—Original Article—

EUS-guided coil placement and cyanoacrylate glue injection for gastric variceal bleeding with obvious spontaneous portosystemic shunts

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ABSTRACT

Background and Objective: Ectopic embolism caused by cyanoacrylate glue for the treatment of gastric varices with obvious spontaneous portosystemic shunts is a serious complication of endoscopic therapy. This study was performed to investigate the safety and therapeutic effect of EUS-guided coil placement and cyanoacrylate glue injection for gastric varices with obvious spontaneous portosystemic shunts. **Materials and Methods:** Six patients with gastric variceal bleeding and obvious spontaneous portosystemic shunts were included in this study. We evaluated the success rate of variceal occlusion after intraoperative embolization, the postoperative rebleeding rate at 48 h and 2 weeks posttreatment, and the incidence of ectopic embolism and other adverse events. Gastroscopy and computed tomography portal venography (CTPV) were performed 7 months later. **Results:** All patients underwent successful coil placement and cyanoacrylate glue injection under EUS guidance. The blood flow was confirmed by Doppler examination, the target vessels were successfully blocked, and no rebleeding had occurred at 48 h or 2 weeks after endoscopic treatment. Gastroscopy was repeated 7 months after endoscopic treatment, revealing local ulcer formation. CTPV was also repeated 7 months after endoscopic treatment, showing that the coils were present in the target vessels with no displacement, the portosystemic shunt vessels were occluded, and no ectopic embolization had occurred. **Conclusion:** The coil placement combined with cyanoacrylate glue embolism is a safe and effective method for patients with gastric variceal bleeding and obvious spontaneous portosystemic shunts.

Key words: coil, cyanoacrylate glue, EUS, gastric varices, spontaneous portosystemic shunts

INTRODUCTION

Cirrhosis-induced esophageal and gastric variceal bleeding is a serious complication with high mortality.[1] Esophageal and gastric varices can lead to a gastrorenal shunt or splenorenal shunt.[2,3] The therapy for esophageal and gastric variceal bleeding

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includes medical, endoscopic, interventional, and surgical treatments.[4] Ectopic embolism caused by cyanoacrylate glue is a serious complication of endoscopic therapy;[5] patients with spontaneous portosystemic shunts have a higher possibility of postoperative ectopic embolization.[6] Coils are often used for endovascular embolization in such cases.[7] We report EUS-guided coil placement in combination with cyanoacrylate glue embolization in patients with gastric varices and spontaneous portosystemic shunts.

MATERIALS AND METHODS

Study design

This retrospective analysis involved six patients who were diagnosed with cirrhosis, portal vein hypertension, gastric variceal bleeding, and obvious spontaneous portosystemic shunts from December 2020 to October 2021 and treated with EUS-guided coil placement combined with cyanoacrylate glue embolization.

Patient selection

Patients who met the following inclusion criteria were enrolled: (1) recent bleeding, (2) obvious spontaneous portosystemic shunts (shunt diameter of >4 mm)[8] were confirmed by computed tomography portal venography (CTPV), and (3) written informed consent to undergo EUS-guided coil placement combined with cyanoacrylate glue embolization.

Exclusion criteria

Patients who met the following criteria were excluded: (1) the presence of hepatorenal syndrome or multiple organ failure, (2) serious heart and lung disease, (3) the presence of other diseases that increase the risk of embolism, and (4) previous endoscopic or surgical treatment.

Endoscopic procedures

All patients were treated with conventional drugs before endoscopic therapy and underwent appropriate blood volume recovery. When the patients' vital signs were stable, the diameter of the spontaneous portosystemic shunts (including splenorenal and gastrorenal shunts) was detected by CTPV.[9] General anesthesia was induced during endoscopic therapy. The coil was selected based on the diameter of the varix to be punctured. For obvious portosystemic shunts which could be seen on CTPV, the diameter of the coil should be more than 1.2 size of the shunt.[10,11]

The specific operation steps were as follows:

1. General gastroscopy was performed to assess the patients' esophageal and gastric varices.[12] The esophageal and gastric varices were graded according to the morphology of the varices, presence of red signs, and risk of bleeding[13]
2. An EUS device (FUJIFILM580UT) was used for observation. The scope was inserted into the stomach, which was then filled with water; the scope was then pulled back to the lower esophagus to facilitate localization of the gastric varices on the ultrasound display
3. Color Doppler was used to understand the structure of the varices, measure the maximum diameter of the varices, and select the maximum diameter to locate the target vessel for puncture[14]
4. The specifications of the coils were MWCE-35-14-10-NESTER and MWCE-35-14-12-NESTER. The nurse preinstalled the appropriate coil after completing the EUS examination and selected the best puncture site. On a sterile treatment table, the needle was removed and the needle core was pulled out. One end of the coil sheath was connected to the tail of the needle, and the length of the coil was released to ensure that the coil was located at the front end of the puncture needle and was not revealed[15]
5. A 19G puncture needle (Cook Medical) was used to enter the target vessel in the lower esophagus, and a Nester coil (Cook Medical) was placed in the gastric varices. After the coil was released in the varices, the needle core was quickly pulled out, and cyanoacrylate glue was injected using the "sandwich" method[16]
6. The protocol for repeat glue injection was that the needle was kept inside the varix after the first injection, and based on Doppler, a second injection was made through the same needle.[17] For patients with moderate and severe esophageal varices, endoscopic variceal ligation (EVL) was performed after successful placement of a coil and injection of cyanoacrylate glue.

Postoperative treatment

All patients underwent electrocardiographic monitoring, intravenous infusion of proton-pump inhibitors, appropriate intravenous transfusion, and fasting for 24 h. If no active bleeding or ectopic embolization was present, a cold fluid diet was permitted after the 24-h fast.

Observational indicators

The diameter of the spontaneous portosystemic shunts was shown by CTPV, and the maximum diameter of

the gastric varices was shown by EUS. The diameter of the coil used and the dosage of cyanoacrylate glue used were recorded. The rebleeding rate at 48 h and 2 weeks and the incidence of other adverse events, such as ectopic embolization, were determined. The incidence of coil displacement was recorded, and the condition of variceal occlusion was evaluated by CTPV 7 months after endoscopic treatment. The success rate of target vascular occlusion was calculated, and the gastric varices were evaluated by gastroscopy 7 months after endoscopic treatment.

RESULTS

Conditions of gastric varices and spontaneous portosystemic shunts

Six patients underwent EUS-guided coil placement combined with cyanoacrylate glue injection. The patients comprised three men and three women with an average age of 50 years (range, 31–77 years). CTPV showed that three patients had a gastrorenal shunt, two patients had a splenorenal shunt, and one patient had both a gastrorenal shunt and a splenorenal shunt. The gastroesophageal varices (GOV) were typed by the Sarin classification.[12] Among the six patients, three had GOV1 (esophageal varices extending to 2–5 cm below the gastroesophageal junction), two had GOV2 (esophageal varices extending to the gastric fundus), and one had isolated gastric varices (IGV1).

Variceal treatment and follow-up

All patients underwent successful coil placement and cyanoacrylate glue injection under EUS guidance. Among five patients with esophageal varices, three had moderate esophageal varices and underwent concurrent EVL. Two patients with mild esophageal varices did not undergo endoscopic treatment [Table 1]. The procedures were smoothly completed in all six patients with varices, and gastric variceal obliteration was confirmed by Doppler examination after cyanoacrylate glue injection in all patients. No rebleeding occurred within 48 h postoperatively, and no other adverse events such as rebleeding or ectopic embolism occurred for 2 weeks postoperatively [Figure 1]. CTPV performed 7 months after endoscopic treatment showed that the coil was still within the target vessel with no displacement. The blood flow had disappeared from the target varices in all patients and was successfully blocked. Gastroscopy performed 7 months after endoscopic treatment revealed local ulcer formation [Figure 2].

DISCUSSION

The most common cause of portal hypertension is cirrhosis after hepatitis, and a main manifestation of this condition is compensatory opening of the collateral circulation. Cirrhosis-induced portal hypertension with gastric varices can become complicated by the development of spontaneous portosystemic shunts. Esophageal and gastric varices can lead to the formation of a gastrorenal or splenorenal shunt, which becomes interlinked with the systemic circulation.[18] The clinical significance of spontaneous portosystemic shunt formation is that on the one hand, the shunt can share part of the portal vein pressure, whereas on the other hand, gastric variceal bleeding after the formation of the shunt channel increases the risk of ectopic embolization during endoscopic embolization treatment, and the formation of spontaneous portosystemic shunts channel makes the treatment of gastric variceal bleeding very difficult.[19] A study of 700 patients with cirrhosis combined with portal hypertension demonstrated spontaneous portosystemic shunts in 16.86% of patients (gastrorenal shunt in 7.14% and splenorenal shunt in 8.43%).[20] Of the six patients in the present study, three had GOV1, two had GOV2, and one had IGV1, and all six had a significant spontaneous portosystemic shunt. The traditional approach for endoscopic treatment of bleeding from gastric varices

Table 1. Treatment of gastric variceal bleeding by embolization combined with EUS-guided coil placement with cyanoacrylate glue injection

Case	The degree of esophageal varices	Red sign	Type of gastric varices	Active bleeding	Maximum diameter of gastric varices (cm)	Diameter of shunt (mm)	Diameter of coil used (mm)	Number of coils used	Amount of cyanoacrylate glue used (mL)
1	No	Negative	IGV1	No	5.1	4.1	10	2	1.5
2	Moderate	Negative	GOV1	Yes	4.3	4.2	10	1	2.0
3	Moderate	Negative	GOV1	Yes	5.3	6.5	12	2	2.5
4	Mild	Negative	GOV2	No	4.3	6.6	12	1	1.5
5	Moderate	Positive	GOV2	No	5.6	4.1	10	2	2.0
6	Mild	Negative	GOV1	No	7.1	7.2	12	2	2.0

IGV1: Isolated gastric varices; GOV1: Gastroesophageal varices extending to 2-5cm below the gastroesophageal junction

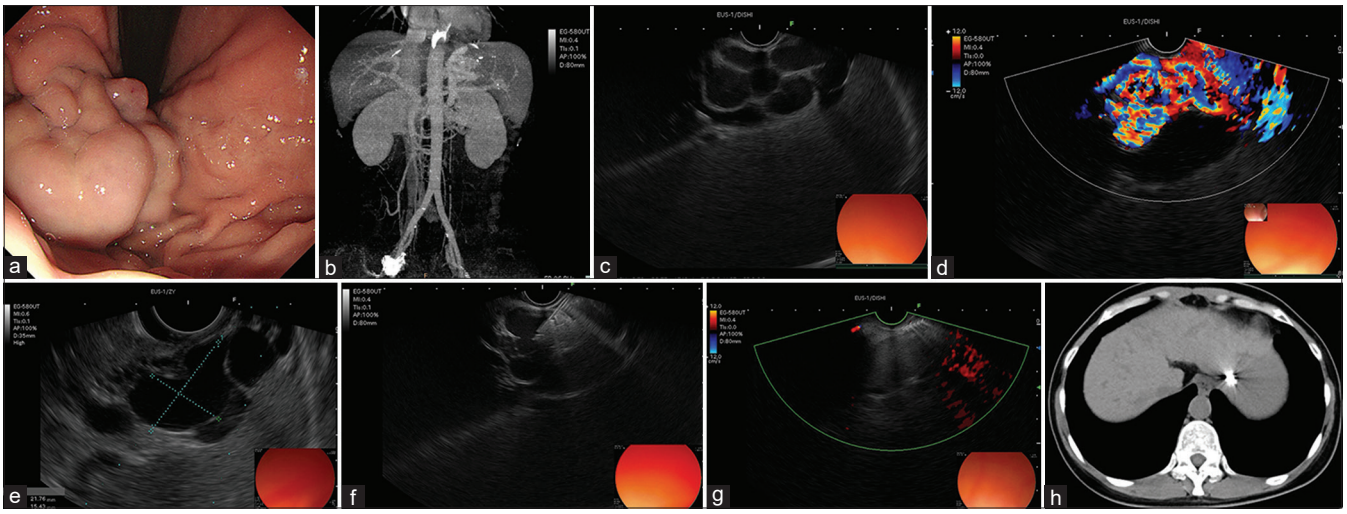

Figure 1. EUS-guided coil placement combined with cyanoacrylate glue injection. (a) Gastric varices with erosion, a sign of recent bleeding, (b) CTPV indicated portal hypertension combined with an obvious gastrorenal shunt, (c) EUS showed multiple echo-free areas with a maximum diameter of 5.3 cm × 2.7 cm at the gastric varices, (d) Doppler examination showed a rich blood flow signal, (e) Measurement of the maximum diameter of the target varices, (f) A 19G needle (Cook Medical) was used to puncture the gastric varices under ultrasound guidance at the lower esophagus, and the coil was released after successful puncture, (g) After coil placement and cyanoacrylate glue injection, Doppler examination showed that the blood flow signal of the varices had disappeared, (h) Postoperative computed tomography showed that the coil was located at the gastric varices, with no displacement. CTPV: Computed tomography portal venography

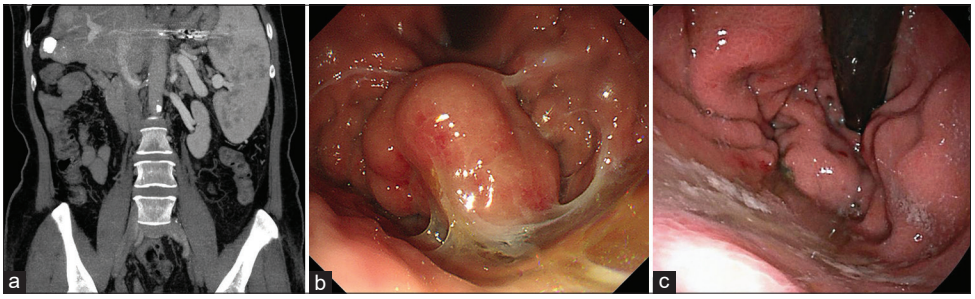

Figure 2. CTPV and gastroscopy 7 months after treatment. (a) CTPV 7 months after treatment showed that the splenorenal shunt had disappeared, (b) Gastroscopy showed gastric varices before treatment, (c) 7 months after treatment, gastroscopy showed that an ulcer had formed at the gastric varices, and the gastric varices had substantially decreased in size. CTPV: Computed tomography portal venography

is cyanoacrylate glue injection; however, in patients with gastrorenal and/or splenorenal shunts, ectopic embolism such as cerebral or pulmonary embolism can be fatal.[21]

EUS is an examination technique that combines endoscopy and ultrasound. It is being used increasingly more frequently in patients with liver disease and portal hypertension. EUS can detect the degree of GOV and whether an accessory vein is present. It can also identify the connected GOV according to the continuity of blood flow, accurately locate the GOV site, and directly target the treatment site.[22] Bhat *et al.* performed a 6-year retrospective study to observe whether EUS-guided placement of coils into closed vessels is safe and effective. The study included 152 patients, including those with varices and acute bleeding. Of these patients, 151 underwent successful treatment (the varices disappeared or hemostasis was achieved), for a success rate of 99%. This study showed that ultrasound-guided coil placement combined with cyanoacrylate glue injection is safe and effective with a very high success rate.[23] Regular endoscopic follow-up with ultrasound not only facilitates evaluation of variceal closure but also allows for observation of variceal recurrence and administration of direct treatment. This combination reduces the risk of ectopic embolism. EUS can also be used to evaluate whether blood vessels have been occluded after cyanoacrylate glue treatment, reducing the incidence of postoperative bleeding and ectopic embolization.[24]

Six patients in the present study successfully underwent EUS-guided coil placement combined with cyanoacrylate glue injection. Computed tomography of pulmonary artery confirmed obvious spontaneous portosystemic shunts in all patients. Three patients had severe esophageal varices, and EVL was performed

during endoscopic treatment. Doppler examination confirmed that the gastric variceal blood flow had disappeared in all patients, successful occlusion of target vessels was achieved, and active bleeding was controlled. No rebleeding had occurred at 48 h after endoscopic treatment, and no patients had developed any other adverse events such as rebleeding or ectopic embolization 2 weeks later. CTPV was repeated 7 months after endoscopic treatment, and the coil left in the target vessels showed no displacement. The blood flow of the target varices in all patients had disappeared and was successfully blocked.

Based on our experience, we have three recommendations regarding this treatment procedure. First, this technique is applicable to gastric varices combined with obvious spontaneous portosystemic shunts and huge gastric varices (diameter of >3 cm) without a shunt. Second, when determining the best path to the varices, the widest inner diameter should be selected as the target vessel, the shortest puncture path should be chosen, and the puncture path should avoid the vessels. Third, the specifications of the coil should be selected according to the expected size of the coil and the inner diameter of the shunt. Generally, the diameter of the coil should be more than 1.2 times the size of the shunt.

Common complications and their prevention are as follows. To prevent sepsis and/or bacteremia, the operation should be performed in strict accordance with the requirements of an aseptic operation. To avoid coil displacement, the diameter of the coil should be greater than the inner diameter of the shunt. To prevent ectopic embolism, the cyanoacrylate glue injection speed should be slowed down, and the "modified sandwich" method of polycinnamyl alcohol—cyanoacrylate-polycinnamyl alcohol can be used to reach the shunt inlet under EUS.

This technology has several major advantages. First, it can achieve accurate positioning, the degree of varices can be detected by EUS, and the shunt branch can be found according to the continuity of blood flow. This allows for precise positioning of the site of the varices and achievement of direct-targeted therapy. Second, this technique reduces the amount of cyanoacrylate glue used. Third, it is beneficial in assessing the prognosis. Using EUS after endoscopic treatment can accurately and immediately assess the degree of vascular closure after endoscopic therapy. Fourth, it allows for a safe operation because the puncture is placed at near-diaphragm horn through the lower esophagus. Fifth, the procedure is not affected by the gastric contents or by coverage of the target varices in the visual field by blood clots during active bleeding. Sixth, radiation use is not required, thus eliminating the risk of radiation injury. Finally, both endoscopy and ultrasound are within the field of digestive endoscopy, and no X-ray equipment is required; a single department can complete the operation independently.

In summary, EUS-guided coil placement combined with cyanoacrylate glue injection in patients with gastric varices and spontaneous portosystemic shunts can reduce or even eliminate the risk of ectopic embolism, and the therapeutic effect and safety are satisfactory. However, randomized controlled studies with large samples are required for further confirmation, and evaluation of the long-term treatment effects requires longer and more intensive follow-up.

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Conflicts of interest

There are no conflicts of interest.

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