

## MELD score can predict early mortality in patients with rebleeding after band ligation for variceal bleeding

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### Abstract

**AIM:** To investigate the outcomes, as well as risk factors for 6-wk mortality, in patients with early rebleeding after endoscopic variceal band ligation (EVL) for esophageal variceal hemorrhage (EVH).

**METHODS:** Among 817 EVL procedures performed for EVH between January 2007 and December 2008, 128 patients with early rebleeding, defined as rebleeding within 6 wk after EVL, were enrolled for analysis.

**RESULT:** The rate of early rebleeding after EVL for acute EVH was 15.6% (128/817). The 5-d, 6-wk, 3-mo, and 6-mo mortality rates were 7.8%, 38.3%, 55.5%, and 58.6%, respectively, in these early rebleeding patients. The use of beta-blockers, occurrence of hypovolemic

shock, and higher model for end-stage liver disease (MELD) score at the time of rebleeding were independent predictors for 6-wk mortality. A cut-off value of 21.5 for the MELD score was found with an area under ROC curve of 0.862 ( $P < 0.001$ ). The sensitivity, specificity, positive predictive value, and negative predictive value were 77.6%, 81%, 71.7%, and 85.3%, respectively. As for the 6-mo survival rate, patients with a MELD score  $\geq 21.5$  had a significantly lower survival rate than patients with a MELD score  $< 21.5$  ( $P < 0.001$ ).

**CONCLUSION:** This study demonstrated that the MELD score is an easy and powerful predictor for 6-wk mortality and outcomes of patients with early rebleeding after EVL for EVH.

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**Key words:** Model for end-stage liver disease score; Esophageal variceal hemorrhage; Rebleeding; Cirrhosis; Mortality

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### INTRODUCTION

Esophageal variceal hemorrhage (EVH) is a serious com-

plication of liver cirrhosis and causes 70% of all upper gastrointestinal bleeding episodes in patients with portal hypertension<sup>[1]</sup>. According to the Baveno Consensus Workshop in portal hypertension, endoscopic variceal band ligation (EVL) therapy is recommended for acute EVH, although endoscopic sclerotherapy may be used if ligation is technically difficult<sup>[2]</sup>. According to the natural course of EVH, the risk of a recurrent episode of EVH increases after the first EVH but becomes similar to non-bleeding esophageal varices (EV) after 6 wk<sup>[3]</sup>. Therefore, rebleeding within 6 wk after the first EVH is coined as early rebleeding. Secondary prophylaxis could reduce the early rebleeding rate to 20%<sup>[11]</sup>. Several factors have been identified as predictors of mortality after EVH, including early rebleeding, bacterial infection<sup>[4]</sup>, hepatic venous pressure gradient (HVPG) > 20 mmHg measured shortly after admission<sup>[5]</sup>, active bleeding at initial endoscopy, severity of initial bleeding, hematocrit level, AST levels, presence of portal vein thrombosis or of hepatocellular carcinoma (HCC), alcoholic liver disease, serum bilirubin and albumin levels, Child-Turcotte-Pugh (CTP) score<sup>[11]</sup>, and Model for End-stage Liver Disease (MELD) score<sup>[6-8]</sup>. Among these predictors, early rebleeding is the most important one<sup>[3,9]</sup>. However, little information is known about the risk factors for mortality in the group of patients with early rebleeding. Thus, the goal of this retrospective study was to investigate the predictive factors for mortality in patients with early rebleeding.

## MATERIALS AND METHODS

A total of 817 consecutive EVL procedures for esophageal variceal bleeding were recorded and evaluated in a 3500-bed tertiary referral medical center between January 2007 and December 2008. All of the patients with early rebleeding, defined as rebleeding between one day and 6 wk after ligation, were enrolled. The patients without endoscopic confirmation of rebleeding focus were excluded. The appropriately convened Institutional Review Board approved this study. Finally, 128 cirrhotic patients (15.6%) with early rebleeding were enrolled in our study. Among these patients, 49 patients who died within 6-wk after rebleeding were classified as the mortality group. The remaining 79 patients who survived more than 6 wk were classified as the survival group. The clinical characteristics and laboratory data of the patients in these 2 groups were collected for comparison. Vasoactive drug therapy (terlipressin, somatostatin, or octreotide) was routinely administered before diagnostic endoscopic examination and was continued for at least 3 d according to national insurance guidelines of Taiwan for variceal hemorrhage. Prophylactic antibiotic treatment with intravenous ceftriaxone and non-selective beta-blockers were prescribed for some, depending on the patients' clinical condition, contraindication, adverse effect with tolerability, and physician's preference. Diagnosis of liver cirrhosis was based on a previous liver biopsy or compatible clinical, laboratory, and imaging findings. Hepatocellular carcinoma (HCC) was diagnosed by liver biopsy, fine needle aspiration cytology, or com-

bined typical dynamic imaging appearance and elevated  $\alpha$ -fetoprotein (AFP). According to the tumor size, patients with HCC were divided into early (one nodule  $\leq$  5 cm or maximum three nodules, each < 3 cm) or advanced (one nodule > 5 cm or > 3 nodules). The diagnosis of infection was made by positive results of blood, sputum, urine, and ascites bacterial culture or elevated ascites fluid and absolute neutrophil count (ANC)  $\geq$  250 cells/ $\mu$ L. In addition, 6-wk mortality was defined as death occurring within 6 wk after rebleeding. The first EVL procedure applied to esophageal variceal bleeding during our study period was considered as the index EVL and index bleeding. The following definitions were used on the basis of the recommendations of the Baveno Consensus Workshop: (1) esophageal variceal bleeding: (a) visible oozing or spurting of blood from a esophageal varix, (b) white nipple sign or blood clot adherent to a varix, (c) presence of medium or large esophageal varices with no other potential bleeding lesion; (2) EVL ulcer bleeding: bleeding from esophageal ulcers after endoscopic EVL with one of the following: (a) active bleeding from the ulcer site, (b) adherent clot at the ulcer site, or (c) absence of other potential bleeding lesions; (3) bleeding duration: the acute bleeding episode was considered finished at the beginning of the first 24-h interval with no hematemesis, stable hemoglobin concentration without blood transfusions, and stable hemodynamic condition; (4) early rebleeding: recurrence of clinically significant hemorrhage (hematemesis/melena, aspiration of greater than 100 mL of fresh blood from nasogastric tube or > 3 g/dL decrease of Hb if no transfusion is given) within 6 wk after index bleeding episode was considered finished; (5) rebleeding 5-d failure: uncontrolled bleeding, death, or recurrent hemorrhage within 5 d since rebleeding; and (6) portal hypertensive gastropathy (PHG) bleeding: a macroscopic finding of a characteristic mosaic-like pattern of gastric mucosa with red-point lesions, cherry red spots, and/or black-brown spots (severe PHG) and the absence of other potential bleeding lesions.

## Statistical analysis

Statistical analysis was performed after proper tabulation of data. Continuous variables were expressed as mean with range, and categorical variables were expressed as count with percentage. Groups were compared using Student's software *t*-test for continuous variables and  $\chi^2$  test for categorical variables. Multivariate analysis was performed using logistic regression, and a receiver operating characteristic (ROC) curve was generated to assess the predictive accuracy of the variables. All of these values were considered statistically significant if the *P*-value was < 0.05. Cumulative survival estimates were calculated by using the Kaplan-Meier method. All statistical analyses were performed with SPSS statistical for Windows (Version 16; SPSS, Inc., Chicago, IL, USA).

## RESULTS

The relevant characteristics of these 128 rebleeding pa-

**Table 1** Characteristics of patients with rebleeding after endoscopic variceal band ligation for esophageal varices bleeding (mean  $\pm$  SD) *n* (%)

Variable	Overall ( <i>n</i> = 128)
Sex (male/female)	107 (83.6)/21 (16.4)
Age (yr)	53.6 $\pm$ 13.9
Etiology	
Virus	61 (47.7)
Alcohol	31 (24.2)
Virus + alcohol	28 (21.9)
Others	8 (6.2)
Index EGD finding	
Active EV bleeding	39 (30.5)
Blood in lumen	49 (38.3)
Clean	40 (31.2)
Duration between rebleeding and Index EVL	14.0 (10.8)
1-5 d	33 (25.8)
6-42 d	95 (74.2)
Index EVL	
CTP score	9.8 $\pm$ 2.3
CTP classification	
A	12 (9.40)
B	44 (34.4)
C	72 (56.2)
MELD	19.8 $\pm$ 8.9
Rebleeding	
CTP score	10.1 $\pm$ 2.6
CTP classification	
A	14 (10.9)
B	36 (28.1)
C	78 (60.9)
MELD	21.4 $\pm$ 9.8

EVL: Endoscopic variceal band ligation; EV: Esophageal varices; CTP: Child-turcotte-pugh; MELD: Model for end-stage liver disease; EGD: Esophago-gastroduodenoscopy.

tients are reported in Table 1. The mean age of the patients was 54 years old (range 14-82); 83.6% were male and 16.4% were female. The etiologies of liver cirrhosis were virus (47.7%), alcohol (24.2%), or combined virus and alcohol (21.9%). The endoscopic findings at index bleeding were active EV bleeding (30.5%), blood in the esophageal or gastric lumen (38.3%), and clean esophago-gastro-duodenal lumen (31.2%). The average interval between index EVL and rebleeding was 14  $\pm$  10.8 d. The average CTP scores at the time of index bleeding and rebleeding were 9.8  $\pm$  2.3 and 10.1  $\pm$  2.6, and the average MELD scores were 19.8  $\pm$  8.9 and 21.4  $\pm$  9.8, respectively.

The surveillance of rebleeding sites was carried out by upper GI endoscopy within 1 day for all enrolled patients; the rebleeding site, therapeutic methods, and outcomes are shown in Table 2. The surveillance revealed 75 patients with residual EV bleeding (58.6%), 24 patients with EVL-related esophageal ulcer bleeding (18.8%), 7 patients with gastric variceal bleeding (5.5%), 11 patients with peptic ulcer bleeding (8.6%), and 11 patients with PHG-related bleeding (8.6%). The management methods for rebleeding included combined endoscopic and pharmacologic therapy (71.9%) and pharmacologic therapy only for EVL ulcers or PHG with mild oozing (27.3%). Only one patient was treated with surgical intervention (0.8%). In total, 24 pa-

**Table 2** Rebleeding focus, therapy and outcome of patients with rebleeding after endoscopic variceal band ligation for esophageal varices bleeding *n* (%)

	Overall ( <i>n</i> = 128)
Rebleeding focus	
EV bleeding	75 (58.6)
Post-EVL ulcer bleeding	24 (18.8)
GV bleeding	7 (5.5)
Peptic ulcer bleeding	11 (8.6)
PHG	11 (8.6)
Therapy for rebleeding	
Endoscopic and pharmacologic therapy	92 (71.9)
Pharmacologic therapy only	35 (27.3)
Surgery	1 (0.8)
Rebleeding 5-d failure	24 (18.8)
Uncontrolled bleeding and died within 5 d	8 (6.3)
Died of non-bleeding cause	2 (1.6)
Recurrent bleeding within 5 d	14 (10.9)
5-d mortality	10 (7.8)
6-wk mortality	49 (38.3)
6-wk mortality causes	
Sepsis-induced multi-organ failure	26 (53.1)
GI bleeding	18 (36.7)
Liver failure	5 (10.2)
3-mo mortality	71 (55.5)
6-mo mortality	75 (58.6)

EV: Esophageal varices; EVL: Endoscopic variceal band ligation; GV: Gastric varices; PHG: Portal hypertensive gastropathy; GI: Gastrointestinal.

tients (18.8%) were associated with 5-d failure at rebleeding of which 8 patients had uncontrolled bleeding and died within 5 d, 2 patients died of other causes within 5 d, and 14 patients had recurrent bleeding within 5 d. The rebleeding mortality rates at 5 d, 6 wk, 3 mo, and 6 mo were 7.8%, 38.3%, 55.5%, and 58.6%, respectively. The causes of death within 6 wk after rebleeding were sepsis-induced multiple organ failure (53.1%), upper gastrointestinal tract hemorrhage (36.7%), and liver failure (10.2%).

We then further divided the patients into two groups according to their mortality or survival during the 6-wk period after rebleeding. The clinical characteristics of patients in the 6-wk mortality group and the survival group are displayed and compared in Table 3. There were no significant differences between these two groups with regard to gender, age, etiology of cirrhosis, HCC, PVT, duration between rebleeding and index EVL, rebleeding focus and treatment methods, antibiotic use, serum platelet count, and sodium and potassium level at rebleeding. However, higher CTP score (11.9 *vs* 8.9), higher MELD score (28.9 *vs* 16.8), and hypovolemic shock during rebleeding ( $P < 0.001$ ); higher serum total bilirubin, creatinine, and white cell count levels; lower serum albumin and hemoglobin levels; longer prothrombin time (INR) and active bleeding on endoscopy; and higher hepatic encephalopathy grade were markedly seen in the 6-wk mortality group. Beta-blocker use after rebleeding was also significantly associated with 6-wk mortality.

Furthermore, by multivariate logistic regression analysis, hypovolemic shock (OR = 9.25, 95% CI: 1.68-50.93,  $P = 0.011$ ), beta-blocker use after rebleeding (OR = 0.18, 95%

**Table 3** Variables associated with 6-wk mortality in patients with rebleeding after endoscopic variceal band ligation for esophageal varices bleeding (mean  $\pm$  SD) *n* (%)

Variable	6-wk mortality ( <i>n</i> = 49, 38.3%)	6-wk survival ( <i>n</i> = 79, 61.7%)	<i>P</i> -value
Sex (male/female)	40 (81.6)/9 (18.8)	67 (84.8)/12 (17.6)	0.637
Age (yr)	53.3 $\pm$ 13.3	53.7 $\pm$ 14.3	0.866
Etiology			0.683
Virus	23 (46.9)	38 (48.1)	
Alcohol	11 (22.4)	20 (25.3)	
Virus + alcohol	13 (26.5)	15 (19.0)	
Others	2 (4.1)	6 (7.6)	
HCC			0.291
No or small	29 (59.2)	54 (68.4)	
Advanced	20 (40.8)	25 (31.6)	
PVT			0.786
Main trunk	12 (24.5)	18 (22.8)	
Branch	5 (10.2)	9 (11.4)	
Duration between rebleeding and index EVL	12.8 $\pm$ 9.0	14.7 $\pm$ 11.7	0.528
1-5 d	13 (26.5)	20 (25.3)	0.879
6-42 d	36 (73.5)	59 (74.7)	
Rebleeding laboratory findings			
CTP score	11.9 $\pm$ 1.9	8.9 $\pm$ 2.3	0.000
CTP classification			
A	1 (2.0)	13 (16.5)	0.017
B	3 (6.1)	33 (41.8)	0.000
C	45 (91.8)	33 (41.8)	0.000
MELD score	28.9 $\pm$ 9.0	16.8 $\pm$ 7.0	0.000
HE (grade)	1.3 $\pm$ 1.5	0.3 $\pm$ 0.8	0.000
Cr ( $\mu$ mol/L)	203.3 $\pm$ 159.1	114.9 $\pm$ 97.2	0.000
Na (mmol/L)	138.7 $\pm$ 9.6	134.6 $\pm$ 14.3	0.084
K (mmol/L)	4.2 $\pm$ 1.0	3.9 $\pm$ 0.9	0.171
Bil ( $\mu$ mol/L)	263.3 $\pm$ 236.0	90.6 $\pm$ 135.1	0.000
Alb (g/L)	25 $\pm$ 5	29 $\pm$ 6	0.000
Hb (g/L)	83 $\pm$ 18	90 $\pm$ 17	0.041
WBC ( $10^9$ /L)	12.5 $\pm$ 6.4	8.2 $\pm$ 4.7	0.000
Platelets ( $10^9$ /L)	102.4 $\pm$ 69.2	101.0 $\pm$ 72.3	0.915
INR (PT)	2.2 $\pm$ 0.9	1.5 (0.4)	0.000
Rebleeding 5-d failure	18 (36.7)	6 (7.6)	0.000
Died within 5 d	10	0	0.000
Recurrent bleeding within 5 d	8	6	0.150
Hypovolemic shock	21 (42.9)	3 (3.8)	0.000
Rebleeding focus			0.500
EV bleeding	28 (57.1)	47 (59.5)	
Post-EVL ulcer bleeding	9 (18.4)	15 (19.0)	
GV bleeding	3 (6.1)	4 (5.1)	
Peptic ulcer bleeding	6 (12.2)	5 (6.3)	
PHG	3 (6.1)	8 (10.1)	
Rebleeding EGD finding			0.019
Active bleeding	20 (40.8)	30 (38.0)	
Blood in lumen	25 (51.0)	27 (34.2)	
Clean	4 (8.2)	22 (27.8)	
EGD Tx			0.716
Endoscopic therapy + medical	36 (73.5)	56 (70.9)	
Medical therapy only	13 (26.5)	22 (27.8)	
Surgery	0 (0.0)	1 (1.3)	
Rebleeding infection	42 (85.7)	36 (45.6)	0.000
Rebleeding antibiotic use	35 (71.4)	46 (58.2)	0.132
Rebleeding Inderal use	8 (16.3)	37 (46.8)	0.000

The *P*-values were calculated by using Student's *t*-test for continuous variables and  $\chi^2$  test for categorical variables. EV: Esophageal varices; EVL: Endoscopic variceal band ligation; HCC: Hepatocellular carcinoma; PVT: Portal vein thrombosis; CTP: Child-turcotte-pugh; MELD: Model for end-stage liver disease; INR (PT): International normalised ratio of a patient's prothrombin time to a normal control sample; PHG: portal hypertensive gastropathy; EGD: Esophagogastroduodenoscopy; GV: Gastric varices.

CI: 0.05-0.63, *P* = 0.007), and higher MELD score (OR = 1.17, 95% CI: 1.10-1.25, *P* < 0.001) at rebleeding were found to be independent factors for 6-wk mortality in these patients and this is reported in Table 4. The ROC curve

was used for predicting 6-wk mortality in cirrhotic patients with early rebleeding, and the area under ROC curve (AU-ROC) of the MELD score for predicting 6-wk mortality was 0.862 (95% CI: 0.80-0.93, *P* < 0.001). An optimized

**Table 4** Logistic regression models for variables associated with 6-wk mortality in patients with rebleeding after endoscopic variceal band ligation for esophageal varices bleeding

Variables	UV		MV			
	Estimate	P-value	Estimate	OR	95% CI	P-value
Rebleeding laboratory						
CTP score	0.61	< 0.001				
MELD score	0.17	< 0.001	0.16	1.17	1.10-1.25	< 0.001
HE (grade)	0.76	< 0.001				
Cr	0.61	0.001				
Bil	0.09	< 0.001				
Alb	-1.18	0.001				
Hb	-0.23	0.045				
WBC	0.15	< 0.001				
INR (PT)	1.85	< 0.001				
Rebleeding	1.96	< 0.001				
5-d failure						
Hypovolemic shock	2.94	< 0.001	2.23	9.25	1.68-50.93	0.011
Rebleeding	-1.47	0.011				
EGD finding						
Rebleeding	1.97	< 0.001				
infection						
Rebleeding	-1.51	0.001	-1.7	0.18	0.05-0.63	0.007
Inderal use						

UV: Univariate analysis; MV: Multivariate analysis; CTP: Child-turcotte-pugh; MELD: Model for end-stage liver disease; HE: Hepatic encephalopathy; INR (PT): International normalised ratio of a patient's prothrombin time to a normal control sample; EGD: Esophagogastroduodenoscopy.

cut-off value of the MELD score is 21.5. As shown in Table 5, the MELD score had a good sensitivity of 78%, specificity of 81%, positive predictive value (PPV) of 72%, and negative predictive value (NPV) of 85% for predicting 6-wk mortality. By the above analyses, a MELD score of  $\geq 21.5$  was subsequently chosen as the value for identifying patients with a high risk of death at 6 wk after rebleeding.

The Kaplan-Meier survival curves in patients classified according to a MELD score of  $< 21.5$  and  $\geq 21.5$  revealed a significant difference as shown in Figure 1. The mortality rate was 14.7% in patients with MELD  $< 21.5$  and 71.7% in patients with MELD  $\geq 21.5$  at 6 wk ( $P < 0.001$ ); 36% in patients with MELD  $< 21.5$  and 83% in patients MELD  $\geq 21.5$  at 3 mo ( $P < 0.001$ ); and 40% in patients with MELD  $< 21.5$  and 84.9% in patients MELD  $\geq 21.5$  at 6 mo ( $P < 0.001$ ), respectively.

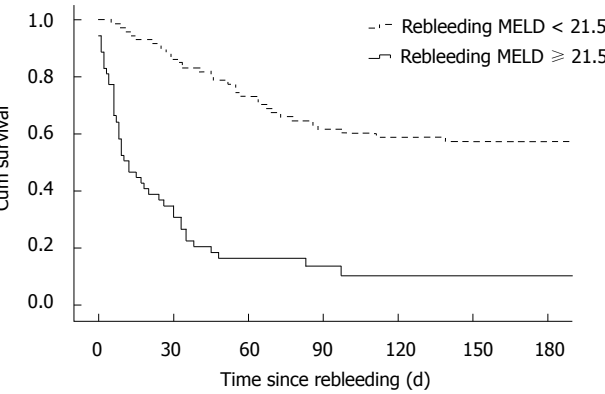
**DISCUSSION**

Our study has revealed that potential rebleeding sources in cirrhosis cases after index EVL for EVH were esophageal varices (58.6%), esophageal ulcer (18.8%), peptic ulcer (8.6%), PHG (8.6%), and gastric varices (5.5%). The results were consistent with a previous study<sup>[1]</sup> reporting that residual esophageal varices were a major source of rebleeding. In addition, beta-blocker usage after rebleeding, hypovolemic shock, and higher MELD score at the time of rebleeding were independent predictors of 6-wk mortality. In addition, we found that the 6-wk mortality rate was 14.7% for patients with MELD scores less than 21.5 and

**Table 5** Sensitivity, specificity, positive predictive value, and negative predictive value for predicting 6-wk mortality in patients with rebleeding after endoscopic variceal band ligation for esophageal varices bleeding *n* (%)

6-wk mortality	Sensitivity	Specificity	PPV	NPV
MELD score $\geq 21.5$	77.55	81.01	71.7	85.33
Hypovolemic shock (+)	42.86	96.20	87.5	26.92
Beta-blocker use after rebleeding	83.67	46.84	49.4	82.22

PPV: Positive predictive value; NPV: Negative predictive value; MELD: Model for end-stage liver disease.



**Figure 1** Kaplan-Meier survival curves in patients classified according to model for end-stage liver disease score  $< 21.5$  or  $\geq 21.5$  ( $P < 0.001$ ). MELD: Model for end-stage liver disease.

71.7% for patients with MELD scores more than 21.5.

The mortality rate within 6 wk in our study was 38.3%, which is higher than the mortality rate of patients after acute variceal bleeding<sup>[1,6]</sup>. This is probably because the patients with rebleeding after EVH were more advanced in disease severity than patients with initial acute EVH. This difference in severity could be reflected in the mean MELD score; the mean score was 21.4 in the rebleeding patients of our study group, higher than the group of acute variceal bleeding with a MELD score of 12 as previously reported<sup>[6]</sup>.

The presence of HCC could influence both early rebleeding and mortality in patients with EVH, as reported previously<sup>[11,10]</sup>. However, in the present study, advanced HCC and portal vein thrombosis were not predictors of 6-wk mortality, which is consistent with previous reports that advanced HCC is not an independent risk factor but MELD score is a good predictor for early mortality after EVH<sup>[11]</sup>.

Another independent factor associated with 6-wk mortality in our study was rebleeding related to hypovolemic shock. This observation was similar to previous studies that found that the severity of the hemorrhage was predictive of 6-wk mortality in acute EVH of all cirrhotic patients<sup>[1,6]</sup>. The third independent factor associated with 6-wk mortality was the use of beta-blockers, which reflected the general consensus that the use of beta-blockers for the secondary prevention of EVH could reduce mortality<sup>[12]</sup>. Overall, 49 patients (38.3%) died within 6 wk after early rebleeding;

among of them, 10 died within 5 d, and 39 died from day 6 to day 42. In our study, the causes of death were sepsis-related multiple organ failure (53.1%), GI bleeding-related complications (36.7%), and liver failure-related complications (10.2%); our results were similar to a recent study reporting that early mortality after cessation of initial EV bleeding is significantly associated with bacterial infection and rebleeding<sup>[13]</sup>. This finding provides evidence to support the AASLD guidelines for the treatment of acute variceal bleeding regarding the early use of pharmacological agents and emergent endoscopic procedure within 12 h<sup>[14]</sup>. Additionally, for reducing sepsis-related multi-organ failure, prophylactic use of antibiotics for all patients with cirrhosis and GI hemorrhage should be encouraged<sup>[2,15]</sup>. Patients with a CTP classification of A respond well to current therapies with minimal risk of death and represented only 2% of the patients in the 6-wk mortality group in our study. Whether current treatment recommendations should be applied to all patients should be further investigated<sup>[16]</sup>.

In conclusion, this study examined the focuses of rebleeding and treatment outcomes in cirrhotic patients with early rebleeding after EVL for acute EVH. Specifically, the study revealed that hypovolemic shock and MELD scores  $\geq 21.5$  at the time of rebleeding are predictors for 6-wk mortality in patients with early rebleeding after EVL for acute EVH. Also, beta-blocker use after rebleeding was associated with lower 6-wk mortality.

## COMMENTS

### Background

The management of variceal bleeding remains a clinical challenge with high mortality. At the present time, available treatments have reduced the 6-wk rebleeding rate to 20%. Early rebleeding is a strong predictor of death from variceal bleeding. Endoscopic therapy increases control of bleeding and decreases the risk of rebleeding and mortality. Despite the fact that endoscopic variceal ligation (EVL) is recommended for acute esophageal variceal bleeding in recent practice guidelines, there has been relatively little research investigating the situation of early rebleeding after EVL for esophageal variceal bleeding.

### Research frontiers

Currently, treatment recommendations are applied to all patients with variceal bleeding. At present, only 40% of deaths are directly related to bleeding, while the majority are caused by infection-related multiple organ failure that is paralleled with the severity of liver cirrhosis. Patients with Child-Pugh classification A have good response to current therapy, with a minimal risk of mortality. However, treatment strategies might be different with different Child-Pugh classification.

### Innovations and breakthroughs

This study provides evidence that there are independent predictors for 6-wk mortality and rebleeding origin in cirrhotic patients with early rebleeding after therapeutic endoscopic band ligation of initial esophageal varices bleeding.

### Applications

This article shows significantly less beta blocker use in the mortality group and recognizes this as an independent poor predictor. To prevent rebleeding with associated mortality, secondary prophylaxis with beta blockers should start as soon as possible from the day after stopping usage of vasoactive drugs. Furthermore, the authors demonstrate that Model for End-Stage Liver Disease (MELD) score is an easy and accurate predictor of 6-wk mortality of patients with early rebleeding after EVL for esophageal variceal bleeding. Accurate predictive rules are provided for early recognition of high risk patients.

### Terminology

The Model for End-Stage Liver Disease, or MELD, is a scoring system for assessing the severity of chronic liver disease. It was initially developed

to predict death within three months of surgery in patients who had undergone a transjugular intrahepatic portosystemic shunt procedure, and was subsequently found to be useful in determining prognosis and prioritizing for receipt of liver transplant instead of the older Child-Pugh score. MELD Score =  $[0.957 \times \ln(\text{Serum Cr}) + 0.378 \times \ln(\text{Serum Bilirubin}) + 1.120 \times \ln(\text{INR}) + 0.643] \times 10$ .

### Peer review

The manuscript is a well designed retrospective study with the aim to investigate the predictive factors for mortality in patients with early rebleeding.

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