PO Box 2345, Beijing 100023, China
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RAPID COMMUNICATION

Evaluation of the effects of combined endoscopic variceal ligation and splenectomy with pericardial devascularization on esophageal varices

Bo Liu, Mei-Hai Deng, Nan Lin, Wei-Dong Pan, Yun-Biao Ling, Rui-Yun Xu

Bo Liu, Mei-Hai Deng, Nan Lin, Wei-Dong Pan, Yun-Biao Ling, Rui-Yun Xu, Department of Hepatobiliary Surgery, Third Affiliated Hospital, Sun Yat-Sen University, Guangzhou 510630, Guangdong Province, China
Supported by the Foundation of Science and Technology Plan of Guangdong Province, China (No. 2004B35001007)
Correspondence to: Mei-Hai Deng, Department of Hepatobiliary Surgery, Third Affiliated Hospital, Sun Yat-Sen University, Guangzhou 510630, Guangdong Province, China. jakeliubo@gmail.com
Telephone: +86-20-85516867-2154 Fax: +86-20-34305271
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Abstract

AIM: To detect the hemodynamic alterations in collateral circulation before and after combined endoscopic variceal ligation (EVL) and splenectomy with pericardial devascularization by ultrasonography, and to evaluate their effect using hemodynamic parameters.

METHODS: Forty-three patients with esophageal varices received combined EVL and splenectomy with pericardial devascularization for variceal eradication. The esophageal vein structures and azygos blood flow (AZBF) were detected by endoscopic ultrasonography and color Doppler ultrasound. The recurrence and rebleeding of esophageal varices were followed up.

RESULTS: Patients with moderate or severe varices in the esophageal wall and those with severe peri-esophageal collateral vein varices had improvements after treatment, while the percentage of patients with severe para-esophageal collateral vein varices decreased from 54.49% to 2.33%, and the percentage of patients with detectable perforating veins decreased from 79.07% to 4.65% ($P < 0.01$). Color Doppler flowmetry showed a significant decrease both in AZBF (43.00%, $P < 0.05$) and in diameter of the azygos vein (28.85%, $P < 0.05$), while the blood flow rate was unchanged. The recurrence rate of esophageal varices was 2.5% (1/40, mild), while no re-bleeding cases were recorded.

CONCLUSION: EVL in combination with splenectomy with pericardial devascularization can block the collateral veins both inside and outside of the esophageal wall, and is more advantagious over splenectomy in combination with pericardial devascularization or EVL in preventing recurrence and re-bleeding of varices.

INTRODUCTION

In patients with portal hypertension, collaterals should be established to reduce the high portal pressure, and the hemodynamic indicators of such collaterals have been used for the evaluation of therapeutic effects. According to the location of veins, they can be divided into collateral veins inside and outside of the esophageal wall[1]. The collateral veins inside of the esophageal wall may form varices which can be evaluated by routine endoscopy, and are the major source of recurrent bleeding. The collateral veins outside of the esophageal wall, where hypoechic round spaces can be shown by endoscopic ultrasound (EUS), include peri-esophageal collateral veins (peri-ECVs), para-esophageal collateral veins (para-ECVs) and perforating veins. Peri-ECVs are adjacent to the esophageal wall while para-ECVs are distal to the esophageal wall, the perforating veins penetrate the esophageal wall connecting peri- or para-ECVs[2-5].

Irisawa *et al*[2-5] demonstrated that both the prevalences of perforating veins and severe peri-ECVs are positively correlated with the form of varices. The incidence of severe peri-ECVs, para-ECVs, and perforating veins in variceal recurrent cases is significantly higher than that in non- variceal recurrent cases (70%, 50% and 90% *vs* 3.6%, 32.1% and 21.4%, respectively)[6].

On the other hand, endoscopic Doppler ultrasound for measurement of azygos blood flow (AZBF) volume has been used widely in evaluation of the porto-systemic collateral circulation[7], and is a safe and useful method for monitoring portal venous flow in patients with portal hypertension.

It is reported that more than 70% of portal hypertension patients with variceal bleeding history may suffer from recurrent bleeding[8,9]. Splenectomy with pericardial devascularization, sclerotherapy, endoscopic variceal ligation (EVL) or other combined therapies have been recommended for those patients. We have previously reported that splenectomy with EVL is superior to splenectomy with pericardial devascularization in the treatment of portal hypertension[10-12]. However, whether combined EVL and splenectomy with pericardial devascularization is effective and the hemodynamic alterations in this process remain unknown.

In this study, we used EUS and color Doppler ultrasound to detect the hemodynamic alterations in collateral circulation before and after EVL in combination with splenectomy with pericardial devascularization. The hemodynamic parameters were used to evaluate its effect. An ultrasound microprobe (UMP) was adopted for the detection of collateral veins, which could provide better images of vascular structures than conventional EUS due to its higher frequency and resolution[3,13,14].

MATERIALS AND METHODS

Patients

From March 2001 to May 2004, consecutive patients with untreated esophageal varices caused by portal hypertension were admitted to the Third Affiliated Hospital of Sun Yat-Sen University. Patients who did not want to participate in the study, those with severe diseases in major organs other than in liver and/or older than 70 years, and those with different Child-Pugh's scores before and after all EVL sessions were excluded to avoid the influence of alterations of Child-Pugh's grade on the portal blood flow rate[5]. Finally, 43 patients who were clinically diagnosed as portal hypertension with endoscopically confirmed esophageal varices were included in this study. The clinical data of the enrolled patients are shown in Table 1.

Written informed consent was obtained from all the patients, and the study was approved by the Ethics Committee of Sun Yat-Sen University.

Ligation of endoscopic varices

Patients underwent EVL first. After local application of lidocaine, an endoscope (GIF 240 or 260, Olympus Optical, Tokyo) was introduced, and ligation was carried out 6-12 times by placing a single rubber band (Bard Interventional Products, Tewksbury, Mass.) over a varix. The ligation was repeated every 2 wk till the complete disappearance of varices under endoscope.

Splenectomy with pericardial devascularization

Patients underwent splenectomy with pericardial devascularization (Hassab's operation) 4-10 wk after the first EVL session as previously described by Yang and Qiu[15]. In brief, extended left subcostal incision or L incision of the left upper abdomen was used for extreme splenomegaly. After routine splenectomy, the gastric branch and 5-8 small branches of the gastric coronary veins were disconnected. The esophageal branch was disconnected and suture-ligated. The gastric posterior vein was ligated by suturing, and then the left subphrenic vein was ligated as well[16]. In addition, the arteries accompanying the veins including the left gastric, left gastroepiploic, gastric posterior and left subphrenic arteries, were disconnected.

Table 1 Clinical data on 43 patients undergoing endoscopic variceal ligation and splenectomy with pericardial devascularization

Sex	
M:F	28:15
Mean age ± SD (range) (yr)	50.8 ± 11.2 (20-66)
Etiology of liver cirrhosis	
Posthepatic	41
Schistosomiasis	1
Alcoholic	1
Liver function, Child-Pugh classification	
A	16
B	18
C	9
History of upper gastrointestinal bleeding	30

Color Doppler ultrasound

Color Doppler ultrasound detection was performed before the treatment and 1 wk prior to discharge. AZBF was measured with EUS duplex Doppler technique with a Pentax FG-32UA echo-endoscope (Tokyo, Japan) and a Hitachi EUB-515A ulterasound scanner (Tokyo, Japan) with a frequency of 7.5 MHz[17]. The diameter of the vessel and the blood velocity were measured, the mean value of 3 repeated measures performed at the same position was used. AZBF was calculated with the following formula: AZBF = $(\text{radius})^2 \times$ blood velocity.

Detection of the veins inside and outside of the esophageal wall

The structure of vessels inside and outside of the esophageal wall was examined before the treatment and 1 wk prior to discharge with an Olympus UM-3R 20MHz UMP (Tokyo, Japan) passed through the accessory channel of a GIF 250 Olympus endoscope (Tokyo, Japan). Before examination, the esophagus was filled with deaerated water through a water supply tube attached to the endoscope. The veins around the esophagus were scanned from the esophago-gastric junction (GEJ) to a point 5 cm proximal to the EGJ. Varices inside of the esophageal wall (EV) were evaluated as mild (< 5 mm in diameter), moderate (5-7 mm in diameter), and severe (> 7 mm in diameter).

According to the definition of location[3], esophageal collateral veins outside of the esophageal wall could be divided into peri-ECVs and para-ECVs. There were less than 4 mild peri-ECVs (< 2 mm in diameter) and more than 5 severe peri-ECVs (≥ 2 mm in diameter) adjacent to the muscularis externa of the esophagus, a few mild para-ECVs (< 5 mm in diameter) and severe para-ECV (≥ 5 mm in diameter) distal to the esophageal wall without contact with the muscular externa. The presentations of

Table 2 Alteration in varices inside and outside of the esophageal wall and formation of perforating veins (n = 43)

	Pre-treatment n (%)	Post-treatment n (%)
EV		
Mild	0 (0)	43 (100)
Moderate	26 (60.47)	0 (0)
Severe	17 (39.53)	0 (0)
Peri-ECVs		
Mild	13 (30.23)	43 (100)
Severe	30 (69.77)	0 (0)
Para-ECVs		
Mild	20 (46.51)	42 (97.67)
Severe	23 (53.49)	1 (2.33)
Perforating veins		
Detectable	34 (79.07)	2 (4.65)
Undetectable	9 (20.93)	41 (95.35)

EV: Varices inside of the esophageal wall; Peri-ECVs: Periesophageal collateral veins; Para-ECVs: Paraesophageal collateral veins.

perforating veins penetrating the esophageal wall which were connected either to peri-ECV or to para-ECV, were recorded.

Follow-up of patients

Endoscopic follow-up was performed every 12 wk after discharge of the patients. The degree of varices was evaluated at each follow-up.

Statistical analysis

Values were expressed as mean ± SD. Statistical analysis was performed using the statistical SPSS version 10.0. Differences in numerical variables between groups were analyzed with paired t test. Mann-Whitney test was used for the analysis of ranked data. Comparison of categorical data was performed by the chi square test. $P < 0.05$ (two-tailed test) was considered statistically significant.

RESULTS

Alterations in varices and perforating veins

Compared to pre-treatment, EV, peri- and para-ECV in varices as well as perforating veins were all improved after treatment. Patients with moderate or severe EV or severe peri-ECVs had improvement after treatment, while the percentage of patients with severe para-ECVs decreased from 54.49% to 2.33%, and the percentage of patients with detectable perforating veins decreased from 79.07% to 4.65% ($P < 0.01$, Table 2).

Alteration in appearance of UMP images

In the UMP images before treatment, enlarged tortuous varices were found inside of the esophageal wall, while many small vessels adjacent to the muscularis externa formed a venous plexus. After treatment, the anechoic areas inside and outside of the esophageal wall disappeared or remained only tiny, while the echo of mucosa and submucosa of the esophagus enhanced. The alteration in appearance of UMP images intuitively implied the improvement in varices after treatment (Figure 1).

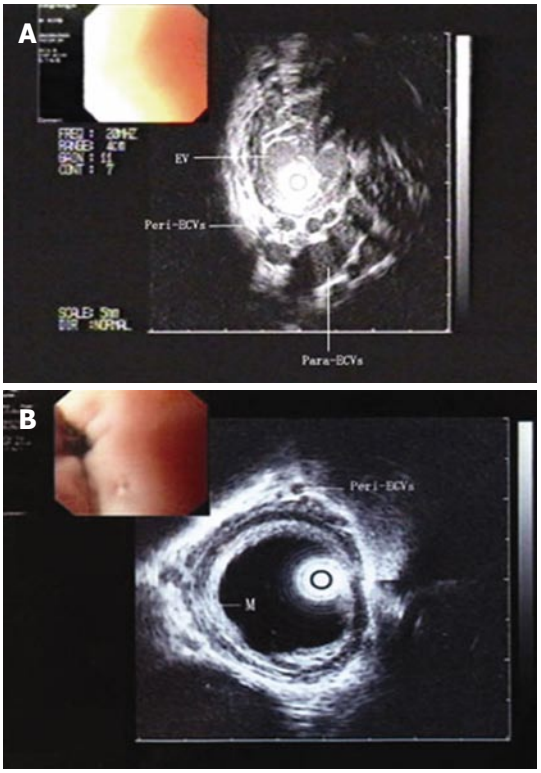

Figure 1 Alteration in appearance of ultrasound microprobe images. **A**: Before treatment, enlarged tortuous varices were found inside of the esophageal wall, while many small vessels adjacent to the muscularis externa formed a venous plexus. **B**: After treatment, anechoic areas inside and outside of the esophageal wall disappeared or remained only tiny, while the echo of mucosa and submucosa of the esophagus enhanced. EV: Varices inside of the esophageal wall; Peri-ECVs: periesophageal collateral veins; Para-ECVs: Paraesophageal collateral veins; M: Esophageal mucosa.

Table 3 Alteration in inside diameter, blood flow and blood flow rate of azygous vein (mean ± SD)

	Inside diameter (mm)	Blood flow (cm/s)	Blood flow rate (mL/s)
Pre-treatment	10.12 ± 1.16	1.00 ± 0.14	22.73 ± 5.46
Post-treatment	7.20 ± 1.13[b]	0.57 ± 0.05[b]	20.15 ± 4.66

[b]$P < 0.01$ *vs* pre-treatment group (ANOVA).

Alteration in azygos blood flow

Color Doppler flowmetry showed a significant decrease both in AZBF (43.00%, $P < 0.05$) and in diameter of the azygos vein (28.85%, $P < 0.05$), while the blood flow rate was uncharged (Table 3).

Results of follow-up

A total of 40 patients were followed up for 6 mo to 1 year, with a follow-up rate of 93.0%. Three patients were not followed up due to death (1 died of liver cancer, 2 died of other diseases). The recurrence rate of esophageal varices was 2.5% (1/40, mild), while no re-bleeding cases were recorded.

DISCUSSION

Although splenectomy with pericardial devascularization has been commonly used for portal hypertension and can control bleeding[15], re-bleeding is likely to occur because of the existing portal hyperdynamic pressure[18]. Varices cannot be eliminated by splenectomy with pericardial devascularization, and the unblocked blood flow in reverse direction in esophageal submucosa and muscular layer may increase the venous pressure at the distal part of stomach, which increases the risk of variceal bleeding.

EVL is a more effective method for portal hypertension with less side effects than surgery[19,20]. However, it causes fibrosis in mucous layer where the esophageal varices locate and has no effect on the formation of collateral circulations in the muscular layer or outside of the esophageal wall.

Nagamine *et al*[13] showed that after repeated EVL, almost all varices are undetectable in UMP imaging. However, neither collateral nor the azygous vein significantly changes its size. Similar results have been repeated by Seno *et al*[21].

In our study, not only varices were relieved, but also the sizes of collaterals and azygous vein were reduced after combined EVL and splenectomy with pericardial devascularization, suggesting that this combined therapy can almost completely relieve collateral vein varices both inside and outside of the esophageal wall.

In addition, more obvious improvement in collateral vein varices outside of the esophageal wall was found in peri-ECVs (the percentage of severe cases reduced from 69.77% to 0%) and perforating veins (the percentage of detectable cases reduced from 79.07% to 4.65%), suggesting that peri-ECVs play a more important role in the formation of esophageal varices than para-ECVs[3].

The incidence of varix and its recurrence observed in a short-term follow-up were low. However, the long-term results of the treatment in this study may be influenced by many factors, such as liver function, infection and food consumption. Therefore, the long-term effect of combined EVL and splenectomy with pericardial devascularization should be further studied.

In conclusion, combined EVL and splenectomy with pericardial devascularization can block the collateral veins both inside and outside of the esophageal wall and is more advantagious over splenectomy with pericardial devascularization or EVL in preventing recurrence and rebleeding of varices.

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