



Endoscopic variceal ligation

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INTRODUCTION

Patients with cirrhosis who develop portal hypertension (ie, increased pressure within the portal venous system) are at risk for complications, including bleeding from esophageal varices. Endoscopic variceal ligation (EVL) was developed in an effort to find an effective endoscopic treatment for esophageal varices with fewer complications than endoscopic sclerotherapy (ie, endoscopic injection of a sclerosant solution into the varices) [1,2]. The EVL technique is similar to hemorrhoidal banding; it works by capturing the varix within a small band, resulting in occlusion from thrombosis. The tissue then becomes necrotic and sloughs off in a few days to weeks, leaving a superficial mucosal ulceration that will heal completely. EVL avoids the use of sclerosant solution and thus eliminates the risk of transmural injury to the esophageal wall that often occurs after endoscopic sclerotherapy.

The use of EVL for treating esophageal varices was first reported in 1988 [3]. Since then, advances in the technique have led to its routine use for treating patients with esophageal varices. One major advance was the development of the multiple-band ligating device, which has simplified and improved the safety of EVL.

This topic will review the clinical applications, procedure technique, and complications of EVL.

The American Association for the Study of Liver Diseases has published guidance for the management of patients with portal hypertension and variceal bleeding, and our approach is generally consistent with society guidance [4]. Consensus statements have also been published by the British Society of Gastroenterology and by Baveno VII Consensus Workshop [5,6].

Additional methods for achieving hemostasis in patients with acute variceal bleeding are discussed separately. (See ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#).)

The complications and general management of cirrhosis are discussed separately. (See ["Cirrhosis in adults: Overview of complications, general management, and prognosis"](#).)

CLINICAL APPLICATIONS

Clinical applications for EVL include:

- Bleeding prevention:
 - EVL is used for primary bleeding prevention for selected patients (ie, those with medium to large esophageal varices who cannot tolerate nonselective beta blocker therapy). (See ["Primary prevention of bleeding from esophageal varices in patients with cirrhosis"](#) and ["Pathogenesis of variceal bleeding in patients with cirrhosis"](#), section on 'Size of varices'.)
 - EVL is performed to eradicate varices and to prevent rebleeding in patients who have recovered from an episode of esophageal variceal bleeding. (See ["Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis"](#).)
 - Management of acute bleeding from esophageal varices. (See ["Overview of the management of patients with variceal bleeding"](#) and ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#).)
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CONTRAINDICATIONS

In general, the following is regarded as a contraindication to EVL:

- Type of varices – We do not typically use EVL for treating large gastroesophageal varices along the lesser curvature of the stomach (GOV1) or gastroesophageal varices extending into the fundus (GOV2) (ie, size assessment by endoscopic ultrasound) [4]. In addition, we do not use EVL to treat isolated gastric varices located in the fundus (IGV1), regardless of size. Management of bleeding gastric varices is discussed separately. (See ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#), section on 'Management of gastric varices'.)

Contraindications to upper gastrointestinal endoscopy (required to perform EVL) are discussed separately. (See ["Overview of upper gastrointestinal endoscopy \(esophagogastroduodenoscopy\)"](#), section on 'Contraindications'.)

PROCEDURE FOR LIGATING VARICES

Nonurgent procedures (prophylaxis)

Preprocedure preparation — Patient preparation for upper endoscopy with endoscopic variceal ligation (ie, dietary restrictions, medication use) is similar to preparation for diagnostic upper endoscopy with the following additions (see ["Overview of upper gastrointestinal endoscopy \(esophagogastroduodenoscopy\)"](#), section on 'Patient preparation'):

- Preprocedure testing – We typically do not obtain laboratory studies prior to a nonurgent procedure if a complete blood count and INR have been checked within the previous three months:
 - Based on clinical experience, patients with platelet count $\geq 50,000/\text{microL}$ and INR ≤ 2 are at minimal risk for bleeding related to EVL.
 - The approach to patients with cirrhosis and platelet count $< 50,000/\text{microL}$ and/or INR > 2 is individualized based several factors including procedure timing, severity of thrombocytopenia, and risk factors for coexisting hemostatic disorders (eg, nutritional status, use of vitamin K antagonists) [7], and these issues are discussed separately. (See ["Hemostatic abnormalities in patients with liver disease"](#), section on 'General approach to invasive procedures'.)
- Sedation assessment – Most patients who are undergoing nonurgent endoscopy with EVL receive monitored anesthesia care, while the approach to procedural sedation depends on several factors (eg, medication history, comorbidities, history of difficult airway). These issues are discussed separately. (See ["Anesthesia for gastrointestinal endoscopy in adults"](#).)
- Antibiotics – For patients who are not actively bleeding, antibiotic prophylaxis is not required prior to EVL. While transient bacteremia has been documented after EVL, it is not regarded as a high-risk procedure for infection [8].

Equipment — Ligating devices are used to place the band on a varix after it has been suctioned into a clear plastic cylinder attached to the tip of the endoscope [9]. Multiple ligator devices typically contain between 4 and 10 bands that can be deployed in immediate

succession. Ligating devices with multiple, preloaded bands have largely replaced single ligator systems. Prior to the availability of multiple ligators, overtube placement was generally required because the endoscope had to be removed to load each band individually, and then the endoscope was reinserted into the esophagus [10]. Use of a multiple ligator device avoids potential overtube-related complications and is also associated with shorter procedure times [11-13].

Commercially available ligating devices include [14]:

- Boston-Scientific – SpeedBand SuperView Super 7
- Wilson-Cook – 4, 6, and 10 Shooter Saeed Multi-Band Ligators

Technique

Performing diagnostic endoscopy — Diagnostic upper endoscopy is performed prior to banding to examine the upper gastrointestinal tract and to identify esophageal varices that require treatment:

- Patients without bleeding – For patients undergoing EVL for bleeding prevention, the goal is to eradicate all varices, while medium and large varices are the primary targets ([picture 1](#)). Assessment of varix size is done with the esophagus insufflated to avoid overestimating the size. (See "[Pathogenesis of variceal bleeding in patients with cirrhosis](#)", [section on 'Size of varices'](#).)
- Patients with active or recent bleeding – Actively bleeding varices or those with stigmata indicating recent bleeding (such as red wale marks or cherry red spots) are selected as primary targets for banding even if they are not located at the gastroesophageal junction ([picture 2](#)). Factors that predict a higher risk of bleeding (eg, varix appearance, size) are discussed separately. (See "[Pathogenesis of variceal bleeding in patients with cirrhosis](#)", [section on 'Predictive factors'](#).)

We measure the distance from the mouth to the most distal targeted varix and to the gastroesophageal junction, since visibility may be reduced once the banding device is placed over the tip of the endoscope. For example, the site of the most distal varix and the gastroesophageal junction may be located at approximately 40 cm from the mouth. These measurements help provide landmarks; in addition, some ligating devices have transparent caps, which have improved endoscopic visualization [10].

Loading banding device onto endoscope — Following the diagnostic upper endoscopy, the endoscope is removed from the patient, and the ligating device with preloaded bands is

placed onto the endoscope. The device typically has a soft sheath portion that fits over the tip of the endoscope and a hard plastic portion (or chamber) that extends beyond the tip. Bands are stretched over the hard portion at the distal end of the device and later deployed onto the varices. (See '[Deploying bands](#)' below.)

Deploying bands — Band deployment is accomplished by identifying a varix, suctioning the varix and its surrounding mucosa into the chamber (or cap) at the endoscope's tip, tightening the trip wire to deploy the band onto the varix, and lastly, releasing suction:

- After the endoscope and the ligating device have been reinserted into the esophagus, the first targeted varix is identified. We begin by treating the most distal varices (typically located at or just proximal to the gastroesophageal junction), and then ascend proximally in the esophagus (for approximately 5 to 8 cm), since deployed bands partially occlude the esophageal lumen.
- After a target varix is identified, the endoscope is pointed toward it and then suction is applied to the mucosa to fill the chamber at the tip of the endoscope. If an adequate amount of tissue has been captured by the device, there will be a "red-out" appearance (caused by close approximation of the mucosa overlying the varix to the lens on the tip of the endoscope). Trying to place a band on a small amount of overlying mucosa will usually result in the band not adhering to the mucosa (or initially adhering and subsequently sliding off); this may also cause superficial mucosal damage with subsequent bleeding.
- The band is deployed by tightening the trip wire, and this is done by turning the dial located at the top of the endoscope's working channel.
- Following band deployment, suction is released.

The process is then repeated. Bands are usually applied in a circumferential pattern, spiraling gradually up the esophagus until all columns of medium to large varices have undergone placement of one to three bands ([picture 3](#)).

Additional tips for band deployment include:

- As bands are applied to the mucosa, less tissue is available to suction into the chamber. This indicates that another site (eg, more proximal site) needs to be selected for the next band deployment.
- After a varix is banded, the endoscope is not typically advanced distally (ie, beyond the site) to avoid dislodging the band [9].

- On occasion, esophageal mucosa without an underlying varix may be unintentionally banded; this is not associated with any immediate adverse effects [9].
- Reduced visibility due to blood accumulating within the device chamber (or due to the ligating device itself) can make EVL challenging [15]. If visualization is limited due to active bleeding, bands can be placed at the gastroesophageal junction without identifying a specific varix. This approach may result in less bleeding, and directed band placement can be accomplished once the field of vision improves. In addition, the accumulation of blood can often be overcome by injecting water through a blunt needle passed along the device wire as it exits from the channel located on the endoscope handle.
- Patients who are returning for a subsequent banding session may have esophageal mucosal ulceration from prior banding. A band can be safely placed near or adjacent to band-induced ulceration. However, we avoid suctioning the ulcerated mucosa whenever possible to avoid inducing ulcer bleeding.

Determining number of bands per session — The goal of EVL is to eradicate varices in the lower 5 to 8 cm of the esophagus. There is theoretically no maximum number of bands that can be applied per session. However, for patients without active bleeding, ≤6 bands are typically placed during each endoscopic session [16].

Postprocedure care

- Diet – Following nonurgent EVL, we advise patients to adhere to a liquid diet for 12 hours and then progress to soft foods as tolerated.
- Symptom management – Symptoms such as retrosternal pain or dysphagia immediately after banding are uncommon. However, some patients may develop symptoms that typically resolve within one to two days. Transient symptoms may be treated with an oral solution consisting of a topical anesthetic (topical [lidocaine](#)) combined with an antacid (eg, magnesium [aluminum hydroxide](#)), which is discussed separately. (See "[Oral toxicity associated with systemic anticancer therapy](#)", section on 'Analgesia'.)

Urgent procedures (active bleeding) — The approach to variceal ligation for patients with active bleeding is generally similar to the care of patients who are undergoing prophylactic banding, with the following exceptions (see '[Nonurgent procedures \(prophylaxis\)](#)' above):

- Antibiotic prophylaxis – For patients with cirrhosis and active variceal bleeding, prophylactic antibiotics are given to lower the risk of infection, and this is discussed

separately. (See ["Overview of the management of patients with variceal bleeding"](#), section on 'Antibiotic prophylaxis'.)

- Airway protection – Patients with hematemesis from variceal bleeding are typically intubated for airway protection, and this also facilitates performing upper endoscopy. (See ["Overview of the management of patients with variceal bleeding"](#), section on 'Resuscitation and support'.)
- Preprocedure testing – Complete blood count and coagulation studies are obtained prior to the procedure. The approach to addressing hemostatic abnormalities in patients with cirrhosis and active bleeding is discussed separately. (See ["Hemostatic abnormalities in patients with liver disease"](#), section on 'Bleeding'.)
- Number of bands – Four to six bands are typically used for achieving initial hemostasis. In randomized trial including 86 patients with varices, compared with placing ≤ 6 bands, placement of >6 bands per session was not more beneficial but did result in longer procedures and increased number of misfired bands [16].
- Postprocedure care:
 - Nutrition – Nutritional support and timing of restarting oral intake for patients with variceal bleeding is discussed separately. (See ["Overview of the management of patients with variceal bleeding"](#), section on 'Nutritional support'.)
 - Nasogastric tube – We avoid placing a nasogastric tube after EVL to avoid inadvertently dislodging the newly placed bands, while data to support this practice are limited [17]. However, if a nasogastric tube is needed (eg, gastric decompression, enteral administration of medications), a tube may be gently passed by an experienced clinician following band placement.

PATIENT FOLLOW-UP

Most patients require more than one session of EVL to eradicate varices, and after eradication, surveillance endoscopy is performed [4]:

- Primary prevention – Patients undergoing EVL for primary prophylaxis undergo upper endoscopy with EVL approximately every two to eight weeks until varices are eradicated. (See ["Primary prevention of bleeding from esophageal varices in patients with cirrhosis"](#), section on 'Preventive strategies'.)

- Secondary prevention – Patients with a history of esophageal variceal bleeding undergo upper endoscopy with EVL every one to four weeks until the varices are eradicated. (See ["Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis"](#), section on 'Endoscopic variceal ligation alone'.)

After eradication of esophageal varices, the first surveillance upper endoscopy is performed one to three months after variceal eradication and then every 6 to 12 months to check for recurrence.

EFFICACY

Prevention of bleeding

- Efficacy of EVL for preventing rebleeding in patients who have recovered from esophageal variceal bleeding is presented separately. (See ["Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis"](#), section on 'Options'.)
- Efficacy of EVL for primary prevention of variceal bleeding in selected patients (ie, those with medium to large varices who cannot tolerate beta blocker prophylaxis) is also presented separately. (See ["Primary prevention of bleeding from esophageal varices in patients with cirrhosis"](#), section on 'Endoscopic variceal ligation'.)

Control of active bleeding — Efficacy of EVL for controlling active bleeding from esophageal varices is discussed separately. (See ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#), section on 'Endoscopic variceal ligation and endoscopic sclerotherapy'.)

COMPLICATIONS

Band-induced ulcer bleeding — Esophageal ulcers often develop at each ligation site as the banded tissue becomes necrotic and sloughs off, which typically occurs within 3 to 10 days after EVL. However, bleeding from band-induced ulcers is uncommon. The ulcers are superficial and approximately ≤ 1 cm in diameter, and most ulcers heal within two to three weeks [18,19]. Prophylaxis with proton pump inhibitor may decrease the ulcer size, while its effect on bleeding risk is uncertain. (See ['Postprocedure care'](#) above.)

Portal hypertensive gastropathy — A concern with EVL is that it may contribute to or worsen portal hypertensive gastropathy (PHG), which then may bleed [20,21]. An exacerbation of PHG may be related to increased portal pressures and gastric blood flow or to increased mucosal

congestion following eradication of esophageal varices [22,23]. However, data supporting this potential effect of EVL are mixed [24-27]. For example, in a study of 22 patients who had EVL, there was no significant difference in hepatic venous pressure gradients when measured before or after eradication of esophageal varices [27].

Other complications — The development of esophageal stricture after banding is uncommon, with a reported incidence of 0 to 2 percent in patients undergoing EVL [28-30].

Rarely reported complications include focal esophageal wall necrosis and perforation [31], esophageal obstruction [32], altered esophageal motility [33], paraplegia [34], and decreased oxygen delivery (possibly due to lower cardiac output from a decreased preload) [35]. (See "[Pathophysiology of heart failure with reduced ejection fraction: Hemodynamic alterations and remodeling](#)", section on 'Preload'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "[Society guideline links: Gastrointestinal bleeding in adults](#)".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "[Patient education: Esophageal varices \(The Basics\)](#)")
- Beyond the Basics topics (see "[Patient education: Esophageal varices \(Beyond the Basics\)](#)")

SUMMARY AND RECOMMENDATIONS

- EVL works by capturing an esophageal varix within a small band, resulting in occlusion from thrombosis. The tissue then becomes necrotic and sloughs off in a few days to weeks, leaving a superficial mucosal ulceration that will heal completely. (See ['Introduction'](#) above.)
- For patients with esophageal varices, EVL is used to treat active bleeding and to prevent future bleeding. (See ['Clinical applications'](#) above.)
- Ligating devices are used to place the band on a varix after it has been suctioned into a clear plastic cylinder attached to the tip of the endoscope. Multiple ligator devices typically contain between 4 and 10 bands that can be deployed in immediate succession; thus an overtube is not needed. (See ['Equipment'](#) above.)
- The banding session typically begins with treating the most distal varices (typically located at or just proximal to the gastroesophageal junction), and then ascending proximally in the esophagus, because deployed bands partially occlude the esophageal lumen. Bands are usually applied in a circumferential pattern, spiraling gradually up the esophagus until all columns of medium to large varices have one to three bands ([picture 3](#)). (See ['Deploying bands'](#) above.)
- The goal of EVL is to eradicate varices in the lower 5 to 8 cm of the esophagus. There is theoretically no maximum number of bands that can be applied per session. However, for most patients without active bleeding, ≤ 6 bands are typically placed during each endoscopic session. (See ['Determining number of bands per session'](#) above.)
- Efficacy data for EVL are discussed separately:
 - (See ["Primary prevention of bleeding from esophageal varices in patients with cirrhosis"](#), section on ['Endoscopic variceal ligation'](#).)
 - (See ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#), section on ['Endoscopic variceal ligation and endoscopic sclerotherapy'](#).)
 - (See ["Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis"](#), section on ['Options'](#).)
- Complications related to EVL are uncommon, but they include band-induced ulcer bleeding and esophageal stricture. (See ['Complications'](#) above.)

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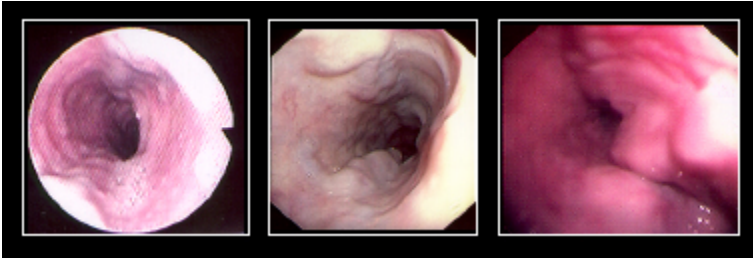
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GRAPHICS

Size classification of esophageal varices



The size of varices, as illustrated in these endoscopic pictures, can be used to estimate the risk of variceal bleeding. The first panel shows small straight varices (F1), the second panel shows enlarged tortuous varices that occupy less than one-third of the lumen (F2), and the third panel shows large coil-shaped varices that occupy more than one-third of the lumen (F3).

Courtesy of Arun Sanyal, MD.

Graphic 61770 Version 3.0

Endoscopic "red wale" sign on esophageal varices

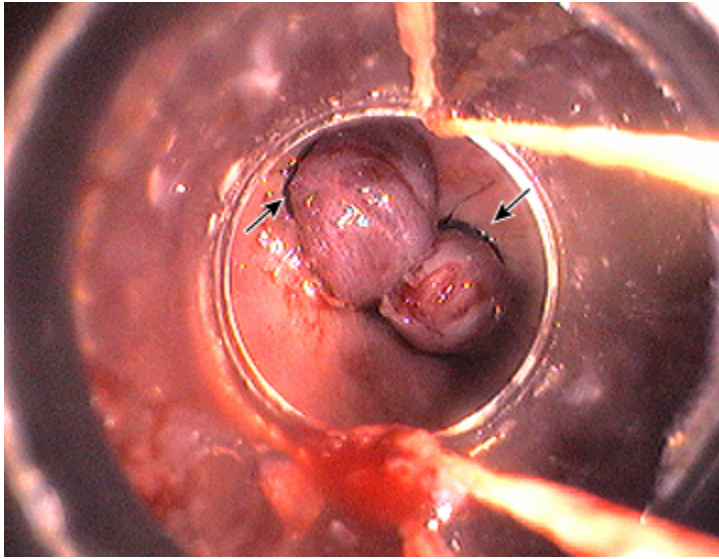


Endoscopy of a chain of varices in the distal esophagus showing erythematous raised areas indicating an increased risk of bleeding.

Courtesy of Eric D Libby, MD.

Graphic 50222 Version 3.0

Esophageal varix band ligation



Endoscopy shows two varices in the distal esophagus that have been banded. The black bands are indicated with the arrows. The two strings in the right of the field are connected to the trigger device used to deploy the bands.

Courtesy of Laurence Bailen, MD.

Graphic 54194 Version 3.0

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