ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2021 July 6; 9(19): 4881-5351

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

Contents

Thrice Monthly Volume 9 Number 19 July 6, 2021

OPINION REVIEW

REVIEW

MINIREVIEWS

World Journal of Clinical Cases

Thrice Monthly Volume 9 Number 19 July 6, 2021

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 9 Number 19 July 6, 2021

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 9 Number 19 July 6, 2021

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 9 Number 19 July 6, 2021

Contents

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Fan-Bo Meng, MD, PhD, Chief Doctor, Deputy Director, Professor, Department of Cardiology, China-Japan Union Hospital of Jilin University, Changchun 130000, Jilin Province, China. mengfb@jlu.edu.cn

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The *WJCC* is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2020 Edition of Journal Citation Reports® cites the 2019 impact factor (IF) for *WJCC* as 1.013; IF without journal self cites: 0.991; Ranking: 120 among 165 journals in medicine, general and internal; and Quartile category: Q3. The *WJCC*'s CiteScore for 2019 is 0.3 and Scopus CiteScore rank 2019: General Medicine is 394/529.

RESPONSIBLE EDITORS FOR THIS ISSUE

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

EDITORS-IN-CHIEF
Dennis A Bloomfield, Sandro Vento, Bao-Gan Peng

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2307-8960/editorialboard.htm

PUBLICATION DATE
July 6, 2021

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

E-mail: bpgoffice@wjgnet.com https://www.wjgnet.com

World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

World J Clin Cases 2021 July 6; 9(19): 5179-5190

DOI: 10.12998/wjcc.v9.i19.5179

ISSN 2307-8960 (online)

SYSTEMATIC REVIEWS

Systematic review and meta-analysis of trans-jugular intrahepatic portosystemic shunt for cirrhotic patients with portal vein thrombosis

Jian-Bin Zhang, Jie Chen, Jin Zhou, Xu-Ming Wang, Shu Chen, Jian-Guo Chu, Peng Liu, Zhi-Dong Ye

ORCID number: Jian-Bin Zhang 0000-0001-5586-5616; Jie Chen 0000-0003-4164-4526; Jin Zhou 0000-0002-3455-3581; Xu-Ming Wang 0000-0002-6462-1004; Shu Chen 0000-0001-9596-4264; Jian-Guo Chu 0000-0002-4815-1129; Peng Liu 0000-0002-2653-0718; Zhi-Dong Ye 0000-0002-1282-3261.

Author contributions: Zhang JB, Chen J, and Zhou J contributed equally to this work; Zhang JB, Chen J, Zhou J, and Ye ZD designed the research study; Zhang JB, Chen J, Zhou J, Wang XM, and Chen S performed the research; Chu JG and Liu P contributed new reagents and analytic tools; Zhang JB, Chen J, Zhou J, and Chen S analyzed the data and wrote the manuscript; All authors have read and approved the final manuscript.

Conflict-of-interest statement: The authors have no conflicts of interests or financial disclosures relevant to this manuscript.

PRISMA 2009 Checklist statement: The authors have read the PRISMA 2009 Checklist, and the manuscript was prepared and revised according to the PRISMA 2009 Checklist.

Open-Access: This article is an

Jian-Bin Zhang, Jie Chen, Jin Zhou, Xu-Ming Wang, Peng Liu, Zhi-Dong Ye, Department of Cardiovascular Surgery, China-Japan Friendship Hospital, Beijing 100029, China

Shu Chen, Department of Interventional Radiology, Affiliated People's Hospital of Inner Mongolia Medical University, Hohhot 010020, Inner Mongolia Autonomous Region, China

Jian-Guo Chu, Department of Radiology, Air Force Medical Center of PLA, Beijing 100142, China

Corresponding author: Zhi-Dong Ye, MD, Chief Doctor, Department of Cardiovascular Surgery, China-Japan Friendship Hospital, No. 2 Yinghua East Street, Beijing 100029, China. yezhidong6618@yeah.net

Abstract

BACKGROUND

Portal vein thrombosis (PVT) was previously a contraindication for trans-jugular intrahepatic portosystemic shunt (TIPS).

AIM

To perform a systematic review and meta-analysis of the current available studies investigating outcomes of TIPS for cirrhotic patient with PVT.

METHODS

Multiple databases were systematically searched to identify studies investigating the outcomes of TIPS for cirrhotic patients with PVT. The quality of studies was assessed by Cochrane Collaboration method and Methodological Index for Non-Randomized Studies. The demographic data, outcomes, combined treatment, and anticoagulation strategy were extracted.

RESULTS

Twelve studies were identified with 460 patients enrolled in the analysis. The technical success rate was 98.9% in patients without portal vein cavernous transformation and 92.3% in patients with portal vein cavernous transformation. One-year portal vein recanalization rate was 77.7%, and TIPS patency rate was 84.2%. The cumulative encephalopathy rate was 16.4%. One-year overall survival was 87.4%.

Manuscript source: Unsolicited manuscript

Specialty type: Medicine, research and experimental

Country/Territory of origin: China

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): 0
Grade D (Fair): 0
Grade E (Poor): 0

Received: February 13, 2021
Peer-review started: February 13, 2021
First decision: March 14, 2021
Revised: March 21, 2021
Accepted: April 25, 2021
Article in press: April 25, 2021
Published online: July 6, 2021

P-Reviewer: Garbuzenko DV
S-Editor: Gao CC
L-Editor: Filipodia
P-Editor: Wang LL

CONCLUSION

TIPS is indicated for portal hypertension related complications and the restoration of pre-transplantation portal vein patency in cirrhotic patients with PVT. Cavernous transfor-mation is an indicator for technical failure. Post-TIPS antico-agulation seems not mandatory. Simultaneous TIPS and percutaneous mechanical thrombectomy device could achieve accelerated portal vein recanalization and decreased thrombolysis-associated complications, but further investigation is still needed.

Key Words: Trans-jugular intrahepatic portosystemic shunt; Portal vein thrombosis; Liver cirrhosis; Systematic review; Meta-analysis

Core Tip: Trans-jugular intrahepatic portosystemic shunt (TIPS) is indicated for portal hypertension related complications and the restoration of pre-transplantation portal vein patency in cirrhotic patients with portal vein thrombosis. Cavernous transformation is an indicator for technical failure. Post-TIPS anticoagulation seems not mandatory. Simultaneous TIPS and percutaneous mechanical thrombectomy device could achieve accelerated portal vein recanalization and decreased thrombolysis-associated complications, but further investigation is still needed.

Citation: Zhang JB, Chen J, Zhou J, Wang XM, Chen S, Chu JG, Liu P, Ye ZD. Systematic review and meta-analysis of trans-jugular intrahepatic portosystemic shunt for cirrhotic patients with portal vein thrombosis. *World J Clin Cases* 2021; 9(19): 5179-5190
URL: https://www.wjgnet.com/2307-8960/full/v9/i19/5179.htm
DOI: https://dx.doi.org/10.12998/wjcc.v9.i19.5179

INTRODUCTION

Portal vein thrombosis (PVT) refers to thrombosis within the portal vein, including main trunk, splenic, or mesenteric vein. The prevalence of PVT in cirrhotic patients can reach to 36%, depending on the severity of liver disease and diagnostic method[1,2]. Trans-jugular intrahepatic portosystemic shunt (TIPS) is indicated for cirrhotic patients with refractory ascites and variceal bleeding not controlled with medical or endoscopic therapy[3,4].

In cirrhotic patients with PVT, increased portal hypertension, decreased liver perfusion, and worsened liver function may occur[5]. Initially, PVT was regarded as contraindication for TIPS because of the technical difficulties, especially in patients with portal vein cavernous transformation[6]. However, some investigator attempted to carry out TIPS in cirrhotic patients with PVT and achieved good results[7]. The theoretical basis is that TIPS can increase portal blood velocity, resulting in clot resorption and portal vein recanalization.

However, most of the relevant studies were anecdote-based, and the sample sizes were relatively small. At present, only limited data are available for TIPS in cirrhotic patients with PVT. Therefore, we wanted to review systematically the published data of TIPS for cirrhotic patients with PVT.

MATERIALS AND METHODS

Literature search

MEDLINE, CNKI, Google Scholar, EMBASE, and Cochrane database were systematically searched for all relevant published studies evaluating outcomes following TIPS in cirrhotic patients with PVT. Several combinations of search terms were used, including "trans-jugular intrahepatic portosystemic shunt," "portal vein thrombosis," "cavernous transformation," "liver cirrhosis," "variceal bleeding," and "early TIPS." Moreover, some journals in interventional radiology, gastroenterology, and vascular

surgery were reviewed manually for relative articles.

Study selection

Titles and abstracts of the papers were screened first. Only studies evaluating outcomes following TIPS in cirrhotic patients with PVT were included. Case reports and review articles were excluded.

Quality assessment and data extraction

Quality of randomized controlled trials were assessed using Cochrane Collaboration method. Quality of non-randomized studies were assessed using Methodological Index for Non-Randomized Studies scale[8].

Demographics and outcome data were extracted for each eligible paper. Demographic data included: (1) etiology of liver cirrhosis, (2) symptom and comorbidity, (3) thrombosis characteristics, (4) technical details, and (5) periprocedural anticoagulative strategies. Outcome data included: (1) technical success rate, (2) portal vein recanalization rate, (3) TIPS patency, (4) hepatic encephalopathy rate, and (5) survival.

Statistical analysis

Intraclass correlation coefficient was calculated for evaluating the level of agreement between investigators assessing the study quality. means ± SD of both Methodological Index for Non-Randomized Studies score and Cochrane Collaboration method score were calculated.

Funnel plot was used for assessing publication bias. Study heterogeneity was tested using Q statistic, with $P < 0.1$ indicating significance. SPSS 22 (SPSS Inc., Armonk, NY, United States) and Open Meta-Analyst software (http://www.cebm.brown.edu/openmeta/download.html) were used for data analysis.

RESULTS

Eligible study

Twelve papers published over the past 15 years, reporting a total of 460 patients, were included in the study[1,2,4,9-17] (Figure 1). The included study characteristics are shown in Table 1. Of these studies, nine were retrospective and three were randomized controlled trials[1,12,13]. All these studies evaluated TIPS for PVT in liver cirrhotic patients; one was for pre-transplantation patients.

Except for one that did not report indication[13], the main indication for TIPS was to treat complications of portal hypertension. Treating gastrointestinal variceal bleeding or preventing re-bleeding was reported in 77.01% of patients, and treating refractory ascites or pleural effusion was reported in 15.82% of patients. In one study[17], TIPS was utilized for the restoration of portal vein patency.

Demographics and results of the included studies are shown in Table 2.

Technical success rate

The overall technical success rate for TIPS was 94.6% (435/460) for all the included studies. In patients with portal vein cavernous transformation, the lowest technical success rate was 53.33%, as reported by Han *et al*[9]. The cumulative technical success rate was 98.9% in patients without portal vein cavernous transformation and 92.3% in patients with portal vein cavernous transformation[1,2,11,14,16]. Most of the TIPS was achieved through a traditional trans-jugular approach; trans-hepatic and trans-splenic approach was employed to facilitate portal recanalization or to target the punctured vessel.

Portal vein recanalization and TIPS patency

One-year portal vein recanalization rate was 77.7%, and TIPS patency rate was 84.2%. TIPS combined with AngioJet thrombectomy device was reported by Zhang *et al*[16], and the portal vein recanalization rate was reported to be 81.8%. Luca *et al*[11] reported that independent predictors for portal vein recanalization were thrombosis of a single vein, PVT severity of grade I, *de novo* diagnosis of PVT, and absence of gastroesophageal varices.

Hepatic encephalopathy

Nine studies[1,4,9-13,16,17] reported hepatic encephalopathy rate. The highest 1-year

Table 1 Characteristics of the included studies

Ref.	Time period	Publication year	Country	Design	Inclusion criteria	Exclusion criteria	End point
Han *et al*[9]	December 2001-September 2008	2011	China	Retrospective	Definite diagnosis of PVT; concomitant decompensated cirrhosis; absence of malignancy; absence of previous primary thrombosis of the hepatic vessels; absence of pancreatitis, appendicitis, and splenectomy by trauma	Patients with thrombosis, in other segments of the portal system rather than the main portal vein (MPV) or with MPV stenosis < 50% within MPV	Technical success and portal vein recanalization; procedure-related complications; shunt dysfunction and revision; hepatic encephalopathy; overall survival
Perarnau *et al*[10]	1990-2004	2010	France	Retrospective	Patient received TIPS with complete portal thrombosis	Lack of cirrhosis (Chiari syndrome, noncirrhotic portal hypertension, metastatic breast cancer); TIPS performed in transplanted liver; hepatocellular carcinoma; unfulfilled medical records	Technical success; early complications; long-term patency; hepatic encephalopathy; survival
Luca *et al* [11]	January 2003-February 2010	2011	Italy	Retrospective	Patient have associated portal vein thrombosis prior to TIPS	Non-cirrhotic patient; Thrombosis limited to right and/or left portal branch; hepatocellular carcinoma; did not undergo imaging study prior or after TIPS	Technical success; recanalization of portal vein; complications and survival
Van Ha *et al*[4]	December 1995-December 2003	2006	United States	Retrospective	Liver cirrhotic patient with portal vein thrombosis received TIPS	N/A	Technical success; TIPS patency; hepatic encephalopathy; survival
Luo *et al*[1]	January 2010-December 2012	2015	China	RCT	Patients with cirrhosis and PVT, aged 18-70 yr, previous episodes of variceal bleeding, and a Child-Pugh score of 7-13	PVT of 25% or less within the vessel lumen; limited thrombosis in the intrahepatic portal branch; portal cavernoma; gastric varices; hepatocellular carcinoma; previous endoscopic treatment of varices within 3 mo; and contradictions to TIPS, EBL, or propranolol	The primary end point was the incidence of recurrent variceal bleeding. The secondary end points were incidence of TIPS dysfunction, recanalization of the portal venous system, occurrence of hepatic encephalopathy, or death for any reason
Wang *et al* [2]	January 2010-September 2010	2014	China	Retrospective	Patients with cirrhosis and concomitant PVT who underwent successful TIPS creation	N/A	Rebleeding events; changes in PVT; survival
Lv *et al*[12]	May 2011-January 2014	2017	China	RCT	Liver cirrhosis (diagnosed by clinical presentations, laboratory tests, images or liver biopsies), age between 18 and 75 yr, PVT > 50% of the portal vein trunk and a history of endoscopy-proven variceal bleeding in the past 6 wk	Uncontrolled active variceal bleeding; technical impracticality of TIPS; previous EBL + NSBB, TIPS placement or shunt surgery; concomitant renal insufficiency; severe cardiopulmonary diseases; uncontrolled systemic infection or sepsis; hepatocellular carcinoma or other extrahepatic malignancy; and contraindications for propranolol, anticoagulation or TIPS	The primary endpoint was variceal rebleeding; The secondary endpoints included survival, overt hepatic encephalopathy, portal vein recanalization and re-thrombosis, other complications of portal hypertension and adverse effects
Wang *et al* [13]	October 2012-February 2014	2016	China	RCT	Patients with cirrhosis and PVT who were undergoing TIPS placement	Technical failure of TIPS; a thrombus limited to the intrahepatic portal branches; diffuse PVT involving the entire portal venous system; a contraindication to anticoagulation therapy; already undergoing anticoagulation or antiplatelet aggregation therapy; platelet count of less than 20000/mm^3 or international normalized ratio greater than 2;	The primary outcome measure was a change in portal vein patency status; secondary outcomes were gastrointestinal bleeding, shunt dysfunction, hepatic encephalopathy, and survival

						a malignancy or myeloproliferative disorder; refusal to participate or enroll in another prospective study	
Lakhoo and Gaba [14]	December 2008-March 2014	2016	United States	Retrospective	Patient underwent TIPS for PVT	Patients who lacked cross-sectional imaging follow-up after TIPS	The primary endpoint was post-TIPS spleno-mesenteric-portal venous patency; Secondary endpoint included durability of patency, patient transplant free survival, liver transplant rate, and post-TIPS variceal bleeding incidence
Modaresi Esfeh and Ansari-Gilani[15]	January 2020-December 2018	2020	United States	Retrospective	Patient with PVT before TIPS placement	N/A	Primary endpoint was recanalization of the portal vein within the first year following TIPS placement
Zhang *et al* [16]	March 2018-April 2019	2020	China	Retrospective	Clearly diagnosed cirrhotic patient with portal vein thrombosis (≤ 2 wk), with visceral bleeding or ascites; thrombosis involved at least 2 branches of superior mesenteric vein, splenic vein and inferior mesenteric vein; contraindication for catheter-directed thrombosis	Merely mural portal thrombosis or the thrombosis is regional; sub-acute or chronic PVT; patient without cirrhosis and portal hypertension; above Child-Pugh C category or coagulation disorders	Portal vein recanalization; TIPS patency; peri-operative complications; encephalopathy
Thornburg *et al*[17]	2009-2015	2017	United States	Retrospective	Medical need for transplantation and presence of chronic PVT on pre-operative imaging	The inability to be listed for transplantation for reasons other than the presence of PVT and complete, chronic portomesenteric thrombosis precluding catheterization of the portal vein or splenic vein	Portal vein and TIPS patency before and after transplantation; clinical and laboratory adverse events; survival

EBL: Endoscopic banding ligation; MPV: Main portal vein; N/A: Not applicable; NSBB: Non-selective beta-blocker; PVT: Portal vein thrombosis; RCT: Randomized controlled trial; TIPS: Trans-jugular intrahepatic portosystemic shunt.

hepatic encephalopathy rate was 27%, reported by Luca *et al*[11]. The overall 1-year encephalopathy rate was 16.4%. The highest 2-year encephalopathy rate was 38.5%, reported by Luo *et al*[1].

Survival

Most of the studies reported 1-year survival rates, and they ranged from 75% to 98.4%. The overall 1-year survival was 87.4%. Two studies[9,17] reported a 5-year survival rates of 82% and 76.7%, respectively. Han *et al*[9] reported that both technical success and survival were closely associated with the degree of main portal vein occlusion.

Anticoagulation strategy

Most studies did not have unified standard for anticoagulation strategy. Only one study[13] evaluated whether post-TIPS anticoagulation was necessary. The result showed that anticoagulation therapy may not be necessary in certain patients with PVT because TIPS placement alone can achieve a high persistent recanalization rate.

DISCUSSION

The primary etiology of PVT is decompensated cirrhosis, especially those with splenectomy. Patients with prior splenectomy have a higher incidence of PVT, which can influence the technical success and patency rate of TIPS[18]. We suggest that patients with portal hypertension should avoid splenectomy if they plan to receive TIPS treatment.

Table 2 Demographics and results of the included studies

Ref.	No.	Male, *n*	Age in yr	TIPS success rate, %	Cavernoma, *n*	1-yr portal vein recanalization rate, %	2-yr portal vein recanalization rate, %	1-yr TIPS patency, %	Encephalopathy rate, %	Survival rate, %	Combined treatment	Follow-up time
Han *et al*[9]	57	20	50.9 ± 1.6	75	30	100	68.2	79.3	1-yr 25; 2-yr 27	1-yr 86.1; 5-yr 76.7	Anti-coagulation, heparin-warfarin-aspirin	5 yr
Perarnau *et al*[10]	34	18	58 ± 11	79	19	N/A	N/A	72	6.9	1-yr 80; 4-yr 55	Heparin for 10 d, prolong to 20 d in patients with thrombocytopenia	4 yr
Luca *et al*[11]	70	47	55 ± 8	100	0	51	81	64.3	1-yr 27; 2-yr 32	1-yr 89; 2-yr 81	N/A	4 yr
Van Ha *et al*[4]	15	13	53	86.7	4	N/A	N/A	92.3	7.7	76.9	Heparin-warfarin in 2 cases, heparin in 2 cases	Mean 17 mo
Luo *et al*[1]	37	19	50.78 ± 13.61	100	0	64.9	71.3	91.7	1-yr 16.2; 2-yr 38.5	1-yr 86.5; 2-yr 72.9	Low molecular weight heparin for 3 d, bridge to warfarin for at least 6 mo	2 yr
Wang *et al*[2]	25	14	47.28 ± 12.36	100	0		N/A	87	N/A	1-yr 96; 3-yr 39.3	Long-term warfarin	3 yr
Lv *et al*[12]	24	13	49 (46-62)	96	11	87	80	82.6	26.1	1-yr 83.5; 2-yr 73	Thrombolysis in 5 cases, anti-coagulation in 22 cases	2 yr
Wang *et al*[13]	64	38	54.76	100	4	76.6	N/A	92.2	1-yr 20.3	1-yr 98.4	Anti-coagulation in 31 cases	1 yr
Lakhoo and Gaba [14]	12	5	63	100	0	58.3	N/A	92	N/A	75%	Anti-coagulation in 3 cases	Median 109 d
Modaresi Esfeh and Ansari-Gilani[15]	50	34	55.3 ± 11	100	N/A	68	N/A	N/A	N/A	N/A	N/A	N/A
Zhang *et al*[16]	11	6	46 ± 9	100	0	81.8	N/A	81.8	18.2	N/A	AngioJet and anti-coagulation	1 yr
Thornburg *et al*[17]	61	37	58 (median)	98	29	92	N/A	92	18	5-yr 82	N/A	5 yr

N/A: Not applicable; TIPS: Trans-jugular intrahepatic portosystemic shunt.

PVT in cirrhotic patients is most often asymptomatic and detected incidentally on routine ultrasound[19]. Spontaneous resolution occurs in approximately 40% of PVT [20]. Symptoms may vary from asymptomatic to life-threatening conditions related to portal hypertension and hepatic decompensation[21]. The treatment strategy for PVT includes anti-coagulation, thrombolysis, and thrombectomy. TIPS is an effective adjunctive therapy to recanalize the portal vein and reduce portal hypertension. For PVT patients with obvious portal hypertensive symptoms, such as recurrent

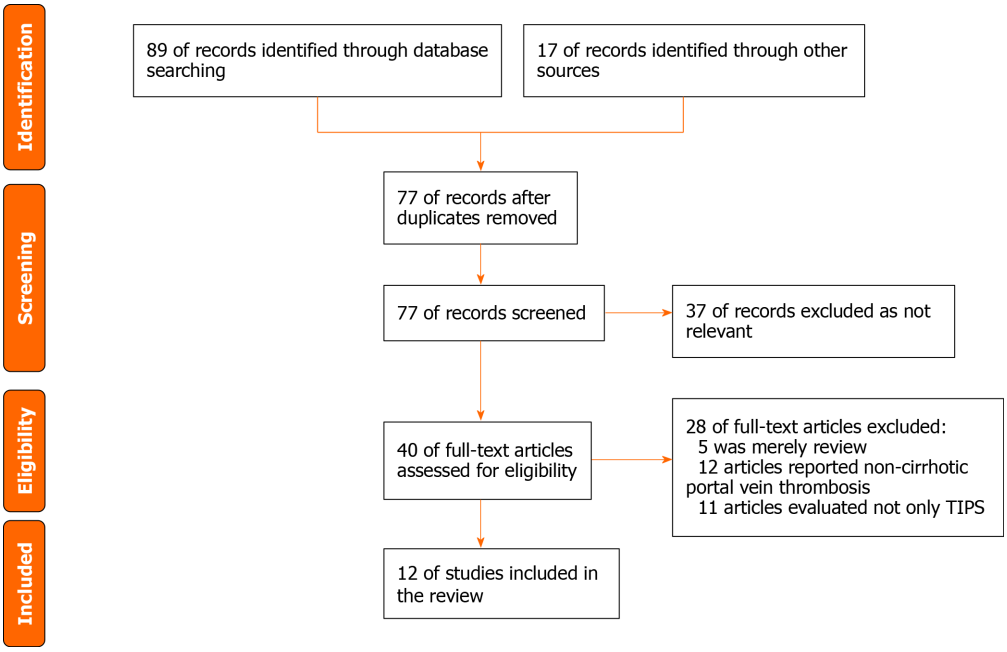


Figure 1 PRISMA flow chart for the selection process. TIPS: Trans-jugular intrahepatic portosystemic shunt.

gastrointestinal bleeding or refractory ascites, TIPS is the only way to improve hepatopetal flow and offers a low-resistance outflow channel.

TIPS placement is challenging in advanced occlusive PVT thrombosis and portal vein cavernous transformation. As the current study reported, the lowest technical success rate was reported to be 53.33% in portal vein cavernous transformation[9]. Some investigators regarded portal cavernous transformation as a contraindication for TIPS because the original portal vein has been obliterated or has become a fibrotic cord [22]. It has come a long way from being a contraindication to an indication because of technical difficulties and frequent procedure related complications. Combined trans-jugular/trans-hepatic or trans-jugular/trans-splenic approach could improve technical success rate[23].

The successful employment of percutaneous mechanical thrombectomy device in PVT has been reported[24,25]. It is more suitable for acute or subacute PVT with accelerated portal vein recanalization and decreased thrombolysis-associated complications. Simultaneous creation of TIPS could reconstruct portal outflow and further improve therapeutic effect. But most of the associated studies were case reports or small case series. Larger patient cohorts should be evaluated for further analysis.

PVT was thought to have a negative impact on liver cirrhosis progression and patient survival because it further increased portal hypertension, which may lead to life-threating complications and worsening liver function[21]. A meta-analysis including 2436 cirrhotic patients suggested that PVT appears to increase mortality and ascites[26]. In the current study, TIPS could not improve the survival of cirrhotic patients with PVT but could alleviate the portal hypertension related complications and improve quality of life, without an increase in hepatic encephalopathy.

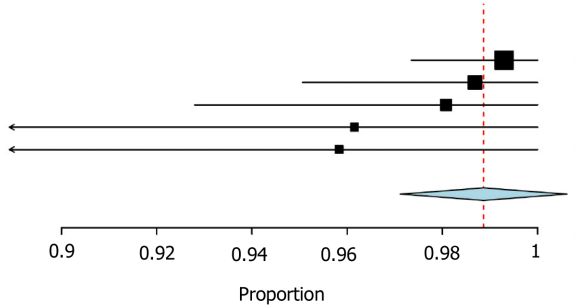
Another indication of TIPS for cirrhotic patients with PVT was to maintain pre-transplantation portal vein patency. Portal vein recanalization-TIPS is a concept aimed at achieving portal vein recanalization in chronic PVT[27]. In these patients, the stent should be implanted in the main portal vein as short as possible to reserve sufficient non-stented PV for end-to-end anastomosis during liver transplantation.

Wang *et al*[13] suggested that increased portal blood velocity after TIPS may offset the hypercoagulable state and result in portal recanalization even without anticoagulation. In addition, the safety of anticoagulation drugs is also a problem, especially in cirrhotic patients. The study, however, did not included PVT in the entire portal venous system because TIPS procedure in those patients is quite difficult. Thus, the value of post-TIPS anticoagulation should be further investigated in patients with diffuse PVT.

Limitations may exist in our study. First, the pooled analysis was based on study-level data (Figure 2). Second, only three of the included studies were random controlled trials, and the others were retrospective cohort studies. Therefore, heterogeneity may exist among the studies.

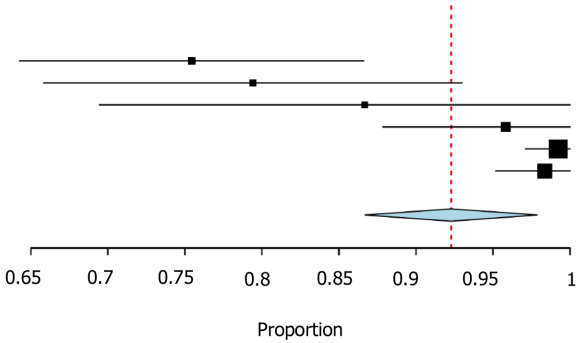
A Technical success rate without portal vein cavernous transformation

Studies	Estimate (95%CI)	Ev/Trt
Luca *et al* 2011	0.993 (0.974, 1.000)	70/70
Luo *et al* 2015	0.987 (0.951, 1.000)	37/37
Wang *et al* 2014	0.981 (0.928, 1.000)	25/25
Lakhoo *et al* 2016	0.962 (0.857, 1.000)	12/12
Zhang *et al* 2020	0.958 (0.845, 1.000)	11/11
Overall (I^2 = 521 % , P = 0.937)	**0.989 (0.971, 1.006)**	**155/155**



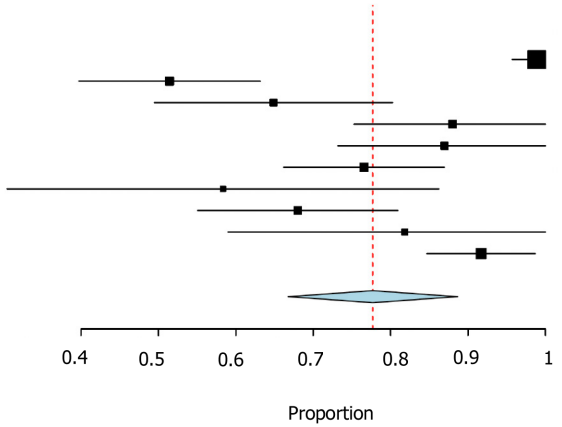
B Technical success rate with portal vein cavernous transformation

Studies	Estimate (95%CI)	Ev/Trt
Han *et al* 2011	0.754 (0.643, 0.866)	43/57
Perarnau *et al* 2010	0.794 (0.658, 0.930)	27/34
Van Ha *et al* 2006	0.867 (0.695, 1.000)	13/15
Lv *et al* 2017	0.958 (0.878, 1.000)	23/24
Wang *et al* 2016	0.992 (0.971, 1.000)	64/64
Thrunbur *et al* 2017	0.984 (0.952, 1.000)	60/61
Overall (I^2 = 8085 % , P < 0.001)	**0.923 (0.867, 0.979)**	**230/255**



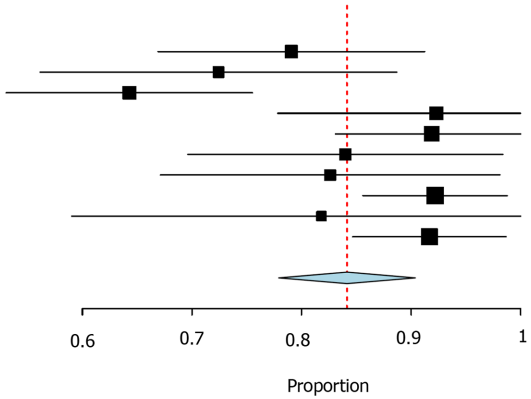
C 1-yr portal vein recanalization rate

Studies	Estimate (95%CI)	Ev/Trt
Han *et al* 2011	0.989 (0.957, 1.000)	43/43
Luca *et al* 2011	0.514 (0.397, 0.631)	36/70
Luo *et al* 2015	0.649 (0.495, 0.802)	24/37
Wang *et al* 2014	0.880 (0.753, 1.000)	22/25
Lv *et al* 2017	0.870 (0.732, 1.000)	20/23
Wang *et al* 2016	0.766 (0.662, 0.869)	49/64
Lakhoo *et al* 2016	0.583 (0.304, 0.862)	7/12
Modaresi Esfeh *et al* 2020	0.680 (0.551, 0.809)	34/50
Zhang *et al* 2020	0.818 (0.590, 1.000)	9/11
Thronburg *et al* 2017	0.917 (0.847, 0.987)	55/60
Overall (I^2 = 9145 % , P < 0.001)	**0.777 (0.667, 0.887)**	**299/395**



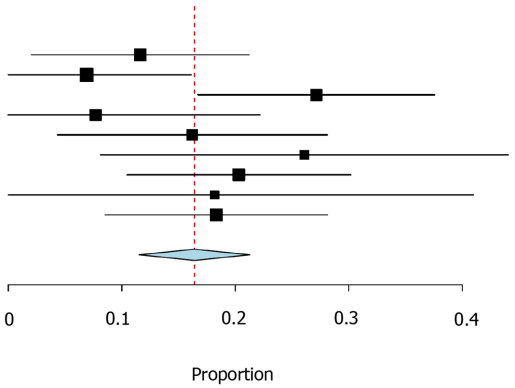
D 1-yr TIPS patency rate

Studies	Estimate (95%CI)	Ev/Trt
Han *et al* 2011	0.791 (0.669, 0.912)	34/43
Perarnau *et al* 2010	0.724 (0.561, 0.887)	21/29
Luca *et al* 2011	0.643 (0.531, 0.755)	45/70
Van Ha *et al* 2006	0.923 (0.778, 1.000)	12/13
Luo *et al* 2015	0.919 (0.831, 1.000)	34/37
Wang *et al* 2014	0.840 (0.696, 0.984)	21/25
Lv *et al* 2017	0.826 (0.671, 0.981)	19/23
Wang *et al* 2016	0.922 (0.856, 0.988)	59/64
Zhang *et al* 2020	0.818 (0.590, 1.000)	9/11
Thronburg *et al* 2017	0.917 (0.847, 0.987)	55/60
Overall (I^2 = 6654 %, P = 0.001)	**0.842 (0.779, 0.904)**	**309/375**



E 1-yr encephalopathy rate

Studies	Estimate (95%CI)	Ev/Trt
Han *et al* 2011	0.116 (0.020, 0.212)	5/43
Perarnau *et al* 2010	0.069 (0.000, 0.161)	2/29
Luca *et al* 2011	0.271 (0.167, 0.376)	19/70
Van Ha *et al* 2006	0.077 (0.000, 0.222)	1/13
Luo *et al* 2015	0.162 (0.043, 0.281)	6/37
Lv *et al* 2017	0.261 (0.081, 0.440)	6/23
Wang *et al* 2016	0.203 (0.105, 0.302)	13/64
Zhang *et al* 2020	0.182 (0.000, 0.410)	2/11
Thronburg *et al* 2017	0.183 (0.085, 0.281)	11/60
Overall (I^2 = 3545 % , P = 0.134)	**0.164 (0.115, 0.213)**	**65/350**



F 1-yr survival rate

Studies	Estimate (95%CI)	Ev/Trt
Han *et al* 2011	0.837 (0.727, 0.948)	36/43
Perarnau *et al* 2010	0.793 (0.646, 0.941)	23/29
Luca *et al* 2011	0.886 (0.811, 0.960)	62/70
Van Ha *et al* 2006	0.769 (0.540, 0.998)	10/13
Luo *et al* 2015	0.865 (0.755, 0.975)	32/37
Lv *et al* 2017	0.652 (0.458, 0.847)	15/23
Wang *et al* 2016	0.984 (0.954, 1.000)	63/64
Lakhoo *et al* 2016	0.750 (0.505, 0.995)	9/12
Thronburg *et al* 2017	0.967 (0.921, 1.000)	58/60
Overall (I^2 = 7565 % , P < 0.001)	**0.874 (0.813, 0.935)**	**308/351**

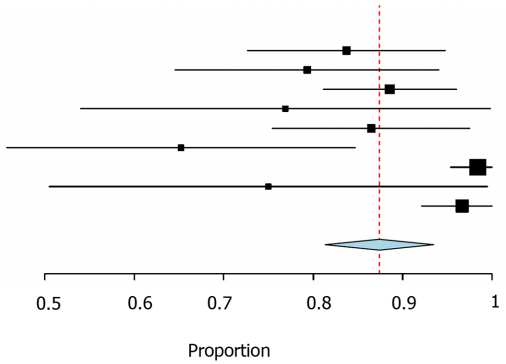


Figure 2 Forrest plots of pooled analysis. A: Technical success rate without portal vein cavernous transformation; B: Technical success rate with portal vein cavernous transformation; C: 1-yr portal vein recanalization rate; D: 1-yr TIPS patency rate; E: 1-yr encephalopathy rate; F: 1-yr survival rate. CI: Confidence interval; TIPS: Trans-jugular intrahepatic portosystemic shunt.

CONCLUSION

In conclusion, TIPS is indicated for portal hypertension related complications and the restoration of pre-transplantation portal vein patency in cirrhotic patients with PVT. Cavernous transformation is an indicator for technical failure. Post-TIPS anticoagulation seems not mandatory. Simultaneous TIPS and percutaneous mechanical thrombectomy device could achieve accelerated portal vein recanalization and decreased thrombolysis-associated complications, but further investigation is still needed.

ARTICLE HIGHLIGHTS

Research background

In clinical practice, portal vein thrombosis (PVT) was previously a contraindication for trans-jugular intrahepatic portosystemic shunt (TIPS).

Research motivation

Evaluating TIPS utility in the management of cirrhotic patients with PVT.

Research objectives

To review systematically the current evidence of TIPS in the management of cirrhotic patients with PVT.

Research methods

Search and evaluate the relevant published paper and then extract and analyze the key data.

Research results

TIPS can be safely carried out using a different approach in cirrhotic patient with PVT. However, in patients with cavernous transformation, it is relatively difficult.

Research conclusions

TIPS is indicated for portal hypertension related complications and the restoration of pre-transplantation portal vein patency in cirrhotic patients with PVT. Cavernous transformation is an indicator for technical failure.

Research perspectives

TIPS could be carried out in most of cirrhotic patients with PVT. We plan to carry out a similar study with a prospective design to evaluate TIPS utility for patients with PVT.

REFERENCES

1 **Luo X**, Wang Z, Tsauo J, Zhou B, Zhang H, Li X. Advanced Cirrhosis Combined with Portal Vein Thrombosis: A Randomized Trial of TIPS *vs* Endoscopic Band Ligation Plus Propranolol for the Prevention of Recurrent Esophageal Variceal Bleeding. *Radiology* 2015; **276**: 286-293 [PMID: 25759969 DOI: 10.1148/radiol.15141252]

2 **Wang Z**, Zhao H, Wang X, Zhang H, Jiang M, Tsauo J, Luo X, Yang L, Li X. Clinical outcome comparison between TIPS and EBL in patients with cirrhosis and portal vein thrombosis. *Abdom Imaging* 2015; **40**: 1813-1820 [PMID: 25504374 DOI: 10.1007/s00261-014-0320-9]

3 **García-Pagán JC**, Caca K, Bureau C, Laleman W, Appenrodt B, Luca A, Abraldes JG, Nevens F, Vinel JP, Mössner J, Bosch J; Early TIPS (Transjugular Intrahepatic Portosystemic Shunt) Cooperative Study Group. Early use of TIPS in patients with cirrhosis and variceal bleeding. *N Engl J Med* 2010; **362**: 2370-2379 [PMID: 20573925 DOI: 10.1056/NEJMoa0910102]

4 **Van Ha TG**, Hodge J, Funaki B, Lorenz J, Rosenblum J, Straus C, Leef J. Transjugular intrahepatic portosystemic shunt placement in patients with cirrhosis and concomitant portal vein thrombosis. *Cardiovasc Intervent Radiol* 2006; **29**: 785-790 [PMID: 16850140 DOI: 10.1007/s00270-005-0090-4]

5 **Englesbe MJ**, Kubus J, Muhammad W, Sonnenday CJ, Welling T, Punch JD, Lynch RJ, Marrero JA, Pelletier SJ. Portal vein thrombosis and survival in patients with cirrhosis. *Liver Transpl* 2010; **16**: 83-90 [PMID: 20035521 DOI: 10.1002/lt.21941]

6 **Copelan A**, Kapoor B, Sands M. Transjugular intrahepatic portosystemic shunt: indications, contraindications, and patient work-up. *Semin Intervent Radiol* 2014; **31**: 235-242 [PMID: 25177083 DOI: 10.1055/s-0034-1382790]

7 **Senzolo M**, Tibbals J, Cholongitas E, Triantos CK, Burroughs AK, Patch D. Transjugular intrahepatic portosystemic shunt for portal vein thrombosis with and without cavernous transformation. *Aliment Pharmacol Ther* 2006; **23**: 767-775 [PMID: 16556179 DOI: 10.1111/j.1365-2036.2006.02820.x]

8 **Slim K**, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (minors): development and validation of a new instrument. *ANZ J Surg* 2003; **73**: 712-716 [PMID: 12956787 DOI: 10.1046/j.1445-2197.2003.02748.x]

9 **Han G**, Qi X, He C, Yin Z, Wang J, Xia J, Yang Z, Bai M, Meng X, Niu J, Wu K, Fan D. Transjugular intrahepatic portosystemic shunt for portal vein thrombosis with symptomatic portal hypertension in liver cirrhosis. *J Hepatol* 2011; **54**: 78-88 [PMID: 20932597 DOI: 10.1016/j.jhep.2010.06.029]

10 **Perarnau JM**, Baju A, D'alteroche L, Viguier J, Ayoub J. Feasibility and long-term evolution of TIPS in cirrhotic patients with portal thrombosis. *Eur J Gastroenterol Hepatol* 2010; **22**: 1093-1098 [PMID: 20308910 DOI: 10.1097/MEG.0b013e328338d995]

11 **Luca A**, Miraglia R, Caruso S, Milazzo M, Sapere C, Maruzzelli L, Vizzini G, Tuzzolino F, Gridelli B, Bosch J. Short- and long-term effects of the transjugular intrahepatic portosystemic shunt on portal vein thrombosis in patients with cirrhosis. *Gut* 2011; **60**: 846-852 [PMID: 21357252 DOI: 10.1136/gut.2010.228023]

12 **Lv Y**, Qi X, He C, Wang Z, Yin Z, Niu J, Guo W, Bai W, Zhang H, Xie H, Yao L, Wang J, Li T, Wang Q, Chen H, Liu H, Wang E, Xia D, Luo B, Li X, Yuan J, Han N, Zhu Y, Xia J, Cai H, Yang Z, Wu K, Fan D, Han G; PVT-TIPS Study Group. Covered TIPS *vs* endoscopic band ligation plus propranolol for the prevention of variceal rebleeding in cirrhotic patients with portal vein thrombosis: a randomised controlled trial. *Gut* 2018; **67**: 2156-2168 [PMID: 28970291 DOI: 10.1136/gutjnl-2017-314634]

13 **Wang Z**, Jiang MS, Zhang HL, Weng NN, Luo XF, Li X, Yang L. Is Post-TIPS Anticoagulation Therapy Necessary in Patients with Cirrhosis and Portal Vein Thrombosis? *Radiology* 2016; **279**: 943-951 [PMID: 26653681 DOI: 10.1148/radiol.2015150369]

14 **Lakhoo J**, Gaba RC. Outcomes of transjugular intrahepatic portosystemic shunt creation for flow-enabled dissolution of spleno-mesenterico-portal venous thrombosis. *Diagn Interv Imaging* 2016; **97**: 1085-1093 [PMID: 27481577 DOI: 10.1016/j.diii.2016.07.005]

15 **Modaresi Esfeh J**, Ansari-Gilani K. Transjugular intrahepatic portosystemic shunt in cirrhotic patients with portal vein thrombosis. *Eur J Gastroenterol Hepatol* 2020; **32**: 762-763 [PMID: 32355095 DOI: 10.1097/MEG.0000000000001680]

16 **Zhang WW**, Ren JZ, Han XW, Chen PF, Li FZ, Kuang DL, Zhou PL, Ding PX, Bi YH. [Clinical application and efficacy of TIPS combined with AngioJet mechanical thrombectomy for liver cirrhosis with extensive portal vein thrombosis]. *Zhonghua Yi Xue Za Zhi* 2020; **100**: 533-537 [PMID: 32164106 DOI: 10.3760/cma.j.issn.0376-2491.2020.07.011]

17 **Thornburg B**, Desai K, Hickey R, Hohlastos E, Kulik L, Ganger D, Baker T, Abecassis M, Caicedo JC, Ladner D, Fryer J, Riaz A, Lewandowski RJ, Salem R. Pretransplantation Portal Vein Recanalization and Transjugular Intrahepatic Portosystemic Shunt Creation for Chronic Portal Vein Thrombosis: Final Analysis of a 61-Patient Cohort. *J Vasc Interv Radiol* 2017; **28**: 1714-1721. e2 [PMID: 29050854 DOI: 10.1016/j.jvir.2017.08.005]

18 **Dong F**, Luo SH, Zheng LJ, Chu JG, Huang H, Zhang XQ, Yao KC. Incidence of portal vein thrombosis after splenectomy and its influence on transjugular intrahepatic portosystemic shunt stent patency. *World J Clin Cases* 2019; **7**: 2450-2462 [PMID: 31559281 DOI: 10.12998/wjcc.v7.i17.2450]

19 **Intagliata NM**, Caldwell SH, Tripodi A. Diagnosis, Development, and Treatment of Portal Vein Thrombosis in Patients With and Without Cirrhosis. *Gastroenterology* 2019; **156**: 1582-1599. e1 [PMID: 30771355 DOI: 10.1053/j.gastro.2019.01.265]

20 **Qi X**, Guo X, Yoshida EM, Méndez-Sánchez N, De Stefano V, Tacke F, Mancuso A, Sugawara Y, Yang SS, Teschke R, Arora A, Valla DC. Transient portal vein thrombosis in liver cirrhosis. *BMC Med* 2018; **16**: 83 [PMID: 29871683 DOI: 10.1186/s12916-018-1069-8]

21 **Faccia M**, Ainora ME, Ponziani FR, Riccardi L, Garcovich M, Gasbarrini A, Pompili M, Zocco MA. Portal vein thrombosis in cirrhosis: Why a well-known complication is still matter of debate. *World J Gastroenterol* 2019; **25**: 4437-4451 [PMID: 31496623 DOI: 10.3748/wjg.v25.i31.4437]

22 **Jiang ZB**, Shan H, Shen XY, Huang MS, Li ZR, Zhu KS, Guan SH. Transjugular intrahepatic portosystemic shunt for palliative treatment of portal hypertension secondary to portal vein tumor thrombosis. *World J Gastroenterol* 2004; **10**: 1881-1884 [PMID: 15222028 DOI: 10.3748/wjg.v10.i13.1881]

23 **Li ZP**, Wang SS, Wang GC, Huang GJ, Cao JQ, Zhang CQ. Transjugular intrahepatic portosystemic shunt for the prevention of recurrent esophageal variceal bleeding in patients with cavernous transformation of portal vein. *Hepatobiliary Pancreat Dis Int* 2018; **17**: 517-523 [PMID: 30262421 DOI: 10.1016/j.hbpd.2018.09.008]

24 **Sze DY**, O'Sullivan GJ, Johnson DL, Dake MD. Mesenteric and portal venous thrombosis treated by transjugular mechanical thrombolysis. *AJR Am J Roentgenol* 2000; **175**: 732-734 [PMID: 10954458 DOI: 10.2214/ajr.175.3.1750732]

25 **Wolter K**, Decker G, Kuetting D, Trebicka J, Manekeller S, Meyer C, Schild H, Thomas D. Interventional Treatment of Acute Portal Vein Thrombosis. *Rofo* 2018; **190**: 740-746 [PMID: 30045398 DOI: 10.1055/a-0631-9265]

26 **Stine JG**, Shah PM, Cornella SL, Rudnick SR, Ghabril MS, Stukenborg GJ, Northup PG. Portal vein thrombosis, mortality and hepatic decompensation in patients with cirrhosis: A meta-analysis. *World J Hepatol* 2015; **7**: 2774-2780 [PMID: 26644821 DOI: 10.4254/wjh.v7.i27.2774]

27 **Salem R**, Vouche M, Baker T, Herrero JI, Caicedo JC, Fryer J, Hickey R, Habib A, Abecassis M, Koller F, Vogelzang R, Desai K, Thornburg B, Hohlastos E, Resnick S, Lewandowski RJ, Sato K, Ryu RK, Ganger D, Kulik L. Pretransplant Portal Vein Recanalization-Transjugular Intrahepatic Portosystemic Shunt in Patients With Complete Obliterative Portal Vein Thrombosis. *Transplantation* 2015; **99**: 2347-2355 [PMID: 25905983 DOI: 10.1097/TP.0000000000000729]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com