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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Modified devascularization surgery for isolated gastric varices assessed by endoscopic ultrasonography

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Abstract
Background: This study aimed to assess the role of endoscopic ultrasonography (EUS) in the surgical management of isolated gastric varices (IGV), and to report the authors' experience in the treatment of IGV with modified devascularization surgery.
Methods: In this study, 26 cirrhotic patients with IGV were treated with devascularization surgery for variceal hemorrhage. Preoperatively, percutaneous transhepatic portography (PTP) and EUS were used to determine the mode of therapy for IGV. Fundectomy was performed for 14 patients with fundic IGV, whereas 12 patients with cardiac IGV underwent proximal gastrectomy.
Results: A significantly higher proportion of patients with cardiac varices showed grade 3 IGV on preoperative EUS than those who had fundic varices ($p < 0.05$). No major complications were observed during or after the operation, and only one patient died of prolonged shock and massive transfusion. Postoperatively, gastric varices had been eradicated completely in 25 of 26 patients, as determined by EUS study. During a mean follow-up period of 50 months, two patients had recurrent varices without bleeding, as demonstrated by EUS. The overall 5-year survival rate for the fundic IGV group was 67.9%, whereas that for the cardiac IGV group was 64.3% ($p > 0.05$).
Conclusions: This study showed that devascularization surgery is highly effective for the prevention of recurrent bleeding from IGV and provides an alternative treatment method. Preoperatively, EUS is very helpful in detailed devascularization of patients with specific IGV, and may be used also for postoperative follow-up evaluation.

Key words: Devascularization surgery — Isolated gastric varices — Endoscopic ultrasonography — Fundectomy — Proximal gastrectomy

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Large gastric varices without esophageal varices, usually located in the proximal area of the stomach, have been recognized in some patients with portal hypertension. These specific gastric varices are known as isolated gastric varices (IGV) [7, 9, 14, 17]. The assessment of collateral vascular structures at the proximal stomach is extremely important for the management of IGV.

In recent years, percutaneous transhepatic portography (PTP) and splenic venography has been the gold standard for the study of portal collateral circulation in patients with cirrhosis and IGV [8]. However, it is difficult to distinguish between intrinsic intramural veins and extraluminal collaterals using PTP [8]. Moreover, the invasiveness of this procedure and the requirement of skillful technique further limit its use in clinical practice. On the other hand, although computed tomography scan can detect large paragastric veins, the identification of small submucosal veins and perforating veins using this method is difficult [3].

Endoscopically, gastric varices have occasionally been identified incorrectly as neoplasms, with the possible consequence of massive bleeding when biopsy is undertaken [2]. In recent years, endoscopic ultrasonography (EUS) has been used in the assessment of portal hypertension. Because EUS clearly visualizes the vascular structures around the gastric wall in patients with portal hypertension, it has been proved superior to endoscopy in the diagnosis of gastric varices [4, 18].

Several studies have advocated surgical intervention for gastric varices, and devascularization surgery has been found effective for preventing recurrent bleeding in patients with IGV [1, 13]. Therefore, the vascular structures of IGV must be evaluated precisely when surgical intervention is planned for these patients. Several arguments have shown EUS to be a reliable method for evaluating venous anatomy around the proximal stomach [5, 15]. The current study aimed to assess the utility of EUS for the surgical management of IGV, with particular attention focused on the specific type of gastric varices. In addition, we report our experience

Fig. 1. Endoscopic ultrasonography (EUS) showing grade 1 cardiac-type gastric varices (GV) (*arrowheads*) connecting to grade 1 paragastric veins (PGV) (*arrows*).

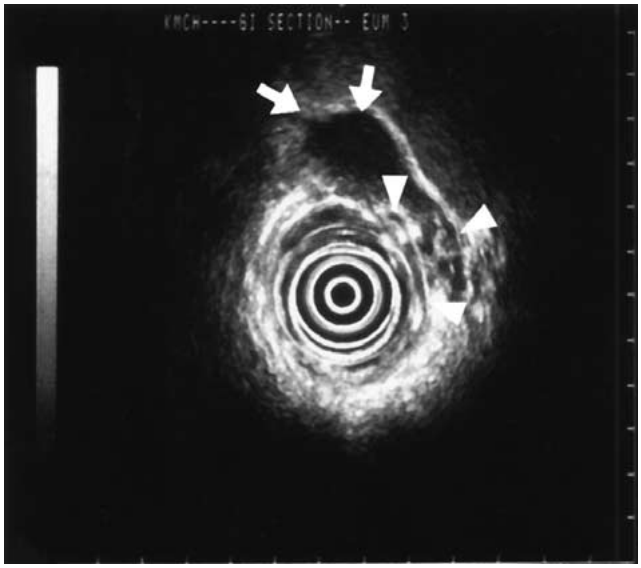

Fig. 2. Endoscopic ultrasonography (EUS) showing grade 2 fundic-type gastric varices (GV) (*arrowheads*) connecting to grade 2 paragastric veins (PGV) (*arrows*).

with the treatment of IGV using two variant techniques of modified devascularization surgery.

Patients and methods

Patients

Between 1992 and 1999, 26 cirrhotic patients with IGV who underwent devascularization surgery for variceal hemorrhage were enrolled in this study. Clinical evaluation and biochemical investigations were conducted for all these patients. The diagnosis of liver cirrhosis was based on findings of transabdominal ultrasonography, transhepatic portography, and liver biopsy. All the patients were subjected to esophagogastroscopy before surgery to document the presence of gastric varices without esophageal varices. They all had experienced at least one episode of bleeding from gastric varices. However, conventional endoscopy for the assessment of bleeding origin was not applicable for 6 of the 26 patients in whom gastric varices were not clearly identified because of active bleeding. Another endoscopy was performed after these patients had recovered from acute bleeding. Isolated gastric varices were defined as variceal lesions located in the fundus or near the gastroesophageal junction without accompanying esophageal varices, as visualized by portography. The characteristics of the patients are summarized in Table 1.

EUS

Because EUS was known to be more sensitive in detecting gastric varices compared with esophagogastroscopy, it was used as the gold standard for the diagnosis of gastric varices. In all cases, EUS was applied using a mechanical sector scan Olympus GF-UM3 (Olympus, Tokyo, Japan) with a 36° view at a wave frequency of either 7.5 or 12 MHz.

After intravenous administration of diazepam, the patients were placed in the left lateral decubitus position while their gastric cavity was filled with 300 to 700 ml of deaeroted water for examination to evaluate the intra- and extragastric vascular structures in the low esophageal and gastric regions. The presence and distribution of gastric varices, paragastric collateral veins, and perforating veins were determined. According to the distribution of the intramural vessels, the EUS findings at the proximal stomach were classified as follows: grade 1 (a few vessels smaller than 3 mm in the submucosa; Fig. 1), grade 2 (uniformly scattered vessels size 3 to 5 mm in the submucosa; (Fig. 2), and grade 3 (abundant vessels larger than 5 mm in the submucosa forming a honeycomb-like pattern (Fig. 3). The EUS grading of paragastric varices was as follows: 0 (none), 1 (small or nonconfluent varices smaller than 5 mm), and 2 (large or confluent varices larger than 5 mm).

PTP

In addition to EUS assessment, the patients underwent detailed angiographic study. The technique for transhepatic portography has been described in greater detail in the literature [12]. For all the patients, a selective splenic venogram was obtained initially for evaluation to determine the patency of the splenic vein, the presence of gastric varices, and the flow direction of the gastrorenal shunt. Occasionally, selective catheterization of the other portal branch and collateral veins also was performed. The portal pressure was measured when the tip of the catheter was in the main portal trunk. The puncture site in the midaxillary line was the reference point, and the pressure was measured with a water manometer.

According to the features of PTP, the vascular anatomy of gastric varices was divided into two types. Type 1 (or fundic) IGV involved a posterior (or short) gastric vein, arising from the splenic vein and forming nodule-like varices in the fundic region, that drained into the left renal vein and then into the inferior vena cava (Fig. 4). Type 2 (or cardiac) IGV involved varices located in the area from the fundus to the cardia whose tortuous, serpiginous appearance consisted of multiple venous channels fed by left gastric and short gastric veins (Fig. 5).

Surgery and follow-up evaluation

The choice of surgical method depends on several factors, but the major determinant in our experience is the patient's vascular anatomy. The detailed surgical procedure for cardiac-type IGV has been reported previously [10]. For patients with fundic-type IGV, instead of using proximal gastrectomy, the fundic portion of the stomach was resected with a mechanical stapler to eradicate the intramural varices. Neither the esophagus nor the stomach was transected. Conversely, for patients with cardiac-type IGV, a proximal gastrectomy was performed. Elective surgery was performed for 21 of the 26 patients, and 5 underwent an emergency procedure necessitated by failure of our medical measures and uncontrollable intermittent hemorrhage. Their clinical state was assessed every 3 months postoperatively, and follow-up endoscopies were performed at 6-month intervals for the first year, and then at yearly intervals. Each year, EUS and the presence of encephalopathy were evaluated. Additional endoscopic injection sclero-

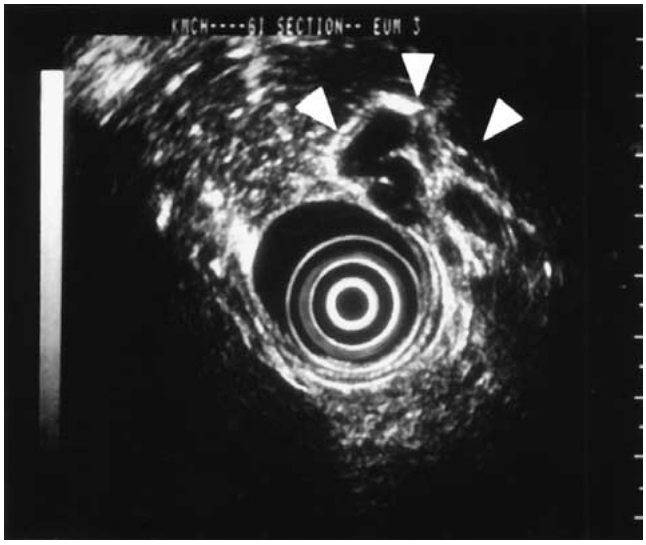

Fig. 3. Endoscopic ultrasonography (EUS) showing grade 3 fundic-type gastric varices (GV) (*arrowheads*).

therapy was performed whenever new, small, dilated venous vessels appeared in either the esophagus or the stomach.

Statistical analysis

The chi-square test and Student's *t*-test were used to analyze the results of the EUS and PTP findings. The analysis also included postoperative mortality, rate of complications, and incidence of residual and recurrent varices, late mortality, and survival. The overall 5-year survival rates were calculated by the Kaplan–Meier method, and the difference in survival rates between the two groups was analyzed using the log-rank test. A probability of less than 0.05 was considered to be statistically significant.

Results

EUS and PTP findings

According to the PTP findings, 14 of the 26 patients in this study had fundic-type IGV, whereas 12 had cardiac-type IGV. The EUS findings of the gastric varices and paragastric collaterals in the patients with IGV are listed in Table 2. A significantly greater proportion of the patients with cardiac varices showed grade 3 gastric varices on EUS than those with fundic varices ($p < 0.05$). There was no significant difference in the EUS findings of paragastric collaterals between the patients with fundic and those with cardiac varices.

Clinical outcomes and follow-up findings

Among the 14 patients with fundic-type IGV, there was no hospital mortality related to the surgical procedure. However, one patient died 5 days after surgery because of disseminated intravascular coagulation and prolonged shock. Postoperative complication was observed in one patient, who had a left subphrenic abscess resulting from extravasation of the pancreatic juice, which was caused by pancreatic tail injury during splenectomy.

Table 1. Clinical features of patients with isolated gastric varices

	Fundic type	Cardiac type
	(n = 14)	(n = 12)
Gender (M/F)	9/5	8/4
Mean age, years (range)	57 (42–69)	56 (37–68)
Child–Pugh class (n)		
A	3	4
B	9	5
C	2	3
Indication of surgery (n)		
Emergency	4	2
Elective	10	10
Surgery (n)		
DS + proximal gastrectomy	0	12
DS + fundectomy	14	0

DS, devascularization and splenectomy

Table 2. Comparison of endoscopic ultrasonography (EUS) findings between fundic and cardiac type varices

EUS grade	Fundic type (n = 14)	Cardiac type (n = 12)	p Value
GV (n)			
1	2	1	
2	9	4	
3	3	7	0.05
PGV (n)			
1 (small, < 5 mm)	6	5	
2 (large, > 5 mm)	8	7	

GV, gastric varices; PGV, paragastric collateral veins

He was cured within 1 month by intraperitoneal drainage and total parenteral nutrition.

Among the 12 patients with cardiac-type IGV, there was neither anastomotic leakage nor operative mortality. Two patients suffered from esophageal stricture and dysphagia caused by mechanical stapling. Dilation is not required, and the episode solved spontaneously 6 months after surgery.

Of the 25 survivors, all are free of residual varices at this writing, but endoscopically demonstrable esophageal varices developed in 2 patients (1 fundic and 1 cardiac) during the follow-up period. However, the recurrent esophageal varices were mild in severity and obliterated by endoscopic injection sclerotherapy. No recurrent variceal bleeding or encephalopathy developed in any of the patients after surgery. Three of the 13 patients with fundic IGV died during the follow-up period at 26, 41, and 52 months, respectively. Two of these patients died of hepatocellular carcinoma, and one died of myocardial infraction. Two of the 12 survivors with cardiac IGV, died of lung cancer and a car accident, respectively, at 36 and 46 months. The overall 5-year survival rates were 67.9% and 64.3% for the fundic and cardiac types, respectively. No significant difference was found in complication, recurrent varices and 5-year-survival rate between the two IGV types (Fig. 6).

Discussion

With the advances in various imaging techniques, IGV has been well recognized in patients with portal hyper-

Fig. 4. Preoperative portogram showing fundic varices (*arrowheads*) and a gastrorenal shunt.

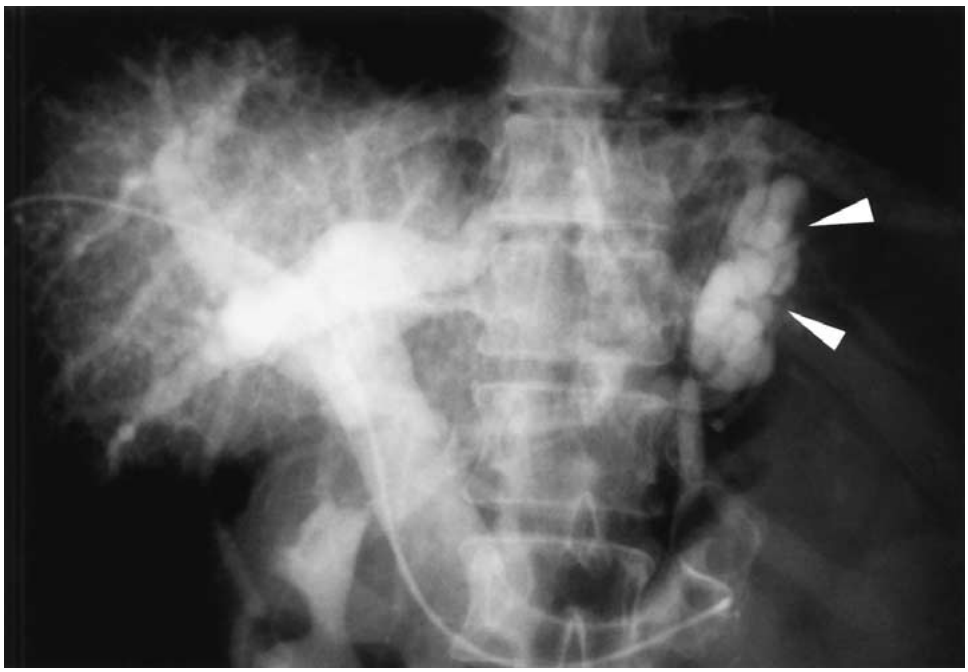

Fig. 5. The Portogram showing multiple varicose vessels with complex connecting ramifications (*arrowheads*) in cardiac varices.

tension. These techniques have enabled the classification of IGV into types 1 (fundic) and 2 (cardiac) according to the origins and numbers of feeding vessels and the distribution of gastric varices from portographic features. However, our findings are not consistent with a recent study describing type 1 vascular anatomy as much more common in the localized-type gastric varices [11]. In contrast, type 2 vascular anatomy was found almost exclusively in the diffuse-type gastric varices according to endoscopic observation. Although direct portography allows visualization of the entire portal system, it is difficult to distinguish intramural from extramural veins. Moreover, it is not feasible portographically to measure the vascular caliber of the varices directly.

In this study, EUS was used successfully to characterize the gastric varices and paragastric collaterals. The finding that the grades of gastric varices are more severe in cardiac-type than in fundic-type IGV may be attributed to multiple feeding vessels and the degree of liver cirrhosis. The use of EUS within the stomach can provide high-resolution images of the gastric wall and adjacent structures that cannot be achieved with other diagnostic methods. Moreover, EUS has many advantages for detecting varices in the gastric wall and

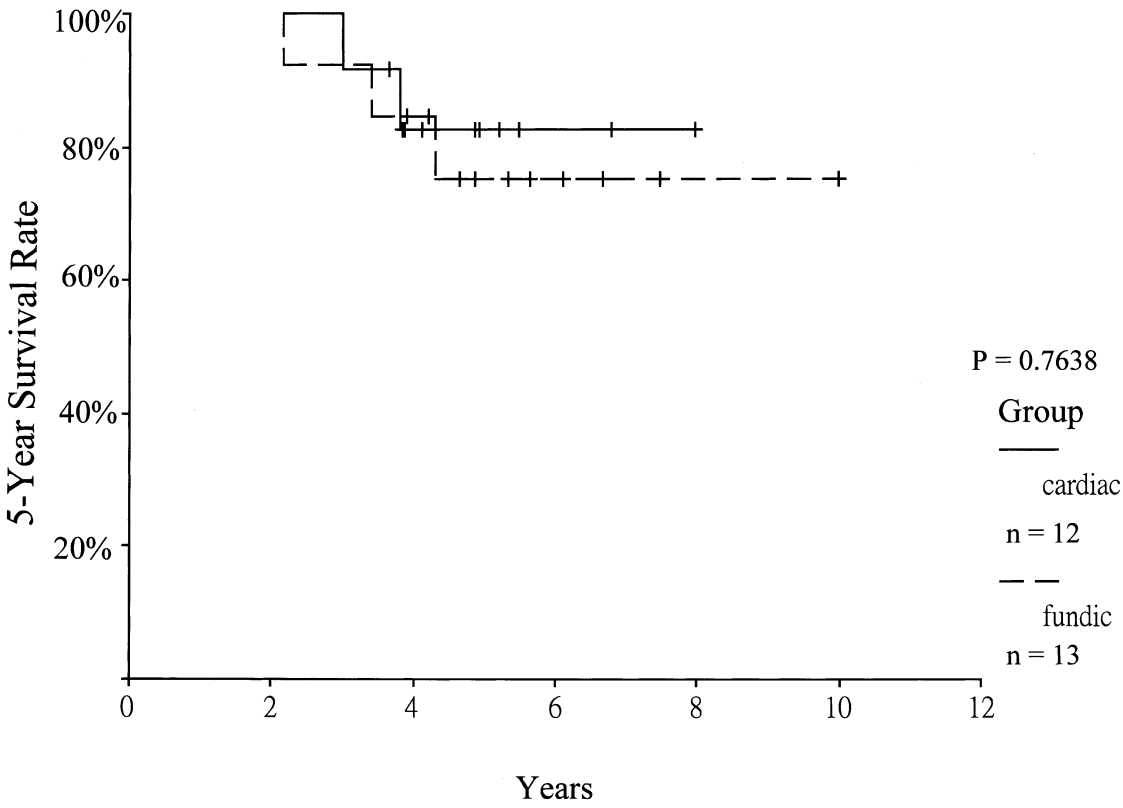

Fig. 6. Comparison of 5-year survival rate between the cardiac and fundic isolated gastric varices (IGV).

Table 3. Clinical results and follow-up evaluation for patients with fundic and cardiac varices

	Fundic type (n = 14)	Cardiac type (n = 12)
Postoperative mortality	1	0
Recurrence of EGV	1	1
Recurrent bleeding	1	0
Eradication of varices	13	12
Complication	1	2

EGV, esophagogastric varices

extramural collaterals, although the flow direction of varices and the collaterals are not shown by EUS.

Currently, EUS is considered the leading technique for assessment of gastric varices and paragastric collateral veins and could be useful for managing and monitoring patients with portal hypertension. However, in this study, selection of the surgical mode was determined by the type of IGV, which as delineated by transhepatic portography. It was determined EUS could offer additional information about the grade of the inner and outer vascular structures, which were of particular importance for adequate devascularization of the paragastric collaterals around the proximal stomach. Portography directed the type of gastric resection, whereas EUS further characterized the grade of IGV.

Previously, we reported the techniques of devascularization and proximal gastrectomy for the treatment of IGV, describing satisfactory results with minimal hospital mortality and morbidity [10]. The rationale of our procedure for treating IGV involves direct interruption of all the varicose networks. Resection of a proximal stomach segment may reduce the immediate recannalization of venous collaterals, and extensive devascularization is used to ablate the extrinsic collaterals to the stomach as much as possible.

In this study, the patients with cardiac IGV were treated with proximal gastrectomy, whereas a technical modification was used for the patients with fundic IGV. The patients underwent a fundectomy instead of a proximal gastrectomy, thus avoiding an esophagogastrostomy. We believe the intramural portion of fundic-type IGV could be *co*mpletely eradicated efficiently with a fundectomy because varicose veins were demonstrated only in the localized area of the fundus by both portography and EUS. This procedure seems technically easier and less time consuming. Meanwhile, the complication of esophagogastrostomy can be prevented. The optimal management of ruptured IGV has not been defined. Attention has been directed recently toward gastric varices as a distinct clinical entity, and newly developed treatments such as endoscopic injection sclerotherapy using new sclerosants and balloon-occluded retrograde transvenous obliteration, have been used successfully [6, 16]. In our opinion, elective surgery still may be indicated for selected patients with bleeding IGV, and emergency surgery is not advisable because of high mortality.

As compared with other reports on surgical intervention, the results in this study seem acceptable and effective for long-term control of IGV hemorrhage [1, 13]. Moreover, using varied techniques, we found no significant difference in surgical mortality and long-term

results between patients with fundic and those with cardiac IGV. Our survival rate is comparable with that obtained from a recent report on extensive devascularization incorporating splenectomy [19]. The favorable result in the current study proves that devascularization surgery is highly effective for the prevention of recurrent bleeding from IGV and can be considered an alternative treatment method.

In conclusion, it is evident that preoperative EUS could provide further information about the grade of IGV, which would be particularly helpful for complete devascularization of extragastric collaterals. Furthermore, postoperative EUS could be used to identify patients who have recurrent varices without clinical evidence of recurrence or bleeding because it is a safe, well-tolerated, relatively noninvasive technique that can be repeated numerous times. Therefore, EUS is strongly recommended preoperatively and postoperatively in the treatment of patients with a specific type of IGV.

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