

## Research Article

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# Foam sclerotherapy during shunt surgery for portal hypertension and varices

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**Abstract:** Objective: This preliminary study investigated the clinical safety and efficacy of foam sclerotherapy during shunt surgery to treat portal hypertension and gastroesophageal varices.

**Methods:** Seven patients with confirmed portal hypertension and a variceal bleeding history underwent mesocaval shunt with simultaneous polidocanol foam injection into the varices. Computed tomography and endoscopic reviews were conducted within two weeks following the procedures and around six months later.

**Results:** Six patients underwent side-to-side mesocaval shunt. One received a prosthetic mesocaval shunt. Polidocanol foam was injected into the gastric varices or the inferior mesenteric vein during the surgery. Surgical success and survival was achieved in all patients. Gastric ulcer formation and thrombocytopenia occurred in one patient respectively, which were ameliorated by conservative treatment. During 12 to 24 months' follow-up, three patients had obvious decrease or eradication of gastroesophageal varices; four patients had obvious decrease of gastric varices but residual esophageal varices; and all patients had unobstructed shunts. Encephalopathy occurred in one patient two months postoperatively. No sclerosant-related complications were observed and no postoperative recurrent variceal bleeding occurred.

**Conclusions:** Foam sclerotherapy during shunt surgery is safe and effective for portal hypertension and varices treatment.

**Keywords:** Portal hypertension; Gastroesophageal varices; Variceal bleeding; Foam sclerotherapy; Polidocanol; Shunt surgery

## 1 Introduction

Portal hypertension is a clinical syndrome that occurs when there is an increased resistance to blood flow in the portal venous system, causing the elevation in the pressure gradient between the portal vein and the inferior vena cava [1]. Portal hypertension can cause gastroesophageal varices and lead to variceal bleeding, which can be life threatening unless effectively controlled. Despite advancement in diagnostics and treatment, the mortality rate of patients with acute variceal hemorrhage can reach to 15-20% [2,3].

Currently, management of portal hypertension involves diverse treatments with drugs, endoscopic therapy, interventional therapy, surgery, and liver transplantation. Although minimal invasive treatments are developing rapidly, they have their limits. Endoscopic variceal ligation and endoscopic sclerotherapy are the first line treatments for acute gastroesophageal variceal bleeding or hemorrhage prophylaxis [4,5]. However, endoscopic therapy cannot reduce the high pressure of the portal venous system, and subsequent variceal re-bleeding may occur [6]. The transjugular intrahepatic portal-systemic shunt (TIPS) is an effective method to reduce portal venous pressure when endoscopy fails but this has a relatively high occlusion rate [7]. One other minimal invasive procedure is Balloon-occluded retrograde transvenous obliteration using foam sclerosant to control hemorrhage, however the method requires an autogenous gastrorenal shunt. Evidence indicates that the role of surgery including shunt surgeries and devascularization still cannot be replaced, especially in extra-hepatic portal hypertension [8,9].

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To date, the management of portal hypertension and its complications requires a multidisciplinary approach. To take advantage of current treatments, we conducted this study to evaluate the safety and efficacy of our modified operation by combining shunt surgery with foam sclerotherapy.

## 2 Material and methods

### 2.1 Patients

Nine consecutive patients diagnosed with portal hypertension and gastroesophageal varices, between February 2015 to January 2016, were considered for shunt surgery combined with foam sclerotherapy.

Inclusion criteria were the following: 1. Portal hypertension and varices confirmed by sonography, contrast-enhanced computed tomography (CT), and endoscopy; 2. Previous failure of endoscopic treatment or other interventional treatment; or repeated variceal hemorrhage; 3. Child-Pugh class A or B liver function.

Exclusion criteria were: 1. Combined serious comorbidities; 2. Patient refused surgery. Two patients were

excluded because one was complicated with renal carcinoma requiring simultaneous partial nephrectomy; the other refused operation. The other seven patients underwent shunt surgery combined with foam sclerotherapy and comprised the study group. Their medical records were retrospectively analyzed (Table 1).

Informed consent was also obtained from all patients before surgery. This study was approved by our institutional review board.

### 2.2 Procedures

All patients underwent a midline abdominal incision while under general anesthesia. After exploring the abdominal cavity and organs, the portal pressure was measured through the epiploic vein. A mesocaval shunt was then established by a side-to-side anastomosis, restricted to 1-cm – 1.5-cm in length, between the superior mesenteric vein and the inferior vena cava. In one case, an 8-mm in diameter prosthetic (W. L. Gore & Associates, Inc.) shunt was chosen because of the high-tension anastomosis between the two vessels. This was followed by exposing the gastric varices and foam sclerosant made up of 2-mL of 1% or 3% polidocanol (Aethoxsklerol, Kreuz-

**Table 1:** Clinical characteristics of patients

Patient No.	Age (y)	Sex	Diagnosis	Varices	Child-Pugh class	Previous variceal bleeding	Previous treatment
1	58	male	portal cavernoma	esophageal and gastric	A	yes	medication
2	60	male	portal cavernoma	esophageal and gastric	A	yes	endoscopic therapy
3	61	female	Budd-Chiari syndrome	esophageal and gastric	A	yes	medication
4	40	male	cirrhosis	esophageal and gastric	A	yes	interventional embolization
5	44	male	portal venous thrombosis	esophageal, gastric and rectal	A	yes	devascularization and endoscopic therapy
6	34	male	portal cavernoma	esophageal and gastric	A	yes	endoscopic therapy
7	49	female	portal venous thrombosis	esophageal and gastric	A	yes	medication

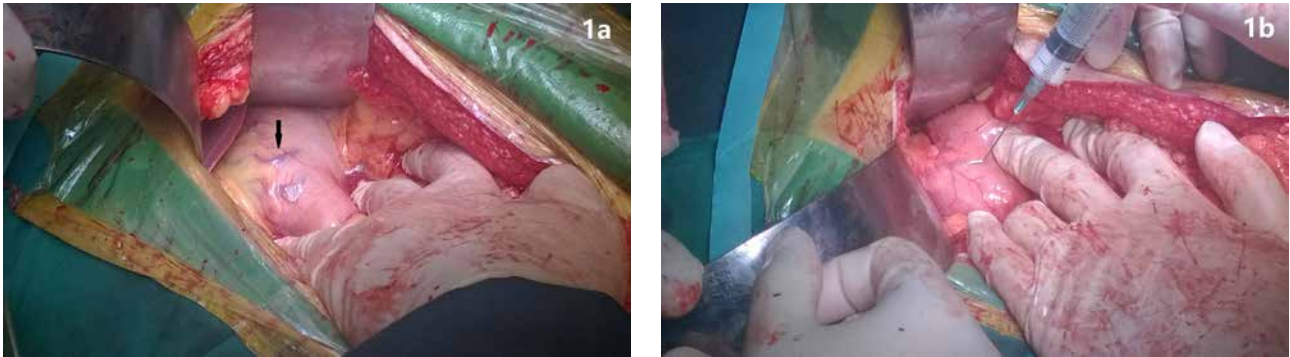
sler, Germany) mixed with 8-mL of air by using the Tessari method was injected into the varices with a 10-mL syringe [10] (Figure 1a, 1b). Soon after the injection, the puncture site vessel was ligated. Normally, 2-mL or 4-mL of 1% polidocanol are administrated to each varicose vein. However, if the varices exceed 6-mm in diameter, 3% polidocanol is applied. In one case, Sclerosant injection was assisted by introducing a catheter through the inferior mesenteric vein to the distal varices (Figure 2a, 2b). Finally, the portal pressure was measured again before closing the incision.

### 2.3 Investigation and follow up

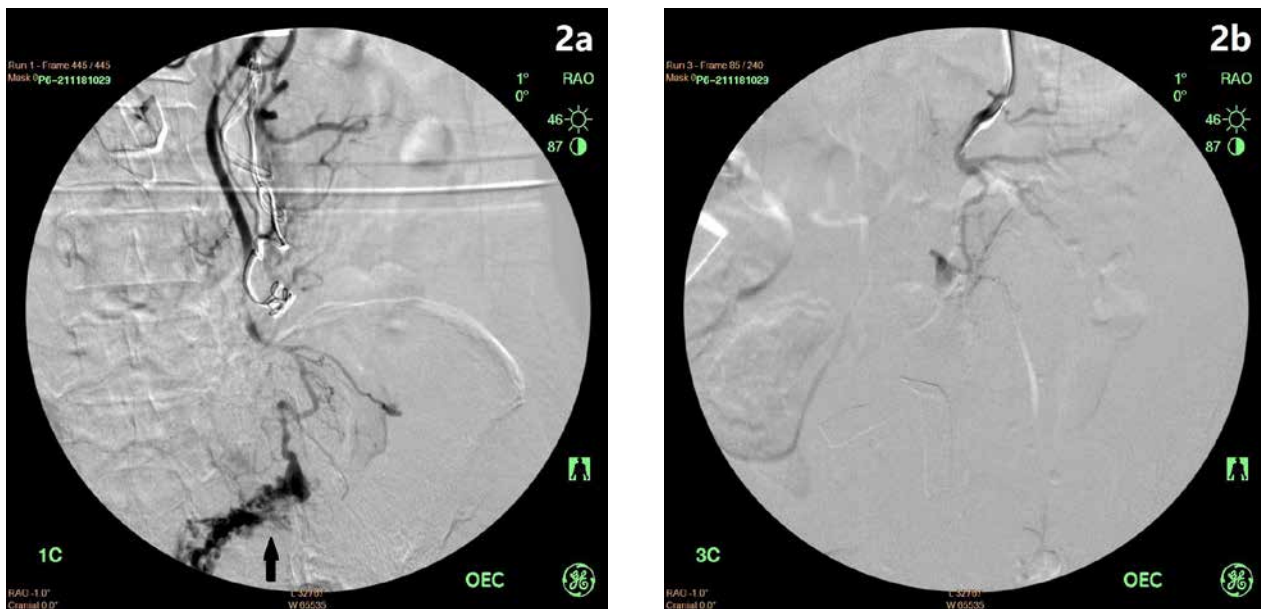
We reviewed the medical records of the 7 patients retrospectively. All patients underwent enhanced CT with or without endoscopic review within two weeks postoper-

atively and around six months after surgery. Laboratory tests, including liver function, routine blood tests, and blood ammonia levels were all obtained during hospital admission and outpatient reviews. Surgical success was defined as completion of the shunt surgery combined with foam sclerotherapy, without operation related deaths.

Meanwhile, treatment success was defined as an obvious decrease of the varices and an unobstructed shunt on CT or endoscopic reexamination and no variceal re-bleeding during the follow-up period. The free of variceal bleeding time and survival time were measured from surgery until the date the incident occurred or the last outpatient review or telephone contact.



**Figure 1:** Varicose veins before and after foam injection. a) Varicose veins at lesser gastric curvature (arrow). b) Occlusion of varicose veins after injection of Polidocanol foam.



**Figure 2:** Rectal varices before and after foam injection. a) Rectal varices (arrow) at intra-operative angiography via inferior mesenteric vein. b) Occlusion of rectal varicose veins after injection of Polidocanol foam..

### 3 Results

All patients underwent shunt surgery combined with foam sclerotherapy with a side-to-side anastomosis mesocaval shunt, except for one patient who received a prosthetic mesocaval shunt. Additionally, 1% polidocanol foam was injected into the gastric varices in seven patients; one of them was simultaneously injected with 3% polidocanol foam via a catheter inserted into the inferior mesenteric vein to seal the rectal varicose vein. The dosage of polidocanol injection ranged from 8-mL to 20-mL (average 12.1-mL). Surgical success was achieved in all patients, with no operative death.

Gastric bleeding occurred in one patient three days after surgery because of fundal ulcer formation, which was confirmed by endoscopic examination and was relieved by acid suppression and blood transfusion. Thrombocytopenia was observed in one patient postoperatively, leading to uncontrolled nasal bleeding. This was managed by plasma transfusion and local hemostasis therapy. No sclerotherapy-related complications were found postoperatively.

The follow-up time ranged from 12 to 24 months (average 15.7 months). During follow up, obvious reduction or eradication of the gastroesophageal varices was observed in three patients; obviously decreased gastric varices but residual esophageal varices was also observed in four patients (Figure 3a, 3b). The patient with rectal varices was found to have obviously decreased varices by colonoscopy; moreover, all shunts were patent until the last CT review. Therefore, treatment success was also achieved in all patients.

Lastly, encephalopathy presenting with lethargy was found to have occurred in one patient two months postoperatively and was relieved by ammonia-lowering and lactulose treatment without recurrence. No variceal re-bleeding occurred after surgery, and all patients were alive at the last follow-up time (Table 2).

### 4 Discussion

It is recognized that endoscopic therapy, including endoscopic variceal ligation and endoscopic sclerotherapy, is the first management choice for variceal hemorrhage caused by portal hypertension. However, recurrence of variceal bleeding is common and occurs in up to 70% of patients following medical and endoscopic treatment [11]. In addition, endoscopic treatment is not as effective for gastric varices as it is for esophageal varices [12], and

the risk of re-bleeding is significantly higher [13]. When endoscopic therapy is difficult or fails, TIPS or other interventional treatment, surgery, or liver transplantation can be effective methods to prevent gastric varices re-bleeding. Although TIPS can reduce the re-bleeding rate and is minimally invasive [14], the high occlusion rate is still a concern.

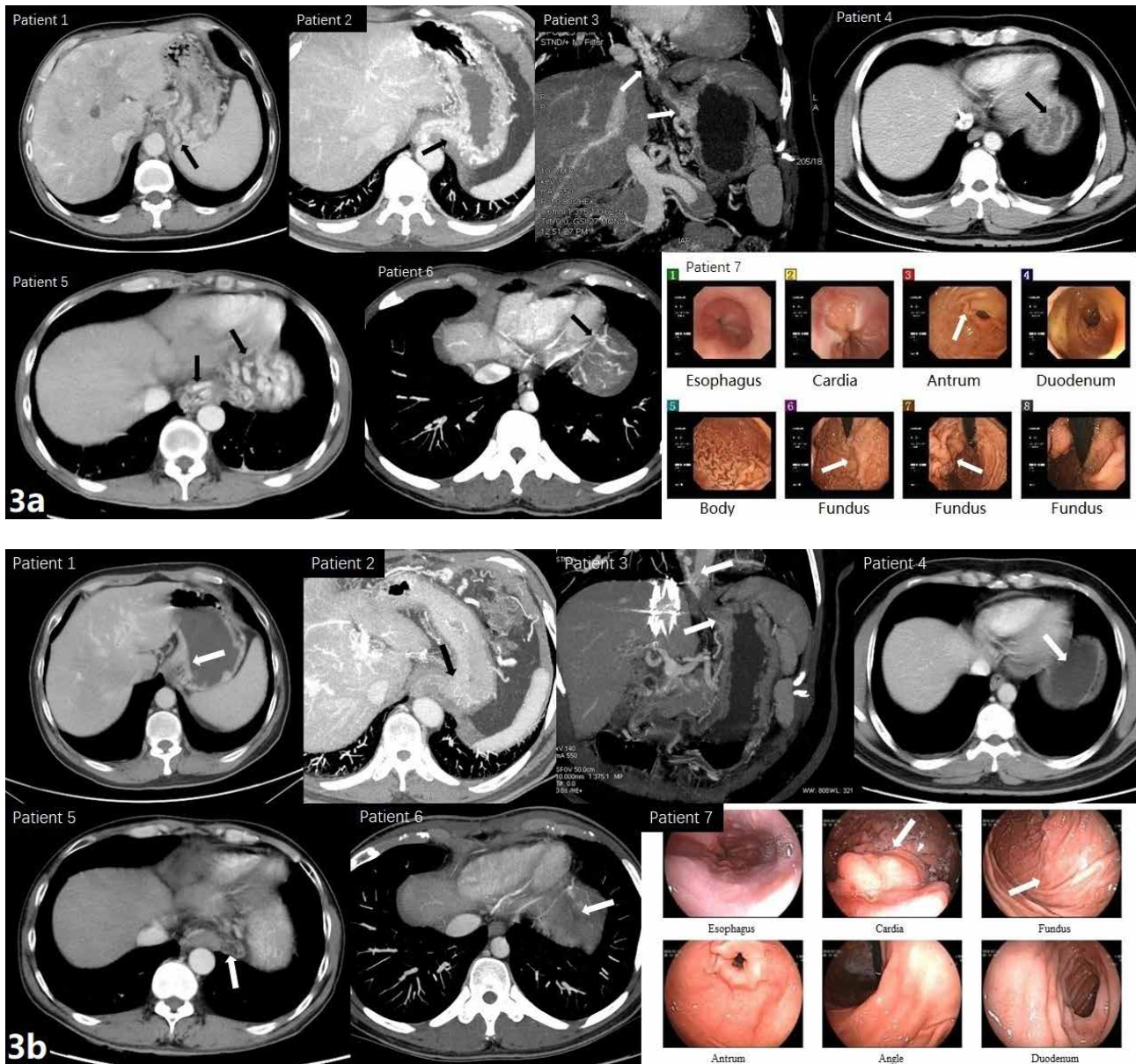
In a prospective randomized trial of 140 patients with Child-Pugh class A or B liver function the results revealed that distal splenorenal shunt and TIPS had similar rates of re-bleeding, encephalopathy, and survival. However, the rate of thrombosis, stenosis, and reintervention were much higher for TIPS (82%) than distal splenorenal shunt (11%) [7]. Liver transplantation seemed to be an ideal treatment for cirrhotic portal hypertension but this is limited by the short supply of donor livers.

Nowadays, both shunt and non-shunt surgeries are still used to prevent recurrent variceal bleeding. Shunt surgery is an effective method for decompression and hemorrhage prevention, although encephalopathy is a concern. Non-shunt surgery, including several types of devascularization, has a certain effect on hemostasis but a relatively high rate of variceal recurrence and re-bleeding due to unresolved high pressure in the portal venous system [15-17]. Considering their advantages and disadvantages, many surgeons have performed complex combined shunt and devascularization surgeries.

Feng et al [18]. performed a mesocaval C graft shunt, ligation of the gastric and coronary vein, and partial splenectomy in 140 patients. Their results were encouraging, as 100 patients were followed up for one month to six years, with no recurrent hemorrhage or encephalopathy. At our hospital, we have performed combined surgery for the past five years. Owing to most of our patients being diagnosed with portal venous thrombosis or cavernoma, we usually perform a mesocaval shunt procedure. To avoid excessive shunt flow causing encephalopathy, the shunt anastomosis was restricted of 1 to 1.5-cm in length, or an 8-mm graft was used to maintain sufficient hepatic blood flow. Since its decompressing effect was less than that of total shunt, combined gastric varices devascularization was a complementary method to ensure prevention of variceal re-bleeding.

However, an effective devascularization procedure is sometimes needed to extend the surgical field to expose the gastric fundus and esophagus, which may lead to increased trauma. To simplify the procedure, we attempted to substitute foam sclerotherapy for devascularization because of the following reasons: foam sclerosant not only occludes the main gastric vessel but also occludes the collaterals, even extending to the esophageal





**Figure 3:** Preoperative and reviewed enhanced CT or endoscopy images. a) Gastroesophageal varices at preoperative enhanced CT or endoscopy in 7 patients (arrows). b) Enhanced CT or endoscopy review of the 7 patients showing obviously decreased or eradicated gastric varices in all patients but residual esophageal varices in patient 3,4,5 and 7 after procedure (arrows).

vessels; some distal vessels such as rectal varices that are difficult to expose can be managed by catheter-guided sclerotherapy; the technique is easy to master; and Polidocanol foam is proved to be an effective and safe sclerosant used in the varicose veins of the lower extremities [19,20]. Compared with liquid sclerosants, polidocanol foam can reduce the amount of sclerosant needed and maximize the intimal irritation, causing vessel occlusion by increasing the contact surface area with the wall of the varices.

In terms of safety and efficacy, there were few complications reported after foam sclerotherapy with the recommended dose (2-mg/kg/day) by the manufacturer [21,22],

even with greater doses than what is recommended [23]. Several studies have shown polidocanol to be as effective as other sclerosants for the treatment of both esophageal and gastric varices [24,25]. There are reports of polidocanol foam used for balloon-occluded retrograde transvenous obliteration of varices via a gastrorenal shunt. The gastric variceal obliteration rate was from 91% to 100%, and re-bleeding occurred in one case during follow up. No severe sclerotherapy-related complications were observed [26-28].

In our study, gastroesophageal varices were obviously decreased or eradicated in three patients postoperatively.

Table 2: Postoperative results

Patient No.	Shunt type	Sclerosant injection site	Foam volume (mL)	Review		Post-surgery varices		Complications	Free of bleeding time (months)
				CT	Endoscopy	Gastric	Esophageal		
1	mesocaval	gastric vein	15	yes	refuse	decrease	decrease	no	24
2	mesocaval prosthetic graft	gastric vein	10	yes	yes	eradication	eradication	no	17
3	mesocaval	gastric vein	8	yes	refuse	decrease	persistence	no	16
4	mesocaval	gastric vein	10	yes	yes	eradication	persistence	no	14
5	mesocaval	gastric vein and inferior mesenteric vein	20	yes	yes	decrease of gastric and rectal varices	persistence	encephalopathy	14
6	mesocaval	gastric vein	12	yes	yes	decrease	decrease	gastric ulcer	13
7	mesocaval	gastric vein	10	yes	yes	eradication	persistence	thrombocytopenia	12

Although the other four cases had a decrease only in the gastric varices, it solved the problem, which often is the cause of re-bleeding after treatment. Following surgery, gastric bleeding occurred in one patient. However, endoscopy confirmed that this was not variceal bleeding but rather ulcer formation following endoscopic glue obturation, which had been reported as a severe complication related to glue embolization [29,30]. Despite this, no sclerosant-related complications were observed, and no recurrent variceal hemorrhage occurred during follow up, demonstrating that there is effectiveness and safety of shunt surgery combined with foam sclerotherapy.

This preliminary study was limited by its small sample size and the short-term outcomes. Due the domination of endoscopic therapy and interventional treatment, the demand for surgery has reduced considerably. However, based on the large number of patients in China, there are still enough patients suited for surgical treatment, which implies that large samples of patients may require such method in the future. Furthermore, a long-term investigation to monitor re-bleeding, encephalopathy, and survival rate should be continue.

## 5 Conclusion

Polidocanol foam injection of the varices is simpler in operating than conventional devascularization and provides confirmed variceal obliteration. The outcomes of

foam sclerotherapy during shunt surgery indicates short-term efficacy and safety for preventing variceal re-bleeding, with a low complication rate. Further investigation of long-term results in a large sample should be undertaken.

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**Conflict of interest statement:** Authors state no conflict of interest.

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