

Risk of hernia-related complications after transjugular intrahepatic portosystemic shunt creation in patients with pre-existing ventral abdominal hernias: 15-year experience at a quaternary medical center

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ABSTRACT

Objective Transjugular intrahepatic portosystemic shunt (TIPS) placement is used to treat the sequelae of portal hypertension, including refractory variceal bleeding, ascites and hepatic hydrothorax. However, hernia-related complications such as incarceration and small bowel obstruction can occur after TIPS placement in patients with pre-existing hernias. The aim of this study was to determine the incidence of hernia complications in the first year after TIPS placement and to identify patient characteristics leading to an increased risk of these complications.

Design This retrospective analysis included patients with pre-existing abdominal hernias who underwent primary TIPS placement with covered stents at our institution between 2004 and 2018. The 1-year hernia complication rate and the average time to complications were documented. Using a Wilcoxon rank-sum test, the characteristics of patients who developed hernia-related complications versus the characteristics of those without complications were compared.

Results A total of 167 patients with pre-existing asymptomatic abdominal hernias were included in the analysis. The most common reason for TIPS placement was refractory ascites (80.6%). A total of 36 patients (21.6%) developed hernia-related complications after TIPS placement, including 20 patients with acute complications and 16 with non-acute complications. The mean time to presentation of hernia-related complications was 66 days. Patients who developed hernia-related complications were more likely than those without complications to have liver cirrhosis secondary to alcohol consumption ($p=0.049$), although this association was no longer significant after multivariate analysis.

Conclusion Within 1 year after TIPS placement, approximately 20% of patients with pre-existing hernias develop hernia-related complications, typically within the first 2 months after the procedure. Patients with pre-existing hernia undergoing TIPS placement should be educated regarding the signs and symptoms of hernia-

Key messages

What is already known about this subject?

- ▶ Umbilical hernias in patients with cirrhosis with ascites can become incarcerated and/or strangulated after rapid resolution of large volume ascites either by paracentesis, transjugular intrahepatic portosystemic shunt (TIPS) or liver transplantation.

What are the new findings?

- ▶ This study found that hernia complications after TIPS occur around 66 days post-procedure.

How might it impact on clinical practice in the foreseeable future?

- ▶ Given that elective surgical repair is preferred to emergent repair due to superior outcomes, the knowledge related to hernia complications is useful and the data of the current study suggest consideration for hernia repair in selected patients within 2 months of successful TIPS procedure.

related complications, including incarceration and small bowel obstruction.

INTRODUCTION

Transjugular intrahepatic portosystemic shunt (TIPS) placement is often used to reduce the portal venous pressure in patients with sequelae of portal hypertension such as refractory ascites, hepatic hydrothorax, gastro-oesophageal varices and portal hypertensive gastropathy.¹⁻³ Although TIPS placement can be an effective treatment option for these patients, it is also associated with complications such as right heart failure, acute liver failure, development of hepatic encephalopathy and procedure-related bleeding.⁴

**Table 1** Summary of patient characteristics (N=167)

Characteristic	Value
Body mass index closest to TIPS, mean±SD	27.8±6.2
Sex, n (%)	
Female	36 (36.5)
Male	106 (63.5)
Age at the time of TIPS, mean±SD	55.4±10.7
Ethnicity, n (%)	
African American	11 (6.6)
Asian	1 (0.6)
Caucasian	151 (90.4)
Hispanic/Latino	3 (1.8)
Multiracial	1 (0.6)
Smoking history, n (%)	
Current	43 (25.7)
Former	65 (38.9)
Never	59 (35.3)
Chronic steroid use, n (%)	
No	155 (92.8)
Yes	12 (7.2)
History of lung disease, n (%)	
No	125 (74.9)
Yes	42 (25.1)
History of diabetes, n (%)	
No	100 (59.9)
Yes	67 (40.1)
History of abdominal wall surgery, n (%)	
No	76 (45.5)
Yes	91 (54.5)
History of pregnancy, n (%)	
Not Applicable	102 (61.1)
No	14 (8.4)
Yes	51 (30.5)

TIPS, transjugular intrahepatic portosystemic shunt.

Another less commonly recognised problem after TIPS placement is the occurrence of hernia-related complications such as incarceration and small bowel obstruction in patients with pre-existing (asymptomatic) hernias.⁵ Umbilical hernias, which may occur as a complication of increased intra-abdominal pressure in the setting of ascites, are seen in approximately 20% of patients with cirrhosis.⁶ These hernias are rarely clinically symptomatic; however, resolution of ascites or reduction in the volume of ascitic fluid has been associated with hernia-related complications.¹ For instance, case reports and series have described bowel incarcerations as a complication after TIPS placement or large-volume paracentesis (LVP) in patients with pre-existing hernias.^{1 7-9} The decision to continue conservative

management of these asymptomatic hernias versus performing elective repair in patients with cirrhosis remains a matter of debate, and evidence-based guidelines are lacking.

The aim of this retrospective study, therefore, was to analyse hernia-related complications after TIPS placement in patients with pre-existing hernia. We sought to determine the rate of hernia complications in the first year after TIPS placement, as well as the time to onset of these complications. We also sought to identify patient characteristics leading to an increased risk of these complications. Further, for patients undergoing hernia repair, we sought to identify the outcomes of hernia repair.

METHODS

The International Classification of Disease, 10th revision (ICD-10) codes were used to identify all patients who had undergone polytetrafluoroethylene (PTFE)-covered TIPS placement (Viatorr stent-graft, Gore Medical, Flagstaff, Arizona, USA) at a single institution between 2004 and 2018. Manual chart review was then used to identify patients from this group who were older than 18 years, had a pre-existing ventral abdominal hernia and had at least 1 year of post-procedural follow-up data available. Patients were excluded if they did not have a ventral abdominal hernia at the time of TIPS placement, if the procedure was a revision of a previously created TIPS or if there were insufficient data in the medical record with regard to follow-up.

Patient characteristics were obtained through medical record review. Data related to demographic characteristics, aetiology of liver disease, indication for TIPS placement, medical comorbidities, history of abdominal wall surgery, history of pregnancy, change in portal systemic gradient, frequency and volume of paracentesis, Child-Pugh score and Model for End-Stage Liver Disease (MELD) score were collected.

The primary goal was to determine the rate of hernia complications within 1 year after TIPS placement and the time to occurrence of these complications. The secondary goal was to compare demographic and clinical characteristics of patients with and without hernia-related complications after TIPS placement to determine factors associated with an increased risk of these complications. Acute and non-acute complications were differentiated. Acute hernia-related complications were defined as new, symptomatic, sudden-onset incarceration, small bowel obstruction or strangulation; non-acute hernia-related complications were defined as chronic incarcerations found on imaging or at the time of surgery without acutely symptomatic component. We also assessed the treatment of hernia-related complications such as need for bowel resection, use of abdominal mesh and type of hernia repair.

Table 2 Summary of characteristics in patients with and without hernia-related complications after TIPS placement

Characteristic	With complications (n=36)	Without complications (n=131)	P value	Adjusted p value*
Age at the time of TIPS placement, median (IQR)	54.0 (49.8–60.2)	57.0 (50.0–63.0)	0.270	1.000
Male, n (%)	24 (66.7)	82 (62.6)	0.700	1.000
Ethnicity, n (%)			0.600	1.000
African American	4 (11.1)	7 (5.3)		
Asian	0 (0.0)	1 (0.8)		
Caucasian	32 (88.9)	119 (90.8)		
Hispanic/Latino	0 (0.0)	3 (2.3)		
Multiracial	0 (0.0)	1 (0.8)		
Type of hernia, n (%)			0.116	1.000
Epigastric	0 (0.0)	1 (0.8)		
Incisional	2 (5.6)	8 (6.1)		
Inguinal	1 (2.8)	14 (10.7)		
Multiple	8 (22.2)	9 (6.9)		
Other (lateral, parastomal)	1 (2.8)	2 (1.5)		
Periumbilical	0 (0.0)	3 (2.3)		
Umbilical	24 (66.7)	87 (66.4)		
Ventral, not otherwise specified	0 (0.0)	7 (5.3)		
Aetiology of cirrhosis, n (%)			0.049	0.587
Alpha-1 antitrypsin deficiency	0 (0.0)	2 (1.5)		
Autoimmune	1 (2.8)	1 (0.8)		
Cryptogenic	1 (2.8)	13 (9.9)		
Drug induced	1 (2.8)	2 (1.5)		
Alcohol consumption	14 (38.9)	35 (26.7)		
Miscellaneous	0 (0.0)	3 (2.3)		
Non-alcoholic steatohepatitis	3 (8.3)	37 (28.2)		
Primary biliary cholangitis	1 (2.8)	2 (1.5)		
Primary sclerosing cholangitis	0 (0.0)	5 (3.8)		
Viral	12 (33.3)	21 (16.0)		
Viral and alcohol consumption	3 (8.3)	10 (7.6)		
Reason for TIPS placement, n (%)			0.179	1.000
Ascites	23 (63.9)	64 (48.9)		
Ascites and hydrothorax	1 (2.8)	9 (6.9)		
Ascites and variceal bleed	5 (13.9)	10 (7.6)		
Hydrothorax	0 (0.0)	10 (7.6)		
Other	2 (5.6)	6 (4.6)		
Variceal bleed	5 (13.9)	32 (24.4)		
Recurrence of hernia after repair, n (%)†			0.071	0.786
Yes	8 (24.2)	14 (46.7)		
No	25 (75.8)	16 (53.3)		
Change in portal systemic gradient, median (IQR)†	11.0 (7.5–15.0)	12.0 (8.0–14.0)	0.793	1.000
Severity of hernia, n (%)				
Small	6 (16.7)	57 (43.5)	0.006	0.074

Continued



Table 2 Continued

Characteristic	With complications (n=36)	Without complications (n=131)	P value	Adjusted p value*
Medium	11 (30.5)	14 (10.6)		
Large	12 (33.3)	29 (22.1)		
Unknown	7 (19.4)	31 (23.6)		
Frequency of paracentesis, n (%)			0.196	1.000
None	6 (16.7)	31 (23.7)		
≤6 weeks	26 (72.2)	72 (55.0)		
>6 weeks	4 (11.1)	28 (21.4)		
Average volume of paracentesis, median (IQR)†	6.0 (3.9–8.0)	6.0 (4.0–8.0)	0.854	1.000
MELD score, median (IQR)	10.5 (8.0–15.0)	11.0 (8.0–16.0)	0.253	1.000
Child-Pugh score, median (IQR)†	8.0 (7.0–9.0)	8.0 (7.0–9.0)	0.567	1.000

*Adjusted p value adjusted for multiple hypothesis testing using Holm's step-down method to maintain study-wise error rate of 0.05.

†Data regarding recurrence status missing for 104 patients, change in portal systemic gradient missing for 1 patient, average volume of paracentesis missing for 47 patients and Child-Pugh score missing for 1 patient.

MELD, Model for End-Stage Liver Disease; TIPS, transjugular intrahepatic portosystemic shunt.

Statistical analysis

Patients who developed complications within 1 year after TIPS creation were compared with those without complications. A Wilcoxon rank-sum test was used to assess between-group differences related to ordinal variables, and Fisher's exact test was used to assess between-group differences related to categorical variables. The resulting p values were adjusted for multiple hypothesis testing using Holm's step-down method. $P < 0.05$ was considered statistically significant.

RESULTS

A total of 687 patients underwent TIPS placement with PTFE-covered grafts during the study period. Of these, 167 patients (64% male) had a pre-existing ventral abdominal hernia and were included in the analysis. In these study patients, the mean age at the time of TIPS placement was 55 years, and 54% of patients had a history of abdominal wall surgery (table 1). The most common indication for TIPS placement was refractory ascites (~80%), followed by refractory variceal haemorrhage (~14%).

A total of 36 patients (21.6%) developed hernia complications after TIPS placement, with a mean of 66 days until presentation. Of the 36 patients with complications, 17 (47.2%) had incarceration only; 11 (30.6%) had incarceration and obstruction; 7 (19.4%) had incarceration, obstruction, and strangulation; and 1 (2.8%) had obstruction only.

There was no significant difference between patients with and those without a complication in terms of MELD score at the time of TIPS placement (10.5 vs 11, respectively) or in terms of mean reduction in portosystemic gradient (11% vs 12%, respectively). Patients who developed hernia-related complications were more likely

than those without complications to have liver cirrhosis secondary to alcohol consumption (38.9%) or hepatitis C virus/hepatitis B virus (33.3%) ($p=0.049$), although this association was no longer statistically significant after multivariate analysis. The pre-TIPS frequency of paracentesis and average volume of ascites removal were also not found to be significant predictors of the occurrence of complications (table 2). At the time of hernia surgery, 100% of patients with acute complications had ascites at the time of surgery compared with 12.5% of patients with non-acute complications (table 3).

The severity of pre-existing hernias was determined based on the European Hernia Society grading system with selected cut-off values of 2 and 4 cm to describe three subgroups according to size¹⁰: small, medium and large hernias in those with complications compared with those without complications (table 2).

Twenty patients had acute hernia-related complications, whereas 16 had non-acute complications. Of patients with acute complications, 78.9% required emergent surgical repair and 15.8% underwent elective surgical repair. Of those with non-acute complications, all underwent elective surgical repair (table 3). At the time of surgery, 26.3% of patients with acute hernia-related complications required small bowel resection because of concurrent bowel ischaemia/necrosis vs only 6.7% of patients with non-acute hernia-related complications. Most patients undergoing hernia repair had no procedure-related complications. Of the complications that did occur, seven occurred in the acute complications group (peritonitis, $n=1$; haematoma, $n=1$; small bowel obstruction, $n=4$; acute kidney injury, $n=1$; unknown complications, $n=4$; death from other causes, $n=2$). Infection occurred after surgical repair in two patients with non-acute hernia-related complications. The rate

Table 3 Summary of surgical characteristics in patients with hernia-related complications after TIPS placement

Characteristic	Acute complication (n=20)	Non-acute complication (n=16)	Overall (n=36)	Missing, %
Surgery type, n (%)				5.6
Acute	15 (78.9)	0 (0.0)	15 (44.1)	
Elective	3 (15.8)	15 (100.0)	18 (52.9)	
Unknown	1 (5.3)	0 (0.0)	1 (2.9)	
Type of hernia repair, n (%)				5.6
Open	16 (84.2)	13 (86.7)	29 (85.3)	
Laparoscopic	0 (0.0)	2 (13.3)	2 (5.9)	
Unknown	3 (15.8)	0 (0.0)	3 (8.8)	
Small bowel resection, n (%)				5.6
Yes	5 (26.3)	1 (6.7)	6 (17.6)	
No	13 (68.4)	14 (93.3)	27 (79.4)	
Unknown	1 (5.3)	0 (0.0)	1 (2.9)	
Use of mesh during surgery for repair, n (%)				5.6
Yes	3 (15.8)	7 (46.7)	10 (29.4)	
No	12 (63.2)	8 (53.3)	20 (58.8)	
Unknown	4 (21.1)	0 (0.0)	4 (11.8)	
Postoperative complication, n (%)				66.7
Peritonitis	1 (10.0)	0 (0.0)	1 (8.3)	
Infection	0 (0.0)	2 (100.0)	2 (16.7)	
Haematoma	1 (10.0)	0 (0.0)	1 (8.3)	
Death	2 (20.0)	0 (0.0)	2 (16.7)	
Unknown	4 (40.0)	0 (0.0)	4 (33.3)	
Small bowel obstruction	1 (10.0)	0 (0.0)	1 (8.3)	
Acute kidney injury	1 (10.0)	0 (0.0)	1 (8.3)	
Presence of ascites at time of repair, n (%)				5.6
Yes	20 (100.0)	2 (12.5)	22 (61.1)	
No	0 (0.0)	13 (81.3)	13 (36.1)	
Recurrence of hernia after repair, n (%)				8.3
Yes	5 (26.3)	3 (21.4)	8 (24.2)	
No	14 (73.7)	11 (78.6)	25 (75.8)	

TIPS, transjugular intrahepatic portosystemic shunt.

of hernia recurrence after hernia surgery was 26.3% in patients with acute hernia repairs and 21.4% in patients with non-acute hernia repairs (table 3).

DISCUSSION

In this study, we found that the incidence of hernia-related complications after TIPS placement was 21.6%, with a mean time of 66 days to occurrence of the complication. No significant predictors of the occurrence of hernia-related complications were identified. A previous retrospective analysis of 57 patients with an abdominal

or inguinal hernia who underwent TIPS placement demonstrated a hernia-related complication rate of 25%, with a mean time to complication of 62 days,⁵ findings similar to our results. Another retrospective analysis of 99 patients found a hernia incarceration rate of 12.1%.¹¹ In this study, hernia complications included incarceration, strangulation and obstruction. However, when assessing solely the rate of incarcerations, a similar rate of 10.1% was found. The difference in hernia-related complications is likely due to our inclusion of several potential complications which are clinically relevant. To the best of



our knowledge, the current study is the largest to date to assess hernia-related complications after TIPS placement.

Ventral hernias are frequently seen in patients with refractory ascites; however, the decision to continue conservative management versus performing hernia repair in patients with cirrhosis is a matter of debate. Traditionally, expectant management has been the mainstay of ventral hernia treatment in this population, but this strategy is associated with an increased risk of complications such as hernia incarceration, skin ulceration/hernia rupture and secondary peritonitis.⁶ Some data suggest that early elective hernia repairs may lead to better outcomes than emergent surgical repair in patients with cirrhosis.^{12 13} In our study, however, patients who underwent emergent surgery had rates of mortality and morbidity similar to those seen in patients who underwent elective repair. This is likely because of the low incidence of complications in both groups and the fact that hernia complications (eg, peritonitis/infection, haematoma, small bowel obstruction, acute kidney injury and death) were predefined and did not include other potential complications such as small bowel resection. In general, patients with cirrhosis are high-risk surgical candidates, and so emergent surgery should be avoided in this patient population whenever possible.

Before hernia repair, the durable resolution of abdominal ascites is recommended; this is best achieved with TIPS placement.¹⁴ However, ascites should be reduced gradually to prevent iatrogenic incarceration. A possible explanation for the occurrence of hernia-related complications after TIPS placement may be related to the rapid reduction of ascitic fluid. Approximately 80.6% of the patients with a hernia-related complication in this study had refractory ascites as the primary indication for TIPS placement. This may suggest that removal of large volumes of ascitic fluid results in immediately decreased diameter of the abdominal wall defect, thus increasing the likelihood of hernia incarceration.^{5–9} Despite attempts to decrease ascites with TIPS and LVP, 100% of patients with acute complications had improved but clinically evident ascites at the time of surgery compared with 12.5% of patients with non-acute complications (table 3).

This study examined possible factors that may influence the risk of hernia-related complications after TIPS placement, such as type of hernia, recurrence of hernia after repair and reason for TIPS placement. However, the examined factors did not appear to affect the rate of hernia-related complications in this study population.

This retrospective study had several limitations, including potential sources of error such as recall bias, misclassification bias and confounding. Additionally, the rate at which ascitic fluid resolved could not be characterised quantitatively, and this variable may play a role in the development of hernia-related complications after TIPS placement. Finally, the institution at which patients were treated is a quaternary multidisciplinary medical centre; the results therefore may not be generalisable.

In conclusion, this study in a relatively large patient population demonstrated that approximately 20% of patients with pre-existing ventral abdominal hernia experienced a hernia-related complication within the first year after TIPS creation. More than half of these complications occurred within 3 months. Providers should therefore consider the risk of hernia-related complications when recommending TIPS placement for their patients. Additionally, our findings suggest that patients with a pre-existing ventral abdominal hernia should be referred for surgical evaluation within 60 days after TIPS placement for potential elective hernia repair.

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