified in multivariate analyses. Additionally, PVST patients who underwent splenectomy had a significantly higher proportion of clinically significant PVST but lower MELD score than those who did not undergo splenectomy. In all analyses, the in-hospital mortality was not significantly different between cirrhotic patient with and without PVST.

Conclusions: Splenectomy may increase by at least 10-fold the risk of PVST in liver cirrhosis independent of severity of liver dysfunction.

MeSH Keywords: Liver Cirrhosis • Portal Vein • Venous Thrombosis

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Portal venous system thrombosis (PVST) refers to the formation of a thrombus within the intrahepatic portal vein branches, main portal vein (MPV), splenic vein (SV), and superior mesenteric vein (SMV) [1,2]. Given the relatively high prevalence and negative prognostic impact of PVST in liver cirrhosis [3–6], understanding the risk factors of PVST is important to optimize the prevention strategy in clinical practice.

Portal vessel wall injury caused by splenectomy may be one of the most important local risk factors of PVST [7–15]. Numerous studies confirmed that the incidence of PVST after splenectomy was up to about 50% [15]. Notably, splenectomy is widely used for the treatment of cirrhotic portal hypertension and hypersplenism in China [16], but not in the West. However, few studies have explored the extent to which the risk of PVST is increased by splenectomy in liver cirrhosis. On the other hand, factor V Leiden and prothrombin G20210A mutations are the major systemic risk factors of PVST in liver cirrhosis [17]. Notably, these 2 gene mutations are frequently observed in Western populations [18], but rarely in Chinese populations [19,20]. Taken together, the distribution of risk factors of PVST in liver cirrhosis may be largely different between Western countries and China.

Herein, we analyzed the prevalence and risk factors of PVST in a retrospective cohort of Chinese patients with liver cirrhosis based on contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI) scans. Additionally, the effect of PVST on the in-hospital mortality of liver cirrhosis was explored.

Material and Methods

Patients

All patients with a diagnosis of liver cirrhosis who were admitted to our hospital between June 2012 and December 2013 were retrospectively reviewed in this study. At our hospital, the diagnosis of liver cirrhosis was made according to the history of chronic liver diseases, clinical symptoms (i.e., decompensated events) and signs, laboratory tests (i.e., liver function and coagulation tests), and abdominal images (i.e., liver and spleen morphology). If necessary, liver biopsy was performed. All eligible patients underwent contrast-enhanced CT and/or MRI scans to evaluate the patency of portal venous system vessels. Malignancy was excluded. The study protocol was approved by the Medical Ethics Committee of our hospital, approval number (k2014)07.

Clinical and laboratory data

As previously mentioned, our study group had continuously collected the data of cirrhotic patients from our hospital [21–26]. Some of them had been included in our previous studies. The primary data were as follows: age, sex, etiology of liver cirrhosis, other diseases, previous history of surgery, abdominal trauma, main clinical presentations (i.e., acute upper gastrointestinal bleeding [AUGIB], ascites, and hepatic encephalopathy [HE]), red blood cell (RBC), hemoglobin (Hb), white blood cell (WBC), platelet count (PLT), total bilirubin (TBIL), albumin (ALB), alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transpeptidase (GGT), blood urea nitrogen (BUN), creatinine (Cr), potassium, sodium, prothrombin time (PT), activated partial thromboplastin time (APTT), and international normalized ratio (INR). Notably, the major indications for splenectomy with or without portal azygous devascularization in our patients were splenomegaly and hypersplenism and prevention of portal hypertension-related bleeding.

Endoscopic examinations, if any, were reviewed. Severity of esophageal varices at endoscopy was evaluated [16]. Several scores/indexes related to the prognosis of liver diseases were also calculated, including Child-Pugh [27], model for end-stage of liver disease (MELD) [28], AST to PLT ratio index (APRI) [29], AST to ALT ratio (AAR) [30], FIB-4 [31], fibrosis index (FI) [32], and King scores [33].

Imaging data

Extension of portal venous system vessels referred to the left portal vein branch (LPV), right portal vein branch (RPV), MPV, SV, and SMV. Degree of MPV thrombosis was divided into mural (thrombus occupation <50%), partial (thrombus occupation >50%), total (thrombus occupation=100%), and obliteratorive (MPV became fibrotic cord) [34]. cavernous transformation of the portal vein (CTPV) was also identified. Clinically significant PVST was defined as any 1 of the following conditions: 1) partial MPV thrombosis with SMV thrombosis; or 2) total MPV thrombosis with or without SMV thrombosis [35]. Additionally, the maximal diameters of spleen, SV, and MPV, and ascites were also evaluated.

Data analysis

Continuous data were expressed as mean ± standard deviation (SD) and median (range) and were compared by the independent-sample t test. Categorical data were expressed as frequency (percentage) and were compared by the chi-square test or Fisher’s exact test. Comparative analyses were performed according to the severity of thrombosis (PVST versus no PVST, partial and total MPV thrombosis versus mural MPV thrombosis and patency, and clinically significant PVST versus no clinically significant PVST). Comparative analyses were...
Further performed after excluding patients who underwent splenectomy. All variables that were statistically significant in the univariate analyses were also entered into the multivariate logistic regression analyses. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to express the association of different variables with PVST. Clinical, laboratory, and imaging data were also compared between PVST patients with and without splenectomy. P value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS statistical software version 16.0.0.

Results

Patients

A total of 113 cirrhotic patients were included in our study. Patient characteristics are shown in Table 1. A majority of patients were male (66.4%) and had Child-Pugh class A and B (79.6%). Major etiologies of liver cirrhosis were hepatitis B virus and alcohol abuse. The prevalence of PVST was 16.8% (19/113). MPV thrombosis was observed in 12.4% (14/113) of patients, including mural (n=5, 4.4%), partial (n=6, 5.3%), and total (n=3, 2.7%) thrombosis. Eight (7.1%) patients had a history of splenectomy. Characteristics of patients without splenectomy are shown in Supplementary Table 1. After excluding splenectomy, the prevalence of PVST was 13.3% (14/105).

Risk factors in all patients

**PVST**

Patients with PVST had significantly higher proportions of splenectomy and severe esophageal varices, lower RBC, Hb, ALB, and sodium, and higher FI score than those without (Table 2). Only Hb, but not RBC, was entered into the multivariate analysis, because there was a collinearity between RBC and Hb. The statistical significance was observed as ascites were categorized into 4 grades, but disappeared as it was categorized into 2 grades. Thus, this variable was not entered into the multivariate analysis. After excluding splenectomy, patients with clinically significant PVST had significantly higher proportions of splenectomy and ascites and lower RBC and Hb than those without (Table 4). Only Hb, but not RBC, was entered into the multivariate analysis, because there was a collinearity between RBC and Hb. The statistical significance was observed as ascites were categorized into 3 grades, but disappeared as it was categorized into 2 grades. Thus, this variable was not entered into the multivariate analysis. Finally, both splenectomy (OR=40.415, 95%CI=3.895–419.295, p=0.002) and higher Hb (OR=0.935, 95%CI=0.891–0.982, p=0.007) were the independent predictors of clinically significant PVST.

**Clinically significant PVST**

Patients with clinically significant PVST had significantly higher proportions of splenectomy and ascites and lower RBC and Hb than those without (Table 4). Only Hb, but not RBC, was entered into the multivariate analysis, because there was a collinearity between RBC and Hb. The statistical significance was observed as ascites were categorized into 2 grades, but disappeared as it was categorized into 2 grades. Thus, this variable was not entered into the multivariate analysis. Finally, both splenectomy (OR=29.987, 95%CI=3.247–276.949, p=0.003) and higher Hb (OR=0.936, 95%CI=0.895–0.980, p=0.004) were the independent predictors of MPV thrombosis >50%.

**Risk factors after excluding splenectomy**

**PVST**

After excluding splenectomy, patients with PVST had significantly lower RBC, Hb, ALB, sodium, PT, APTT, INR, MELD score, and FI score, and higher Cr than those without (Table 5). Given the potential collinearity among variables, only Hb and INR, but not RBC or PT, were entered into the multivariate analysis. Additionally, because Cr and INR were 2 components of the MELD score, MELD score was not entered. Similarly, because ALB was 1 component of the FI score, FI score was not entered. Finally, no variables were identified as independent predictors of PVST.

**MPV thrombosis >50%**

After excluding splenectomy, patients with MPV thrombosis >50% had significantly lower Hb and higher BUN than those without (Table 6). Severity of liver dysfunction was not significantly different between them. In the multivariate analysis, only Hb (OR=0.952, 95%CI=0.909–0.997, p=0.035) was an independent predictor of MPV thrombosis >50%.

**Clinically significant PVST**

After excluding splenectomy, patients with clinically significant PVST had a significantly higher proportion of ascites, lower Hb, and higher BUN and FI score than those without (Table 7). The statistical significance was observed as ascites were categorized into 3 grades, but disappeared as it was categorized into 2 grades. Thus, this variable was not entered into the multivariate analysis. Because ALB was 1 component of the FI score, FI score, FI
**Table 1.** Characteristics of all patients.

| Variables                        | N   | Values                                      |
|----------------------------------|-----|---------------------------------------------|
| Age (years)                      | 113 | 55.15±12.87; 55.18 (22.14–85.46)           |
| Sex (Male/Female) – n.           | 113 | 75 (66.4%)/38 (33.6%)                      |
| Etiology of liver diseases – n.  | 113 |                                             |
| – Hepatitis B virus alone        | 34  | (30.1%)                                     |
| – Hepatitis C virus alone        | 7   | (6.2%)                                      |
| – Hepatitis B + C virus          | 4   | (3.5%)                                      |
| – Alcohol                        | 30  | (26.5%)                                     |
| – Hepatitis B virus + Alcohol    | 9   | (8.0%)                                      |
| – Hepatitis C virus + Alcohol    | 1   | (0.9%)                                      |
| – Hepatitis B + C virus + Alcohol| 1   | (0.9%)                                      |
| – Autoimmunity                   | 6   | (5.3%)                                      |
| – Drug related                   | 2   | (1.8%)                                      |
| – Unknown                        | 20  | (17.7%)                                     |
| Disease history – n.             | 113 |                                             |
| – Diabetes                       | 15  | (13.3%)                                     |
| – Coronary heart disease         | 8   | (7.1%)                                      |
| – Ischemic stroke                | 5   | (4.4%)                                      |
| – Arterial hypertension          | 9   | (8.0%)                                      |
| – Deep vein thrombosis           | 1   | (0.9%)                                      |
| Surgery history – n.             | 113 |                                             |
| – Splenectomy                    | 8   | (7.1%)                                      |
| – Appendicectomy                 | 3   | (2.7%)                                      |
| – Gastric surgery                | 2   | (1.8%)                                      |
| – Colonic surgery                | 1   | (0.9%)                                      |
| – Orthopedic surgery             | 3   | (2.7%)                                      |
| Abdominal trauma history – n.    | 113 | (0.9%)                                      |
| Acute upper gastrointestinal bleeding – n. | 113 | 19 (16.8%)                                |
| Ascites at CT scans – n.         | 113 |                                             |
| – No                             | 5   | (43.4%)                                     |
| – Mild                           | 30  | (26.5%)                                     |
| – Moderate-Severe                | 34  | (30.1%)                                     |
| Hepatic encephalopathy – n.      | 112 |                                             |
| – No                             | 6   | (5.4%)                                      |
| Esophageal varices at endoscopy – n. | 48  |                                             |
| – No                             | 10  | (20.8%)                                     |
| – Mild                           | 3   | (6.2%)                                      |
| – Moderate                       | 10  | (20.8%)                                     |
| – Severe                         | 25  | (52.1%)                                     |
| Red blood cell (10^12/L)         | 110 | 3.39±0.88; 3.36 (1.19–5.27)                |
| Hemoglobin (g/L)                 | 110 | 105.15±30.48; 106.00 (42.00–170.00)        |
| White blood cell (10^9/L)        | 110 | 5.10±1.52; 4.49 (1.50–11.50)               |
| Platelet count (10^9/L)          | 110 | 101.37±82.67; 75.00 (11.00–545.00)         |
Table 1 continued. Characteristics of all patients.

| Variables                                      | N   | Values                                      |
|------------------------------------------------|-----|---------------------------------------------|
| Total bilirubin (umol/L)                        | 112 | 46.79±69.82; 22.50 (5.10–436.50)            |
| Albumin (g/L)                                   | 111 | 32.27±6.53; 31.70 (11.70–44.30)             |
| Alanine aminotransferase (U/L)                  | 112 | 51.74±61.61; 33.00 (8.00–429.00)            |
| Aspartate aminotransferase (U/L)                | 112 | 74.18±95.92; 47.00 (10.00–889.00)           |
| Alkaline phosphatase (U/L)                      | 112 | 120.88±86.96; 92.00 (34.00–524.40)          |
| Gamma-glutamyl transpeptidase (U/L)             | 112 | 154.86±216.00; 66.00 (12.00–1130.00)        |
| Blood urea nitrogen (mmol/L)                    | 110 | 5.70±2.58; 5.09 (1.73–17.18)               |
| Creatinine (umol/L)                             | 110 | 58.85±21.00; 55.65 (29.00–151.00)          |
| Potassium (mmol/L)                              | 110 | 4.04±0.47; 4.00 (3.01–5.43)                |
| Sodium (mmol/L)                                 | 110 | 138.07±6.32; 138.80 (83.00–144.50)         |
| Prothrombin time (seconds)                      | 111 | 16.21±6.35; 14.70 (11.40–62.80)            |
| Activated partial thromboplastin time (seconds) | 111 | 44.56±16.09; 42.00 (29.90–180.00)          |
| International normalized ratio                 | 111 | 1.34±0.81; 1.16 (0.77–7.96)                |
| Child-Pugh score                                | 108 | 7.61±2.02; 7.50 (5.00–12.00)               |
| Child-Pugh class A/B/C                          | 108 | 40 (37.0%)/45 (41.7%)/23 (21.3%)            |
| MELD score                                      | 108 | 5.93±6.95; 4.73 (~5.20–24.52)              |
| APRI score                                      | 110 | 3.12±5.98; 1.67 (0.10–56.99)               |
| AAR score                                       | 112 | 1.27±1.66; 0.69 (0.20–10.08)               |
| FIB-4 score                                     | 110 | 8.94±4.99; 5.85 (0.38–61.59)               |
| Fi score                                        | 109 | −25.33±6.73; −25.24 (−39.25 ~ −3.85)        |
| King score                                      | 109 | 115.74±299.39; 43.31 (1.77–2589.47)        |
| Portal vein system thrombosis – n.              | 113 | 19 (16.8%)                                  |
| According to the location of thrombosis         |     |                                             |
| – Left portal vein branch thrombosis – n.       | 113 | 7 (6.2%)                                    |
| – Right portal vein branch thrombosis – n.      | 113 | 6 (5.3%)                                    |
| – Main portal vein thrombosis – n.              | 113 | 14 (12.4%)                                  |
| – Splenic vein thrombosis – n.                  | 113 | 4 (3.5%)                                    |
| According to the degree of MPV thrombosis       |     |                                             |
| – Mural thrombosis (<50%) – n.                  | 113 | 5 (4.4%)                                    |
| – Partial thrombosis (>50%) – n.                | 113 | 6 (5.3%)                                    |
| – Total thrombosis (100%) – n.                  | 113 | 3 (2.7%)                                    |
| Cavernous transformation of the portal vein – n.| 113 | 5 (4.4%)                                    |
| Clinically significant PVST – n.                | 113 | 8 (7.1%)                                    |
| Maximal diameter of spleen (mm)                 | 105 | 140.27±30.77; 138.20 (83.8–240.9)          |
| Maximal diameter of splenic vein (mm)           | 105 | 10.68±3.83; 10.3 (4.3–29.6)                |
| Maximal diameter of main portal vein (mm)       | 113 | 18.38±5.44; 17.90 (0–35.4)                 |
| In-hospital mortality – n.                      | 113 | 4 (3.5%)                                    |
Table 2. Overall comparison between patients with and without PVST.

| Variables                                      | PVST Values | No PVST Values | P value |
|------------------------------------------------|-------------|----------------|---------|
| Age (years)                                    | 19 53.14±12.21 | 94 55.56±13.02 | 0.457   |
| Sex (Male/Female) – n.                         | 13 (68.4%)/6 (31.6%) | 94 62 (66%)/32 (34%) | 0.836   |
| – Hepatitis B virus alone                      | 5 (26.3%) | 29 (30.9%) | 0.723   |
| – Hepatitis C virus alone                      | 1 (5.3%)  | 6 (6.4%)  | 0.916   |
| – Hepatitis B + C virus                        | 1 (5.3%)  | 3 (3.2%)  | 0.916   |
| – Alcohol                                      | 5 (26.3%) | 24 (26.6%) | 0.916   |
| – Hepatitis B virus + Alcohol                  | 3 (15.8%) | 6 (6.4%)  | 0.916   |
| – Hepatitis C virus + Alcohol                  | 0 (0%)    | 1 (1.1%)  | 0.916   |
| – Autoimmunity                                 | 1 (5.3%)  | 5 (5.3%)  | 0.916   |
| – Drug related                                 | 0 (0%)    | 2 (2.1%)  | 0.916   |
| – Unknown                                      | 3 (15.8%) | 17 (18.1%) | 0.916   |
| Disease history – n.                           | 19 3 (15.8%) | 94 12 (12.8%) | 0.723   |
| – Diabetes                                     | 5 (26.3%) | 12 (12.8%) | 0.723   |
| – Coronary heart disease                       | 0 (0%)    | 8 (8.5%)  | 0.187   |
| – Ischemic stroke                              | 1 (5.3%)  | 4 (4.3%)  | 0.846   |
| – Hypertension                                 | 0 (0%)    | 9 (9.6%)  | 0.846   |
| – Deep vein thrombosis                         | 0 (0%)    | 1 (1.1%)  | 0.846   |
| Surgery history – n.                           | 19 2 (10.5%) | 94 1 (1.1%)  | 0.652   |
| – Appendicectomy                               | 0 (0%)    | 3 (3.2%)  | 0.652   |
| – Gastric surgery                              | 0 (0%)    | 2 (2.1%)  | 0.652   |
| – Colonic surgery                              | 0 (0%)    | 1 (1.1%)  | 0.652   |
| – Orthopedic surgery                           | 0 (0%)    | 3 (3.2%)  | 0.652   |
| Abdominal trauma history – n.                  | 19 0 (0%)  | 94 1 (1.1%) | 0.652   |
| Acute upper gastrointestinal bleeding – n.     | 19 3 (15.8%) | 94 16 (17.0%) | 0.896   |
| Ascites at CT scans – n.                       | 19 3 (15.8%) | 94 16 (17.0%) | 0.896   |
| – No                                           | 5 (26.3%) | 12 (12.8%) | 0.896   |
| – Mild                                         | 9 (47.4%) | 21 (22.3%) | 0.896   |
| – Moderate- Severe                             | 5 (26.3%) | 29 (30.9%) | 0.896   |
| Esophageal varices at endoscopy – n.           | 10 2 (10.5%) | 93 4 (4.3%)  | 0.896   |
| – No                                           | 0 (0%)    | 10 (26.3%) | 0.896   |
| – Mild                                         | 2 (10.0%) | 1 (2.6%)  | 0.896   |
| – Moderate                                     | 1 (10.0%) | 9 (23.7%)  | 0.896   |
| – Severe                                       | 7 (70.0%) | 18 (47.4%) | 0.896   |
| Red blood cell (10^12/L)                       | 18 2.86±0.64 | 92 3.49±0.88 | 0.004   |
| Hemoglobin (g/L)                               | 18 84.39±26.89 | 92 109.21±29.59 | 0.001   |
| White blood cell (10^9/L)                      | 18 5.24±3.07 | 92 5.08±3.26 | 0.844   |
| Platelet count (10^9/L)                        | 18 110.33±102.15 | 92 99.62±78.85 | 0.617   |
Table 2 continued. Overall comparison between patients with and without PVST.

| Variables                                      | PVST        | No PVST      | P value |
|------------------------------------------------|-------------|--------------|---------|
| Total bilirubin (umol/L)                       | 19          | 93           | 0.552   |
| Albumin (g/L)                                  | 19          | 92           | 0.035   |
| Alanine aminotransferase (U/L)                 | 19          | 93           | 0.884   |
| Aspartate aminotransferase (U/L)               | 19          | 93           | 0.605   |
| Alkaline phosphatase (U/L)                     | 19          | 93           | 0.510   |
| Gamma-glutamyl transpeptidase (U/L)            | 19          | 93           | 0.617   |
| Blood urea nitrogen (mmol/L)                   | 19          | 92           | 0.377   |
| Creatinine (umol/L)                            | 18          | 92           | 0.171   |
| Potassium (mmol/L)                             | 18          | 92           | 0.954   |
| Sodium (mmol/L)                                | 18          | 92           | 0.025   |
| Prothrombin time (seconds)                     | 18          | 93           | 0.068   |
| Activated partial thromboplastin time (seconds)| 18          | 93           | 0.168   |
| International normalized ratio                 | 18          | 93           | 0.052   |
| Child-Pugh score                               | 18          | 90           | 0.126   |
| Child-Pugh class A/B/C                         | 18          | 90           | 0.356   |
| MELD score                                     | 18          | 90           | 0.181   |
| APRI score                                     | 18          | 92           | 0.487   |
| AAR score                                      | 19          | 93           | 0.740   |
| FIB-4 score                                    | 18          | 92           | 0.451   |
| FL score                                       | 18          | 91           | 0.029   |
| Maximal diameter of spleen (mm)                | 14          | 91           | 0.092   |
| Maximal diameter of splenic vein (mm)          | 14          | 91           | 0.703   |
| Maximal diameter of main portal vein (mm)      | 19          | 94           | 0.542   |
| In-hospital mortality – n.                     | 19          | 94           | 0.656   |

Table 3. Overall comparison between patients with and without MPV thrombosis >50%.

| Variables                                      | MPV thrombosis >50% | MPV thrombosis <50% and MPV patency | P value |
|------------------------------------------------|---------------------|-------------------------------------|---------|
| Age (years)                                    | 9                   | 104                                 | 0.542   |
| Sex (Male/Female) – n.                         | 9                   | 104                                 | 0.740   |
| Etiology of liver diseases – n.                | 9                   | 104                                 | 0.740   |
| – Hepatitis B virus alone                      | 2                   | 32                                  | 0.037   |
| – Hepatitis C virus alone                      | 0                   | 7                                   | 0.672   |
| – Hepatitis B + C virus                        | 1                   | 3                                   | 0.617   |
| – Alcohol                                      | 2                   | 28                                  | 0.014   |
| – Hepatitis B virus + Alcohol                  | 1                   | 1                                   | 0.107   |
| – Hepatitis C virus + Alcohol                  | 0                   | 1                                   | 0.107   |
Table 3 continued. Overall comparison between patients with and without MPV thrombosis >50%.

| Variables                        | MPV thrombosis >50% | MPV thrombosis <50% and MPV patency | P value |
|----------------------------------|----------------------|--------------------------------------|---------|
| Autoimmunity                     | N Values             | N Values                             |         |
|                                  | N (0%)               | N (0%)                               |         |
| Drug related                     | 0 (0%)               | 2 (1.9%)                             |         |
| Unknown                          | 18 (17.3%)           | 9 (8.7%)                             | 0.358   |
| Disease history – n.             | 9                    | 104                                  |         |
| Diabetes                         | 2 (22.2%)            | 13 (12.5%)                           | 0.410   |
| Coronary heart disease           | 0 (0%)               | 8 (7.7%)                             | 0.388   |
| Ischemic stroke                  | 1 (11.1%)            | 4 (4.6%)                             | 0.309   |
| Arterial hypertension            | 0 (0%)               | 9 (8.7%)                             | 0.358   |
| Deep vein thrombosis             | 0 (0%)               | 1 (1.0%)                             | 0.768   |
| Surgery history – n.             | 9                    | 104                                  |         |
| Splenectomy                      | 4 (44.4%)            | 4 (3.8%)                             | <0.001  |
| Appendicectomy                   | 0 (0%)               | 3 (2.9%)                             | 0.606   |
| Gastric surgery                  | 0 (0%)               | 2 (1.9%)                             | 0.675   |
| Colonic surgery                  | 0 (0%)               | 1 (1.0%)                             | 0.768   |
| Orthopedic surgery               | 0 (0%)               | 3 (2.9%)                             | 0.606   |
| Abdominal trauma history – n.    | 9                    | 104                                  |         |
| No                               | 1 (11.1%)            | 48 (46.2%)                           |         |
| Mild                             | 5 (55.6%)            | 25 (24.0%)                           |         |
| Moderate-Severe                  | 3 (33.3%)            | 31 (29.8%)                           |         |
| Hepatic encephalopathy – n.      | 9                    | 103                                  |         |
| No                               | 0 (0%)               | 10 (24.4%)                           |         |
| Mild                             | 0 (0%)               | 3 (7.3%)                             |         |
| Moderate                          | 0 (0%)               | 10 (24.4%)                           |         |
| Severe                           | 7 (100%)             | 18 (43.9%)                           |         |
| Red blood cell (10^12/L)         | 9                    | 101                                  |         |
| Hemoglobin (g/L)                 | 2.70±0.37            | 3.45±0.88                            | 0.013   |
| White blood cell (10^9/L)        | 9                    | 101                                  |         |
| Platelet count (10^9/L)          | 136.33±122.15        | 98.26±78.33                          | 0.187   |
| Total bilirubin (umol/L)         | 9                    | 103                                  |         |
| Albumin (g/L)                    | 29.94±7.21           | 32.48±6.47                           | 0.266   |
| Alanine aminotransferase (U/L)   | 9                    | 103                                  |         |
| Aspartate aminotransferase (U/L) | 9                    | 103                                  |         |
| Alkaline phosphatase (U/L)       | 9                    | 103                                  |         |
| Gamma-glutamyl transpeptidase (U/L) | 9              | 103                                  |         |
| Blood urea nitrogen (mmol/L)     | 9                    | 101                                  |         |
| Creatinine (umol/L)              | 9                    | 101                                  |         |
| Potassium (mmol/L)               | 9                    | 101                                  |         |
Table 3 continued. Overall comparison between patients with and without MPV thrombosis >50%.

| Variables                        | MPV thrombosis >50% | MPV thrombosis <50% and MPV patency | P value |
|----------------------------------|---------------------|--------------------------------------|---------|
| N                                | Values              | N                                    | Values  |
| Sodium (mmol/L)                  | 9                   | 138.64±2.85                          | 101     | 138.02±6.54                          | 0.778    |
| Prothrombin time (seconds)       | 9                   | 15.78±3.02                           | 102     | 16.25±6.57                           | 0.832    |
| Activated partial thromboplastin time (seconds) | 9 | 39.22±7.22                          | 102     | 45.03±16.59                          | 0.302    |
| International normalized ratio   | 9                   | 1.28±0.33                            | 102     | 1.34±0.84                            | 0.824    |
| Child-Pugh score                 | 9                   | 7.67±1.41                            | 99      | 7.61±2.07                            | 0.932    |
| Child-Pugh class A/B/C           | 9                   | 2 (22.2%)/6 (66.7%)/1 (11.1%)        | 99      | 38 (38.4%) 39 (39.4%)/22 (22.2%)    | 0.282    |
| MELD score                       | 9                   | 3.11±5.58                            | 99      | 6.19±7.03                            | 0.205    |
| APRI score                       | 9                   | 1.14±0.92                            | 101     | 3.29±6.21                            | 0.303    |
| AAR score                        | 9                   | 0.48±0.31                            | 103     | 1.34±1.71                            | 0.543    |
| FIB-4 score                      | 9                   | 5.37±3.89                            | 101     | 9.26±9.78                            | 0.240    |
| Fi score                         | 9                   | −23.31±7.63                          | 100     | −25.52±6.66                          | 0.348    |
| King score                       | 9                   | 34.26±28.62                          | 100     | 123.08±311.55                        | 0.396    |
| Maximal diameter of spleen (mm)  | 5                   | 158.50±48.02                         | 100     | 139.36±29.73                         | 0.176    |
| Maximal diameter of splenic vein (mm) | 5                   | 11.74±4.04                          | 100     | 10.63±3.84                           | 0.530    |
| Maximal diameter of main portal vein (mm) | 9 | 18.64±8.98                          | 104     | 18.36±5.09                           | 0.881    |
| In-hospital mortality – n.       | 9                   | 0 (0%)                               | 104     | 4 (3.8%)                             | 0.549    |

Table 4. Overall comparison between patients with and without clinically significant PVST.

| Variables                        | Clinically significant PVST | No clinically significant PVST | P value |
|----------------------------------|-----------------------------|------------------------------|---------|
| N                                | Values                      | N                            | Values  |
| Age (years)                      | 8                           | 58.47±14.69                  | 105     | 54.90±12.76                          | 0.451    |
| Sex (Male/Female) – n.           | 8                           | 4 (50%)/4 (50%)              | 105     | 71 (67.6%)/34 (32.4%)                | 0.309    |
| Etiology of liver diseases – n.  | 8                           | 105                          | 71 (67.6%)/34 (32.4%) | 0.309 |
| – Hepatitis B virus alone        | 2                           | 32 (30.5%)                  |         |
| – Hepatitis C virus alone        | 0                           | 7 (6.7%)                    |         |
| – Alcohol                        | 1                           | 3 (2.9%)                    |         |
| – Hepatitis B + C Virus          | 1 (12.5%)                   | 3 (2.9%)                    |         |
| – Hepatitis C virus + Alcohol    | 2 (25%)                     | 7 (6.7%)                    |         |
| – Alcohol + Drug related         | 0 (0%)                      | 6 (5.6%)                    |         |
| – Autoimmunity                   | 0 (0%)                      | 2 (1.9%)                    |         |
| – Unknown                        | 2 (25%)                     | 18 (17.1%)                  |         |
| Disease history – n.             | 8                           | 105                          |         |
| – Diabetes                       | 2 (25%)                     | 13 (12.4%)                  | 0.311   |
| – Coronary heart disease         | 0 (0%)                      | 8 (7.6%)                    | 1.000   |
| – Ischemic stroke                | 1 (12.5%)                   | 4 (3.8%)                    | 0.312   |
| – Arterial hypertension          | 0 (0%)                      | 9 (8.6%)                    | 1.000   |
| – Deep vein thrombosis           | 0 (0%)                      | 1 (1.1%)                    |         |
### Table 4 continued. Overall comparison between patients with and without clinically significant PVST.

| Variables                          | Clinically significant PVST | No clinically significant PVST | P value |
|------------------------------------|-----------------------------|--------------------------------|---------|
|                                    | N | Values | N | Values |                  |
| Surgery history – n.               | 8 |        | 105 |        |                  |
| – Splenectomy                      |   | 0 (0%) | 4 (3.8%) | <0.001 |
| – Appendicectomy                   |   | 0 (0%) | 3 (2.9%) |         |
| – Gastric surgery                  |   | 0 (0%) | 2 (1.9%) | 1.000   |
| – Colonic surgery                  |   | 0 (0%) | 1 (1.0%) | 1.000   |
| – Orthopedic surgery               |   | 0 (0%) | 3 (3.2%) | 1.000   |
| Abdominal trauma history – n.      | 8 |        | 105 |        | 1.000 |
| – No                               |   | 1 (12.5%) | 48 (45.7%) |        |
| – Mild                             |   | 5 (62.5%) | 25 (23.8%) |        |
| – Moderate-Severe                  |   | 2 (25%) | 32 (30.5%) |        |
| Hepatic encephalopathy – n.        | 8 |        | 105 |        | 1.000 |
| – No                               |   | 0 (0%) | 10 (23.8%) |        |
| – Mild                             |   | 0 (0%) | 3 (7.1%) | 0.302   |
| – Moderate                         |   | 0 (0%) | 10 (23.8%) |        |
| – Severe                           |   | 6 (100%) | 19 (45.2%) |        |
| Red blood cell (10^12/L)           | 8 | 2.71±0.39 | 102 | 3.44±0.88 | 0.022 |
| Hemoglobin (g/L)                   | 8 | 70±13.72 | 102 | 107.90±29.73 | 0.001 |
| White blood cell (10^9/L)          | 8 | 5.06±3.18 | 102 | 65.10±3.23 | 0.972 |
| Platelet count (10^9/L)            | 8 | 153.8±21 | 102 | 97.45±78.37 | 0.076 |
| Total bilirubin (umol/L)           | 8 | 18.78±15.73 | 104 | 48.95±71.91 | 0.241 |
| Albumin (g/L)                      | 8 | 28.89±6.46 | 103 | 32.54±6.46 | 0.129 |
| Alanine aminotransferase (U/L)     | 8 | 30.5±7.27 | 104 | 53.3±6.325 | 0.314 |
| Aspartate aminotransferase (U/L)   | 8 | 42.25±45.11 | 104 | 76.63±98.45 | 0.331 |
| Alkaline phosphatase (U/L)         | 8 | 78.18±44.36 | 104 | 124.17±88.67 | 0.150 |
| Gamma-glutamyl transpeptidase (U/L)| 8 | 34.88±24.65 | 104 | 164.09±221.44 | 0.103 |
| Blood urea nitrogen (mmol/L)       | 8 | 6.58±4.86 | 102 | 5.64±2.34 | 0.322 |
| Creatinine (umol/L)                | 8 | 56.9±16.81 | 102 | 59.00±21.36 | 0.786 |
| Potassium (mmol/L)                 | 8 | 3.95±0.31 | 102 | 4.05±0.47 | 0.541 |
| Sodium (mmol/L)                    | 8 | 138.45±2.98 | 102 | 138.04±6.51 | 0.861 |
| Prothrombin time (seconds)         | 8 | 16.23±6.54 | 103 | 16.23±6.54 | 0.887 |
| Activated partial thromboplastin time (seconds) | 8 | 38.31±7.14 | 103 | 45.04±16.50 | 0.256 |
| International normalized ratio     | 8 | 1.29±0.35 | 103 | 1.34±0.84 | 0.877 |
| Child-Pugh score                   | 8 | 7.75±1.49 | 100 | 7.6±2.06 | 0.841 |
| Child-Pugh class A/B/C             | 8 | 2 (25.0%)/5 (62.5%)/1 (12.5%) | 100 | 38 (38%)/40 (40%)/22 (22%) | 0.460 |
| MELD score                         | 8 | 3.45±5.86 | 100 | 6.13±7.02 | 0.296 |
| APRI score                         | 8 | 0.15±0.23 | 82 | 3.28±0.62 | 0.094 |
| AAR score                          | 8 | 0.48±0.33 | 104 | 1.33±1.70 | 0.160 |

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### Table 4 continued. Overall comparison between patients with and without clinically significant PVST.

| Variables                            | Clinically significant PVST | No clinically significant PVST | P value |
|--------------------------------------|----------------------------|-------------------------------|---------|
| **N**                                | Values                     | N                             | Values  |        |
| FIB-4 score                          | 8                          | 4.34±2.57                     | 102     | 9.30±9.75 | 0.156 |
| Fl score                             | 8                          | -22.40±7.63                   | 101     | -25.57±6.64 | 0.202 |
| King score                           | 8                          | 32.03±29.75                   | 101     | 122.37±310.06 | 0.414 |
| Maximal diameter of spleen (mm)      | 4                          | 137.9±15.66                   | 101     | 140.36±31.26 | 0.876 |
| Maximal diameter of splenic vein (mm)| 4                          | 11.68±4.67                    | 101     | 10.64±3.82 | 0.600 |
| In-hospital mortality – n.           | 8                          | 0 (0%)                        | 105     | 4 (3.7%)   | 1.000 |

### Table 5. Comparison between patients with and without PVST after excluding splenectomy.

| Variables                            | PVST                       | No PVST                      | P value |
|--------------------------------------|-----------------------------|------------------------------|---------|
| **N**                                | Values                     | N                             | Values  |        |
| Age (years)                          | 14                         | 52.67±11.69                  | 91      | 55.60±13.22 | 0.435 |
| Sex (Male/Female) – n.               | 14                         | 11 (78.64%)/3 (21.4%)        | 91      | 60 (65.9%)/31 (34.1%) | 0.347 |
| Etiology of liver diseases – n.      | 14                         | 91                            |         | 0.988 |
| – Hepatitis B virus alone            | 5                          | (35.7%)                      | 27      | (29.7%) |         |
| – Hepatitis C virus alone            | 1                          | (7.1%)                       | 6       | (6.6%)  |         |
| – Hepatitis B + C virus              | 0                          | (0%)                         | 3       | (3.3%)  |         |
| – Alcohol                            | 5                          | (35.7%)                      | 25      | (27.5%) |         |
| – Hepatitis B virus + Alcohol        | 1                          | (7.1%)                       | 6       | (6.6%)  |         |
| – Hepatitis C virus + Alcohol        | 0                          | (0%)                         | 1       | (1.1%)  |         |
| – Autoimmunity                       | 0                          | (0%)                         | 5       | (5.5%)  |         |
| – Drug related                       | 0                          | (0%)                         | 2       | (2.0%)  |         |
| Disease history – n.                 | 14                         | 91                            |         |         |
| – Diabetes                           | 2                          | (14.3%)                      | 11      | (12.1%) | 0.816 |
| – Ischemic stroke                    | 1                          | (7.1%)                       | 4       | (4.4%)  | 0.518 |
| – Arterial hypertension              | 0                          | (0%)                         | 9       | (9.9%)  | 0.604 |
| Surgery history – n.                 | 14                         | 91                            |         |         |
| – Splenectomy                        | 0                          | (0%)                         | 0       | (0%)    | NA     |
| – Appendicectomy                     | 0                          | (0%)                         | 3       | (3.3%)  | 1.000 |
| – Gastric surgery                    | 0                          | (0%)                         | 2       | (2.2%)  | 1.000 |
| – Colonic surgery                    | 0                          | (0%)                         | 1       | (1.1%)  | 1.000 |
| – Orthopedic surgery                 | 0                          | (0%)                         | 3       | (3.3%)  | 1.000 |
| Abdominal trauma history – n.        | 14                         | 0 (0%)                       | 91      | 1 (1.1%) | 1.000 |
| Ascites at CT scans – n.             | 14                         | 0 (0%)                       | 91      | 1 (1.1%) | 1.000 |

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### Table 5 continued. Comparison between patients with and without PVST after excluding splenectomy.

| Variables                                      | PVST                  |      | No PVST                |      | P   |
|------------------------------------------------|-----------------------|------|------------------------|------|-----|
|                                                 | N Values              |      | N Values               |      |     |
| - No                                           | 4 (28.6%)             |      | 42 (46.2%)             |      |     |
| - Mild                                         | 6 (42.9%)             |      | 20 (22.0%)             |      |     |
| - Moderate–severe                               | 4 (28.6%)             |      | 29 (31.9%)             |      |     |
| Hepatic encephalopathy – n.                    | 14                    | 2    | (14.3%)                | 90   | 4   | 0.142|
| Esophageal varices at endoscopy – n.            | 5                     | 37   |                        |      |     |
| - No                                           | 1                     |      | 10                     |      | (27.0%)|
| - Mild                                         | 1                     |      | 1                      |      | (2.7%) |
| - Moderate                                     | 1                     |      | 8                      |      | (21.6%)|
| - Severe                                       | 3                     | (60%)| 11                     |      | (40.5%)|
| Red blood cell (10¹²/L)                         | 13                    | 2.92±0.71 | 89 | 3.49±0.89 | 0.028|
| Hemoglobin (g/L)                               | 13                    | 88.69±28.60 | 89 | 108.73±29.84 | 0.025|
| White blood cell (10⁹/L)                        | 13                    | 4.85±3.19 | 89 | 4.98±3.23 | 0.897|
| Platelet count (10⁹/L)                         | 13                    | 58.77±38.48 | 89 | 97.97±79.65 | 0.085|
| Total bilirubin (umol/L)                        | 14                    | 66.26±111.35 | 90 | 45.36±63.99 | 0.269|
| Albumin (g/L)                                  | 14                    | 28.65±7.28 | 89 | 32.91±6.48 | 0.027|
| Alanine aminotransferase (U/L)                  | 14                    | 46.71±64.26 | 90 | 52.37±63.22 | 0.757|
| Aspartate aminotransferase (U/L)                | 14                    | 56.79±69.92 | 90 | 76.82±103.56 | 0.480|
| Alkaline phosphatase (U/L)                      | 14                    | 123.12±94.37 | 90 | 116.82±78.22 | 0.786|
| Gamma-glutamyl transpeptidase (U/L)            | 14                    | 145.00±202.98 | 90 | 162.02±225.43 | 0.791|
| Bilirubin nitrogen (mmol/L)                     | 13                    | 5.67±3.39 | 89 | 5.67±3.49 | 0.093|
| Creatinine (umol/L)                            | 13                    | 71.12±29.62 | 89 | 57.71±19.83 | 0.036|
| Potassium (mmol/L)                             | 13                    | 4.05±0.51 | 89 | 4.03±0.46 | 0.880|
| Sodium (mmol/L)                                | 13                    | 137.3±15.66 | 89 | 138.64±5.51 | 0.010|
| Prothrombin time (seconds)                      | 13                    | 20.25±13.12 | 90 | 15.77±4.84 | 0.021|
| Activated partial thromboplastin time (seconds) | 13                    | 54.82±38.25 | 90 | 43.73±10.01 | 0.023|
| International normalized ratio                 | 13                    | 1.87±1.86 | 90 | 1.28±0.55 | 0.016|
| Child-Pugh score                               | 13                    | 8.62±1.76 | 87 | 7.49±2.08 | 0.069|
| Child-Pugh class A/B/C                         | 13                    | 2 (15.4%)/6 (46.2%)/5 (38.5%) | 87 | 35 (40.2%)/34 (39.1%)/18 (20.7%) | 0.167|
| MELD score                                     | 13                    | 10.48±8.57 | 87 | 5.60±6.62 | 0.019|
| APRI score                                     | 13                    | 2.64±2.22 | 89 | 3.37±6.56 | 0.694|
| AAR score                                      | 14                    | 1.38±2.54 | 90 | 1.32±1.56 | 0.903|
| Fl circuit (seconds)                            | 13                    | 9.19±4.71 | 89 | 9.45±10.23 | 0.928|
| King score                                     | 13                    | 12.83±254.16 | 88 | 121.70±318.66 | 0.944|
| FIB-4 score                                    | 13                    | 11.05±4.44 | 91 | 10.63±3.76 | 0.703|
| In-hospital mortality – n.                     | 14                    | 1 (7.1%) | 91 | 3 (3.3%) | 0.441|

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Table 6. Comparison between patients with and without MPV thrombosis >50% after excluding splenectomy.

| Variables | MPV thrombosis >50% | MPV thrombosis <50% and MPV patency | P value |
|-----------|----------------------|--------------------------------------|---------|
| Age (years) | 5 61.13±11.72 | 100 54.92±13.06 | 0.300 |
| Sex (Male/Female) – n. | 5 3 (60%)/2 (40%) | 100 68 (68.0%)/32 (32.0%) | 0.658 |
| Etiology of liver diseases – n. | 5 100 | | 0.996 |
| – Hepatitis B virus alone | 2 (40%) | 30 (30.0%) | |
| – Hepatitis C virus alone | 0 (0%) | 7 (7.0%) | |
| – Hepatitis B + C virus | 0 (0%) | 3 (3.0%) | |
| – Alcohol | 2 (40%) | 28 (28.0%) | |
| – Hepatitis B virus + Alcohol | 0 (0%) | 7 (7.0%) | |
| – Hepatitis C virus + Alcohol | 0 (0%) | 1 (1.0%) | |
| – Autoimmunity | 0 (0%) | 5 (5.0%) | |
| – Drug related | 0 (0%) | 2 (2.0%) | |
| – Unknown | 1 (20%) | 17 (17.0%) | |
| Disease history – n. | 5 100 | | 1.000 |
| – Diabetes | 1 (20%) | 12 (12.0%) | 0.491 |
| – Coronary heart disease | 0 (0%) | 8 (8.0%) | 1.000 |
| – Ischemic stroke | 1 (20%) | 4 (4.0%) | 0.220 |
| – Arterial hypertension | 0 (0%) | 9 (9.0%) | 1.000 |
| – Deep vein thrombosis | 0 (0%) | 1 (1.0%) | 1.000 |
| Surgery history – n. | 5 100 | | |
| – Splenectomy | 0 (0%) | 0 (0%) | NA |
| – Appendectomy | 0 (0%) | 3 (3.0%) | 1.000 |
| – Gastric surgery | 0 (0%) | 2 (2.0%) | 1.000 |
| – Colonic surgery | 0 (0%) | 1 (1.0%) | 1.000 |
| – Orthopedic surgery | 0 (0%) | 3 (3%) | 1.000 |
| Abdominal trauma history – n. | 5 100 | | 1.000 |
| – No | 0 (0%) | 100 1 (1.0%) | |
| – Mild | 0 (0%) | 2 (5.1%) | |
| – Moderate-Severe | 3 (60%) | 23 (23.0%) | |
| – Severe | 2 (40%) | 31 (31.0%) | |
| Acute upper gastrointestinal bleeding – n. | 5 100 | | 0.589 |
| – No | 1 (0%) | 100 17 (17.0%) | |
| – Mild | 0 (0%) | 46 (46.0%) | |
| – Moderate-Severe | 3 (60%) | 23 (23.0%) | |
| – Severe | 2 (40%) | 31 (31.0%) | |
| Hepatic encephalopathy – n. | 5 100 | | 1.000 |
| – No | 0 (0%) | 99 6 (6.1%) | |
| – Mild | 0 (0%) | 38 6 (6.1%) | |
| – Moderate-Severe | 3 (60%) | 23 (23.0%) | |
| – Severe | 2 (40%) | 31 (31.0%) | |
| Esophageal varices at endoscopy – n. | 3 100 | | 0.357 |
| – No | 0 (0%) | 10 (25.6%) | |
| – Mild | 0 (0%) | 2 (5.1%) | |
| – Moderate-Severe | 3 (60%) | 23 (23.0%) | |
| – Severe | 2 (40%) | 31 (31.0%) | |
| Red blood cell (10^12/L) | 5 2.75±0.29 | 97 3.46±0.89 | 0.081 |
| Hemoglobin (g/L) | 5 72.40±8.73 | 97 107.92±30.00 | 0.010 |
| White blood cell (10^9/L) | 5 4.36±4.25 | 97 4.99±3.17 | 0.669 |
| Platelet count (10^9/L) | 5 52.00±32.85 | 97 95.08±77.75 | 0.222 |
| Variables                                | MPV thrombosis >50% | MPV thrombosis ≤50% and MPV patency | P value |
|-----------------------------------------|----------------------|--------------------------------------|---------|
| N                                      | Values               | N                                    | Values  |         |
| Total bilirubin (umol/L)                | 5 23.12±18.39        | 99 49.72±73.35                       | 0.422   |
| Albumin (g/L)                           | 5 28.40±8.92         | 98 32.53±6.59                        | 0.181   |
| Alanine aminotransferase (U/L)          | 5 15.80±6.14         | 99 53.4±6.14                         | 0.195   |
| Aspartate aminotransferase (U/L)        | 5 21.80±9.50         | 99 76.77±99.85                       | 0.223   |
| Alkaline phosphatase (U/L)              | 5 77.28±60.19        | 99 119.71±80.67                      | 0.250   |
| Gamma-glutamyl transpeptidase (U/L)     | 5 32.00±19.66        | 99 166.18±225.31                     | 0.188   |
| Blood urea nitrogen (mmol/L)            | 5 8.22±5.30          | 97 5.68±2.40                         | 0.033   |
| Creatinine (umol/L)                     | 5 62.94±19.34        | 97 59.24±21.80                       | 0.711   |
| Potassium (mmol/L)                      | 5 1.13±0.40          | 97 1.02±0.47                         | 0.640   |
| Sodium (mmol/L)                         | 5 138.84±21.15       | 97 137.98±6.65                       | 0.773   |
| Prothrombin time (seconds)              | 5 16.24±3.40         | 98 16.34±6.68                        | 0.973   |
| Activated partial thromboplastin time   | 5 42.02±8.12         | 98 45.28±16.86                       | 0.669   |
| (seconds)                               |                      |                                     |         |
| International normalized ratio          | 5 1.32±0.38          | 98 1.35±0.86                         | 0.933   |
| Child-Pugh score                        | 5 8.20±1.30          | 95 7.61±2.11                         | 0.538   |
| Child-Pugh class A/B/C                  | 5 0 (0%)/4 (20%)     | 95 37 (38.9%)/36 (37.8%)/22 (23.2%) | 0.130   |
| MELD score                              | 5 5.43±5.30          | 95 6.27±7.15                         | 0.796   |
| APRI score                              | 5 1.28±0.69          | 97 3.38±6.32                         | 0.462   |
| AAR score                               | 5 1.13±0.40          | 97 1.38±0.79                         | 0.204   |
| FIB-4 score                             | 5 7.68±3.45          | 97 9.51±9.90                         | 0.683   |
| Th score                                | 5 −20.92±8.87        | 96 −25.54±6.78                       | 0.147   |
| Maximal diameter of spleen (mm)         | 5 158.50±48.02       | 100 139.36±29.73                     | 0.176   |
| Maximal diameter of splenic vein (mm)   | 5 11.74±4.04         | 100 10.63±3.84                       | 0.530   |
| Maximal diameter of main portal vein    | 5 17.86±11.43        | 100 18.36±5.09                       | 0.833   |
| In-hospital mortality – n.              | 5 0 (0%)             | 100 4 (4.0%)                         | 1.000   |

Table 6 continued. Comparison between patients with and without MPV thrombosis >50% after excluding splenectomy.

| Variables                           | Clinically significant PVST | No clinically significant PVST | P value |
|-------------------------------------|-----------------------------|--------------------------------|---------|
| N                                   | Values                      | N                              | Values  |         |
| Age (years)                         | 4 63.59±11.96               | 101 54.88±12.99                | 0.191   |
| Sex (Male/Female) – n.              | 4 2 (50%)/2 (50%)           | 101 69 (68.3%/32 (31.7%)      | 0.593   |
| Etiology of liver diseases – n.     | 4                            | 101                            | 0.996   |
| - Hepatitis B virus alone           | 2 (50%)                     | 30 (29.7%)                     |         |
| - Hepatitis C virus alone           | 0 (0%)                      | 7 (6.9%)                       |         |
| - Hepatitis B + C virus             | 0 (0%)                      | 3 (3.0%)                       |         |
| - Alcohol                           | 1 (25%)                     | 28 (27.7%)                     |         |
| - Hepatitis B virus + Alcohol       | 0 (0%)                      | 7 (6.9%)                       |         |
Table 7 continued. Comparison between patients with and without clinically significant PVST after excluding splenectomy.

| Variables                                      | Clinically significant PVST | No clinically significant PVST | P value |
|------------------------------------------------|-----------------------------|-------------------------------|---------|
| – Hepatitis C virus + Alcohol                  | 0 (0%)                      | 1 (1.0%)                      |         |
| – Autoimmunity                                 | 0 (0%)                      | 5 (5.0%)                      |         |
| – Drug related                                 | 0 (0%)                      | 2 (2.0%)                      |         |
| – Unknown                                      | 1 (25%)                     | 17 (16.8%)                    |         |
| Disease history – n.                           | 4                           | 101                           |         |
| – Diabetes                                     | 1 (25%)                     | 12 (11.9%)                    | 0.115   |
| – Coronary heart disease                       | 0 (0%)                      | 8 (7.9%)                      | 1.000   |
| – Ischemic stroke                              | 1 (25%)                     | 4 (4.0%)                      | 0.180   |
| – Arterial hypertension                        | 0 (0%)                      | 9 (8.9%)                      | 1.000   |
| – Deep vein thrombosis                         | 0 (0%)                      | 1 (1.0%)                      | 1.000   |
| Surgery history – n.                           | 4                           | 101                           |         |
| – Splenectomy                                  | 0 (0%)                      | 0 (0%)                        | NA      |
| – Appendicectomy                               | 0 (0%)                      | 3 (3.0%)                      | 1.000   |
| – Gastric surgery                              | 0 (0%)                      | 1 (0.9%)                      | 1.000   |
| – Colonic surgery                              | 0 (0%)                      | 1 (1.0%)                      | 1.000   |
| – Orthopedic surgery                           | 0 (0%)                      | 3 (3.0%)                      | 1.000   |
| Acute upper gastrointestinal bleeding – n.      | 4                           | 101                           |         |
| – No                                           | 0 (0%)                      | 46 (45.5%)                    |         |
| – Mild                                         | 3 (75%)                     | 23 (22.8%)                    |         |
| – Moderate-Severe                              | 1 (25%)                     | 32 (31.7%)                    |         |
| Ascites at CT scans – n.                       | 4                           | 101                           | 0.047   |
| – No                                           | 0 (0%)                      | 46 (45.5%)                    |         |
| – Mild                                         | 3 (75%)                     | 23 (22.8%)                    |         |
| - Moderate-Severe                              | 1 (25%)                     | 32 (31.7%)                    |         |
| Hepatic encephalopathy – n.                    | 4                           | 101                           |         |
| – No                                           | 0 (0%)                      | 10 (25%)                      |         |
| – Mild                                         | 0 (0%)                      | 2 (5%)                        |         |
| – Moderate                                     | 0 (0%)                      | 9 (22.5%)                     |         |
| Esophageal varices at endoscopy – n.           | 2                           | 40                            | 0.552   |
| – No                                           | 0 (0%)                      | 10 (25%)                      |         |
| – Mild                                         | 0 (0%)                      | 2 (5%)                        |         |
| – Moderate                                     | 0 (0%)                      | 9 (22.5%)                     |         |
| Red blood cell (10^12/L)                       | 4                           | 98                            | 0.145   |
| Hemoglobin (g/L)                               | 4                           | 98                            | 0.023   |
| White blood cell (10^9/L)                      | 4                           | 98                            | 0.081   |
| Platelet count (10^9/L)                        | 4                           | 98                            | 0.397   |
| Total bilirubin (umol/L)                       | 4                           | 100                           | 0.536   |
| Albumin (g/L)                                  | 4                           | 99                            | 0.050   |
| Alanine aminotransferase (U/L)                 | 4                           | 100                           | 0.265   |
| Aspartate aminotransferase (U/L)               | 4                           | 100                           | 0.297   |
| Alkaline phosphatase (U/L)                     | 4                           | 100                           | 0.415   |
| Gamma-glutamyl transpeptidase (U/L)            | 4                           | 100                           | 0.248   |
| Blood urea nitrogen (mmol/L)                   | 4                           | 98                            | 0.013   |
| Creatinine (umol/L)                            | 4                           | 98                            | 0.542   |
Table 7 continued. Comparison between patients with and without clinically significant PVST after excluding splenectomy.

| Variables                                      | Clinically significant PVST | No clinically significant PVST | p value |
|-----------------------------------------------|----------------------------|--------------------------------|---------|
| Potassium (mmol/L)                            | 4.03±0.38                  | 4.04±0.47                      | 0.969   |
| Sodium (mmol/L)                               | 138.5±2.32                 | 138.00±6.62                    | 0.881   |
| Prothrombin time (seconds)                    | 16.6±3.81                  | 16.33±6.65                     | 0.935   |
| Activated partial thromboplastin time (seconds)| 40.9±8.92                  | 45.30±16.77                    | 0.605   |
| International normalized ratio                | 1.36±0.43                  | 1.35±0.85                      | 0.983   |
| Child-Pugh score                              | 8.6±1.29                   | 7.60±2.10                      | 0.400   |
| Child-Pugh class A/B/C                        | 0 (0%)/3 (75%)/1 (25%)     | 37 (38.5%)/37 (38.5%)/22 (22.9%)| 0.244   |
| MELD score                                    | 6.69±5.18                  | 6.21±7.13                      | 0.895   |
| APRI score                                    | 1.06±0.54                  | 3.17±2.29                      | 0.466   |
| AAR score                                     | 0.47±0.32                  | 1.37±1.73                      | 0.303   |
| FIB-4 score                                   | 6.22±1.25                  | 9.58±9.86                      | 0.503   |
| FI score                                      | –18.5±8.81                 | –25.59±6.77                    | 0.044   |
| King score                                    | 36.38±23.32                | 126.10±315.86                  | 0.573   |
| Maximal diameter of spleen (mm)               | 137.9±15.66                | 140.36±31.26                   | 0.876   |
| Maximal diameter of splenic vein (mm)         | 11.68±4.67                 | 10.64±3.82                     | 0.600   |
| Maximal diameter of main portal vein (mm)     | 18.6±13.06                 | 18.33±4.78                     | 0.919   |
| In-hospital mortality – n.                    | 0 (0%)                     | 4 (4.0%)                       | 1.000   |

score was not entered. Finally, no variables were identified as independent predictors of clinically significant PVST.

Comparison of characteristics between PVST patients with and without splenectomy

PVST patients with splenectomy had significantly higher proportions of clinically significant PVST and RPV thrombosis, higher PLT, and lower MELD and FIB-4 scores than those without (Table 8).

Discussion

Our study found that the prevalence of PVST was 16.8% (19/113) in all patients with liver cirrhosis and was 13.3% (14/105) in cirrhotic patients after excluding splenectomy. We are confident about the data, because axial contrast-enhanced CT scans were used to more objectively detect the presence of PVST. Our data are consistent with a review by Fimognari et al. (5–20%) [4] and suggest that PVST should be a relatively frequent complication of liver cirrhosis.

The most important finding of our study was that splenectomy was a very strong risk factor for the development of PVST in liver cirrhosis. Their association became closer as PVST was more severe (Supplementary Figure 1). In detail, if the severity of PVST was not restricted, the OR for splenectomy was 10.833 and 11.494 in univariate and multivariate analysis, respectively; if only patients with MPV thrombosis >50% were analyzed, the OR for splenectomy was 20.000 and 29.987 in univariate and multivariate analysis, respectively; and if only patients with clinically significant PVST were analyzed, the OR for splenectomy was 25.250 and 40.415 in univariate and multivariate analysis, respectively. In addition, our study demonstrated that cirrhotic patients with splenectomy had more severe PVST but less severe liver dysfunction than those without. Thus, splenectomy might be more independent of liver dysfunction in the development of PVST in liver cirrhosis.

Based on these findings, we should fully balance the clinical benefits and adverse effects of splenectomy in liver cirrhosis. The indications for splenectomy in cirrhosis should be clearly specified. On the other hand, low-quality evidence suggested that the pharmacological prophylaxis of PVST in liver cirrhosis should be effective [36]. Thus, well-designed randomized studies are needed to accurately identify the candidates for and timing of pharmacological prophylaxis of PVST in cirrhotic patients treated with splenectomy. Certainly, when its clinical significance is explained, the regions should be also taken into account.
### Table 8. Comparison between PVST patients with and without splenectomy.

| Variables                        | Splenectomy | No splenectomy | P value |
|----------------------------------|-------------|----------------|---------|
| **N** | **Values**     | **N** | **Values**     |         |
| Age (years) | 5 | 54.46±14.98 | 14 | 52.67±11.69 | 0.787 |
| Sex (Male/Female) – n. | 5 | 2 (40%)/3 (60%) | 14 | 11 (78.6%)/3 (21.4%) | 0.111 |
| Etiology of liver diseases – n. | 5 | 1 (20%) | 14 | 0 (0%) | 0.005 |
| – Hepatitis B virus alone | 0 (0%) | 5 (35.7%) |
| – Hepatitis C virus alone | 0 (0%) | 1 (7.1%) |
| – Hepatitis B + C virus | 1 (20%) | 0 (0%) |
| – Alcohol | 0 (0%) | 5 (35.7%) |
| – Hepatitis B virus + Alcohol | 2 (40%) | 1 (7.1%) |
| – Hepatitis C virus + Alcohol | 0 (0%) | 0 (0%) |
| – Hepatitis B + C virus + Alcohol | 0 (0%) | 0 (0%) |
| – Autoimmunity | 1 (20%) | 0 (0%) |
| – Drug related | 0 (0%) | 0 (0%) |
| – Unknown | 1 (20%) | 2 (14.3%) |
| Disease history – n. | 5 | 14 |
| – Diabetes | 1 (20%) | 2 (14.3%) | 0.764 |
| – Coronary heart disease | 0 (0%) | 0 (0%) | NA |
| – Ischemic stroke | 0 (0%) | 1 (7.1%) | 0.005 |
| – Arterial hypertension | 0 (0%) | 0 (0%) | NA |
| – Deep vein thrombosis | 0 (0%) | 0 (0%) | NA |
| Surgery history – n. | 5 | 14 |
| – Appendicectomy | 0 (0%) | 0 (0%) | NA |
| – Gastric surgery | 0 (0%) | 0 (0%) | NA |
| – Colonic surgery | 0 (0%) | 0 (0%) | NA |
| – Orthopedic surgery | 0 (0%) | 0 (0%) | NA |
| Abdominal trauma history – n. | 5 | 14 |
| – No | 4 (28.6%) | 14 |
| – Mild | 3 (60%) | 6 (42.9%) |
| – Moderate-Severe | 1 (20%) | 4 (28.6%) |
| Acute upper gastrointestinal bleeding – n. | 5 | 14 |
| – No | 1 (20%) | 2 (14.3%) | 0.764 |
| – Mild | 3 (60%) | 6 (42.9%) |
| – Moderate-Severe | 1 (20%) | 4 (28.6%) |
| Esophageal varices at endoscopy – n. | 5 | 5 |
| – No | 0 (0%) | 0 (0%) | 0.565 |
| – Mild | 1 (20%) | 1 (20%) |
| – Moderate | 0 (0%) | 1 (20%) |
| – Severe | 4 (80%) | 2 (60%) |
| Red blood cell ($10^{12}$/L) | 5 | 2.7±0.45 | 13 | 2.92±0.71 | 0.532 |
| Hemoglobin (g/L) | 5 | 73.2±20.08 | 13 | 88.69±28.60 | 0.287 |
| White blood cell ($10^{9}$/L) | 5 | 6.24±2.82 | 13 | 4.85±3.19 | 0.408 |
| Platelet count ($10^{9}$/L) | 5 | 244.4±93.79 | 13 | 58.77±38.48 | <0.001 |
Table 8 continued. Comparison between PVST patients with and without splenectomy.

| Variables                                      | Splenectomy | No splenectomy | P value |
|------------------------------------------------|-------------|----------------|---------|
| Total bilirubin (umol/L)                       | 5           | 14             | 0.356   |
| Albumin (g/L)                                  | 5           | 14             | 0.419   |
| Alanine aminotransferase (U/L)                 | 5           | 14             | 0.710   |
| Aspartate aminotransferase (U/L)               | 5           | 14             | 0.380   |
| Alkaline phosphatase (U/L)                     | 5           | 14             | 0.580   |
| Gamma-glutamyl transpeptidase (U/L)            | 5           | 14             | 0.626   |
| Blood urea nitrogen (mmol/L)                   | 5           | 13             | 0.109   |
| Creatinine (umol/L)                            | 5           | 13             | 0.126   |
| Potassium (mmol/L)                             | 5           | 13             | 0.804   |
| Sodium (mmol/L)                                | 5           | 13             | 0.525   |
| Prothrombin time (seconds)                     | 5           | 13             | 0.371   |
| Activated partial thromboplastin time (seconds)| 5           | 13             | 0.277   |
| International normalized ratio                 | 5           | 13             | 0.427   |
| Child-Pugh score                               | 5           | 13             | 0.193   |
| Child-Pugh class A/B/C                         | 5           | 13             | 0.280   |
| MELD score                                     | 5           | 13             | 0.041   |
| APRI score                                     | 5           | 13             | 0.165   |
| CAR score                                      | 5           | 13             | 0.804   |
| FIB-4 score                                    | 5           | 13             | 0.010   |
| Fl score                                       | 5           | 13             | 0.163   |
| King score                                     | 5           | 13             | 0.410   |
| According to the location of thrombosis        | 5           | 14             | 0.207   |
| – Left portal vein branch thrombosis – n.      | 3           | 4              | 0.211   |
| – Right portal vein branch thrombosis – n.     | 4           | 2              | 0.007   |
| – Main portal vein thrombosis – n.             | 5           | 9              | 0.120   |
| – Superior mesenteric vein thrombosis – n.     | 5           | 4              | 0.089   |
| – Splenic vein thrombosis – n.                 | NA          | 4              | NA      |
| According to the degree of MPV thrombosis      | 5           | 14             | 0.046   |
| – Mural thrombosis (<50%) – n.                 | 1           | 4              | 0.286   |
| – Total thrombosis (100%) – n.                 | 2           | 4              | 0.286   |
| – Cavernous transformation of the portal vein  | 5           | 14             | 0.418   |
| – Maximal diameter of spleen (mm)              | 5           | NA             | 0.857   |
| – Maximal diameter of splenic vein (mm)        | 5           | NA             | NA      |
| – Maximal diameter of main portal vein (mm)    | 5           | 14             | 0.539   |
| In-hospital mortality – n.                     | 5           | 14             | 0.039   |
into account. Splenectomy with porta-azygous devascularization is a major treatment option for portal hypertension and hypersplenism in China and Japan [7,10,11,16,37]. By comparison, it is rarely recommended by the practice guidelines and consensus from Western countries [38–40]. Thus, this finding may be relevant in Western populations.

Theoretically, the portal pressure and risk of portal hypertension-related bleeding may be higher in cirrhotic patients with PVST than in those without. If so, the preventive and therapeutic strategy of variceal bleeding should be actively applied in patients with PVST. In agreement with this, we found a significantly higher proportion of high-risk varices in patients with PVST than in those without, but the statistical significance disappeared in other subgroup analyses due to the relatively small number of patients with MPV thrombosis >50% and clinically significant PVST (Supplementary Figure 2). On the other hand, all patients with clinically significant PVST who underwent endoscopic examinations had high-risk varices. Therefore, they should undergo careful variceal eradication before anticoagulation is initiated for the treatment of PVST in cirrhosis [41–45]. All analyses demonstrated that cirrhotic patients with PVST had significantly lower Hb than those without, which suggested a larger amount of upper gastrointestinal bleeding in patients with PVST. However, the prevalence of AUGIB was statistically similar between patients with and without PVST.

Regardless of splenectomy, all analyses showed no statistically significant association between Child-Pugh score and PVST in liver cirrhosis. Notably, after excluding patients with splenectomy, cirrhotic patients with PVST might have a higher Child-Pugh score than those without. Similarly, all but 1 analyses showed no significant association of MELD score with PVST. Notably, after excluding patients with splenectomy, MELD score was higher in cirrhotic patients PVST than in those without.

Taken together, we should not neglect the role of liver dysfunction in the development of PVST in liver cirrhosis.

A previous study by D’Amico et al. found that PVST is significantly associated with worse short-term prognosis of cirrhotic patients with AUGIB [46]. By comparison, our study population was not restricted to AUGIB. In this setting, the in-hospital mortality was not significantly different between patients with and without PVST. Additionally, long-term outcome was lacking in our study.

Several other limitations should be clarified. First, the concentrations of coagulation and anticoagulation factors were not tested in any patients. Second, several studies suggested that abdominal surgery, such as colon and rectal surgery and sleeve gastrectomy, might increase the risk of PVST [47,48]. However, we did not identify any statistically significant association of appendicectomy and gastric and colonic surgery with the development of PVST in liver cirrhosis. It should be noted that very few patients underwent such abdominal surgery. Finally, the statistical power of our study may have been inadequate.

Conclusions

Splenectomy increases by at least 10-fold the risk of PVST in liver cirrhosis. Given the effect of PVST on the outcomes of liver cirrhosis, physicians should fully balance the benefits and risks of splenectomy for the treatment of portal hypertension and hypersplenism in liver cirrhosis. Further studies are warranted to explore the prevention of PVST after splenectomy.

Conflict of interest

None.

Supplementary Material

Supplementary Table 1. Characteristics of patients after excluding splenectomy.

| Variables                        | N  | Values                        |
|----------------------------------|----|-------------------------------|
| Age (years)                      | 105| 55.21±13.01; 55.19 (22.14–85.46) |
| Sex (Male/Female) – n.           | 105| 71 (67.6%)/34 (32.4%)         |
| Etiology of liver diseases – n.  | 105|                              |
| – Hepatitis B virus alone        | 32 | (30.5%)                       |
| – Hepatitis C virus alone        | 7  | (6.7%)                        |
| – Hepatitis B + C virus          | 3  | (2.9%)                        |
| – Alcohol                        | 30 | (28.6%)                       |
| – Hepatitis B virus + Alcohol    | 7  | (6.7%)                        |

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS] [Index Copernicus]
## Supplementary Table 1 continued. Characteristics of patients after excluding splenectomy.

| Variables | N | Values |
|-----------|---|--------|
| – Hepatitis C virus + Alcohol | 1 | (1%) |
| – Autoimmunity | 5 | (4.8%) |
| – Drug related | 2 | (1.9%) |
| – Unknown | 18 | (17.1%) |
| Disease history – n. | 105 | |
| – Diabetes | 13 | (12.4%) |
| – Coronary heart disease | 8 | (7.6%) |
| – Ischemic stroke | 5 | (4.8%) |
| – Arterial hypertension | 9 | (8.6%) |
| – Abdominal trauma history – n. | 105 | 1 (1%) |
| – Acute upper gastrointestinal bleeding – n. | 105 | 17 (16.2%) |
| – Ascites at CT Scans – n. | 105 | |
| – No | 46 | (43.8%) |
| – Mild | 26 | (24.8%) |
| – Moderate-Severe | 33 | (31.4%) |
| – Hepatic encephalopathy – n. | 104 | 6 (5.8%) |
| – Esophageal varices at endoscopy – n. | 42 | |
| – No | 10 | (23.8%) |
| – Mild | 2 | (4.8%) |
| – Moderate | 9 | (21.4%) |
| – Severe | 21 | (50.0%) |
| Red blood cell (10^12/L) | 102 | 3.42±0.88; 3.38 (1.19–5.27) |
| Hemoglobin (g/L) | 102 | 106.18±30.30; 107 (42–170) |
| White blood cell (10^9/L) | 102 | 4.96±3.21; 4.15 (1.5–20.5) |
| Platelet count (10^9/L) | 102 | 92.97±76.65; 73.5 (11–545) |
| Total bilirubin (umol/L) | 104 | 48.44±71.87; 23.8 (5.1–436.5) |
| Albumin (g/L) | 103 | 32.33±6.67; 32.11 (11.7–44.3) |
| Alanine aminotransferase (U/L) | 104 | 51.61±63.08; 33 (8–429) |
| Aspartate aminotransferase (U/L) | 104 | 74.13±98.12; 47 (10–889) |
| Alkaline phosphatase (U/L) | 104 | 117.67±80.09; 92 (34–524.4) |
| Gamma-glutamyl transpeptidase (U/L) | 104 | 159.73±222.69; 68.5 (12–1130) |
| Blood urea nitrogen (mmol/L) | 102 | 5.80±2.60; 5.26 (1.73–17.18) |
| Creatinine (umol/L) | 102 | 59.42±21.61; 57 (29–151) |
| Potassium (mmol/L) | 103 | 4.04±0.47; 4 (3.01–5.43) |
| Sodium (mmol/L) | 103 | 138.02±6.50; 139.2 (83–144.5) |
**Supplementary Table 1 continued.** Characteristics of patients after excluding splenectomy.

| Variables                                      | N  | Values                        |
|------------------------------------------------|----|-------------------------------|
| Prothrombin time (seconds)                     | 103| 16.34±6.55; 14.8 (11.4–62.8)  |
| Activated partial thromboplastin time (seconds)| 103| 45.13±16.53; 42.1 (29.9–180)  |
| International normalized ratio                 | 103| 1.35±0.84; 1.16 (0.77–7.96)   |
| Child-Pugh score                               | 100| 7.64±2.07; 8 (5–12)           |
| Child-Pugh class A/B/C                         | 100| 37 (37%)/40 (40%)/23 (23%)    |
| MELD score                                     | 100| 6.23±7.04; 4.86 (5.20–34.52)  |
| APRI score                                     | 102| 3.28±6.18; 1.69 (0.10–56.99)  |
| AAR score                                      | 104| 1.33±1.70; 0.72 (0.22–10.08)  |
| FIB-4 score                                    | 102| 9.42±6.68; 6.97 (0.38–61.59)  |
| Fl score                                       | 101| –25.31±6.91; –25.24 (–39.25 – –3.85)|
| King score                                     | 101| 122.54±310.00; 46.97 (1.77–2589.47)|

According to the location of thrombosis

| – Left portal vein branch thrombosis – n.     | 105| 4 (3.8%)                     |
| – Right portal vein branch thrombosis – n.    | 105| 2 (1.9%)                     |
| – Main portal vein thrombosis – n.            | 105| 9 (8.6%)                     |
| – Superior mesenteric vein thrombosis – n.    | 105| 5 (4.8%)                     |

According to the degree of MPV thrombosis

| – Mural thrombosis (<50%) – n.                 | 105| 4 (3.8%)                     |
| – Partial thrombosis (>50%) – n.              | 105| 4 (3.8%)                     |
| – Total thrombosis (100%) – n.                | 105| 1 (11.1%)                    |

Cavernous transformation of the portal vein – n.

| 105 | 3 (2.9%) |

Clinically significant PVST – n.

| 105 | 4 (3.8%) |

Maximal diameter of spleen (mm)

| 105 | 140.27±30.77; 138.2 (83.8–240.9) |

Maximal diameter of splenic vein (mm)

| 105 | 10.68±3.83; 10.3 (4.3–29.6) |

Maximal diameter of main portal vein (mm)

| 105 | 18.34±5.18; 18 (0–31) |

In-hospital mortality – n.

| 105 | 4 (3.8%) |

**Supplementary Figure 1.** The ORs for splenectomy in the development of PVST according to the severity of PVST.
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Supplementary Figure 2. The proportions of degree of esophageal varices in cirrhotic patients with and without PVST. (A) All patients. (B) Patients after excluding splenectomy.
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