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EC MICROBIOLOGY
Review Article

Overview of Trans Jugular Intrahepatic Portosystemic Shunts

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Received: November 19, 2019; **Published:** November 28, 2019

Abstract

Introduction: When there is an increase in the pressure in the portal vein the blood flow to the liver gets blocked. This is known as portal hypertension. Trans jugular Intrahepatic Portosystemic shunts (TIPS) is a noninvasive procedure used universally that can manage portal hypertension. It uses imaging guidance and is usually performed by an interventional radiologist. TIPS help in lowering the hepatic sinusoidal pressure and increasing the circulatory flow which diverts the blood flow from the portal venous system to the systemic circulation. TIPS also help in decreasing the sodium retention, recurrence of ascites and variceal bleeding. An improvement in the mortality rates and reduction in the risk of rebleeding is also seen. TIPS show an overall improvement in technical, clinical and hemodynamic aspects.

The aim of work: The review outlines the pathological aspects, indications,contraindications, complications,patient selection and outcomes along with the technical aspects and management of transjugular intrahepatic portosystemic shunts.

Methodology: The review is comprehensive research of PUBMED from the year 1969 to 2018.

Conclusion: Due to the significant technological advances that has happened in TIPS, it has been gaining popularity among patients as a safe and successful approach. The results are showing a gradual overall improvement with reduction in restenosis -the main complication of the procedure Even though TIPS remain to be a complicated procedure to perform, evolving technique expertise can make the procedure easier and more widespread in the near future.

Keywords: *TIPS; Portal Hypertension; Porto-Systemic Shunt; Transhepatic*

Introduction

The trans jugular intrahepatic portosystemic shunt (TIPS) is a recognized procedure that benefits patients who have conditions such as portal hypertension with complications such as variceal bleeding and ascites. The liver comprises of two important types of blood vessels. The portal and hepatic veins. The former transports nutrient-rich blood to the liver from the abdominal organs. Whereas the later drains blood from the liver and returns it to the heart [1].

In a pathological condition like advanced liver diseases (cirrhosis or liver scarring), pressure builds up in the small vessels which connects the large veins of the liver which leads to high portal vein pressure, known as portal hypertension. There is obstruction to the blood flowing by the scarred tissue which prevents its forward movement. The TIPS procedure can help to decrease the pressure in the portal vein and reduce the complications.

Originally described in 1969 by Rösch., et al. TIPS is a percutaneous imaging-guided procedure where a channel is created within the

liver to reduce portal pressure by redirecting blood to the systemic circulation from the portal circulation [2].

In 1987 Gordon., et al. described the same procedure in humans [3]. However this method lacked the durable patency of the tract that was created between the hepatic and portal vein. The modified TIPS procedure developed by Kerlan., et al. in 1995 used a metallic stent which helped bridge the hepatic parenchyma between the hepatic and portal vein [4].

TIPS though cannot be used as a replacement for endoscopic therapy or surgery, is an efficient therapeutic option for patients with complications of portal hypertension [1].

Initially the commonly used stent was that of bare metal, but as years passed the evolution to stents coated with polytetrafluorethylene (ePTFE) have amplified. Since there is a marginal decrease in the clinical relapse rate and improve in long term shunt patency, these stents are primarily used at present [5].

To assess the safety and efficacy of the procedure, several clinical trials have been conducted which influences the clinic value of TIPS. The model of end-stage liver disease (MELD) scoring system is used for risk assessment of short-term mortality of patients undergoing TIPS, which also evaluates the clinical efficacy of the procedure. TIPS efficacious in the technical, clinical and hemodynamic aspects. The shunt created between the hepatic vein and intrahepatic branch of the portal vein accounts to its technical efficiency. Clinically TIPS help relieve the symptoms and long-term shunt patency. Hemodynamically there is an improvement in portosystemic gradient [6].

Pathological principles

The TIPS procedure is aimed at reducing the portal resistance to increase the portal venous inflow so that instant decompression of the mesenteric venous congestion is seen which reduces the portal pressure up to 50%. This eventually improves the extrahepatic hemodynamic circulation during the first year itself. In the first 6 months vasoconstrictive system normalizes [6].

Administration of non-selective beta blockers (NSBBs) improve the hemodynamic response. It also protects again variceal bleeding which reduces bacterial translocation and prevents chronic liver failure. The TIPS procedure increases the benefits of the NSBBs by rectifying the vascular dysfunction. However, these groups of drugs should only be administered in certain situations [7].

Within a span of two weeks renal function and systemic inflammation improvement is seen. There is an effective volume increase that is seen in TIPS as the stent helps in the improvement of renal perfusion, elimination of sodium and controlling ascites [7].

Indications

The indication of TIPS are as follows: [8].

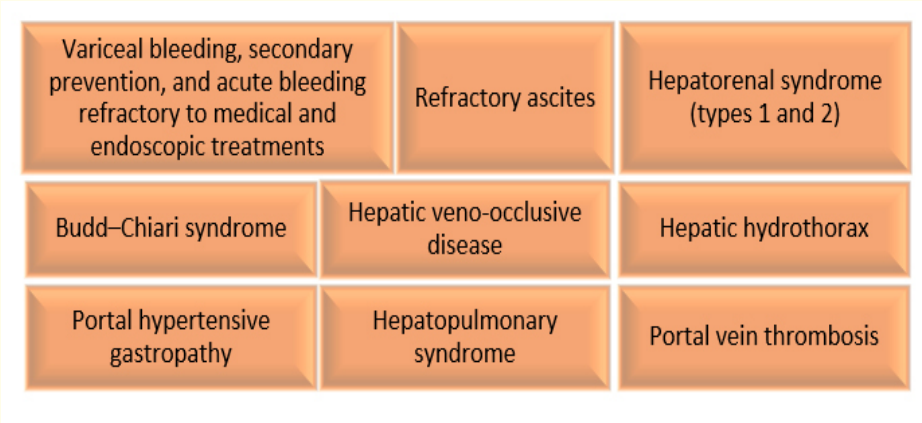

Figure 1: *Indication of TIPS.*

Out of these the most significant evidence of efficacy of the TIPS procedure are seen in

1. Secondary prevention of esophageal variceal bleeding.
2. Management of refractory ascites.

Figure 2: *Yellow arrow->dilated tortuous varices around lower esophagus; Black arrow->Perihepatic and Perisplenic ascites.*

Coronal contrast-enhanced computed tomography of the abdomen [8]

Patients susceptible to risk of treatment failure (e. g. patients with Child-Pugh stage C < 14 points or Child-Pugh stage B with active bleeding), the primary TIPS procedure must be done after the initial pharmacological and endoscopic treatment (within the first 72 hours) Even though glomerular filtration rate increases, refractory ascites is better controlled with the use of TIPS procedure in patients who do not respond to treatment with NSBBs Survival rates are better with TIPS as compared to paracentesis [8].

Contraindications

The American Association for the Study of Liver Diseases lists the absolute and relative contraindications are [1,7].

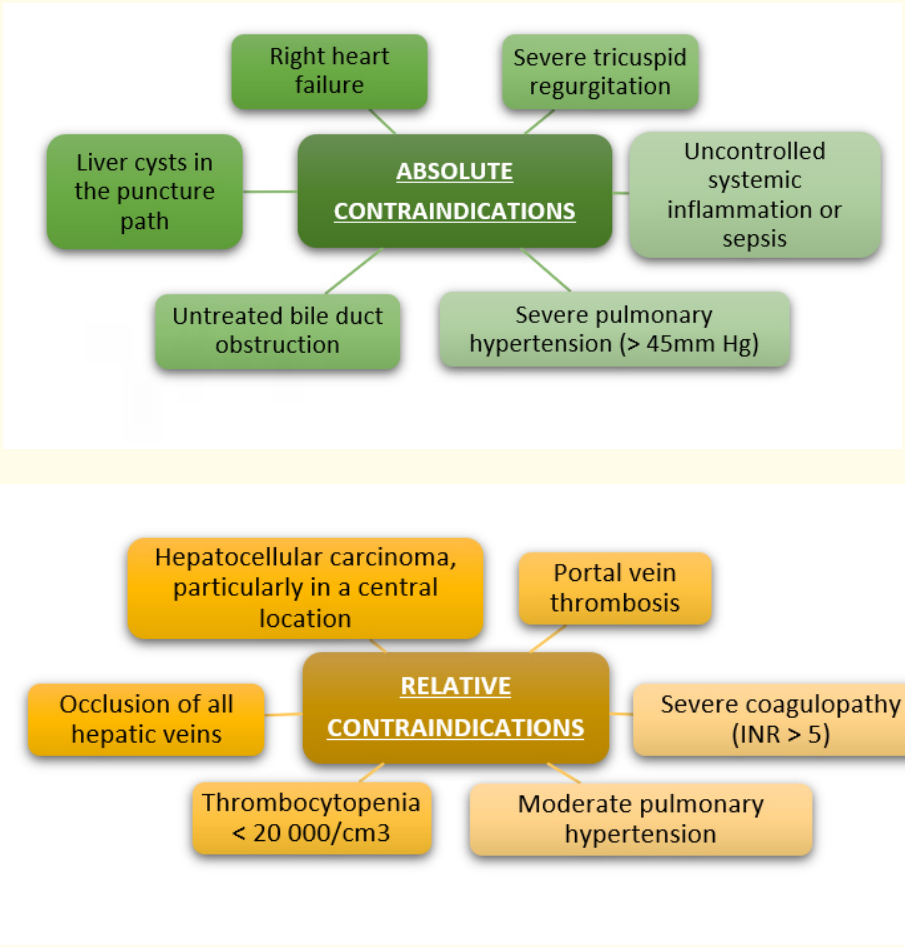

Figure 3: *contraindications to TIPS.*

Complications

A number of adverse effects can be seen with the TIPS procedure. It can be the result of intervention which leads to bleeding or due to perforation of the liver capsule, vessels or bile ducts During the time of the TIPS placement:

1. In about 33% of the cases trans capsular puncture is seen.
2. In 1 - 2% capsular perforation leading to intraperitoneal hemorrhage is observed.
3. Rarely haemobilia.
4. Placement of stent too far into the inferior vena cava/right atrium/main portal vein.

5. Migration of the stent due to catheter and balloon manipulation.
6. In 30 - 46% reduction of metabolic filtering effect of hepatic parenchyma leading to or worsening of encephalopathy.
7. In 10% deterioration of hepatic function.
8. Rarely hepatorenal syndrome.

Bare-metal stents showed stenosis due to hyperplasia in 18-78% of the cases, which lead to the recurrence of complications due to portal hypertension. The introduction of PTFE-covered stents improved the long-term patency [1].

Patient selection

The decision if a patient should undergo TIPS is primarily a team-decision by the hepatologist, gastroenterologist and the intervening radiologist. Clinical questions like if the procedure is required for a particular complication of portal hypertension and the presence of absolute or relative contraindication should be answered. Patients above the age of 65 have a higher risk of developing problems later [8].

The patient's MELD score should be noted. It is usually calculated based on the creatine, bilirubin and INR (international normalized ratio) and is effective in predicting port-TIPS mortality. A MELD score of > 18 indicated a probability of higher mortality 3 months after TIPS than as opposed to those with < 18 [9].

Increasing severity of cirrhosis can lead to encephalopathic complications in such patients.

Once the decision of a patient's fitness to undergo TIPS has been made a comprehensive case history and physical examination is vital. 24 hours post procedure a complete blood count, liver function test, blood coagulation profile and comprehensive metabolic panel including serum electrolyte levels must be done. If coagulopathy is present, then the required blood products (platelets or hematocrit) must be administered. Patients with a history of pulmonary or cardiac disease should be checked by an echocardiogram or newer methods such as Doppler ultrasound or cross-sectional imaging. It is advisable to perform large-volume paracentesis in case of refractory ascites or thoracentesis in hepatic hydrothorax patients, one day prior or on the day of the TIPS procedure [8].

Technical considerations

The procedure is generally performed under general anesthesia with endotracheal intubation, however conscious sedation can also be used for the same though most practitioners prefer the former. Conventionally practitioners use the right hepatic vein approach to create a shunt (as shown in the figure below) Schematic diagram showing TIPS connects the Venogram showing course of right hepatic vein [1] right hepatic vein to right portal vein [1].

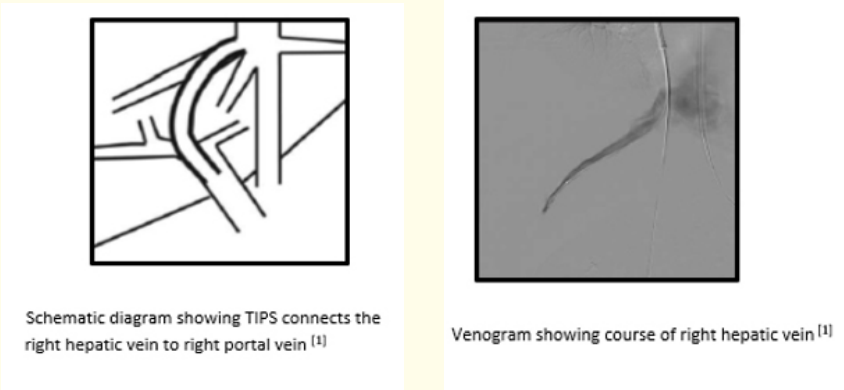

Figure 4: *Right hepatic vein for access.*

Conventional TIPS creation technique

Access to the portal vein can be achieved from any hepatic vein or from the inferior vena cava in those patients where the hepatic veins are completely occluded [1].

Balloon occlusion hepatic venography with carbon dioxide is commonly used by practitioners which helps to show the course and direction of flow in the portal veins.

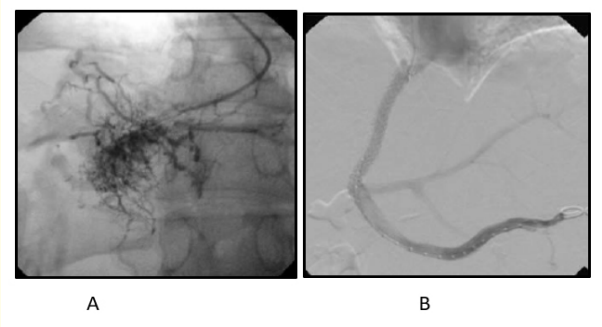

Figure 5: *A. Wedged hepatic venogram showing a B. Patent TIPS shown on complete portal venogram [1] small collateral vessel network [1].*

Budd-Chiari syndrome with TIPS [1]

Puncture of the portal vein branch from the hepatic vein is a common technical difficulty in TIPS placement. There has been a great improvement in image guidance (percutaneous or intravascular ultrasound guidance /contrast injection/CBCT) which increases the success and reduces the complications of TIPS. The ultrasound-guided puncture done percutaneously is the simplest and effective method without radiation exposure. A guide-wire is inserted through a hollow needle. After cannulation of a hepatic vein (usually the right), ultrasonography is used to analyze if the vein can provide suitable access to a right-sided portal vein branch. If not, an alternative hepatic vein should be probed [7].

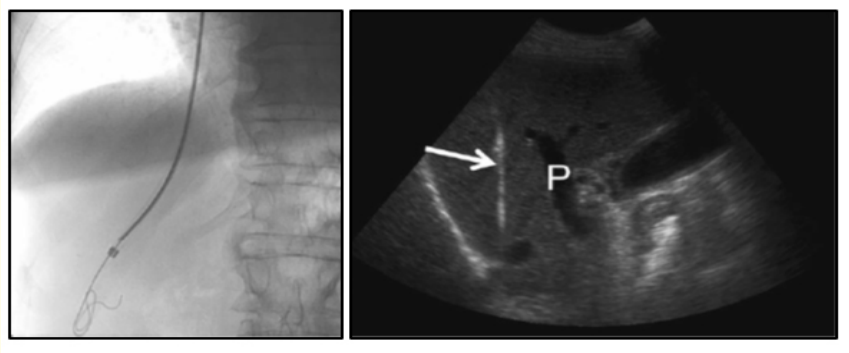

Figure 6: *A. Cannulation of a liver vein with stiff hydrophilic coated guide wire [7] B. Ultrasonography from right lateral position to check for suitable puncture track from liver vein [7].*

The selection of the correct hepatic vein is important, or else it makes the entire procedure problematic. The guidewire in the catheter improves the perceptibility of the catheter on the ultrasound. A right sided portal vein branch is punctured with adequate ultrasound and intermittent fluoroscopy guidance from ventral approach. After the puncture of the portal vein branch is verified with an angiograph, the main portal vein is accessible and then probed. The quality of the image guidance further dictates the effectiveness of the procedure [7].

In an Ultrasound guided puncture, a thrombosed portal vein or a larger collateral de to cavernous transformation can be punctured. Since Transhepatic portal venography can only help with the 2D image of the nature of the course of the vein, precise localization of the portal vein is difficult. This inability to visualize leads to many needle passes within the parenchyma of the liver the can cause injuries to the hepatic artery, bile duct or liver capsule. Direct intrahepatic portocaval shunt (DIPS) is a variant of the classic TIPS procedure which was described by Peterson., et al. in 2001 [11]. Here a side-to side shunt is made with the help of endovascular ultrasound guidance through the caudate lobe as the parenchymal tract, between the inferior vena cava and the portal vein [12].

DIPS technique does not require intravascular ultrasound skills to be perfect in it. The needle can be guided through a large intraparenchymal portal vein branch to the inferior vena cava with a transabdominal ultrasound. The main advantage of the DIPS procedure is the lack of hepatic vein as shunt outflow. It also negates real-time imaging guidance during needle advancement into the portal vein. Lack of ultrasound use reduces the radiation exposure and there is an overall reduction in the procedural time [7].

Another possibility is to use a ultrasound-guided puncture, where a guidewire is inserted via a needle, which is captured and withdrawn using a snare from the jugular vein access. A large-bore catheter or sheath can be introduced in the jugular through the parenchymal trach using the guidewire (which is running to the jugular from the right lateral flank). the parenchymal tract is then dilated and stented. These variants of TIPS are mainly indicated in Budd-Chiari Syndrome [7].

Maintenance of tips

If a situation with recurrence or worsening of the symptoms of portal hypertension occurs, an ultrasound with Doppler must be carried out to exclude stenosis of TIPS.

Shunt dysfunction can be seen if the shunt velocities are lower than 50cm/s or higher than 250cm/s. It is advisable to carry out routine

surveillance tests regularly in asymptomatic patients. If a TIPS dysfunction is suspected, a TIPS venography must be done. In situations to increase the caudal or cranial lengths of the stents, additional stents can be placed [12].

In cases with hepatic encephalopathy, endovascular shunt reduction may be required.

Shunt catheterization with two parallel guidewires following simultaneous deployment of two stents within the shunt is commonly used. The endograft covers on stent and the second one is a balloon-expandable bare-metal stent (which determines the ultimate shunt diameter). The cephalic aspect of the stent is usually the bare-metal stent which gives continuous access to the balloon expandable stent if further reduction has to be done [13].

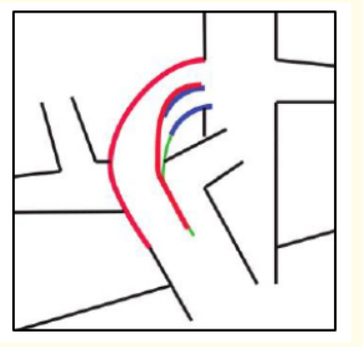

Figure 7: *Covered endograft (RED) along with balloon-expandable uncovered stent (BLUE) inside the original TIPS (GREEN), which narrows the cephalic aspect of the shunt calibre [7].*

Conclusion

TIPS is a recognized noninvasive endovascularly created portosystemic shunt that is primarily used in patients with portal hypertension, which reduces the portal decompression in over 95% of cases. The usage of TIPS has become popular in secondary prevention of refractory ascites and variceal bleeding. Other conditions like Budd-Chiari syndrome, hepatic hydrothorax and acute variceal hemorrhage are also benefited from TIPS. The revolutionization of the procedure was seen with the invention of covered stents which improved the patency of these shunts drastically. Though there is a considerable amount of risk associated with TIPS the benefits seem to outweigh the risks in appropriate clinical situations. More technical advancements are being done in the field to decrease the post-operative complications of TIPS. With an improved patient selection criteria and diligent observation of the contraindications to the procedure, improved covered stents the efficiency of TIPS is being increased. Very soon it can be considered as the first-line of therapy in those patients where this is the only option of therapy left.

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Volume 15 Issue 12 December 2019