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Preoperative elective transjugular intrahepatic portosystemic shunt for cirrhotic patients undergoing abdominal surgery

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Abstract

Despite improvements in the surgical techniques, anesthesia and intensive care, abdominal surgery in patients with cirrhosis remains a challenge. Transjugular intrahepatic portosystemic shunt (TIPS) has been used to manage complications of portal hypertension. Preoperative TIPS (prophylactic) can theoretically improve outcomes in this population. Seven original studies were identified with 24 patients who underwent prophylactic TIPS before abdominal surgery. No perioperative mortality or major abdominal bleeding attributable to portal hypertension was reported for this cohort. One patient had poor wound healing post surgery (4.2%), one had right heart failure (4.2%), and five developed hepatic encephalopathy (20.8%) post surgery. More evidence is needed to optimize the timing of surgery post TIPS and the selection of an appropriate stent size to further decrease the associated morbidity. Overall, the decision for prophylactic TIPS placement for cirrhotic patients undergoing abdominal surgery needs individualization to allow its safe use with concomitant improvement in perioperative morbidity.

Keywords Prophylactic transjugular intrahepatic portosystemic shunt, cirrhosis, portal hypertension, abdominal surgery

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Introduction

By virtue of the pathophysiology of cirrhosis, in addition to the contribution from its etiologic agent (hepatitis B/C, alcohol, autoimmune), the cirrhotic patient is at risk for encephalopathy, ascites (infections and poor wound healing), increased pressures in portal circulation (bleeding), renal dysfunction (hepatorenal syndrome), cardiac dysfunction (high cardiac output leading to cirrhotic cardiomyopathy), electrolyte disturbances (hyponatremia), respiratory issues (portopulmonary hypertension, hepatic hydrothorax, hepatopulmonary syndrome), malnutrition (poor wound healing), and poor tolerance to stress (surgery). One or more of these factors are together responsible for poor surgical outcomes in this population. Abdominal surgery in patients with cirrhosis is associated with higher rates of morbidity and mortality [1]. Despite improvements in the surgical techniques, anesthesia and intensive care, major abdominal surgery in patients with cirrhosis remains a challenge. The mortality can be as high as 50% in emergent cases [2]. The mortality and morbidity risk correlates with the Child-Turcotte-Pugh (CTP) class of cirrhosis [3]. Consequently, abdominal surgery may be contraindicated in some patients with cirrhosis and portal hypertension who would otherwise have been candidates for potentially curative surgical procedures.

Transjugular intrahepatic portosystemic shunt (TIPS) has been used to manage complications of portal hypertension, including bleeding esophageal varix, refractory ascites and hepatic hydrothorax [4]. Preoperative TIPS can theoretically improve outcomes in patients with cirrhosis and portal hypertension undergoing abdominal surgery by decompressing the varices and resolution of ascites, thus decreasing bleeding (perioperative), improving wound healing, and minimizing the infection risk.

In this review article, we have summarized the single-center reports describing the prophylactic use of TIPS in patients undergoing major abdominal surgery.

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Materials and methods

An extensive English literature search was performed, using PubMed and Google Scholar, to identify the peer-reviewed original and review articles published up to December 2016, using the following keywords: prophylactic transjugular intrahepatic portosystemic shunt, cirrhosis, abdominal surgery. Only human studies were included. To identify additional studies, the reference lists of pertinent studies were searched manually. Studies reporting abdominal surgery in cirrhotic patients with TIPS, but placed for indications other than surgery itself, were excluded. After applying the exclusion criteria, the search yielded only eight single-center studies. The indications, procedural details, success rates, clinical outcomes, complications and limitations of each individual study were studied. Descriptive statistics (percentages, means, median, range) were calculated for each outcome (success, failure, complications) and the same were used to interpret the composite data.

Results

A total of 8 original studies were identified. These included two case reports from the UK [5] and Italy [6], three case series from the USA [7], Spain [8] and France [9], and three retrospective studies from the USA [10,11] and Canada [12]. A retrospective study from the USA described 25 patients with cirrhosis undergoing abdominal or cardiothoracic surgeries [10]. However, only 4 patients who had prophylactic TIPS before planned abdominal surgery were included [10]. Another retrospective study from the USA described 7 patients who had a TIPS procedure before surgery with the intent to minimize perioperative complications [11]. The retrospective study from Canada compared the clinical outcomes of patients with cirrhosis who underwent TIPS before abdominal surgery with those of the group without TIPS [12]. In this study, only 13 patients had elective TIPS placed before planned abdominal surgery [12]. Data were not reported separately for these 13 patients; hence, we have mentioned the results in the table but have not combined them with those of other studies in order to maintain uniformity in our inclusion and exclusion criteria for this review article.

The results from each individual study are summarized in Table 1.

Patient characteristics

These studies were small, with the number of subjects undergoing preoperative TIPS varying between 1 and 18 [5-12]. Only one study had more than 10 subjects [12]. A total of 43 patients across all studies had preoperative TIPS. Thirty-one patients were male and 12 were female. Age for the study cohort varied from as young as 41 years [5] to as old as 80 years [6].

The etiology of liver cirrhosis was alcohol in 47.6% (10/21) of patients, hepatitis C in 28.6% (6/21), a combination of alcohol and hepatitis C in 9.5% (2/21), primary biliary cirrhosis in 9.5% (2/21), and cryptogenic in 4.8% (1/21) of patients [5-9,11]. Vinet *et al* reported 61.1% (11/18) of patients to have a non-alcohol etiology without any further specification [12]. The severity of liver cirrhosis was described using CTP in 7 studies [5-11]. Of 25 patients, 48.0% (12/25) had CTP class A, 36.0% (9/25) had CTP class B and 16.0% (4/25) patients had CTP class C disease [5-11]. Vinet *et al* reported a mean CTP score of 7.7 (6-10) for the patients undergoing TIPS and 6.2 (5-9) for the control group [12]. All patients from each study had one or more signs of portal hypertension: ascites [7-12], esophageal varices [5-11], gastric varices [9,10], or gastrointestinal bleeding [5-11].

The baseline patient characteristics from each individual study are summarized in Table 2.

Overall, our study results are reflective of wide heterogeneity in the selected patients considered for elective pre-surgery TIPS, which points to the lack of uniform criteria. We believe that there is a selection bias in all reported studies towards patients expected to do well with or without TIPS followed by surgery. Current guidelines of the American Association for the Study of Liver Diseases suggest caution in placing TIPS in patients with a Model for End-Stage Liver Disease score >15-18 or total bilirubin >4.0 mg/dL [13]. Other absolute contraindications include severe pulmonary hypertension, congestive heart failure, and uncontrolled sepsis. Relative contraindications include anatomical challenges for TIPS placement, coagulopathy and prior episodes of encephalopathy. A multidisciplinary approach should be used, taking into consideration the center's experience, surgeon's expertise and hepatologist's input to allow patient recruitment for TIPS before the planned major abdominal surgery to be safe overall in this high-risk population subgroup.

Timing of TIPS

The time period between TIPS placement and abdominal surgery was variable and ranged from 1 week [8] to a mean of 2.9 months [9]. Although the hepatic venous pressure reduces immediately after TIPS placement, new hemodynamic equilibrium and its clinical effects take time [14].

Currently, there is no consensus about the optimal timing of surgery after TIPS placement. There are a number of factors that need to be considered, including the type and urgency of abdominal surgery, local expertise, availability of TIPS, and resolution of ascites and varices.

Indication and type of planned surgery

The most frequent indication for surgery was cancer potentially resectable [5-12]. Surgery would have been the treatment of choice in these patients in the absence of cirrhosis and portal hypertension. These patients underwent a large variety of abdominal surgical procedures,

Table 1 Summary of individual studies

Author/year/ location	No. of subjects	Stage of cirrhosis	Indication for surgery	Surgery	Time between TIPS and surgery	Bleeding	Complications (other than bleeding)	Hospital stay	Follow-up time
Norton *et al* 2003 UK [5]	1	CTP A 1/1	GC 1/1	Distal gastrectomy 1/1	1 wk	None	None	10 d	6 m
Liverani *et al* 2015 Italy [6]	1	CTP B 1/1	GC 1/1	Distal gastrectomy 1/1	1 m	None	None	14 d	DNA
Grubel *et al* 2002 USA [7]	2	CTP C 1/2	SC 1/2	Sigmoid colectomy 1/1	3 wks	Number of pts requiring blood transfusion- 1) Perioperative- 1/1 a) PRBC- 2 b) FFP- 2 c) Platelets- 16	None	7 d	10 m
		CTP C 1/2	RCC 1/2	Radical nephrectomy and retroperitoneal lymph node dissection 1/1	8 wks	Number of pts requiring blood transfusion- 1) Perioperative 1/1 a) PRBC 2 b) FFP 2 c) Platelets 8		5 d	24 m
Gil *et al* 2003 Spain [8]	3	CTP A 1/3	CC- 1/3	Right hemicolectomy 1/3	Mean 29.6 d Range 14-45 d	Number of pts requiring blood transfusion- 1) Intraoperative- 0/3 2) Post-operative 1/3 (CTP B) (two PRBC in one pt due to hematemesis)	1) Right cardiac insufficiency 1/3 (CTP A) 2) Encephalopathy 1/3 (CTP A) (treated with reduced stent placed which was further complicated by aspiration and respiratory insufficiency)	10 d	DNA
		CTP B 1/3	GC and SC- 1/3	Subtotal gastrectomy and sigmoidectomy 1/3				17 d	DNA
		CTP A 1/3	PC- 1/3	Pancreatoduodenectomy 1/3				60 d	DNA

(contd...)

Table 1 *(Continued)*

Author/year/ location	No. of subjects	Stage of cirrhosis	Indication for surgery	Surgery	Time between TIPS and surgery	Bleeding	Complications (other than bleeding)	Hospital stay	Follow-up time
Azoulah *et al* 2001 France [9]	7	CTP A 5/7 CTP B 1/7 CTP C 1/7	RCC 1/7 CC 2/7 EC 1/7 GC 1/7 Aneurysm 1/7 Establishment of colorectal continuity 1/7	Abdominal surgery 6/7 (pt with GC did not underwent planned surgery secondary to widespread metastasis and instead got PEG tube placement and radiation treatment)	Mean 2.9±1.3 m Median 3 m	Number of pts requiring blood transfusion 1) Intraoperative 2/6 (CTP A- 2/2) (two units for one pt, one unit for another pt) 2) Postoperative 1/6 (CTP C) (2 units for one pt due to intra-abdominal bleeding)	None	Post operative mortality (60 d) 1/6 (CTP C) (liver failure)	6-33 m (1 pt died at 24 m from underlying cancer)
Kim *et al* 2009 USA [10]	4	CTP A 1/4 CTP B 2/4 CTP C 1/4	CC 1/4 RC 1/4 Toxic megacolon 1/4 Ruptured umbilical hernia 1/4	Subtotal colectomy 2/4 Total colectomy and cholecystectomy 1/4 Umbilical herniorhaphy 1/4	Mean 24.3 d Range 6-33 d	DNA	1) Encephalopathy 2/4 (CTP B 1/2; CTP C 1/2) 2) Ileus 1/4 (CTP A) 3) ARDS 1/4 (CTP B) 4) Pneumonia 1/4 (CTP B) 5) Pancreatitis 1/4 (CTP B)	9-33 d	0.9-39.3 m (1 pt died at 32.8 m from cancer)
Schlenker *et al* 2009 USA [11]	7	CTP A 3/7 CTP B 4/7	Pelvic mass 2/7 RCC 1/7 CC 1/7 GC 1/7 Ovarian cyst 1/7 Cervical dysplasia-1/7	Nephrectomy 1/7 Total abdominal hysterectomy and Bilateral salpingo-oophorectomy 1/7 Exploratory laparotomy and BS0 2/7 Oophorectomy 1/7 Sigmoid colectomy 1/7 Subtotal gastrectomy and segmental transverse colectomy 1/7	Mean 12 d Range 1-32 d	Number of pts requiring blood transfusion 1) Perioperative 2/7 (CTP A- 2/2) (2 units for one patient, 1 unit for another patient)	1) Encephalopathy 2/7 (CTP A 1/2; CTP B 1/2) 2) Wound infection 1/7 (CTP A) 3) Peritonitis1/7 (CTP A) 4) Pneumonia 1/7 (CTP B) 5) Ascites 1/7 (CTP A)	DNA	3-34 m (1 pt died at 14 m from liver failure) (CTP B)

(contd...)

Table 1 Summary of individual studies *(Continued)*

Author/year/ location	No. of subjects	Stage of cirrhosis	Indication for surgery	Surgery	Time between TIPS and surgery	Bleeding	Complications (other than bleeding)	Hospital stay	Follow-up time
Vinet *et al* 2006 Canada [12]	TIPS 18	Median CTP score 7.7 (Range: 6-10)	CC 8/18 UC 2/18 GAVE 3/18 GC 1/18 Gastric polyp 1/18 Ampulloma 1/18 Small bowel stenosis 1/18 RCC 1/18	Colectomy 10/18 Gastrectomy 5/18 Duodenopancreatectomy 1/18 Nephrectomy 1/18 Small Bowel resection 1/18	Mean 72±21 d	Number of pts requiring blood transfusion 1j Perioperative 6/18 (1-4 units per patient, total of 17 units)	1) Encephalopathy 4/18 2) Liver failure 3/18 3) ARDS 2/18 4) Abdominal abscess 1/18 5) Ascites infection 1/18 6) Ascites leak 1/18	17.4 d	30 d post surgery Mortality 2/18 1 year post surgery Mortality 8/18
	Control (No TIPS) 17	Median CTP score 6.2 (Range: 5-9) (P<0.05)	CC 10/17 Colon angiodysplasia 1/17 Bladder cancer with colon involvement 1/17 UC 1/17 GAVE 1/17 Cholangiocarcinoma 1/17 Chronic pancreatitis 1/17 RCC 1/17	Colectomy 13/17 Duodenopancreatectomy 2/17 Gastrectomy 1/17 Nephrectomy 1/17	DNA	Number of pts requiring blood transfusion 1j Perioperative 7/17 (2-4 units per patient, total of 16 units)	1) Encephalopathy 5/17 2) Liver failure 3/17 3) ARDS 1/17 4) Abdominal abscess 3/17 5) Ascites infection 1/17 6) Ascites leak 2/17 7) Anastomotic leak 1/7	22.6 d	30 d post surgery Mortality 2/17 1 year post surgery Mortality 6/17

ARDS, acute respiratory distress syndrome; CTP, Child-Turcotte-Pugh ; CC, colon cancer; d, days; DNA, data not available; EC, esophageal cancer; FFP, fresh frozen plasma; GAVE, gastric antral vascular ectasia; GC, gastric cancer; m- months; PC, pancreatic cancer; PRBC, packed red blood cells; pt, patient; RC, rectal cancer; RCC, renal cell cancer; SC, sigmoid cancer; UC, ulcerative colitis; wks, weeks

including cholecystectomy [10], umbilical herniorhaphy [10], gastrectomy [5,6,8,11,12], sigmoidectomy [7,8,11], colectomy [8,10-12], nephrectomy [7,11,12], small bowel resection [12], bilateral salpingo-oophorectomy [11], oophorectomy [11], total abdominal hysterectomy [11], pancreato-duodenectomy [8,12] and exploratory laparotomy [11]. The indication and the type of surgery across all individual studies are given in Table 1.

Pre- and post-TIPS hepatovenous portal gradient (HVPG)

Generally, an HVPG of less than 12 mmHg is targeted for TIPS to be effective. The HVPG was reduced to a range between 6 mmHg and 14 mmHg in the included studies [5-12]. Gil *et al* reported a patient who had a pre TIPS HVPG of 28 mmHg and a post TIPS HVPG of 6 mmHg [8]. This patient had the largest change in HVPG (22 mmHg) among the reported patients. The patient developed right cardiac insufficiency. There is a lack of data to allow an accurate prediction of post-TIPS pressure gradient based on the size of shunt. It is unknown whether TIPS of different sizes should be individualized depending on pre-TIPS pressure gradient, patient's cardiovascular status, body mass index, type of hepatic decompensation and severity of liver disease. Pre- and post-TIPS HVPG values across individual studies have been summarized in Table 3.

The timing of pressure measurement after TIPS placement is also important. In the studies included, the HVPG was measured at the time of TIPS placement; however, it may not be indicative of portal pressures at the time of surgery. A recent study compared portal pressure gradient (PPG) at different times after TIPS placement [15]. The immediate PPG (immediately after TIPS placement) differed significantly from the early PPG (measured

Table 2 Baseline patient characteristics from each individual study

Author/year/ location	No. of subjects	Mean age (range) (years)	Sex	Etiology of cirrhosis	Stage of cirrhosis	Portal hypertension
Norton *et al* 2003 UK [5]	1	41	Male 1	Alcohol 1/1	CTP A 1/1	GIB 1/1 EV 1/1
Liverani *et al* 2015 Italy [6]	1	80	Female 1	Hepatitis C 1/1	CTP B 1/1	GIB 1/1 EV 1/1
Grubel *et al* 2002 USA [7]	2	47 (43-51)	Male 2	Alcohol 1/2 Alcohol+Hepatitis C 1/2	CTP C- 2/2	GIB 2/2 EV 2/2 Ascites 2/2 SBP 1/2 HE 1/2
Gil *et al* 2003 Spain [8]	3	64 (60-70)	Male 2 Female 1	Hepatitis C 3/3	CTP A 2/3 CTP B 1/3	GIB 1/3 EV 3/3 Ascites 1/3
Azoulah *et al* 2001 France [9]	7	56 (47-69)	Male 6 Female 1	Alcohol 5/7 Hepatitis C 2/7	CTP A 5/7 CTP B 1/7 CTP C 1/7	GIB 5/7 EV 6/7 GV 1/7 Ascites 3/7
Kim *et al* 2009 USA [10]	4	53	Male 3 Female 1	DNA	CTP A 1/4 CTP B 2/4 CTP C 1/4	GIB 2/4 EV 2/4 GV 1/4 Ascites 2/4
Schlenker *et al* 2009 USA [11]	7	57 (48-69)	Male 3 Female 4	Alcohol 3/7 Alcohol+Hepatitis C- 1/7 Primary biliary cirrhosis 2/7 Cryptogenic 1/7	CTP A 3/7 CTP B 4/7	GIB 2/7 EV 3/7 Ascites 5/7
Vinet *et al* 2006 Canada[12]	TIPS 18	58	Male 14 Female 4	Alcohol 7/18 Non-alcohol 11/18	Median CTP score 7.7 (Range: 6-10)	Ascites 7/18 HE 3/18
	Control (No TIPS) 17	62	Male 11 Female 6	Alcohol 6/17 Non-alcohol 11/17 (P: NS)	Median CTP score 6.2 (Range: 5-9) (P<0.05)	Ascites 5/17 HE 0/17 (P: NS)

CTP, Child-Turcotte-Pugh; DNA, data not available; EV, esophageal varix; GIB, gastrointestinal bleeding; HE, hepatic encephalopathy; NS, non significant; SBP, spontaneous bacterial peritonitis

after 24 h); however, there was no significant difference between proportion of patients with early PPG vs. late PPG (measured at 1 month) for values of <12 mmHg.

Outcome (morbidity)

Perioperative bleeding

Minor bleeding. This was defined as ≤2 units of red blood cells (RBCs) in the perioperative period. It is more likely to be the result of the surgery itself and less likely to be the result of portal hypertension.

No bleeding was reported in the cases described by Norton *et al* and Liverani *et al* [5,6]. Grubel *et al* reported two patients (2/2, both CTP C) who each had a transfusion of 2 units of RBCs and 2 units of fresh frozen plasma [7]. In the study by Gil *et al*, none of the subjects (0/3) required intraoperative transfusion, though one patient (CTP B) did require 2 units of RBCs in the postoperative period because of hematemesis [8]. In another study, two patients (2/6, both CTP A) received intraoperative transfusion and one patient (1/6, CTP C) required 2 units of RBCs in the postoperative period because of intra-abdominal bleeding [9]. Schlenker *et al* reported the requirement of 1 unit of RBCs for one patient and 2 units for another patient of 7 study patients (2/7, both CTP A) [11]. Of eight patients with minor bleeding, four were CTP A, one was CTP B and three were CTP C class.

Major bleeding. This was defined as the need for >2 units of RBCs in the perioperative period. This amount of bleeding is more likely to be attributable to persistent portal hypertension. None of the patients (0/20) from studies had major abdominal bleeding in the perioperative post-surgery period [5-9,11].

Vinet *et al* reported that the number of transfusions and the total quantity needed were lower for patients with TIPS compared to those without TIPS undergoing abdominal surgery [12]. Six of 18 patients in the TIPS group required 1 to 4 units of RBCs, whereas 7 of 17 patients in control group required between 2 and 4 units [12]. The authors did not report data specifically for patents with prophylactic TIPS.

Wound healing

Ascites can potentially delay wound healing and may even increase the risk for peritonitis and wound infection. TIPS placement seems to lower the risk of these complications. Among the studies evaluated [5-11], Schlenker *et al* reported two patients, one with new ascites and wound infection (related to portal hypertension) and the other developing a fecal fistula with localized peritonitis post surgery (unrelated to portal hypertension) [11]. Both of these patients improved with antibiotics and drainage. In composite, only one (CTP-A) of 24 patients (4.2%) had trouble with wound healing post surgery.

Encephalopathy

TIPS placement can potentially worsen hepatic encephalopathy secondary to shunting of blood with toxins to the brain. In our study cohort [5-11], a total of 5 patients (5/24) were reported to develop hepatic encephalopathy post surgery [8,10,11]. Two of these patients had changes in portosystemic gradient (PSG) of 22 mmHg [8] and 13 mmHg [11] post TIPS, whereas the data for the other three patients [10,11] were not available. Currently, we lack prediction models for the expected change in PSG with different sizes of shunt. In addition, other factors, such as the pre-TIPS severity of liver disease, also play a role. Of 5 patients with hepatic encephalopathy, 2 were CTP A, 2 were CTP B, and one was CTP C class [8,10,11]. Careful evaluation of each individual patient with cirrhosis is essential to determine the safety of TIPS for these patients.

Cardiac complications

Cardiac complications post TIPS are in most cases seen in patients who have a pre-existing cardiovascular disease that worsens post TIPS as a result of volume overload. In our cohort [5-11], one patient (1/24) (CTP A) developed right-heart failure post TIPS [8]. As explained above, this was likely due to an inadvertent decrease in PSG post TIPS and the patient consequently underwent a repeat procedure with a smaller stent size. None of the other studies reported this complication [5-7,9-11]. The remainder of the complications secondary to surgery (unrelated to portal hypertension) are summarized in Table 1.

Composite portal hypertension-related morbidity (complication) events for our study cohort were 8 among 12 CTP A class patients, 3 among 8 CTP B class patients, and 4 among 4 CTP C class patients. All of these, as mentioned above, were successfully managed conservatively with zero mortality.

Outcome (mortality)

Zero mortality was observed in patients with TIPS in the perioperative period following abdominal surgery [5-11]. Two deaths from liver failure at 5 weeks [9] and 14 months [11] in CTP C and CTP B class patients, respectively, were reported. Mortality from non–liver-related causes has been summarized in Table 1.

Concluding remarks

Prophylactic TIPS placement for cirrhotic patients scheduled for abdominal surgery has been sought as a viable option to improve surgical outcomes in this population subset. The evidence for its safety and its real-world impact on perioperative morbidity is still sparse. Prophylactic TIPS placement was successful in preventing mortality secondary to abdominal surgery in cirrhotic patients. No major abdominal bleeding was noted. One patient had poor wound healing post surgery (4.2%), one had right heart failure (4.2%), and five developed hepatic encephalopathy (20.8%). No uniform trend was noted for the timing of abdominal surgery post TIPS. More evidence is needed to optimize the selection of stent size

Table 3 Hepatovenous portal gradient (HVPG) pre and post transjugular intrahepatic portosystemic shunt (TIPS) for patients from each individual study

Author/year/ location	Number of subjects	HVPG pre TIPS (mmHg)	HVPG post TIPS (mmHg)	Change in HVPG (mmHg)
Norton *et al* 2003 UK [5]	1	16	12	4
Liverani *et al* 2015 Italy [6]	1	28	12	16
Grubel *et al* 2002 USA [7]	2	17 26	8 14	9 12
Gil *et al* 2003 Spain [8]	3	22 20 28	7 7 6	15 13 22
Azoulah *et al* 2001 France [9]	7	Mean 18±5	Mean 9±5	Mean 9
Kim *et al* 2009 USA [10]	4	NA	NA	NA
Schlenker *et al* 2009 USA [11]	7	Mean 15.2 (Range: 9-22)	Mean 7.4 (Range: 4-10)	Mean 6.8 (Range: 2-13)
Vinet *et al* 2006 Canada [12]	TIPS- 18	Mean 21.4±3.9	Mean 8.4±3.4	Mean 13
	Control (No TIPS) 17	Not applicable	Not applicable	Not applicable

NA, not available

to prevent an inadvertent decrease in HVPG and consequently reduce the complication rate. Overall, the decision regarding prophylactic TIPS placement for cirrhotic patients undergoing abdominal surgery needs individualization to allow its safe use, with concomitant improvement in perioperative morbidity.

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