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*Original Article*

# Clinical application value of preoperative selective partial splenic embolization before splenectomy plus portal-azygous disconnection

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**Abstract:** The aim of this study is to explore the clinical application value of preoperative selective partial splenic embolization before splenectomy plus portal-azygous disconnection. 158 cases of liver cirrhosis combined with upper gastrointestinal hemorrhage patients were selected, which were randomly divided into splenic embolization group (S, n=77) and the non-splenic embolization group (U, n=81). Group S patients were firstly performed partial splenic embolization (PSE), and then underwent splenectomy plus portal-azygous disconnection, and the group U patients were directly performed splenectomy plus portal-azygous disconnection. Statistical analysis was used SAS8.0 statistical analysis software. One week after partial splenic embolization, the platelet of group S returned to normal, and the rise of white blood cells and hemoglobin, and shorten of prothrombin time in group S were much better than that in group U ($P$<0.01, $P$<0.05); the indexes, such as the intraoperative blood loss, the blood transfusion amount, the amount of platelet infusion, and the incidence of complications in group S were more superior than that in group U ($P$<0.05). Preoperative selective splenic artery embolization before splenectomy plus portal-azygous disconnection can restore the spleen function, and reduce the risk of surgery and incidence of complications.

**Keywords:** Liver cirrhosis, hypersplenism, splenic embolization, splenectomy, the portal-azygous disconnection

## Introduction

Portal hypertension refers to the high pressure of portal system caused by blocked blood flow to the portal vein and blood stagnation, which often occurs in late period of various liver diseases, with liver cirrhosis after hepatitis B as the main cause in China, and the clinically manifestations are mainly impaired liver function, splenomegaly, hypersplenism, and esophagogastric varices [1]. About 50%-60% patients with esophagogastric varices may combine with massive hemorrhage, once the massive hemorrhage occurs, it is serious, and if it is mistreated or not treated in time, it will cause serious consequences, which is a serious threat to the patient's life [2]. When a variety of non-surgical treatment measures cannot effectively control hemorrhage, the surgical shunt or devascularizaion [3-5] need to be performed to achieve effective hemostasis and reduce mortality [6]. Hypersplenism is a kind of clinical syndrome that can cause the thrombocytopenia, decreased white blood cell count, anemia and disturbance of blood coagulation caused by liver function injury, which can increase the risks of shunt or devascularizaion surgery, and if it is serious, it can cause death due to intraoperative bleeding or postoperative liver failure [7]. With the development of interventional radiology, the partial splenic embolization (PSE) has been widely used in clinic, which uses the splenic artery intubation and transcatheter embolic agent injected to make corresponding regional splenic artery ischemia, necrosis, and atrophy, to weaken the phagocytic and globulicidal ability, and to increase the white blood cells and platelets counts, so as to improve the body's immune ability, and improve the function of blood coagulation [8-10]. After simultaneously splenic artery trunk and branch embolization, the blood flow may decrease 60% with the

**Table 1.** Comparison of general materials and clinical indexes of patients between the two groups before admission ($\bar{x}$±s)

| Group | Cases m/f | Age Y/O | Course years | PLT $10^9$/L | ALB g/L | WBC $10^9$/L | Hb g/L | PT sec |
|---|---|---|---|---|---|---|---|---|
| PSE | 42/35 | 52±10 | 19±5 | 5.2±2.0 | 28±1.0 | 2.8 ±1.0 | 89±16 | 15±3.0 |
| Non-PSE | 50/31 | 54±10 | 18±4 | 4.9±1.0 | 27±3.1 | 2.5±1.2 | 86±19 | 14±4.0 |
| t | | 1.680 | 1.720 | 0.950 | 0.020 | 1.076 | 0.930 | 0.890 |
| $\chi^2$ | 0.837 | | | | | | | |
| *P* | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |

**Table 2.** Comparison of clinical laboratory indexes of patients between the two groups one week after splenic embolization ($\bar{x}$±s)

| Group | PLT $10^9$/L | ALB g/L | PT sec | WBC $10^9$/L | Hb g/L |
|---|---|---|---|---|---|
| PSE | 15.2±5.1 | 29±2.7 | 12±2.1 | 5.9±1.6 | 130±3.2 |
| Non PSE | 4.9±1.0 | 28±3.0 | 15±3.8 | 3.1±1.3 | 87±18 |
| t | 4.416 | 0.021 | 2.890 | -3.227 | 2.11 |
| *P* | <0.01 | >0.05 | <0.05 | <0.05 | <0.05 |

spleen embolism, only 1/6-1/5 of the original, and the portal vein pressure will accordingly decrease, which reduces the risk of liver cirrhosis upper gastrointestinal bleeding. However, whether can preoperative selective splenic artery embolization before splenectomy plus portal-azygous disconnection lower the risk of surgery? In order to increase operation security and reduce mortality and complications of the liver cirrhosis patients combined with portal hypertension and hemorrhage of upper gastrointestinal tract, this paper randomly selected partial splenectomy plus portal-azygous disconnection patients to perform preoperative PSE, so as to observe and explore the clinical application value.

## Materials and methods

### *General data*

Between January 2009 and June 2012, we have collected 158 cases of decompensation period of liver cirrhosis and portal hypertension patients with upper gastrointestinal bleeding patients in our hospital, including 92 males, 66 females; age 28-71 years old, with an average of 56.4±11.3 years old. All patients were the decompensation period of hepatitis B with liver cirrhosis patients, in which 89 cases were liver function child class B, and 69 cases were liver function Child class C; with 7-37 years history of hepatitis, an average of 19.3±11.2 years, and upper gastrointestinal hemorrhage 2-6 times, an average of 3.2±0.3 times. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of People's Hospital of Zhengzhou. Written informed consent was obtained from all participants.

### *Experimental subgroup and treatment methods*

The experimental group and control group were set up, and according to the liver function Child grading B, and C, the patients were even distributed to each group. Experimental group (splenic embolization group, S), 77 cases, included 43 cases of liver function child grade B, and 34 cases of child grade C, which were performed preoperative PSE before splenectomy plus portal-azygous disconnection, with infarcted area of 65-75%, and splenectomy plus portal-azygous disconnection was performed in 5-7 days after partial splenic embolization; Control group (non-splenic embolization group, U), 81 cases, included 46 cases of liver function child B and 35 cases of liver function child grade C, which were performed simple splenectomy plus portal-azygous disconnection. In each group, patients with liver function child grade C were preoperatively transformed to liver function grade B, and then performed operation.

### *Splenic artery embolization*

The strongest point of femoral artery pulses below the inguinal ligament was chosen as the puncture point, which was preoperatively marked. Taking supine position, the patients were routine disinfected and draped, and then performed local anesthesia with 2% lidocaine injection; making about 3 mm skin incision with sharp knife, the right femoral artery retrograde puncture was performed with the modified Seldinger technique under DSA (GE Medical

**Table 3.** Comparison of intraoperative and postoperative observation indexes of patients between the two groups ($\bar{x}$±s)

| Group | Operation time (Sec) | The amount of bleeding (ml) | The amount of transfusion (ml) | The amount of platelet transfusion (μ) | Medical expenditure (10,000 yuan) |
|---|---|---|---|---|---|
| PSE | 156±13 | 242±78 | 121±26 | 1±0.20 | 1.24±0.27 |
| Non-PSE | 145±14 | 501±90 | 253±38 | 4±0.31 | 1.83±0.45 |
| t | 1.518 | 2.832 | 4.417 | 4.82 | 1.67 |
| P | >0.05 | <0.05 | <0.01 | <0.05 | <0.05 |

**Table 4.** Comparison of postoperative complications of patients between the two groups

| Group | Death (n, n%) | Bleeding (n, n%) | Hepatic encephalopathy (n, n%) | Infection (n, n%) | Portal venous embolization (n, n%) |
|---|---|---|---|---|---|
| PSE | 0, 0 | 4, 5.2 | 2, 2.6 | 0, 0 | 2, 2.6 |
| Non-PSE | 4, 4.9 | 13, 16.0 | 6, 7.4 | 7, 8.6 | 7, 8.6 |
| t | 4.66 | 5.64 | 4.10 | 5.21 | 4.414 |
| *P* | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |

**Table 5.** Comparison of clinical laboratory indexes of patients between the two groups before discharged ($\bar{x}$±s)

| Group | PLT 109/L | ALB g/L | PT sec | WBC 109/L | Hb g/L |
|---|---|---|---|---|---|
| PSE | 17.4±6 | 31.2±2.7 | 12.9±3.5 | 5.3±1.6 | 95±4.3 |
| Non PSE | 18.2±5.8 | 30.4±3.1 | 13.3±2.7 | 5.6±1.5 | 96±3.9 |
| t | 0.606 | 2.18 | 1.515 | 0.865 | 1.106 |
| P | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |

Systems SCS Innova 4100-IQ, France); the guide wire was inserted after successful puncture, and the pigtail catheter was sent to the twelfth thoracic vertebra to perform angiography. According to the imaging conditions, the cobra catheter (Terumo, Tokyo, Japan) was switched and sent to the celiac axis to super-selectively entering splenic artery. Angiography was performed once again to display the splenic artery branches. The catheter was introduced to the spleen helium by the guide wire, according to the distribution of the branches, the catheter was super-selectively inserted to the splenic artery branches for transcatheter releasing the moderate amount of polyvinyl alcohol particles embolic agent (560 μm-710 μm, Eric Pharmaceutical Technology Co., LTD, Hangzhou, China), and the angiography was once again performed to display the splenic arterial embolization reaching to 65%-75%.

*Observation indexes*

The observation indexes were changes of clinical inspection indexes before and after surgery, such as blood routine, coagulation function and other indexes, the incidence of complications, operation time and the medical expenditure.

*Statistical analysis*

SAS8.0 statistical analysis software was used for statistical analysis. The results of the two groups were compared using the $\chi^2$ test for the enumeration data, a t-test for the numerical data. The significance level (apha) was set at 0.05.

## Results

*General data and preoperative examination of patients*

There was no significant difference of age, course of the disease, the number of cases (*P*>0.05), and there was no significant difference of preoperative platelet (PLT), white blood cell count (WBC), hemoglobin (HB), serum albumin (propagated), and prothrombin time (PT) (*P*>0.05, **Table 1**).

*Comparison of postoperative clinical laboratory indexes*

There was no significant difference of ALB (*P*>0.05). PLT of group S rose, and which was significant difference compared with group U (*P*<0.01), and there was significant difference of PT, WBC, and HB between the two groups (*P*<0.05, **Table 2**).

*Comparison of intraoperative and postoperative indexes*

There was no significant difference of operation time (*P*>0.05), and the transfusion red blood cells and platelets and medical expenditure of

group S was less than that of group U ($P<0.05$, **Table 3**).

*Comparison of postoperative complications*

The incidence of death, hemorrhage, hepatic encephalopathy, infection portal vein embolization in group S was less than that in group U ($P<0.05$, **Table 4**).

Comparison of clinical laboratory indexes of the two groups' patients before discharge. There was no significant difference of PLT, WBC, ALB and PT ($P>0.05$, **Table 5**).

No serious postoperative complications such as bleeding, infection, death occurred in all the included selective partial splenic embolization patients.

## Discussion

Portal hypertension often occurs in late period of a variety of liver diseases, while post-hepatic cirrhosis of the liver is the main cause of the disease in our country. The most common and serious complication is acute bleeding from ruptured esophagogastric varices, which is the leading cause of death in patients [11, 12]. A variety of treatments method have been carried out in recent years, including the cardia-lower esophageal varicose vein disconnection, the portosystemic shunts, endoscopic sclerotherapy, the esophageal variceal ligation [13], interventional treatment [14, 15] (transjugular intrahepatic portosystemic stent-shunt, TIPS) and liver transplantation, but each operation has its advantages and disadvantages. The ideal operation method can either prevent and treat the upper gastrointestinal hemorrhage, or maintain effective perfusion of portal vein to the liver, and which should be simple operation, with low incidence of complications. Splenectomy plus portal-azygous disconnection can not only guarantee the portal blood flow, but also completely stop bleeding, which is the main surgical treatment on digestive bleeding complications [16]. However, this operation method still exist postoperative complications, such as intraoperative and postoperative massive bleeding, intraperitoneal massive bleeding, hepatic encephalopathy, infection, and portal vein thrombosis, while severe cases can lead to death [17, 18].

The hypersplenism is one of the most common complications of liver cirrhosis, which can make the white blood cells, platelets, red blood cells sustained damage and the whole blood cells reduce in peripheral blood, with leukopenia and thrombocytopenia especially significant [19]. Leukopenia can lead to a variety of increased chance of infections, and thrombocytopenia can trigger or worsen bleeding [20]. Therefore, the hypersplenism can increase the incidence of bleeding and infection and other complications and surgery risks. PSE is a means of intervention, selectively inserting the catheter to the splenic artery via the peripheral artery, injecting the embolic agent into the splenic artery branches to make corresponding regional ischemia, necrosis and atrophy of spleen, weaken its phagocytic and globulicidal ability, so as to make partial spleen function loss, at the same time, which can reduce the inflow of the spleen, so that the splenomegaly and peripheral blood can be improved. The currently embolic agents mainly include gelatin sponge, polyvinyl alcohol particles and anhydrous ethanol, sodium morrhuate and other embolic agents such as surgical sutures, spring coil, etc. Study [21-23] proved that the hemoglobin levels, white blood cell count, platelet count can be improved significantly, after PSE, which is consistent with the results of this group. In this study, one week after the splenic embolization, the platelet of the PSE group patients returned to normal ($P<0.01$), the white blood cell count and hemoglobin levels, and the prothrombin time increased, and the intraoperative and postoperative blood loss, blood transfusion amount, platelet consumption, medical costs of PSE group patients were much less than the control group ($P<0.05$), which possible mechanism is partial splenic embolization can reduce the deposition of the white blood cells and red blood cells in the spleen and the damage of the phagocytes to the blood cells, and relates to the increase of the boost thrombopoietin secretion. In addition, patients with liver cirrhosis portal hypertension can reach 3-4 times of normal splenic artery and venous blood flow and 3-4 times of normal portal venous. 60%-70% of portal venous blood flow comes from spleen vein (normal is 20%-30%), and embolized main trunk of splenic artery can reduce splenic venous blood flow and portal venous pressure, which can reduce the intraoperative blood loss, avoid blood transfusion or decrease the amount of blood transfusion, and increase the safety of operation. The incidence of postoperative

death, bleeding, hepatic encephalopathy, infection and portal vein thrombosis and other serious complications of the experimental group was much less than that of the control group ($P<0.05$), and which proved its superiority.

Thus it can be seen that patients with liver cirrhosis and portal hypertension combined with upper gastrointestinal hemorrhage can be performed preoperative selective partial splenic embolization before splenectomy plus portal-azygous disconnection, which is a kind of safe, effective and reliable method that can significantly improve the hypersplenism, correct coagulant function abnormality, and increase patients tolerance to surgery, avoid the intraoperative wound bleeding or postoperative disseminated intravascular coagulation (DIC), reduce the operation risk and incidence of complications, and there are still some problems of this operation worth exploring, such as the choice of splenic embolization material, position and area of spleen embolism, operation timing after splenic embolization, etc., which will be summarized in the future major surgery cases.

## Disclosure of conflict of interest

None.

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