Interventional Radiology in Portal Hypertension

Dr Alankar Kumar

Resident DNB G.I surgery

Transhepatic variceal embolisation
Anders Lunderquist, 1974

TRANSHEPATIC CATHETERIZATION AND OBLITERATION OF THE CORONARY VEIN IN PATIENTS WITH PORTAL HYPERTENSION AND ESOPHAGEAL VARICES

ANDERS LUNDERQUIST, M.D., AND JOHANNES VANG, M.D.

Abstract For the management of esophageal varices complicating portal hypertension, we have developed a method that consists of (1) percutaneous transhepatic portal venipuncture, (2) manipulation of a catheter via the portal vein into the coronary vein, and, (3) if injection of contrast medium demonstrates retrograde flow through that vein as well as esophageal varices, injection of 30 ml of 50 per cent glucose solution followed by injection of a small amount of thrombin solution. Portography is used throughout to facilitate the procedure and assess results.

Four patients have been treated, two of them with variceal bleeding. In all four, obliteration of the coronary vein by this method was successful. (N Engl J Med 291:646-649, 1974)

FOR many years percutaneous splenoportography and arterial portography (i.e., demonstration of the venous system after injection of large doses of contrast medium into the celiac and superior mesenteric arteries) have been methods of choice to chart the portal-vein anatomy and collaterals before shunt surgery. When percutaneous transhepatic cholangiography has been more widely used in jaundiced patients radiologists have found that accidental puncture of intrahepatic portal-vein branches occurred fairly often.

Using the same technic as for percutaneous transhepatic cholangiography, we have found the portal-vein system easily available for catheterization, and for six months all preoperative examinations of patients with portal hypertension have been performed in this way. Branches of the portal, splenic and superior mesenteric veins can be catheterized. It seemed reasonable to suppose that catheterization of the coronary vein and short gastric veins with injection of some blood clotting agent could be used to control bleeding esophageal varices. We have treated four patients in this way without adverse reactions.

METHOD AND MATERIAL

Under local anesthesia the liver is punctured in the mid-axillary line below the costophrenic angle of the lung with a 27-cm-long needle within a radiopaque catheter (outside diameter of 1.58 and inside diameter of 1.14 mm, Surgimed, Denmark). During posteroanterior fluoroscopy the needle is aimed against the 12th vertebral body of the thoracic spine, and one vertebral body ventral to the spine in the lateral view. The needle is introduced until about 3 cm from a vertical plane through the right border of the spine. When the needle is pulled out, the catheter is slowly withdrawn until blood is [illegible] without resistance. A test injection of a few milliliters of [illegible] medium confirms the position of the catheter in the main [illegible] the portal vein or one of its branches. A curved guidewire is then inserted through the catheter and manipulated into the splenic vein, after which the catheter is pushed over the guidewire until its tip is in the midportion of the splenic vein.

Portography is performed with the catheter in this position, 40 ml of contrast medium (Isopaque Coronar, Nyegaard, Norway) being used at an injection rate of 12 to 15 ml per second.

If retrograde flow through the coronary vein to esophageal varices is found, the catheter is pulled back to the main stem of the portal vein. The curved guidewire is inserted and manipulated as far up into the coronary vein as possible, and the catheter is then pushed over the guidewire. A new test injection of contrast medium confirms the position of the catheter.

Thirty milliliters of 50 per cent glucose is injected through the catheter to damage the intima of the coronary vein and the esophageal varices. The catheter is then filled with thrombin solution (Topostasin, Roche, Switzerland, 3000 NIH U, in 10 ml of saline), and not more than a few drops are allowed to be injected into the coronary vein. A blood clot is immediately formed, and if blood can be withdrawn through the catheter, the guidewire is inserted clean the catheter and a check injection of contrast medium is formed. If the coronary vein is not obliterated, the procedure is repeated until no more blood flows toward the esophageal varices. The catheter is then withdrawn to the main stem of the portal and again placed with the tip in the splenic vein. The portography repeated to check the result.

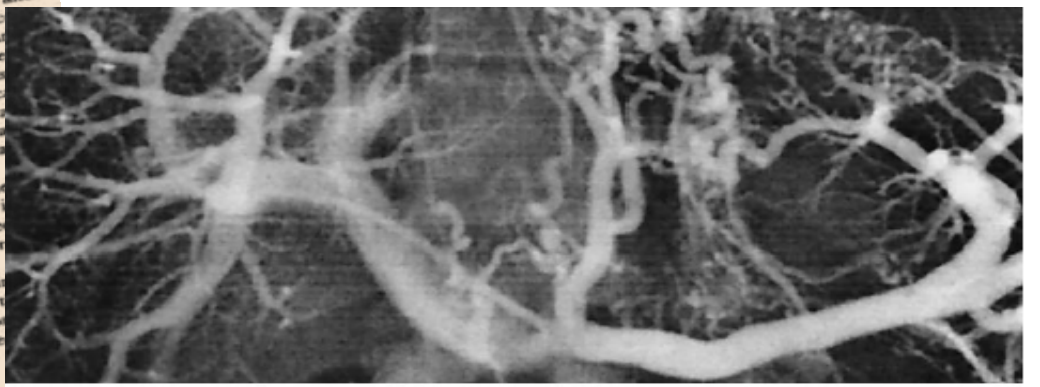
In one patient only 30 ml of 50 per cent glucose was injected the esophageal balloon of a Sengstaken–Blakemore tube was inflated after half the volume was injected. The balloon was inflated hours, and then another portography demonstrated obliteration the coronary vein.

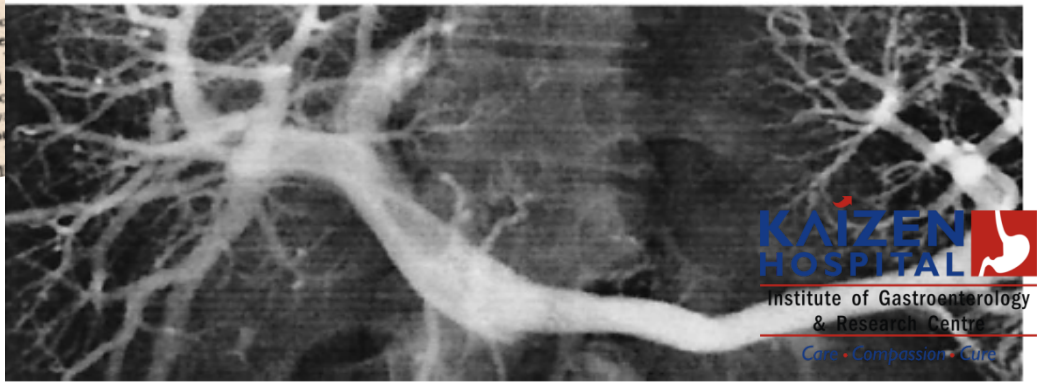
In another patient small particles of absorbable gelatin (Spongostan, Ferrosan, Denmark) were injected into the vein produced by the thrombin. The obliteration of the coronary vein was successful in all four patients. Two patients were treated of bleeding esophageal varices; two had not bled.

CASE REPORTS

CASE 1. A 64-year-old woman was referred to the hospital pain in the right upper part of the abdomen and increasing ness. The abdomen was slightly distended by ascites. The previously the diagnosis of liver cirrhosis was made, and splenoportography showed portal hypertension with collaculation over esophageal varices. Now shunt surgery was and percutaneous transhepatic portography was performed the portal-vein anatomy and collateral circulation. neous transhepatic portography showed a rather small

[illegible] of Diagnostic Radiology and Surgery, University [illegible] reprint requests should be addressed to Dr.

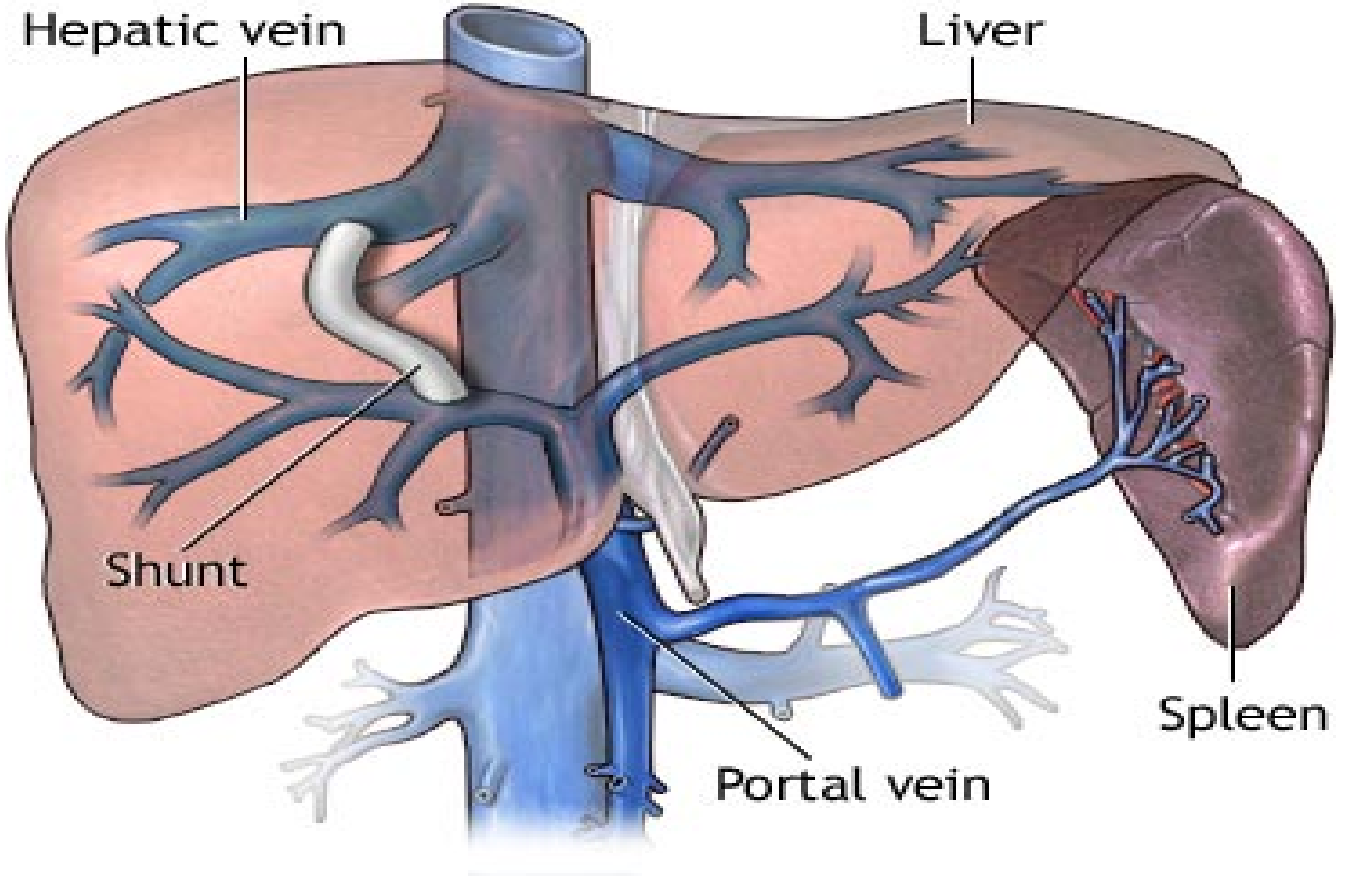




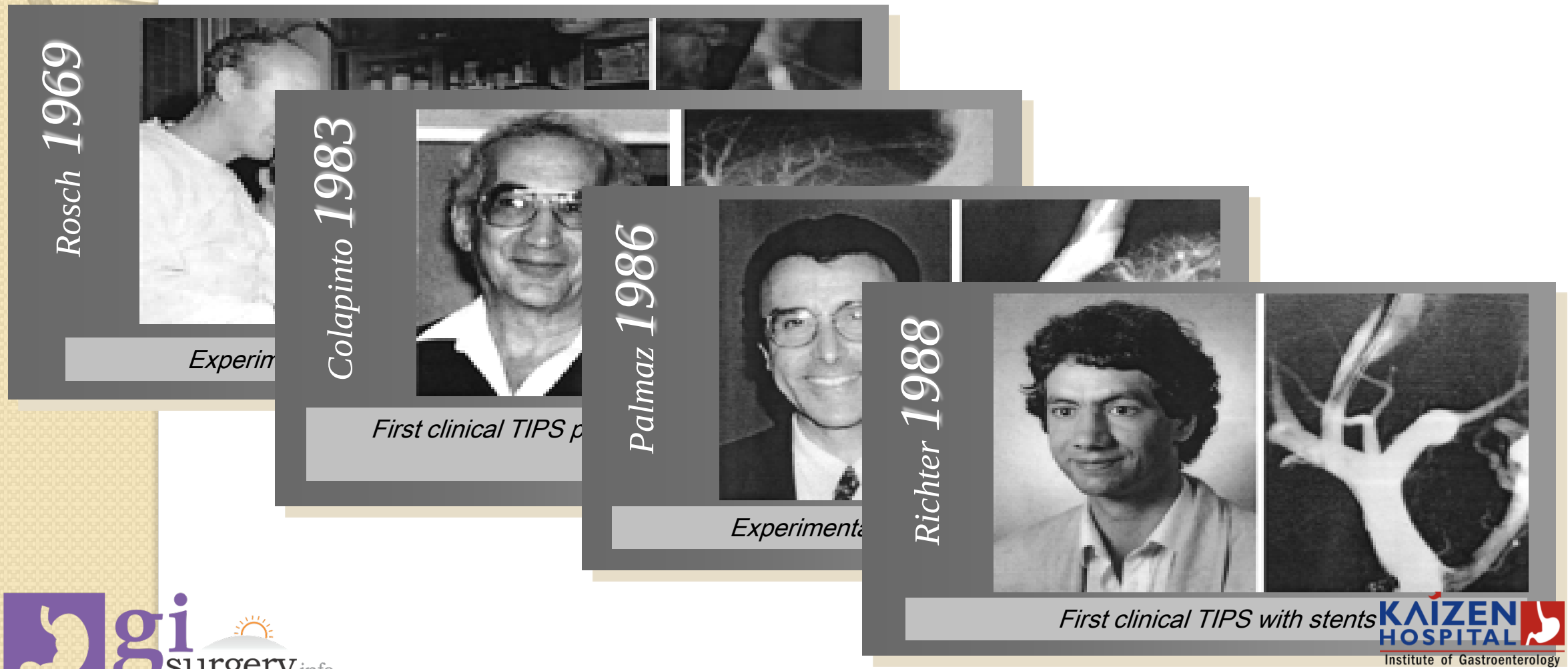
Radiological treatment of PHT

Reduction of Portal Venous Pressure	TIPS
	Recanalisation of portal inflow
	Recanalisation of hepatic outflow
	Embolisation of arterioportal fistula
	Partial splenic embolisation
Palliation of PHT symptoms	Percutaneous transhepatic variceal embolisation
	BRTO
	Image guided paracentesis
	Percutaneous peritoneovenous shunts

Transjugular Intrahepatic Portosystemic Shunt (TIPS)



TIPS : Evolution



TIPS: Indications

Indication	Level of evidence
Acute variceal bleeding unresponsive to endoscopic and medical therapy	Ia
Recurrent variceal bleeding with failed endoscopic or medical therapy	Ia
Ectopic variceal bleeding	4
Non-variceal bleeding secondary to portal hypertensive gastropathy	2b
Ascites resistant or intolerant to optimal medical therapy	Ia
Hepatic hydrothorax resistant or intolerant to optimal medical therapy	4
Budd Chiari syndrome	4
Hepatorenal syndrome	2b
Hepatopulmonary syndrome	4
Veno-occlusive disease	4
Neo-adjuvant TIPS prior to major abdominal surgery	4

Variceal bleeding
TIPS v Endoscopic Therapy

		Burroughs and Vangeli (2002)	Zheng et al (2008)
No. of RCTs		13	12
No. of patients		948	883
TIPS: ET		472:476	440:443
Recurrent bleeding	TIPS	88 (18.6%)	86 (19.0%)
	ET	210 (44.1%)	194 (43.8%)
	OR (95%CI) for TIPS	0.30 (0.21-0.44)	0.32 (0.24-0.43)
Encephalopathy	TIPS	134 (28.4%)	148 (33.6%)
	ET	83 (17.4%)	86 (19.4%)
	OR (95%CI) for TIPS	2.08 (1.49-2.94)	2.21 (1.61-3.03)
All causes mortality	TIPS	130 (27.5%)	111 (25.2%)
	ET	118 (24.8%)	98 (22.1%)
	OR (95%CI) for TIPS	1.14 (0.85-1.54)	1.17 (0.85-1.61)

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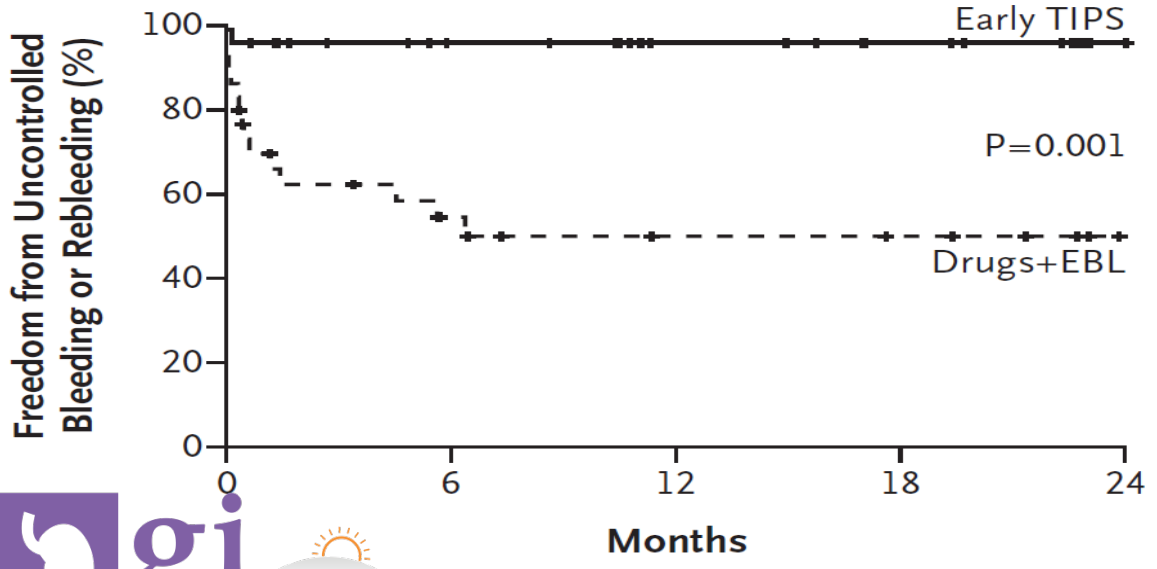
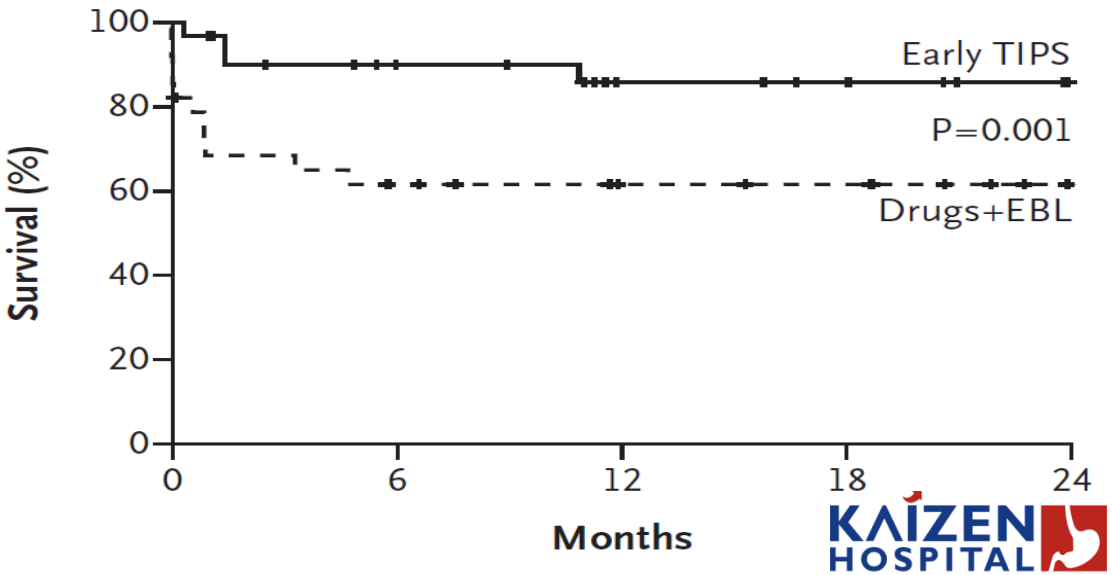
Early TIPS in variceal bleed

- Randomized trial for high risk group (HVPG >20 mm Hg)
- Child B, C patients (not Child A)
- TIPS (using stent grafts) v Endoscopic Band Ligation (+continued pharmacologic therapy)





Garcia-Pagan JC, et al. New Engl J Med 2010; 362:2370-2375

Ascites
TIPS v LVP

		D'Amico et al (2005)
No. of RCTs		5
No. of patients		330
TIPS: LVP		162:168
Recurrent tense ascites	TIPS	76 (46.9%)
	LVP	146 (86.9%)
	OR (95%CI) for TIPS	0.14 (0.08-0.26)
Encephalopathy	TIPS	75 (46.3%)
	LVP	51 (30.3%)
	OR (95%CI) for TIPS	2.34 (1.41-3.87)
All causes mortality	TIPS	78 (48.1%)
	LVP	86 (51.2%)
	OR (95%CI) for TIPS	0.90 (0.44-1.81)

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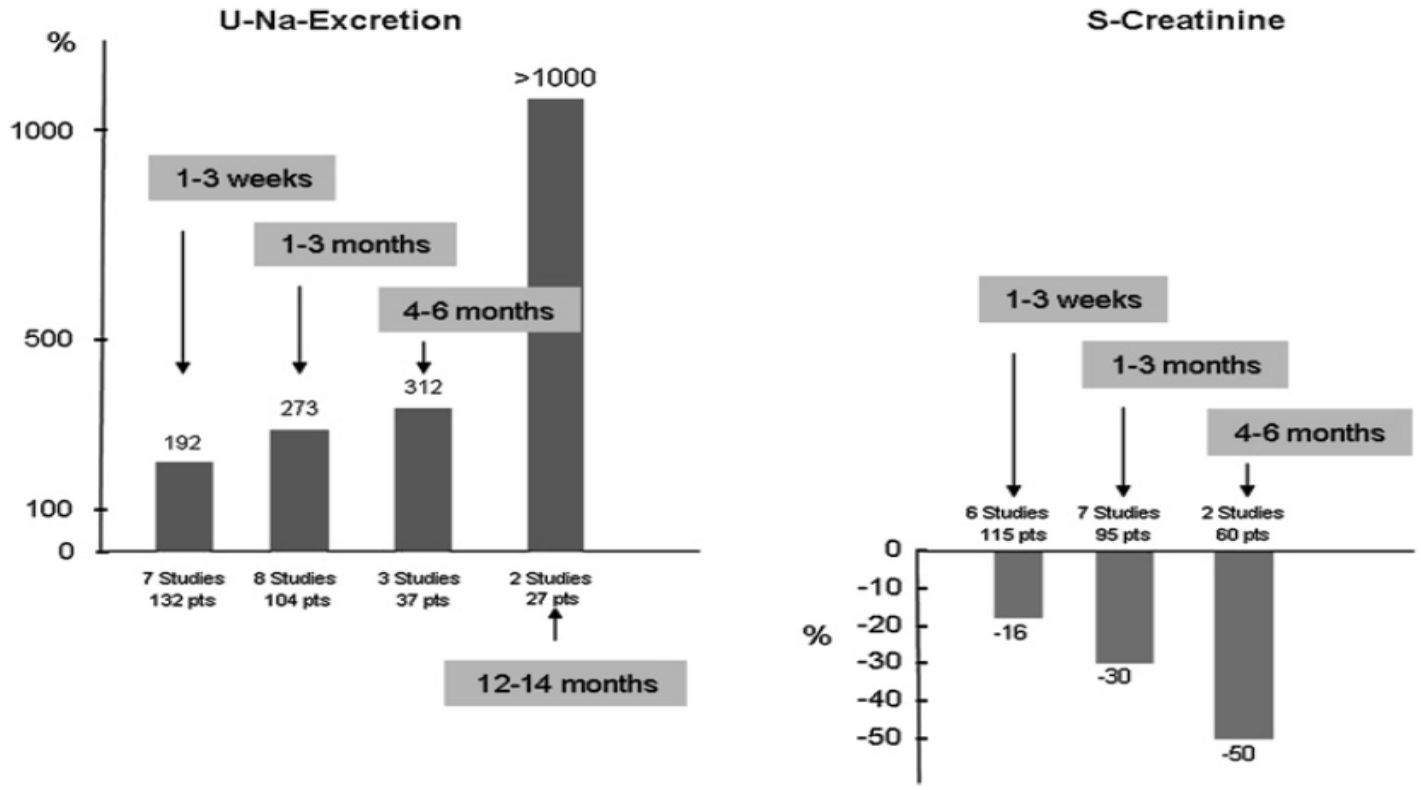
Hepatorenal syndrome

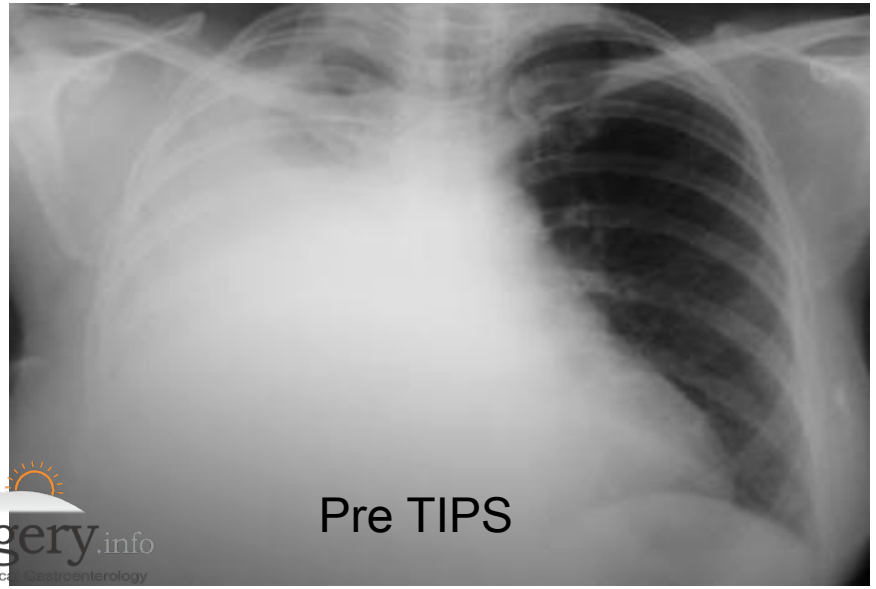


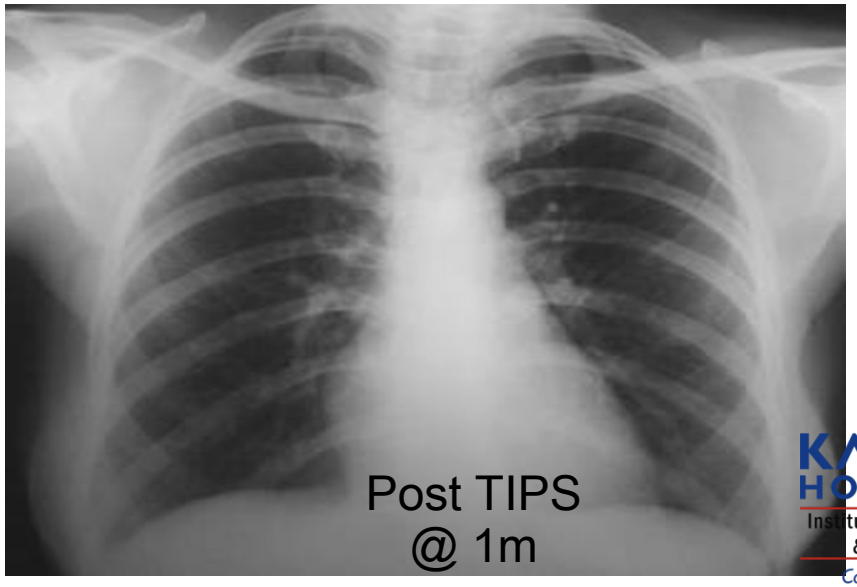
- TIPS improves renal function in HRS.
- TIPS augments effect of vasoconstrictor drugs in HRS.

Rossle M, Gerbes AL. Gut 2010; 59:988-1000

Hepatic hydrothorax

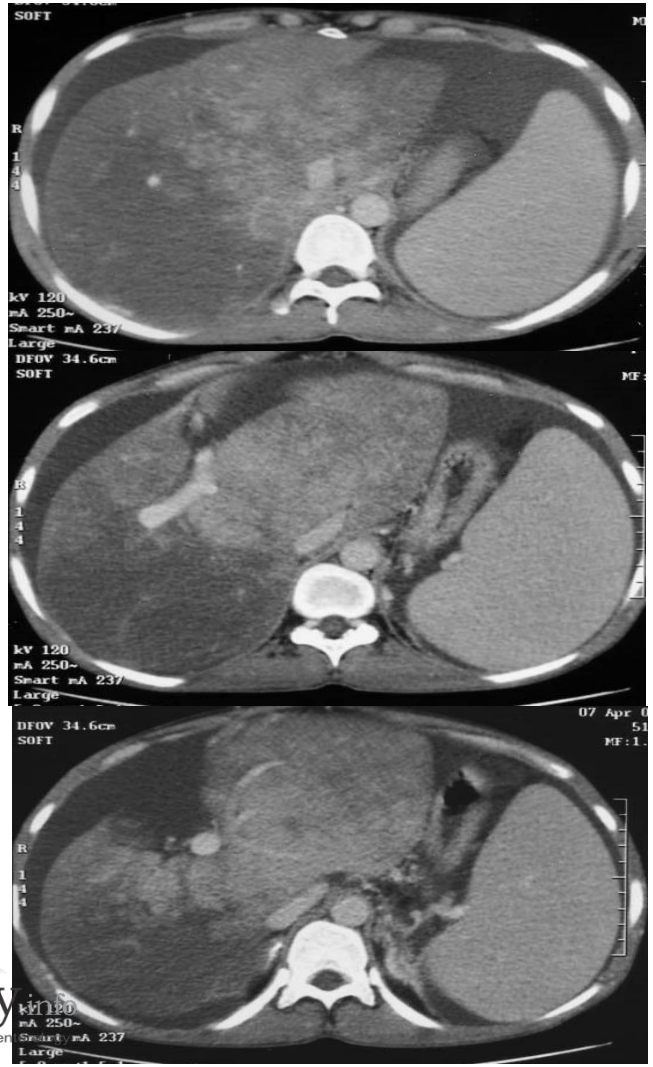
Author	*n*	Response	30-d mortality
Gordon, 1997	24	79	21
Siegerstetter, 2001	40	82	5
Spencer, 2002	21	74	29
Wilputte, 2007	28	68	14
Dhanasekaran, 2009	73	75	19
Total/range	186	68-82	5-29



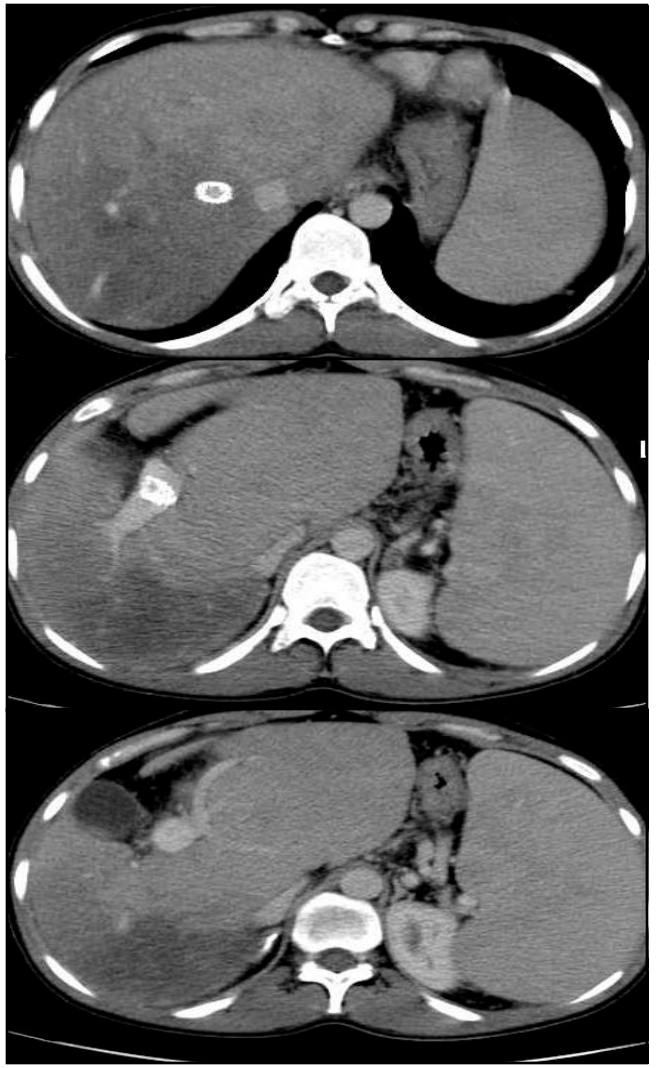


Budd Chiari syndrome

Pre TIPS



Post TIPS @ 3m



Budd Chiari syndrome

- Garcia-Pagan et al (2008)
  - Multi-centre study, 124 patients
  - Indications
    - Refractory ascites 59%
    - Liver failure 22%
    - Variceal bleed 9.5%
  - Transplant-free survival
    - 1-yr (88%) and 2-yr (78%)

Problems with TIPS

- Poor patency
- Hepatic decompensation
- Encephalopathy

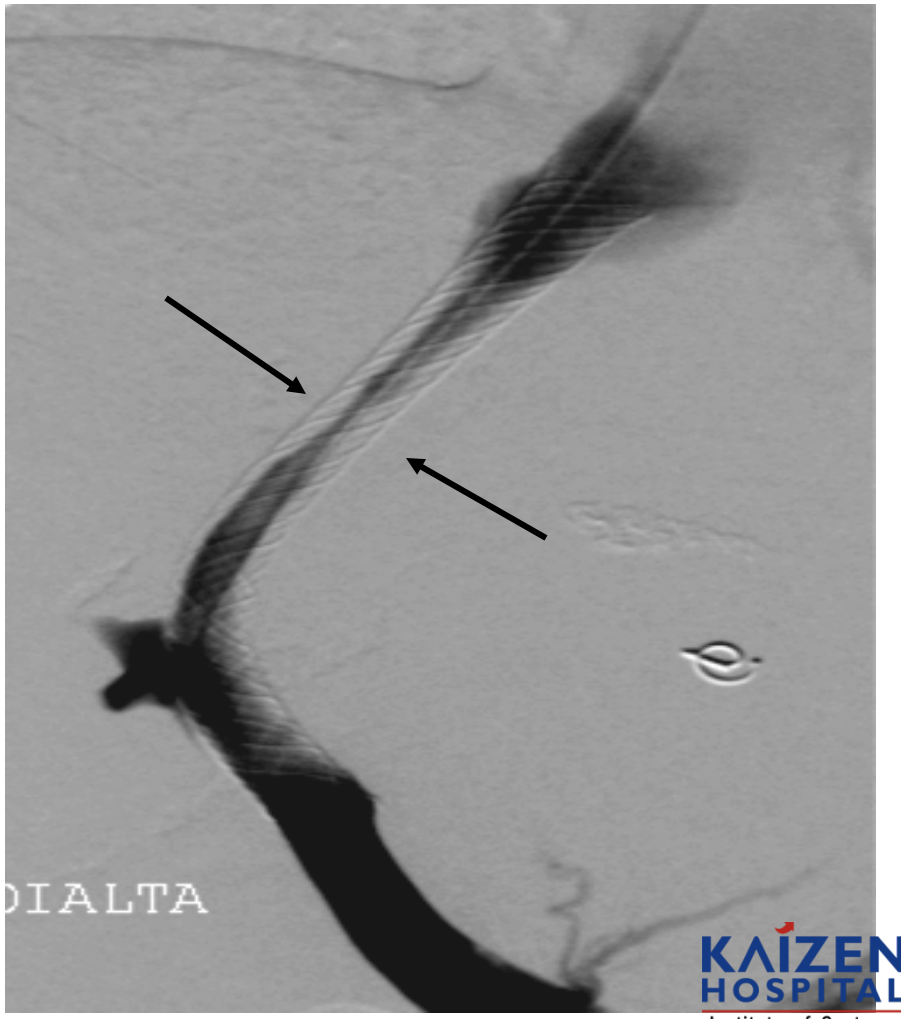
Patency of TIPS with bare stents

Patency rate :@ 1 yr 25-66%

@ 2 yr 5-32%

Shunt stenosis almost always associated with reappearance of varices and ascites

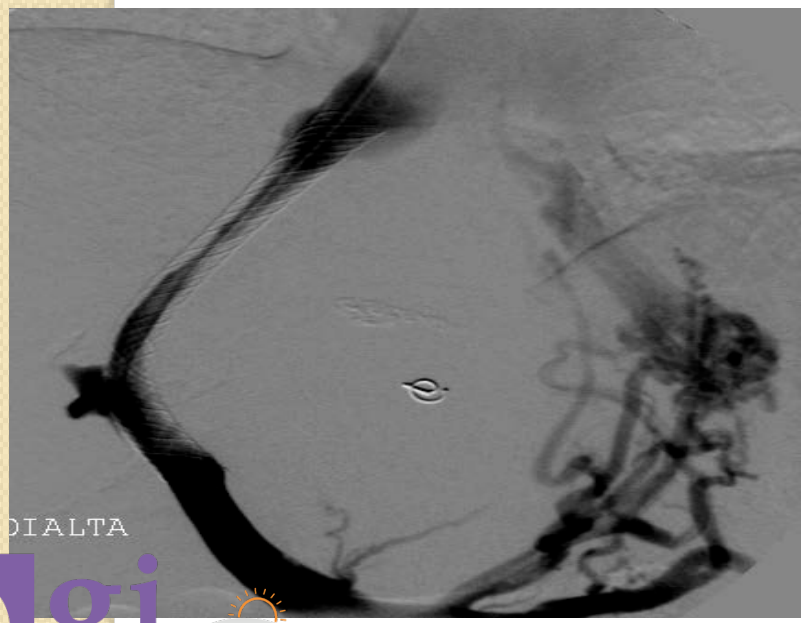
Can potentially impact survival (massive bleeding, SBP, sepsis, hepatic decompensation)

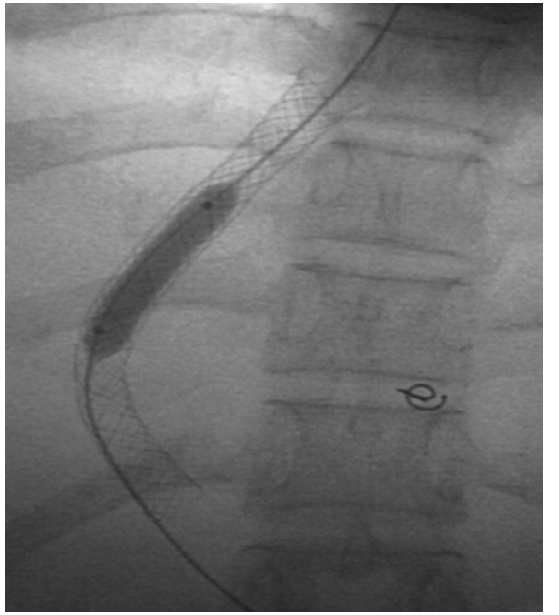


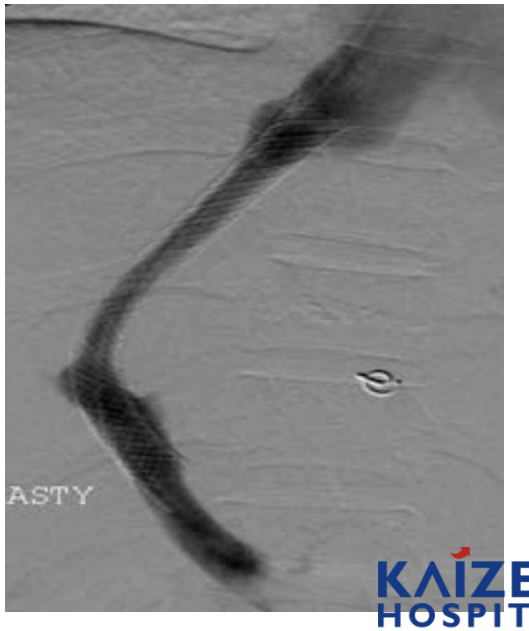
Patency of TIPS with bare stents

Requires repeat interventions

Balloon Angioplasty



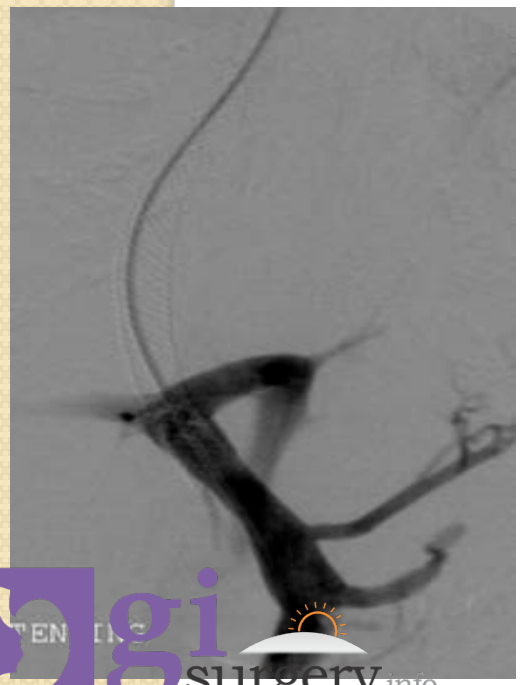


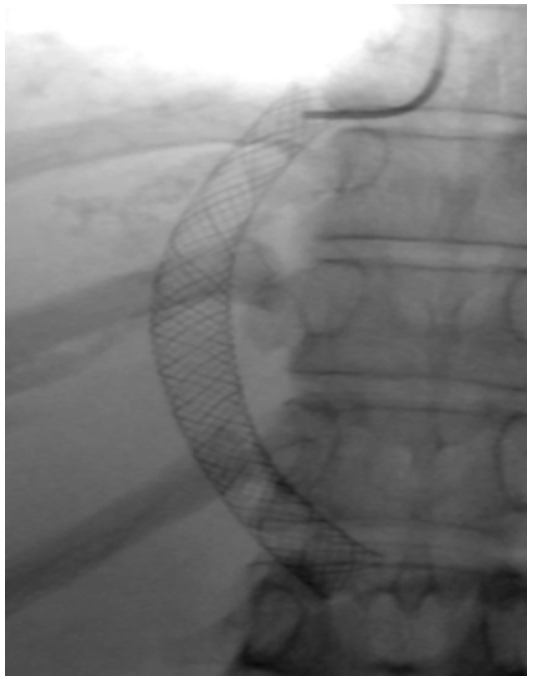


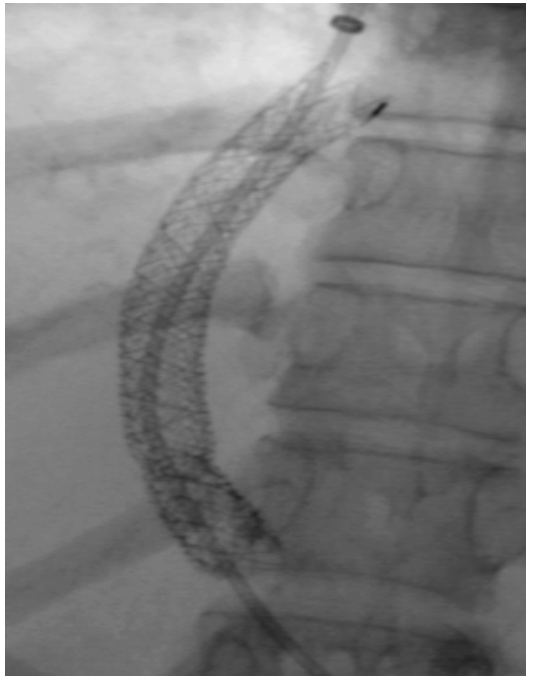
Patency of TIPS with bare stents

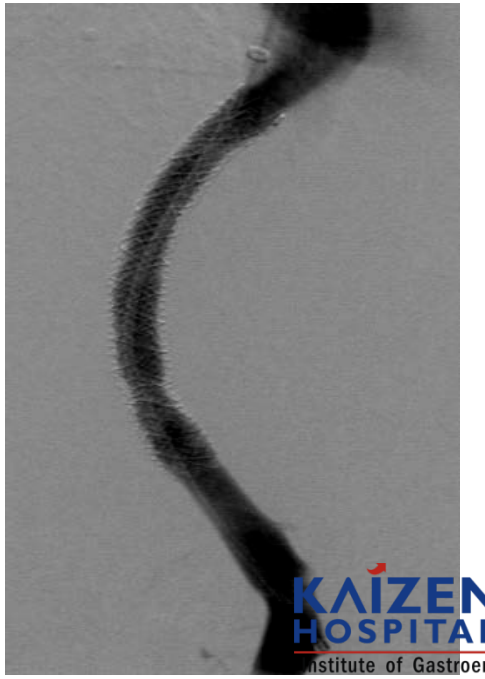
Requires repeat interventions

Repeat stenting









Patency of TIPS with bare stents

Secondary patency @ 3yrs 87%

BUT

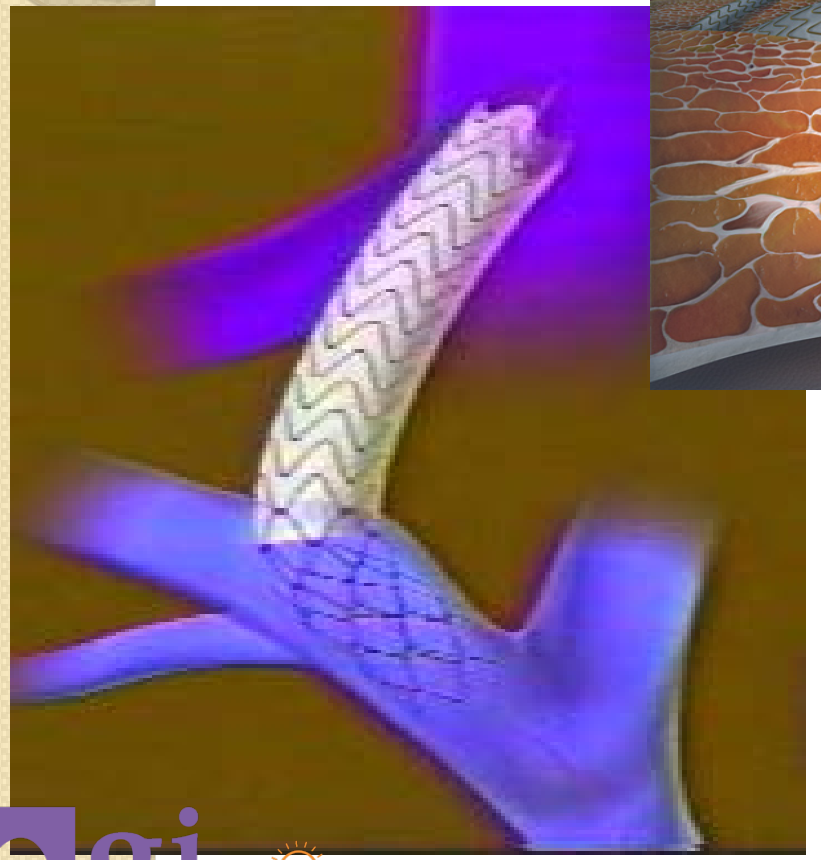
- Requires patient compliance
- Increases expenditure
- Reduces clinician confidence

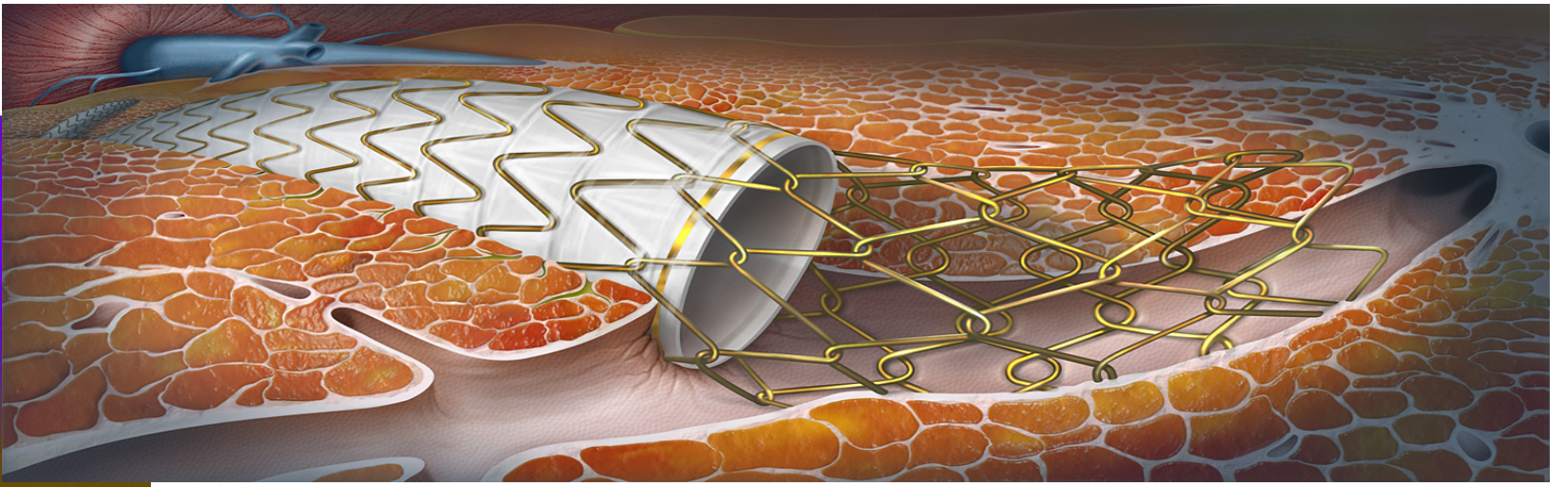
Cause of shunt malfunction

Intimal hyperplasia

Bile / mucin leak

TIPS using stent-grafts

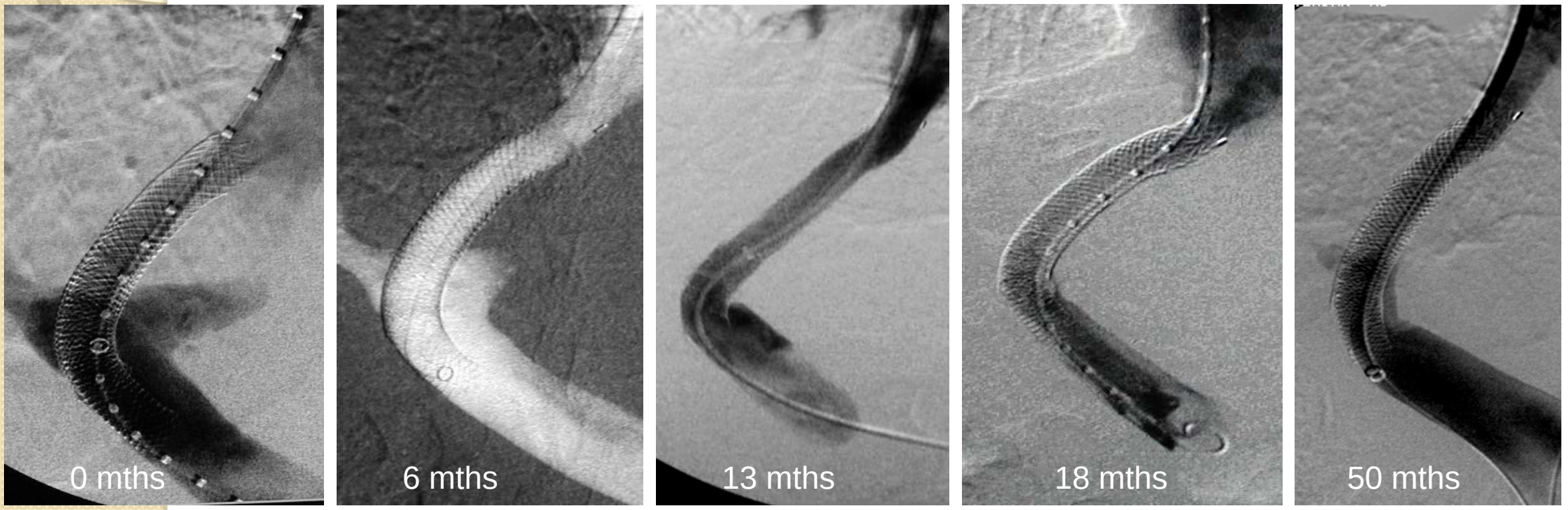




Prevents ingrowth of intimal hyperplasia

Protects shunt against bile permeation

Patency of TIPS with covered stents

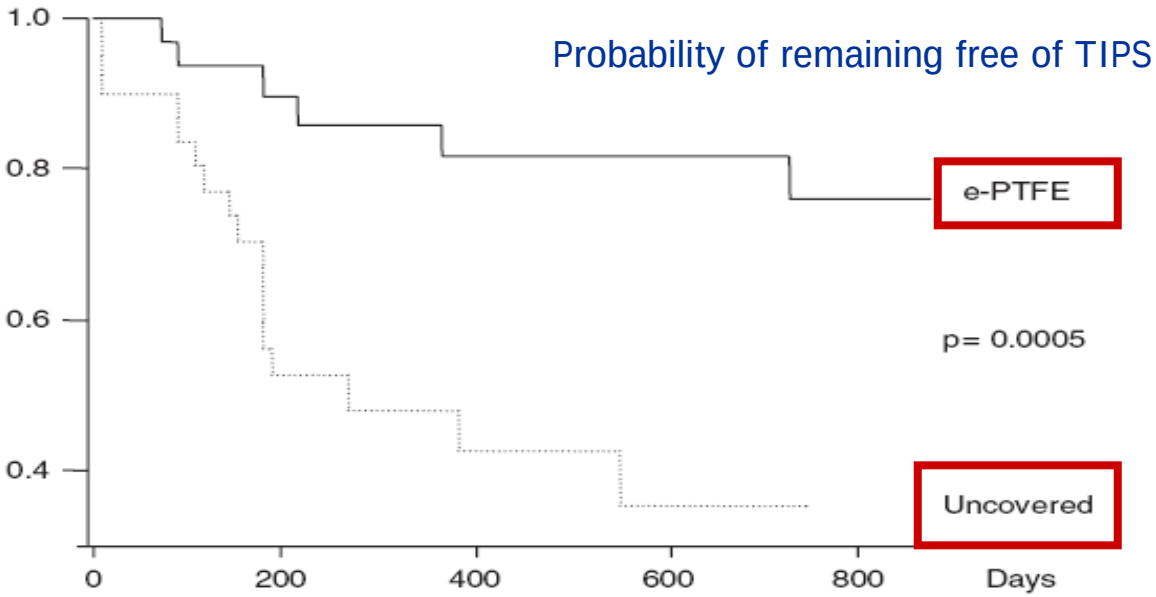


From: Case study information by Prof Ziv Haskal, www.goremedical.com

Improved patency with stent-grafts

Patency of stents covered with polytetrafluoroethylene in patients treated by transjugular intrahepatic portosystemic shunts: long-term results of a randomized multicentre study

Christophe Bureau[1,2], Juan Carlos Garcia Pagan[3], Gilles Pomier Layrargues[4], Sophie Metivier[2], Pablo Bellot[3], Pierre Perreault[4], Philippe Otal[5], Juan-G Abraldes[3], Jean Marie Peron[1], Hervé Rousseau[5], Jaume Bosch[3] and Jean Pierre Vinel[1,2]



Bureau C, et al. Liver Int 2007; 15:742-747

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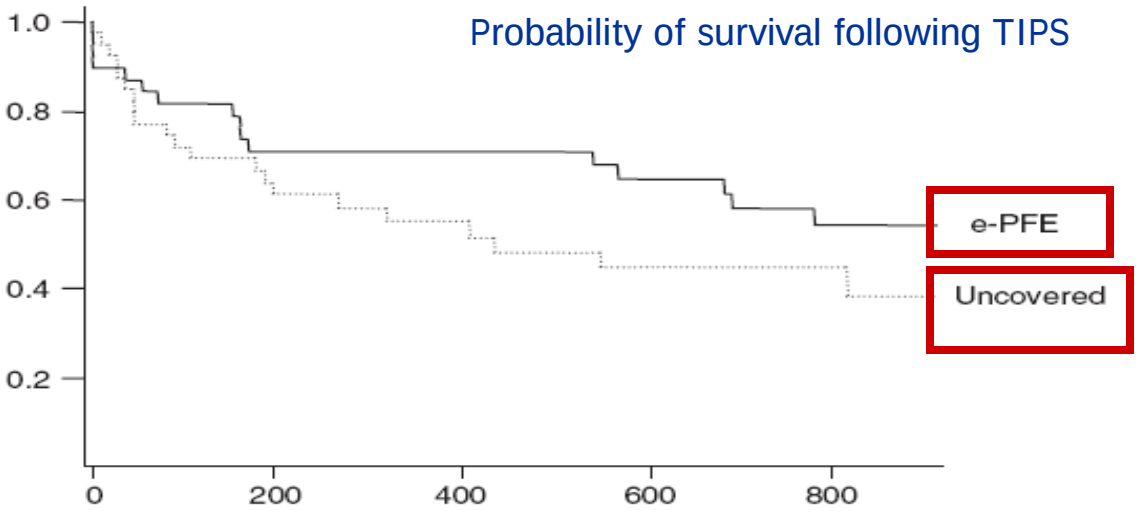


Bureau C, et al. Liver Int 2007; 15:742-747

Although stent-grafts provide durability

and improved survival…

Post TIPS survival is not

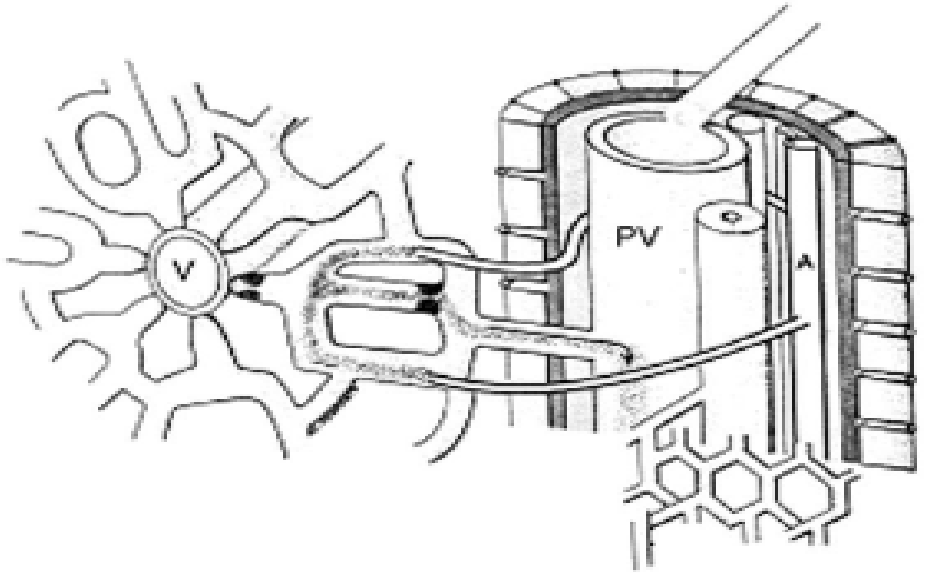
dependent on just the device…

Higher TIPS mortality

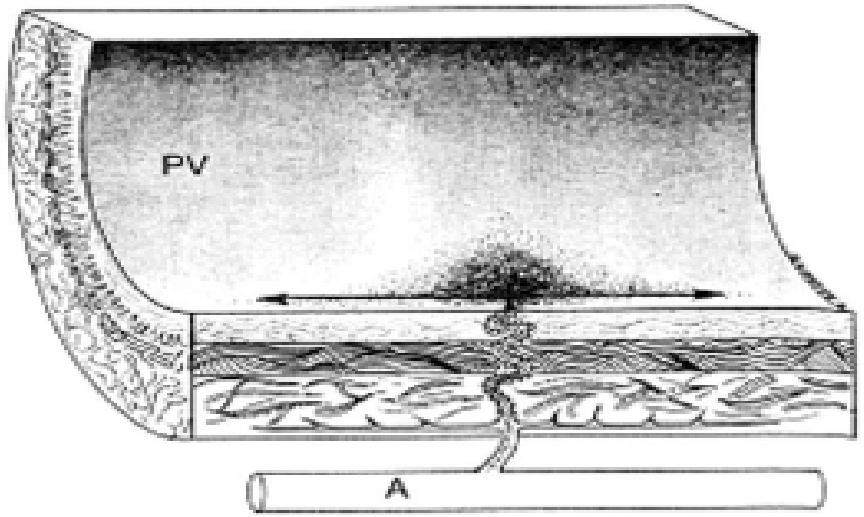
- Poor liver function
- Severe encephalopathy
- Congestive cardiac failure
- Severe pulmonary hypertension (Mean PAP >45 mm Hg)
- Uncontrolled systemic infection

Arterioportal shunting in cirrhosis

Trans-sinusoidal shunting

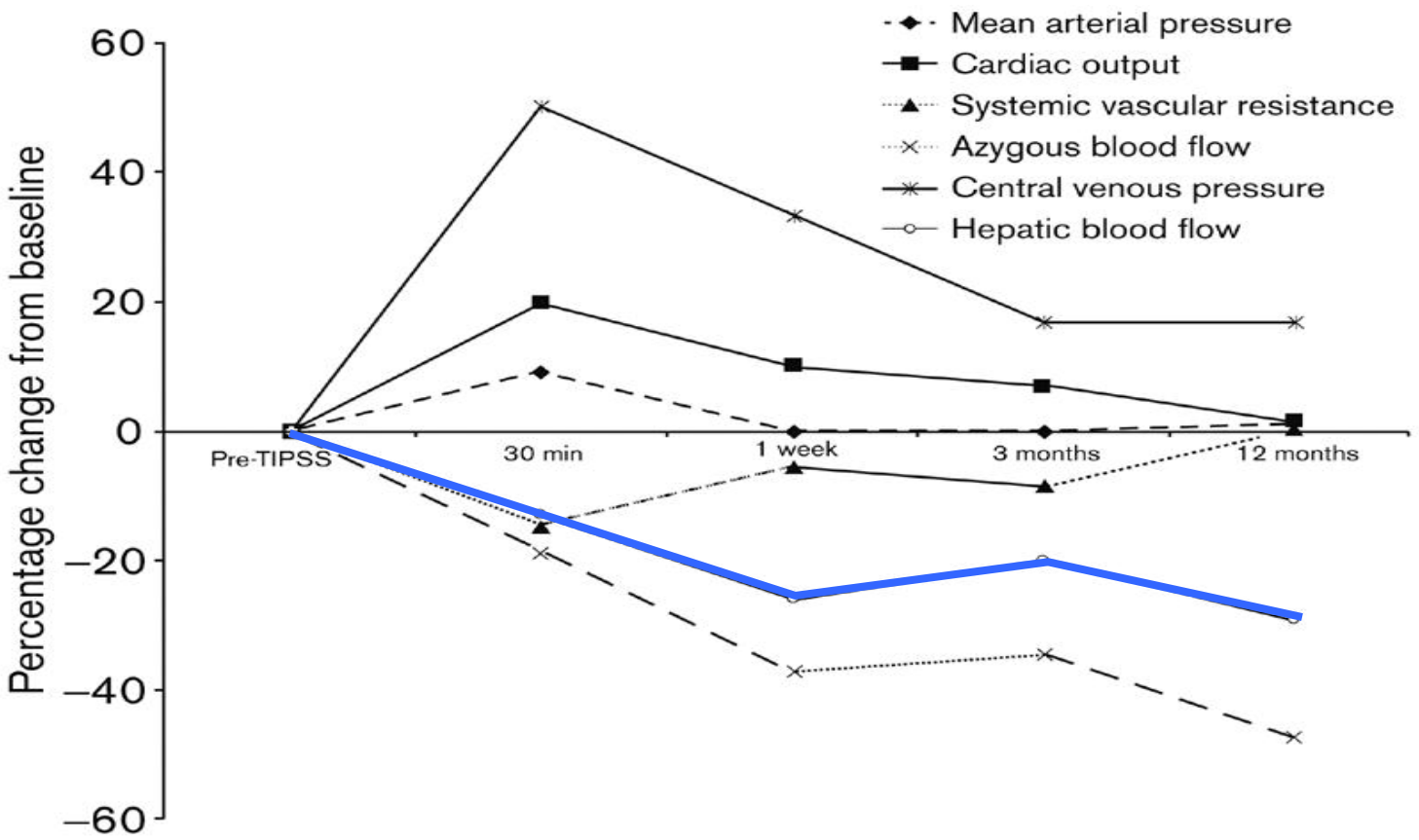


Trans-vasal shunting



Bookstein JJ, et al. Radiology 1982; 142:581-590

Arterioportal shunting ↑ after TIPS



HBF ↓

Leads to hepatic insufficiency and decompensation

Lotterer E, et al. Hepatology 1999; 29:632–639

TIPS : Prediction of mortality

- Various parameters to predict death
  - Bilirubin
  - Child-Pugh score
  - MELD score
  - Emory score
  - Bonn index
  - APACHE score

Rajan DK et al. J Vasc Interv Radiol 2002; 13:155-161
Haskal ZJ, et al. J Vasc Interv Radiol 1997; 8:289-297
Salerno F, et al. J Hepatol 2002; 36:494-500
Rubin RA et al. Am J Gastroenterol 1995; 90:556-563

Which prognostic model to use?

Comparison of MELD, Child-Pugh, and Emory Model for the Prediction of Survival in Patients Undergoing Transjugular Intrahepatic Portosystemic Shunting

Michael Schepke, Felix Roth, Rolf Fimmers, Karl-August Brensing, Thomas Sudhop, Hans H. Schild, and Tilman Sauerbruch

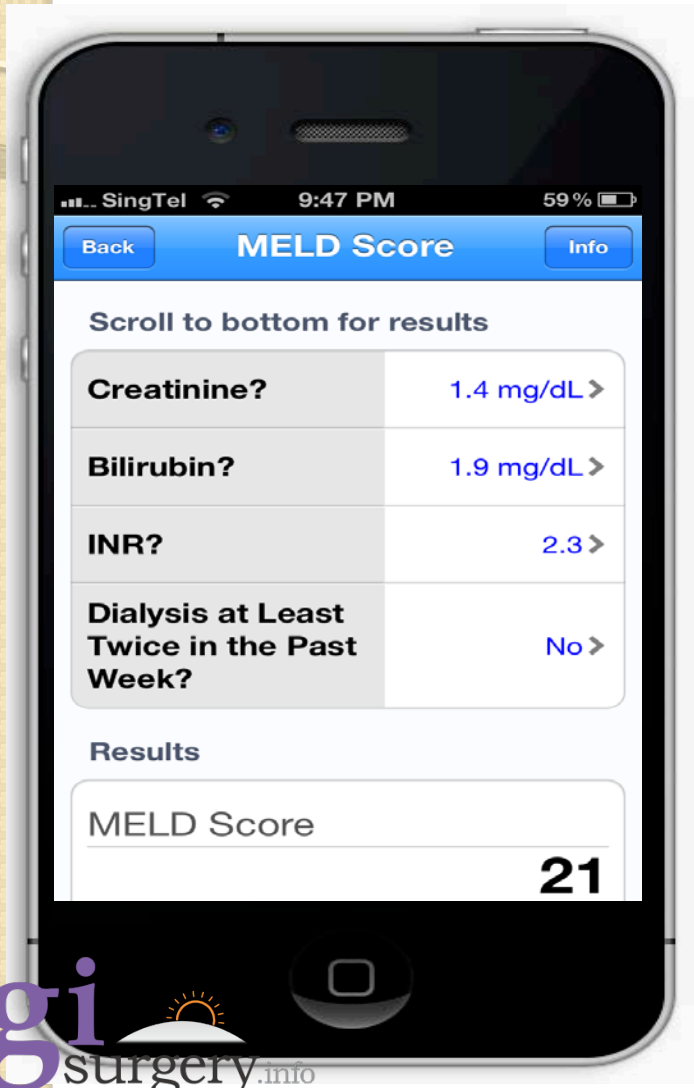
Departments of Internal Medicine I, Medical Biometry, Clinical Pharmacology, and Radiology, University of Bonn, Bonn, Germany

All models predict short-term (3m) survival with similar accuracy

Long-term (>1y) survival best predicted with MELD score

Schepke M et al. Am J Gastroenterol 2003;98:1167-1174

TIPS : Prediction of mortality



MELD SCORE

MELD Score =

3.8 $\log_e$(bilirubin mg/dl)

+ 11.2 $\log_e$(INR)

+ 9.6 $\log_e$(creatinine mg/dl)

+ 6.43

Kamath PS, et al. Hepatology 2001; 33:464-470
Malinchoc M, et al. Hepatology 2000; 31:864-871

Selection of cases for TIPS using MELD score

<10 ✔ Low risk, TIPS is safe

10-17 ✔ Some risk, benefit outweighs risk

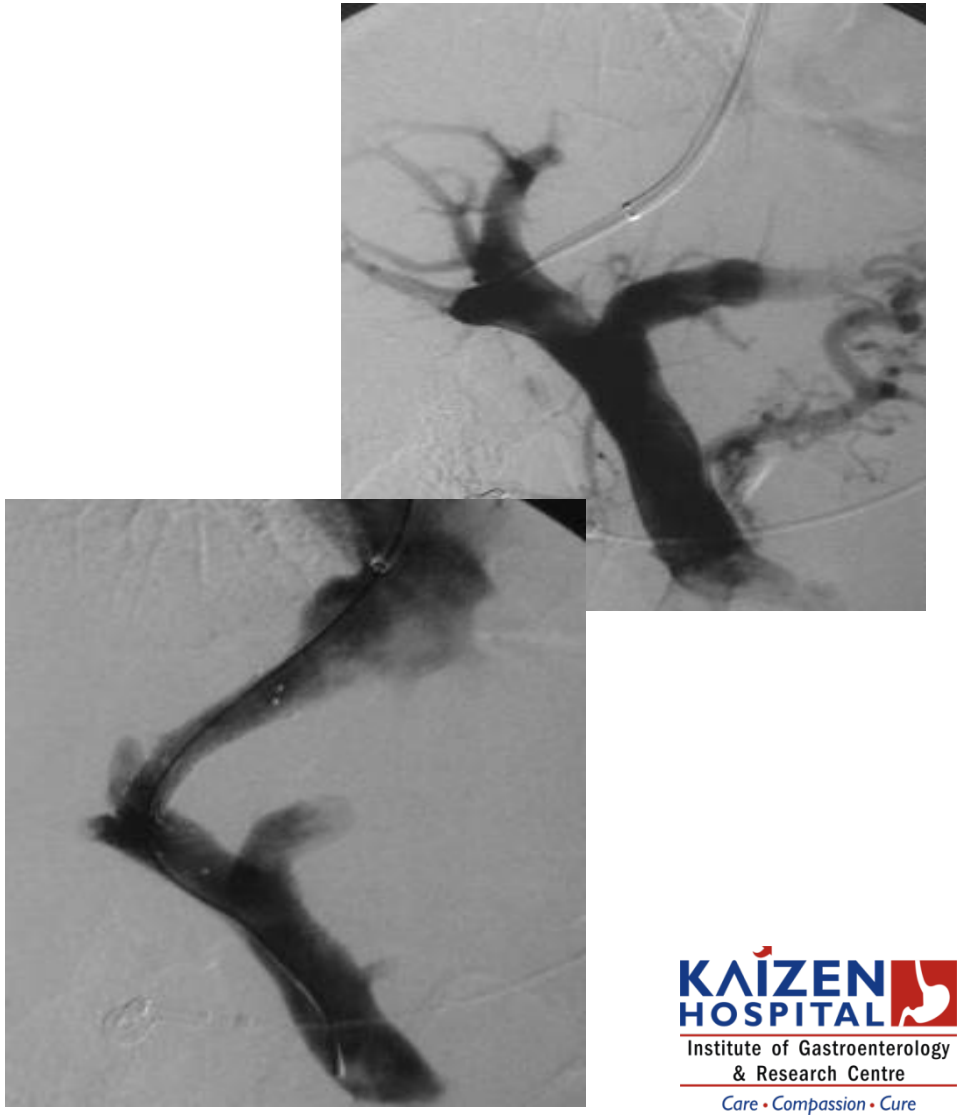
18-25 ? Potentially hazardous, TIPS offered on case-to-case basis, ? undersized

25-40 ✘ High risk, "compassionate" TIPS

Hepatic Encephalopathy

- Incidence 25-45%
  - New or worsened HE 13-36%

- Related to
  - Diversion of ammonia into systemic circulation
    - Lack of 1st pass effect by liver
    - Increased splanchnic flow
    - Increased intestinal glutaminase activity
  - Portal hypoperfusion



Hepatic Encephalopathy

Indication	No of RCTs	No of patients		Incidence of HE		Incidence of chronic HE	
		TIPS	Control	TIPS	Control	TIPS	Control
Variceal bleeding	14	516	515	33%	19%	1.9%	0.7%
Ascites	6	192	198	53%	32%	3.6%	1.5%

Treatment of HE

- Episodic HE
  - Correction of precipitating factor

    Constipation, high protein intake, hypokalemia, hypoxia, sedatives, psychoactive drugs, GI bleed, sepsis
  - Dietary management
  - Non-absorbable disaccharides

    Lactulose
  - Non-absorbable antibiotics

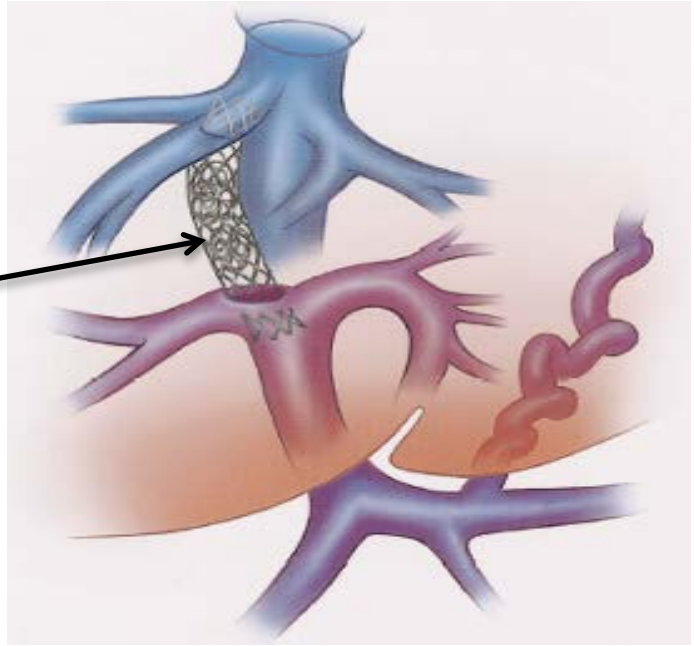
    Neomycin, Rifaximin
  - General support of patient

Treatment of HE

- Refractory HE
  - Incidence between 3-7%
  - Requires endovascular treatment
    - Shunt occlusion
    - Shunt reduction

Refractory encephalopathy

Shunt occlusion

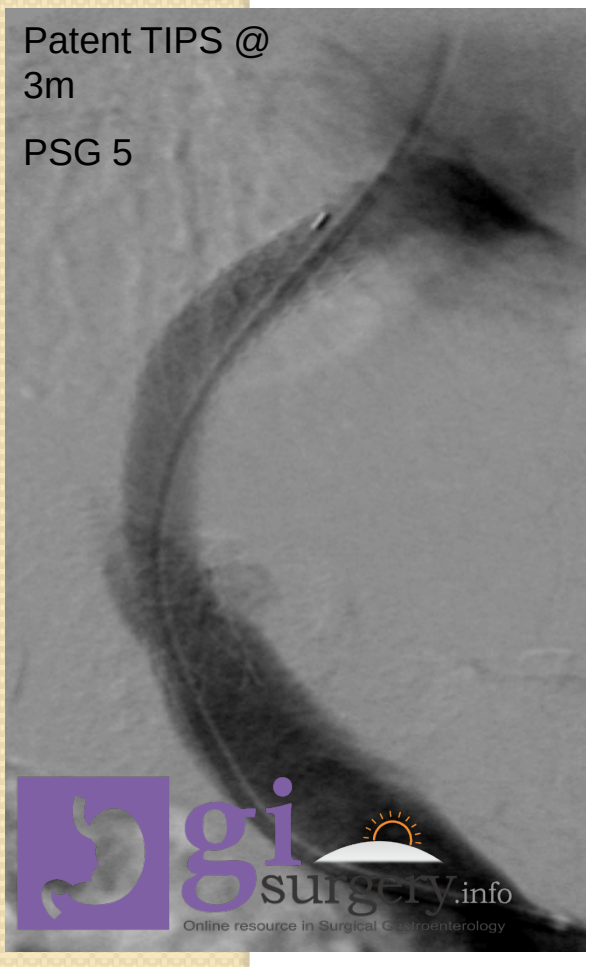


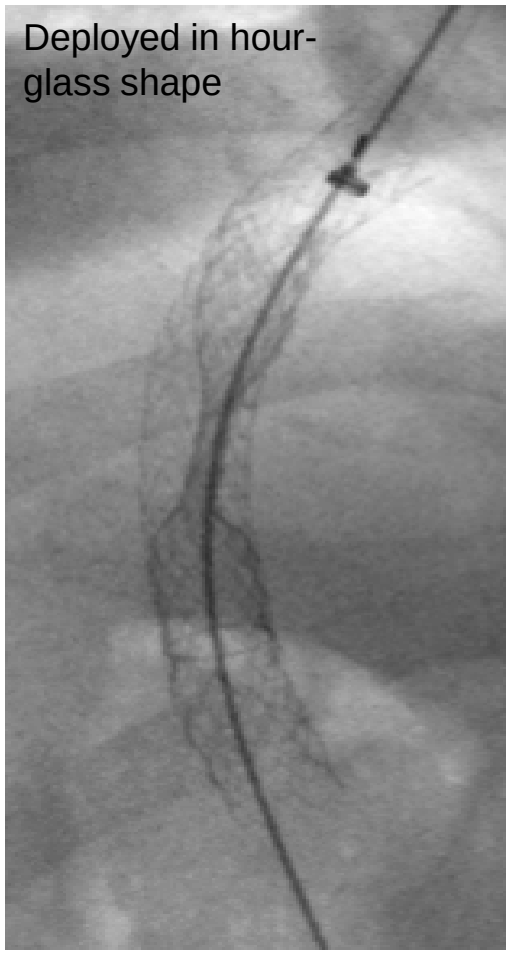
Courtesy: Madoff DC et al, RadioGraphics 2004

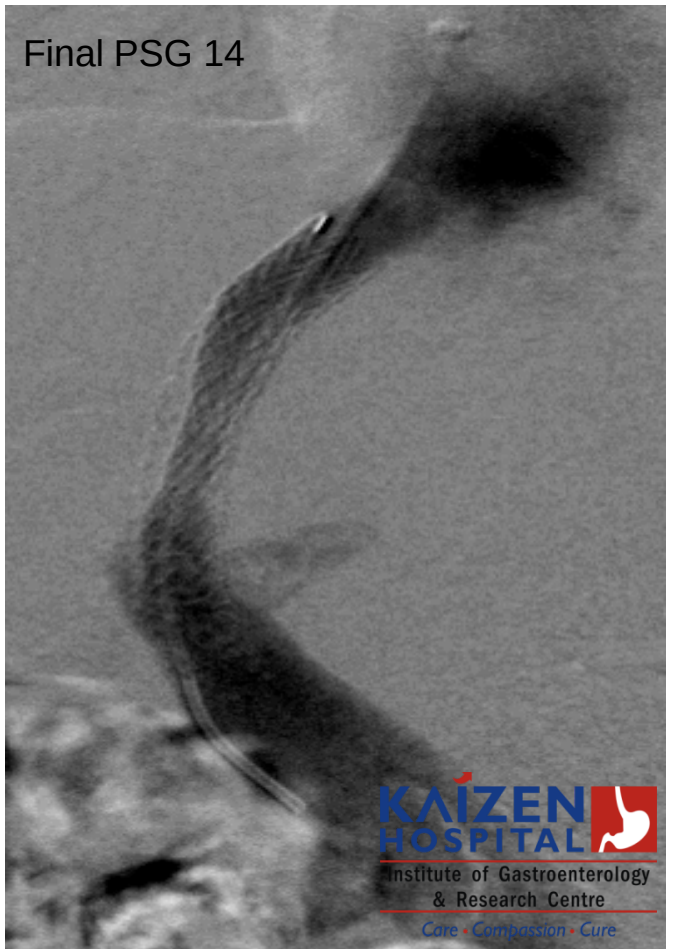
- Drawbacks
  - Potential for variceal bleeding
  - Hemodynamic alterations can be fatal

Refractory encephalopathy

Shunt reduction







Does shunt reduction work?

Author	*n*	Child-Pugh (A/B/C)	Improved	Adverse events	Pre PSG	Post PSG
Cookson (2011)	8	0/3/5	5/8	Bleeding (3)	4.9	10.5
Fanelli (2009)	12	1/5/9	12/12	Ascites (1)	6.6	15.1
Riggio (2008)	6	-	6/6	Ascites (1) Bleeding (1)	5.5	14.7
Chung (2008)	4	0/0/4	4/5	-	-	-
Maleux (2007)	17	3/7/7	13/17	Ascites (1) Hydrothorax (1)	6.3	11.9
Kochar (2006)	38	0	21/38	Ascites (3) Bleeding (3)	-	-
Kerlan (1995)	5	-	4/5	Bleeding (1)	-	-

Riggio O, et al. Clin Liver Dis 2012;16:133-146

When should we reduce the shunt?

- Patient having refractory HE
  - At least 3 episodes of severe HE in last 3 months without precipitating factors, despite lactulose
  - Continuously altered mental state despite standard medical therapy
- Causal relationship between TIPS and HE
  - Recent TIPS implantation
  - Low PSG
  - Deterioration of liver function

Riggio O, et al. Clin Liver Dis 2012;16:133-146

Can we prevent encephalopathy?

- NO !!!
- Higher incidence in
  - Pre-existing encephalopathy
  - Child C, MELD 14
  - Non-alcohol CLD
  - Renal failure
  - Elderly patients
  - Male sex
  - Hepatopedal direction of portal flow
  - Marked portal decompression

Somberg KA et al. Am J Gastroenterol 1995;90:549-444
Chung HH et al. J Gastroenterol Hepatol 2008;23:95-101
Haskal ZJ et al. J Vascu Interv Radiol 2008; 19:516-520
Hasssoun Z et al. Am J Gastroenterol 2001; 96:1205-1209

Ideal portosystemic gradient = 5-12 mm Hg

- PSG < 12 mm Hg required to control PHT
- PSG < 5 mm Hg has high incidence of encephalopathy and liver decompensation

Portosystemic pressure gradient during transjugular intrahepatic portosystemic shunt with Viatorr stent graft: What is the critical low threshold to avoid medically uncontrolled low pressure gradient related complications?

Hwan-Hoon Chung,* Mahmood K Razavi,† Daniel Y Sze,† Joan K Frisoli,† Stephen T Kee,† Michael D Dake,† Jeffrey C Hellinger† and Byung-Chul Kang‡

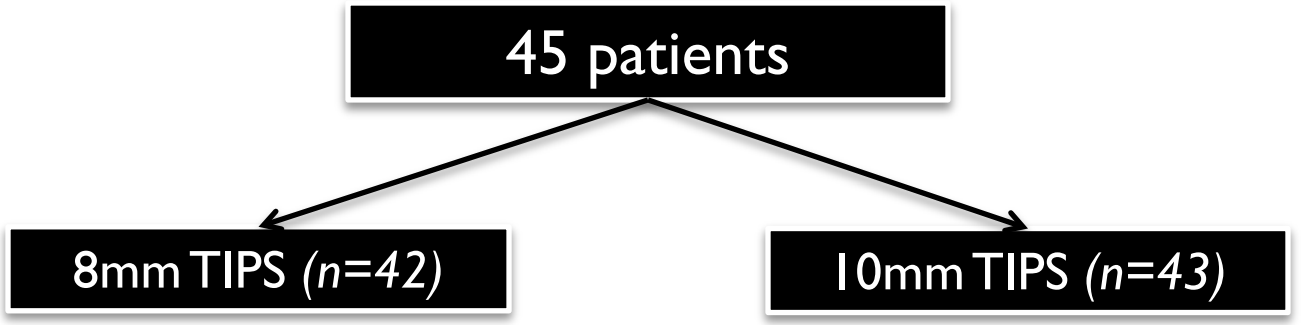
*Department of Diagnostic Radiology, Ansan Hospital, Korea University College of Medicine, Ansan City, Kyonggido, and ‡Department of Diagnostic Radiology, Mokdong Hospital, Ewha University College of Medicine, Seoul, Korea; and †Division of Interventional Radiology, Stanford University Medical Center, Palo Alto, California, USA

Chung HH et al. J Gastroenterol Hepatol 2008; 23:95-101

Should we use smaller TIPS then?

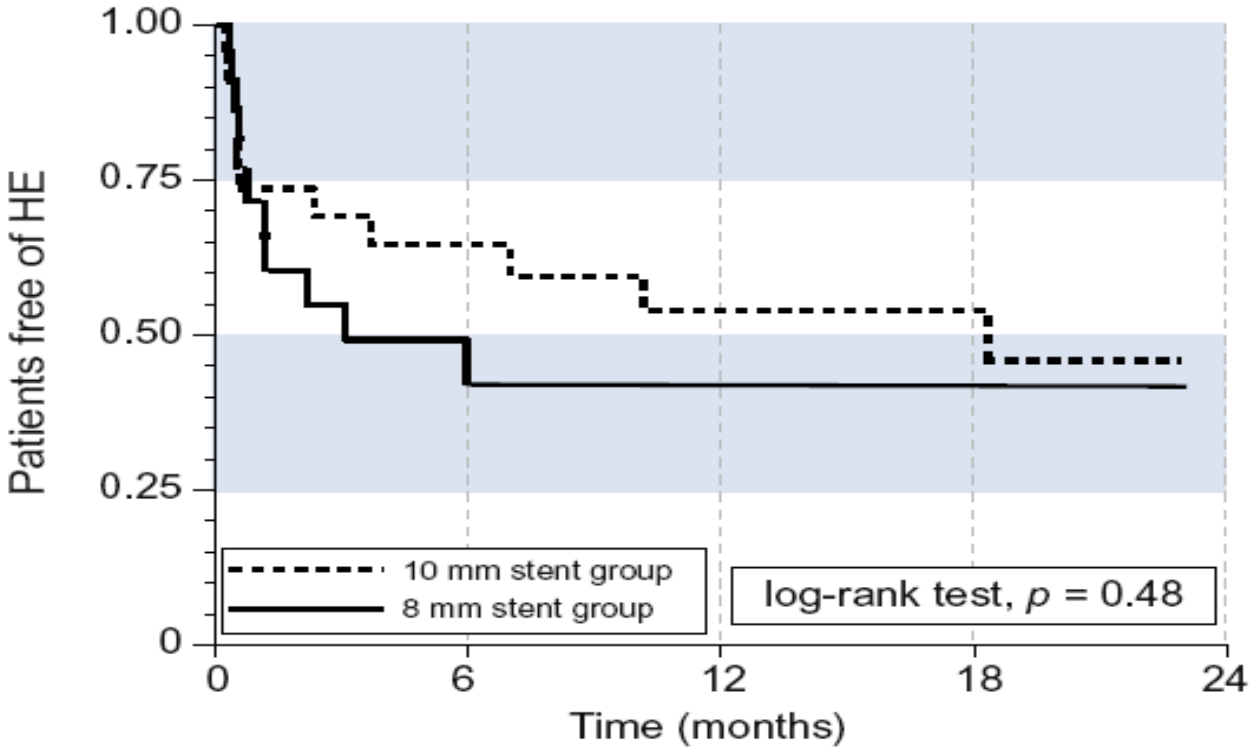
Clinical efficacy of transjugular intrahepatic portosystemic shunt created with covered stents with different diameters: Results of a randomized controlled trial

Oliviero Riggio[1,*], Lorenzo Ridola[1], Stefania Angeloni[1], Federica Cerini[1], Chiara Pasquale[1], Adolfo Francesco Attili[1], Fabrizio Fanelli[2], Manuela Merli[1], Filippo Maria Salvatori[2]



Riggio O, et al. J Hepatol 2010 (ePub)

Should we use smaller TIPS then?

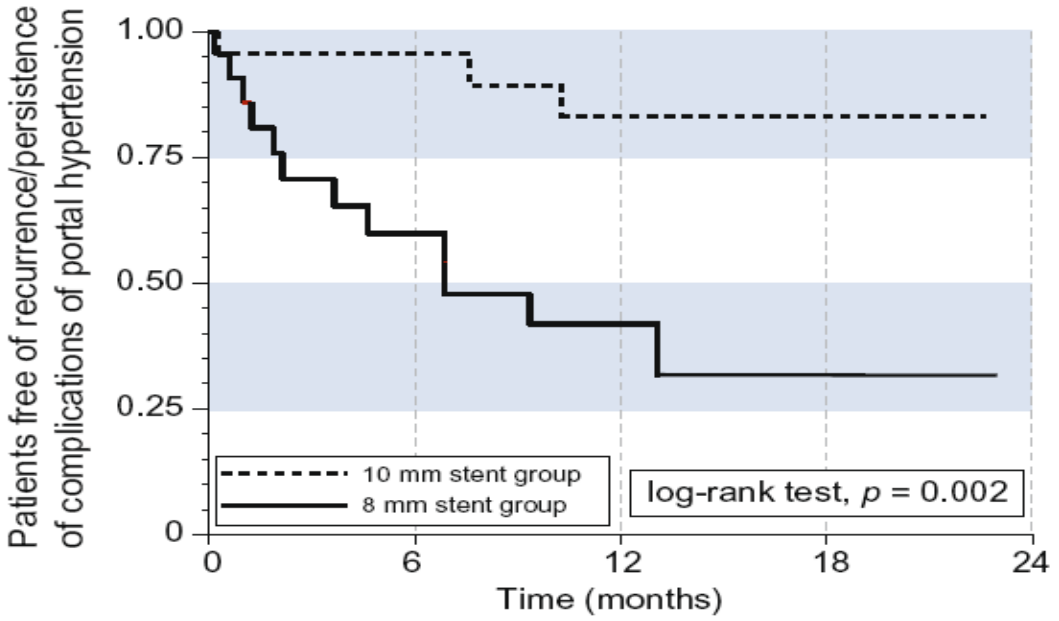


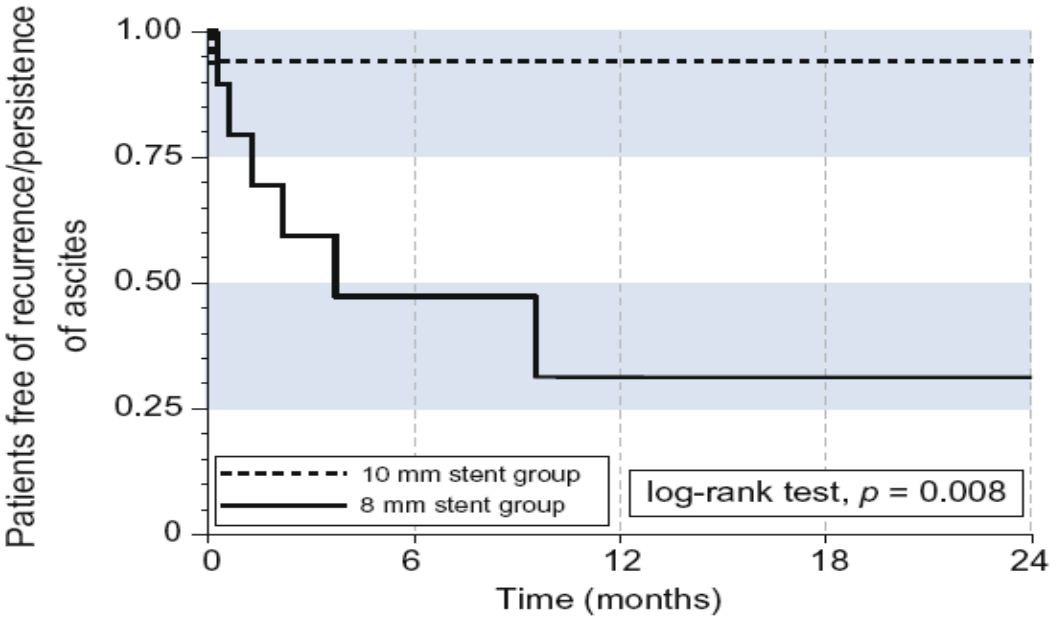
No change in encephalopathy

No change in survival

Riggio O, et al. J Hepatol 2010 (ePub)

Should we use smaller TIPS then?





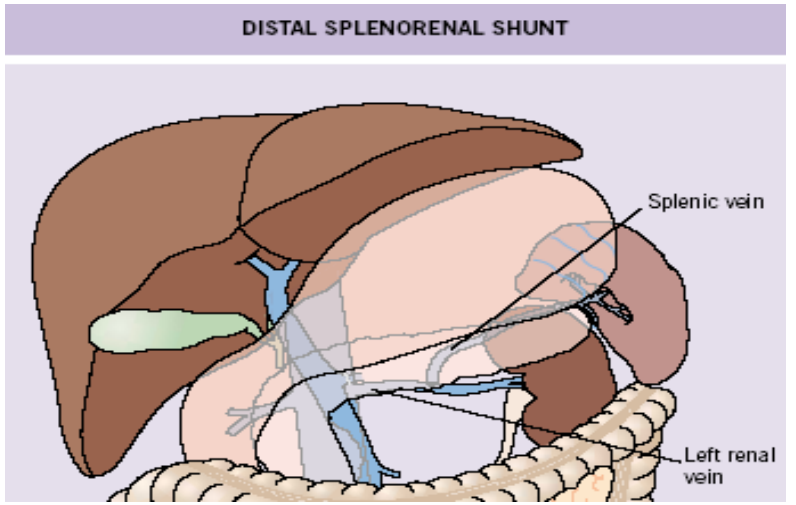
8mm TIPS was ineffective in controlling PHT

Premature closure of the study !

Riggio O, et al. J Hepatol 2010 (ePub)

What about surgical shunts?

Surgical PS Shunt



- Surgery is very effective
  - Control of bleeding >90%
  - Re-bleed rates ~10%
- Surgery provides good long-term results
- However……

Surgical PS Shunt

- However…
  - It is very invasive
  - It is associated with prolonged anesthesia, ICU care, parenteral nutrition, immobilisation, etc
  - It has a high mortality rate esp in emergent Sx

- TIPS is preferred, esp Child B, C patients

TIPS v Surgical PS Shunt

Distal Splenorenal Shunt Versus Transjugular Intrahepatic Portal Systematic Shunt for Variceal Bleeding: A Randomized Trial

J. MICHAEL HENDERSON,* THOMAS D. BOYER,† MICHAEL H. KUTNER,§,‖ JOHN R. GALLOWAY,‖ LAYTON F. RIKKERS,¶ LENNOX J. JEFFERS,# KAREEM ABU–ELMAGD,** JASON CONNOR,§,†† and the DIVERT Study Group

Multi-center prospective trial for Child A and Child B

140 pts, 5 year follow-up

	TIPS	DSRS	p value
Rebleed	10.5%	5.5%	NS
Encephalopathy	50%	50%	NS
Survival @ 2y	88%	81%	NS
Survival @ 5y	61%	62%	NS
Reintervention	82%	11%	p<.001

Henderson JM et al. Gastroenterology 2006;130:1643-1651

TIPS v PV shunts

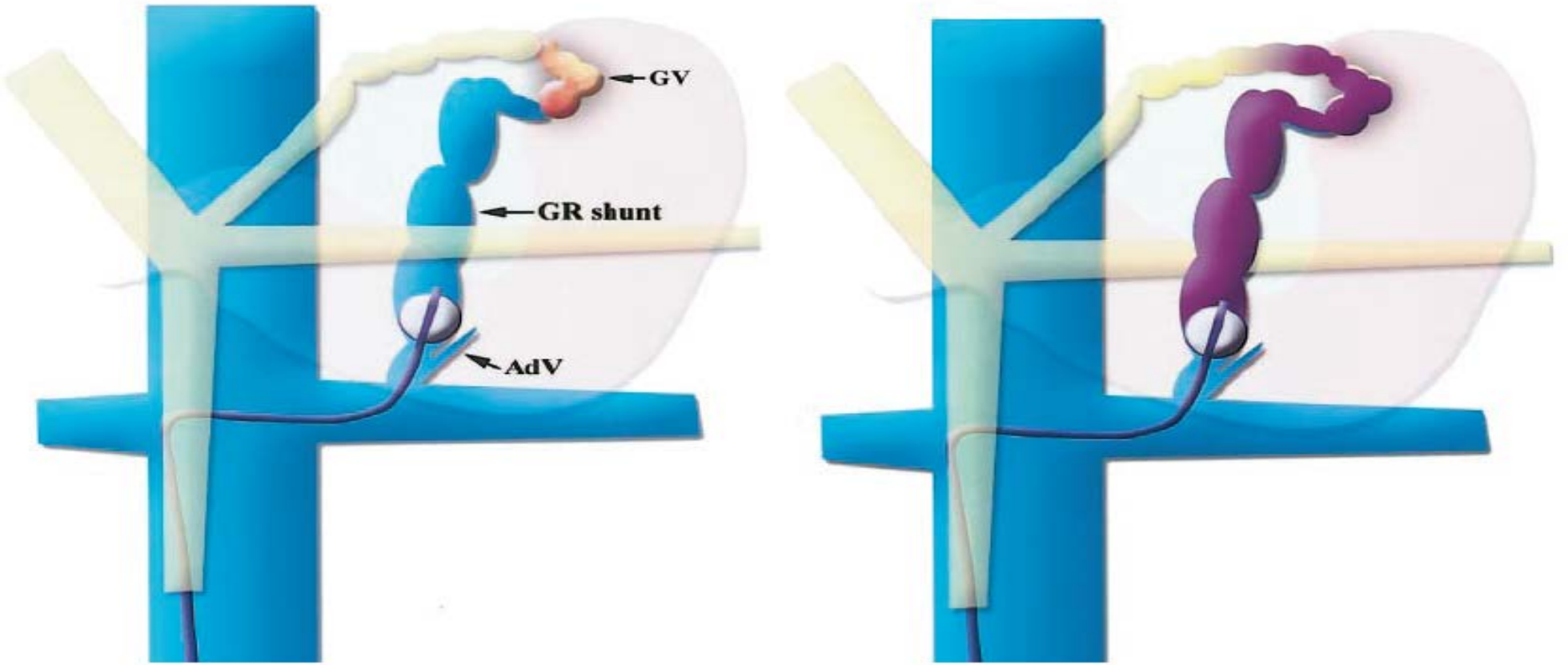
	TIPS	Denver shunt
S.Bilirubin	3.3 ± 3.53	1.6 ± 1.09
MELD score	11.1 ± 7.0	9.3 ± 3.95
Assisted shunt patency	31.3m	13.1m
Irreversible occlusion	19%	38%
Survival	28.7m	16.1m
Control of ascites @ 3y	85%	40%

Rosemurgy et al, Ann Surg 2004

TIPS is not the only therapy…

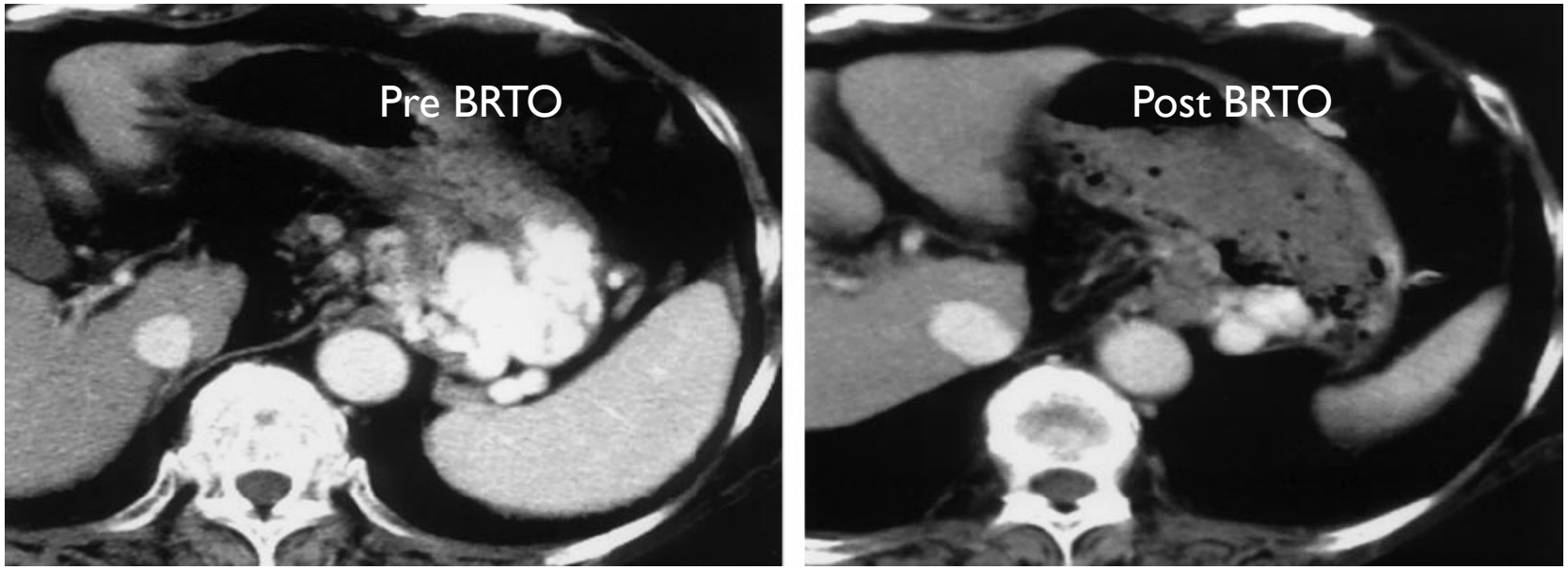
- Balloon-occluded transvenous obliteration of varices (BRTO)
- Splenic artery embolisation or partial splenic emoblisation (PSE)

BRTO: Gastric varices



Images courtesy
Kiyosue AH et al. RadioGraphics 2003;23:911-920

BRTO: Gastric varices



Images courtesy
Kiyosue AH et al. RadioGraphics 2003;23:911-920

BRTO: Advantages over TIPS

- Better variceal obliteration (75-100%) v TIPS (50%)
- No portosystemic shunting → No risk of encephalopathy / worsening of liver function)
- Augments portal flow → Improves liver function
- Easily repeatable
- Done under LA

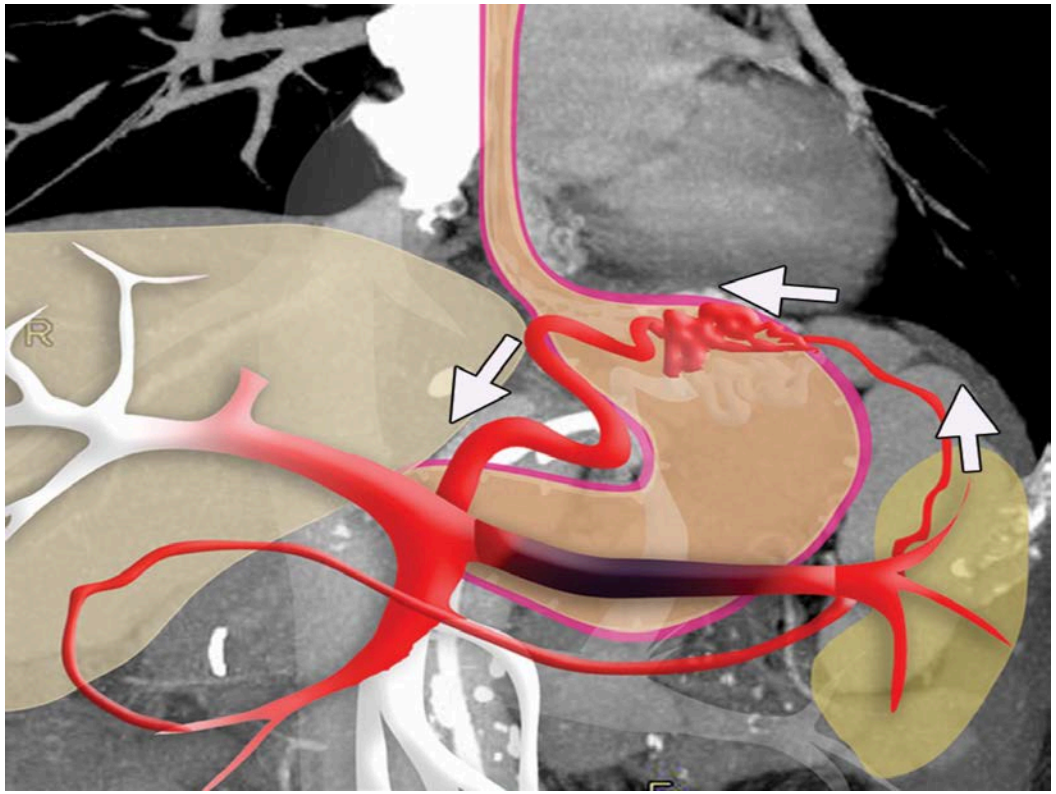
BRTO: Disadvantages

- Increases portal pressure
  - Aggravation of oesophageal varices
    - 27-35% (1y), 45-66% (2y), 45-91% (3y)
    - Global variceal rebleed rate 19-31% (TIPS 11-20%)
  - New onset portal hypertensive gastropathy 5-13%
  - New onset ascites 0-44%
  - New onset hydrothorax 0-8%
- Improvement in liver function is not sustained
  - Return to baseline function in 6-9 months
- Prolonged procedural time
- Little experience outside Japan and Korea
  - Ethanolamine oleate, haptaglobin, special catheters not available

When should BRTO be preferred?

- When TIPS cannot be offered
  - Encephalopathy
  - Poor hepatic reserve (MELD>18)
  - Failed TIPS
  - Coagulopathy
- Absence of global complications of PHT like ascites, hydrothorax, PHG
- ? Primary prophylaxis for isolated gastric varices

Splenic artery embolisation



Splenic artery embolisation

↓

Reduced splenic inflow

↓

Reduced splenic outflow

↓

Decompression of gastric varices

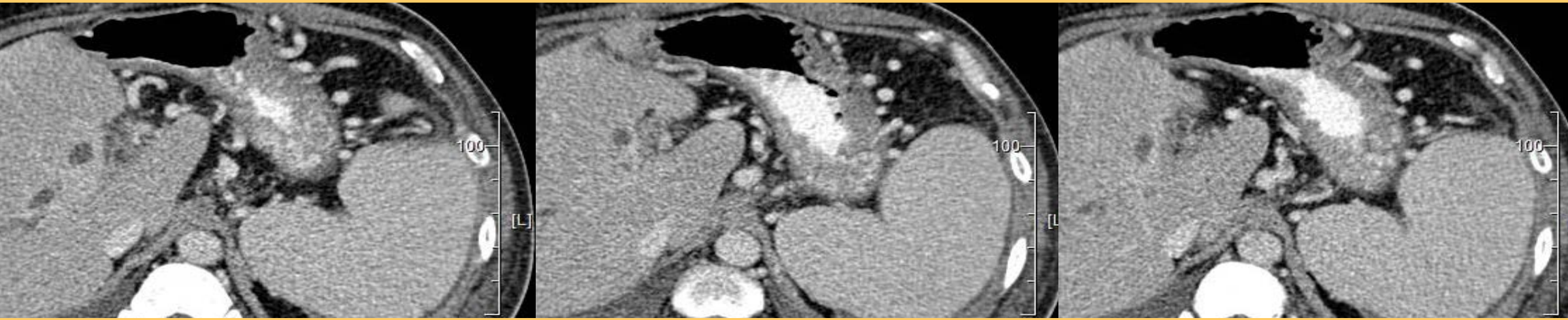
- Useful in left-sided PHT (sinistrial PHT) especially with splenic vein thrombosis.
- Alternative to splenectomy

Splenic artery embolisation

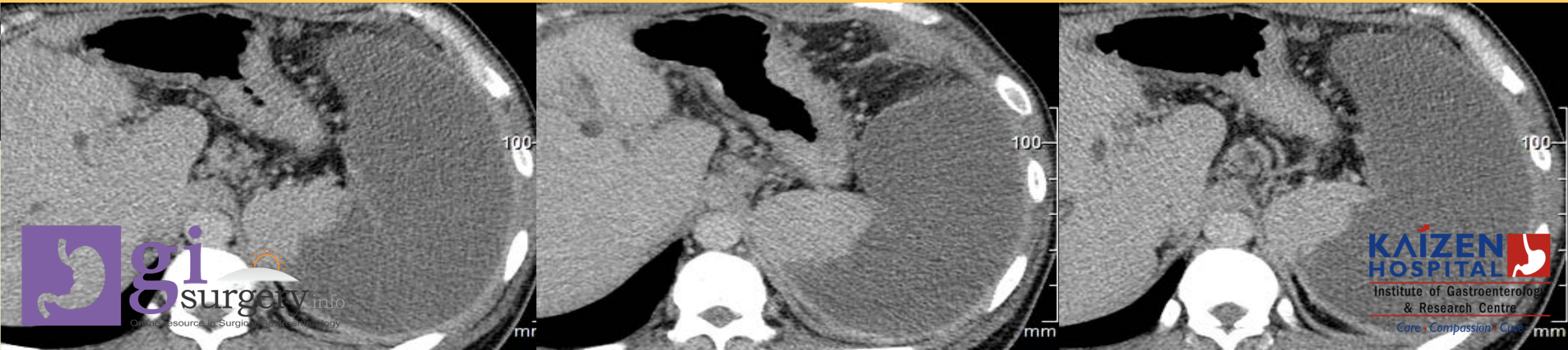
56 yo male, chronic splenic and portal vein thrombosis,
recurrent bleeding from gastric varices, glue x2, IHD EF 15%

Splenic artery embolisation

PRE EMBOLISATION



POST EMBOLISATION



Conclusions

- Various IR procedures can be offered to patients with Portal HTN.
- Choice of procedure is dependent on aetiology of PHT, symptoms, anatomy and clinical status.
- The high success rates and low morbidity of IR makes it more attractive than surgery.
- Therapy of choice in most instances !!!