CLINICAL STUDY

# Gastric Varices Bleed at Lower Portosystemic Pressure Gradients than Esophageal Varices

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## ABSTRACT

**Purpose:** To quantify and compare portosystemic pressure gradients (PSGs) between bleeding esophageal varices (EV) and gastric varices (GV).

**Materials and Methods:** In a single-center, retrospective study, 149 patients with variceal bleeding (90 men, 59 women, mean age 52 y) with EV (n = 69; 46%) or GV (n = 80; 54%) were selected from 320 consecutive patients who underwent successful transjugular intrahepatic portosystemic shunt (TIPS) creation from 1998 to 2016. GV were subcategorized using the Sarin classification as gastroesophageal varices (GEV) (n = 57) or isolated gastric varices (IGV) (n = 23). PSG before TIPS was measured from the main portal vein to the right atrium. PSGs were compared across EV, GEV, and IGV groups using 1-way analysis of variance.

**Results:** Overall mean baseline PSG was 21 mm Hg ± 6. PSG was significantly higher in patients with EV versus GV (23 mm Hg vs 19 mm Hg; $P < .001$). Mean PSG was highest among EV (23 mm Hg) with lower PSGs identified for GEV (20 mm Hg) and IGV (16 mm Hg); this difference was statistically significant ($P < .001$). Among 95 acute bleeding cases, a similar pattern was evident (EV 23 mm Hg vs GEV mm Hg 20 vs IGV 17 mm Hg; $P < .001$). At baseline PSG < 12 mm Hg, 13% (3/23) of IGV bled versus 9% (5/57) of GEV and 3% (2/69) of EVs ($P = .169$). Mean final PSG after TIPS was 8 mm Hg (IGV 6 mm Hg vs EV and GEV 8 mm Hg; $P = .005$).

**Conclusions:** GV bleed at lower PSGs than EV. EV, GEV, and IGV bleeding is associated with successively lower PSGs. These findings highlight distinct physiology, anatomy, and behavior of GV compared with EV.

## ABBREVIATIONS

EV = esophageal varices, GEV = gastroesophageal varices, GV = gastric varices, IGV = isolated gastric varices, MELD = Model for End-stage Liver Disease, PSG = portosystemic pressure gradient, TIPS = transjugular intrahepatic portosystemic shunt

Esophageal varices (EV) and gastric varices (GV)—the latter of which encompasses both gastroesophageal varices (GEV) and isolated gastric varices (IGV)—are increasingly recognized as distinct pathologic entities. Each varix type displays a unique anatomic framework varying in venous supply and drainage (1–4), and each is associated with specific bleeding and rebleeding frequencies before and after medical and interventional treatments (5–8). Despite these apparent differences, clinical management paradigms often handle EV and GV as equivalent, prescribing the same interventional procedure and employing comparable procedure indications and endpoints. The identification of unique pathophysiologic characteristics of EV and GV may thus be critical to driving the recognition of need for more customized clinical management. Although published reports have studied hemodynamic differences between EV and GV (1,5), these investigations are limited to patients with hepatitis B virus liver cirrhosis—which is not fully reflective of Western liver disease—and do not report data at the time of acute hemorrhage. In all, few modern data are available that compare portosystemic pressure gradient (PSG) differences among EV and GV in a Western liver disease (alcohol, hepatitis C virus, and nonalcoholic steatohepatitis) population in the acute bleeding setting. This study was thus undertaken to quantify

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and compare PSGs at which EV and GV bleed in contemporary US interventional radiology) practice at a single tertiary care transplant center treating patients with a wide breadth of liver cirrhosis etiologies.

## MATERIALS AND METHODS

Institutional review board approval was granted for this study with waiver of informed consent for retrospective review of medical records. The patient sample for this single-center, retrospective study was selected from a registry of 320 patients who underwent 323 technically successful transjugular intrahepatic portosystemic shunt (TIPS) procedures between 1998 and 2016 at an academic tertiary care medical center. Medical record review identified 179 variceal bleeding cases. Patients lacking endoscopic information (n = 30) were excluded, resulting in a final cohort of 149 patients in whom varices were diagnosed by upper endoscopy. Patient cohort features are presented in **Table 1**. Patients with EV showed statistically higher mean Child-Pugh ($P = .008$) and Model for End-stage Liver Disease (MELD) scores ($P = .009$) than patients with GV. There was no difference in the percentage of patients taking nonselective β-blocker medications ($P = .871$) or in the pattern of acute bleeding parameters ($P = .807$) between EV and GV groups. Transfusion requirements were also similar between EV and GV groups (10 U of packed red blood cells ± 14 vs 7 U of packed red blood cells ± 8; $P = .310$).

### TIPS Procedures

The technique for TIPS has been previously described (9,10). Procedures were performed by 9 interventional radiologists with 2 years to > 20 years of attending physician experience. TIPS were created using 10-mm stent grafts (GORE VIATORR; W.L. Gore & Associates, Flagstaff, Arizona) (n = 103; 69%) or bare metal stents (WALLSTENT; Boston Scientific, Marlborough, Massachusetts) (n = 46; 31%). PSG was measured using a multi–side hole catheter or 10-F sheath and was defined as the direct portal vein pressure minus the right atrial pressure (11). PSG before TIPS was measured after successful attainment of portal venous access, and final PSG was obtained after TIPS creation; the targeted final PSG was < 12 mm Hg (12), with hemodynamic success defined as a PSG reduction meeting this threshold.

### Medical Chart Review

Electronic medical records were reviewed by a medical student research associate (J.D.M.) under the supervision of a Certificate of Added Qualification–licensed interventional radiologist with 8 years of attending physician experience (R.C.G.) to collect clinical, laboratory, and procedure data, including endoscopic information and PSG values. GV were categorized using the Sarin classification (13,14). Liver fibrosis was classified according to the METAVIR system (15).

**Table 1.** Study Population Features

| Measure | EV Group | GV Group | *P* Value |
|---|---|---|---|
| Number | 69 (46%) | 80 (54%) | — |
| Age, y | 52 ± 9 | 52 ± 11 | .699 |
| Sex | | | .182 |
| Male | 37 (54%) | 52 (65%) | |
| Female | 32 (46%) | 28 (35%) | |
| Ethnicity | | | .293 |
| White | 27 (39%) | 44 (55%) | |
| Hispanic | 25 (36%) | 21 (26%) | |
| African American | 11 (16%) | 11 (14%) | |
| Other | 6 (9%) | 4 (5%) | |
| Liver disease etiology | | | .387 |
| Alcohol | 22 (32%) | 21 (26%) | |
| Alcohol and HCV | 16 (23%) | 20 (25%) | |
| Alcohol, HCV, and HBV | 1 (1%) | 2 (3%) | |
| HCV | 11 (16%) | 14 (18%) | |
| HBV | 3 (4%) | 1 (1%) | |
| NASH | 6 (9%) | 5 (6%) | |
| Other* | 10 (15%) | 17 (21%) | |
| Fibrosis stage | | | .493 |
| 1 | 0 (0%) | 0 (0%) | |
| 2 | 3 (4%) | 2 (3%) | |
| 3 | 4 (6%) | 4 (5%) | |
| 4 | 9 (13%) | 17 (21%) | |
| Nonselective β-blocker use | | | .871 |
| Yes | 33 (48%) | 37 (46%) | |
| No | 36 (52%) | 43 (54%) | |
| MELD score | 19 ± 10 | 15 ± 6 | .009 |
| Child-Pugh score | 9 ± 2 | 8 ± 2 | .008 |
| Child-Pugh class† | | | .255 |
| A | 7 (10%) | 9 (11%) | |
| B | 31 (45%) | 46 (58%) | |
| C | 30 (44%) | 25 (31%) | |
| TIPS indication | | | .312 |
| Acute refractory bleeding | 47 (68%) | 48 (60%) | |
| Secondary prophylaxis | 22 (32%) | 32 (40%) | |
| Acute refractory bleeding‡ | | | .807 |
| Failure of endoscopic therapy | 9 (19%) | 10 (21%) | |
| Hemoglobin drop | 38 (81%) | 40 (83%) | |
| Transfusion ≥ 2 U PRBCs | 21 (45%) | 18 (38%) | |
| Need for vasopressor medications | 18 (38%) | 7 (15%) | |

Note–Values reported as mean ± SD or number (percent).
EV = esophageal varices; GV = gastric varices; HBV = hepatitis B virus; HCV = hepatitis C virus; MELD = Model for End-stage Liver Disease; NASH = nonalcoholic steatohepatitis; PRBCs = packed red blood cells; TIPS = transjugular intrahepatic portosystemic shunt.
*Includes autoimmune hepatitis or unknown causes of cirrhosis.
†One patient in EV group had missing data, precluding Child-Pugh score calculation.
‡Single patients may be represented in multiple categories.