



Safety and Efficacy of Novel Cost-Effective EUS Coiling and Glue Technique for the Management of Large Gastric Varices: A Long-Term Follow-up Study

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Abstract

Aims and Objective Mortality by gastric variceal bleeding can reach up to 30%. Gastric varices can be treated by either direct endoscopic glue or endoscopic ultrasound (EUS) coiling + glue injection. Now, enough data show that EUS coil + glue is an effective option for large varices. However, it is a costlier option than direct endoscopic glue injection. In our study, after putting the coil under EUS guidance, direct endoscopic glue injection is done with a 21G sclerotherapy needle. Since the EUS needle was not used for the glue injection, it can be reused for up to three cases for deployment of the EUS coil, hence reducing the cost of the whole procedure. In short, our study aims to find the safety and efficacy of a cost-effective method of EUS coiling + glue injection in a cohort of the Indian population.

Material and Methods Retrospective review of prospectively collected data on EUS coiling + direct endoscopic glue injection over a period spanning from July 2017 to December 2023 from a tertiary care center in North India.

Results A total of 103 patients (gastroesophageal varices type 2, GOV2 [$n = 82$] and isolated gastric varices type 1, IGV1 [$n = 21$]) were taken up for the study. Among the 103 patients, 74 patients were males and 29 were females. The mean follow-up duration of the study population was 34.2 ± 21 months. The average size of the varix was 2.3 cm. The average number of coils was 3.3 and the volume of injected glue was 3.1 mL. In our study, 4 out of 103 patients had rebleeding, but the cause of rebleeding turned out to be nonvariceal. Regarding the intraprocedural and postprocedural adverse events, 1 out of 103 patients in our study experienced abdominal pain and fever, which responded to oral analgesics and antipyretics. There was no active bleeding from the puncture site or evidence of systemic embolization. Technical

Keywords

- ▶ EUS coil
- ▶ gastric varices
- ▶ rebleeding

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success was 100% in our study. Reuse of needles was not associated with any increment in risk of infection.

Conclusion EUS coiling + direct endoscopic glue injection is a safe and effective endoscopic therapy for large gastric varices with sustainable long-term beneficial effects with a negligible amount of rebleeding. Direct endoscopic injection of glue following EUS coiling with a 21G sclerotherapy needle can significantly reduce the cost of the procedure without any risk of infection.

Introduction

Gastroesophageal varices are seen in up to 50% of cirrhosis patients.¹ Gastric and esophageal varices are the major cause of gastrointestinal bleeding in cirrhosis patients. Among them, esophageal varices are the major contributors to upper gastrointestinal bleed. Even though gastric variceal bleeding is less than esophageal variceal bleeding, it poses more morbidity and mortality.² Mortality by gastric variceal bleeding can reach up to 30%.³ Approximately, 20% of cirrhosis patients will have gastric varices.⁴ Gastric varices contribute to 10 to 30% of gastroesophageal variceal bleeding. Other than cirrhosis, the different causes of gastric varices are noncirrhotic portal hypertension, extrahepatic portal vein obstruction (EHPVO), and splenic vein thrombosis. In these situations, the chances of isolated gastric varices are higher. Management of gastroesophageal varices evolved over the period. Esophageal variceal ligation became the treatment of choice for esophageal varices. Treatment of gastric varices has been injection of glue (histoacryl and cyanoacrylate).⁵⁻⁹ Problems with glue injections are as follows:¹⁰⁻¹³

1. Systemic embolization of glue.
2. Deep ulceration at the injection site that can lead to rebleeding.

Because of these adverse effects, endoscopic ultrasound (EUS)-guided coiling with or without glue injection was tried as an alternative to direct endoscopic glue injection. Studies have shown that EUS coiling with glue injection is superior or noninferior to direct endoscopic glue injection with a reduced rate of systemic embolization of glue.¹⁴ The only drawback of studies comparing EUS coil with glue and direct endoscopic glue injection is that almost all of the studies were from select centers with particular expertise. However, a recent multicenter study published by Bazarbashi et al showed that there was no significant difference between high-volume centers and low-volume centers as far as technical success and long-term outcomes of EUS coiling and glue were concerned.¹⁵ There is only limited data from the Indian population on EUS coiling plus glue injection for gastric varices.¹⁶ Secondly, the EUS coiling + glue technique is quite an expensive option than direct endoscopic glue injection. In our study, after putting the coil under EUS guidance, direct endoscopic glue injection is done with a 21G sclerotherapy needle. Since the EUS needle was not used for the glue injection it can be reused for up to three cases for deployment

of the EUS coil, hence reducing the cost of the whole procedure.

In short, our study aims to find the safety and efficacy of a cost-effective method of EUS coiling + direct endoscopic glue injection in a cohort of the Indian population.

Materials and Methods

A retrospective review was conducted on prospectively collected data from the department of gastroenterology at a tertiary care hospital in North India over a period from July 2017 to December 2023. Baseline clinical and laboratory parameters were obtained from medical records. The etiology of gastric varices and Child status of cirrhosis patients were also obtained from medical records. Sarin's classification was used to classify gastric varices.

Inclusion Criteria

1. Patients with > 1 cm gastroesophageal varices (GOV) type 2 or isolated gastric varices (IGV) type 1 who were willing to consent.
2. Bleeding gastric varix or signs of recent bleeding on gastric varix.
3. Age > 18 years.

Exclusion Criteria

1. Age < 18 years.
2. Not willing to consent.
3. Small gastric varices.
4. Advanced hepatocellular carcinoma (Barcelona Clinic Liver Cancer [BCLC] staging system stage C or D).
5. Advanced splenoportal venous thrombosis (portal vein and splenic vein, or portal vein and superior mesenteric vein).
6. Portosystemic shunting, especially hepatopulmonary syndrome or intracardiac shunt increases the probability of systemic embolization.

The Technique of EUS Coiling and Glue

Before the procedure, the whole portosystemic shunts were assessed by using CT portography. All procedures were performed under general anesthesia without endotracheal intubation, and endoscopists were trained in interventional gastroenterology. All patients underwent upper endoscopy (GIF-HQ190; Olympus) before EUS. The linear echoendoscope (GF-UCT180; Olympus) was positioned in the distal

esophagus or gastric cardia to evaluate the gastric fundus, intramural varices, and feeder vessels. Water was instilled into the gastric fundus with the patient shifted to the left lateral decubitus to optimize acoustic coupling and sonographic assessment of the gastric variceal (GV) vessels. EUS coiling was done either transesophageal-transcureal approach or the transgastric approach. The varix was punctured by a standard fine needle aspiration (FNA) needle (19 G Expect needle, Boston Scientific). Given the serpiginous path of the GV vessels, oftentimes, the needle punctured the vessel wall multiple times en route to its target, and in such case, proximal varices were targeted first, followed by the distal varices. Coils (Cook Medical) were deployed using the stylet as a “pusher” under EUS guidance. Initially, the coil diameter was selected according to the short axis diameter of the varix (at least 30% larger); later, the coil diameters of 10 to 20 mm were used indiscriminately. The coil was deployed into the vessel lumen with three criteria in mind:

1. Reduction/cessation of the Doppler flow.
2. Dense “packing” achieved on EUS.
3. Resistance to stylet advancement.

After the deployment of coils, in the same settings, direct endoscopy-guided glue (*N*-butyl cyanoacrylate) was injected through the injector (21G sclerotherapy needle) into gastric varices by using Olympus GIF-HQ190 forward viewing scope. Since the EUS needle was not used for the glue injection, it can be reused for an additional two or three cases for deployment of the EUS coil, hence reducing the cost of the whole procedure.

After the procedure, hemostasis was ascertained in endoscopic view, and the flow of the blood in the varix was checked by doing EUS with Doppler. There should be a lack of

active bleeding and absent flow during Doppler examination (► **Fig. 1**). Diet was usually resumed 6 hours after the procedure, as it was done under anesthesia. Initially, a clear liquid diet was started and upgraded as tolerated. Hemoglobin was monitored. Standard medical management was followed as per the clinical protocols for the underlying disease. Repeat endoscopy after 4 weeks was usually scheduled to assess the presence of residue varices.

The indications of EUS coiling + direct endoscopic glue were similar to previous studies, including active variceal bleed, primary prophylaxis (for large varix, high-risk stigmata, and Child C cirrhosis), as well as rescue and rebleeding (when endoscopic glue fails to control bleed or rebleed after initial control). Technical success of the procedure was defined as complete solidification of varix on probing after direct endoscopic glue injection and absent flow during EUS Doppler examination. Clinical success was defined as complete solidification of varix on probing after direct endoscopic glue injection and absent flow during EUS Doppler examination along with hemodynamic stability without the need for further endoscopic or interventional radiology treatment. Patients were also observed for intraoperative and postoperative adverse events. The patients were followed up every week with clinical examination and CBC (complete blood count) and CRP (C-reactive protein) were done to look for signs of sepsis for 1 month.

Statistical Analysis

Continuous data were expressed as median and range or mean and standard deviation based on a test of normality. Categorical data were expressed as frequency and percentage. Univariate analysis was done using a *t*-test. A *p*-value

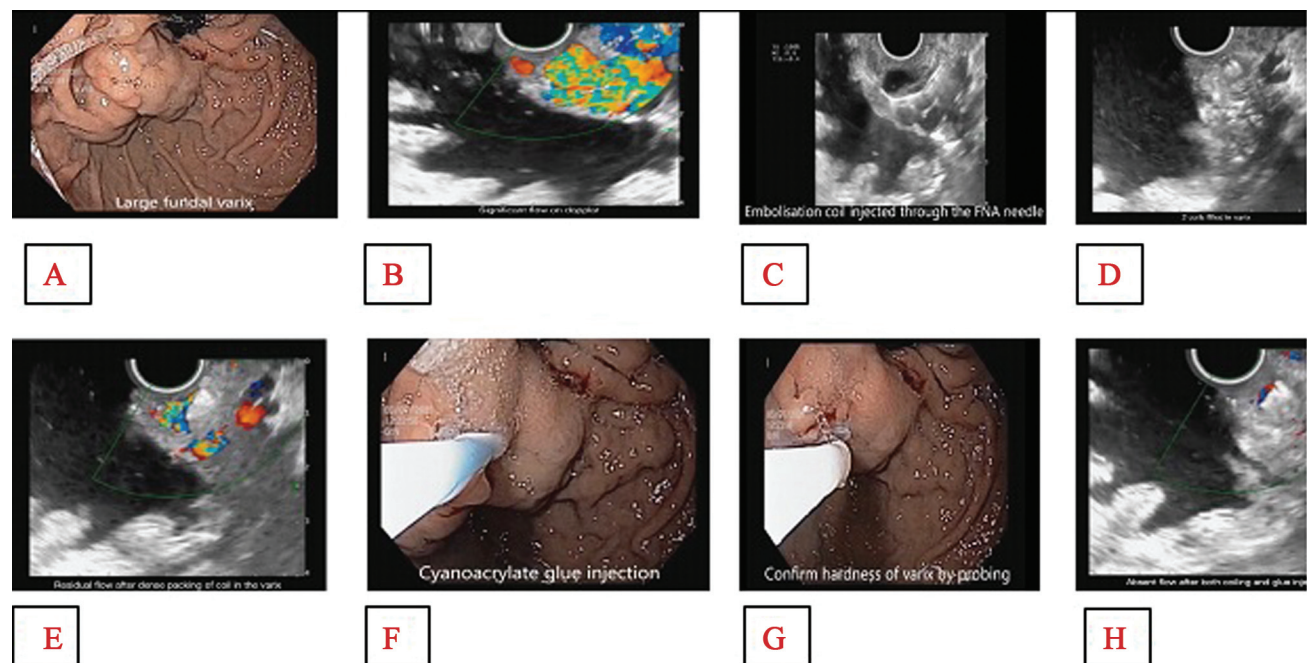


Fig. 1 Steps of EUS coiling and glue. (A) Large fundal varix. (B) Significant flow in doppler. (C) Coil injected through FNA needle. (D) Coil inside the varix. (E) Residual flow in varices. (F) Cyanoacrylate glue injection. (G) Confirm hardness of varix by probing. (H) Absence of flow in varix after coiling and glue injection. EUS, endoscopic ultrasound; FNA, fine needle aspiration.

Table 1 Rebleeding among the study population, child status among the study population, cirrhosis versus noncirrhosis in the study population, and sex distribution among the study population

	Level	Count	Total	Proportion
Rebleeding	No	99	103	0.961
	Yes	4	103	0.039
Child status	A	26	97	0.268
	B and C	71	97	0.732
Cirrhosis or noncirrhosis	Cirrhosis	97	103	0.942
	NCPF and EHPVO	6	103	0.058
Sex	Male	74	103	0.718
	Female	29	103	0.282

Abbreviation: EHPVO, extrahepatic portal vein obstruction. Note: etiology: ethanol 45% > NASH 26% > HBV & HCV 13% > AIH 10% > noncirrhotics 6%.

< 0.05 was considered to be statistically significant. Statistical analyses were performed using Jamovi software version 2.4.14.

Results

A total of 103 patients were taken up for the study, with a mean age of 51.7 years. Of these, 74 patients were males and 29 were females. Among the 103 patients, 97 had cirrhosis (ethanol being the most common etiology), and 6 patients had NCPF or EHPVO. Of the cirrhotic patients, 82 patients had GOV2 and 21 had IGV1. A total of 40 patients died during the study. Among the 97 cirrhotic patients, 26 patients had Child A cirrhosis and 71 had non-Child A cirrhosis (Child B or Child C). Rebleeding occurred only in 4 patients out of 103 total patients (►Table 1). Causes of rebleeding were Gastric antral vascular ectasia (GAVE) in 2 patients and minor bleeding from the coil or glue ulcer site in the other 2 patients.

The mean follow-up duration of the study population was 34.2 ± 21 months (►Table 2).

Death rate was more in non-Child A cirrhosis compared with Child A cirrhosis (►Table 3).

Table 2 Duration of follow-up in the study population

	MONTHS
Total number of patients	103
Missing	0
Mean	34.2
Median	29
Standard deviation	21.0
Minimum	5
Maximum	84

Table 3 Death among various child status

Child status	Deceased	Counts	% Of total
A	No	18	18.6%
	Yes	8	8.2%
B and C	No	39	40.2%
	Yes	32	33.0%

Table 4 Number of coils used

	Number of coils	Number of patients	Proportion
Number of coils	<3 coil	41	0.893
	3–6 coil	57	0.553
	>6	5	0.048

Table 5 Average numbers of coils, glue, varix size, type of varix, and average procedure time

Average number of coils	3.3
Average amount of glue	3.1 mL
Average varix size	2.3 cm
Type of varix	IGV1 (n = 74, 70%); GOV2 (n = 29, 30%)
Average procedure time	26 min

Line Removed

The minimum number of coils used was 1 and the maximum number used was 11 (►Table 4).

The average number of coils was 3.3, and the amount of glue was 3.1 mL in this study. The average size of varices was 2.3 cm (►Table 5).

Cost-Effective Analysis

In the recommended technique of EUS coil and glue, we inject coil and glue with the same FNA needle and after that needle cannot be reusable. The cost of the FNA needle is around 25,000 INR (Indian rupee) in our center, but if we use this novel cost-effective technique of EUS coil and glue, in which we do EUS coiling with FNA needle and glue injection by direct endoscopy, we can save the needle and can use in up to 3 more times in EUS coiling procedure except in case of hepatitis B and C. Cost of EUS FNA needle can reduce up to 4 times per procedure (25,000/4 = 6,250 INR). In our study, the average amount of glue was 3.1 mL, for which an average of 3 sclerotherapy/glue injectors were required. The cost of a sclerotherapy injector is around 1,000 INR in our center, so the cost of an injector per procedure is around 3,000 INR (3 × 1,000 INR). The cost for an FNA needle and glue injector in the cost-effective EUS coil and glue technique is around 9,250 INR (6,250 + 3,000). The financial burden can reduce up to 15,750 INR per procedure (25,000–9,250 = 15,750 INR) by using cost-effective EUS coil and glue technique. After

excluding hepatitis B and C patients ($n = 13$), in the remaining 90 patients, we have reduced the financial burden by 1,417,500 INR without any increment in any complication like infection.

Discussion

The major drawback of studies comparing EUS coiling with glue and direct endoscopic glue injection is that almost all of these studies were conducted at selected centers with particular expertise. There is limited data available from the Indian population on the use of EUS coiling plus glue injection for gastric varices.¹⁶ Moreover, in our study, after putting Coil under EUS guidance, direct endoscopic glue injection is done with a 21G sclerotherapy needle. Since the EUS needle was not used for the glue injection, it can be reused for an additional one or two cases for deployment of the EUS coil, hence reducing the cost of the whole procedure. In short, our study aims to find a cost-effective method of EUS coiling + glue injection in a cohort of the Indian population.

The total number of patients in our study population was 103 patients with a mean age of 51.7 years. Of them, 74 were males and 29 were females. In a multicenter study by Bazarbashi et al, 106 patients were taken up for the study, with a mean age of 60.4 + 20.8 years. Out of these, 41.5% were females and 59.5% were males.¹⁵ A study by Jamwal et al had 80 patients, but it was a case-control study comparing EUS coil + glue and direct endoscopic glue injection.¹⁴ The EUS coiling + glue group included 40 patients, with 30 males and 10 females. In a study by Puri et al, 86 patients were taken up for the study, with a mean age of 53.5 + 14.4 years.¹⁶

Technical success was 100% in our study. Similarly, technical success was 100% with the Puri et al study. Based on the literature review, the technical success of EUS coiling + glue is almost 99%.¹⁷⁻²¹

Regarding the intraprocedural and postprocedural adverse events, 1 out of 103 patients in our study had abdominal pain and 1 had fever. Both patients responded to oral analgesics and antipyretics. There was no active bleeding from the puncture site or systemic embolization. The literature review has shown that adverse events following EUS coiling + glue can range from 0 to 7%.¹⁷⁻²¹ In the study by Bazarbashi et al, 1 out of 106 patients had systemic embolization, 1 had abdominal pain, and 3 had transient fever.¹⁵

The mean follow-up of our study population was 34.2 ± 21 months compared with 283 + 325 days by Bazarbashi et al, 201 days by Jamwal et al, and 175.2 days by Puri et al.¹⁴⁻¹⁶

Regarding rebleeding, 4 out of 99 patients in our study had rebleeding, but the cause of rebleeding turned out to be nonvariceal causes. Rebleeding was 14.1% in the study by Bazarbashi et al with 0% in Jamwal et al. The literature review showed that the rebleeding rate can range from 0 to 16%.¹⁷⁻²¹

The average number of coils was 3.3, and the amount of glue was 3.1 mL in our study. IGV1 type was the commonest type of varix with an average size of 2.3 cm. In the study by Puri et al, the mean number of coils used was 2.9, and the average quantity of glue used was 1.6 mL.¹⁶ In the study by

Bhat et al, the mean number of coils was 1.4 and the mean volume of glue was 2 mL.¹⁷ In the study by Binmoeller et al, the mean number of coils was 1.3 and the mean volume of glue was 1.4 mL.¹⁸

Conclusion

- EUS coiling + glue injection is a safe and effective endoscopic therapy for large gastric varices with sustainable long-term beneficial effects with a negligible amount of rebleeding.
- Direct endoscopic injection of glue following EUS coiling with a 21G sclerotherapy needle can significantly reduce the cost of the procedure.

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No financial aid was taken for this study.

Conflict of Interest

Authors have no conflict of interest and competing interest.

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