

## Two surgical procedures for esophagogastric variceal bleeding in patients with portal hypertension

Lin Yang, Li-Juan Yuan, Rui Dong, Ji-Kai Yin, Qing Wang, Tao Li, Jiang-Bin Li, Xi-Lin Du, Jian-Guo Lu

Lin Yang, Li-Juan Yuan, Rui Dong, Ji-Kai Yin, Qing Wang, Tao Li, Jiang-Bin Li, Xi-Lin Du, Jian-Guo Lu, Department of General Surgery, Tangdu Hospital of the Fourth Military Medical University, Xi'an 710038, Shaanxi Province, China

**Author contributions:** Yang L, Yuan LJ and Dong R contributed equally to this work; Yang L collected and analyzed the data, and drafted the manuscript; Yuan LJ designed and supervised the study; Dong R and Yin JK revised the manuscript for important intellectual content; Wang Q, Li T and Li JB offered the technical or material support; Du XL and Lu JG provided funding and administrative support; all authors have read and approved the final version to be published.

**Correspondence to:** Jian-Guo Lu, PhD, Department of General Surgery, Tangdu Hospital of the Fourth Military Medical University, No. 1 Xinsi Road, Xi'an 710038, Shaanxi Province, China. [lujguo@fmmu.edu.cn](mailto:lujguo@fmmu.edu.cn)

Telephone: +86-29-84777431 Fax: +86-29-84777431

Received: August 16, 2013 Revised: October 16, 2013

Accepted: November 1, 2013

Published online: December 28, 2013

### Abstract

**AIM:** To determine the clinical value of a splenorenal shunt plus pericardial devascularization (PCVD) in portal hypertension (PHT) patients with variceal bleeding.

**METHODS:** From January 2008 to November 2012, 290 patients with cirrhotic portal hypertension were treated surgically in our department for the prevention of gastroesophageal variceal bleeding: 207 patients received a routine PCVD procedure (PCVD group), and 83 patients received a PCVD plus a splenorenal shunt procedure (combined group). Changes in hemodynamic parameters, rebleeding, encephalopathy, portal vein thrombosis, and mortality were analyzed.

**RESULTS:** The free portal pressure decreased to  $21.43 \pm 4.35$  mmHg in the combined group compared with  $24.61 \pm 5.42$  mmHg in the PCVD group ( $P < 0.05$ ). The changes in hemodynamic parameters were more

significant in the combined group ( $P < 0.05$ ). The long-term rebleeding rate was 7.22% in the combined group, which was lower than that in the PCVD group (14.93%), ( $P < 0.05$ ).

**CONCLUSION:** Devascularization plus splenorenal shunt is an effective and safe strategy to control esophagogastric variceal bleeding in PHT. It should be recommended as a first-line treatment for preventing bleeding in PHT patients when surgical interventions are considered.

© 2013 Baishideng Publishing Group Co., Limited. All rights reserved.

**Key words:** Comparative study; Portal hypertension; Splenorenal shunt; Devascularization; Esophagogastric variceal bleeding

**Core tip:** A comparison of two surgical techniques for esophagogastric variceal bleeding in patients with cirrhotic portal hypertension was performed. Pericardial devascularization and shunt are the main surgical strategies for the prevention of esophagogastric variceal bleeding in patients with portal hypertension (PHT). In this study, we found that devascularization plus splenorenal shunt was an effective and safe strategy for controlling esophagogastric variceal bleeding in PHT patients. This surgical technique should be recommended as a first-line treatment for the prevention of bleeding in PHT patients when surgical interventions are considered.

Yang L, Yuan LJ, Dong R, Yin JK, Wang Q, Li T, Li JB, Du XL, Lu JG. Two surgical procedures for esophagogastric variceal bleeding in patients with portal hypertension. *World J Gastroenterol* 2013; 19(48): 9418-9424 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v19/i48/9418.htm> DOI: <http://dx.doi.org/10.3748/wjg.v19.i48.9418>

## INTRODUCTION

In China, portal hypertension (PHT) is a major health threat in patients with hepatitis-related cirrhosis. PHT usually leads to multiple complications including splenomegaly, ascites, hepatorenal syndrome, encephalopathy, and even variceal hemorrhage. Of these complications, the main complication associated with mortality risk is variceal hemorrhage, along with a high rate of recurrence<sup>[1]</sup>. Variceal hemorrhage develops in half of patients with cirrhosis, and bleeding occurs in approximately 20%. Patients with large varices have a 30% risk of bleeding over 2 years<sup>[2]</sup>. The risk of rebleeding without intervention is 65% over 2 years<sup>[3,4]</sup>. Although 70%-80% patients can be treated effectively with a non-cardioselective  $\beta$ -blocker and band ligation, 20%-30% of them will fail in such treatment and require further therapy<sup>[2]</sup>. In recent years, with the advent of alternative treatments, particularly the widespread use of endoscopy and transjugular intrahepatic portosystemic shunt (TIPS), the use of surgery in the acute management of active variceal bleeding has decreased<sup>[5]</sup>.

Although the results of endoscopic procedures are satisfactory, the rate of hemostasis failure is almost 10%-20%, and mortality is approximately 60% if a second unsuccessful endoscopic treatment is performed without further intervention<sup>[6,7]</sup>. TIPS is currently one of the most commonly used therapies to decrease the free portal pressure (FPP) and stop bleeding. Although the rate of encephalopathy is higher (30%) with a high mortality rate<sup>[8,9]</sup>, it results in better control of rebleeding, but no change in mortality<sup>[2]</sup>. TIPS is also a useful method for patients who are immediate candidates for liver transplantation, which is the only treatment to significantly prolong long-term survival in patients with cirrhosis.

However, in China, the majority of patients with refractory variceal bleeding do not have the opportunity of liver transplantation due to the high cost and a shortage of donor livers. Moreover, there are many patients with Child-Pugh class A disease who may not require transplantation for many years and TIPS is not recommended. Thus, in these cases, surgical intervention is necessary, and may be the only effective treatment to control rebleeding. Devascularization and shunts are two widely accepted surgical techniques for the management of portal hypertension. Although pericardial devascularization (PCVD) and the shunt procedure have their advantages, they also have disadvantages, such as a significant rebleeding rate following PCVD and a high encephalopathy rate following shunt procedures<sup>[10-12]</sup>.

Hence, over the last two decades, we have performed a new combined operation (splenorenal shunt plus devascularization) to manage variceal esophageal bleeding resulting from portal hypertension secondary to cirrhosis. The aim of this operation is to combine the advantages of devascularization and the shunt, and to reduce the disadvantages of both techniques. In addition, we aimed to identify a more suitable treatment for those

patients who have no other conditions or are unsuitable for liver transplantation or TIPS.

## MATERIALS AND METHODS

### *Patients and exclusion criteria*

From January 2008 to November 2012, 290 patients with PHT secondary to cirrhosis were hospitalized in our department. The patients were divided into two groups who received either the combined operation of PCVD and splenorenal shunt or PCVD only for esophageal and gastric varices. Exclusion criteria for the combined group were as follows: (1) thrombosis of the splenic vein; (2) the splenic vein was not suitable for a shunt; (3) extensive bleeding in the upper digestive tract associated with poor liver condition; (4) FPP lower than 30 mmHg after splenectomy; (5) patients with Child-Pugh class B or less, and poor condition; (6) regional portal hypertension; and (7) emergency surgery. Otherwise, patients received the combined operation. However, the final decision was often made during surgery.

Portal hypertension was due to liver cirrhosis in all patients, and these patients underwent routine preoperative clinical, biochemical and radiological evaluations, computed tomography scanning, and endoscopy. Prior to surgery, all patients were grouped according to Child-Pugh classification.

### *PCVD*

PCVD was carried out using the modified Hassab procedure<sup>[13]</sup> first described by Qiu<sup>[10]</sup>. Briefly, we made a left transabdominal incision, and after the abdomen was opened, we measured the FPP *via* catheterization of the right gastroepiploic vein, and performed a splenectomy and PCVD. We used sequential ligation to devascularize the upper two-third vessels of both the lesser and greater curvatures of the stomach, including the left gastroepiploic vein, short gastric vein, and left gastric vein. The retrogastric venous collaterals running from the upper border of the pancreas to the gastroesophageal junction were meticulously divided and ligated. The lower 5 cm of the esophagus was devascularized *via* the transhiatal approach by sequential ligation.

### *PCVD plus a splenorenal shunt*

In the combined group, after the PCVD was performed, a modified proximal splenocaval shunt was carried out. The tail and body of the pancreas, and the splenic vein and tributaries were carefully dissociated and placed to the right *via* the transverse mesocolon. The splenic vein was dissociated to a length of 2-3 cm and the infrarenal inferior vena cava was freed to a length of 4-5 cm for the preparation of a splenocaval anastomosis, and the splenocaval shunt was then performed. The diameter of the anastomotic stomas ranged from 6 to 8 mm, and the tail of the pancreas was fixed to the connective tissue surrounding the inferior vena cava to reduce the tension

**Table 1 Clinical characteristics**

Characteristics	PCVD group (n = 207)	Combined group (n = 83)
Mean age (yr)	45.79	43.72
SD	11.35	8.03
Range	17-77	30-63
Gender		
Male	130	55
Female	77	28
Etiology		
HBV-related	142	58
HCV-related	28	10
HBV and HCV	3	1
Other causes	14	4
Alcohol-related	20	10
Child-Pugh		
Grade A	134	73
Grade B	67	10
Grade C	6	0
Grade of varices		
Grade I - II	41	15
Grade III - IV	143	56
Bleeding site		
Esophageal	55	25
Fundus varices	10	6

PCVD: Pericardial devascularization; HBV: Hepatitis B virus; HCV: Hepatitis C virus.

of the anastomotic stoma. During both operations, the FPP was measured *via* the right gastroepiploic vein after opening the abdomen, ligation of the splenic artery, removal of the spleen, and PCVD, respectively. The FPP was also measured in the combined group after the shunt procedure.

All patients underwent color Doppler ultrasound before and after the operation to measure the portal and splenic vein diameters, maximum velocity, flow direction, and to determine the presence of thrombosis in the portal system. A follow-up visit was scheduled after the patients were discharged from hospital. The postoperative mortality (defined as death in the perioperative period), the rate of complications, the incidence of rebleeding, the rate of encephalopathy, and survival were recorded.

### Statistical analysis

The data were analyzed by SPSS 19.0 statistical software. All results are presented as mean  $\pm$  SD. The Mann-Whitney *U* test and the  $\chi^2$  test were used appropriately. The Kaplan-Meier method (log rank test) was used to analyze long-term complications appropriately.  $P < 0.05$  was considered statistically significant. This study was exempt from IRB review after institutional IRB review.

## RESULTS

### Clinical characteristics

Patient age, sex ratio and Child-Pugh classification were statistically similar between the two groups ( $P > 0.05$ ). Of 290 patients, 207 underwent PCVD, and the remaining 83 patients underwent the combined operation. No emergency surgery was carried out in either of the two

**Table 2 Intra- and post-operative clinical characteristics n (%)**

Clinical characteristics	PCVD group	Combined group	P value
Intraoperative			
Operative time (min)	246 $\pm$ 71	307 $\pm$ 68	< 0.01
Blood loss (mL)	936 $\pm$ 1627	744 $\pm$ 832	< 0.01
Blood transfusion (mL)	843 $\pm$ 1237	760 $\pm$ 583	0.010
Postoperative			
Fever	56	10	< 0.01
Ascites	941 $\pm$ 833	759 $\pm$ 695	0.24
Rebleeding	12 (5.80%)	2 (2.41%)	0.04
Long-term complications			
Congestive gastropathy	35 (17.41%)	2 (2.41%)	< 0.01
Encephalopathy	3 (1.45%)	2 (2.41%)	0.58
Portal vein thrombosis	16 (7.96%)	3 (3.61%)	0.04
Rebleeding	30 (14.93%)	6 (7.22%)	< 0.05

PCVD: Pericardial devascularization.

groups (Table 1).

### Hemorrhage during the operation and operation time

During the operation, the average blood loss in the PCVD group was 936  $\pm$  1627 mL compared with 744  $\pm$  832 mL in the combined group ( $P < 0.05$ ). Moreover, the operation time was significantly shorter in the PCVD group compared with the combined group (246  $\pm$  71 min *vs* 307  $\pm$  68 min,  $P < 0.05$ ) (Table 2).

### Complications in the perioperative period

In the perioperative period, the main complications were ascites and postoperative fever. After surgery, there were no significant differences in the mean amount of postoperative ascites, which was 941  $\pm$  833 mL in the PCVD group and 759  $\pm$  695 mL in the combined group (Table 2). However, the incidence of postoperative fever in the PCVD group (27.86%, 56 of 201 patients) was significantly higher than that in the combined group (12.04%, 10 of 83 patients) ( $P < 0.05$ ) (Table 2).

### Changes in free portal pressure

In both groups, the postoperative free portal pressure (FPP) was significantly lower than that preoperatively ( $P < 0.01$ ). However, there was no difference in the first measured FPP at abdominal opening, 29.23  $\pm$  4.58 mmHg in the PCVD group *vs* 29.81  $\pm$  3.83 mmHg in the combined group. However, after PCVD and shunt surgery, a significant decrease in the combined group (21.43  $\pm$  4.35 mmHg) was observed compared to the PCVD group (24.61  $\pm$  5.42 mmHg) ( $P < 0.01$ ) (Table 3).

### Changes in hemodynamic parameters

Hemodynamic parameters of the portal vein (PV) were measured preoperatively and postoperatively (Table 4). There were no significant differences in the inner diameter, blood flow velocity and venous flow preoperatively, however, significant changes were found after surgery. In the PCVD group and the combined group, the postoperative inner diameter, blood flow velocity and venous flow of the PV were significantly decreased ( $P < 0.01$ ),

**Table 3** Changes of free portal pressure in the two groups (mmHg)

	PCVD group	Combined group	Z	P value
Abdominal opening	29.23 ± 4.58	29.81 ± 3.83	-0.36	0.72
Splenectomy	22.32 ± 5.33	24.60 ± 5.01	-2.91	< 0.05
PCVD	24.61 ± 5.42	22.06 ± 4.03	-3.08	< 0.05
Shunt		21.43 ± 4.35		

PCVD: Pericardial devascularization.

and the *D* values were also significantly different ( $P < 0.01$ ), respectively. Similar results for the splenic vein (SV) and the superior mesenteric vein (SMV) are also shown in Table 4.

### Rebleeding rate

The postoperative rebleeding rates in the PCVD and combined groups were 5.80% (12/207) and 2.41% (2/83), respectively. In the PCVD group, 10 of 12 patients had bleeding before the operation. Compared with the PCVD group, 2 patients had preoperative bleeding in the combined group (Table 2). The data in Table 2 also show the long-term results of rebleeding. In the 284 survived patients (6 died in the perioperative period), the overall incidence of rebleeding in the PCVD group and combined group was 14.93% (30/201) and 7.22% (6/83), respectively ( $P < 0.05$ ). Twenty-one of 30 patients in the PCVD group had postoperative rebleeding, and 23 patients had preoperative bleeding, while 6 patients in the combined group had either preoperative bleeding or postoperative rebleeding.

### Long-term results of complications

The incidence of congestive gastropathy in the PCVD group was 17.41% (35/201), which was significantly higher than that in the combined group, with only 2 patients (2.41%) affected ( $P < 0.05$ ). The main long-term liver disease-related complications were encephalopathy and thrombosis. The incidence of encephalopathy was 1.45% (3/201) and 2.41% (2/83) in the PCVD group and combined group, respectively ( $P = 0.58$ ). In each group, one patient died of progressive liver failure at 10 mo postoperatively due to severe encephalopathy. Portal vein thrombosis was found in 16 (7.96%) patients in the PCVD group and 3 (3.61%) patients in the combined group ( $P = 0.04$ ), (Table 2).

### Postoperative mortality and survival

As a result of the small number of deaths in both groups, we analyzed the cause of death and did not use statistical methods to evaluate mortality and survival. In contrast to the combined group with no death during the perioperative period, 6 of the 207 patients in the PCVD group died during the perioperative period. Two of these patients died due to rebleeding, 3 due to hepatic failure, and one due to multiple system organ failure (MSOF) caused by gastric fistula. The 3-year survival rate was 95.52% (192/201) in the PCVD group, 2 died

due to rebleeding, 3 due to hepatic failure, 2 due to primary hepatic cancer, 1 due to cerebral hemorrhage, and 1 due to other reasons. The 3-year survival rate in the combined group was 96.39% (80/83), 1 died due to hepatic failure, 1 due to primary hepatic cancer, and 1 due to other reasons.

## DISCUSSION

The main aims of the treatments used in PHT patients are to control variceal bleeding and to prevent rebleeding. In addition, it is necessary to maintain enough portal hepatopetal perfusion and protect the limited liver function. In China, PCVD and distal splenorenal shunt are favored and widely accepted by surgeons, and have prevailed until now. Although these two favorable procedures are based on two different hemodynamic theories, they achieve reliable effects by controlling variceal bleeding. However, a high rebleeding rate caused by recurrent varices or a high rate of residual varices and changes in the gastric mucosa following PCVD have been observed<sup>[14-16]</sup>. In addition, it was reported that the shunt can preserve hepatopetal perfusion to support liver function and improve the microcirculation of gastric mucosa<sup>[17-19]</sup>, however, the incidence of hepatic encephalopathy needs to be reduced.

Thus, in order to combine the advantages of these two operations, we integrated these two different surgical procedures into one operation. Although there are limited reports on this combined operation, a comprehensive analysis is needed to prove its rationality. In this study, we retrospectively analyzed clinical data to determine the clinical value of the combined procedure in patients with cirrhotic portal hypertension and variceal bleeding. A total of 290 patients with portal hypertension of cirrhotic origin were enrolled in this study and received either PCVD only or the combined operation, respectively.

The primary end point of this study was variceal rebleeding. According to reports in the literature, the rebleeding rate of patients who underwent devascularization was 7.1%-37%<sup>[20-22]</sup>, and following distal splenorenal shunt the rebleeding rate was approximately 5%-15%<sup>[2,22-25]</sup>. In China, the rebleeding rate after prolonged follow-up in patients who underwent the combined operation was 5%-10%, in contrast to 10%-30% in patients who underwent PCVD<sup>[26-29]</sup>. Furthermore, after the PCVD procedure, the postoperative venous pressure in the gastric wall increased and exacerbated pathologic changes and congestive conditions in the gastric mucosa, therefore increasing the risk of congestive gastropathy. It has been reported that the rate of postoperative rebleeding caused by congestive gastropathy is 20%-83%<sup>[21,30,31]</sup>. However, the rates of rebleeding and the incidence of congestive gastropathy in our study were lower than those reported in the literature. In addition, the rebleeding rate in our combined group was significantly lower than that following TIPS which was reported to be 10.5%<sup>[2]</sup>.



**Table 4** Comparison of hemodynamics in the two groups pre- and post-operatively

		Inner diameter (cm)				Blood flow velocity (cm/s)			
		Pre-op	Post-op	D value	P value	Pre-op	Post-op	D value	P value
PV	PCVD	1.42 ± 0.21	1.24 ± 0.26	0.15 ± 0.17	< 0.01	15.28 ± 4.69	13.27 ± 4.76	2.01 ± 3.01	< 0.01
	Combined	1.39 ± 0.26	1.01 ± 0.30	0.38 ± 0.25	< 0.01	16.52 ± 4.67	11.33 ± 3.78	5.19 ± 3.42	< 0.01
	P	0.57	< 0.01	< 0.01		0.06	< 0.05	< 0.01	
SV	PCVD	1.21 ± 0.24	1.05 ± 0.21	0.18 ± 0.13	< 0.01	17.65 ± 5.53	14.10 ± 5.58	3.55 ± 0.92	< 0.01
	Combined	1.25 ± 0.22	0.81 ± 0.22	0.43 ± 0.20	< 0.01	18.76 ± 5.76	13.10 ± 5.38	5.65 ± 3.00	< 0.01
	P	0.25	< 0.01	< 0.01		0.17	0.21	< 0.01	
SMV	PCVD	0.95 ± 0.70	0.81 ± 0.21	0.14 ± 0.17	< 0.01	13.17 ± 4.61	11.00 ± 4.76	2.13 ± 2.33	< 0.01
	Combined	0.92 ± 0.19	0.66 ± 0.23	0.26 ± 0.27	< 0.01	14.69 ± 5.23	10.40 ± 4.46	4.29 ± 3.07	< 0.01
	P	0.3	< 0.01	< 0.01		< 0.05	0.33	< 0.01	

PV: Portal vein; SV: Splenic vein; SMV: Superior mesenteric vein; PCVD: Pericardial devascularization.

The lower rebleeding rate and incidence of gastropathy in the combined group resulted from the following mechanisms. First, it has been demonstrated that extensive PCVD of at least 6–8 cm under the mediastinal esophagus and the dissociation of the uppermost gastric vessels<sup>[32]</sup> are necessary for the disappearance of esophageal varices<sup>[33]</sup>. Second, congestive gastropathy can be attenuated by an effective shunt, which can reduce the blood flow to the gastroesophageal mucosa and improve mucosal microcirculation in the stomach. Third, portal hypertension is relieved to some extent after splenocaval shunt surgery, and this may delay the reformation of gastroesophageal varices.

The changes in FPP and hemodynamics in the present study had significant clinical implications. In both groups, the postoperative FPP decreased significantly, however, in the PCVD group, it was still higher than normal. The postoperative FPP in patients who underwent the combined procedure decreased to a normal level. Furthermore, we also found that in both groups the PV, SV, and SMV parameters after the treatments were lower than preoperative levels. However, these changes were more significant in the combined group. These findings suggested that: (1) the combined operation efficiently reduced hypertensive congestion in the portal system; (2) a splenorenal shunt reduced the FPP more and markedly decreased hypertensive congestion in the portal system, and the combined procedure maintained PV patency and prevented a significant decrease in the pressure and blood flow of the PV; (3) the combined operation not only decreased PVF, but also resulted in good control of rebleeding. However, PCVD alone did not achieve control of rebleeding; (4) the postoperative FPP was normal in the combined group, and may have contributed to the complementary action of the hypotensive effect of the shunt and the hypertensive effect of PCVD; and (5) a significant decrease in the postoperative inner diameter and blood flow velocity in the combined group indicated that the PCVD plus shunt resulted in better hemodynamics.

These changes in hemodynamics may also maintain blood flow to the liver and prevent hepatic failure. Therefore, in our combined procedure we restricted the anastomotic stoma to maintain the hemodynamics in the

appropriate range. Our historical experience showed that if we restricted the stoma more than 1.0 cm the FPP would decrease faster following PCVD, and the stoma would diminish due to an excessive drop in the FPP. In our department, we restrict the anastomotic stoma to 6–8 mm. This procedure also reduces the rate of encephalopathy. Based on previous experience, all types of shunts have been shown to have high encephalopathy rates due to a sharp drop in the PV and a reduction in portal pressure. In our study, the rate of encephalopathy in the two groups was similar, indicating that PCVD plus shunt did not increase the risk of encephalopathy.

During both procedures, splenectomy was performed in all patients due to splenomegaly associated with hypersplenism. However, after surgery the platelet count was elevated, which resulted in a high-coagulation status and injury to the inner mucosa of vessels, and blood flow velocity was reduced. As a result, thrombosis occurred in the portocaval stoma and portal vein. The rate of thrombosis is an important prognostic factor in patients with portal hypertension and cirrhosis. In our future studies, more effective efforts will be made to prevent thrombosis.

According to the results from our study, we can conclude that splenorenal shunt plus devascularization is an effective choice in patients with esophagogastric variceal bleeding due to PHT. The clinical characteristics in the combined group were better than those in the PCVD group. Although the surgical risk in the combined group was equal to the PCVD group, the combined procedure resulted in a lower rate of complications. Furthermore, the combined procedure maintained liver function, which is beneficial in patients who may have the opportunity of future liver transplantation.

In the present study, we compared the outcomes following treatment with PCVD and the combined operation. We hope that a comparative study of this combined procedure and other treatments in cirrhotic PHT patients can be carried out in the future.

## ACKNOWLEDGMENTS

We thank the clinicians and other hospital staff in the Department of General Surgery of Tangdu Hospital for

their support of this research.

## COMMENTS

### Background

In China, portal hypertension (PHT) is a major threatening event due to hepatitis-related cirrhosis. In recent years, with the advent of alternative treatments, the role of surgery in the acute management of active variceal bleeding caused by PHT has decreased. However, devascularization and shunts are still two widely accepted surgeries for the management of portal hypertension. In this study, the authors investigated the clinical value of a splenorenal shunt plus pericardial devascularization (PCVD) in PHT patients with variceal bleeding.

### Research frontiers

Liver transplantation is the major treatment for portal hypertension and upper gastrointestinal bleeding; however, due to the shortage of liver source and high cost, it is not acceptable extensively. It is important to find an effective method to control the complication of portal hypertension and prolong the survival time of the patients.

### Innovations and breakthroughs

The authors performed a combined operation (devascularization plus splenorenal shunt) over the past two decades to manage variceal esophageal bleeding which results from the portal hypertension secondary to cirrhosis. They evaluated the clinical value of this combined surgery, and found that the devascularization plus splenorenal shunt is an effective and safe strategy to control esophagogastric variceal bleeding in PHT patients. It is superior to the traditional surgeries.

### Applications

The devascularization plus splenorenal shunt is an effective and safe strategy to control esophagogastric variceal bleeding in PHT patients. It could be recommended as a first-line treatment for preventing bleeding in PHT patients when surgical interventions are considered.

### Terminology

In the combined group, after the splenectomy and PCVD, a modified proximal splenocaval shunt was performed. The tail and body of the pancreas, and the splenic vein and tributaries were carefully dissociated and were turned right via the transverse mesocolon. The splenic vein was dissociated to a length of 2-3 cm and the infrarenal inferior vena cava was freed to a length of 4-5 cm for the preparation of a splenocaval anastomosis, and then the splenocaval shunt was performed. The diameter of the anastomotic stomas ranged from 6 to 8 mm, and the tail of the pancreas was fixed to the connective tissue surrounding the inferior vena cava to reduce the tension of the anastomotic stoma.

### Peer review

This is a very interesting topic and has puzzled the surgeons for many decades. It still remains controversial in China. The authors investigated the surgical outcomes of patients with PHT who underwent PCVD alone or splenorenal shunt plus PCVD. They conclude that the devascularization plus splenorenal shunt is an effective and safe strategy to control esophagogastric variceal bleeding in PHT patients. Strengths of the study are the large number of cases, good follow-up and excellent annotation with clinical data.

## REFERENCES

- 1 Roberts LR, Kamath PS. Pathophysiology and treatment of variceal hemorrhage. *Mayo Clin Proc* 1996; **71**: 973-983 [PMID: 8820773 DOI: 10.1016/S0025-6196(11)63772-5]
- 2 Henderson JM, Boyer TD, Kutner MH, Galloway JR, Rikkers LF, Jeffers LJ, Abu-Elmagd K, Connor J. Distal splenorenal shunt versus transjugular intrahepatic portal systematic shunt for variceal bleeding: a randomized trial. *Gastroenterology* 2006; **130**: 1643-1651 [PMID: 16697728 DOI: 10.1053/j.gastro.2006.02.008]
- 3 D'Amico G, De Franchis R. Upper digestive bleeding in cirrhosis. Post-therapeutic outcome and prognostic indicators. *Hepatology* 2003; **38**: 599-612 [PMID: 12939586 DOI: 10.1053/jhep.2003.50385]
- 4 Sharara AI, Rockey DC. Gastroesophageal variceal hemorrhage. *N Engl J Med* 2001; **345**: 669-681 [PMID: 11547722 DOI: 10.1056/NEJMr003007]
- 5 Bari K, Garcia-Tsao G. Treatment of portal hypertension. *World J Gastroenterol* 2012; **18**: 1166-1175 [PMID: 22468079 DOI: 10.3748/wjg.v18.i11.1166]
- 6 Poza Cordon J, Froilan Torres C, Burgos García A, Gea Rodríguez F, Suárez de Parga JM. Endoscopic management of esophageal varices. *World J Gastrointest Endosc* 2012; **4**: 312-322 [PMID: 22816012 DOI: 10.4253/wjge.v4.i7.312]
- 7 Wright AS, Rikkers LF. Current management of portal hypertension. *J Gastrointest Surg* 2005; **9**: 992-1005 [PMID: 16137597 DOI: 10.1016/j.gassur.2004.09.028]
- 8 Peter P, Andrej Z, Katarina SP, Manca G, Pavel S. Hepatic encephalopathy after transjugular intrahepatic portosystemic shunt in patients with recurrent variceal hemorrhage. *Gastroenterol Res Pract* 2013; **2013**: 398172 [PMID: 23606833 DOI: 10.1155/2013/398172]
- 9 Funes FR, Silva Rde C, Arroyo PC, Duca WJ, Silva AA, Silva RF. Mortality and complications in patients with portal hypertension who underwent transjugular intrahepatic portosystemic shunt (TIPS) - 12 years experience. *Arq Gastroenterol* 2012; **49**: 143-149 [PMID: 22767002 DOI: 10.1590/S0004-28032012000200009]
- 10 Qiu FZ. [Evaluation of the pericardial devascularization in portal hypertension]. *Zhonghua Waike Zazhi* 1983; **21**: 275-277 [PMID: 6628110]
- 11 Huang Y, Wang W, Wang J, Bai C. Surgical treatment of portal hypertension: 45 year experience. *Zhonghua Waike Zazhi* 2000; **38**: 85-88 [PMID: 11831994]
- 12 Voros D, Polydorou A, Polymeneas G, Vassiliou I, Melemini A, Chondrogiannis K, Arapoglou V, Fragulidis GP. Long-term results with the modified Sugiura procedure for the management of variceal bleeding: standing the test of time in the treatment of bleeding esophageal varices. *World J Surg* 2012; **36**: 659-666 [PMID: 22270986 DOI: 10.1007/s00268-011-1418-7]
- 13 Wu YK, Wang YH, Tsai CH, Yung JC, Hwang MH. Modified Hassab procedure in the management of bleeding esophageal varices—a two-year experience. *Hepatogastroenterology* 2002; **49**: 205-207 [PMID: 11941955]
- 14 Chen FM, Wang JY, Huang TJ, Hsieh JS. The effect of portal hypertension on the glycoprotein biosynthesis of rat gastric mucosa. *J Invest Surg* 2002; **15**: 311-317 [PMID: 12542865 DOI: 10.1080/08941930290086128]
- 15 Ohta M, Yamaguchi S, Gotoh N, Tomikawa M. Pathogenesis of portal hypertensive gastropathy: a clinical and experimental review. *Surgery* 2002; **131**: S165-S170 [PMID: 11821805 DOI: 10.1067/msy.2002.119499]
- 16 Thuluvath PJ, Yoo HY. Portal Hypertensive gastropathy. *Am J Gastroenterol* 2002; **97**: 2973-2978 [PMID: 12492178 DOI: 10.1111/j.1572-0241.2002.07094.x]
- 17 Rosemurgy AS, Zervos EE, Bloomston M, Durkin AJ, Clark WC, Goff S. Post-shunt resource consumption favors small-diameter prosthetic H-graft portacaval shunt over TIPS for patients with poor hepatic reserve. *Ann Surg* 2003; **237**: 820-825; discussion 825-827 [PMID: 12796578 DOI: 10.1097/01.SLA.0000072102.38993.05]
- 18 Leng X, Zhu J, Du R. [Portacaval shunt with H-grafts of small diameter in treating cirrhotic patients with portal hypertension]. *Zhonghua Waike Zazhi* 1998; **36**: 330-332 [PMID: 11825402]
- 19 Triger DR. Portal hypertensive gastropathy. *Baillieres Clin Gastroenterol* 1992; **6**: 481-495 [PMID: 1421596 DOI: 10.1016/0950-3528(92)90034-C]
- 20 Gouge TH, Ranson JH. Esophageal transection and para-esophagogastric devascularization for bleeding esophageal varices. *Am J Surg* 1986; **151**: 47-54 [PMID: 3484912 DOI: 10.1016/0002-9610(86)90010-3]
- 21 Johnson M, Rajendran S, Balachandrar TG, Kannan D, Jeswanth S, Ravichandran P, Surendran R. Transabdominal modified devascularization procedure with or without esophageal stapler transection—an operation adequate for effective control of a variceal bleed. Is esophageal stapler transection necessary? *World J Surg* 2006; **30**: 1507-1518; discussion 1519 [PMID: 16865318 DOI: 10.1007/s00268-005-0754-x]
- 22 Orozco H, Mercado MA. The evolution of portal hypertension

- surgery: lessons from 1000 operations and 50 Years' experience. *Arch Surg* 2000; **135**: 1389-1393; discussion 1394 [PMID: 11115336]
- 23 **Henderson JM**, Nagle A, Curtas S, Geisinger M, Barnes D. Surgical shunts and TIPS for variceal decompression in the 1990s. *Surgery* 2000; **128**: 540-547 [PMID: 11015086 DOI: 10.1067/msy.2000.108209]
- 24 **Jenkins RL**, Gedaly R, Pomposelli JJ, Pomfret EA, Gordon F, Lewis WD. Distal splenorenal shunt: role, indications, and utility in the era of liver transplantation. *Arch Surg* 1999; **134**: 416-420 [PMID: 10199316 DOI: 10.1001/archsurg.134.4.416]
- 25 **Rikkers LF**. The changing spectrum of treatment for variceal bleeding. *Ann Surg* 1998; **228**: 536-546 [PMID: 9790343 DOI: 10.1097/0000658-199810000-00010]
- 26 **Idezuki Y**, Kokudo N, Sanjo K, Bandai Y. Sugiura procedure for management of variceal bleeding in Japan. *World J Surg* 1994; **18**: 216-221 [PMID: 8042326 DOI: 10.1007/BF00294404]
- 27 **Orozco H**, Takahashi T, Mercado MA, Prado E, Chan C. Surgical management of extrahepatic portal hypertension and variceal bleeding. *World J Surg* 1994; **18**: 246-250 [PMID: 8042330 DOI: 10.1007/BF00294409]
- 28 **Spence RA**, Johnston GW. Results in 100 consecutive patients with stapled esophageal transection for varices. *Surg Gynecol Obstet* 1985; **160**: 323-329 [PMID: 3885444]
- 29 **Du L**, Wu W, Zhang Y, Sun Z, Hu H, Liu X, Liu Q. Effects of modified splenocaval shunt plus devascularization on esophagogastric variceal bleeding: a comparative study of this treatment and devascularization only in cirrhotic portal hypertension. *J Hepatobiliary Pancreat Sci* 2010; **17**: 657-665 [PMID: 20703844 DOI: 10.1007/s00534-010-0262-8]
- 30 **Mathur SK**, Shah SR, Nagral SS, Soonawala ZF. Transabdominal extensive esophagogastric devascularization with gastroesophageal stapling for management of noncirrhotic portal hypertension: long-term results. *World J Surg* 1999; **23**: 1168-1174; discussion 1174-1175 [PMID: 10501880 DOI: 10.1007/s002689900641]
- 31 **Hirano S**, Kondo S, Ambo Y, Tanaka E, Morikawa T, Okushiba S, Katoh H. Appraisal of DSRS with SPGD for esophagogastric varices: a retrospective comparative study according to the underlying liver diseases. *Hepatogastroenterology* 2005; **52**: 152-155 [PMID: 15783017]
- 32 **Mathur SK**, Dalvi AN, Someshwar V, Supe AN, Ramakantan R. Endoscopic and radiological appraisal of gastric varices. *Br J Surg* 1990; **77**: 432-435 [PMID: 2340395 DOI: 10.1002/bjs.1800770424]
- 33 **Koyanagi N**, Iso Y, Higashi H, Kitano S, Sugimachi K. Recurrence of varices after oesophageal transection: intra-operative and postoperative assessment by endoscopy. *Br J Surg* 1988; **75**: 9-11 [PMID: 3257402 DOI: 10.1002/bjs.1800750105]

P- Reviewers: Kong SH, Wei L, Wakai T  
S- Editor: Qi Y L- Editor: Wang TQ E- Editor: Liu XM





Published by **Baishideng Publishing Group Co., Limited**

Flat C, 23/F., Lucky Plaza,  
315-321 Lockhart Road, Wan Chai, Hong Kong, China

Fax: +852-65557188

Telephone: +852-31779906

E-mail: [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)

<http://www.wjgnet.com>



ISSN 1007-9327



9 771007 932045