Contact thermal devices for the treatment of bleeding peptic ulcers

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INTRODUCTION

The treatment of bleeding peptic ulcers includes resuscitation, treatment with acid suppressive therapy, and application of endoscopic therapy for patients at high risk of further bleeding (table 1). Several endoscopic approaches can be used to treat bleeding peptic ulcers, including use of contact thermal devices, endoscopic clips, and epinephrine injection.

This topic will review the use of contact thermal devices for the treatment of bleeding peptic ulcers. An overview of the treatment of bleeding peptic ulcers, issues to consider when deciding which specific endoscopic therapies to use, and treating bleeding ulcers with endoscopic clips, epinephrine injection, or argon plasma coagulation are discussed elsewhere. (See "Approach to acute upper gastrointestinal bleeding in adults" and "Overview of the treatment of bleeding peptic ulcers" and "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond", section on 'Bleeding peptic ulcers' and "Argon plasma coagulation in the management of gastrointestinal hemorrhage".)

INDICATIONS

Contact thermal therapy is one option for treating ulcers with stigmata of recent hemorrhage (table 2). It can also be used to treat patients with bleeding from Dieulafoy's lesions, Mallory-Weiss tears, and gastric antral vascular ectasias. (See "Overview of the treatment of bleeding peptic ulcers", section on 'Endoscopic therapy' and "Causes of upper gastrointestinal bleeding in adults", section on 'Specific causes'.)

The appearance of ulcers can be described using the Forrest classification [1]:

- Class Ia: Spurting hemorrhage (picture 1 and movie 1)
- Class Ib: Oozing hemorrhage
- Class IIa: Nonbleeding visible vessel (picture 2A-C)
- Class IIb: Adherent clot (picture 3)
- Class IIc: Flat pigmented spot (picture 4)

- Class III: Clean ulcer base (picture 5)

Stigmata of recent hemorrhage are present if anything other than a clean ulcer base is seen. Patients with active bleeding (spurting or oozing) or a nonbleeding visible vessel are at high risk for further bleeding and require endoscopic therapy. Whether to treat an adherent clot depends on whether the clot can be gently removed, the location of the ulcer, the comfort of the endoscopist with treating adherent clots, and the availability of surgical and/or interventional radiology support. Patients with flat pigmented spots and clean ulcer bases are considered low-risk and do not require endoscopic therapy. (See "Overview of the treatment of bleeding peptic ulcers", section on 'Endoscopic therapy' and "Overview of the treatment of bleeding peptic ulcers", section on 'Inpatient versus outpatient management'.)

AVAILABLE DEVICES

Three types of contact thermal devices have gained popularity due to their efficacy, safety profiles, ease of use, and portability:

- Multipolar probes (Gold Probe, Quicksilver Bipolar Probe, BICAP Superconductor, BiCOAG Bipolar Probe, Bipolar Hemostasis Probe)
- Heater probe (HeatProbe; no longer being produced)
- Monopolar probe (Coagrasper)

Multipolar probes — Multipolar electrocautery (MPEC) probes achieve hemostasis by heating the contacted tissue with electricity that passes between the alternating arrays of positive and the negative electrodes located within the tip of the probe. The electrical circuit is completed between two electrodes on the tip of the probe, so the circuit is completed locally and no grounding pad is required.

Tissue coagulation occurs at the tip or sides of the multipolar probe when the tissue temperature reaches approximately 70ºC [2]. The tissue's resistance to further coagulation increases exponentially once the tissue in contact with the MPEC probe has been completely desiccated. As a result, deep tissue coagulation is restricted. Coagulation depth can be increased by using large probes (10 rather than 7 French, although this requires an endoscope with a >3.2 mm diameter instrument channel), using lower energy levels applied over a longer period of time, and using firmer contact (tamponade).

Coaptive coagulation is the goal of coagulation therapy of ulcers. By applying pressure directly over the vessel with the probe while applying cautery, the bleeding vessel is cauterized in a sealed state that does not allow for further blood flow. MPEC probes can be used perpendicularly or tangentially to the lesion being treated since the electrode tip allows for therapy with any angle of surface contact, though the angle may affect the ability to apply pressure.

The standard MPEC probe permits water irrigation at the tip of the probe that facilitates washing the bleeding site, permitting improved visualization and precise application of endoscopic therapy. To prevent the probe from sticking to the area that has been treated, water irrigation via the probe can be applied after each application of cautery to gently separate the probe from the underlying area before retracting the device.

A catheter that combines an MPEC probe with a retractable injection needle (the Injection-Gold probe) allows for the direct use of combination therapy (typically, dilute epinephrine injection in conjunction with thermal therapy) without having to exchange catheters.

Heater probe — While used in the past, heater probes are no longer being produced.

Monopolar probe — Monopolar probes designed for bleeding control are similar to hot biopsy forceps, except that the jaws are flat (not curved and cutting) and rotatable. Similar to other forms of monopolar technology (such as using a snare with cautery), a grounding pad is required. The electrocautery used in this technique is a soft coagulation mode which maximizes cautery without tissue carbonization or cutting. The technique for bleeding control is different than the other thermal contact devices in that the tissue for therapy is grasped with the forceps and pulled or "tented" away from the gastrointestinal wall or the vessel or the probe is placed next to the vessel and gentle pressure is applied using the closed tip of the hemostatic forceps. This device has been widely used to control bleeding during endoscopic maneuvers such as endoscopic submucosal dissection. Experience in controlling nonvariceal bleeding is growing and it appears that this is another effective modality for achieving hemostasis [3-7].

USE IN PATIENTS WITH IMPLANTED CARDIAC PACEMAKERS OR DEFIBRILLATORS

When multipolar electrocautery is used, the current flow is localized to the area being treated, minimizing the risk of interaction between the probe and implanted cardiac devices. Unlike monopolar cautery devices, multipolar electrocautery does not require special precautions to prevent interference with the cardiac device.

No specific precautions are required in patients being treated with heater probes. A grounding pad is required for patients being treated with monopolar electrocautery. It is recommended that the patient plate (dispersive electrode) be placed on the lower extremity opposite the pacer/implantable cardioverter-defibrillator location to draw current away from the unit.

TECHNIQUES

Thermal coagulation with multipolar or heater contact probes achieves acute hemostasis and prevents recurrent bleeding by coaptive coagulation of the underlying artery in the ulcer base (picture 2B and picture 2D). It can be used in patients with active bleeding, a nonbleeding visible vessel, or to treat a vessel underneath an adherent clot (following clot removal).

Equipment — The equipment required to perform hemostasis with a contact thermal device includes the endoscope (preferably a large-channel therapeutic scope), a multipolar electrocautery (MPEC) or heater probe, and an electrosurgical generator. Large diameter (3.2 mm or 10 French) thermal probes are preferable. Other equipment to have on hand includes endoscopic clips, an injection needle, snares (for adherent clot removal after epinephrine injection), epinephrine (diluted 1:10,000 to 1:100,000 for injection), and glucagon (for control of peristalsis).

In addition, a Doppler ultrasound probe may be helpful to confirm successful hemostasis, but is not required.

Choice of endoscope — Endoscopic diagnosis and treatment of severe upper gastrointestinal bleeding is best performed with therapeutic gastroduodenoscopes that have a single large channel (3.7 to 6 mm diameter) or two channels (at least one large diameter). These endoscopes have a separate water jet for targeted irrigation of the bleeding site. A two-channel therapeutic endoscope permits high-volume suctioning through one channel, while a hemostatic probe is in the other channel.

Choice of probe — Studies suggest similar efficacy with MPEC probes and heater probes [8]. In most cases, the choice between probes will depend on which equipment is available in a given endoscopy unit or hospital. MPEC probes can be used both perpendicularly and tangentially relative to the bleeding lesion, but heater probes can only be used perpendicularly. In addition, inadvertent deep cauterization may be less likely with MPEC probes than with heater probes because the depth of cauterization is limited by tissue desiccation, something that does not occur with heater probes. (See 'Available devices' above and 'Efficacy' below.)

When possible, it is preferable to use a large diameter probe (3.2 mm diameter or 10 French) through a therapeutic endoscope, although a smaller probe (2.3 mm diameter or 7 French) can be used through a standard endoscope.

Use of Doppler ultrasound — Doppler ultrasound probes can be used to help determine the risk of continued or ongoing bleeding [9,10]. The probes help visualize the underlying blood flow to determine whether hemostasis is complete.

An endoscopic Doppler ultrasound probe consists of a thin catheter with an ultrasound probe at the tip that provides an auditory signal that can be advanced through the channel of an endoscope. It can be used to evaluate blood flow underlying the ulcer bed before and after treatment, with the goal of ablating the signal of vessel blood flow [9-11]. The Doppler ultrasound probe is complementary to clinical standard endoscopic assessment of bleeding risk. The risk of recurrent or ongoing bleeding is increased when underlying blood flow persists beneath the ulcer, whereas recurrent bleeding is less likely when blood flow is absent upon completion of hemostasis.

The use of Doppler ultrasound was evaluated in a randomized trial in patients with severe upper GI bleeding [12]. There were 148 patients evaluated (125 with ulcers, 19 with Dieulafoy's lesions, and 4 with Mallory Weiss tears). Doppler ultrasound was used in 72 patients, whereas the 76 patients in the control group underwent standard visually-guided hemostasis. Rebleeding within 30 days was less common in the Doppler group compared with the control group (11 versus 27 percent), with a number needed to treat to prevent one episode of rebleeding of seven.

Doppler probes may best be utilized to determine if adequate treatment has been delivered to high-risk lesions, particularly in patients at high risk for further bleeding or with multiple comorbidities and in patients with rebleeding. In addition, Doppler probes may be used to evaluate whether a lesion with questionable high-risk stigmata of hemorrhage needs treatment [13].

Application of thermal coagulation — Thermal coagulation with contact probes achieves acute hemostasis and prevents recurrent bleeding by applying pressure to the vessel with the probe to compress it while coagulation is performed (coaptive coagulation). This results in sealing (coaptation) of the vessel (picture 2B and picture 2D) [14]. Thermal coagulation is often used in combination with epinephrine injection (combination therapy).

A potential advantage of combination therapy is that epinephrine is easy to administer and it can help slow or stop bleeding prior to the application of thermal therapy. During active bleeding, this may improve visualization, permitting targeted treatment of the bleeding site and result in more durable hemostasis. (See "Overview of the treatment of bleeding peptic ulcers", section on 'Injection therapy'.)

Active bleeding or a nonbleeding visible vessel — Once a bleeding site or nonbleeding visible vessel is identified (possibly after epinephrine injection), an MPEC probe is used to tamponade the site (picture 6). The probe is then activated via a foot pedal to cauterize the site. The power level and duration of cauterization varies depending on the lesion. For patients with active bleeding, the goal is to achieve hemostasis. In patients with a nonbleeding visible vessel, good coagulation with complete flattening of the vessel should be the visual endpoint (picture 2B, 2D).

Many of the electrosurgical generators used with MPEC probes come with preset settings based on which part of the gastrointestinal tract is being treated. If a generator with preset settings is not available, we use the following settings with MPEC probes [15]:

- Active bleeding and nonbleeding visible vessel
  - Gastric ulcer: Moderate to firm pressure, 15 to 20 watts, 10 seconds per pulse (prior to probe retraction), three to five pulses total
  - Duodenal ulcer: Light to moderate pressure, 10 to 15 watts, 10 seconds per pulse (prior to probe retraction), three to five pulses total

Irrigation via the probe is used to wash the ulcer base, to release the probe to prevent sticking after cautery, and to facilitate repositioning of the probe for further treatment if bleeding continues. Targeted irrigation and suctioning of excess blood or fluid are extremely important to identify the specific bleeding site and focus the treatment.

Nonbleeding adherent clots — One of the problems in assessing the risk for rebleeding in patients with an adherent clot is that the clot obscures the underlying ulcer stigmata. Nonbleeding vessels may be present underneath and are associated with a significantly higher rebleeding rate than minor stigmata, such as flat spots or clean ulcer bases [16-22]. Studies suggest improved outcomes when patients with adherent clots have the clots removed and receive appropriate treatment of underlying high-risk stigmata [19-21]. If the clot appears to be amenable to removal, our approach is to gently remove it and then treat any high-risk underling lesion. However, it is reasonable to not attempt removal of the clot if it is located in an area that is likely to be difficult to treat if bleeding is precipitated, if appropriate surgical or interventional radiology backup is not available, or if the endoscopist is not comfortable with the techniques used for clot removal. (See "Overview of the treatment of bleeding peptic ulcers", section on 'Stigmata of recent hemorrhage' and "Overview of the treatment of bleeding peptic ulcers", section on 'Endoscopic therapy'.)

We use the following approach for patients with nonbleeding adherent clots [18]:

- Targeted jet irrigation is used to try to wash off parts of the clot with suction of any dislodged clots or blood.
- Dilute epinephrine (1:10,000 to 1:20,000 in saline) is injected in four quadrants at the pedicle of the clot. The clot is then gently cold guillotined with a polypectomy snare (without electrocoagulation) to shave it down (avoiding shearing of the clot) to reveal any underlying stigmata. Only a portion of the clot is removed with each closing of the snare to decrease the risk of accidentally capturing the vessel within the snare.
- Once the clot is removed, if there is active bleeding or a nonbleeding visible vessel, the site is treated with a contact thermal device (as described above) or an endoscopic clip. (See 'Active bleeding or a nonbleeding visible vessel' above and "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond", section on 'Technique'.)

This technique of cold guillotine after epinephrine injection has been shown to be safe and does not induce the bleeding seen in earlier studies when clots were forcibly removed by other techniques [19,20]. Furthermore, it permits exposure and precise targeted treatment of the underlying ulcer stigmata.

An alternative to mechanically removing the clot is to irrigate the clot with 3 percent hydrogen peroxide using a spray catheter. Hydrogen peroxide acts by oxidizing hemoglobin, which makes the clot translucent and aids with its dissolution. While this technique has been shown to effectively remove the clot [23], it can be associated with patient discomfort and a significant amount of foaming, requiring washing before endoscopic therapy can be applied. Because of these limitations, we prefer removing clots using the cold guillotine method described above.

EFFICACY

Treatment of bleeding peptic ulcers with contact thermal devices, either as monotherapy or in conjunction with epinephrine injection, is associated with initial hemostasis in 78 to 100 percent of patients, with rebleeding rates of 0 to 18 percent [2,7,24-30]. Studies suggest that multipolar electrocoagulation and heater probes have similar efficacy rates [8].

COMPLICATIONS

Complications of endoscopic therapy include perforation and precipitation (or worsening) of bleeding. In addition, epinephrine can cause tachycardia and arrhythmias.

While perforation with multipolar electrocautery is rare, it may precipitate bleeding in up to 18 percent of patients [29]. However, most cases of precipitated bleeding can be managed with additional endoscopic therapy. The perforation rate with heater probe coagulation may be as high as 2 to 3 percent, with provocation of bleeding in 5 percent [31].

Aggressive initial treatment or repeated applications of thermal or injection therapy may improve hemostasis, but also increase the risk of treatment-induced complications. Thus, predetermined limits (volume of injection solution, total treatment pulses, and total energy delivered) should be set and not exceeded for each technique in order to minimize the risk of complications. We usually do not exceed 20 mL of epinephrine (1:10,000 dilution) injection or more than five applications of thermal coagulation. In patients at increased risk for cardiac complications from epinephrine, one option is to further dilute the epinephrine to 1:100,000.

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".)

SUMMARY AND RECOMMENDATIONS

- **Overview –** The treatment of bleeding peptic ulcers includes resuscitation, treatment with acid suppressive therapy, and application of endoscopic therapy for patients at high risk of ongoing or recurrent bleeding (table 1). Several endoscopic approaches can be used to treat bleeding peptic ulcers, including use of contact thermal devices, endoscopic clips, and epinephrine injection. (See "Approach to acute upper gastrointestinal bleeding in adults" and "Overview of the treatment of bleeding peptic ulcers" and "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond", section on 'Bleeding peptic ulcers' and "Argon plasma coagulation in the management of gastrointestinal hemorrhage".)

- **Types of contact thermal devices –** Three types of contact thermal devices have gained popularity due to their efficacy, safety profiles, ease of use, and portability (see 'Available devices' above):

  - Multipolar electrocautery probes
  - Heater probes (not currently being produced)
  - Monopolar probes

- **Technique –** Thermal coagulation with contact probes achieves acute hemostasis and prevents recurrent bleeding by coaptive coagulation of the underlying artery in the ulcer base (picture 2B and picture 2D). Coaptive coagulation involves applying pressure to the vessel with the probe to compress it while coagulation is performed. This results in sealing (coaptation) of the vessel. It can be used in patients with active bleeding, a nonbleeding visible vessel, or an adherent clot (following clot removal). (See 'Techniques' above.)

- **Efficacy –** Treatment of bleeding peptic ulcers with contact thermal devices, either as monotherapy or in conjunction with epinephrine injection, is associated with initial hemostasis in 78 to 100 percent of patients, with rebleeding rates of 0 to 18 percent (table 2). Studies suggest that multipolar electrocoagulation and heater probes have similar efficacy rates. (See 'Efficacy' above.)

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Topic 2589 Version 22.0

GRAPHICS

Acute management of severe upper gastrointestinal bleeding

1. Resuscitation and stabilization, initiation of medical therapy with an intravenous proton pump inhibitor
2. Assessment of onset and severity of bleeding
3. Risk stratification using validated prognostic scale
4. Diagnostic endoscopy
▪ Preparation for emergent upper endoscopy
▪ Localization and identification of the bleeding site
▪ Identification of stigmata of recent hemorrhage
▪ Stratification of the risk for rebleeding
5. Therapeutic endoscopy
▪ Control of active bleeding or high-risk lesions
▪ Minimization of treatment-related complications
▪ Treatment of persistent or recurrent bleeding

Graphic 52860 Version 5.0

Endoscopic predictors of recurrent peptic ulcer hemorrhage[1,2]

Endoscopic stigmata of recent hemorrhage	Prevalence, percent	Risk of rebleeding on medical management, percent
Active arterial bleeding (Forrest Ia)	12% (arterial bleeding + oozing)	55 (arterial bleeding + oozing)
Oozing without visible vessel (Forrest Ib)		
Non-bleeding visible vessel (Forrest IIa)	8	43
Adherent clot (Forrest IIb)	8	22
Flat spot (Forrest IIc)	16	10
Clean ulcer base (Forrest III)	55	5

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1. *Katschinski B, Logan R, Davies J, et al. Prognostic factors in upper gastrointestinal bleeding. Dig Dis Sci 1994; 39:706.*
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Graphic 78607 Version 8.0

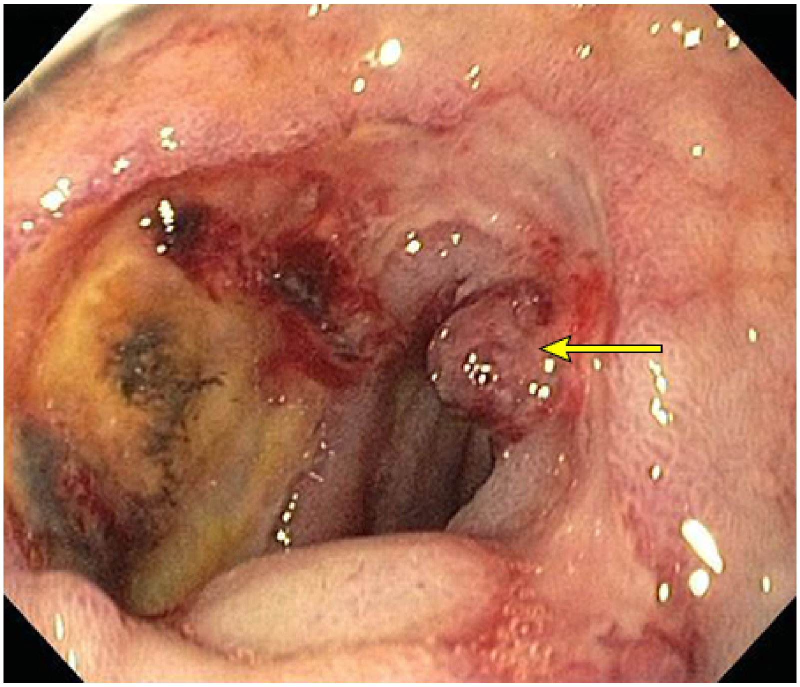
Bleeding gastric ulcer

Endoscopy shows an actively bleeding gastric ulcer (Forrest classification Ia) along the lesser curvature.

Courtesy of Rome Jutabha, MD and Dennis M Jensen, MD.

Graphic 61646 Version 2.0

Duodenal ulcer with visible vessel

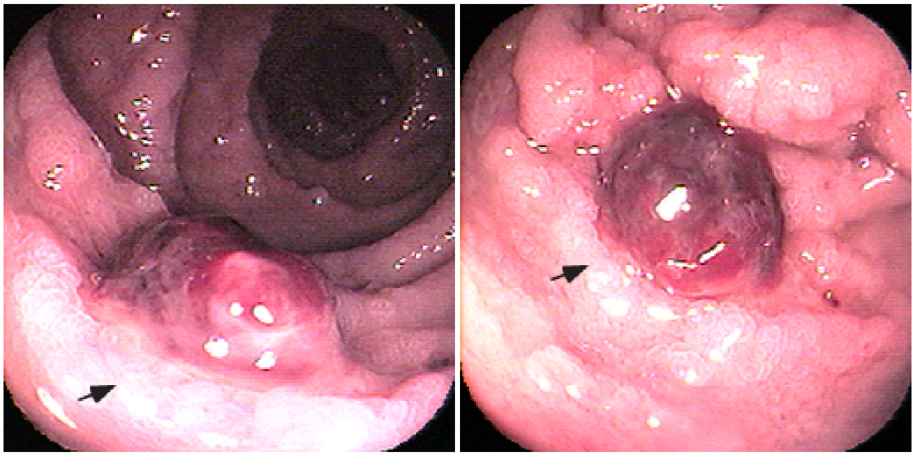


Upper endoscopy showing a duodenal ulcer with a nonbleeding visible vessel (arrow) in a large circumferential ulcer (Forrest classification IIa).

Courtesy of Rome Jutabha.

Graphic 54960 Version 4.0

Duodenal ulcer with visible vessel

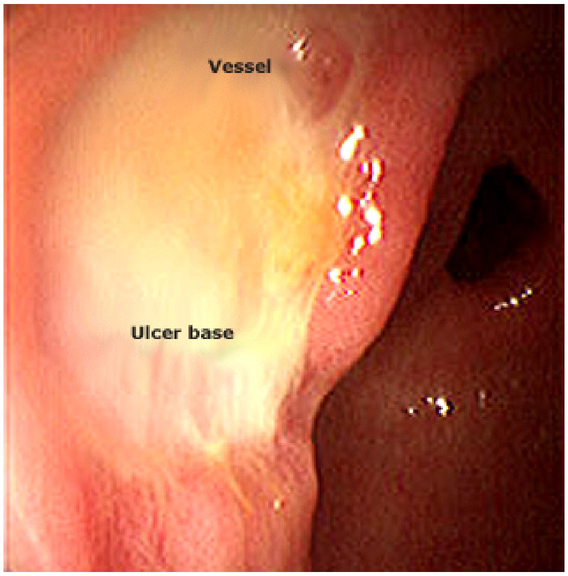


Duodenal ulcer in a patient with recent upper gastrointestinal bleeding. The ulcer base (arrows) is visible as the whitish rim underlying the protruding vessel. The erythematous mound in the center of the ulcer represents an arteriole that has eroded into the lumen of the duodenum.

Courtesy of Eric D Libby, MD.

Graphic 79058 Version 2.0

Gastric ulcer with a visible vessel

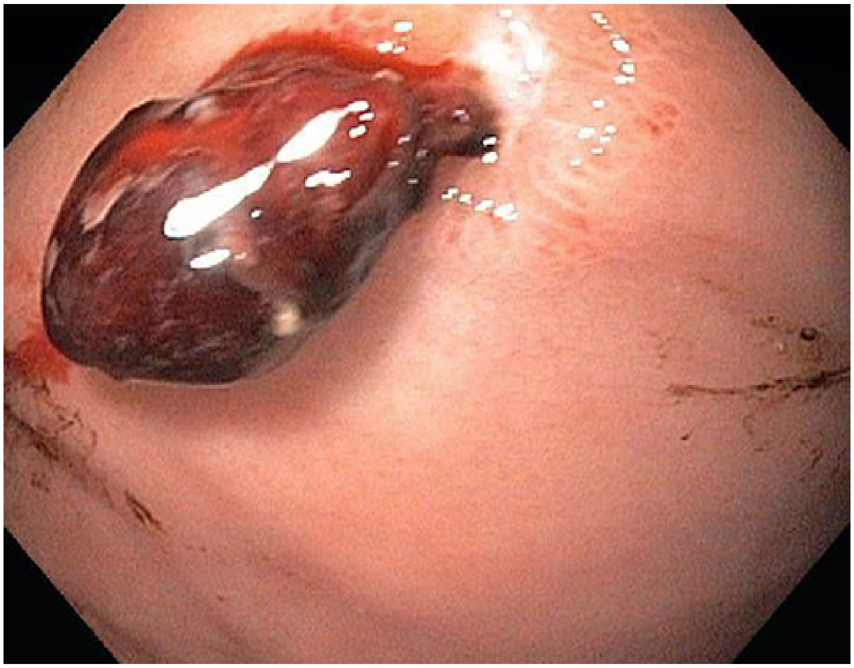


Ulcer in the gastric antrum seen on endoscopy. The visible vessel appears as a small protuberance in the one o'clock position.

Courtesy of Eric D Libby, MD.

Graphic 61604 Version 1.0

Gastric ulcer with adherent clot

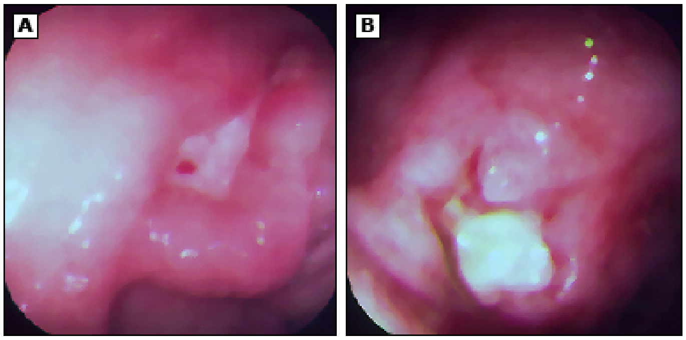


Upper endoscopy showing a gastric ulcer with an adherent clot (Forrest classification IIb).

Courtesy of Rome Jutabha, MD.

Graphic 76246 Version 1.0

Peptic ulcers at low risk for rebleeding

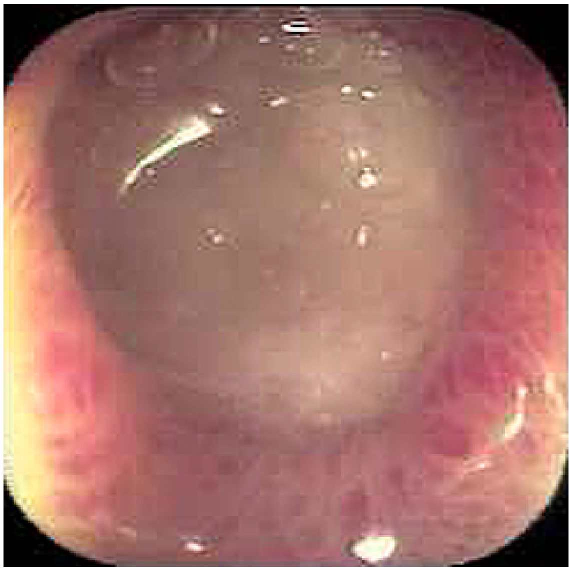


Ulcers with a flat pigmented spot (Forrest classification IIc; panel A) or a clean base (Forrest classification III, panel B) are at low risk for rebleeding and do not need to be treated endoscopically.

Courtesy of Rome Jutabha, MD and Dennis M Jensen, MD.

Graphic 52497 Version 2.0

Ulcer with a clean base

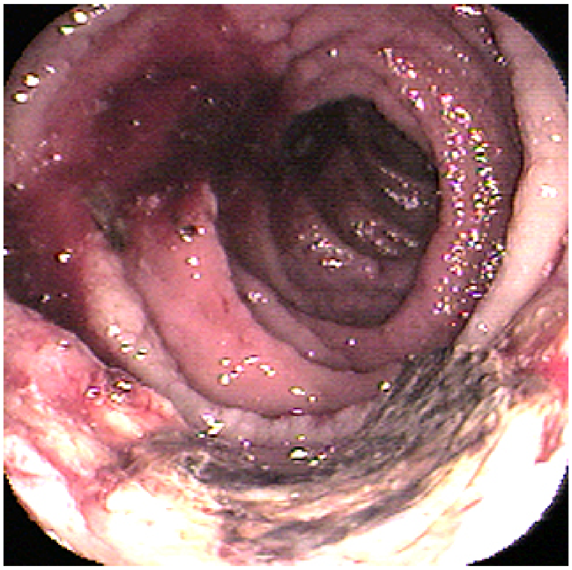


The opalescent ulcer in the center of this image taken during endoscopy has a "clean" base, which has a low risk of bleeding.

Courtesy of Eric D Libby, MD

Graphic 74032 Version 1.0

Combination therapy for a bleeding duodenal ulcer with a visible vessel

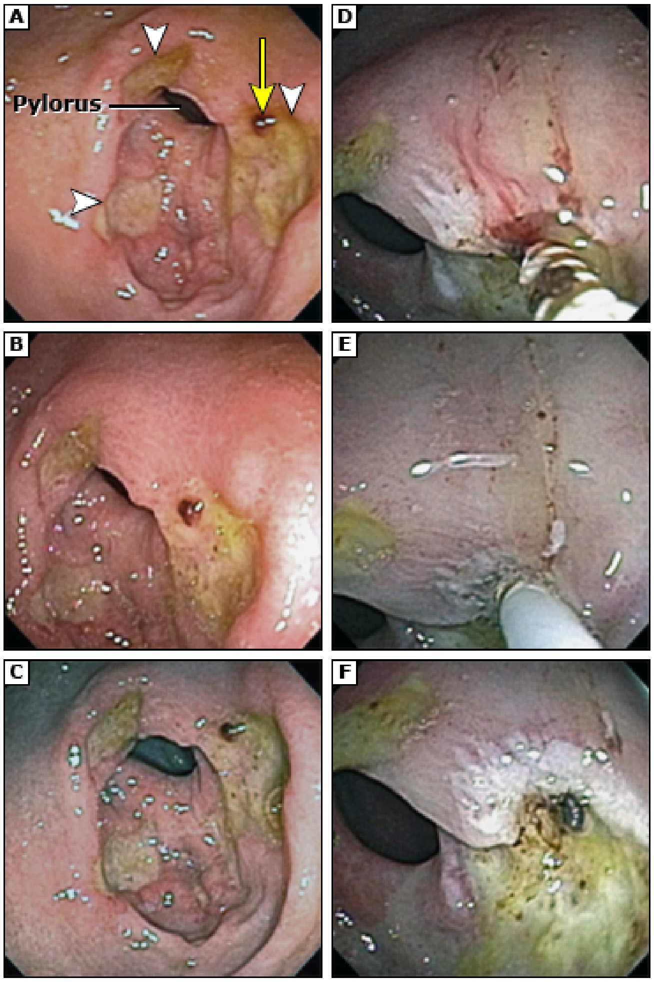


Appearance of a duodenal ulcer that had a visible vessel following injection therapy with epinephrine and thermal coagulation. Note that the visible vessel has been flattened.

Courtesy of Eric D Libby, MD.

Graphic 70660 Version 2.0

Combination therapy for a nonbleeding visible vessel



Upper endoscopy showing a deformed gastric antrum with three circumferential ulcers (arrowheads) near the pylorus (panels A-C). One of the ulcers contains a nonbleeding visible vessel (arrow), which was treated by a combination of epinephrine injection and multipolar electrocoagulation (panels D-E). Panel F shows the coagulated vessel after treatment.

Courtesy of Dennis M Jensen, MD, and Gustavo A Machicado, MD.

Graphic 56986 Version 2.0

Contributor Disclosures

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