

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Ryan BM, Stockbrugger RW, Ryan JM. A pathophysiologic, gastroenterologic, and radiologic approach to the management of gastric varices. <i>Gastroenterology</i> 2004; 126(4):1175-1189.	7	N/A	To describe the pathophysiology, diagnosis, natural history, endoscopic, and interventional radiologic treatment options for gastric varices.	Gastroesophageal varices are classified as EV extending down to cardia or lesser curve should be treated as for EV. First-line treatment of bleeding fundal varices is endoscopic variceal obturation. TIPS is currently second-line acute treatment and is used for prevention of rebleeding.	4
2. Sarin SK, Kumar A. Gastric varices: profile, classification, and management. <i>Am J Gastroenterol</i> 1989; 84(10):1244-1249.	7	N/A	Review profile, classification, and management of gastric varices.	Endoscopy and/or splenoportovenography and a high index of suspicion are required for the diagnosis of gastric varices.	4
3. Sarin SK, Lahoti D, Saxena SP, Murthy NS, Makwana UK. Prevalence, classification and natural history of gastric varices: a long-term follow-up study in 568 portal hypertension patients. <i>Hepatology</i> 1992; 16(6):1343-1349.	3a	568 patients (393 bleeders and 175 nonbleeders)	Prospectively examine patients with portal hypertension to determine the prevalence and natural history of gastric varices. Cirrhosis in 301 patients, noncirrhotic portal fibrosis in 115 patients, extrahepatic portal vein obstruction in 117 patients and hepatic venous outflow obstruction in 35 patients.	Type 1 gastroesophageal varices (lesser curve varices) were the most common (75%). After obliteration of EV, type 1 gastroesophageal varices disappeared in 59% of patients and persisted in the remainder; bleeding from persistent gastroesophageal varices was more common than it was from gastroesophageal varices that were obliterated (28% vs 2%, respectively; P<0.001). Type 2 gastroesophageal varices, which extend to greater curvature, bled often (55%) and were associated with high mortality. Type 1 isolated gastric varices patients had only fundal varices, with a high (78%) incidence of bleeding.	2
4. Al-Osaimi AMS, Caldwell SH. Medical and Endoscopic Management of Gastric Varices. <i>Semin Intervent Radiol</i> 2011; 28(03):273,282.	7	N/A	To address the current concepts of classification, epidemiology, pathophysiology, and emerging management options of gastric varices. The authors describe the stepwise approach to patients with gastric varices, including the different available modalities, and the pearls, pitfalls, and stop-gap measures useful in managing patients with gastric variceal bleed.	No results stated.	4

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5. Castaneda B, Morales J, Lionetti R, et al. Effects of blood volume restitution following a portal hypertensive-related bleeding in anesthetized cirrhotic rats. <i>Hepatology</i> 2001; 33(4):821-825.	15	38 cirrhotic rats (common bile duct ligation and occlusion)	To examine the influence of different strategies of blood volume restitution in the outcome of portal hypertension-related bleeding in anesthetized cirrhotic rats.	Survival in the no transfusion group was 47%. Rats given 5 mL transfusion had 64% survival. The worst survival was observed in the 10 mL transfusion group (0% survival; P<.05). Authors concluded that a transfusion policy aimed at completely replacing blood loss worsens the magnitude of bleeding and mortality from portal hypertensive-related bleeding in cirrhotic rats. On the contrary, moderate blood transfusion allowed hemodynamic stabilization and increased survival.	4
6. de Franchis R. Evolving consensus in portal hypertension. Report of the Baveno IV consensus workshop on methodology of diagnosis and therapy in portal hypertension. <i>J Hepatol</i> 2005; 43(1):167-176.	15	N/A	Report of the Baveno IV consensus workshop on methodology of diagnosis and therapy in portal hypertension. Purpose of the consensus definitions about the variceal bleeding episode is to use them in trials and other studies on portal hypertension, as well as in clinical practice.	No results stated.	4
7. Gabriel DA, Li X, Monroe DM, 3rd, Roberts HR. Recombinant human factor VIIa (rFVIIa) can activate factor FIX on activated platelets. <i>J Thromb Haemost</i> 2004; 2(10):1816-1822.	7	N/A	To show that factor (F)VIIa can activate factor (F)IX on activated platelets in the absence of tissue factor.	Data show that pharmacological doses of rFVIIa result in the direct activation of FIX by rFVIIa to form additional tenase complexes ultimately resulting in improved thrombin generation. These results may explain, at least in part, the mechanism of action of rFVIIa in hemorrhagic conditions seen in otherwise normal patients who develop an acquired coagulopathy due to trauma, surgery or a variety of other events in which rFVIIa has been found to be effective.	4

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8. Kravetz D, Bosch J, Arderiu M, Pilar Pizcueta M, Rodes J. Hemodynamic effects of blood volume restitution following a hemorrhage in rats with portal hypertension due to cirrhosis of the liver: influence of the extent of portal-systemic shunting. <i>Hepatology</i> 1989; 9(6):808-814.	15	29 rats	To examine whether, in rats with portal hypertension due to cirrhosis of the liver induced by carbon tetrachloride, blood volume restitution following a hemorrhage produces an increase of portal pressure beyond control values, as observed in rats with prehepatic portal hypertension.	Since carbon tetrachloride-induced cirrhosis caused mild portal-systemic shunting, in some of the cirrhotic rats (12/29 rats) portal-systemic shunting was enhanced by a transient (4 days) partial constriction of the portal vein, which was removed 1 week prior to the study. After baseline measurements of portal pressure and arterial pressure, 15 ml/kg of blood were withdrawn at a rate of 0.3 ml/per minute and reinfused 15 minutes later. After blood reinfusion, portal pressure and arterial pressure were measured again, and cardiac output, regional blood flows and portal-systemic shunting were determined using radioactive microspheres. Portal-systemic shunting was 78 +/- 11% of total blood flow in the cirrhotic rats that had temporary portal vein constriction, but only 5 +/- 2% (P<0.001) in those that did not. Blood volume restitution in low-portal-systemic shunting rats did not produce any significant modification in splanchnic or systemic hemodynamics. However, in rats with high portal-systemic shunting, blood volume restitution produced a significant increase in portal pressure (from 9.9 +/- 0.9 to 13.5 +/- 0.9 mmHg, P<0.02).	4

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9. Porte RJ, Molenaar IQ, Begliomini B, et al. Aprotinin and transfusion requirements in orthotopic liver transplantation: a multicentre randomised double-blind study. EMSALT Study Group. <i>Lancet</i> 2000; 355(9212):1303-1309.	1	137 patients received high-dose aprotinin (n=46), regular-dose aprotinin (n=43), or placebo (n=48)	Multicentre randomized double-blind study to determine whether aprotinin, a potent antifibrinolytic agent, reduces blood loss and transfusion requirements.	Intraoperative blood loss was significantly lower in the aprotinin-treated patients, with a reduction of 60% in the high-dose group and 44% in the regular-dose group, compared with the placebo group (P=0.03). Total amount of red blood cell (homologous and autologous) transfusion requirements was 37% lower in the high-dose group and 20% lower in the regular-dose group, than in the placebo group (P=0.02). Thromboembolic events occurred in two patients in the high-dose group, none in the regular-dose group, and in 2 patients in the placebo group (P=0.39). Mortality at 30 days did not differ between the three groups (6.5%, 4.7%, and 8.3%; P=0.79). Intraoperative use of aprotinin in adult patients undergoing orthotopic liver transplantation significantly reduces blood-transfusion requirements and should be routinely used in patients without contraindications.	1
10. Villanueva C, Ortiz J, Minana J, et al. Somatostatin treatment and risk stratification by continuous portal pressure monitoring during acute variceal bleeding. <i>Gastroenterology</i> 2001; 121(1):110-117.	1	40 patients	Randomized study to assess the effects of somatostatin by continuously monitoring portal pressure and systemic hemodynamics during esophageal variceal hemorrhage, and to investigate whether changes of hepatic venous pressure gradient affect the course of the acute bleeding episode. Patients received somatostatin (n=25) or placebo (n=15) under double blind conditions.	Somatostatin but not placebo produced a sustained decrease in hepatic venous pressure gradient (from 20.7 +/- 3.7 mm Hg to 17.7 +/- 2.7, P<0.01). In patients receiving placebo, hepatic venous pressure gradient increased after a test meal (P=0.018) and after blood transfusion (P=0.034). Somatostatin completely prevented these increments. Hepatic venous pressure gradient decreased significantly only in patients without further bleeding. One of 27 patients with hepatic venous pressure gradient <20 mm Hg at baseline or decreased >10% rebled vs 9/13 who had neither of these 2 criteria (P<0.0001). Both criteria had independent prognostic value for further bleeding. During acute variceal bleeding, somatostatin produces a significant and sustained decrease in hepatic venous pressure gradient and prevents secondary elevations. Monitoring hepatic venous pressure gradient may stratify further bleeding risk and discriminate treatment response.	1

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11. Argo CK, Balogun RA. Blood products, volume control, and renal support in the coagulopathy of liver disease. <i>Clin Liver Dis</i> 2009; 13(1):73-85.	7	N/A	Review use of plasma-based products in patients who have chronic liver disease to treat coagulopathy.	No results stated.	4
12. Garcia-Tsao G, Bosch J. Management of varices and variceal hemorrhage in cirrhosis. <i>N Engl J Med</i> 2010; 362(9):823-832.	7	N/A	Review of the three areas of management of varices and variceal hemorrhage in cirrhosis: primary prophylaxis, treatment and secondary prophylaxis.	No results stated.	4
13. Garcia-Tsao G, Sanyal AJ, Grace ND, Carey W. Prevention and management of gastroesophageal varices and variceal hemorrhage in cirrhosis. <i>Hepatology</i> 2007; 46(3):922-938.	7	N/A	Practice guidelines approved by the American Association for the Study of Liver Diseases and the American College of Gastroenterology to assist healthcare providers in providing care for patients with varices and variceal hemorrhage in cirrhosis.	No results stated.	4
14. Sarin SK. Long-term follow-up of gastric variceal sclerotherapy: an eleven-year experience. <i>Gastrointest Endosc</i> 1997; 46(1):8-14.	3a	209 patients; 71 (with cirrhosis 33, noncirrhotic 38) underwent gastric variceal sclerotherapy, 53 of these (75%) for gastric variceal bleeding	Long-term follow-up of gastric variceal sclerotherapy was performed to determine its role in gastric variceal bleeding. Gastric varices were divided into gastroesophageal varices, type 1 (GOV1) and type 2 (GOV2), and isolated gastric varices, type 1 (IGV1).	Emergency gastric variceal sclerotherapy arrested acute bleeding in 12 (66.7%) of 18 patients. Variceal obliteration was achieved in 43 of the 60 (71.6%) patients who underwent repeated elective sclerotherapy. Variceal obliteration was higher in patients with GOV1 (94.4%) than in those with GOV2 (70.4%) and IGV1 (41%). Rebleeding after elective gastric variceal sclerotherapy was seen in 5.5%, 19%, and 53%, respectively, in the three types of gastric varices. Gastric variceal recurrence was not seen during a mean follow-up of 24.2 +/- 22.9 months. Seventeen (24%) patients died, nearly equally from rebleeding and liver failure. Sclerotherapy can effectively arrest acute gastric variceal bleeding and achieve gastric variceal obliteration; it is more effective in patients with gastroesophageal varices, and; alternative therapies need to be evaluated for patients with IGV1.	3

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15. Jutabha R, Jensen DM, Kovacs TO, et al. Initial results of a prospective study of combination banding & sclerotherapy compared to sclerotherapy alone for bleeding gastric varices. <i>Gastrointest Endosc</i> 1998; 47(4):AB86.	1	6 patients sclerotherapy 11 patients combo	Prospective study to examine: endoscopic criteria for diagnosis of gastric varices as the bleeding site, standardized endoscopic techniques for sclerotherapy and combination therapy, and outcomes and cost comparisons.	For sclerotherapy vs combination at 180 days, rates of rebleeding, failure, complications and OLT were similar. Mortality at 180 days from all causes and 2 to bleeding were higher in the sclerotherapy group, and estimated mean direct costs of care by 180 days were \$5,535/patient more for sclerotherapy than combination. Overall, the results favor combination over sclerotherapy for gastric varices with major stigmata.	2
16. Lo GH, Lai KH, Cheng JS, Chen MH, Chiang HT. A prospective, randomized trial of butyl cyanoacrylate injection vs band ligation in the management of bleeding gastric varices. <i>Hepatology</i> 2001; 33(5):1060-1064.	1	31 patients endoscopic obturation (group A); 29 patients band ligation (group B)	Prospective randomized trial to compare the efficacy and complications of butyl cyanoacrylate injection with band ligation in the management of bleeding gastric varices.	Active bleeding occurred in 15 patients in group A and 11 patients in group B. Initial hemostatic rate (defined as no bleeding for 72 hours after treatment) was 87% in group A and 45% in group B (P=.03). The sessions required to achieve variceal obliteration and obliteration rates were similar in both the groups. However, rebleeding rates were significantly higher in group B (54%) than group A (31%) (P=.0005). Treatment-induced ulcer bleeding occurred in 2 patients (7%) in group A and 8 patients (28%) in group B (P=.03). The amount of blood transfusions required were also higher in group B than group A (4.2 +/- 1.3 vs 2.6 +/- 0.9 units, respectively) (P<.01). Nine patients of group A and 14 patients of group B died (P=.05). Endoscopic obturation using cyanoacrylate proved more effective and safer than band ligation in the management of bleeding gastric varices.	2

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17. Tan PC, Hou MC, Lin HC, et al. A randomized trial of endoscopic treatment of acute gastric variceal hemorrhage: N-butyl-2-cyanoacrylate injection vs band ligation. <i>Hepatology</i> 2006; 43(4):690-697.	1	48 patients received endoscopic band ligation, and another 49 patients received endoscopic N-butyl-2-cyanoacrylate injection	Prospective randomized study to compare the efficacy of endoscopic band ligation and endoscopic N-butyl-2-cyanoacrylate injection in the treatment of acute gastric variceal hemorrhage.	Both treatments were equally successful in controlling active bleeding (14/15 vs 14/15, P=1.000). More of the patients who underwent endoscopic band ligation had gastric variceal rebleeding (endoscopic band ligation vs endoscopic N-butyl-2-cyanoacrylate injection, 21/48 vs 11/49; P=.044). The 2-year and 3-year cumulative rate of gastric variceal rebleeding were 63.1% and 72.3% for endoscopic band ligation, and 26.8% for both periods with endoscopic N-butyl-2-cyanoacrylate injection; P=.0143, log-rank test. The rebleeding risk of endoscopic band ligation was sustained throughout the entire follow-up period. Multivariate Cox regression indicated that concomitance with HCC (relative hazard: 2.453, 95% CI: 1.036-5.806, P=.041) and the treatment method (endoscopic band ligation vs endoscopic N-butyl-2-cyanoacrylate injection, relative hazard: 2.660, 95% CI: 1.167-6.061, P=.020) were independent factors predictive of gastric variceal rebleeding. There was no difference in survival between the two groups. Severe complications attributable to these two treatments were rare.	2
18. Soehendra N, Grimm H, Nam VC, Berger B. N-butyl-2-cyanoacrylate: a supplement to endoscopic sclerotherapy. <i>Endoscopy</i> 1987; 19(6):221-224.	3a	202 patients	A report on 2 years experience with the tissue adhesive n-butyl-2-cyanoacrylate.	The endoscopic hemostasis of severe variceal bleedings has become safer and surer. The overall hospital mortality of these patients has sunk from 31.5% to 17.5%. Cyanoacrylate is a very useful substance for obliterating large esophagogastric varices. However, the complete elimination of EV, which is the guarantee for a long-term freedom from recurrent bleeding, can only be achieved by using a genuine sclerosing agent.	3

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19. Caldwell SH, Hespeneheide EE, Greenwald BD, Northup PG, Patrie JT. Enbucrilate for gastric varices: extended experience in 92 patients. <i>Aliment Pharmacol Ther</i> 2007; 26(1):49-59.	3a	92 patients (80 had portal hypertension and 12 had splenic vein thrombosis)	To assess enbucrilate in patients with gastric variceal bleeding under an FDA-approved investigation. The results extend prior report of the first 44 patients.	In the portal hypertensive group, re-bleeding from gastric varices was seen in 4/ 80 (5%) from 0 to 72 h, 5/76 (6.5%) from >72 h to 3 months and 9/51 (17%) from >3 months to 1 year. Rebleeding and survival were significantly related to the Child-Pugh class. In the splenic vein thrombosis group (n=12), there was early rebleeding in 2 (17%) patients from 0 to 72 h, 1 (8%) from >72 h to 3 months and none in the chronic phase (>3 months to 1 year) although 1-year survival in this group was only 6 (50%) due to the underlying malignancy in most. Serious embolization was suspected in 2 patients (2%). Enbucrilate offers an important intervention in gastric variceal bleeding which should be further studied in the U.S.	3
20. Rengstorff DS, Binmoeller KF. A pilot study of 2-octyl cyanoacrylate injection for treatment of gastric fundal varices in humans. <i>Gastrointest Endosc</i> 2004; 59(4):553-558.	3a	25 patients	To prospectively evaluate the efficacy and safety of 2-octyl cyanoacrylate injection for treatment of gastric fundal varices.	Within 2 weeks of treatment, 52% of patients had a history of significant variceal bleeding, and 12% had active gastric variceal bleeding at the time of injection. The rate of immediate hemostasis was 100%. Gastric variceal bleeding recurred in 4% of patients (mean follow-up 11 months). The overall mortality rate was 12%; the bleeding-related mortality rate was 4%. Injection of 2-octyl cyanoacrylate appears to be efficacious and safe for both prevention and control of gastric variceal hemorrhage.	3

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21. Mahadeva S, Bellamy MC, Kessel D, Davies MH, Millson CE. Cost-effectiveness of N-butyl-2-cyanoacrylate (histoacryl) glue injections vs transjugular intrahepatic portosystemic shunt in the management of acute gastric variceal bleeding. <i>Am J Gastroenterol</i> 2003; 98(12):2688-2693.	15	20 patients with bleeding gastric varices had TIPS; 23 patients had cyanoacrylate glue injection	Retrospective review to compare the cost-effectiveness of N-butyl-2-cyanoacrylate (histoacryl) glue injections with TIPS in the management of acute gastric variceal bleeding.	There were no significant differences between the two groups in patient characteristics, transfusion requirement, and gastric variceal anatomy. In the TIPS group, 15/20 patients had the procedure performed within 24 h of hemorrhage, and 90% of stent insertions were successful. In the glue group, there were 3 +/- 1.5 endoscopies and 2 +/- 1 injections per patient, with a 96% initial hemostasis. There was one case of (glue) pulmonary embolism and one blocked front endoscope lens, which required repair. The initial rebleed rate was significantly lower in patients who had TIPS (15% vs 30%, P=0.005). The inpatient stay was shorter in the glue group (13 +/- 1 vs 18 +/- 2 days, P=0.05), but there was no difference in the overall mortality rate. The median cost within 6 months of initial gastric variceal bleeding was \$4,138 US dollars (\$3,009-\$8,290 US dollars) for glue vs \$11,906 US dollars (\$8,200-\$16,770 US dollars) for TIPS (P<0.0001). Cyanoacrylate glue injection was more cost effective than TIPS in the management of acute gastric variceal bleeding.	3
22. Greenwald BD, Caldwell SH, Hespenheide EE, et al. N-2-butyl-cyanoacrylate for bleeding gastric varices: a United States pilot study and cost analysis. <i>Am J Gastroenterol</i> 2003; 98(9):1982-1988.	3c	44 patients (37 with cirrhosis and 7 with noncirrhotic portal hypertension)	Prospective study to evaluate the safety, efficacy, and relative costs of cyanoacrylate for bleeding gastric varices.	Mortality and costs were substantially higher in the non-cyanoacrylate group. The odds of death were greater by 7-fold in the non-cyanoacrylate group than within the cyanoacrylate group (95% CI, 1.18-41.36, P=0.0318). At 3 months, there was a 3.18-fold difference (95% CI, 1.05-9.64, P=0.0411) in accrued costs; at 1 year, the difference was 2.55-fold (95% CI, 0.96-6.94, P=0.0585). The cost-effective ratio was estimated as 108,237 US dollars/death averted, reflecting marked cost reduction with improved survival in the cyanoacrylate-treated group. This is believed to result largely from avoidance of shunt interventions. Cyanoacrylate treatment of gastric varices is safe, clinically effective, and cost effective.	2

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23. Procaccini NJ, Al-Osaimi AM, Northup P, Argo C, Caldwell SH. Endoscopic cyanoacrylate vs transjugular intrahepatic portosystemic shunt for gastric variceal bleeding: a single-center U.S. analysis. <i>Gastrointest Endosc</i> 2009; 70(5):881-887.	3a	105 patients	Retrospective cohort analysis to compare endoscopic cyanoacrylate glue with TIPS to determine first line of treatment for gastric variceal bleeding.	There were no significant pretreatment differences between the 2 groups in age, sex, MELD (Model for End-Stage Liver Disease) score at the time of admission, or cause of liver disease. There were no significant differences in rebleeding at 72 hours, 3 months, and 1 year; survival at 3 months and 1 year; and aggregate long-term survival or acute complications. However, the TIPS group had a higher rate of long-term morbidity requiring hospitalization (41% with a TIPS and 1.6% in the cyanoacrylate arm, P<.0001). In patients with similar characteristics, cyanoacrylate therapy performed as well as TIPS in controlling and preventing gastric variceal hemorrhage with no significant differences in survival. Patients receiving cyanoacrylate therapy experienced significantly less long-term morbidity related to therapy than patients who received TIPS. Cyanoacrylate therapy appears to be safe and effective and compares favorably with TIPS therapy.	2

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24. Lo GH, Liang HL, Chen WC, et al. A prospective, randomized controlled trial of transjugular intrahepatic portosystemic shunt vs cyanoacrylate injection in the prevention of gastric variceal rebleeding. <i>Endoscopy</i> 2007; 39(8):679-685.	1	TIPS (n=35) and obturation using cyanoacrylate (n=37)	Prospective randomized trial to compare endoscopic obturation and TIPS in the prevention of gastric variceal rebleeding.	Stent shunt insertion was successful in all TIPS patients, and mean portal pressure gradient decreased from 21.4 +/- 7.5 mm Hg to 7.5 +/- 3.5 mm Hg (P< 0.001). Variceal obliteration was achieved in 19 patients in the cyanoacrylate group (51%) compared with 7 TIPS patients (20%) (P<0.02). After a median follow up of 33 months, upper gastrointestinal bleeding occurred in 15 TIPS patients (43%) and 22 cyanoacrylate patients (59%) (P=0.12). Rebleeding from gastric varices was encountered in 4 TIPS patients (11%) and 14 cyanoacrylate patients (38%) (P=0.014; odds ratio 3.6, 95% CI, 1.2 - 11.1). Blood transfusion requirements were lower in the TIPS group than in the cyanoacrylate group (P<0.01). Survival and frequency of complications were similar in both groups. TIPS proved more effective than glue injection in preventing rebleeding from gastric varices, with similar survival and frequency of complications.	1
25. Przemioslo RT, McNair A, Williams R. Thrombin is effective in arresting bleeding from gastric variceal hemorrhage. <i>Dig Dis Sci</i> 1999; 44(4):778-781.	4	52 patients	A report on the efficacy and safety of bovine thrombin in the treatment of bleeding gastric varices.	Initial hemostasis was achieved in 49/52 patients (94%). Bleeding-related mortality at 72 hr after the index bleed was 3/52 (6%). The mean amount of thrombin used to achieve initial hemostasis was 1070 IU (range 400-2000 IU) and no adverse drug effects were observed. The median number of treatment sessions required to achieve gastric variceal ablation was 2 (range 1-3). At 6 weeks, 9/49 surviving patients (18%) rebled and one further patient died. The 6-week mortality in patients treated with thrombin was 4/52 (8%). Safe and effective hemostasis of bleeding gastric varices can be achieved by intravariceal injection with thrombin.	3

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26. Ramesh J, Limdi JK, Sharma V, Makin AJ. The use of thrombin injections in the management of bleeding gastric varices: a single-center experience. <i>Gastrointest Endosc</i> 2008; 68(5):877-882.	3a	42 patients identified; 13 had thrombin injection	Retrospective review to examine the use of bovine thrombin injection for the treatment of bleeding gastric varices.	Of the 13 patients who underwent thrombin injections, hemostasis in the acute setting was successful in 92% of cases. Patients received 1 to 4 sessions of thrombin, with a mean total dose of 10.8 mL for variceal eradication. One patient continued to bleed and needed TIPS as a rescue procedure. The patient with HCC died within 30 days, and 4 more patients died after a median follow-up of 22 months; none died because of bleeding. There was no rebleeding in the remaining patients at a median follow-up of 25 months. Injection with thrombin proved to be an effective endoscopic treatment in the majority of patients with bleeding gastric varices. The overall mortality, after controlling bleeding, was 38% (5/13), subsequent to a median follow-up of 22 months.	3
27. Williams SG, Peters RA, Westaby D. Thrombin--an effective treatment for gastric variceal haemorrhage. <i>Gut</i> 1994; 35(9):1287-1289.	4	11 consecutive patients (9 with fundal, 2 with high lesser curve varices)	To evaluate the use of bovine thrombin in the control of bleeding from gastric varices.	After a median follow-up of 9 months only one patient had rebled from a gastric varix. Thrombin may represent a valuable alternative injectate for the treatment of gastric varices.	3
28. Yang WL, Tripathi D, Therapondos G, Todd A, Hayes PC. Endoscopic use of human thrombin in bleeding gastric varices. <i>Am J Gastroenterol</i> 2002; 97(6):1381-1385.	4	12 patients	To examine the use of human thrombin in the treatment of bleeding gastric varices.	Hemostasis in the acute setting was successful in 9 patients all of whom received thrombin within 48 hours of the bleed. In the longer term, 9 of the 12 had no further bleeding. Of these, 5 patients did well with thrombin alone, one died of cancer, and the other three went on electively to more definitive shunt procedures. Three patients rebled from their gastric varices of which one was successfully retreated with thrombin. Only one death was related to variceal bleeding (8%). No adverse reactions were noted. Study demonstrates that endoscopic therapy with thrombin appears safe and can be effective in the management of gastric variceal bleeding.	3

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29. Chikamori F, Shibuya S, Takase Y, Ozaki A, Fukao K. Transjugular retrograde obliteration for gastric varices. <i>Abdom Imaging</i> 1996; 21(4):299-303.	4	20 patients	To examine the use of TJO in the treatment of gastric varices.	In all cases, gastric varices were obliterated successfully. Endoscopic examination 3 months after treatment revealed the complete eradication of gastric varices in all cases. No major complications during or after therapy were observed. TJO can be an effective method for the treatment of gastric varices with gastrosplenic shunt.	3
30. Trudeau W, Prindiville T. Endoscopic injection sclerosis in bleeding gastric varices. <i>Gastrointest Endosc</i> 1986; 32(4):264-268.	3a	92 consecutive patients	Patients with bleeding varices were prospectively studied using sclerotherapy to control and prevent rebleeding. Nine patients with gastric variceal bleeding were identified.	Endoscopic injection sclerotherapy in patients with bleeding gastric varices offers only temporary control of bleeding, and the high incidence of severe early rebleeding requires consideration of alternative methods for management or modified sclerotherapy techniques.	2
31. Yassin MY, Eita MS, Hussein AMT. Endoscopic sclerotherapy for bleeding gastric varices. <i>Gut</i> 1985; 26:A1105.	4	35 patients	A report on the use of endoscopic sclerotherapy for bleeding gastric varices.	Serious complications of endoscopic sclerotherapy for bleeding gastric varices including recurrent bleeding are numerous and frequently fatal. Necrotic complications are greater with old age and poor hepatic function.	3
32. Fukuda T, Hirota S, Sugimura K. Long-term results of balloon-occluded retrograde transvenous obliteration for the treatment of gastric varices and hepatic encephalopathy. <i>J Vasc Interv Radiol</i> 2001; 12(3):327-336.	3a	43 patients	To evaluate the long-term results of BRTO for the treatment of gastric varices and hepatic encephalopathy.	Gastric varices disappeared or decreased markedly in size, and hepatic encephalopathy was completely cured in all patients. Improvement in Child-Pugh score was observed in 21 patients (50%) 6 months after BRTO, but in only 11 patients (25.6%) 1 year after BRTO. Cumulative relapse-free survival rate was 90.8% at 1 year and 87.4% at 3 years after BRTO. BRTO is a safe and effective treatment for patients with gastric varices and hepatic encephalopathy. Most important prognostic factors are the extent of Child-Pugh classification.	2

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33. Kiyosue H, Mori H, Matsumoto S, Yamada Y, Hori Y, Okino Y. Transcatheter obliteration of gastric varices: Part 2. Strategy and techniques based on hemodynamic features. <i>Radiographics</i> 2003; 23(4):921-937; discussion 937.	7	N/A	To describe the strategy and techniques of transcatheter obliteration of gastric varices based on the afferent and draining venous patterns of the varices.	Additional techniques include stepwise injection of the sclerosing agent, selective injection of the agent via a microcatheter, coil embolization of the afferent gastric veins, double-balloon catheterization, and BRTO performed with percutaneous transhepatic portal venous access or transileocolic venous access. The majority of gastric varices can be treated successfully with a combination of these techniques. However, accurate assessment of the variceal hemodynamic pattern is the most important factor in ensuring successful treatment.	4
34. Kiyosue H, Mori H, Matsumoto S, Yamada Y, Hori Y, Okino Y. Transcatheter obliteration of gastric varices. Part 1. Anatomic classification. <i>Radiographics</i> 2003; 23(4):911-920.	4	60 patients	To describe standard BRTO technique and an anatomic classification system for gastric varices that is based on their hemodynamic features during balloon occlusion of the draining vein.	The degree of difficulty in performing BRTO depends on the afferent and draining venous patterns of the varices. Therefore, accurate assessment of the hemodynamic pattern before and during each procedure is essential for successful treatment.	3
35. Ninoi T, Nishida N, Kaminou T, et al. Balloon-occluded retrograde transvenous obliteration of gastric varices with gastroduodenal shunt: long-term follow-up in 78 patients. <i>AJR</i> 2005; 184(4):1340-1346.	3a	78 patients	Retrospective cohort study to evaluate the long-term clinical results after BRTO for gastric varices with spontaneous gastroduodenal shunt.	Recurrence of gastric varices found in 2 patients; the 5-year recurrence rate was 2.7%. Bleeding of gastric varices occurred in only one patient after BRTO; the 5-year bleeding rate was 1.5%. BRTO is an effective method for gastric varices with gastroduodenal shunt and provides lower recurrence and bleeding rates.	2
36. Hirota S, Matsumoto S, Tomita M, Sako M, Kono M. Retrograde transvenous obliteration of gastric varices. <i>Radiology</i> 1999; 211(2):349-356.	4	20 patients	To evaluate the clinical efficacy, techniques, and complications associated with BRTO of gastric varices.	Technical success was achieved in all patients. Occlusion of collateral veins was essential for the occlusion of gastric varices with a grade greater than grade 2. The clinical symptoms of hepatic encephalopathy in the 3 patients improved remarkably. Follow-up endoscopy 3 months after the procedure revealed the disappearance of gastric varices in 15 patients and reduced variceal size in five. During the follow-up period, 19 patients had no recurrence of gastric varices; three patients had aggravation of the EV. BRTO is a feasible alternative to TIPS for patients with large gastroduodenal shunts or hepatic encephalopathy (or both).	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
37. Choi YS, Lee JH, Sinn DH, et al. Effect of balloon-occluded retrograde transvenous obliteration on the natural history of coexisting esophageal varices. <i>J Clin Gastroenterol</i> 2008; 42(9):974-979.	2	237 patients	To determine whether the natural history of coexisting EV is affected by BRTO. Clinical, laboratory, and endoscopic features were compared between 25 patients who underwent BRTO due to GV bleeding (BRTO group) and 198 patients who never experience gastric variceal bleeding (control group) during follow-up. The incidences of EV bleeding were evaluated and compared between these 2 groups.	The BRTO and control groups were not significantly different with respect to baseline characteristics including age, sex, etiologies of cirrhosis, hepatic function, and the classification or extent of EV and gastric variceal. During follow-up (median 48 months), the overall incidence of first EV bleeding in the patients with fundal varices was significantly higher in the BRTO group (P=0.04). The incidences of EV bleeding were not different at 1 or 3 years (10.1% vs 12.9%, P=0.32 and 39.3% vs 38.4%, P=0.57), but became significantly higher in the BRTO group at 5 (72.2% vs 48.5%, P=0.02) and 7 years (90.7% vs 50.6%, P<0.01). BRTO increased the bleeding rate of coexisting EV in the long term. Close monitoring and prophylaxis of EV bleeding may be warranted after BRTO.	2
38. Hayashi S, Saeki S, Hosoi H, et al. [A clinical and portal hemodynamic analysis for obliteration of gastric-renal shunt communicated with gastric fundic varices]. <i>Nippon Shokakibyo Gakkai Zasshi</i> 1998; 95(7):755-763.	4	24 patients	To clear the efficacy of treatment for large porto-systemic shunts, changes of liver function and portal hemodynamics after obliteration of gastric-renal shunt or gastric-inferior phrenic vein shunt communicated with gastric fundic varices in patients treated with BRTO were studied.	Increment of portal flow and improvement of liver function can be expected by obliteration of gastric-renal shunt or gastric-inferior phrenic vein shunt in patients that, whose superior mesenteric venous blood flow into large gastric-renal shunt or gastric-inferior phrenic vein shunt. After obliteration of gastric-renal shunt or gastric-inferior phrenic vein shunt, the incidence of aggravation of esophageal varices in patients with collaterals besides gastric-renal shunt or gastric-inferior phrenic vein shunt before treatment is high, while that in cases without collateral is low.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
39. Nakamura S, Torii N, Yatsuji S, et al. Long-term follow up of esophageal varices after balloon-occluded retrograde transvenous obliteration for gastric varices. <i>Hepatol Res</i> 2008; 38(4):340-347.	3a	22 patients	To assess the long-term outcome of BRTO, including changes in EV. Patients were divided according to the severity of EV at baseline; there were no EV (n=7), F(1) varices (n=11), and F(2) varices (n=4).	The cumulative bleeding-free probability for all 22 patients at 3 years after BRTO was 100%. The overall 3-year survival was 94.4%. Seven patients who had no EV prior to BRTO did not develop any after the procedure. Seven (63.6%) of the 11 patients with stage F(1) EV prior to BRTO showed no changes in the varices after BRTO, while two patients progressed to F(2) varices and two developed F(3) varices. The cumulative treatment-free probability of the EV at 24 months after BRTO was 100% for patients without EV at baseline, 80.8% for patients with pre-existing F(1) varices, and 75% for those with pre-existing F(2) varices. Although the BRTO procedure is considered useful for the treatment of gastric varices, changes in hemodynamics due to obliteration of this major shunt must be taken into account and observed closely.	3
40. Tanihata H, Minamiguchi H, Sato M, et al. Changes in portal systemic pressure gradient after balloon-occluded retrograde transvenous obliteration of gastric varices and aggravation of esophageal varices. <i>Cardiovasc Intervent Radiol</i> 2009; 32(6):1209-1216.	3a	19 patients	To evaluate change in the portal systemic pressure gradient following BRTO and the aggravation of EV.	Eradiation of gastric varices was obtained in all patients and aggravation of EV was seen in 11 patients. The portal systemic pressure gradient was significantly elevated by BRTO (P=0.0362). The portal systemic pressure gradient was significantly elevated in patients with Grade 2 compared with those with Grade 1 (7.7 +/- 3.7 vs 3.3 +/- 4.3 mmHg, respectively; P=0.0314) and in those with EV before treatment compared with those without (7.4 +/- 4.0 vs 3.2 +/- 3.9 mmHg, respectively; P=0.0482). The cumulative aggravation rate of EV was significantly higher in 11 patients with a portal systemic pressure gradient elevation >5 mmHg than in 8 patients with one of ≤5 mmHg (P=0.0105). BRTO induced a significant elevation in portal systemic pressure gradient, with the degree of elevation influencing the aggravation of EV following BRTO.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
41. Barange K, Peron JM, Imani K, et al. Transjugular intrahepatic portosystemic shunt in the treatment of refractory bleeding from ruptured gastric varices. <i>Hepatology</i> 1999; 30(5):1139-1143.	3a	32 consecutive patients	To examine the use of TIPS in patients with refractory gastric variceal bleeding.	Hemostasis was achieved in 18/20 patients actively bleeding at the time of the procedure. In 32 patients, rebleeding rates were 14%, 26%, and 31%, respectively at 1 month, 6 months, and 1 year. De novo encephalopathy was observed in 5 (16%) patients. Seven patients experienced complications and consequently 4 of these patients died. TIPS primary patency rates were 84%, 74%, and 51%, respectively, at 1 month, 6 months, and 1 year. For the same periods of time, survival rates were 75%, 62%, and 59%. Results suggest that TIPS can be used in cirrhotic patients with refractory gastric variceal bleeding and are effective in achieving hemostasis as well as in preventing rebleeding.	3
42. Chau TN, Patch D, Chan YW, Nagral A, Dick R, Burroughs AK. "Salvage" transjugular intrahepatic portosystemic shunts: gastric fundal compared with esophageal variceal bleeding. <i>Gastroenterology</i> 1998; 114(5):981-987.	3a	112 consecutive patients (84 - EV group and 28 - gastric variceal group)	To compare the efficacy of TIPS in a consecutive series of patients with uncontrolled gastric variceal and EV bleeding.	Variceal bleeding was controlled in all patients after TIPS except for 1 in each group. There were no significant differences between the two groups in terms of markers of disease severity, severity of bleeding, or portal hemodynamics. During a median follow-up period of 7 months, 20 in the EV group (24%) and 8 in the gastric variceal group (29%) developed clinical rebleeding. Most early rebleeding (within 7 days after TIPS) was related to esophageal ulceration secondary to previous sclerotherapy. Rates of mortality were similar in both groups. Results suggest that emergency TIPS is equally effective in the immediate short-term control of gastric fundal variceal bleeding compared with esophageal variceal bleeding.	2

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
43. Choi YH, Yoon CJ, Park JH, Chung JW, Kwon JW, Choi GM. Balloon-occluded retrograde transvenous obliteration for gastric variceal bleeding: its feasibility compared with transjugular intrahepatic portosystemic shunt. <i>Korean J Radiol</i> 2003; 4(2):109-116.	3c	21 patients	To assess the feasibility of BRTO in active gastric variceal bleeding, and to compare the findings with those of TIPS. In 15 patients, contrast-enhanced CT scans demonstrated gastorenal shunt, and the remaining 6 (Group 1) underwent TIPS. Seven of the 15 with gastorenal shunt (Group 2) were also treated with TIPS, and the other 8 (Group 3) underwent BRTO.	One patient in Group 1 died of sepsis, acute respiratory distress syndrome, and persistent bleeding 3 days after TIPS, while the remaining 20 survived the procedure with immediate hemostasis. Hepatic encephalopathy developed in 4 patients (one in Group 1, three in Group 2, and none in Group 3); one, in Group 2, died while in an hepatic coma 19 months after TIPS. Rebleeding occurred in one patient, also in Group 2. Except for transient fever in two Group 3 patients, no procedure-related complication occurred. In terms of immediate hemostasis, rebleeding and encephalopathy, there were no statistically significant differences between the groups (P>0.05). In Group 3, the Child-Pugh score showed a significant decrease after the procedure (P=0.02). BRTO can effectively control active gastric variceal bleeding, and because of immediate hemostasis, the absence of rebleeding, and improved liver function, is a good alternative to TIPS in patients in whom such bleeding, accompanied by gastorenal shunt, occurs.	3
44. Ninoi T, Nakamura K, Kaminou T, et al. TIPS vs transcatheter sclerotherapy for gastric varices. <i>AJR</i> 2004; 183(2):369-376.	3c	104 patients	Retrospective study to compare the efficacy and long-term results of TIPS with those of transcatheter sclerotherapy for the treatment of gastric varices.	The cumulative gastric variceal bleeding rate at 1 year was 20% in the TIPS group and 2% in the transcatheter sclerotherapy group (P<0.01). Cumulative survival rates at 1, 3, and 5 years were, respectively, 81%, 64%, and 40% in the TIPS group and 96%, 83%, and 76% in the transcatheter sclerotherapy group (P<0.01). For patients categorized in Child-Pugh class A, the survival rate was higher in the transcatheter sclerotherapy group than in the TIPS group (P<0.01). For patients in Child-Pugh classes B and C, no significant difference was seen between the two groups. Transcatheter sclerotherapy may provide better control of gastric variceal bleeding than TIPS. Transcatheter sclerotherapy may contribute to a higher survival rate than TIPS in patients with Child-Pugh class A disease.	2

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
45. Rees CJ, Nylander DL, Thompson NP, Rose JD, Record CO, Hudson M. Do gastric and oesophageal varices bleed at different portal pressures and is TIPS an effective treatment? <i>Liver</i> 2000; 20(3):253-256.	3a	64 patients 12 patients underwent TIPS for gastric variceal haemorrhage and 52 for oesophageal variceal haemorrhage	To assess the difference in portosystemic pressure gradients measured at the time of TIPS insertion between patients bleeding from gastric and those bleeding from oesophageal varices. Rebleeding and mortality rates between the two groups were also compared.	There was no significant difference in median portosystemic pressure gradients between patients with gastric variceal haemorrhage, 21 mmHg (range 15-30 mmHg) and oesophageal variceal haemorrhage, 22 mmHg (range 12-45 mmHg). Following TIPS, portosystemic pressure gradients was 8.5 mmHg (range 3-11 mmHg) and 9 mmHg (range 4-20 mmHg) in gastric variceal haemorrhage and oesophageal variceal haemorrhage patients respectively. Rebleeding occurred in 2/12 (16%) gastric variceal haemorrhage patients and 12/52 (23%) oesophageal variceal haemorrhage patients (P= 1.0). Mortality during follow-up was 25% (4/12) in the gastric variceal haemorrhage and 25% (13/52) in the oesophageal variceal haemorrhage patients. There was no difference between the pressures at which gastric and oesophageal varices bled. Rebleeding and mortality rates were similar in the two groups. TIPS is equally effective in the treatment of both oesophageal and gastric variceal haemorrhage.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
46. Angeloni S, Merli M, Salvatori FM, et al. Polytetrafluoroethylene-covered stent grafts for TIPS procedure: 1-year patency and clinical results. <i>Am J Gastroenterol</i> 2004; 99(2):280-285.	3c	87 consecutive cirrhotics underwent TIPS with conventional stents, 32 consecutive cirrhotics treated with PTFE-covered stent grafts	Prospective trial to assess TIPS safety and 1-year patency with a new commercially available PTFE-covered stent graft in comparison with a group of historical controls treated with conventional stents.	The 1-year probability of remaining free of shunt dysfunction tended to be higher in the covered stent group: 76.3% (95% CI = 58.7%-93.9%) vs 57.5% (95% CI = 46.6%-68.4%); log rank test: P=0.055. However, stenoses inside the stent were significantly higher in patients with bare stents (88% vs 17%), while stenoses at the hepatic or portal vein were more frequent in PTFE-covered stent-graft group (50% vs 9% and 33% vs 3%, respectively), (chi2 = 15.42; df = 2.0; P=0.0004). Stenoses inside the covered portion of the stent did not occur. One-year cumulative rebleeding, encephalopathy, and survival were similar. PTFE-covered stents are able to solve pseudointimal hyperplasia within the stent tract, but have a high incidence of hepatic or portal vein stenosis. Improvements in stent design and insertion techniques are necessary to fully achieve the potential benefit of this new device.	2
47. Angermayr B, Cejna M, Koenig F, et al. Survival in patients undergoing transjugular intrahepatic portosystemic shunt: ePTFE-covered stentgrafts vs bare stents. <i>Hepatology</i> 2003; 38(4):1043-1050.	3c	Bare TIPS (419/466) e-PTFE endoprosthesis (89/100)	Retrospective analysis of patients receiving either bare TIPS or undergoing implantation of e-PTFE endoprosthesis in several centers in Austria.	Patients having e-PTFE stentgraft implantation had higher survival rates in all analyses. The 3-month, 1-year, and 2-year survival rates were 93%, 88%, and 76% for the e-PTFE-group and 83%, 73%, and 62% for conventional TIPS patients, respectively. Prospective study needed for validation of data.	2
48. Bureau C, Garcia-Pagan JC, Otal P, et al. Improved clinical outcome using polytetrafluoroethylene-coated stents for TIPS: results of a randomized study. <i>Gastroenterology</i> 2004; 126(2):469-475.	1	80 patients	Randomized trial to compare patency rates of PTFE-coated prostheses and uncoated stents in patients treated by TIPS.	After 300 days of follow-up, 5 patients (13%) in group 1 and 18 (44%) in group 2 had shunt dysfunction (P<0.001). Clinical relapse occurred in 3 patients (8%) in group 1 and 12 (29%) in group 2 (P<0.05). Actuarial rates of encephalopathy were 21% in group 1 and 41% in group 2 at 1 year (not significant). Estimated probabilities of survival were 71% and 60% at 1 year and 65% and 41% at 2 years in groups 1 and 2, respectively (not significant). Study concludes that the use of PTFE-covered prostheses improves TIPS patency and decreases the number of clinical relapses and reinterventions without increasing the risk of encephalopathy.	1

* See Last Page for Key

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
49. Bureau C, Pagan JC, Layrargues GP, et al. Patency of stents covered with polytetrafluoroethylene in patients treated by transjugular intrahepatic portosystemic shunts: long-term results of a randomized multicentre study. <i>Liver Int</i> 2007; 27(6):742-747.	1	80 patients	Multicenter study. Patients randomized to be treated by TIPS either with a covered stent (Group 1) or an uncovered prosthesis (Group 2) were followed-up for 2 years.	Actuarial rates of primary patency in Groups 1 and 2 were 76% and 36%, respectively (P=0.001). Actuarial rates of being free of encephalopathy were 67% in Group 1 and 51% in Group 2 (P<0.05). Probability of survival was 58% and 45% at 2 years, respectively, in Groups 1 and 2. Improvement in TIPS patency by using covered prostheses is maintained over time with a decreased risk of encephalopathy, while the risk of death was not increased.	1
50. Charon JP, Alaeddin FH, Pimpalwar SA, et al. Results of a retrospective multicenter trial of the Viatorr expanded polytetrafluoroethylene-covered stent-graft for transjugular intrahepatic portosystemic shunt creation. <i>J Vasc Interv Radiol</i> 2004; 15(11):1219-1230.	3a	100 consecutive patients	To report the results of a retrospective multicenter experience with the Viatorr e-PTFE-covered stent-graft for TIPS creation in which patency and clinical outcome were evaluated.	Technical success rate was 100%. TIPS creation resulted in an immediate decrease in mean portosystemic pressure gradient (+/- SD) from 21 mm Hg +/- 6 to 7 mm Hg +/- 3. Acute repeat intervention (within 30 days) was required for portal vein thrombosis (n=1), continued bleeding (n=3), and encephalopathy (n=1). The all-cause 30-day mortality rate was 12%. Study confirms preliminary findings of other investigators of good technical results and improved patency compared with bare stents.	2

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
51. Hausegger KA, Karnel F, Georgieva B, et al. Transjugular intrahepatic portosystemic shunt creation with the Viatorr expanded polytetrafluoroethylene-covered stent-graft. <i>J Vasc Interv Radiol</i> 2004; 15(3):239-248.	3a	71 patients	To evaluate the midterm clinical results and patency of TIPS created with a commercially available e-PTFE-covered stent-graft based on angiographic and US criteria.	TIPS creation was successful in all patients without complications, and effective portal decompression was observed with a reduction of the mean portal gradient from 19 mm Hg to 6 mm Hg before and after TIPS creation. Four shunt occlusions were observed after 5 days, 2 months, 3 months, and 6 months. Shunt stenosis was observed in 3 patients at the hepatic vein, which was not fully covered by the stent-graft, after 6 months (n=2) and 12 months, and at the portal side after 1 month in a patient who initially had portal vein thrombosis. The repeat intervention rate was 11.3%. The primary patency rates were 87.4% (95% CI, 77.7%-97.1%) after 6 months and 80.8% (95% CI, 68.2%-93.4%) after 12 months. The rate of de novo or deteriorated hepatic encephalopathy was 31%. The recurrent bleeding rate was 3.7% (one of 27), and ascites improved or resolved in 64% of patients after 1 month. TIPS patency can be significantly increased if the e-PTFE-covered stent-graft is used for shunt creation. The increased shunt patency contributes to low repeat intervention and recurrent bleeding rates. The rate of hepatic encephalopathy is within the range of previously reported rates.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
52. Rossi P, Salvatori FM, Fanelli F, et al. Polytetrafluoroethylene-covered nitinol stent-graft for transjugular intrahepatic portosystemic shunt creation: 3-year experience. <i>Radiology</i> 2004; 231(3):820-830.	3a	53 consecutive patients	To prospectively evaluate the use of a recently developed e-PTFE-covered nitinol stent-graft in preventing the need for repeated intervention after TIPS creation.	Technical success rate of 100% was obtained, with an early clinical success rate of 96.2%. During the follow-up period, the recurrence rate was 3.4% (1/29 patients) for bleeding and 9.0% (2/22 patients) for ascites. Shunt malfunction occurred in 9/53 patients (16.9%); in one of these 9 patients, shunt occlusion was evident after revision, and a parallel shunt was created. The 1-year primary and secondary patency rates were 83.8% and 98.1%, respectively. In this series, the incidence of encephalopathy (included even as a single short-lived episode) was 47.1% (25/53 patients). The 30-day mortality rate was 3.8% (2/53), and the late mortality rate was 17.3% (8/46), excluding 7 patients who underwent transplantation. The new PTFE-covered nitinol stent-graft used appears to be excellent in preventing the need for repeated interventions. A primary patency rate of 83.8% and a secondary patency rate of 98.1% were achieved.	2
53. Rossle M, Siegerstetter V, Euringer W, et al. The use of a polytetrafluoroethylene-covered stent graft for transjugular intrahepatic portosystemic shunt (TIPS): Long-term follow-up of 100 patients. <i>Acta Radiol</i> 2006; 47(7):660-666.	3a	100 patients	To retrospectively evaluate results and clinical outcome of TIPS after implantation of a PTFE-covered stent graft.	The actuarial rates of shunt patency were 90%, 84%, and 74% at 1, 2, and 3 years of follow-up, respectively. Two patients developed early (within 1 month) and 14 patients late shunt failure. Except for one transient rise in liver enzymes due to outflow obstruction by the stent graft, no technical complications were seen. Primary response to treatment was seen in 97% of patients treated for variceal bleeding and 84% of patients treated for refractory ascites. A relapse of the index symptom was seen in 13% of bleeders and 9% of patients treated for refractory ascites. TIPS created with a PTFE-covered stent graft showed favorable long-term results.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
54. Saad WE, Darwish WM, Davies MG, Waldman DL. Stent-grafts for transjugular intrahepatic portosystemic shunt creation: specialized TIPS stent-graft vs generic stent-graft/bare stent combination. <i>J Vasc Interv Radiol</i> 2010; 21(10):1512-1520.	3a	126 TIPSs	Retrospective review to compare functional and anatomic outcomes of TIPSs created with the specialized Viatorr stent vs a Wallstent/Fluency stent combination.	No significance in demographic factors or portosystemic shunt grafts was found among groups ($P>.05$). Major encephalopathy rates were 3.6% and 4.3% in the Fluency and Viatorr groups, respectively ($P=1.000$). Hemodynamic success rates were 93% and 98% in the Fluency and Viatorr groups, respectively ($P=.099$). The primary unassisted patency rates at 6, 9, and 12 months were 87%, 81%, and 81%, respectively, in the Fluency group and 95%, 93%, and 89%, respectively, in the Viatorr group ($P=.03$). Portal and hepatic end stenoses were the causes of TIPS narrowing in the Fluency and Viatorr groups, respectively. The Wallstent/Fluency stent combination is associated with a 1-year patency rate greater than 80%, with no significant difference vs the Viatorr stent regarding technical and hemodynamic success and encephalopathy rate. However, the Viatorr stent is associated with improved patency (89%) vs this bare stent/stent-graft combination.	2
55. Saxon RR. A new era for transjugular intrahepatic portosystemic shunts? <i>J Vasc Interv Radiol</i> 2004; 15(3):217-219.	12	N/A	Comment on a study by Hausegger et al on TIPS. The study adds substantially to a growing body of knowledge about the creation of TIPS with use of a commercial e-PTFE-covered stent-graft that is designed for TIPS creation and revision.	Author concludes that the vast majority of TIPS creations and revisions should now be done with e-PTFE-covered endografts, even though this represents an off-label use. When further study has confirmed that Viatorr stent-grafts should replace uncovered stents for TIPS creation, the role of TIPS relative to other forms of therapy will have to be reassessed.	4

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
56. Tripathi D, Ferguson J, Barkell H, et al. Improved clinical outcome with transjugular intrahepatic portosystemic stent-shunt utilizing polytetrafluoroethylene-covered stents. <i>Eur J Gastroenterol Hepatol</i> 2006; 18(3):225-232.	3c	316 patients (group 1) and 157 patients (group 2)	To assess the shunt function and clinical efficacy of PTFE-covered stents in a single centre. Group 1 constitutes patients with uncovered stents before the introduction of covered stents and Group 2 constitutes patients with the Viatorr Gore PTFE-covered stents at the time of TIPS creation.	The mean follow-up was 22.8 +/- 25.4 and 13.1 +/- 12.5 months, respectively (P<0.01). Shunt insufficiency was greater in group 1 [54 vs 8% at 12 months; relative hazard 8.6; 95% CI, 4.8-15.5; P<0.001]. The incidence of variceal rebleeding was greater in group 1 (11% vs 6% at 12 months; relative hazard 2.4; 95% CI, 1.1-5.1; P<0.05). The incidence of hepatic encephalopathy was greater in group 1 (32% vs 22% at 12 months; relative hazard 1.5; 95% CI, 1.1-2.3; P<0.05). Mortality was similar in the two groups. The Viatorr type of PTFE-covered stent results in vastly improved patency compared with uncovered stents, with reduced rates of variceal rebleeding and hepatic encephalopathy. This type of covered stent has the potential for superior clinical efficacy compared with uncovered stents.	2
57. Vignali C, Bargellini I, Grosso M, et al. TIPS with expanded polytetrafluoroethylene-covered stent: results of an Italian multicenter study. <i>AJR</i> 2005; 185(2):472-480.	3a	114 patients	To describe the results of a multicenter prospective trial on the safety and efficacy of TIPS using the Viatorr stent-graft.	Procedure was successful in 113 (99.1%) of 114 patients. Viatorr stent-graft is safe and effective in TIPS creation, with high primary patency rates. Covering the entire track up to the inferior vena cava can increase patency.	2
58. Chao Y, Lin HC, Lee FY, et al. Hepatic hemodynamic features in patients with esophageal or gastric varices. <i>J Hepatol</i> 1993; 19(1):85-89.	3c	150 cirrhotic patients	Patients with or without EV and/or gastric varices were investigated by endoscopy and hepatic venous catheterization to evaluate differences in the degree of portal hypertension, main portal venous diameter and frequency of portal systemic encephalopathy.	Patients with large gastric varices had wedged hepatic venous pressures and hepatic venous pressure gradients which were lower than patients with EV only, but similar to patients without varices. In addition, in patients with large gastric varices, a decrease in the diameter of the main portal vein and an increase in the incidence of chronic portal systemic encephalopathy were noted. Results implied that patients with large gastric varices presented different hemodynamic features including the degree of portal hypertension and the incidence of portal systemic encephalopathy from patients with EV only.	3

**Radiologic Management of Gastric Varices
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
59. Sanyal AJ, Freedman AM, Luketic VA, et al. The natural history of portal hypertension after transjugular intrahepatic portosystemic shunts. <i>Gastroenterology</i> 1997; 112(3):889-898.	3a	100 consecutive patients	To define prospectively the effects of TIPS on portal pressures and flow, variceal resolution, and hepatic function.	In 100 patients, mean portosystemic gradient decreased from 24 to 11 mm Hg (means) (P<0.001) after TIPS. Recurrent portal hypertension caused by stent thrombosis (n=5), stent retraction (n=2), and stent stenosis (n=51) occurred at 6 months but, by year 5, was not present in survivors (n=0 of 8). Fundic gastric varices failed to resolve in 6/12 cases. Systemic venous pressures of >15 mm Hg, stent dysfunction, and continued alcoholism were risk factors for recurrent hemorrhage. Angiography was superior to endoscopy, which was superior to Doppler US for detection of recurrent portal hypertension. Progressive liver failure occurred in 8 patients. Recurrent portal hypertension caused by stent stenosis occurs commonly in the first 2 years after TIPS. Fundic gastric varices often fail to disappear after TIPS. The effects of TIPS on liver function are unpredictable.	2
60. Saad WEA, Darcy MD. Transjugular Intrahepatic Portosystemic Shunt (TIPS) versus Balloon-occluded Retrograde Transvenous Obliteration (BRTO) for the Management of Gastric Varices. <i>Semin Intervent Radiol</i> 2011; 28(03):339,349.	7	N/A	Review the management of gastric varices using TIPS as compared with BRTO. Future research prospects and speculation as to the ideal patients for each procedure are discussed.	No results stated.	4

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
61. Cho SK, Shin SW, Lee IH, et al. Balloon-occluded retrograde transvenous obliteration of gastric varices: outcomes and complications in 49 patients. <i>AJR</i> 2007; 189(6):W365-372.	3a	49 consecutive patients	To evaluate the clinical outcomes, techniques, and complications of BRTO for treating gastric varices with spontaneous gastrosystemic shunts.	There were six procedural failures and two procedure-related deaths. Disappearance or marked shrinkage of the treated gastric varices with no recurrent gastric variceal bleeding was noted in 39 patients (79.6% clinical success rate). Approximately two thirds of patients experienced worsening of EV during the median follow-up period of 457 days. The cumulative survival rates at 1 year and 3 years after BRTO were 83.1% and 65.7%, respectively. The prognostic factors associated with survival were the preprocedural Child-Pugh classification and the total bilirubin level. The survival rates and procedural outcomes for the patients with severely compromised liver function were poor. BRTO is an effective treatment for the obliteration of gastric varices. However, application of this procedure to severely compromised patients should be considered carefully.	3
62. Kitamoto M, Imamura M, Kamada K, et al. Balloon-occluded retrograde transvenous obliteration of gastric fundal varices with hemorrhage. <i>AJR</i> 2002; 178(5):1167-1174.	4	24 consecutive patients	To evaluate the clinical efficacy, feasibility, and complications of BRTO obliteration for patients with hemorrhage from gastric fundal varices.	Complete success was obtained in 88% (21/24) of patients, and partial success was obtained in 2 patients. In 9/11 patients with acute bleeding, complete success was achieved. BRTO obliteration followed by any hemostatic procedure might be effective for both prophylaxis of rebleeding and eradication of gastric fundal varices, even in urgent cases.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
63. Akahoshi T, Hashizume M, Tomikawa M, et al. Long-term results of balloon-occluded retrograde transvenous obliteration for gastric variceal bleeding and risky gastric varices: a 10-year experience. <i>J Gastroenterol Hepatol</i> 2008; 23(11):1702-1709.	3a	68 patients	To examine the long-term effects of BRTO on rebleeding, prevention of first bleeding, mortality and occurrence of risky EV.	BRTO was successfully performed in 63/68 patients (92.6%). Varices eradication was confirmed by endoscopy in 61/63 patients (96.6%). During follow up, gastric varices bleeding occurred in 2 patients (3.2%). The 8-year cumulative rebleeding rates of patients with bleeding and risky gastric varices were 14% and 0%, respectively. Risky EV occurred in 10 patients (17%) and the cumulative occurrence rate was 22% in 8 years. The cumulative occurrence rate of risky EV was higher in gastric varices with EV (GOV2-GVx) compared to GV without EV (IGV1, P<0.05). No ectopic variceal bleeding occurred. No patients died from variceal bleeding. HCC was the only significant prognostic factor (P<0.05). BRTO is beneficial over the long-term, despite worsening EV in some patients, because of excellent treatment efficacy and improved mortality.	3
64. Chikamori F, Kuniyoshi N, Kawashima T, Takase Y. Gastric varices with gastroduodenal shunt: combined therapy using transjugular retrograde obliteration and partial splenic embolization. <i>AJR</i> 2008; 191(2):555-559.	3a	33 consecutive patients; 14 patients treated by combining TJO and partial splenic embolization (group 1); 19 patients treated by only TJO (group 2)	To prospectively evaluate the effectiveness of the combination of TJO and partial splenic embolization in the treatment of gastric varices with gastroduodenal shunt.	The disappearance rate of gastric varices after TJO was 100% in both groups. The 3-year cumulative survival rate after TJO was 92% in group 1 and 95% in group 2. The 3-year cumulative occurrence rate of EV after TJO was 9% in group 1 and 45% in group 2, a significant difference (P<0.05). Study findings indicate that partial splenic embolization contributed to preventing portal congestion after TJO.	2

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
65. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Eight years of experience with transjugular retrograde obliteration for gastric varices with gastrosrenal shunts. <i>Surgery</i> 2001; 129(4):414-420	4	52 patients	To analyze 8 years of experience with TJO for treating gastric varices with gastrosrenal shunts.	The gastric varices were successfully obliterated by TJO in all cases. The complications were all minor and transient. The mortality rate for TJO was 0%. There was no recurrence and no bleeding of gastric varices at all after TJO. Patient survival differed depending on the presence or absence of HCC (P<.05). The development of HCC in the cirrhotic liver was the most common cause of late death. Gastrointestinal bleeding was not a cause of death. The occurrence rate of EV after TJO was high, but these varices could be treated easily by endoscopic injection sclerotherapy before they bled. Portal blood flow through the gastrosrenal shunt is diverted to the porto-azygos venous system after the gastrosrenal shunt is obliterated by TJO. TJO is a safe option that is recommended for treating gastric varices with gastrosrenal shunts, provided that the TJO is followed by endoscopic injection sclerotherapy.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
66. Hong CH, Kim HJ, Park JH, et al. Treatment of patients with gastric variceal hemorrhage: endoscopic N-butyl-2-cyanoacrylate injection vs balloon-occluded retrograde transvenous obliteration. <i>J Gastroenterol Hepatol</i> 2009; 24(3):372-378.	3c	27 patients	To evaluate the therapeutic results of endoscopic N-butyl-2-cyanoacrylate injection and BRTO in patients with gastric variceal hemorrhage and/or high-risk gastric varices.	Endoscopic N-butyl-2-cyanoacrylate injection or BRTO was initially used for the treatment of with gastric variceal hemorrhage in 14 and 13 patients, respectively. Technical success was achieved in all 14 patients (100%) initially treated with endoscopic N-butyl-2-cyanoacrylate injection, and 10/13 patients (76.9%) initially treated with BRTO. Significant rebleeding occurred in 10 patients (71.4%) of the endoscopic N-butyl-2-cyanoacrylate injection group, and 2 patients (15.4%) of BRTO group (P<0.01). 5/6 patients (83.3%) treated with rescue BRTO due to rebleeding after initial endoscopic N-butyl-2-cyanoacrylate injection achieved technical success, and all 6 patients who were treated with rescue BRTO had no rebleeding during the median follow up of 17 (range: 2-37) months. The cumulative survival rate of the EBC with the BRTO rescue group/BRTO group was significantly higher than the endoscopic N-butyl-2-cyanoacrylate injection group. The therapeutic efficacies of endoscopic N-butyl-2-cyanoacrylate injection and BRTO for the treatment of active with gastric variceal hemorrhage and/or high-risk gastric varices appeared to be similar. However, endoscopic N-butyl-2-cyanoacrylate injection might be associated with a higher rebleeding rate than BRTO. BRTO could be an effective rescue treatment for patients with gastric variceal hemorrhage after initial treatment of endoscopic N-butyl-2-cyanoacrylate injection.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
67. Kim ES, Park SY, Kwon KT, et al. [The clinical usefulness of balloon occluded retrograde transvenous obliteration in gastric variceal bleeding]. <i>Taehan Kan Hakhoe Chi</i> 2003; 9(4):315-323.	3a	13 patients	To evaluate the therapeutic effects and complications on follow-up of BRTO as a new treatment option for gastric variceal bleeding.	Technical success was achieved in 12/13 patients (92%) with gastric variceal bleeding. There were no significant side effects. In the one case of failure, the bleeding was controlled with TIPS. 11/12 patients who had technical success were shown to be clinically successful. The follow-up endoscopic exam showed some aggravation of pre-existing EV in 4 patients and a new development of EV in 2 patients. Endoscopic variceal ligation was done on one patient in whom esophageal variceal bleeding was present during the follow-up period. BRTO was proven to be a feasible, safe and less invasive procedure than TIPS and found to be an effective treatment of a gastric variceal bleeding. Considering the possible aggravation of pre-existing EV or the new development of EV, regular endoscopic examinations might be needed during the follow-up period.	4
68. Kumamoto M, Toyonaga A, Inoue H, et al. Long-term results of balloon-occluded retrograde transvenous obliteration for gastric fundal varices: hepatic deterioration links to portosystemic shunt syndrome. <i>J Gastroenterol Hepatol</i> 2010; 25(6):1129-1135.	3a	SRS (-) group – 19 patients SRS (+) group – 20 patients BRTO group – 20 patients	To examine the long-term effects of a large splenorenal shunt on liver function and survival. Patients were divided into three groups: an SRS (-) group consisting of cirrhotic patients without SRS; an SRS (+) group consisting of patients with gastric fundal varices and SRS; and a BRTO group with a completely obliterated SRS by BRTO.	After a 3-year follow-up period the Child-Pugh scores showed significant differences among the SRS (+), SRS (-), and BRTO groups. The score worsened for the SRS (+) group. The cumulative survival rates were significantly different between the SRS (+) and SRS (-) groups and between the SRS (+) and BRTO groups. The vital prognosis worsened for the SRS (+) group. The presence of a large SRS (portosystemic shunt) was indicated to lower liver function and vital prognosis. BRTO, which completely obliterates large SRSs, inhibited the lowering of hepatic functional reserve and the worsening of vital prognosis, indicating a protective role. Liver pathology and the presence of a large portosystemic shunt each separately result in progressive liver dysfunction and worsen the survival rate. Authors found that such a pathological condition had occurred due to a large portosystemic shunt, and it should be called 'portosystemic shunt syndrome.'	3

* See Last Page for Key

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
69. Matsumoto A, Hamamoto N, Nomura T, et al. Balloon-occluded retrograde transvenous obliteration of high risk gastric fundal varices. <i>Am J Gastroenterol</i> 1999; 94(3):643-649.	4	10 patients	To examine the relationship between portal hemodynamics and the occurrence of EV after prophylactic BRTO.	Fundal varices disappeared endoscopically in all 10 patients and the gastroduodenal shunt was also occluded after the procedure. No patient showed worsening of liver function or systemic complications during follow-up. The increase in portal blood flow was more significant in type Ib patients than in the others. EV occurred in all type I patients, and as to those in type Ib, high risk varices developed within 6 months after treatment. On the other hand, EV did not occur in type II patients. This procedure was effective for treating gastric fundal varices. However, type Ib patients are likely to develop high risk EV after occlusion of the gastroduodenal shunt.	4
70. Miyamoto Y, Oho K, Kumamoto M, Toyonaga A, Sata M. Balloon-occluded retrograde transvenous obliteration improves liver function in patients with cirrhosis and portal hypertension. <i>J Gastroenterol Hepatol</i> 2003; 18(8):934-942.	4	14 patients	To determine the effects of balloon-occluded retrograde transvenous on liver function in patients with cirrhosis and portal hypertension.	The BRTO was successful in all patients. Contrast-enhanced CT showed complete obliteration of the SRS prior to the follow-up measurements. Endoscopic eradication of the fundal varices was obtained 6 months after BRTO in all patients and encephalopathy was improved within 1 week after BRTO. Following the BRTO, hepatic blood flow (441 +/- 214 vs 668 +/- 299 mL/min, P<0.0001) and the intrinsic clearance of ICG (233 +/- 123 vs 285 +/- 148 mL/min, P<0.05) were significantly increased. Furthermore, intrahepatic resistance decreased after the BRTO (P<0.005). From short-term assessment, BRTO increases hepatic blood flow and improves the metabolic activity of the liver in patients with portal hypertension.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
71. Park KS, Kim YH, Choi JS, et al. [Therapeutic efficacy of balloon-occluded retrograde transvenous obliteration in patients with gastric variceal bleeding]. <i>Korean J Gastroenterol</i> 2006; 47(5):370-378.	4	28 patients	Retrospective study to determine the therapeutic efficacy of BRTO in patients with gastric variceal bleeding.	Technical and clinical success rates were 89.3% and 85.7%, respectively. Follow-up duration was 17.5 +/- 12.5 months in 23 patients. Gastric varices disappeared in 78.3% and decreased in 21.7%. Relapses occurred in 4.3% of the patients. Pre-existing hepatic encephalopathy improved in all 11 patients. Aggravation of ascites, EV, portal hypertensive gastropathy was observed in 45.8%, 30.4%, and 56.5%, respectively. Increased Child-Pugh score (P<0.001) and decreased albumin concentration (P=0.002) were observed 3 days after BRTO, but resolved 7 days later. Increased albumin concentration and decreased Child-Pugh score maintained thereafter. Rebleeding occurred in 3 patients which were caused by EV. 2-year survival rate was 54.6%. Presence of HCC (P=0.001) and Child-Pugh grade (P=0.033) affected the survival, but HCC was the only independent risk factor (P=0.010, odds ratio = 15.837) in multivariate analysis. BRTO is an effective therapeutic procedure for primary hemostasis, secondary prevention, and for improving survival in gastric variceal bleeding.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
72. Park SJ, Chung JW, Kim HC, Jae HJ, Park JH. The prevalence, risk factors, and clinical outcome of balloon rupture in balloon-occluded retrograde transvenous obliteration of gastric varices. <i>J Vasc Interv Radiol</i> 2010; 21(4):503-507.	4	69 patients	To retrospectively evaluate the prevalence, risk factors, and clinical outcome after balloon rupture during BRTO.	The prevalence of balloon rupture was 8.7% (6/69 patients). No significant risk factor for balloon rupture was identified because of the small number of balloon rupture cases. Migration of the sclerosant occurred in 3 patients with early balloon rupture within 1 hour. One of these patients died of recurrent gastric variceal bleeding and another experienced dyspnea and died of fungal sepsis. Among the 63 patients without rupture, no migration of the sclerosant was noted, and one patient died of sepsis caused by liver abscess. Incidences of sclerosant migration and in-hospital mortality were significantly higher in patients with balloon rupture vs patients without balloon rupture (P=.018 and P<.001, respectively). Balloon rupture during BRTO occurred in 8.7% of patients. Balloon rupture may cause rapid migration of sclerosant, pulmonary embolism, and recurrent gastric variceal bleeding.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
73. Shimoda R, Horiuchi K, Hagiwara S, et al. Short-term complications of retrograde transvenous obliteration of gastric varices in patients with portal hypertension: effects of obliteration of major portosystemic shunts. <i>Abdom Imaging</i> 2005; 30(3):306-313.	4	38 patients with fundic gastric varices and 43 BRTO procedures	To evaluate complications of BRTO for gastric varices in patients with portal hypertension.	Endoscopic evaluation at 8 weeks showed resolution of gastric varices in 35/38 patients (92%) and smaller varices in the remaining three (8%). BRTO caused transient hypertension in 35% of patients, hemoglobinuria in 49%, and fever in 33% during phases 1, 2, and 3, respectively. Pleural effusion, pulmonary infarction, ascites, gastric ulcers with unique appearance, localized mosaic-like change of gastric mucosa, and hemorrhagic portal hypertensive gastropathy were noted in phase 4. There were no fatalities. Lactate dehydrogenase, aspartate aminotransferase, and bilirubin increased on day 1. Each datum was retrieved within 7 days. The severity of lactate dehydrogenase elevation correlated significantly with the volume of infused ethanolamine oleate. BRTO is a safe and effective management of fundic varices. However, short-term hemodynamic change after BRTO may cause gastric mucosal damage. Pulmonary infarction and pleural effusion are potential complications.	3
74. Sonomura T, Sato M, Kishi K, et al. Balloon-occluded retrograde transvenous obliteration for gastric varices: a feasibility study. <i>Cardiovasc Intervent Radiol</i> 1998; 21(1):27-30.	4	14 patients	To evaluate the clinical feasibility of BRTO for gastric varices.	The gastric varices completely disappeared in 12/14 patients and was partially resolved in the remaining 2 patients. Neither a recurrence nor an aggravation of gastric varices was found. No major complications were experienced. BRTO is a safe and effective treatment for gastric varices.	3
75. Yamagami T, Kato T, Hirota T, Yoshimatsu R, Matsumoto T, Nishimura T. Infusion of 50% glucose solution before injection of ethanolamine oleate during balloon-occluded retrograde transvenous obliteration. <i>Australas Radiol</i> 2007; 51(4):334-338.	5	5 patients	To evaluate the feasibility of infusion of 50% glucose solution before BRTO to occlude collateral vessels draining gastric varices other than gastrosplenic shunt.	The degree of collateral vessels had decreased when BRTO was carried out so that sclerotic agents sufficiently occupied the gastric varices in all patients. In three patients, embolization of collateral vessels with coils was unnecessary. There were no complications. Retrograde infusion of 50% glucose solution assists in effectively carrying out BRTO.	4

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
76. Saad WEA, Sabri S. Balloon-occluded Retrograde Transvenous Obliteration (BRTO): Technical Results and Outcomes. <i>Semin Intervent Radiol</i> 2011; 28(03):333-338.	7	N/A	To examine the technical success results and outcomes of BRTO.	The technical success rate, intent-to-treat (including technically failed BRTO-procedures) obliteration rate, and the obliteration rate of gastric varices of technically successful BRTO procedures was 91% (79%-100%), 86% (73%-100%), and 94% (7%-100%), respectively. The 1-, 2-, and 3-year esophageal variceal aggravation rates are 27%-35%, 45%-66%, and 45%-91%, respectively. The gastric variceal rebleed rate of successful BRTO procedures, the intent-to-treat gastric variceal rebleed rate, and the global (all types of varices) variceal rebleed rate are 3.2%-8.7%, 10%-20%, and 19%-31%, respectively. Patient 1-, 2-, 3-, and 5-year survival rates are 83%-98%, 76%-79%, 66%-85%, and 39%-69%, respectively. Patient survival is determined by baseline hepatic reserve and the presence of hepatocellular carcinoma.	4
77. Arai H, Abe T, Shimoda R, Takagi H, Yamada T, Mori M. Emergency balloon-occluded retrograde transvenous obliteration for gastric varices. <i>J Gastroenterol</i> 2005; 40(10):964-971.	4	11 patients	To evaluate the efficacy of emergency BRTO performed within 24 hours after initial hemostasis for the prevention of rebleeding from ruptured gastric varices.	After hemostasis was achieved (4 patients), emergency BRTO was immediately performed within 24 hours and was successful in all 11 patients. 10 (90.9%) of the 11 gastric varices were obliterated and the other 1 (9.1%) was diminished in size. During the mean follow-up period of 1,136 days, no rebleeding or recurrence as found. Four patients died during the follow-up period, but none died from variceal bleeding. Survival rates were 90.9% and 70.7%, respectively, at 1 year and 3 years. In 6 patients, development of EV appeared during the follow-up period, all of which were controlled by usual endoscopic therapy. No severe side effects were found after the BRTO treatment. Emergency BRTO is an effective treatment for the prevention of rebleeding from ruptured gastric varices.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
78. Arai H, Abe T, Takagi H, Mori M. Efficacy of balloon-occluded retrograde transvenous obliteration, percutaneous transhepatic obliteration and combined techniques for the management of gastric fundal varices. <i>World J Gastroenterol</i> 2006; 12(24):3866-3873.	3a	93 patients	To evaluate the effect of three interventional treatments involving transvenous obliteration for the treatment of gastric varices, and to compare the efficacy and adverse effects of these methods.	The BRTO, percutaneous transhepatic obliteration, and combined therapy were technically successful in 81% (75/93), 44% (8/18), and 100% (10/10) patients, respectively. Recurrence of gastric varices was found in 3 patients in the BRTO group and in 3 patients in the percutaneous transhepatic obliteration group. Rebleeding was observed in 1 patient in the BRTO group and in 1 patient in the percutaneous transhepatic obliteration group. The 1- and 3-year survival rates were 98% and 87% in the patients without HCC in the BRTO group, 100% and 100% in the percutaneous transhepatic obliteration group, and 90% and 75% in the combined therapy group, respectively. Combined BRTO and percutaneous transhepatic obliteration therapy may rescue cases with uncontrollable gastric fundal varices that remained even after treatment with BRTO and/or percutaneous transhepatic obliteration.	3

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
79. Kiyosue H, Matsumoto S, Onishi R, et al. [Balloon-occluded retrograde transvenous obliteration (B-RTO) for gastric varices: therapeutic results and problems]. <i>Nihon Igaku Hoshasen Gakkai Zasshi</i> 1999; 59(1):12-19.	4	21 patients	To evaluate the usefulness of BRTO in the treatment of gastric varices.	19 patients (90%) were successfully treated with BRTO. In 17 of them, CT within two weeks after BRTO showed complete thrombosis of the gastric varices, and the varices had disappeared or markedly regressed on endoscopy after 1-3 months. In the other 2 patients, in whom CT showed partial thrombosis of the varices, the varices regressed minimally. Liver and renal function tests did not show significant changes in 17/19 patients (89%). Transient worsening of liver function was seen in one patient in whom a small amount of ethanolamine oleate iopamidol moved into the splenic vein during balloon occlusion. Acute renal failure occurred in the other patient with the use of 50 ml of ethanolamine oleate iopamidol. BRTO is an effective therapy for gastric varices. However, careful attention should be paid to the amount of ethanolamine oleate iopamidol and hemodynamic change caused by shunt occlusion.	3
80. Koito K, Namieno T, Nagakawa T, Morita K. Balloon-occluded retrograde transvenous obliteration for gastric varices with gastrosplenic or gastrocaval collaterals. <i>AJR</i> 1996; 167(5):1317-1320.	4	30 patients	To evaluate the efficacy of BRTO for gastric varices with gastrosplenic or gastrocaval collaterals.	After BRTO, gastric varices disappeared completely in all 30 cases in 4-16 weeks (mean, 10 weeks). Recurrence of gastric varices was observed in three cases (10%), which were treated with repeated BRTO. EV was aggravated in 3 patients (10%), who underwent successful endoscopic injection sclerotherapy. Complications of BRTO were fever and hemoglobinuria, which disappeared in about 5 days. BRTO offers good control of gastric varices with gastrosplenic or gastrocaval collaterals, even if hepatic function is poor.	3
81. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Combination treatment of transjugular retrograde obliteration and endoscopic embolization for portosystemic encephalopathy with esophageal varices. <i>Hepatogastroenterology</i> 2004; 51(59):1379-1381.	5	1 patient	To examine the value of a combination treatment of TJO and endoscopic embolization for portosystemic encephalopathy with EV.	Combination treatment of TJO and endoscopic embolization is a rational, effective and safe treatment for chronic portosystemic encephalopathy complicated with EV.	4

**Radiologic Management of Gastric Varices
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
82. Takuma Y, Nouse K, Makino Y, Saito S, Shiratori Y. Prophylactic balloon-occluded retrograde transvenous obliteration for gastric varices in compensated cirrhosis. <i>Clin Gastroenterol Hepatol</i> 2005; 3(12):1245-1252.	3c	17 patients (BRTO group) and 17 controls	Prospective study to examine the effectiveness of BRTO for the treatment of gastric fundal varices.	The respective nonbleeding rates at 1, 3, and 5 years were 100%, 100%, and 83% in the BRTO group and 81%, 59%, and 39% in the control. The respective cumulative survival rates at 1, 3, and 5 years were 94%, 85%, and 39% in the BRTO group and 71%, 41%, and 22% in the control. Both the nonbleeding rate and the cumulative survival rate of the BRTO group were significantly higher than those of the control (P=.01 and .04, respectively). BRTO was determined by multivariate analysis to be a significant factor for low bleeding rate (relative risk, 0.06; 95% CI, 0.004-0.79), whereas BRTO (0.11; 95% CI, 0.03-0.44) and Child-Pugh class A (0.10; 95% CI, 0.03-0.39) were the significant factors for a low mortality rate, and the presence of HCC (5.68; 95% CI, 1.49-21.7) was the significant factor for a high mortality rate. Prophylactic BRTO is effective in preventing gastric variceal rupture and consequently improves patient survival.	2
83. Ferral H, Patel NH. Selection criteria for patients undergoing transjugular intrahepatic portosystemic shunt procedures: current status. <i>J Vasc Interv Radiol</i> 2005; 16(4):449-455.	7	N/A	To provide an overview of the prognostic models available to evaluate patients before a TIPS procedure, with an emphasis on recently described selection criteria.	No results stated.	4
84. Chikamori F, Kuniyoshi N, Shibuya S, Takase Y. Transjugular retrograde obliteration for chronic portosystemic encephalopathy. <i>Abdom Imaging</i> 2000; 25(6):567-571.	5	5 patients	To examine and report cases of chronic portosystemic encephalopathy using TJO.	One patient died of HCC 27 months after TJO. The other 4 patients survived without recurrence of chronic portosystemic encephalopathy 17-74 months (44 +/- 24 months) after TJO. TJO can be adopted as a safe and effective treatment for chronic portosystemic encephalopathy.	4

Evidence Table Key

Study Type Key

Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.

1. Randomized Controlled Trial — Treatment
2. Controlled Trial
3. Observation Study
 - a. Cohort
 - b. Cross-sectional
 - c. Case-control
4. Clinical Series
5. Case reviews
6. Anecdotes
7. Reviews

8. Randomized Controlled Trial — Diagnostic
9. Comparative Assessment
10. Clinical Assessment
11. Quantitative Review
12. Qualitative Review
13. Descriptive Study
14. Case Report
15. Other (Described in text)

Strength of Evidence Key

- Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.
- Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Abbreviations Key

BRTO = Balloon-occluded retrograde transvenous obliteration

CI = Confidence interval

CT = Computed tomography

e-PTFE = Expanded-polytetrafluoroethylene

EV = Esophageal varices

HCC = Hepatocellular carcinoma

PTFE = Polytetrafluoroethylene

SRS = Splenorenal shunt

TIPS = Transjugular intrahepatic portosystemic shunt

TJO = Transjugular retrograde obliteration

US = Ultrasound