Int J Clin Exp Med 2015;8(8):14036-14041
www.ijcem.com /ISSN:1940-5901/IJCEM0009327

Original Article

Therapeutic effects and complications of simplified pericardial devascularization for patients with portal hypertension

Hongwei Lu*, Sida Liu*, Yafei Zhang, Hao Shang, Hong Ji, Yiming Li

*Department of General Surgery, Second Affiliated Hospital, Xi'an Jiaotong University School of Medicine, Xi'an 710004, Shaanxi, China. *Equal contributors.*

Received April 19, 2015; Accepted July 28, 2015; Epub August 15, 2015; Published August 30, 2015

Abstract: Objectives: To evaluate the therapeutic effects and complications of simplified pericardial devascularization for patients with portal hypertension. Methods: By means of prospective study, 212 patients who underwent simplified pericardial devascularization (Group A) and 309 patients who underwent traditional pericardial devascularization (Group B) were followed up from 2003' to 2011'. Results were performed with the general condition of the patients and the incidence of complications to assess the value of the two operating methods. Results: The operating time was 1.0-3.83 hours (mean 1.94 ± 0.32 hours) in Group A versus 1.67-4.50 hours (mean 2.86 ± 0.40 hours) in Group B. The amount of bleeding, postoperative hospital stay and hospitalization expenses were 110-500 ml (mean 224.81 ± 78.44 ml), 7-22 days (mean 10.41 ± 4.01 days) and 15700-27500 yuan with an average of 19300 ± 1600 yuan in Group A and 200-700 ml (mean 423.50 ± 85.19 ml), 9-32 days (mean 14.76 ± 4.52 days) and 18700-44500 yuan with an average of 23400 ± 2200 yuan in Group B. In September 2012', successful follow-up was completed for 438 patients, of which, 181 underwent the simplified devascularization with 31 patients lost (follow-up rate 85.4%). Meanwhile, 257 patients in Group B were followed up completely and 52 patients were lost (follow-up rate 83.2%). The follow-up time ranged from 1 to 9.5 years and the average time was 5.03 ± 2.13 years. The mortality, rebleeding rate, rate of hepatic encephalopathy, rate of ascites and the incidence of gastric fistula and (or) esophageal fistula were 6.1%, 6.1%, 1.7%, 8.3% and 0 in Group A versus 14.0%, 15.2%, 4.3%, 17.7% and 3.1% in Group B. Conclusions: The final results suggested that simplified pericardial devascularization performed more effectively and conveniently than the traditional method, depending on the mitigated operative wound and the shortened operation time. We concluded that simplified pericardial devascularization was better in treatment of portal hypertension compared than the traditional method.

Keywords: Pericardial devascularization, portal hypertension, postoperative follow-up, operation effect, postoperative complications

Introduction

Surgical treatments for portal hypertension mainly include portosystemic shunt, devascularization, interventional therapy and liver transplantation. The most important methods are portosystemic shunt and devascularization [1]. Although portosystemic shunt reduces portal pressure, the portal blood flow will be reduced after operation, which can cause progressive attenuation of liver function and associate with hepatic encephalopathy. These can reduce the quality of patients' lives and cause a amount of patients' death due to hepatic failure [2]. Compared with the shunt, the advantage of devascularization is not to reduce portal blood flow, which will not affect the liver nutrition or lead to liver function impairment. Therefore, the patients with portal hypertension will have better quality of lives after devascularization [3].

We sum up the experiences and simplify the surgical procedure of devascularization, which is simpler and can shorten the operation time obviously. In order to evaluate the long-term effects of the simplified pericardial devascularization, all the patients we observed were divided into two groups: 212 patients with portal hypertension who undergo simplified pericardi-

al devascularization & splenectomy (Group A) and 309 patients with portal hypertension who undergo traditional pericardial decascularization & splenectomy (Group B) from 2003' to 2011'.

Materials and methods

Patients

General information: 212 patients, who underwent simplified pericardial devascularization & splenectomy, were selected in the simplified group (Group A) and 309 patients, who underwent traditional simplified pericardial devascularization & splenectomy, were selected in the traditional group (Group B). All patients included were hospitalized in the Second Affilited Hospital of Xi'an Jiaotong University with portal hypertension from 2003' to 2011'. Of the 521 patients, 313 patients were male (60.1%) and 208 patients were female (39.9%). The age ranged from 18 to 79 years (mean age 48.41 ± 11.63 years). In Group A, there were 121 patients male (57.1%) and 91 female (42.9%) and the age ranged from 18 to 77 years (mean age 47.26 ± 12.06 years). In Group B, there were 192 patients male (62.1%) and 117 patients female (37.9%) and the age ranged from 24 to 79 years (mean age is 49.16 ± 11.23 years).

Of all the patients observed, 464 patients had viral liver cirrhosis (89.1%), 5 patients had autoimmune liver cirrhosis (1.0%), 36 patients have alcoholic liver cirrhosis (6.9%), 6 patients had cholestatic liver cirrhosis (1.2%) and 10 patients had drug-induced liver cirrhosis (1.9%). In terms of the preoperative liver function grade, there were 212 patients in Child A, 279 patients in Child B and 43 patients in Child C. All the patients had hematemesis and/or hematochezia history and 421 patients had bloody diarrhea (80.8%). In addition, preoperative gastroscopy showed that 233 patients had moderate esophageal varices and 288 patients had severe esophageal varices.

Surgery

Operation method of simplified pericardial devascularization & splenectomy: ① Take the left costal margin curved incision after the anesthesia; ② Take a abdominal exploration and remove spleen; ③ Interrupt but not amputate the left gastric vessel in transfixion method and sew the gastic vein, esophageal vein and high esophageal vein in 1 cm length along the lesser gastric curvature; ④ Sew the posterior peritoneum for hemostasis; ⑤ Close the peritoneal cavity routinely.

Follow up

All patients were followed up once every 6 months. During this time, the patients could return to our hospital for re-examination when special cases happened. Examination parameters included observing survival, rehaemorrhagia, hepatic encephalopathy, ascites, the blood routine, liver function, ultrasound and gastroscopy, etc. Postoperative rehaemorrhagia was defined as hematemesis, hematochezia or melena, which appeared two weeks after operative. Postoperative encephalopathy was mean that the patient's clinical manifestations contained unresponsive, spirit scattered, personality changes, behavioral disorders and disorientation.

Statistical analysis

$\bar{x} \pm s$ was used to express the data and analysis of variance (ANOVA) was used for statistical analysis. Statisticians at the Department of General Surgery of the Second Affilited Hospital of Xi'an Jiaotong University performed the statistical analyses using the SPSS13.0 system (SPSS Inc. Chicago, IL, USA). Differences were considered statistically significant with $P < 0.05$.

Results

Patient clinicopathologic characteristics

521 patients hospitalized in the Second Affilited Hospital of Xi'an Jiaotong University with portal hypertension from 2003' to 2011' were included, of which, 313 were male (60.1%) and 208 were female (39.9%). The age ranged from 18 to 79 years (mean age 48.41 ± 11.63 years). In Group A, there were 121 males (57.1%) and 91 females (42.9%) and the age ranged from 18 to 77 years (mean age 47.26 ± 12.06 years). In Group B, there were 192 males (62.1%) and 117 females (37.9%) and the age ranged from 24 to 79 years (mean age is 49.16 ± 11.23 years). Of all the patients observed, 464 patients had viral liver cirrhosis (89.1%), 5

Table 1. Liver functions of the patients in simple group

Items	Preoperative	Postoperative	t	P
ALT (U/L)	92.65 ± 144.89	34.34 ± 51.91	6.82	< 0.05
AST (U/L)	83.41 ± 106.90	36.44 ± 26.65	7.04	< 0.05
TBIL (umol/L)	33.46 ± 23.26	17.21 ± 11.28	10.32	< 0.05
DBIL (umol/L)	12.30 ± 7.81	7.02 ± 5.23	9.04	< 0.05
ALB (g/L)	34.51 ± 5.19	40.17 ± 3.71	-11.49	< 0.05

Table 2. Liver functions of the patients in traditional group

Items	Preoperative	Postoperative	t	P
ALT (U/L)	94.68 ± 156.67	35.07 ± 45.64	6.846	< 0.05
AST (U/L)	82.77 ± 102.14	42.28 ± 26.99	7.77	< 0.05
TBIL (umol/L)	33.90 ± 23.17	18.89 ± 12.25	11.59	< 0.05
DBIL (umol/L)	11.93 ± 8.14	8.01 ± 4.74	7.99	< 0.05
ALB (g/L)	34.88 ± 4.92	38.68 ± 3.64	-9.65	< 0.05

Table 3. Liver function of the two groups of patients

Items	Group A	Group B	t	P
ALT (U/L)	34.34 ± 51.91	35.07 ± 45.64	-0.16	> 0.05
AST (U/L)	36.44 ± 26.65	42.28 ± 26.99	-2.24	< 0.05
TBIL (umol/L)	17.21 ± 11.28	18.89 ± 12.25	-1.46	> 0.05
DBIL (umol/L)	7.02 ± 5.23	8.01 ± 4.74	-2.05	< 0.05
ALB (g/L)	40.17 ± 3.71	38.68 ± 3.64	4.18	< 0.05

patients had autoimmune liver cirrhosis (1.0%), 36 patients have alcoholic liver cirrhosis (6.9%), 6 patients had cholestatic liver cirrhosis (1.2%) and 10 patients had drug-induced liver cirrhosis (1.9%). In terms of the preoperative liver function grade, 212 patients were in Child A, 279 patients in Child B and 43 patients in Child C. All the patients had hematemesis and/or hematochezia history and 421 patients had bloody diarrhea (80.8%). In addition, preoperative gastroscopy showed that 233 patients had moderate esophageal varices and 288 patients had severe esophageal varices.

Followed-up

All the operations performed successfully and no patient died in perioperative period in simplified group. In traditional group, there were 4 patients died in perioperative period (mortality rate 1.3%). A total of 438 patients were followed up. Meanwhile, 83 patients were lost and the follow-up rate was 84.1%. In terms of the groups, the number of the followed-up patients and lost patients was 181 and 31 respectively in simplified group. In traditional group, 257 patients were followed up and 52 patients were lost. The lost of the followed-up patients occurred in two groups due to: ① Patients provided no or wrong contact information; ② Patients refused to be followed up or contact information had been changed. Follow-up period was 1-9.5 years and the average time was 5.03 ± 2.13 years.

Survival condition

Of all the patients observed, 11 patients died in simplified group (mortality rate 6.1%) versus 36 patients died in traditional group (mortality rate 14.0%). Causes of death in Group A (simplified group) were rehaemorrhagia (7 patients: 1 patient in 2nd years, 2 patients in 3rd years, 2 patients in 6th years, 1 patient in 7th years and 1 patient in 9th years), liver cancer (1 patient in 2nd years), liver failure (2 patients in 5th and 7th years, respectively) and cerebral hemorrhage (1 patient in 6th years) after operation respectively. Compared with the simplified group, causes of death in Group B (traditional group) were rehaemorrhagia (24 patients: 1 patient in 1st years, 3 patients in 2nd years, 2 patients in 3rd years, 2 patients in 4th years, 4 patients in 5th years, 6 patients in 7th years, 4 patients in 8th years and 2 patients in 9th years), liver cancer (4 patient: 1patient in 1st years, 2 patients in 3rd years and 1 patient in 5th years), liver failure (8 patient: 1 patient in 2nd years, 2 patients in 4th years, 1 patient in 5th years, 3 patients in 7th years and 1 patient in 8th years) after operation. Compared the Group A with Group B, the difference of mortality rate was statistically significant.

Liver functions

Liver functions of patients are improved in both groups after operation. Their liver functions are shown in **Tables 1-3**.

Compared the preoperative liver functions with postoperative functions of the two groups, the difference is significant ($P < 0.05$).

The independent samples t-test on the two groups of all the patients during the follow-up liver function shows that Group A is much better than Group B ($P < 0.05$).

Table 4. Operative time, blood loss and time of hospital stay and costs

	Group A	Group B	t	*P*
Operative time (h)	1.94 ± 0.32	2.86 ± 0.40	-28.98	< 0.05
Blood loss (ml)	224.81 ± 78.44	423.50 ± 85.19	-27.00	< 0.05
Postoperative hospital stay (d)	10.41 ± 4.01	14.76 ± 4.52	-11.32	< 0.05
Costs (yuan)	19300 ± 1600	23400 ± 2200	-24.96	< 0.05

Table 5. Major postoperative complications rate

	Group A	Group B	X^2	*P*
Rebleeding (%)	6.1	15.2	8.69	< 0.05
Hepatic encephalopathy (%)	1.7	4.3	2.36	> 0.05
Ascites (%)	8.3	17.7	8.56	< 0.05
Gastric and (or) fistula (%)	0	3.1	4.13	< 0.05

Operative time, blood loss, length of hospital stay and costs

The operating time was 1.0-3.83 hours (mean 1.94 ± 0.32 hours) in Group A versus 1.67-4.50 hours (mean 2.86 ± 0.40 hours) in Group B. The amount of bleeding, the postoperative hospital stay and hospitalization expenses were 110-500 ml (mean 224.81 ± 78.44 ml), 7-22 days (mean 10.41 ± 4.01 days) and 15700-27500 yuan with an average of 19300 ± 1600 yuan in Group A and 200-700 ml (mean 423.50 ± 85.19 ml), 9-32 days (mean 14.76 ± 4.52 days) and 18700-44500 yuan with an average of 23400 ± 2200 yuan in Group B. All of the above showed statistically significant differences ($P < 0.05$) shown in **Table 4**.

Major postoperative complications

*Postoperative complications rate were shown in **Table 5**:* the mortality, the rebleeding rate, the rate of hepatic encephalopathy, the rate of ascites and the incidence of gastric fistula and (or) esophageal fistula were, respectively, 6.1%, 6.1%, 1.7%, 8.3% and 0 in Group A versus 14.0%, 15.2%, 4.3%, 17.7% and 3.1% in Group B.

X^2 test for simplified group and traditional group showed that the rates of rebleeding, ascites incidence and gastric (or) esophageal fistula had statistically significant ($P < 0.05$) and no significant difference ($P > 0.05$) in the rate of hepatic encephalopathy.

Others

In addition to the death, the remaining follow-up patients all had a CT scan: 125 of all the patients had no significant change in the degree of liver cirrhosis in simplified group (36 patients had worsened and 9 patients had significantly worsened) versus 169 in tradtional group (70 patients had worsened and 18 patients had significantly worsened). The number of patients whose portal vein widths was less than 15 mm in two groups were 51 (Group A) and 44 (Group B), respectively. Meanwhile, The number of patients in two groups whose portal vein widths was greater than 15 mm were 119 (Group A) and 213 (Group B) respectively. Gastroscopy: in the simplified group, 50 patients didn't have esophageal varices, 132 patients had mild or moderate esophageal varices and 24 patients had severe esophageal varices. By contrast, 57 patients didn't have esophageal varices, 96 patients had mild or moderate varicose veins, 75 patients had severe esophageal varices in traditional group. All rebleeding patients had esophageal varices.

Discussion

The resistance to portal outflow and (or) an increase in the portal venous inflow cause the increase of venous pressure in the portal vein and its branches, which is called portal hypertension (PHT) [4]. The reasons and mechanism of portal hypertension are complicated. Its formation is associated with the changes of hemodynamics and mechanical dynamics of liver and systemic circulation, in which, the increased resistance to portal venous system and the increased blood flowing from the viscera to the liver plays a key role [5, 6]. The ensuing development of elevated flow and transmural pressure through collateral vessels from the hypertensive portal vasculature into the lower pressure systemic venous circulation accounts for many of the complications, such as bleeding esophageal varices, observed with portal hypertension [7]. The forming of portal venous hypertension and the following hydrodynamic vein rami communicans opening cause the col-

lateral circulation expand, and then expand the ramus communicans of left gastric vein, short gastric vein and Azygos vein branches, which play an important role in clinic (esophageal gastric venous plexus varices) [8].

The prevention and treatment of the upper gastrointestinal hemorrhage caused by portal hypertension can be divided into non-surgical treatment and surgical treatment. Nevertheless, the effect of traditional non-surgical treatment is not satisfied. Thus, surgery is considered to be a main and effective method to prevent and treat the upper gastrointestinal hemorrhage caused by portal hypertension for a long time [9-11].

Presently, the main treatments of portal hypertension are shunt and devascularization. In 1981, Qiu Fazu [12] raised pericardial devascularization firstly [10], which was widely used in clinic for its advantages of simplicity of operation and curative effect. The advantages of devascularization are as follows: Firstly, devascularization can maintain a higher portal venous pressure to increase portal outflow to the liver, which ensure the blood perfusion from the portal vein to the liver. Secondly, portal venous system is divided into mesenteric area and spleen stomach area in function, which are separated by a barrier. The most fundamental reason of the esophageal varices is left gastric venous pressure rising. The devascularization is a surgery for spleen stomach area, especially for left gastric vein hypertension, which is purposeful and the hemostasis effect is satisfactory [13, 14].

Traditional pericardial devascularization needs to incise the serosa when amputates and ligates vascular, which will cause more wounds, more blood loss and prolong operative time and damage the liver function of the patients by increasing the burden of the liver and the risks of the complications of hepatic coma, hepatorenal syndrome etc, especially for the patients whose liver function are poor. At the same time, the damage of the gastral and esophageal seromuscular layer can lead to gastric and esophageal fistula. We sum up the experiences and simplify the traditional pericardial devascularization. We amputate and ligate the posterior gastric vessels instead of pericardial vein, then suture and ligate the left gastric artery and gastric and esophageal vascular. For the simplified surgical procedure, the ligation injury will be avoided for not incising the seromuscular layer when sutured. Meanwhile, it will also reduce the intraoperative bleeding and shorten the operation time, which can decrease the burden of the liver due to surgery to patients. The patients recovered well after operation and had the low incidence of the complications of bleeding, hepatosis, etc.

The operating time was 1.0-3.83 hours (mean 1.94 ± 0.32 hours) in Group A versus 1.67-4.50 hours (mean 2.86 ± 0.40 hours) in Group B. The amount of bleeding, the postoperative hospital stay and hospitalization expenses were 110-500 ml (mean 224.81 ± 78.44 ml), 7-22 days (mean 10.41 ± 4.01 days) and 15700-27500 yuan with an average of 19300 ± 1600 yuan in Group A and 200-700 ml (mean 423.50 ± 85.19 ml), 9-32 days (mean 14.76 ± 4.52 days) and 18700-44500 yuan with an average of 23400 ± 2200 yuan in Group B. In September 2012, successful follow-up was completed for 438 patients. Of these 438 patients, 181 underwent the simplified devascularization with 31 patients lost (follow-up rate 85.4%). Meanwhile, 257 patients of Group B were followed up completely and 52 patients were lost (follow-up rate 83.2%). The follow-up time ranged from 1 to 9.5 years and the average time was 5.03 ± 2.13 years. The mortality, rebleeding rate, rate of hepatic encephalopathy, rate of ascites and the incidence of gastric fistula and (or) esophageal fistula were 6.1%, 6.1%, 1.7%, 8.3% and 0 in Group A versus 14.0%, 15.2%, 4.3%, 17.7% and 3.1% in Group B.

Up to September 2012, 438 patients were followed up successfully. Meanwhile, 83 patients were lost and the follow-up rate was 84.1%. In terms of the groups, the number of the followed-up patients and lost patients was 181 and 31 in the simple group respectively. In traditional group, 257 patients were followed up and 52 patients were lost. Reasons of the lost were as fellows: Patients provided no or wrong contact information; Patients refused to be followed up or contact information had been changed. Follow-up period was 1-9.5 years and the average time was 5.03 ± 2.13 years. Postoperative complications rate: the mortality, the rebleeding rate, the rate of hepatic encephalopathy, the rate of ascites and the incidence of gastric fistula and (or) esophageal fistula

were, respectively, 6.1%, 6.1%, 1.7%, 8.3% and 0 in Group A versus 14.0%, 15.2%, 4.3%, 17.7% and 3.1% in Group B. X^2 test for simplified group and traditional group showed that the rates of rebleeding, ascites incidence and gastric (or) esophageal fistula had statistically significant ($P < 0.05$) and no significant difference ($P > 0.05$) for the rate of hepatic encephalopathy.

The simplified pericardial devascularization is much simpler than traditional pericardial devascularization. The operative time, blood loss, length of hospital stay and the costs of simplified pericardial devascularization are all less than traditional method. Simplified pericardial devascularization is considered to be a better operation method which worth spreading.

Disclosure of conflict of interest

None.

Address correspondence to: Yafei Zhang and Yiming Li, Department of General Surgery, Second Affiliated Hospital, Xi'an Jiaotong University School of Medicine, 157 Xiwu Road, Xi'an 710004, Shaanxi, China. E-mail: 740228223@qq.com (YFZ); liyimingdoc@163.com (YML)

References

[1] Wu J, Li Z, Wang Z, Han X, Ji F, Zhang WW. Surgical and Endovascular Treatment of Severe Complications Secondary to Non-cirrhotic Portal Hypertension: Experience of 56 Cases. Ann Vasc Surg 2013; 27: 441-446.

[2] Parker R. Role of Transjugular Intrahepatic Portosystemic Shunt in the Management of Portal Hypertension. Clin Liver Dis 2014; 18: 319-334.

[3] Yao HS, Wang WJ, Wang Q, Gao WC, Xiang HG, Hu ZQ, Gao JD, Chen XY, Wang WM. Randomized clinical trial of vessel sealing system (LigaSure) in esophagogastric devascularization and splenectomy in patients with portal hypertension. Am J Surg 2011; 202: 82-90.

[4] Fernandez M. Molecular pathophysiology of portal hypertension. Hepatology 2015; 61: 1406-15.

[5] Buob S, Johnston AN, Webster CR. Portal hypertension: pathophysiology, diagnosis, and treatment. J Vet Intern Med 2011; 25: 169-186.

[6] Kim MY, Baik SK. Hyperdynamic circulation in patients with liver cirrhosis and portal hypertension. Taehan Sohwagi Hakhoe Chi 2009; 54: 143-148.

[7] Peck-Radosavljevic M, Angermayr B, Datz C, Ferlitsch A, Ferlitsch M, Fuhrmann V, Hafner M, Kramer L, Maieron A, Payer B, Reiberger T, Stauber R, Steininger R, Trauner M, Thurnher S, Ulbrich G, Vogel W, Zoller H, Graziadei I; Austrian Society of Gastroenterology and Hepatology. Austrian consensus on the definition and treatment of portal hypertension and its complications (Billroth II). Wien Klin Wochenschr 2013; 125: 200-219.

[8] Al-Busafi SA, McNabb-Baltar J, Farag A, Hilzenrat N. Clinical manifestations of portal hypertension. Int J Hepatol 2012; 2012: 1-10.

[9] Choy TY, Simoens C, Thill V, Mboti F, Vandaele S, Mendes CP. Results of surgical treatment of uncontrollable upper gastrointestinal hemorrhage using endoscopy. Hepatogastroenterology 2011; 58: 89-95.

[10] Wang WM, Wang XG. Effects of medicine in prevention and treatment of upper gastrointestinal hemorrhage in portal hypertension. Zhonghua Wai Ke Za Zhi 2007; 45: 865-867.

[11] de la Mora-Levy JG, Tamayo-de la Cuesta JL, Castaneda-del Rio AG, Garcia-Mendoza R, Olaeta-Elizalde R, Peniche-Gallareta LF, Ramos-Narvaez FA, Rueda-Torre G, Zamarripa-Dorsey F. Clinical guidelines for the diagnosis and treatment of nonvariceal upper gastrointestinal hemorrhage. Definition, epidemiology, etiology and physiopathology. Revista De Gastroenterologia De Mexico 2007; 72: 397-398.

[12] Qiu FZ. Evaluation of the pericardial devascularization in portal hypertension. Zhonghua Wai Ke Za Zhi 1983; 21: 275-277.

[13] Du LX, Wu WJ, Zhang Y, Sun ZJ, Hu HT, Liu XG, Liu QG. 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.

[14] 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 Gastroentero 2013; 19: 9418-9424.